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## MODELING AND MAPPING FOR CANOPY PHENOLOGY OF DECIDUOUS FORESTS IN THE HOME RANGE OF A PAIR OF GOLDEN EAGLES ON MT. AKITA-KOMAGATAKE, JAPAN

ABE, S.<sup>1</sup>, TAKEUCHI, T.<sup>1</sup>, MATSUKI, R.<sup>1</sup>, ISHII, T.<sup>1</sup> and NASHIMOTO, M.<sup>1</sup>

<sup>1</sup>Central Research Institute of Electric Power Industry, 1646 Abiko, Abiko-city, Chiba-prefecture 270-1194, Japan. (e-mail: [abe@criepi.denken.or.jp](mailto:abe@criepi.denken.or.jp))

**Abstract:** Vegetation maps have been frequently used for habitat evaluation of animals. In a previous study, we used the actual vegetation maps for evaluating hunting preference of Golden eagles (*Aquila chrysaetos*), a representative predator in Japan. Because their feeding behaviors are affected by deciduous canopy phenology, actual vegetation maps alone might be unable to explain hunting conditions of those eagles. Therefore, we try to examine canopy leaf expansion in the home range of Golden eagles on Mt. Akita-komagatake, Japan. In the study area, we measured leaf expanded rates of deciduous canopies by digital camera with fish-eye lens at 21 sites. Leaf expanded rates were strongly correlated with heat accumulations for beech (*Fagus crenata*) and oak (*Quercus* spp.) forest respectively. Thus, we constructed two statistical models separately for beech and oak forests. Logistic curves were highly fitted with leaf expanded of beech forest ( $r^2=0.97$ ) and oak forest ( $r^2=0.94$ ). Based on above models, we constructed predictive maps of leaf expanded rates by vegetation maps and digital elevation models using GIS. By the predictive maps, leaf expanded areas in the home range were calculated everyday in early summer. The timing which canopy leaves of beech and oak forest entirely expanded well corresponded to the end of the breeding period. This result suggests that the reproduction of Golden eagle in Japanese mountainous area is limited by leaf expansions of deciduous forest canopies.

## EFFECTS OF DISTURBANCE ON SANDY COASTAL VEGETATION IN CENTRAL ITALY

ACOSTA A.<sup>1</sup>, CARRANZA, L.<sup>2</sup>, ERCOLE, S.<sup>3</sup>, STANISCI, A.<sup>2</sup> and BLASI, C.<sup>3</sup>

<sup>1</sup>University of "Roma 3", Rome, Italy; <sup>2</sup>University of Molise, Isernia, Italy ; <sup>3</sup>University "La Sapienza", Rome, Italy, (acosta@uniroma3.it

**Abstract:** The scope of this study is to evaluate the state of conservation of the sandy coastal phytocoenoses in Lazio region comparing the distribution of the Real Vegetation Zonation (RVZ), or present vegetation, with the Potential Natural Vegetation (PNV), deduced using a hierarchical landscape classification approach. This approach identifies land units on the basis of a combination of climatic, lithological and geomorphological factors, integrated with phytosociological data (241 relevés).

In this way the main types of disturbance were described and the effects on the phytocoenoses were assessed by analyzing the degree of similarity between PNV and RVZ. The factors causing the disturbance in central Italy are of various types and, as a consequence, effects tend to be diverse according also to the severity of the disturbance.

Observation of real vegetation showed that coastal zonation is relatively well-preserved at only a few sites along the Lazio coast. At these sites the RVZ is very similar to the PNV. However, widespread disturbance means that actual vegetation is drastically different from the hypothetical phyto-toposequence along most of the coast. Where disturbance has been particularly intense or prolonged in time some plant coenoses have often completely disappeared. Where disturbance is less severe phytocoenoses became fragmented or substituted by replacement communities.

## **DISTURBANCE REGIMES AND VEGETATION DYNAMICS IN THE GALÁPAGOS ISLANDS**

ADSERSEN, H.

*Biological Institute, University of Copenhagen, DK-1353 Oster Farimagsgade 2D, Copenhagen, Denmark. ([ADSER@BI.KU.DK](mailto:ADSER@BI.KU.DK))*

**Abstract:** The vegetation of the Galápagos Islands has developed under special conditions: frequent eruptions, extreme drought years and very wet Niño years with unpredictable intervals, heavy tortoise grazing and trampling in precolonial time; heavy grazing by feral animals, and introduction of aggressive alien plants, and severe fires in postcolonial times; and release of grazing in the National Park era.

Snapshot examples of the effects of these disturbances are given, and the results of long term permanent plot studies following goat eradication are presented. Ordination analyses of these data identify Niño events as significant for vegetation studies and show that vegetation recovery after goat eradication may be a slow process even in relation to succession in control areas.

## **SUSTAINING MECHANISM OF SPECIES DIVERSITY IN TROPICAL MONTANE RAIN FOREST**

AN, S., ZHANG, S.

*School of Life Science, Nanjing University, Nanjing 210093, China. [anshq@nju.edu.cn](mailto:anshq@nju.edu.cn)*

**Abstract:** There are over 100 hypotheses on maintaining of high biodiversity in tropical rain forests, but none of them can dependently explain the complex mechanism of the maintenance, synthetic hypothesis exists for the tropical rain forest. According to long term studies on tropical montane rain forest in southern Hainan, we tentatively conclude: Firstly, small and random distributed gaps are generated in tropical forests under intermediate disturbance, the gaps with different vegetation phases provide lots of environmental niches. Secondly, grazing pressure limits the roles and colonization capacity of dominants, and furthermore increases the heterogeneity of niches and survivor of weak species. Thirdly, small gaps induce low-density species and random distributed gaps, which induce random distribution of all the species, and most of species only have lottery competition. Fourthly, negative correlation among the species can further weak the possible competition, and finally there are quite lots of plants co-survived and the highest plant diversity in tropical forest occurred.

**Key words:** gap; grazing pressure; lottery competition; low-density population; niche

## **NATURAL DISTURBANCE BASED PLANNING DEMONSTRATION AREA IN WEST-CENTRAL ALBERTA: HOW DID WE DO?**

ANDISON, D.W.

*Bandaloop Landscape-Ecosystem Services, 3426 Main Ave, Belcarra, BC, V3H 4R3, Canada,  
(604) 939-0830, [andison@bandaloop.ca](mailto:andison@bandaloop.ca)*

**Abstract:** The Foothills Model Forest in Hinton, Alberta facilitated the development of an operational scale “disturbance plan” based on patterns of natural disturbance across a 70,000 ha landscape that includes parts of three separate forest management areas, and one protected area. The project is meant to be a test of the degree to which a natural disturbance foundation converges with other sustainable forest management values. The project will also serve as a test of the degree to which a comprehensive list of natural patterns can be translated into operational reality, as well as create a “real” example of these techniques from which we can collectively learn and adapt. The disturbance plan otherwise differs from traditional operational harvesting plans in several important ways. First, it includes all forms of disturbance, including prescribed fire, harvesting, road building and oil and gas exploration and development. Second, it requires collaboration of four different land management agencies to develop an ecologically meaningful plan in an area that has high ecological value. Third, the plan will include all parts of the landscape, including non-forested and other non-merchantable areas. Finally, the plan will include specific disturbance activities for 10 years, and a more general spatial disturbance plan for 40 years – far beyond current requirements for operational planning. This presentation summarizes our successes, our failures, and the new questions and concerns that were generated by this innovative, large-scale experiment.

