Conservation Sri Lanka 2012

Proceedings of the Symposium

The Institute of Biology Sri Lanka
Biodiversity Secretariat

Conservation Sri Lanka 2012

Proceedings of the Symposium

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Message from the President, Institute of Biology Sri Lanka

To us in Sri Lanka, the concept of conservation is not of recent origin. History bears evidence to the fact that our ancient kings, realizing the need to conserve what nature has bestowed on us, declared large extents of land as reserves, so ensuring the protection of the country's biotic wealth. Today, scientists, rulers, and even the general public are well informed of the urgent need for conservation. At present, although we are left with only around 24 % of our land under forest cover, we can yet boast of the fact that our Protected Area Network in proportion to the island's land area is far greater than that of many other countries. A matter for concern, however, is that only a relatively small proportion of this network falls within the wet areas of the island where biodiversity and endemism are richest and where the human population density is highest. Despite the continuing conservation efforts by conservationists and progressive governments, we are still faced with an ever increasing number of species and ecosystems that are facing risks of extinction and degradation.

One of the basic problems in developing a well focused conservation effort is the lack of adequate scientific information. Population sizes of the relatively large-sized animals may be fairly well documented, but what about the numerous species of small-bodied fauna – amphibians, fishes and the invertebrates? There have been many recent discoveries of new species of frogs and lizards from the montane forests. Many unique and species-rich habitats still remain poorly explored.

Even where there is no loss of forest cover, progressive degradation of natural ecosystems occurs, changing the status of the inhabitants (plants and animals) from highly abundant to rare. Many species have suffered range reductions in the face of climate change and human-induced disturbances. Some species, particularly the more tolerant species such as the invasives, weeds and pests, may have, on the other hand, expanded their distribution. Some species are subject to overexploitation. The generation, expansion and updating of information on the country's biological wealth is a basic requirement for biodiversity conservation and management planning. There is a need to characterize species in terms of conservation status in order to prioritize conservation efforts. Biologists are therefore called upon to gather knowledge, devise conservation tools, regularly monitor populations, and assess ecosystem health. Such measures are imperative for accurate predictions of the fate of species and habitats and to develop and implement a corrective and mitigatory course of action.

As one of the leading institutions dealing with biology, the Institute of Biology Sri Lanka (IOBSL) is called upon to make contributions to the knowledge base that will accelerate conservation efforts. In line with one of its foremost objectives, which is to promote the acquisition, dissemination and interchange of biological knowledge in Sri Lanka, the IOBSL organized the symposium entitled "Conservation Sri Lanka 2012". This symposium, which brings together experts, researchers and conservationists, will provide a forum to share scientific knowledge, ideas and experiences on all aspects of conservation biology and education. We hope that the information disseminated at this symposium will make some contribution to the conservation of Sri Lanka's astounding, yet fragile, biodiversity. I wish this event every success.

Mayuri R. Wijesinghe

Message from the Director, Biodiversity Secretariat, Ministry of Environment

Sri Lanka is blessed with a high diversity of flora and fauna. Although, from ancient times, people of this country have adapted to live in harmony with nature, the biodiversity of the country is now facing a threat of extinction due to economic development activities.

In the conservation of biodiversity and ecosystems, it is vital to prioritize the species and ecosystems which are under threat in order to focus on the needed conservation actions with the limited funds available. Therefore, research on both species and ecosystems is very important.

Currently the biodiversity Secretariat of the Ministry of Environment is involved in the preparation and updating of the National List of threatened Flora and Fauna. Therefore this symposium can contribute in providing necessary data for the preparation of an updated Redlist of Flora and Fauna of Sri Lanka.

At the Biodiversity Secretariat we believe that sustainable conservation should involve the young scientific community together with the decision makers. The approach of this symposium is to disseminate the knowledge and experience in biodiversity conservation and promote research in much needed areas.

I wish to thank the Institute of Biology Sri Lanka for organizing this symposium in collaboration with the Biodiversity Secretariat of the Ministry of Environment. I wish the symposium all success.

Ajith Silva

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Abstracts of the Technical Sessions

(01)

Figs (*Ficus* spp.) dispel the splendor of Colombo streets: A case study

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Abstract

Street trees are considered as an essential element of urban infrastructure as they offer immeasurable services to maintain urban sustainability. At present several activities are being conducted to escalate and improve 'greenery' in urban ecosystems including Colombo City. However, some streets have become a sorry sight due to infestation by Figs (Moraceae; *Ficus* spp.). This study investigates the spread of Figs along streets in postal zone 07 (Cinnamon Gardens), in which the highest number of street trees is reported. Objectives of the study were to i) identify problematic (hemi-epiphytic) *Ficus* spp. ii) determine their growth stages and hosts iii) identify suitable measures to minimize population of Figs. Observations were recorded for all street trees located in Colombo 7 postal zone during April 2011. Hemi-epiphytic *Ficus* species and their hosts were identified using available literature. Growth stage of *Ficus* spp. was ranked according to a scale 1-7 (1= Fig sapling <1m, 2= sapling with developing roots, 3= Fig with hanging roots, 4= Fig roots touching ground, 5= host replacement initiation, 6=host almost replaced, 7= independent Fig with no clue of host). Girth measurements for host trees were recorded at approximately 1m above soil level and categorized into 9 classes (within <1m–8m range).

