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A positive relationship between ant biodiversity and predatory function across a disturbance gradient in a SE Asian rain forest (2009)

The recruitment time of ant species in forested and edge habitats at Danum Valley (2009)

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Do epiphytes reach the sky? A study on vertical stratification of *Asplenium* and *Drynaria* on *Parashorea* spp. in Danum Valley (2010)

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The effect of microclimate in Borneo rains forest on macrofungal communities (2009)

The effect of plant density on insect herbivory in two plant species (*Melastoma malabathricum* and *Clidemia hirta*): A comparison of native and invasive species in Danum Valley Conservation Area (2009)

The effect of seedling density of a shade-tolerant species, *Mallotus miquelianus* (Euphorbiaceae), on herbivory in the tropical rainforest in Danum Valley Conservation Area, Malaysia (2009)

ECOLOGY: Abstracts

Habitat selection by two size classes of fish and shrimp in the Tambun stream in Danum Valley

The length of animals and the water depth were measured to see variation of habitats in the stream and sizes of fish and shrimp. More than 200 fish individuals and 150 shrimp individuals were caught in the 200 m of the Tambun stream at Danum Valley Field Centre. Our study demonstrated that the size of fish and shrimp varied significantly amongst water depth. Two predation experiments were done. In the first experiment big fish and small shrimp and small fish were collected as prey items. In the second experiment prey items were small fish (live/dead) and shrimp (live, dead). Our study showed that both big shrimp and big fish are predators. Big fish preferred to eat small shrimps. Big shrimp preferred to eat dead prey items.

**Kongsy Khammavong, Wildlife Conservation Society, Lao PDR
Malgorzata Bruzio, Warsaw University of Life Sciences, Poland
2011**

Acoustic niche segregation: Does it happen at Danum Valley?

Acoustic signals play an integral role in many animals' communication. Acoustic environments can be very complex. Competition for limited acoustic channels and space could drive the partitioning of the acoustic environment resulting in niche segregation. However, few studies have examined the distribution of calls from individuals across different taxonomic groups. This study examines time as a factor by which species across different taxonomic groups segregate into acoustic niches. Birds and cicadas dominated the day while frogs and crickets dominated the night. Within the cicada and cricket group, some species were more specialised in the calling times than others. Acoustic niche segregation by time was found to occur in the primary dipterocarp forests of Danum Valley to a certain degree. However, there was not a clear cut pattern of acoustic niche segregation, suggesting that factors other than time of day might be important.

**Chin Lijin, Monash University Sunway Campus, Malaysia
Michal Korniluk, University of Warsaw, Poland
2010**

HERPETOFAUNA: Abstracts

Influences of environmental factors on Rough Guardian Frog (*Limnonectes finchi*) tadpole abundance in the streams of Danum Valley Conservation Area

We investigated the distribution of tadpoles of Rough Guardian Frog (*Limnonectes finchi*) related to environmental factors within six streams in Danum Valley Conservation Area. The factors which we examined were tadpole predators, stream size and microhabitat types. These environmental factors were measured and correlations were tested. Streams with high density of leaf litter showed a positive relationship with higher tadpole abundance of the species while streams with a higher proportion of rocks showed the lowest abundance of tadpoles. To have a clearer observation of predator-prey interaction, a predation test was conducted on tadpoles by two predators which were dragonfly larvae (*Macromia* sp.) and diving beetles. Dragonfly larvae results to be the best tadpole predator. The roles of leaves litter were recognised as protection and food source as previous studies suggested. Hence, prey survival-strategies were further tested with the treatment of leaves litter as protection for tadpoles. Our results showed that leaves litter did not significantly influence the predator efficiency. We concluded that leaves litter may act as food source rather than refuge for tadpole.

Ha Hoang Van (Vietnam), Cleveland Metroparks Zoo, USA
Mung Seng Chua, Universiti Malaysia Sabah, Malaysia
2011

Spacing and aggressive behaviour in the Yellow-bellied Puddle Frog (*Occidozyga laevis*)

There have been no detailed ecological studies regarding the Yellow-bellied Puddle Frog (*Occidozyga laevis*), found in Borneo, to date. Relying on field analysis and pilot observations in a pond located in the Danum Valley Field Centre in Sabah, Malaysia, we hypothesised that *O. laevis* in the pond had a non-random, even distribution and therefore may show territoriality or spacing behaviour. We also considered potential aggressive behaviour between *O. laevis* males as an additional support for our hypothesis. During our study we created 15 density maps which we used to test for non-random distribution. We also performed behaviour trials in the field, matching resident frogs with intruder frogs as well as resident frogs with a negative control (a rock). The Clark-Evans average R value indicated an even and therefore non-random dispersal. We did observe aggressive behaviours during the matches, but there was no significant dominance of the resident over the intruder or vice-versa. Our results suggested that male *O. laevis* show a clear spacing behaviour, likely connected to energetic cost trade-offs. However, given the fluctuations of the occupancy areas and the lack of resident dominance, we cannot infer that *O. laevis* present territoriality.