## **VEGETATION DATABASES: INTERFACING THEM WITH ECOLOGICAL THEORY AND PRACTICAL ANALYSIS**

AUSTIN, MIKE P., ZERGER, ANDRE AND CAWSEY, CSIRO, MARGARET

*Sustainable Ecosystems, GPO Box 284 Canberra City, ACT 2601 Australia ,email:mike.austin@csiro.au*

**Abstract:** Cost-effective analysis of vegetation data requires the combination of a relational database and a geographic information system (GIS) with explicit models for ecological theory, data collection and measurement and statistical analysis. The success of this framework is conditional on recognising the purpose of the study and the compatibility of the various models. Australian examples of the practical and theoretical issues that can arise in the use of databases are presented for (1) testing theory regarding species response shapes to environmental variables (2) use of cover/abundance values for statistical modelling (3) incorporating existing environmental databases in predictive modelling of species distribution (4) producing regional vegetation maps. We conclude that the ecological assumptions built into vegetation databases can have important implications for their effective use.

## DYNAMICS OF PINUS CANERIENSIS OLD-GROWTH STANDS

BARBOUR, M.G.<sup>2</sup> and DEL ARCO, M.<sup>2</sup>

<sup>1</sup>University of California, Davis, CA, USA; <sup>2</sup>Universidad de La Laguna, Tenerife, Canary Islands, SPAIN (mgbarbour @ucdavis.edu)

**Abstract:** We described the density, canopy cover, age structure, horizontal pattern, and growth rates of *Pinus canariensis* in 20 old-growth stands dominated by Canary Island pine, chosen to span the ranges of elevation, topographic position, geology, slope aspect, and slope steepness existing on Tenerife Island. Only stands without cut stumps and fire-free for at least the past several years were included, and each stand was representative of a homogeneous forest >100 ha in extent. Releves generated complete species lists and permitted us to classify the stands to association or sub-association levels. Although stands were typically multiple-aged, juveniles <5 cm diameter breast height (dbh) were under-represented. The density of plants 1-5 yr old varied dramatically among sites, as did the density of resprouted saplings. The youngest trees capable of producing mature female cones averaged 25 yr. Trees/populations/stands could be classed into two groups that significantly differed in growth rates. No trees with more than 350 rings were directly counted. Trees too large to core (>70 cm diameter breast height) were aged from regressions of diameter to ring count, and the oldest of them were estimated to be >500 yr. Mature trees in all stands were distributed in a random pattern. Although some researchers have claimed that this species is serotinous, we encountered very few closed cones.

## **NATIVE TREE REGENERATION FOLLOWING ERADICATION OF INVASIVE KAHILI GINGER (HEDYCHIUM GARDNERIANUM) IN HAWAII VOLCANOES NATIONAL PARK, 1998-2003**

BENITEZ, DAVID M. <sup>1</sup> and LOH, R. <sup>2</sup>

<sup>1</sup> Pacific Cooperative Studies Unit, University of Hawai'i, PO Box 52, Hawai'i Volcanoes National Park, 96718, USA. <sup>2</sup> National Park Service, Division of Resources Management, PO Box 52, Hawai'i Volcanoes National Park, 96718, USA. (david\_benitez@contractor.nps.gov).

**Abstract:** Prolific regeneration of native tree species including 'Ohi'a (*Metrosideros polymorpha*), Kolea (*Myrsine lessertiana*), Kaawau (*Ilex anomala*) and Hapu'u (*Cibotium glaucum*) was observed five years after removal of dense thickets of invasive Kahili ginger from rain forest in Hawai'i Volcanoes National Park. In eight 100 meter-square plots, species richness, cover and density of arborescent species were tallied three months after control work (1998) and again in 2003. 'Ohi'a and Hapu'u displayed the most dramatic recovery, likely benefiting from increased light levels and the availability of propagules within surrounding native forest. Average density of both 'Ohi'a and Hapu'u individuals (< 50 cm height) increased fifty-fold from 0.02 individuals/m<sup>2</sup> in 1998, to 1 individual/m<sup>2</sup> 2003. Seedling densities of Pilo (*Coprosma spp.*) increased nearly four-fold, Kolea increased six-fold, and Kaawau increased twenty-fold. Alien taxa, including faya tree (*Myrica faya*) and strawberry guava (*Psidium cattleianum*) showed minimal increases in abundance, due to ongoing control efforts and low densities of mature individuals in the surrounding area.

These findings are encouraging to scientists and resource managers wanting to restore rain forests where Kahili ginger forms a dense contiguous understory that precludes native plant regeneration. This study documents the initial stages of native species recovery following removal of Kahili ginger. Future monitoring will determine whether additional management is required to ensure the long term recovery of the forest.



## **DESTRUCTIVE RABBIT GRAZING IN A SMALL INSULAR NATURE RESERVE IN OSLO, SE NORWAY – VEGETATION CHANGES AND IMPLICATIONS FOR MANAGEMENT**

BJØRNDALEN, J.E.

*Agricultural University of Norway, Aas, Norway. ([jorn.bjorndalen@ina.nlh.no](mailto:jorn.bjorndalen@ina.nlh.no))*

**Abstract:** The limestone island Gressholmen (a nature reserve) in the interior Oslofjord contains a rich flora with many rare species, a wide spectre of calcareous vegetation types and an interesting bird life. A large number of feral rabbits (more than 700 individuals per September 2003) cause a multitude of negative impacts on the vegetation such as e.g. dying-back of the rich thermophilous forest-margin thickets and digging disturbances of extensive areas. The most serious effects are however related to fertilization of the vulnerable calcareous plant communities. The rabbits have added enormous quantities of faeces, and dung middens are found all over the island. Spreading of weedy plants have exploded during the last 2-3 years, and dense patches of nitrophilous species threaten to take over the calcareous meadows and forest-margin thickets. An extensive shooting program has now been carried out, and the intention is to keep the rabbit population at an absolute minimum. One problem is a negative attitude among the public against rabbit control, since the island is intensively used as a recreation area. The many visitors to the island cause also deterioration of the nature qualities. The biological values have been seriously damaged, and proper management efforts should be started as soon as possible to restore the valuable calcareous vegetation types. I intend to follow the recovery dynamics by means of permanent plots and to carry out management experiments.

## VEGETATION SERIES MAP OF ITALY

BLASI, C., FILIBECK, G. and ROSATI, L.

*Dip. Biologia Vegetale, Università La Sapienza, 00185 Roma, Italy  
(carlo.blasi@uniroma1.it)*

**Abstract:** We present the methods and the final results of the vegetation sub-project within the national program “Ecological Information in Italy”. The Italian Ministry of the Environment requested the development of a 1:250,000 map of potential natural vegetation and vegetation series of Italy. A hierarchical land classification of the whole country was therefore developed as a tool to locate and delimit potential vegetation units (Blasi *et al.*, 2000, *Appl. Veg. Sci.*, 2:233-242; Ricotta *et al.*, 2002, *Appl. Veg. Sci.*, 5: 271-275). Land classification, through the integration of litho-morphological and phytoclimatical GIS layers, generated a map of land units. Vegetation series (potential vegetation types and their seral stages), defined according to phytosociological classification, were then assigned to land units, using available data and the expert knowledge of the relationships between actual vegetation types, environmental factors and vegetation dynamics.