Out of 890 street trees observed (belonged to 45 species, 42 genera and 23 plant families), 38 were independent Fig trees (that have probably replaced hosts completely!). Among five hemi- epiphytic *Ficus* spp. identified, four (*F. benghalensis, F. macrophylla, F. tinctoria* ssp. *parasitica*, *F. elastica*) except *Ficus religiosa* showed strangling habit. Figs grew either separately or in a mixed manner on the same host tree. Nearly 17% of street trees in the study area were colonized by *Ficus* spp., majority being *F. macrophylla* and *F. benghalensis*. Among infested street trees were 60% *Peltophorum pterocarpum*, 25% *Albizia saman* and 5% *Pithecelobium dulce* all of which are exotic. With respect to populations of host tree species, 37% *Peltophorum pterocarpum*, 40% *Albizia saman* and 12% *Pithecelobium dulce* were affected. Distribution of Figs was high in host trees belong to girth classes >5 in *Peltophorum pterocarpum* and *Albizia saman* and none of these were free of Figs. Fork of branches had been the most (96%) favourable place for establishment of Figs. Decomposed areas due to cutting/damaging of host stem and other epiphytic growth also had provided suitable niches as colonization sites for Figs. Most of the strangling Figs were in their first stages of establishment indicating that many street trees could be made 'free of Figs' by complete removal of saplings. Number of independent Figs and those ranked at top of the growth scale reflected the intensity of hazardous situations they may cause to pedestrians as all of them have spread into street pavements. For these too, a complete removal is suggested.

***Keywords*:** Figs, *Ficus*, street trees, Colombo

(02)

Investigation of pelage patterns and morphometrics of the captive mouse deer reveal potential dangers of captive breeding and release

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Abstract

The mouse-deer are an ancient group of ungulates, belonging to the family Tragulidae. One genus, *Moschiola* is distributed in the Asian region, and consists of three species; *M. indica* (Indian mouse deer) confined to India and the other two, *M. meminna* (White-spotted Chevrotain) and *M. kathygre* (Yellow-striped Chevrotain), being confined to Sri Lanka. The latter two, respectively, inhabits the dry and the wet zones of the country. *M. kathygre* was identified as a separate species relatively recently by Groves and Meijaard (2005) who considered this form to be different from *M. meminna*. The distinctions between the two species were based largely on pelage features and bone structure of a small sample of museum specimens. However, no studies have examined interspecific differences with regard to morphometric characters of live animals. Thus the present study conducted at the National Zoological Gardens, Dehiwala, was undertaken to verify these differences in live specimens.

The captive population of mouse deer at the National Zoological Gardens, Dehiwala, are currently housed in a single enclosure (n=14 *M. kathygre* and n=7 *M. meminna*). This group consists of individuals that had been brought into the zoo from various parts of the island as well as those who have been born in captivity. All animals within the enclosure were captured for detailed observations of pelage features and to obtain morphometric measurements. This study revealed that the pattern of stripes and spots of the individuals, characters that had been previously used for distinguishing the two species, was subject to much intra and inters specific variation. The pelage of some individuals fitted the ideal patterns of strips or spots whilst many had intermediate stripe or spot patterns. One of the characters that did not appear to be variable however, was the colour of the pelage and that of the spots or stripes; yellow in *M. kathygre* and white in *M. meminna*. The extent of variation in pelage patterns and the lack of variation in morphometric parameters may suggest the possibility of interbreeding within the common enclosure. These findings therefore indicate that such captive animals should not be released to the wild at any cost as it would result in the contamination of the wild populations.

***Keywords*:** Captive populations, morphometry, mouse deer, pelage patterns, Sri Lanka

(03)

Mixed species bird flocks in the Hiyare Forest Reserve, Galle

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Abstract

The Hiyare Forest Reserve is an extension of the Kottawa -Kombala Man and Biosphere (MAB) reserve located in the Galle district of Sri Lanka. The species composition and frequency of birds attending in mixed species foraging flocks in the Hiyare Forest was studied from October 2010 to May 2011. A mixed species bird flock is defined as an association of two or more species that moves consistently in the same direction.

Flocks were observed in selected locations within the forest from 09 00 - 13 00 hrs and also in open areas surrounding the Hiyare reservoir. Flocks were located by observing movements and listening to the calls of birds. Each flock was followed within the forest until no new species and individuals were encountered. Birds and mammals attending the flock and the number of individuals were recorded. The number of bird species attending a flock was defined as the maximum number of bird species observed for the period of observation of a particular flock. The highest number counted during observations at any one instance was recorded as the number of individuals of that species within the flock. The percentage frequency of each bird species, average number of bird species and average number of individuals (birds) in a flock were calculated. Based on the percentage frequency of occurrence, birds were categorized as nuclear, regular, occasional, rare and very rare species.

A total of 31 bird species were recorded which included the endemics Sri Lanka scimitar babbler, Sri Lanka grey hornbill, Sri Lanka white-throated flowerpecker and Sri Lanka yellow-fronted barbet. The average number of bird species in a flock was 5.07 ± 2.99 whereas the highest number of bird species recorded in a flock was 11. The average number of individuals (birds) in a flock was 8.90 ± 5.63 while the highest number was 23. The Crested drongo and Dark-fronted babbler were the most frequent (being present in 50% of the flocks) and the nuclear species. The Yellow-browed bulbul, Malabar trogon and Black-naped monarch were identified as regular species (30% - 50% frequency). The Asian paradise-flycatcher, Black-crested bulbul, Scarlet minivet, Asian black bulbul and Greater flameback were the occasional species (20% - 30% frequency). The Dark-fronted babbler was the most abundant bird species in most of the flocks, with the highest number of individuals recorded as seven. Three mammals the Giant squirrel, Dusky-striped jungle squirrel and Layard's jungle squirrel also attended flocks.

The Hiyare bird flocks are typical of that of near equatorial tropical forests. The migrants form only a very small proportion and most birds are insectivores. However, the species composition can be expected to be more diverse in the Hiyare flocks.

Keywords: Bird flocks, occurrence, nuclear species, species composition

(04)

Morphological diversity of natural hybrids of *Nymphaea nouchali* Burm f. (Nil Manel)

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Abstract

Nymphaea nouchali Burm. f. (Nymphaeaceae), a native plant to Sri Lanka is valued as an ornamental aquatic in man-made landscapes. It is naturally distributed in all parts of the country in shallow waters. It is commonly known as 'Nil Manel' and has been declared as the national flower of Sri Lanka. However, many literature erroneously refer to an exotic violet flowered *Nymphaea* species as *N. nouchali*. This exotic species has now become naturalized in local water bodies. Studies have revealed the possible hybridization between this violet flowered *Nymphaea* species with the native *N. nouchali.* Since hybridization of exotics with natives is identified as a threat to natives, it is important to assess and record the possible hybrids in the wild. Therefore, the present study was conducted with the aim of recording the morphological diversity of natural hybrids of *N. nouchali* in the wild.