Bianca Corlett (Canada), Lund University, Sweden
Nicole Ponta (Italy), ETH, Zurich, Switzerland
2011

Interactions between males of tree hole frogs (*Metaphrynella sundana*) in Danum Valley Field Centre area

Males of tree hole frogs (*Metaphrynella sundana*) produce sounds to advertise their presence both to females and to the rival males. The rate of calls of the male frogs might be a good indicator to investigate how the males compete with each other and attract females. This study investigates whether the density of tree hole frogs influences the rate of calls a male makes and whether the distance to the nearest neighbour influences the male calling rate. We show that males in plots with only one individual had a significantly lower calling rate than males in plots with two individuals. These data were corroborated by our playback experiment which shows that the calling rate of males increases after a recording of a different is played. There is no correlation between distance and the

rate of calls. For conclusion, our work shows that rate of male calls depends on presence of another calling male, but distance between them does not influence it.

Piotr Kuterba, Jagiellonian University, Poland
Rizka Apriani Putri, Universitas Gadjah Mada, Indonesia
2010

Species richness and microhabitat preferences of frog species in Danum Valley Conservation Area

Resource partitioning allows the co-existence of various species as it reduces competition. Our aim was to find out if there is habitat and microhabitat partitioning among frog species in Danum Valley. Two artificial ponds, two natural ponds, and one stream section were sampled. Our results show that species richness in the stream is higher than in the ponds. Frog species have certain microhabitat preferences but they also occur in less preferred microhabitats. The same microhabitat can support more than one species. Thus, we concluded that the main factor allowing the presence of different species in the same place is the ability of sharing the microhabitat.

Ninda Lara Baptista, University of Lisbon, Portugal
Nurul Silva Lestari, Dipterocarps Research Centre, Indonesia
2010

Adjustment of tree-hole frog (*Metaphrynella sundana*) calling characteristics in relation to tree-hole properties in the field

Previous studies have indicated that male Bornean tree-hole frogs (*Metaphrynella sundana*) change their call frequencies to tune in to the resonant frequency of their cavity under laboratory conditions. We carried out a field study at Danum Valley Field Centre, Sabah, Borneo to investigate the correlation between call frequency and volume of water in natural tree cavities under field conditions. We recorded the calls of 19 frogs before and after adjusting the water volume in steps of 5 and 10 ml in the cavity. We found a significant relationship between the mean call frequency and air column volume. Continuous recording of an individual frog over a 32 minute period, as we added water, also showed an increase in frequency with increasing air column volume. Call frequency in response to changes in volume varied among individual frogs in cavities with different resonance properties. Although the laboratory evidence could not directly be translated into the field, we demonstrate that tree hole cavities influence the ability of *M. sundana* to vary its call.

Björn Johansson, Linköping University, Sweden
Stephen Hyland, National University of Ireland, Galway, Ireland
2009

Microhabitats of co-occurring tree frogs (*Polypedates* and *Rhacophorus*) around ponds of Danum Valley Field Centre, Sabah, Malaysia

Six tree frog species, *Polypedates leucomystax*, *P. macrotis*, *P. otlophus*, *Rhacophorus appendiculatus*, *R. pardalis* and *R. dulitensis* were observed to use the same ponds for breeding in around the Danum Valley Field Centre (Sabah). We investigated whether these six species shared the same ecological niche, or whether different microhabitats could be defined. For one week, the location of every individual encountered around three ponds was recorded every night. We found that the frog species occurred at different heights; *P. leucomystax* was different from all other species by occurring close to the ground at a maximum of 1 m. Seventy percent of all individuals were located within 0.50 meters from the water. *Rhacophorus pardalis* and *R. dulitensis* showed a preference for herbs over trees. All species were distributed randomly around the ponds. *R. dulitensis* was the main species in the temporary pond after heavy rain, which is an indication of a difference in breeding pattern.