The application of the proposed model proved very effective for identifying and mapping vegetation series.

The resulting syntaxonomic scheme for Italian potential vegetation types is presented, in the frame of main ecological regions. Data on the geographical and ecological distribution of main series and physiognomies are discussed, along with some applications concerning landscape planning and biodiversity conservation. Finally, a few issues concerning the state of the art of phytosociologic knowledge in Italy will be underlined.

## **SOCIOECONOMIC ASPECTS OF PHYTODIVERSITY IN URBAN ECOSYSTEMS. EXAMPLES FROM GERMANY**

BLOCK, M.

*University of Erlangen-Nürnberg, Germany. ([mblock@geographie.uni-erlangen.de](mailto:mblock@geographie.uni-erlangen.de))*

**Abstract:** The objective the study is first to describe the multiscale diversity patterns of German cities (diversity of higher plants) second to explain these patterns focussing the interactions between physical and anthropogenic influences.

Regarding spatial scales of phytodiversity in cities we have to consider the differences between the city itself and the surroundings on the macroscale, innerurban gradients on the mesoscale and the diversity of urban habitats on the microscale. On a metascale all patterns are to be compared between various cities.

In twelve German cities the vegetation of two example habitats has been analyzed: The free spaces around street accompanying trees and groves. Various socioeconomic variables have been used for statistical analysis. In addition the results of interviews have been used for interpretation.

There is a significant correlation between species diversity and the intensity of site treatment. Treatment itself is depending on two main factors: first the economic situation of the city or district- poor cities and poor districts are species rich; second the mainstream idea of the best or most aesthetic maintenance method – in some cities weeds are interpreted as “a comeback of nature” and therefore not removed.

In conclusion the spontaneous vegetation of cities can be used as a mirror of urban structures, reflecting human action.

## LONG-TERM REGENERATION DYNAMICS OF A MONTANE RAIN FOREST ON THE ISLAND OF HAWAII

BOEHMER, H. J.<sup>1</sup>, GERRISH, G. C.<sup>2</sup>, JACOBI, J. D.<sup>3</sup>, and MUELLER-DOMBOIS, D.<sup>4</sup>

<sup>1</sup>Technical University of Munich, Department of Ecology, D-85350 Freising, Germany ([neobiota@web.de](mailto:neobiota@web.de)); <sup>2</sup>University of Hawaii at Hilo, Biology Department, HI 96720, USA; <sup>3</sup>US Geological Survey, PIERC Kilauea Field Station, Hawaii National Park, HI 96718, USA; <sup>4</sup>University of Hawaii at Manoa, Department of Botany, Honolulu, HI 96822, USA

**Abstract:** A large area of *Metrosideros polymorpha* (Myrtaceae) dominated montane rain forest on the island of Hawaii was affected in various patterns by a decline of the canopy ('*ohia* dieback') in the 1970's. Declining forests were located on the windward side of the volcanic mountains Mauna Loa and Mauna Kea. In 1976, 25 permanent plots (20x20m) were established to assess tree vigor, composition, and structure of the vegetation. *Metrosideros* regeneration was quantified in sixteen 3x5m subplots systematically established within each plot. Collected data include the total number of seedlings (0.1-0.5 m tall), the total number of saplings (0.5m - 5.0 m tall) in five stem-height classes, and the diameter at breast height for all trees taller than 5 m. Tree vigor for all trees bigger than 5 m tall was quantified in 5 classes. Data were resampled in 1982, 1985, 1990, 1995, and 2003. Results show that *Metrosideros polymorpha* regenerated in recent decades. After a seedling flush in the early 1970's, the number of seedlings strongly decreased since 1976. The seedling flush resulted in a sapling wave which had its peak in the early 1980's. Due to recruitment of young individuals into the tree layer, a new cohort of trees has been established about 30 years after the decline started. Today, the density of healthy *Metrosideros* trees per hectare has almost reached the level of unaffected forest stands again.

## REGENERATION OF *METROSIDEROS* *POLYMORPHA* (MYRTACEAE) DIEBACK STANDS OF A MONTANE TROPICAL RAIN FOREST

BOEHMER, H. J.<sup>1</sup>, GERRISH, G. C.<sup>2</sup>, JACOBI, J. D.<sup>3</sup>, and MUELLER-DOMBOIS, D.<sup>4</sup>

<sup>1</sup>Technical University of Munich, Department of Ecology, Landscape Ecology, <sup>2</sup>University of Hawai'i at Hilo, <sup>3</sup>US Geological Survey, Kilauea Field station, <sup>4</sup>University of Hawai'i at Manoa

**Abstract:** A wide-spread canopy dieback occurred during the 1960s and 1970s across the east slopes of Mauna Kea and Mauna Loa in various contiguous and non-contiguous patches. About 50,000 ha out of a total area of 100,000 ha between 700 m to 1800 m altitude was affected, but the dieback was restricted to *Metrosideros* only, the `ōhi`a lehua tree. Originally, the dieback was thought to be a new disease. But no biotic agent was found to be responsible. The dieback turned out to be a natural phenomenon related to the demography and history of the affected *Metrosideros* stands. An explanation was published in 1987 as the “cohort senescence theory” and presented in form of a stand demography model as portrayed on this poster. Repeated surveys of 25 permanent plots established in 1976 showed `ōhi`a seedlings to sapling development in dieback stands. The number of seedlings strongly decreased in dieback stands as many grew into saplings since the mid 1970s. The latest survey in 2002-2003 shows redevelopment of a new *Metrosideros* canopy in eleven plots with 600 young-mature trees per hectare. Further information under [www.botany.hawaii.edu/pabitra](http://www.botany.hawaii.edu/pabitra)

## **FIFTY YEARS OF VEGETATION DYNAMICS IN A DISTURBED XEROTHERMIC GRASSLAND IN CENTRAL EUROPE**

BORNKAMM, R.

*Technical University Berlin, Germany*

**Abstract:** On a limestone slope near Goettingen (NW Germany) with xerothermic grassland dominated by *Bromus erectus* the vegetation within a 4 m<sup>2</sup> plot was removed in fall 1953. The area was not grazed from 1953 until 1986 (period I), but was grazed intermittently since 1987 (period II). During 50 years the presence of all species was recorded annually using a 10cm x 10cm grid in order to investigate recovery of the former plant community or eventual succession. Since 1976 standing crop of the stand, amount of bare soil and nitrogen content of leaves were determined.

Altogether 88 species were recorded. Species richness and the presence of the most frequent plants increased steadily throughout period I, but varied considerably during period II. Monthly precipitation in the main growing season varied by factor 5. However, the influence of dry periods on species occurrences and species diversity was unexpectedly low. Grazing, in contrary, exerted a strong impact on presence, biomass and nitrogen content as well.

Shrubs did not establish. This suggests that succession did not occur, only recovery after disturbance - modified by periods of grazing. In a regional scale the results describe in detail a local piece of the longterm invasion process of *Bromus erectus* in NW Germany.