Thirty nine specimens were collected from 13 different locations. Sixty four different vegetative and reproductive morphological characters were studied in detail and coded into a data matrix and analyzed using PC-ORD version 4. The resulting dendrogram identified clusters resembling parents; *N. nouchali* and the exotic violet flowered *Nymphaea* and also two clusters of *Nymphaea* with intermediate characters of both *N. nouchali* and the exotic violet flowered *Nymphaea*. The individuals of the hybrid *Nymphaea* population resembling *N. nouchali* shared 6 morphological characters (epiphyllous plantlets, green colour abaxial surface with violet dots, absence of leaf adaxial surface streaks, absence of out growths in the cross sections of the pedicels and petiole and absence of fruits) common with its exotic violet flowered *Nymphaea* parent. While the individuals of the hybrid *Nymphaea* population that resembled the exotic *Nymphaea* shared 3 morphological characters (purple colour abaxial surface with dots, absence of leaf adaxial surface streaks and presence of out growths in the cross sections of the pedicels and petiole) common with its native parent, *N. nouchali*. Since individuals of both hybrid populations had the ability of forming epiphyllous plantlets, they are more successful in spreading compared to the *N. nouchali* and therefore would cause a threat to the survival of the native.

The present study confirms the occurrence of hybrids of *N. nouchali* that resulted from the hybridization of the native *N. nouchali* with the exotic violet flowered *Nymphaea* species. Since the exotic violet flowered *Nymphaea* is identified as a silent invader in local water bodies, and as hybridization of invasive aliens with native flora is currently identified as a major threat that could lead to the extinction of the native flora, detection of hybrid populations and identifying them from the parent taxa would be important in conservation and management of the native *N. nouchali*.

Keywords: Diversity, hybrids, morphology, *Nymphaea nouchali*

(05)

Diversity of mealybugs in homegardens of the Eastern Province, Sri Lanka: Implications of the threat of invasive pests

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Abstract

Mealybugs (Hemiptera: Pseudococcidae) are important plant pests causing severe economic damage to a wide variety of crops. The present study was conducted to provide more information on the composition of mealybug species in home gardens in the Eastern Province. Twenty five locations were randomly selected from Batticaloa, Ampara and Trincomalee districts. In this study mealybug samples were collected from different plants including ornamentals plants, food crops, trees and weeds in fifteen randomly selected locations within the selected districts during the period from June 2008 to December 2010. The collected specimens were preserved and mounted on slides for identification which were confirmed using standard taxonomic keys.

During this survey nine different species of mealybugs were collected and among them seven were identified to the species level. They were the Cotton mealybug *Phenacoccus solenopsis* (Tinsley), Citrus mealybug *Planococcus citri* (Risso), Striped mealybug *Ferrisia virgata* (Cockerell), Papaya mealybug *Paracoccus marginatus* (Williams and Granara de Willink), Pink hibiscus mealybug *Maconellicoccus hirsutus* (Green) , *Saccharicoccus sacchari* (Cockerell) and Annona mealybug *Dysmicoccus neobrevipes* (Beardsley). *P.marginatus* and *P. solenopsis* are two invasive species that were recently identified from Sri Lanka. *P. solenopsis* was found to be the predominant mealybug species with a wide host range and wre recorded in 70% of the samples examined during the study. The first incidence of the species was reported by the authors in 2009. The higher incidence reveals that *P. solenopsis* might presents a significant threat to many agricultural and horticultural crops where it was found. Southern Asian region was categorized as one of the areas with a high risk of invasion from this species. *P. marginatus*, a polyphagous pest was first detected in the mid 2008 from the Western region of the country and subsequently spread throughout the country. It has already killed many papaya plants and is capable of surviving on and damaging more than 80 different plant species. Except for these two, the other species are those that have been previously recorded in Sri Lanka. They can be described as minor pests but are sucessfully controlled by natural enimies and other pest management practices.

Managing invasive species are one of the major challenges for the future of the agricultural sector in Sri Lanka. It should also be kept in mind that climate change may further aggravate pest problems by facilitating the increase and spread species that have not yet attained pest status. By exploring the diversity and distribution of native and exotic mealybug species in Sri Lanka, we could hope to manage possible threats from these species wisely and effectively.

***Keywords**:* Diversity, invasives, mealy bugs, *Phenacoccus, Paracoccus*

(06)

Climate consciousness: It is a priority for future leaders in Sri Lanka

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Abstract

Global warming due to human activities has accelerated climate change in the world during the past few decades. It has become the most challenging environmental issue ever faced by human beings. Although developed countries are more responsible for these actions, negative impacts are shared by developing countries. According to climate change scenarios and modeling, one of most vulnerable groups is the youth of today who would become our future leaders. As a country that emits only 0.6 metric tons of CO_2 per capita, Sri Lanka would not be able to mitigate the problem but may need to implement actions that focus on climate change adaptation. The lack of awareness among grass root level communities in Sri Lanka on the current issues of climate change has been identified by the National Strategy on Climate Change.

A public survey was conducted using a questionnaire with 10 open-ended questions related to climate change issues among 250 individuals who were randomly selected from five provinces (North Central, Central, Sabaragamuwa, Uva, and Western). The analyses of the results indicated that 99 % of them were not aware of the climate change issues whilst all (100 %) were not aware of the carbon foot print or that they have a role to play in mitigating it. All of the interviewed persons burn or dump polythene and plastic as a solution to non-biodegradable waste. This survey clearly indicated that there is an urgent need to raise awareness and consciousness on climate change issues at the grass root level communities.