Lieneke Bakker, Wageningen University, The Netherlands
Cheryl Cheah, Universiti Putra Malaysia, Malaysia
2009

**Tree hole frog (Microhylidae: *Metaphrynella sundana* Peters):
habitat utilisation and density**

We investigated patterns of habitat use and density in the tree hole frog *Metaphrynella sundana* in the Danum Valley Conservation Area, Sabah Malaysia. We recorded a total of 46 calling sites in five 10 x 100 m transects. When calling from tree holes, *M. sundana* showed no preferences for specific tree diameter at breast height (dbh), tree height, canopy cover, litter depth or slope. Tree hole diameter and hole height (a preference for small holes close to the ground), as well as the height of trees (frogs preferred smaller trees compared to reference samples) affected the frog's occurrence. The density of calling males was lower after heavy rainfall, and there is strong evidence that frogs regularly move between tree holes. Our result suggests that the density of *M. sundana* populations vary temporally and spatially, meaning that environmental heterogeneity is important for conservation management and should not be overlooked.

Phuong Thi Thanh Sam, Nature and People Reconciliation, Hanoi, Vietnam
Robin Lim, Danum Valley Field Centre, Sabah, Malaysia
2009

INVERTEBRATES: Abstracts

Do ants protect *Korthalsia furtadoana* J. Dransf. against herbivory?

Many plants are known to host ant colonies for protection against herbivores. *Korthalsia furtadoana* is a common rattan in Borneo that has very simple domatia as ant-housing structures and hosts many different species of ants. This study tested the effectiveness of the resident ants in protecting the host rattan against herbivory and whether this differed between ant species. The time of response of different ant species to two different types of herbivore was measured: the chewer herbivores (e.g. caterpillars) and the sucker herbivores (e.g. scale insects). The time of response and ant activity were compared with the leaf damage and number of herbivores identified in the plant during day and night observations.

Our results show that *Korthalsia furtadoana* does not have a mutualistic relationship with the host ants; however some interesting observations in Myrmicinae sp. 2 might suggest a possible mutualistic relationship still in evolutionary progress.

Patricia Dos Santos (Portugal), Royal Botanic Gardens Edinburgh, UK
Edith Sabara, Bogor Agricultural University, Indonesia
2011

Ecology of water striders (Family Gerridae) at puddles in Danum Valley Field Centre

Water strider is the one interesting aquatic insect. They are capable of skating on the water surface, including in puddle habitat. Twenty-eight puddles (large, medium and small puddles) were surveyed in seven days from 18th to 27th October, 2011. This research aims to measure relationship between puddle size and number of Gerridae. It also collects information about behaviour and prey taken by Gerridae. Our results showed a significant relationship between size of puddles and number of Gerridae. Large puddles are important habitats for Gerridae while small puddles may be too short lived to support individuals for long. Gerridae activity types differed significantly from one another. Gerridae use puddles for feeding – largely flies and ants and small insects and even fruit. They also use the puddle habitats for breeding, even though Gerridae also predate on eggs from the same species.

Fauziah Syamsi, Andalas University, Indonesia
Lan Ho Thi Kim, Wildlife At Risk, Vietnam
2011

Foraging ants on the forest floor

Ants are very species rich, especially in the tropics. To be species rich ants have developed coexistence strategies to deal with competition. This study looked at several characteristics that might be able to explain the coexistence of several genera using the same resources. The study was carried out in primary rainforest in Danum Valley Conservation Area in the period 18-25 October 2011. Bait was placed on 30 random plots. For each ant genera arrival time, recruitment time and distance to the nest were measured. A total of five genera of ant were identified in the study. Results showed differences among the ant genera for arrival time, recruitment time and distance to the nest. Main differences were between Myrmicinae and *Camponotus* with the main difference but none of the variables could clearly explain species coexistence. Observation showed large variation in social organisation and foraging behaviour of the present ant genera. Smaller ants have shorter arrival and recruitment times and distance to the nest compared to larger ants. Larger ants take bait usually immediately after arrival. Larger ants on the other hand are stronger and seem to have a more

individualistic social organisation. Species specific social organisation could be a good explanation for explaining scavenging species coexistence.