## RESTORING ABANDONED FIELDS BY TRANSPLANTING KEYSTONE SPECIES IN THE STEPPE OF LA CRAU (SOUTH-EASTERN FRANCE)

BUISSON E.<sup>1</sup>, CORCKET, E.<sup>2</sup>, DUTOIT, T.<sup>3</sup> and PEETERS, A.<sup>4</sup>

<sup>1</sup>UMR 6116 IMEP, FST Saint-Jérôme, case 461, 13397 Marseille Cedex 20, France (elise.buisson@univ-u-3mrs.fr). <sup>2</sup>UMR INRA BIOECO, Université Bordeaux 1, avenue des Facultés, 33405 Talence Cedex, France. <sup>3</sup>UMR INRA-UAPV 406 Ecologie des Invertébrés, Université d'Avignon, site Agroparc, Domaine Saint-Paul, 84914, Avignon, France. <sup>4</sup>Laboratoire d'Ecologie des Prairies, Université Catholique de Louvain, 6600 Michamps, Bastogne, Belgium

**Abstract:** The steppe of La Crau, dominated by *Brachypodium retusum* and *Thymus vulgaris*, has been highly disturbed by melon and cereal cultivation between 1965 to 1985. Even in a landscape modified so that patches of steppe border abandoned fields, autogenic restoration does not occur. One efficient restoration strategy is to improve environmental conditions and re-introduce keystone species (*Thymus* and *Brachypodium*) because the reintroduction of sheep grazing alone is not a successful restoration technique. This study aims to determine the roles of two abiotic and two biotic factors in this restoration. We set up a factorial experiment to test four treatments on planted seedlings:

Effect of stone cover. The 50% stone cover removed for cultivation was restored.

Effect of soil fertility. Different agricultural practices were used on the fields resulting in abandoned fields in various state of fertility. We experimented on one melon field (highly fertilized), one cereal field (moderately fertilized) and one patch of steppe (control - no fertilization).

Plant neighboring effect. We weeded annual arable weeds (spontaneously colonized fields after abandonment) to test their effect on focal species.

Effect of sheep grazing. Seedlings were protected from grazing.

Our results show that focal species grow better when stone percent cover is restored. Focal species do not have compensatory growth mechanisms to overcome heavy grazing, but without grazing, annual weeds compete against them.

## **OWNERSHIP AND ACCESS TO DATA DEPOSITED TO A PUBLIC-GOOD VEGETATION ARCHIVE – WHO’S INFORMATION IS IT ANYWAY?**

BURROWS, L.E.

*Landcare Research, PO Box 69, Lincoln, New Zealand. ([burrowsl@landcareresearch.co.nz](mailto:burrowsl@landcareresearch.co.nz))*

**Abstract:** There are numerous views of data ownership, and who has rights to control its access or use – field collectors and creators, principle investigators, technical managers, their organisations, funding organisations, analysts, landowners, other parties with contractual arrangements etc, - all claim some degree of connection with data and expectation to influence its use. This paper attempts to explore both the legal view and professional view of other ‘interested parties’ to resolve some of the issues that arise around ownership and intellectual property rights. It draws on experience in relation to data deposited into a national vegetation archive/databank (NVS) in New Zealand, and who might control its use. Then looks at ‘owners’ and comments on who should have a say. Although it may be a legal expectation that data collected as public-good research by publicly owned organisations should be made freely available under Freedom of Information/Official Information statutes, it is important for the sake of trust in the databank, ongoing provision of data, and the needs of users to ensure the interests of data depositors are upheld.



## VEGETATION AND SPECIES RICHNESS PATTERNS OF EAST AFRICAN TROPICAL MONTANE FORESTS

BUSSMANN, R. W.<sup>1</sup>

*University of Hawaii, Harold L. Lyon Arboretum, Honolulu, HI 96822, USA,*  
[bussmann@hawaii.edu](mailto:bussmann@hawaii.edu)

**Abstract:** Tropical Mountain Forests are one of the most important ecosystems. Harboring frequently higher species numbers per area than Lowland Rainforests, they are much smaller, often highly fragmented, and have a paramount function as water catchments and erosion barriers.

The presented contribution, based on more than 1300 phytosociological relevés, depicts species richness patterns along the altitudinal gradient of tropical mountain forests systems in Eastern Africa, and compares to an Andean Cloud Forest system. The different forest units along the altitudinal gradient are shortly described and their floras compared. Mosaic-climax formations dominate the lower montane zone, with monotypic forests taking over at higher altitudes. In African Mountain Forests, herbs are very abundant due to the availability of large gaps created by Megaherbivores. Diversity is highest in mid-altitudes, and only slowly declines towards the alpine zone. Neotropical mountain forests harbor a much higher species diversity however, mainly due to the extreme radiation of tree- and epiphyte species. Characteristically, plant diversity declines with altitude. Similar regeneration processes can be observed in both systems, although the role of natural landslides is much more important in the Andes, whereas fire is the dominant motor for regeneration in East Africa.

## **SPATIAL PATTERNS AND MECHANISMS IN BEECH FORESTS AT DIFFERENT REGENERATION PHASES AFTER DISTURBANCE: A STUDY CASE IN THE NATURAL RESERVE OF TORRICCHIO (CENTRAL ITALY)**

CAMPETELLA, G.<sup>1</sup>, BARTHA, S.<sup>2</sup>, CANULLO, R.<sup>1</sup>, CSETE, S.<sup>3</sup>, PÁL, R.<sup>3</sup>, RAMADORI, M.<sup>1</sup> and PORFIRI, N.<sup>1</sup>

<sup>1</sup> *Department of Botany and Ecology, University of Camerino, Italy;* <sup>2</sup> *Institute of Ecology and Botany of the Hungarian Academy of Sciences, Vácrátót, Hungary;* <sup>3</sup> *Department of Botany, University of Pécs, Hungary.* ([diego.campetella@unicam.it](mailto:diego.campetella@unicam.it))

**Abstract:** In coppice ecosystems, the short-term time-rotation of disturbance induced by anthropic practices makes unavoidable changes in forest structure, interfering with self-regulating processes and species diversity. In Central Apennine (Italy), this forest management is still predominant, with clear-cutting after 18-25 years. However, in the Torricchio Natural Reserve these practices were stopped ca. 70 years ago and consequently we have the chance to follow the recovery of vegetation. In this context, contributions about the multivariate spatial patterns of species at fine scale seem of considerable importance but are still missing. The spatial patterns of herb layer of three beech coppice stands, at different regeneration phases after disturbance (25, 54, 64 years), were studied using information theory (JNP models: Juhász-Nagy & Podani 1983, *Vegetatio* 51: 129-140). Sampling of plant species presence/absence was performed in 20x20 cm contiguous quadrats along a 200 m circular transect, with 6 replicates in each successional stand. Field data were analysed considering spatial variability (Florula diversity) and spatial dependence (Associatum) of species; these descriptors were calculated at a series of increasing plot size (spatial scaling). Both coenological characteristics resulted strongly scale-dependent, underlining the importance of plot size in vegetation studies. The plant assemblages were more diverse and associated in the medium (54 years) than in young and old stands (25 and 64 years), suggesting that, in forest communities, the regeneration process is characterized by a non-linear textural evolution.