Therefore, the "Kelani Nadee Yatra- a river journey" was organized to create awareness on climate change at the grass root level communities. This activity was performed through practical actions and a media campaign using youth as agents of change. Twenty one youth representing six provinces (North Central, Central, North, Eastern, Western and Sabaragamuwa) were selected. They were given a basic training on creating public awareness before the journey commenced. They also gained further training while participating in the awareness campaign for 12 days along the Kelani river. The journey also provided an opportunity for the youth to gather knowledge on biodiversity, invasive species and river pollution whilst creating awareness among the local communities. Water quality assessments were also made along the river. Currently, nine months after the river journey, some of the youth leaders that participated in the river journey are implementing projects on their own at the grass root level. This attempt has clearly showed that a significant change could be made with a properly planned awareness campaign and if there is long term commitment towards changing attitudes and behavior of the youth and of those in grass root level communities.

Keywords: Awareness, climate change, grass root communities, youth

(07)

Management of biological invasions: Bringing economics into the foray

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Abstract

The introduction of Invasive Alien Species (IAS) to ecosystems not only generates ecological ramifications, but also possesses economic and human welfare consequences. Thus, management strategies and conservation policies linked with invasive species needs to be an outcome of engaging the human and social dimensions together with the ecological and bio-geographic approaches. We report the outcome of three empirical studies carried out within this framework. Two of which investigated the social processes and perceptions about aquatic invasive plants in Lunuwewa Tank Habitat (LTH) (n=32) in the Anuradhapura District (as a case for invasive species infestation in the Dry Zone tank system), while the other was focused on assessing the perceptions and attitudes of Environmental Managers (n=100) on various issues related to the IAS problem. A multidisciplinary approach, including rapid rural appraisal techniques, key informant surveys, personal interviews, focus group discussions and consultative meetings and questionnaire-based surveys were used for gathering data. Several qualitative (text analysis, code development, etc.) and quantitative (mean ranks, Kruskal Wallis test, Hierarchical Cluster Analysis, etc.) data analysis techniques were used to derive conclusions.

In LTH, exploratory assessments revealed four broad, distinct stakeholder groups: 'direct farmers', 'farmers of the tank catchment/reservation', 'fishermen' and 'administrators', in terms of their livelihood linkages with the tank. Although they all identified aquatic invasive plants as a 'problem' or 'threat', their level of interest and definition of this varies drastically; among the aquatic invasives present, not all were identified as "invasive". The farming community was not clear in the views with the problem of IAS, while the fishermen failed to identify IAS as a problem. Although most of Environmental Managers rated IAS to have a very significant threat, their responses differed significantly as IAS were compared in relation to other environmental problems faced by the nation such as impacts of climate change, extinction of flora/fauna and land degradation etc. Interestingly, each of the major species assessed were perceived with multiple attributes, often simultaneously; in addition to "invasive" and "alien", other labels such as "native", "useful" and even "harmless" were cited.

Keywords**:** Ecosystem, environmental management, human dimensions, invasive alien species, social perceptions

(08)

Seed germination and vegetative propagation of *Hibiscus furcatus* Roxb.

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Abstract

Hibiscus furcatus (Malvaceae), locally known as "Napiritta" is an important medicinal plant growing in secondary forests and scrub lands of low country, Sri Lanka. Due to lack of information on its' seed germination and vegetative propagation, the present study was aimed to study propagation of *H. furcatus* via seeds and stem cuttings. Sexual propagation was examined by studying viability of seeds using Tetrezolium chloride (TTC), germination percentage of seeds before and after pre-sowing treatments (mechanical damaging of seed coat, heat shocks for 5 and 10 minutes – at 40°C, 60°C and 80°C and conc.H_2SO_4 treatments for 10, 25 and 45 minutes). Vegetative propagation potential was tested using stem cuttings of three maturity stages; tender cuttings (stem-tip cuttings), semi hard-wood cuttings and hardwood cuttings with 50 replicates. Further, 50 plants were up-rooted and 50 main stems were cut with keeping residual stem of 5 cm from the ground and their sprouting abilities under natural conditions were tested to determine the self regeneration ability of *H. furcatus*. The data collected were analyzed with One-way ANOVA with Minitab R 14.

Though viability of *H. furcatus* seeds were 100%, their germination was 1% indicating an inherent seed dormancy. Among seed dormancy breaking treatments, soaking in conc. H_2SO_4 for 45 min. was the best (germination percentage 65.3; One-way ANOVA, p= 0.05). Seed germination after mechanical damaging of the seed coat was 55% and that of soaking in conc. H_2SO_4 for 25 min. was 52% and those two were not significantly lower than that of the other treatments (One-way ANOVA; p= 0.05). Heat shock treatment was not suitable for breaking of dormancy of *H. furcatus* seeds as their germination percentage was low (6%). Sprouting ability of hardwood cuttings of *H. furcatus* was highest (92%) and it was significantly different with both softwood cuttings and semi hard-wood cuttings (68%) (One-way ANOVA; p= 0.05). No re-sprouting was recorded with all the up-rooted plants as they died. Percentage re-sprouting from stem bases was 100%.

Findings indicate that *H. furcatus* seed dormancy breaking by 45 min. soaking in conc. H_2SO_4 is better than other methods tested. Propagation by stem cuttings which is the most commonly used method to propagate many woody ornamental plants was better than sexual propagation in *H. furcatus* and hardwood cuttings could be recommended for its propagation.

***Keywords*:** *Hibiscus furcatus,* seed germination, vegetative propagation, seed dormancy

(09)

Sexual biology and breeding system of threatened *Exacum trinervium* (L.) for conservation and utilization

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Abstract

Exacum trinervium (L) (Gentianaceae) is a rare, wild, endemic and potentially ornamental and medicinal plant species in Sri Lanka. Due to paucity of information on its reproductive biology and breeding, this study was aimed to enumerate floral biology in relation to pollination, breeding system and pollinators. Floral level phenological changes; timing and duration of anther dehiscence and stigmatic receptivity, changes in direction of the style were observed in 10 plants in the Pilikutthuwa forest reserve. UV color attractants of flowers were investigated in 25 flowers collected from the forest under UV lamp. Among floral visitors, effective pollinators were identified. Availability of carbohydrates, lipids and amino acids in pollen were determined. Viability of pollen after anther dehiscence and under cold storage conditions (at 4°C and 0°C) and *in vitro* pollen germination was tested using series of sucrose concentrations (0 - 25%). Pollen: Ovule ratio (P:O ratio), Index of Self Incompatibility (ISI) and Out Crossing Index (OCI) were used to estimate the breeding system. Controlled pollination with 60 replicates of flowers for each treatment was used to determine breeding system in 10 individuals.