Nico de Koning, Wageningen University, Netherlands

Thomas Haee Mogensen, Aarhus University, Denmark
2011

Foraging and recruitment behaviour of *Camponotus gigas* in a dipterocarp forest in Danum Valley, Sabah, Borneo

Ants represent a large amount of biomass in tropical ecosystems and demonstrate complex foraging and recruitment behaviours. We studied the behavioural and foraging ecology of *Camponotus gigas* at the Danum Field Valley Centre in October 2011. We recorded foraging activity at 14 nests and performed an experiment, where we varied the size of bait and recorded the recruitment behaviour. We also observed 7 nests at dusk and recorded changes in activity within 30 minutes. We found that *Camponotus gigas* mainly forages alone and only rarely in groups. We found no effect of bait size on recruitment. However, even though the results were not significant we observed a trend - that ants recruit more conspecifics when more bait is available. Further, we found a significant increase in foraging activity at dusk. Additionally, we found that Temperature had a positive effect on the numbers of foraging ants at dusk. Our results are consistent with previous studies on the foraging behaviour of *Camponotus gigas* and generated several new interesting observations. Although *C. gigas* is largely known to be a nocturnal species, we found that some workers forage during the day and are able to recruit high numbers of conspecifics, when lots of food is available. The ecological impact of *Camponotus* on the rainforest is thus not solely restricted to night time.

Miranda A. Strubel, University of Leeds, UK
Joel O. Baumann, University of Berne, Switzerland
2011

On the prowl: Why do different ant species use floral and extra-floral resources on *Senna alata*?

A key factor in triggering ant-plant interactions is the provisioning of food by the host plant. Extra-floral nectaries in *Senna* are regarded as an important innovation for symbiotic relationships in this genus. Despite the fact that *Senna alata* does not have extra-floral nectaries, high numbers of different ant species were observed on inflorescences and stipules. It was the aim of this study to investigate the patterns of ant resource use on *S. alata*, a plant with the phylogenetic and physiological potential to develop ant mutualisms. Ants of different species show an increase in activity as a result of the addition of sugar and mashed buds to the inflorescence stems. The ants show no change in activity if access to the flowers or stipule like “bract” structures of the host plant is denied. It can therefore be assumed that ants obtain resources from these structures, opening up new perspectives in ant-*Senna* evolution.

Amy Munro-Faure, University of Cambridge, UK
Agnes Dellinger, University of Vienna, Austria
2011

Differences in fruit feeding beetle communities through the canopy of a primary lowland forest in Malaysia

Vertical stratification has been shown to have an influence on the communities of insects in the rainforest canopy. Here we studied the community composition of fruit feeding beetles through the rainforest canopy at Danum Valley Conservation Area, Sabah, Malaysia. 42 morphospecies from 7 families were recorded from three different canopy heights: 1 m, 10 m and 20 m. The community was

dominated by the family Nitidulidae but there were differences in the canopy layers with more families including Staphylinidae being found at ground level. The species richness and diversity of fruit feeding beetles did not differ between canopy layers. The abundance of beetles however differed significantly; particularly samples from 1 m differed significantly from 10 and 20 m. The complexity of the immediate environment in terms of canopy cover held no relationship with species richness, diversity or abundance. It is likely that the difference in abundance is related to the high abundance of ripe fruit on the forest floor dropped from the tree and opened by large mammals.

Felicia Lasmana, University of Padjadjaran, Indonesia
Jasmine King, University of Nottingham, United Kingdom
2010

Ecosystem engineers: Earthworms in tropical forests: A study from Danum Valley, Malaysia

The forest floor of Danum Valley in Sabah, Malaysia, is densely covered with thousands of miniature tower-like soil structures. This study investigated the role of earthworms, which were found to be the creators of these towers, in nutrient retention and soil turnover in tropical forests. Results showed these small earthworms are potentially major ecosystem engineers in tropical forest ecosystems, which turn over and process huge amounts of soil per year (over 88 kg per m²). The worm casts were found to have significantly higher levels of nitrate and conductivity than surrounding soils. It is well known that tropical forests are scarce in nutrients, particularly nitrate. This makes the activity of earthworms potentially crucial for retaining nutrients within the ecosystem and preventing loss through leaching. Soil moisture content was found to be an important factor determining the distribution of earthworms. The implications are especially significant for dry degraded forests where our study showed that the presence of earthworms was lower than in primary and intermediate forests.