## **VEGETATION AND LANDSCAPE DIVERSITY FOR DEFINING THE URBAN BIOSPHERE RESERVE OF ROME (ITALY)**

CAPOTORTI, G., MARTA, M. and BLASI, C.

*University of Rome "La Sapienza", Italy. ([blasilab@uniroma1.it](mailto:blasilab@uniroma1.it))*

**Abstract:** Knowledge of natural, archaeological, historical and cultural heritage of Rome is currently being updated by the work of a multidisciplinary scientific group. Aim of these studies is to define a proposal for a Urban Biosphere Reserve of Rome within the MAB Project (UNESCO). The zonation of the Reserve is firstly based on the land ecological network; secondly, cultural and human characteristics are considered for monitoring and logistic support activities.

The plan for zoning the Urban MAB Reserve into "core areas", "buffer zones" and "transition areas" is here presented. In particular, the floristic, vegetation and landscape components of the land ecological network are analyzed. Richness and biogeographic importance of species, communities and landscapes are investigated within homogeneous land units, derived from a hierarchical land classification. In this way biodiversity values at different levels can be easily integrated with other biotic (mainly faunistic), physical and human features.

The project of the Urban Biosphere Reserve of Rome, based on both conservation aims and ecological network functionality, represents a concrete tool to support sustainable management and development of the City and promote life quality.

## ENVIRONMENTAL MONITORING BASED ON THE CONTRAST AND AFFINITY BETWEEN ADJACENT PATCHES

CARRANZA, M.L.<sup>2</sup>, SMIRAGLIA, D.<sup>1</sup>, BLASI, C.<sup>1</sup>

<sup>1</sup>University of Rome "La Sapienza", Rome, Italy; <sup>2</sup>University of Molise, Isernia, Italy.  
(blasilab@uniroma1.it)

**Abstract:** The aim of this study is to propose boundaries temporal changes as a landscape quality monitoring method. In this context, we considered recent historical changes in landscape of Lepini Range (Central Italy) focusing on the evolution of boundaries between patches for the characterization of spatial organization. The replacement of traditional agricultural, silvicultural and pastoral practices by more intensive exploitation has strong impact: structural simplification, changes in spatial diversity and boundaries, and modification of matter and energy flows between patches. Analyzing landscape spatial organization, the use of boundaries could be more informative than the use of patches because each boundary not only gives information about the presence of a patch, but also on its contiguity with another one. To evaluate landscape conservation dynamic, the land cover maps of 1954 and 2000 have been reclassified on the basis of an environmental conservation scale. The landscape conservation status was evaluated through the contrast and affinity indexes. The contrast and the affinity represent the degree of difference and similarity respectively, between the adjacent patches. Results show that from an ecological point of view, the proposed method may be a good approach to quantify and monitor land quality, and that it could be a good instrument for assessing the conservation status of different areas with different management regimes.

## **HOT SPOTS OF PLANT DIVERSITY IN ITALIAN MEDITERRANEAN CITIES**

CELESTI-GRAPOW, L. and BLASI, C.

*La Sapienza University, Rome, ITALY. ([laura.celesti@uniroma1.it](mailto:laura.celesti@uniroma1.it))*

**Abstract:** The Mediterranean Basin has one of the world's highest floristic richness. This is one of the reasons for the remarkably high plant diversity found in Italian Mediterranean cities. In addition to factors which typically enhance biodiversity in urban areas, such as habitat heterogeneity and richness in alien species, in the Mediterranean Basin climate and human impact have selected a large number of plants pre-adapted to the environmental conditions occurring in urban habitats, e.g. high temperatures, water stress and disturbance. This is particularly true for annuals. Consequently, not only urban parks and nature reserves, but also disturbed areas, such as archaeological sites and grasslands are hot spots of native species diversity. They shelter plants of rocky-habitat origin that colonize ruins, an exceptionally high number of grasses and forbs of Mediterranean pastures, as well as vines, shrubs and trees in patches of Mediterranean forest and maquis.

On the basis of findings in several major cities falling within the Italian Mediterranean Region, this study emphasises yet another factor favouring the high diversity of the flora analyzed - the permanence of connections between urban green areas and semi-natural biotopes in the neighbourhood. Such connections allow residuals of natural vegetation rich in endemic or rare species to be maintained even in city centers, and cause a peculiar periphery-centre gradient of increasing biodiversity.

## ON THE BIODIVERSITY, ECO-COMPLEXITY AND THE STABILITY OF ECOSYSTEM IN ECOLOGICAL RESTORATION

CHANG, J. and GE, Y.

*College of Life Science, Zhejiang University, Hangzhou 310012, PR China*  
([jchang@mail.hz.zj.cn](mailto:jchang@mail.hz.zj.cn))

**Abstract:** The debate on the relationship between biodiversity and stability of ecosystem deepens recently. Based on the non-linear theory, we find there exists confuse understanding in concepts of diversity and complexity.

The behavior of the models shows that the stability of ecosystems increase with the linking of the components (plants and animals etc.) increasing, but turn to decrease after the linking intensity more strong afterward. According to systematic theory, same diversity can have different complexity, and structural complexity is maximized when the nodes linked in middle density. It means that the stability and complexity has the same trend. The stability of a system is the highest at middle linkage (such as the food web) of the components. The stability of an ecosystem links to its complexity directly but not diversity of the components.

In natural ecosystem, higher diversity have higher complexity normally, however, high diversity with low complexity may occur in the artificial or strongly controlled ecosystem by human being. So it is important to rebuilt high biodiversity in ecological restoration. While it should avoid the components have neither too weak nor too strong linking when we restore an ecosystem, so as to keep high complexity and stability.

## FOREST REDISTRIBUTION IN INTERIOR SIBERIA IN A CHANGING CLIMATE

CHEBAKOVA, N. and PARFENOVA, E. V.N.

*Sukachev Institute of Forest, Siberian Branch, Russian Academy of Sciences, Academgorodok, 660035 Krasnoyarsk, Russia, ([ncheby@forest.akadem.ru](mailto:ncheby@forest.akadem.ru))*

**Abstract:** Permafrost is a prominent feature of interior Siberia, covering 80% of it. Only two tree species *Larix gmelini* and *L. cajanderii* can withstand the shallow and cold permafrost soils. Other Siberian forest-forming conifers (*Larix sibirica*, *Pinus sylvestris*, *Pinus sibirica*, *Abies sibirica*, and *Picea obovata*) cannot survive on the permafrost if the active layer depth (the depth of summer thawing) is less than 2 meters.

We designed a Siberian bioclimatic vegetation model that predicted a vegetation type from climatic variables (positive degree days, base 5°C, negative degree days, and a moisture index) and the active layer depth. We applied our vegetation model to current climate and a climate change scenario of the Hadley Center, UK, for the year 2090 to model a vegetation distribution nowadays and in the future.

Currently, only forests occur within the study area. According to the used climate change scenario with a warmer and dryer climate, forests would shift northwards, and their area would shrink by half by 2090. Across the forest area, predicted warming will not be sufficient to melt the permafrost deep enough to support other tree species but *Larix gmelini* and *L. cajanderii* which would continue to dominate the forests of interior Siberia.

## **RELATIONSHIP BETWEEN VASCULAR PLANTS AND BRYOPHYTE SPECIES DIVERSITY IN FOREST ECOSYSTEMS IN TUSCANY**

BONINI, I., CHIARUCCI, A.