The flowers fully open at around 6.00 a.m. and last for six days. Anthers and stigma are spatially separated. Flexistlyly facilitates autogamy. Simultaneous occurrence of pistillate and staminate phase flowers facilitates the geitonogamy. *E. trinervium* flowers show monomorphic enantiostyly. Pollen of *E. trinervium* were strachless and contained lipids and amino acids. Stigma is dry and papillate. The highest pollen germimation was determined in 20 % sucrose solution/4 hrs. However, it was not significantly different from 3 and 5 hrs. (One way ANOVA, $p<0.05$). Pollen germination was significantly higher in 2nd and 3rd days old flowers (One way ANOVA, $p<0.05$). 4°C and 0°C were not appropriate for pollen storage.

Pollinators attractants of flower visible under UV were identified. The effective pollinators identifed were *Xylocopa* sp., *Amegilla* sp. and *Lasioglossum* sp. which were belongs to order Hymenoptera. The P:O ratio was 2013.61 ± 401.66, indicating facultative xenogamous breeding system. The OCI and ISI values of *E. trinervium* flowers indicate that they have high demand for pollinators. Natural pollination success was not significantly influence by monomorphic enantiostyly of flowers (One way ANOVA; $p< 0.05$). The highest fruit set obtained from xenogamy (56.67±4.49), but no significant differences between natural pollination success (41.67%) and geitonogamy (46.67 %) was recoreded in controlled pollination experiments. The results of this study indicated that mixed mating system of *E. trinervium* and the findings strengthen the knowledge of breeding pattern of the plant in its native environment.

Keywords: *Exacum trinervium* , breeding system, pollination, floral biology, Hymenoptera

(10)

Necessity for the conservation of medicinal plants through community participation in Kumbiyangoda, Matale area

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Abstract

Sri Lanka has been identified as one of the 25 global biodiversity hot spots of international importance. It contains high diversity of medicinal plants. Out of 4,143 flowering plants more than 1400 species are medicinal. Out of them 200 are in common usages, while 50 are heavily used in ayurvedic and traditional health care systems. Sri Lankans use medicinal plants in rituals, cultural activities and in religious functions. An ethno botanical study was conducted from October 2010 to January 2011 to investigate the uses of medicinal plants and their conservation aspects in Kumbiyangoda area, Matale district in the Central province of Sri Lanka. Information was gathered using a structured questionnaire and personal interviews. A structured questionnaire was distributed among randomly selected 100 individuals to find out the utilization pattern and potential of cultivation of medicinal plants by the people. The information of indigenous knowledge was gathered by interviewing the Ayurvedic practitioners and elderly people in the village. Most useful medicinal plants, the threats created by the community and the present conservation practices were identified from the questionnaire. Vegetation analysis was done using plot sample method. Data was analyzed using SPSS (17.0). A Total of 89 species belong to 42 families recorded from the study. Among them trees and herbs were dominant. The documented medicinal plants were mostly used to cure skin diseases, poison bites, stomachache and nervous disorders. Extraction of plant materials from trees can be considered as sustainable while extraction of most herbs species has lead to over exploitation. Fifteen species were most common to the home gardens. Abundance of *Cyperus rotundus* was low due to over extraction. The highest willingness to cultivate medicinal plants was shown by the 16-30 age category while the lowest was shown by the >50 age category. Willingness to cultivate medicinal plants was higher among females than males. Majority of villagers (62%) were taken medicinal plants from home gardens. Currently the villagers received seedlings and seeds from Agrarian Service Department. Thenna Ayurvedic medical center promote the medicinal plants cultivation in their home gardens. The major draw back in this village is lack of knowledge on medicinal plants and its importance. No measures were taken on conservation of rare medicinal plant species. Medicinal plants in this area are under considerable threat due to human activities such as cutting trees, cattle ranching, agricultural practices, fire, and poor caring. Community participation is important for the conservation of medicinal plants in this area.

***Keywords*:** Conservation, medicinal plants, community, Matale, Kumbiyangoda

(11)

Effects of vegetation and isolation on the recolonization of abandoned tea plantations by Anurans in the Knuckles Mountain Forest range

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Abstract

Many studies that explore the ecological effects of habitat degradation focus on deforestation in tropical areas, and the subsequent impact of this on biodiversity. However, little is known about the potential for recovery and recolonization of the fauna and flora following such disturbances. A few studies have focused on the recovery of herpetofaunal elements. The main objective of our research was to test two hypotheses regarding the effect of (1) the distance between virgin sub-montane forest and abandoned agricultural lands; and (2) the vegetational structure of abandoned agricultural lands on rates of recolonization. The Knuckles Mountain Forest Range in the Matale and Kandy Districts were selected for this study.