Sarah Johnson, University of Salford, UK
Arshiya Bose, University of Cambridge (UK), India
2010

Invertebrate drift in the Tambun stream in Danum Valley

The invertebrate drift is the main food source of stream fish, but do the fish eat just the aquatic animals or do they also eat the terrestrial animals that drop down into the water? The drift composition was measured and fish gut contents were examined in the Tambun stream (Danum Valley, Sabah, Borneo). The results show that invertebrate drift in the Tambun Stream accounted for 41 million potential food particles drifting down the Tambun Stream each 24 hours. The numbers of aquatic animals drifting were greatest at night. The reason may be that the animals are minimising risks of being eaten by fish, which are visual predators. Also, the fish guts content showed that the fish prefer terrestrial and aquatic animal to exuviae. The terrestrial animals drop accidentally into the water and flounder. They are not adapted to the water environment and are therefore more vulnerable to predation in water. The aquatic animals are adapted to living and surviving under these conditions through structural and behavioural adaptation. One of those adaptations could be the voluntary drift during the night, when they are not visible to fish. Such controlled drift allows redistribution with minimum risk.

Anita Bousa, Wildlife Conservation Society, Lao PDR
Chiara De Cesare, University of Innsbruck (Austria), Italy
2010

Leech hide and seek: How leech awareness of hosts changes with environment and moisture levels

Leeches are parasitic organisms that take blood meals, most commonly from warm blooded mammals. A wide range of leech species exist and are widely distributed around the world, however the largest proportion of leech species is found in the tropics. In order to assess changes in leech activity and density across the forest at Danum Valley Field Centre, four habitat types were selected and sampled in two main areas. Samples were taken at different times of day and after different time periods had elapsed since heavy rainfall. Field observations showed no difference in leech density across habitat type or across levels of rainfall, however further experiments in the lab concluded that leech activity and awareness is increased after spending time in a wet environment.

Jenny Mason, University of Liverpool, UK
Sysomphane Sengthavideth, Wildlife Conservation Society, Laos
2010

The acoustic landscape and cicada call patterns in Danum Valley

Cicadas are a dominant feature of the acoustic environment in the tropics and are known to have species-specific calls making them useful subjects for investigating acoustic niches. Cicadas in Sabah, Borneo however, have been relatively poorly studied. This study described the daily acoustic landscape of Danum Valley by measuring sound pressure levels, humidity and temperature along a transect, together with recording the dominant calling animals. The presence/absence of eight 'sound species' of cicadas was scored to investigate potential partitioning in their acoustic behaviour. The acoustic landscape was shown to have a daily cyclical pattern, clearly dominated by cicadas. Cicada calls were found to be partitioned amongst other animal groups as well as between cicada sound species. This partitioning was found to occur temporally and by call frequency and call pattern. Observations also found spatial location influenced partitioning. Avoidance of interspecific competition seems to be the most likely driver for species occupying different acoustic niches.

Emma Ligtermoet, Charles Darwin University, Australia
Stefanie Weigl, Ludwig Maximilian University, Germany
Ana Filipa Palmeirim, University of Lisbon, Portugal
2009

Blood suckers in our midst: Leech (Haemadipsidae) abundance on forest trails and off-trails in the Danum Valley Conservation Area, Sabah, Malaysia

Danum Valley Conservation Area (DVCA) is exceptionally rich in both flora and fauna. Forming part of this richness, DVCA has two species of terrestrial leeches, the tiger leech (*Haemadipsa picta*) and the brown leech (*Haemadipsa zeylanica*). Our study looked at the composition and abundance of leeches in trails and off-trails in three sites in the forest. We tested the hypothesis that leech abundance would be greater in the trails than off-trails mainly because more animals use trails for foraging. The results showed no significant differences between species composition and abundance of leeches overall. However leeches were more abundant in one trail system when we tested for differences between sites. We also found no significant correlation between the abundance of leeches in relation to temperature and humidity.

Legi Sam, University of Papua New Guinea, Papua New Guinea
Dwi Susanto, Bogor Agricultural University, Indonesia
2009

Diversity and interaction of dragonflies in Danum Valley Field Centre

This study investigated diversity and interaction of dragonflies around the Danum Valley Field Centre. Six days samplings were conducted (18th-23rd October 2009) in different locations which included two ponds (114 m², 28.98 m²) and a wet-grass area (486.3 m²). Twenty two species were recorded in three study sites. Different types of interaction within two particular species of dragonflies were observed during different times of the day. Apart from gathering information on diversity and interaction, data collection on behaviour is also included in this study.