*Dipartimento di Biologia Ambientale, Università di Siena, Italy. (chiarucci@unisi.it).*

**Abstract:** Forest ecosystems cover more than half of the surface of Tuscany, central Italy, and are located from the Mediterranean coastline to the Apennine mountains. These forests are submitted to different types of management, from nature preservation to conifer plantation for timber production.

In the present contribution we applied an objective sampling, based on the forest inventory of Tuscany, to collect information on species richness and composition of vascular plants and bryophytes in six large forests belonging to the Tuscan regional administration. The project aimed to obtain sample-based information to be used in future to assess the ecosystem changes. The sample design was based on 109 plots, 400 m<sup>2</sup> each, distributed in proportion to the extension of each forest. Within each plot vascular plants and bryophytes were sampled at different scales. Woody species with DBH > 3 cm were measured and used to get estimates of total basal area and stem density. Within each plot, bryophyte were sampled in 24 bryoplot, each 10 x 15 cm.

Comparisons of species richness and composition of vascular plants and bryophytes were performed, from the plot to the whole forest scale, and related to the environmental factors as well as to management practices. Species accumulation curves allowed the comparison of the different areas and to make inference on larger scale diversity.



## VEGETATION STRUCTURE DETERMINES SEED RAIN IN A HAWAIIAN DRY FOREST

CHIMERA, C.

University of Hawaii, Honolulu, HI, USA. ([chimera@hawaii.edu](mailto:chimera@hawaii.edu))

**Abstract:** Trees can serve as recruitment foci for bird-disseminated plants. Remnant Hawaiian dry forests, such as the mixed native/non-native community in the Kanaio Natural Area Reserve, Maui, are composed of isolated trees or small groves surrounded by shrubs, grasses and barren lava. To determine how tree distribution affects seed dispersal patterns, I quantified seed rain for one year under trees and in open areas. To measure seed rain, I placed seed traps under four common native tree species (*Diospyros sandwicensis*, *Pleomele auwahiensis*, *Reynoldsia sandwicensis* and *Santalum ellipticum*), dead standing trees, a non-native tree (*Bocconia frutescens*) and in adjacent open areas with shorter vegetation. Open areas received the lowest density of bird-dispersed seeds (0.81 seeds m<sup>-2</sup> year<sup>-1</sup>) and highest density of wind-dispersed seeds (91.4 seeds m<sup>-2</sup> year<sup>-1</sup>). The wind-dispersed alien *Melinis repens* (grass) accounted for >82% of seeds collected in the open. Although fleshy-fruited, the four natives were collected at highest densities under parent trees and were rarely bird-dispersed. *Bocconia frutescens* and *Lantana camara* (non-native shrub) were collected under all native and dead trees, and accounted for 92% of bird-dispersed seeds. Non-native birds are concentrating the dispersal of smaller-seeded, mostly non-native, fleshy-fruited plants under trees. Current dispersal patterns suggest that a few readily disseminated non-native plants may eventually replace the remaining native flora.

## DIFFERENCE OF FLORISTIC STRUCTURE AND PROGRESSIVE SUCCESSION ON THE FOREST VEGETATION IN AND SURROUNDING TAEGU, SOUTH KOREA

CHOUNG, H.-L., LEE, H.-J.<sup>1</sup>, ROH, H.-C.<sup>2</sup>, KIM, J.-H.<sup>3</sup>

<sup>1</sup>Korea Environment Institute, Seoul 122-706, Republic of Korea; <sup>2</sup>Department of Biological Sciences, Division of Natural Science, Konkuk University, Seoul 143-701, Republic of Korea; <sup>3</sup>Biodiversity Research Department, National Institute of Environmental Research, Incheon 404-170, Republic of Korea; <sup>4</sup>Department of Biological Science, College of Natural Science, Sunchon National University, Sunchon 540-742, Republic of Korea. (chlak@kei.re.kr)

**Abstract:** In order to know a progressive succession, we have analyzed floristic structure of the forest vegetation in and surrounding Taegu, South Korea. It was based on the phytosociological data that collected from September, 1994 to August, 1997.

According to the result of affinity analysis by chi-square test, the component species groups of the study area were distinctly divided into 2 large groups in accordance with similar habitat quality. The group □ have *Carex humilis*, *Rhus trichocarpa*, *Pinus densiflora*, *Potentilla freyniana* etc. And the group □ have *Athyrium yokoscense*, *Quercus mongolica*, *Rhododendron schlippenbachii*, *Acer pseudo-sieboldianum* etc. The group □ is similar to species composition of *Pinus densiflora* community, *Quercus variabilis* community, *Quercus acutissima* community, *Quercus dentata* community and the group □ is similar to that of *Quercus mongolica* community and *Carpinus cordata*-*Acer* mono community. The life form spectrum based on the Raunkiaerian system was described as follows; Ph 31.5%, Ch 5%, H 27.2%, G 25.3%, Th 8.6%, HH 1.7% and E 0.7%. However, the hemicryptophyte rate of the *Q. mongolica* community was higher at 29.1% than the 23.3% of the *P. densiflora* community, while the geophyte rate of the *Q. mongolica* community was lower at 25.7% than the 27.3% of the *P. densiflora* community. The successional pathway is expected as follows : 1) *Quercus mongolica* comm., *Quercus dentata* comm. *Rhododendron schlippenbachii* subcomm. of *Pinus densiflora* comm. → *Quercus mongolica* comm., 2) Typical subcomm. and *Sanguisorba officinalis* subcomm. of *Pinus densiflora* comm. → *Quercus serrata* comm., 3) *Carpinus cordata*-*Acer* mono comm → *Carpinus cordata*-*Acer* mono comm., 4) *Quercus variabilis* comm., *Quercus acutissima* comm. → *Quercus mongolica* comm. or *Quercus serrata* comm., Consequently, Based on the analyses of species composition of the *Pinus densiflora* community, the *Quercus variabilis* community and the *Quercus acutissima* community, *Quercus mongolica* and *Quercus serrata* commonly appear at subtree layer, shrub layer or herb layer. Therefore, in relation to conditions of locality and present species composition, we suggest three pathway of progressive succession such that the *Quercus mongolica* community, the *Quercus serrata* community and the *Carpinus cordata*-*Acer* mono community in this study area.

## FUNCTIONAL DIVERSITY OF NATIVE HAWAIIAN DRY FOREST SPECIES

CORDELL, S.<sup>1</sup>, SANDQUIST, D.R.<sup>2</sup>, and LITTON, C.<sup>2,1</sup>

<sup>1</sup>USDA Forest Service, Hilo, HI 96720, USA; <sup>2</sup>California State University, Fullerton, CA 92834, USA. ([scordell01@fs.fed.us](mailto:scordell01@fs.fed.us))

**Abstract:** Hawaii's dry forests are among the most endangered of all ecosystems in the archipelago. Unfortunately, these once extensive and diverse communities have been severely fragmented and degraded by deforestation, development, fire, nonnative ungulate grazing, and invasions by alien plant species such as fountain grass (*Pennisetum setaceum*). Understanding specific plant traits associated with the high diversity of this ecosystem can help us interpret current forest composition and evaluate the threat of invasive species. We studied the mechanisms for partitioning limited water sources of six co-existing dominant trees from the Kaupulehu dry forest on the island of Hawaii. Our data revealed suites of traits which correspond to contrasting resource use strategies ranging from high resource use to tolerance of low resource supply. For example, *Diospyros sandwicensis* exhibits a "tolerance" strategy with scleromorphic long lived leaves of low specific leaf weight and foliar nitrogen, low rates of photosynthesis and stomatal conductance and low water potential during dry periods. Alternatively, *Colubrina oppositifolia* possesses a suite of traits which promote rapid growth and high resource acquisition such as large, short lived leaves of high specific leaf weight and foliar nitrogen, and high rates of photosynthesis. These results may explain the high diversity of canopy tree species as well as suggest that invasion of non-native grasses into this ecosystem may have critical effects on community structure and dynamics.