We categorized the vegetation in the experimental plots into three broadly-defined successional stages: early, intermediate, and late. The virgin sub-montane forest was used as the reference stage, and tea plantations currently-in-production represented an extremely (maximum) disturbed stage. We hypothesized that abandoned tea plantations at different successional stages (early, intermediate and late) that were equidistant from the virgin sub-montane forest would be recolonized by anuran species based on vegetational structure. Additionally, it was hypothesized that abandoned tea plantations that were in the same stage of secondary succession (in this case, the intermediate stage) but were located at different distances (within 10 m; 100 m away and 500 m away) from the virgin sub-montane forest, would be recolonized by anurans according to the distance (the closer sites being recolonized sooner). Each successional stage was sampled five times from April 2008 to April 2009, with field-work being conducted from 0600 - 1000 hrs (day sampling), and 1800 - 2200 hrs (night sampling). We employed a constant quadrat size (10 m x 10 m), and a total of ten quadrats were sampled per stage per season. At the experimental plots we measured seven structural characteristics of the vegetation: percentage litter cover; litter depth; percentage of crown cover; density of woody trees; girth at breast height of trees; height of vegetation; and density of tea plants. The study revealed, as hypothesized, that abundance, species richness and diversity of anurans in abandoned tea plantations equidistant from the virgin sub-montane forest were greater in plots representing late successional stages than early successional stages. We also found that abundance, species richness and diversity of anurans in the intermediate successional stages were greater in localities closer to the virgin sub-montane forest than in those at greater distances. Our findings indicate that anurans display replacement patterns that are directly related to the progression of vegetational succession.

Keywords: Anurans, Knuckles, recolonization, Sri Lanka, succession

(12)

Recovery of avifaunal communities along-side tropical forest regeneration: A comparison of bird species composition and abundance between a mature semi ever-green forest and an adjoining regenerating forest

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Abstract

The study was carried out in the Ceylon Tobacco Company (CTC) Biodiversity Conservation Site, Maragamuwa, Naula. Here the mature moist semi-evergreen forest, which is the natural vegetation type, has been degraded over the years due to shifting cultivation. The area was acquired by the CTC in 1981 in order to grow *Eucalyptus* as fuel wood. In 2005, once the *Eucalyptus* was harvested, assisted natural regeneration practices were applied and today the area has reached the status of a regenerating forest. In the present study we compared the relative abundance of bird species between the mature forest in close proximity to the CTC plantation (with a canopy of large old-growth trees) and the regenerating forest (where large trees were essentially absent).

An avifaunal survey was conducted along line transects using three forest foot paths in the primary forest and along three fire belts and a foot path in the regenerating forest. A total of 20 sampling hours were spent for the avifaunal survey in each of the forests. A total of 1549 birds belonging to 97 species were recorded from the primary forest whilst 1951 individuals of 89 species were recorded from the regenerating forest. Although bird species richness was greater in the natural forest than in the regenerating forest, the high numbers in the regenerating forest indicates that birds recolonized the disturbed area. But the recovery process of some species was more rapid than that of others. If pictured in a guild perspective, the bark gleaning insectivores which included the five species of woodpeckers showed the lowest rate of recovery proving their preference for pristine forest conditions and thus can be recommended as good indicators to monitor the success of forest restoration. The granivores, nectarivores as well as the habitat generalist omnivores were present in greater numbers in the regenerating forest compared to the natural forest. The arboreal frugivores, arboreal insectivores and foliage gleaning insectivores showed less resilience to the regenerating forest conditions. This study suggests that bird species vary greatly in their sensitivity to habitat alteration and that the loss of sensitive species is masked by the invasion of new species that readily adapt to the relatively disturbed conditions. The most resilient species as well as the most affected species by changes in the habitat are suitable to be used as indicators of forest ecosystem health.

***Keywords**:* Assisted natural regeneration, bird guilds, CTC Biodiversity Conservation Site, ecological indicators, ecosystem health

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(13)

Population status of two *Varanus* species (Reptilia: Sauria: Varanidae) of the Puttalam lagoon: Their conservation status

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Abstract

Varanids are the largest living lizards in the world and they are swift and very active predators. In Sri Lanka, the Varanid lizards are represented by the genus *Varanus* which in turn has two species V. *bengalensis* (Land monitor) and *V. salvator* (Water monitor), both of these being nationally protected. A population survey of the monitors was conducted in the Puttalam lagoon area (North-Western Province) from November 2008 to October 2009. Observations of the lizards were made at distances of 2 to 20 m between the 0700 and 2000 hrs using the Visual Encounter Survey method. Searching was conducted in all conceivable microhabitats, both natural and manmade, and involved the overturning of decaying logs, stones, probing tree holes and rock crevices and roof tops, in stream banks, home gardens and forests. A total of 46 field days were spent on the survey. Some animals were captured, photographed and released into the same habitat. It is noteworthy that only three individuals of *V*. *salvator* were recorded during the survey. In contrast, to *V*. *salvator,* 76 *V*. *bengalensis* individuals were recorded. Of the individuals of *V. bengalensis,* 37 (48%) were adult males, 24 (32%) were adult females and 15 (20%) were juveniles. The male: female sex ratio is therefore 3:2. The majority of *V. bengalensis* were recorded from home gardens whilst some were recorded from forested areas. The three individuals of *V. salvator* were only recorded from forested areas. During the present survey we were able to record many threats to the *Varanus* species. Over the years, a large extent of the land (over a 1000 ha) consisting mangroves and inland forests that provide ideal habitats for monitor lizards, have been cleared for prawn cultivation. Sadly many of these areas are now abandoned but do not in the present state provide conducive habitats for these species. Limestone extraction in the area is also leading to the sedimentation of the natural water bodies which are used by the monitors, particular, *V. salvator.* It was also significant that we recorded 26 incidents of animals having being hunted. There is a local belief that eating the tongue of *V. bengalensis* increases memory power. Additionally, some villagers extract an oily liquid from roasted (burned) *V. salvator* which is considered to be a deadly poison. Vehicular traffic is also an eminent threat. We recorded 42 additional specimens of *V. bengalensis* as road kills most of them hit during the afternoons. This survey therefore clearly indicates that unless measures of protection for these species are strengthened, monitor lizards in the Puttalm area may face dangers of local extinction.

***Keywords*:** Conservation, monitor lizards, Puttlam, threats, Sri Lanka

(14)

Effects of introduction of empty shells of the invasive mollusc, *Achatina fulica* (Achatinidae) on the size of hermit crab, *Clibanarius longitarsus* (Diogenidae) in the Negombo estuary

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Abstract

Hermit crabs represent an important component of many intertidal and benthic marine communities worldwide, where they play an important role in the food chain. They use empty gastropod shells to protect their soft bodies from predation and desiccation. The objectives of the present study were to determine whether the low abundance of proper sized gastropod shells may function as a limiting resource to *C. longitarsus* and to investigate the effects of *A. fulica* shells on their size.