Sithisack Paninhuan, Wildlife Conservation Society (WCS), Lao Program, Lao
Kai Lin Ling, Institute for Tropical Biology & Conservation (ITBC), Borneo, Malaysia
2009

A positive relationship between ant biodiversity and predatory function across a disturbance gradient in a SE Asian rain forest

Human modification of pristine habitats almost always leads to the local extinction of a subset of the species present. This means that the ecosystem processes carried out by the remaining species may change. It is well documented that particular species of ants carry out important ecosystem processes. However, while much work has been carried out to investigate the link between biodiversity and ecosystem functioning in other taxa, this has received relatively little attention for ant communities. Here we investigate the impacts of anthropogenic disturbance on ant-mediated predation, using bait removal rates as a surrogate measure. We found that although ant species richness, diversity, biomass and rates of bait removal did not change systematically across the disturbance gradient, the rate of bait removal was related to both ant species richness and biomass. Sites with a higher species richness and biomass of ants experienced a faster rate of bait removal. If these results are applicable at larger spatial scales for a wider range of prey items, then loss of ant species could lead to changes in the way that ecosystems function.

Tom M. Fayle *et al.* (class exercise)
2009

The recruitment time of ant species in forested and edge habitats at Danum Valley

Ants recruit nest mates to a food source through the use of chemical trails. This study aimed to determine the differences in recruitment times for ant species in two different habitats. A four day study was carried out on the recruitment times and abundances of ants in edge and forested habitats. The abundance of each ant species was recorded every minute over a 30 minute period. Recruitment time is defined as the time difference between the first arriving ant and the arrival time of the second ant of the same species. The abundance in forest ant species was negatively correlated with recruitment time. The same significant relationship was found with edge ant species. However, no significance difference in species diversity, species richness or abundance was found between the two habitat types. Qualitative observations of competitive interactions were also recorded and examined.

Adam D. Earl, University of Sussex, UK
Judy F. Walsh, Trinity College Dublin, Ireland
2009

PLANT, FUNGI AND FOREST ECOLOGY: Abstracts

Antiherbivory strategy by red young leaves of rainforest tree seedlings

Delayed greening and presence of anthocyanin provide adaptive advantages to developing young leaves. Among the many hypothetical functions of leaf reddening, its potential defensive value against herbivory was examined among seedling of *Hopea nervosa* and *Pentace laxiflora*. Herbivory was examined in green phenotypes and red phenotypes of both species based on proportion of damaged leaves and leaf area lost to herbivory. Levels of foliar damage were significantly lower for red phenotypes than for green phenotypes in *Hopea nervosa*, suggesting a successful antiherbivory strategy. In *Pentace laxiflora*, protection against insect damage was only observed in red young leaves but did not persist in matured green leaves.

Shen Nyan Leong, Wildlife Conservation Society, Malaysia
Naing Lin, Wildlife Conservation Society, Myanmar
2011

Does nectar production in *Musa beccari* show adaptations to bird pollinators?

We studied diurnal patterns of investment of wild banana *Musa beccari* into nectar volume and sucrose concentration in male and female flowers. We also measured the final volume of nectar produced by flowers that experienced nectar removal throughout the day and flowers that did not. We found no effect of nectar removal on final volume of nectar. Volume of nectar produced by both male and female flowers declined sharply before the night, when bird pollinators are not available. Sucrose content on the first day of anthesis dropped before night in male, but not in female flowers.

Katarzyna Mikolajczak (Poland), University of Edinburgh, UK
Xaysompheng Sengkhamyong, Integrated Ecosystem & Wildlife Management Project, Lao PDR
2011

The pollination ecology of *Globba pendula* Roxb. (Zingiberaceae) in Danum Valley, Sabah, Malaysia

The pollination of *Globba pendula* is poorly known to science. This study aims to document the fruit set variation between the opened and closed forested areas. Sixty plants were tagged, measured and observed (for 28 hours 45 minutes) in open and closed forested areas. Floral visitors were also observed on video cameras. The light density did not have any effect on the fruit set of *Globba pendula*. The number of floral visitors was highly related to the number of opened flowers and with the time of day. The study suggests that the main pollinator for *Globba pendula* could be *Anthophora* bees (Anthophoridae) regardless of whether the flower is in the open or closed forested areas.

Billy Bau, University of Papua New Guinea, Papua New Guinea
Chhin Sophea, Royal University of Phnom Penh, Cambodia
2011

Is reproductive success in *Calanthe zollingeri* (Rchb.f. 1857) related to distance from the water body and canopy openness?

Fruit production in many orchid species is low and, as light is a key factor for terrestrial orchid distribution, we studied the influence that distance to the water and canopy openness have on the reproductive success of the terrestrial orchid *Calanthe zollingeri* in Danum Valley Field Centre. We measured attributes of the vegetative and reproductive structures of each plant as well as canopy openness and distance from the closest water source. Results show that fruit production is resource limited. Even though we could not observe any variations in pollination level due to spatial factors, the reproduction success was positively related to light availability and negatively related to distance

from the water. Thus we suggest that a temporal difference in pollination success during the 2011 flowering schedule occurred.