## FRAGMENTATION DEPENDENT DEVASTATION OF SEMI-NATURAL GRASSLANDS IN THE HUNGARIAN FOREST- STEPPE ZONE

CZÚCZ, B.<sup>1</sup>., RÉVÉSZ, A.<sup>2</sup> and HORVÁTH, F.<sup>2</sup>

<sup>1</sup>*Budapest University of Economic Sciences and Public Administration, Budapest, Hungary;*

<sup>2</sup>*Institute of Ecology and Botany of the Hungarian Academy of Sciences, Vácrátót, Hungary.*

*(czucz@nimbus.elte.hu)*

**Abstract:** The vast majority of natural grassland areas in the forest-steppe zone of the Great Hungarian Plain disappeared during the 19th century. The destruction of the remnants has further accelerated since the political change in 1989. In this study we examined the relationship between the fragmentation characteristics of the semi-natural grassland patches and their exposure to anthropogenic destruction based on the example of a characteristic region of the Great Hungarian Plain, "Duna-Tisza köze". We used 1:25000 topographic maps of the Hungarian Army (drawn between 1969 and 1982) to locate the distribution of semi-natural grassland fragments at that time. The devastation of the grasslands was discernible from the comparison of former maps and the results of a project, which mapped all the remaining semi-natural grassland areas of the region between 1996–2000. To describe the fragmentation characteristics of the grasslands we used three landscape indices: patch area, fractal dimension and proximity index. We also differentiated four main destruction types: ploughing, construction, flooding and afforestation. During the last 20 years altogether 23% of the grasslands fragments have disappeared, the main destruction types were ploughing and afforestation. Half of the area of grasslands that disappeared was converted into arable fields independently of patch size, proximity or fractal dimension. Afforestation and construction mainly affected small and fragmented patches. Though the extent of flooding was small, it affected grasslands of large sizes (above 1000 acre).

## COMPARISON OF INTRODUCED AND INVASIVE PLANTS ACROSS THREE PABITRA SITES: FIJI, SAMOA, AND HAWAII

DAEHLER, C.C.

*University of Hawaii, Honolulu, HI USA (daehler@hawaii.edu).*

**Abstract:** A unique advantage of the PABITRA approach is that it allows horizontal comparisons of biodiversity and vegetation patterns across several high islands spanning the Pacific. Initial PABITRA surveys have been conducted in Fiji (Viti Levu) and Samoa (Savai'i), and comparable survey data are also available from Hawai'i PABITRA sites on O'ahu (low elevation) and Hawai'i Island (high elevation). Invasive plants are a major component of biotic change on all of these Pacific islands; therefore, comparisons of invasive plants among the PABITRA sites can yield insights into future vegetation patterns across the Pacific islands. All three PABITRA sites included examples of relatively undisturbed montane wet forest as well as disturbed or human-dominated lowlands. Relatively few invasive plants were found in the montane wet forests, although, *Clidemia hirta*, a Melastome native the New World Tropics, was present at all three sites. In some cases, native species appeared to behave like invaders, forming dense thickets following disturbance (e.g. *Coriaria ruscifolia*, *Merremia peltata*). The lowland, disturbed sites had far more ruderal aliens species. Species behaving differently at different sites represent research opportunities. Ornamental plantings are a major source of new invasive species, and future PABITRA surveys might make formal surveys of nearby ornamental plants in order to identify high risk species.

## **IMPLEMENTATION OF NATURAL DISTURBANCE BASED LANDSCAPE LEVEL PLANNING IN NORTHERN BRITISH COLUMBIA**

DELONG, C.<sup>1</sup>

<sup>1</sup>*Ministry of Forests, Prince George, BC, Canada V2L 3H9, 250 565 6202,  
craig.delong@gems1.gov.bc.ca*

**Abstract:** Knowledge of natural disturbance dynamics in northern British Columbia has recently been incorporated into landscape level guidance for forest management. Mapped estimates old forest extent, in combination with other map layers of ecologically based information was used to derive units of the landscape with similar natural disturbance rates, processes, and successional development. For each of these “natural disturbance units”, applicable local natural disturbance research was used to describe the natural range of variability (NRV) in landscape temporal and spatial pattern and stand structure created by natural disturbance. The timber supply implications of implementing different scenarios for old forest protection and patch size distribution, based on NRV, were estimated and a final scenario negotiated for implementation. Larger rotating reserves of forest > 140 yrs of age of 12 – 17% of the total forested area are being applied in drier plateau units whereas 50 – 85% old forest primarily in fixed reserves are being applied in wet montane landscapes. The goal for patch size distribution will be to trend towards natural considering practical and social limitations. Landscape level guidance based on NRV can be reasonably implemented for ecologically diverse landscapes.

## **INVASIVE PLANTS ON TROPICAL ISLANDS: LESSONS FOR CONTINENTS?**

DENSLOW, J.

*USDA Forest Service, Hilo, HI 96720, USA (jdenslow@fs.fed.us)*

**Abstract:** Tropical island ecosystems appear to be especially vulnerable to invasive species. A review of the literature and the situation in Hawaii suggests that two interacting processes—high net resource availability and poor ability of native species to preempt those resources—make island communities vulnerable to alien species spread. Also, historically high rates of introduction have provided opportunity in the form of a diverse and abundant propagule rain of exotic species. Thus, native ecosystems on islands are particularly vulnerable to naturalizing exotics growing on their borders, and while disturbance from a variety of causes, including pigs, fire, grazing, and natural dieback of the canopy dominants, increases the opportunities for exotic incursions, even intact forests are not immune. Unless these forests are aggressively managed and alien propagule pressure reduced, they will be highly modified by expanding exotic plant populations. Tropical islands are an effective early warning system of the impacts that successive waves of exotic species invasions may cause to isolated ecosystems. As mainland natural areas become fragmented, degraded and depauperate, they acquire many island attributes, including limited habitat area, missing functional groups, declining species diversity, and disturbed habitats. A better understanding of invasions on islands may improve our attempts to protect both mainland and island ecosystems from the impacts of exotic species.

## **RECIPROCAL ANALYSIS OF ECOLOGICAL AND GENETIC FACTORS OF ALIEN PLANT INVASIONS ALONG ALTITUDINAL GRADIENTS IN THE SWISS ALPS AND THE WALLOWA MOUNTAINS (OR, USA)**

DIETZ, H., BILLETER, R. and EDWARDS, P. J.