Three sites, each with an area of 50 m^2 in the intertidal zone were selected to carry out the study. Twenty quadrats of 0.25 m^2 were randomly thrown to determine both the densities of *C. longitarsus* and empty gastropod shells. *C. longitarsus* was also sampled in the same quadrats to meaure their weights and lengths of right chela. Empty *A. fulica* shells with higher weights (mean weight 8.3 ± 1.0 g) than the naturally available gastropod shells were introduced to the selected sites with a density of one shell/ m^{-2}. Shells were introduced three times during the study period and individual shells were separately marked for the identification of different introductions. After one month of each introduction crabs occupying the introduced *A. fulica* shells were collected for further measurements.

Shells of *Terebralia palustris, Telescopium telescopium* and *Cerithedia* spp. were occupied by *C. longitarsus* in the Negombo estuary. There was a significant positive correlation ($p<0.05$) between density of gastropod shells and the density of the occurrence of *C. longitarsus*. The largest naturally occurring empty gastropod shell belonged to *T. palustris* and it was occupied by *C. longitarsus* with a higher body weight (2.4 ± 0.3 g) and a longer chela length (10.0 ± 0.5 mm). *Cerithedia* shells were the smallest in size and were occupied by crabs with smaller body weights (0.2 ± 0.04 g) and shorter chela lengths (4.9 ± 0.4 mm). There was a significant correlation ($p<0.05$) between weight and chela length of *C. longitarsus* with the occupied shell size.

Addition of larger sized empty *A. fulica* shells increased the mean wet body weight and mean chela length of hermit crabs from 1.5 g to 3.5 g and 7.6 mm to 12.0 mm, respectively. There were significantly positive linear relationships between the body size of *C. longitarsus* with width, length, volume and volume/weight ratio ($p < 0.05$) of *A. fulica* shells. The growth of *C. longitarsus* had stunted or retarded due to the limited supply of proper sized gastropod shells in the Negombo estuary. Introduction of empty *A. fulica* shells to the estuarine environment is a possible solution for the low abundance of larger sized empty gastropod shells that limit the growth of *C. longitarsus*.

Keywords: hermit crab, *Clibanarius longitarsus*, invasive mollusc, *Acatina fulica*

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Distribution of butterfly fauna in home gardens of Knuckles region

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Abstract

Sri Lanka consists of a rich diversity of butterflies compared to other Asian countries but information on taxa remains very limited. The present study on butterflies at the Knuckles region was carried out to fill this information gap and also to attempt to identify the reasons for their decline in the study area. A survey of butterflies was carried out from January to March 2012 in several home gardens in 3 different locations of the Northern flank of the Knuckles range namely Mahalakotuwa, Attanwela and Bellanela. A linear transect of 1 km each was selected at each site for sampling and each transect was trekked for 1.5 hrs to sample butterflies using the standard 'Pollard Walk' methodology. The Shannon index (H′) was used to compare the diversity of butterfly species within sites. The feeding plants of the adult butterflies were also recorded.

A total of 52 species of butterflies belonging to eight families which represents more than 1/5 of the total butterflies of Sri Lanka were recorded during the present study .This includes five endemic species. Two endangered species (*Pachliopta jophon* and *Lethe daretis*) were also recorded. Among the three sites the highest diversity of butterflies was observed in Mahalakotuwa (H'-3.87) with 44 species, while the lowest diversity was in Attanwela (H'-3.68) with 38 species. Bellanela had 43 species. Nymphalidae was the most species rich family in all three sites where as Papilionidae formed the most abundant family. The Common jezebel (*Delias eucharis*), Chocolate soldier (*Junoniaiphita*) and Blue mormon (*Papiliopolym nestor*) were the most abundant butterflies species in Attanwala, Mahalakotuwa and Bellanela, respectively. It is noteworthy that all the five endemic species was recorded only in Bellanela*.* A total of 22 plant species belonging to 10 plant families were used by adult butterflies for feeding. Introduced plant species such as *Lantana camara* and *Austroeupatorium inulifolium* were heavily utilized probably due to nectar being present in their flowers during the study period. The variation in abundance of certain rare butterfly species among the three sites may be due to the use of agro-chemicals on flowering plants which destroys both the butterflies and the larvae that feed on them. It was observed that the presence of feeding plants are an essential factor that influenced the occurrence of adult butterflies and therefore the conservation of feeding plants is essential for their protection. This study has shown that the home gardens in the Knuckles range hold rich and unique butterfly assemblages. The use of agro-chemicals in the home gardens may result in population reductions and also probably local extinction of many of these valuable butterfly species.

Keywords: Butterflies, diversity, Knuckles, endemics, agrochemicals

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Current status of faunal diversity in the Dombagaskanda Forest Reserve

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Abstract

The Dombagaskanda Forest Reserve (DFR) is a small, but valuable, area in the wet zone of Sri Lanka. A one year survey was undertaken to document the diversity and abundance of several selected faunal groups in the DFR. A total of 30 days (8 hrs per day) were spent on fieldwork. The Visual Encounter Survey (VES) was used to sample the different taxonomic groups. Surveys were conducted during both day and night with the aid of head lamps and torches. All microhabitats which provide refuges for animals, such as logs and stones, were over turned and searchers were also made in tree and rock crevices. All captured specimens were examined carefully, identified and released at sites of capture to ensure minimal disturbance. A total of 178 species of vertebrate fauna and 82 species of invertebrate fauna were recorded from the DFR during the present survey. Of these species 38 (14%) are endemic whilst 10 (3.8%) are nationally threatened. Fourteen species (0.3%) are categorized as near threatened and 1 species (1.7%) as data deficient.