Sophak Sett, Royal University of Phnom Penh, Cambodia
Ambra Tosto, Camerino University, Italy
2011

Ant predation and herbivore damage on *Mallotus lackeyi* (Euphorbiaceae) in a lowland dipterocarp forest in Borneo

We did predation experiments using 600 termite baits and 200 plasticine caterpillar baits placed on 30 *Mallotus lackeyi* (Euphorbiaceae) trees with varying degree of herbivore damage. There was no statistically significant relationship between the herbivory damage and the predation rate on the termite baits. However, we found significant correlation between the herbivore damage and the rate of ant attacks on the plasticine caterpillar baits. This result suggests that the artificial plasticine caterpillars may be more suitable for assessing ant predation activity than live termites used as baits.

Hla Naing, WCS, Myanmar Program, Myanmar
Chris Dahl, New Guinea Binatung Research Centre, Papua New Guinea
2010

Different gradients and its influence to recruit of seedlings in primary forest in Danum Valley

Seedling recruitment was examined across a topographical gradient of the lowland dipterocarp forest in the Danum Valley Field Centre. Difference between number of recruits, species, and location were tested in three sites. Eighteen sample plots were set up and seedlings were counted and identified. The results indicated that most of the new seedlings are from the dipterocarp species, accounting for 86 per cent of the total seedlings. In addition, the number of old seedlings is very small, only accounting for 4 per cent of the total seedlings. Moreover, statistical tests show that there is no difference between the number of recruits and its locations; but there is a difference in term of species and its gradient.

Ngoc Thang Nguyen, WWF Greater Mekong - Vietnam Program, Vietnam
Hoeun Seanglay, Royal University of Phnom Penh, Cambodia
2010

Do epiphytes reach the sky? A study on vertical stratification of *Asplenium* and *Drynaria* on *Parashorea* spp. in Danum Valley

In this study, we examine whether there is vertical stratification in big epiphytic ferns of the genus *Asplenium* and *Drynaria* on *Parashorea* spp. Measuring the epiphyte occurrence on these trees together with a study on the abundance of epiphytes gives us a clear picture of how the epiphyte world looks like in the forest. The large epiphytes are mainly found in the canopy, only two were found at lower heights, less than 30 metres, on the trunks of the trees. There is a significant difference between the heights at which the *Asplenium* and the *Drynaria* grow. The *Asplenium* is not more abundant compared to the total of all other species of epiphyte in forest. However it does take up a large proportion of the present epiphyte community.

Chau Phing Ong, Massey University, New Zealand
Els Ton, Wageningen University, the Netherlands
2010

Pollination biology and fruit dispersal of *Alocasia sarawakensis* (M.Hotta) Araceae in a lowland rainforest in Borneo

This study investigated the reproductive ecology of *Alocasia sarawakensis* in Danum Valley Field Centre. Nothing is known about the pollination and dispersal biology of this species. Our

investigation reports the first thermogenesis measurements and also observations on pollinators (Diptera, Drosophilidae). In addition unique spathe movements within this genus were recorded and are believed to act as a pollinator management device. Dispersal observations indicate that seeds of this species are exclusively dispersed by birds. A total of nine bird species were observed removing fruits, indicating *A. sarawakensis* is an important food resource for many species in lowland rainforest. Spiderhunters (Nectarinidae, Arachnothera) dominated in visitation rates and total seed removal. This may be due to the characteristic beak morphology of the genus allowing easy removal of often relatively inaccessible fruits, or possibly territorial exclusion of other species.

Conor Redmond, Trinity College Dublin, Ireland
Florian Etl, University of Vienna, Austria
2010

Seed dispersal ability of *Dryobalanops*, *Dipterocarpus*, *Shorea* and *Parashorea* of Danum Valley Field Station, Sabah

In this study we worked on the question whether dipterocarp seeds of different species differ in their dispersal abilities. Moreover we were interested in the morphological features of the seeds which mostly determine this issue. Since we took an experimental approach as well as observations in the forest to investigate our question we also wanted to know whether our experimental based findings can be applied for natural environment.

In both approaches we could find significant differences in seed dispersal among the different species. Moreover correlation tests showed that the seed weight and wing area are mostly responsible for the flying abilities of the seeds. Comparing our two approaches we found out that general trends of dispersal ability that we gained in our experiment can also be seen in natural patterns.

Felix Steinmeyer, University of Regensburg, Germany
Sentiko Ibalim, New Guinea Binatung Research Centre, Papua New Guinea
2010

Ecology of *Pterospermum stapfianum*

Pterospermum stapfianum is usually found growing along riverine primary lowland forest. The effect of proximity to the river and canopy cover on this plant was examined. Six plots were established along two rivers and measurements on adult tree and seedling for this species were collected. Results showed, the distribution of adult tree was related to the distance from the river. This suggested, their distribution were affected by disturbance from river, presumably flood. The density of seedlings was affected by the canopy cover, and seedlings were found in areas with less canopy cover than adult trees.

Huaimei Yong, Universiti Malaysia Sabah, Malaysia
Phouthakone Luangyotha, Wildlife Conservation Society, Lao
2009

The effect of microclimate in Borneo rains forest on macrofungal communities

Understanding the ecology of fungi is of great importance due to their relevance to questions of biodiversity and to the role they play in regulating populations of other organisms. This study was conducted in Danum Valley Conservation Area to investigate the effect of microclimate on the occurrence, density and state of host decay on the fruiting macrofungi. Macrofungi were recorded at relative humidities between 85.20 - 97.20 %; temperatures between 27.5 - 31.0 °C; and a substrate moisture content of 31.40 - 77.62 %. Different macrofungi groups showed a tendency to prefer different states of decay (measured by bark characteristics). The density of fruiting bodies was not influenced by abiotic conditions. These results suggest that further work on the succession of macrofungi on different substrates would help understand their diverse microhabitats and role in ecosystem function.

Bruno Herlander Martins, University of Lisbon, Portugal
Mui Ching Tan, Universiti Putra Malaysia, Malaysia
2009

The effect of plant density on insect herbivory in two plant species (*Melastoma malabathricum* and *Clidemia hirta*): A comparison of native and invasive species in Danum Valley Conservation Area

The effect of plant density on insect herbivory was examined in two plant species. It was expected that with increasing density higher levels of herbivory would be sustained. A native melastome, *Melastoma malabathricum*, and *Clidemia hirta*, a non-native from the same family, were compared. Under the enemy release hypothesis any effect of density would be expected to be more severe in the native species. Five measures of density were used in order to test which aspect of plant distribution was the best predictor of herbivory. Light availability was measured to assess the impact of growth rate. Finally herbivory types were recorded so that any differences between the two species could be analysed. There was no difference between mean herbivory levels in the two species. For *C. hirta* height provided the best model and was a significant predictor of herbivory levels showing a negative relationship. For *M. malabathricum*, volume provided the best model but none of the terms were significant. Herbivory type differed between the two species in number and frequency. These results suggest that density measures are not the best predictors of herbivory levels in *C. hirta* and *M. malabathricum* and that *C. hirta* is not becoming abundant as a result of the release from natural enemies.

Alexandra Davey, Oxford University, UK
Sebastian Kepfer Rojas, Lund University, Sweden
2009

The effect of seedling density of a shade-tolerant species, *Mallotus miquelianus* (Euphorbiaceae), on herbivory in the tropical rainforest in Danum Valley Conservation Area, Malaysia

Mallotus miquelianus is a shade-tolerant shrub (Euphorbiaceae) which is usually found in both primary and secondary forest. This paper reports the results of a study on *M. miquelianus*. There was no relationship between seedling density and herbivory. This may be insects feeding on the plant species are generalist species. The study also showed that younger leaves exhibit more herbivory level than the mature leaves, which could be explained in terms of the nutritional value where young leaves mean higher nitrogen concentrations. Herbivory levels were not related to seedling height and the distance to the nearest neighbour. This could be because the insect types that feed on the plant are mobile and not restricted to localised feeding areas (dense seedlings). There is a significant negative relationship between the number of parent trees nearby and seedling density. Our study also showed *M. miquelianus* seedlings prefer high canopy cover compared with open canopy areas. Shaded areas may be the optimum condition where seedlings are high in number. Herbivory is influenced by a range of factors all occurring simultaneously and a better understanding of this very important concept would be to look into these various factors insect herbivores, florist composition and the abiotic factors.

Agus Wahyudi, Dipterocarp Research Centre, Indonesia
Francesca F. Dem, New Guinea Binatang Research Centre and UPNG, Papua New Guinea
2009