The vertebrates comprised 25 species (14%) of fishes which included the endangered and endemic Jonklaas' loach (*Lepidocephalichthys jonklaasi*), 17 species (10%) of amphibians inclusive of the Sri Lanka Rock Frog (*Nannophrys ceylonensis*) and the Ceylon caecilian (*Ichthyophis glutinosus*), 38 species (21%) of reptiles including the Hump-nosed lizard (*Lyriocephalus scutatus*) and the Green pit viper (*Trimeresurus trigonocephalus*), 78 species (44%) of birds including the Green-billed coucal (*Centropus chlororhynchus*), 20 species (11%) of mammals including the Rufous horse-shoe bat (*Rhinolophus rouxii*) and the Purple-faced leaf monkey (*Semnopithecus vetulus*). The invertebrate survey focusing on dragonflies and butterflies recorded 14 species (17%) of dragonflies and 68 species (83%) of butterflies including the endangered Southern duffer (*Discophora lepida*).

According to the present survey birds were the most abundant faunal group in the DFR and the amphibians and mammals were the least abundant. Although small in extent, the findings of this survey indicate that there is a wide variety of microhabitats within the forest which can support a high diversity of species. Within each taxon we failed to record some species that had been recorded in previous studies. However, some new species that were not previously recorded from this site were observed. Examples of such species are the Spot winged thrush, Chestnut-winged cuckoo and the Marbled spiny eel.

Anthropogenic activities such as illegal logging, unauthorized agriculture (several areas of the DFR have been cleared for tea and rubber cultivation), road kills and man-made forest fires currently threaten this valuable forest ecosystem. If such trends continue it may in the future lead to the reduction of faunal diversity within the forest.

***Keywords*:** Biodiversity, conservation, Dombagaskanda Forest Reserve, endemics, wet-zone

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First record of the Smooth horned lizard *Ceratophora stoddartii* Gray, 1835 (Sauria: Agamidae: Draconinae) from the Kegalle District

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Abstract

Sri Lanka's rich agamid fauna comprises 18 species including 15 endemic species and three endemic genera. The endemic genus of horned nosed lizards *Ceratophora* comprises a unique group of 5 allopatric species which occupy diverse rainforest habitats of the South Western wet zone of the island. Some of these species are point endemics. The Smooth horned lizard, *Ceratophora stoddarti* Gray, 1835 is hitherto known to be distributed in Horton Plains, Hakgala, Namunukula, Galaha, Pidurutalagala and Peak Wilderness which fall within an elevational range of 1,200 – 2,200 m, and fall within the districts of Kandy, Nuwara-Eliya and Badulla. This species has a comparatively wider distribution than its congeners. However, due to the rapid loss of its habitats, *C. stoddarti* is at present categorized as an endangered species. Hence new distributional data becomes essential for the conservation of this species. Here, we record the existence of this species from a vulnerable habitat in the Kegalle district.

Five adult individuals (two males and three females) of *Ceratophora stoddartii* were encountered within the Moratiya State forest (7° 07' 10" N 80° 26' 28" E) near Dothalu-oya, Aranayake, which is at an elevation of around 1050 m. The observations were made in January 2012 between 13:00 – 14.40 hrs. The individuals were seen to use the forest floor. The forest consists of a mixture of moist and dry sub-montane type vegetation. There was approximately 50% canopy cover and the undergrowth consisted primarily of litter. The wind speed was considerably high. The animals were not disturbed during observation. This is the first record of *C. stoddarti* in the Kegalle district.

It is noteworthy that this habitat has been encroached upon for tea cultivation. Furthermore, the forest at the locality is affected by frequent illegal logging and open fires. Strengthening the protection of this forest patch will facilitate the protection of this important species. This study emphasizes the need to identify potential refuges of the currently threatened species in order to provide for their conservation in as many different locations as possible.

Keywords: *Ceratophora stoddartii,* distribution, endangered, horned lizards, conservation

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Ichthyofaunal diversity in selected areas of Theligam Oya and its tributaries in the Dumbara massif

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Abstract

The Dumbara Forest Reserve, located in the Kandy and Matale Districts of central uplands of Sri Lanka, is one of the most important water sheds in Sri Lanka. The Theligam Oya is a tributary of the Amban River which flows through the Dumbara massif. This study was carried out to identify the ichthyofaunal diversity of the Theligam Oya and its tributaries in the northern flank of the knuckles range. Three main tributaries; Rathninda, Ambagaha-Ela and Patti-Ela and the main stream were selected to sample the fish fauna. Five replicates were carried out at each site. Fish were collected in the four main sampling sites (including riffle, pools and run) during the study period of December 2011 to March 2012 using scoop nets.

Eighteen fish species were recorded belonging to six families. Of the 2765 fish recorded, 77% belongs to the family Cyprinidae. Ten endemic species (56%) namely, *Acanthocobitis urophthalmus, Belontia signata, Channa orientalis, Devario aequipinnatus*, *Garra ceylonensis, Garra phillipsi, Puntius martenstyni, Puntius srilankensis, Puntius ticto* and *Schistura notostigma* were recorded of which two species namely *Puntius srilankensis* and *Puntius martenstyni* are point endemics. The highest species diversity was recorded in the Illukkumbura region of the Theligam Oya (Shannon diversity=2.639) while the lowest diversity was recorded in the Rathninda tributary (Shannon diversity=1.792). The highest abundance was observed in the populations of *Puntius bimaculatus*, *Devario aequipinnatus* and *Garra ceylonensis* in the four main sites. *Belontia signata* was recorded only from the Illukkumbura region of the Theligam Oya. No invasive fish species were recorded. Even though the endemism of the fish species are high in the Dumbara massif, they are under serious threat due to several anthropogenic activities. The most detrimental is the poisoning of fish species during the drought season which results in a considerable reduction of the endemic species. The present study confirms that the ichthyofaunal diversity is high in the Dumbara massif and that necessary action must be taken to conserve these species urgently, by not only the related government agencies but also by the local people before they face local extinction.

Keywords: Dumbara massif, ichthyofaunal diversity, Theligam Oya, threats

Notes

Notes