*Geobotanical Institute ETH, Swiss Institute of Technology, 8044 Zurich, Switzerland.  
(georg.vonarx@env.ethz.ch).*

**Abstract:** The comparative study of plant invasions into mountain systems is particularly promising because it allows detecting factors limiting the invasion ability of species along pronounced environmental gradients in the introduced area. Our hypotheses are (i) that invasive species reach lower relative altitudes in the introduced area because of lag effects, the absence of mountain ecotypes or due to biotic interactions with the native community to which they are not (yet) adapted and (ii) that less plastic but well-adapted genotypes among the invasive plants are more successful under the more homogeneous stress conditions at higher altitudes. To investigate these hypotheses we will compare groups of related native and invasive Asteraceae species in two mountain systems, the Swiss Alps and the Wallowa Mountains in the US in a reciprocal approach. This will include (i) field surveys of invasive populations along altitudinal gradients, (ii) analysis of the patterns of genetic variation within and between populations, (iii) common garden experiments at different altitudes in Switzerland and (iv) transplant experiments in both mountain systems. The results will provide insight into the mechanisms of plant invasions by elucidating the limiting factors of the invasion processes as obtained from mountain systems as model systems for pronounced environmental gradients. The results will also be valuable for an evaluation of the system-specificity of plant invasion patterns and mechanisms, and for the development of policies to control plant invasions, especially to protect fragile mountain ecosystems.



## **GROWTH RESPONSES IN PERENNIAL FORBS TO ALPINE ENVIRONMENTAL GRADIENTS AND CLIMATIC FLUCTUATION: A HERB- CHRONOLOGICAL ANALYSIS**

DIETZ, H. and VON ARX, G.

*Geobotanical Institute ETH, Swiss Institute of Technology, 8044 Zurich, Switzerland.  
(georg.vonarx@env.ethz.ch)*

**Abstract:** Annual rings in the roots of perennial forbs may be used to reconstruct fluctuations in growth due to environmental variation. Here we ask whether growth trajectories of alpine forbs change along snowbank gradients and whether climatic fluctuations impact plant growth on top of such an environmental gradient. We studied the growth increments (annual rings) in two alpine forbs, *Pedicularis recutita* and *Cirsium spinosissimum* that can grow in the centre and at the periphery of snowbanks in the Swiss Alps. While the growth increments in plants from the centre of the snowbank were mostly relatively narrow, plants growing at the periphery showed large growth increments in the first years that declined rapidly towards later years. These results indicate that initially favourable growth conditions at the periphery of the snowbank are compensated for in the centre of the snowbank, in the long run, by continuously low-competition growth conditions. In plants growing in the centre of the snowbank there were also significant, non-random fluctuations in the width of the annual growth increments that were apparently related to inter-annual variation in climatic conditions. A synchronous impact of strong climatic events on growth increments in the roots could be confirmed for further forb species in sub(-alpine) locations of the Swiss Alps. We conclude that climatic fluctuations may influence plant growth considerably and synchronously over large areas in (sub-)alpine settings and that these effects can be considerably amplified for plants growing in snowbank areas.

# **GEOGRAPHIC QUANTIFICATION OF THE INTERACTIONS BETWEEN MILITARY TRAINING AND FIRE DISTURBANCE:**

*A case study*

DORR, J.L.<sup>1</sup>, EMRICK, V.R.<sup>1</sup>, and WIESNICHT, D.<sup>2</sup>

<sup>1</sup>*Conservation Management Institute, Virginia Polytechnic Institute and State University, Blacksburg, VA 24061, USA;* <sup>2</sup>*Army National Guard Maneuver Training Center – Fort Pickett, Department of Plans, Training, and Security, Blackstone, Virginia 23824, USA. ([jdorr@vt.edu](mailto:jdorr@vt.edu))*

**Abstract:** Army National Guard Maneuver Training Center-Fort Pickett (ANGMTC-FP) is located in the lower piedmont of southeastern Virginia. The mission of ANGMTC-FP is to provide a Maneuver Training Center capable of handling up to Brigade size elements for live fire and maneuver training for Army Reserve Components and Active Components of all services.

Military training inevitably leads to ecosystem disturbance. This disturbance creates unique vegetation associations and wildlife habitat. Major military training disturbance include vehicle traffic and explosive munitions that often lead to accidental fire. Prescribed fire is also a large component of management to maintain open training lands. These disturbance classes are not discrete, but interact across the landscape.

The goal of this project is to quantify the spatial distribution and interactions between accidental/prescribed fire and military training disturbance at ANGMTC-FP using a geographic information system (GIS). Disturbance levels were identified through current military mobility and land classification and fire occurrence GIS data. These military training and fire disturbance levels were combined to account for the spatial and temporal interactions of disturbance. This map of disturbance classes will be used to examine ecological patterns across the landscape.

## SEED DISPERSAL BY FLYING FOXES: EVIDENCE FOR A THRESHOLD EFFECT IN POLYNESIA

DRAKE, D.<sup>1</sup>., MCCONKEY, K.<sup>2</sup> and MEEHAN, H.<sup>2</sup>

<sup>1</sup>University of Hawaii, Honolulu, HI, USA; <sup>2</sup>Victoria University, Wellington, New Zealand.  
([dondrake@hawaii.edu](mailto:dondrake@hawaii.edu))

**Abstract:** Analysis of fruit and frugivore traits revealed that extinctions of large birds have left flying foxes (*Pteropus tonganus* fruit bats) as the only native dispersers of seeds > 28 mm diameter in Tonga's rain forests. Flying foxes swallow seeds <5 mm in diameter, but spit out larger ones. Flying foxes defend feeding territories; when animal abundance is low, interactions are rare, and a forager usually remains in one tree, dropping seeds beneath its crown. As abundance increases, animals in fruiting trees repel newcomers, who may snatch a fruit to eat elsewhere, thus dispersing seeds. Comparing flying fox abundance indices (animals h<sup>-1</sup> transect<sup>-1</sup>/relative density of fruiting trees) and seed dispersal revealed a threshold flying fox abundance is required to initiate social interactions and achieve significant seed dispersal. At abundance indices from 0-0.6, the median number of seeds dispersed was low and constant (2%). As indices rose from 0.6-1.1, dispersal increased linearly to 60%. In addition, flying foxes were responsible for > 97% of the dispersed seeds of the 13 large-seeded tree species examined. Polynesia's increasingly rare flying foxes may stop playing a functional ecological role long before becoming extinct, potentially leading to a shift in forest composition favoring small-seeded trees.

## COMPARATIVE NATURALIZATION RATES IN THE EXOTIC FLORAS OF AUSTRALIA AND NEW ZEALAND

DUNCAN, RICHARD P.<sup>1</sup>, RANDALL, RODERICK P.<sup>2,4</sup>, WILLIAMS, PETER A.<sup>3,4,1</sup>

*Ecology and Entomology Group, Soil, Plant, and Ecological Sciences Division, P.O.Box 84, Lincoln University, New Zealand;* <sup>2</sup> *Department of Agriculture, Western Australia, Locked bag 4, Bently Delivery Centre, Western Australia 6983, Australia;* <sup>3</sup> *Landcare Research, Private Bag 6, Nelson, New Zealand;* <sup>4</sup> *Cooperative Research Centre for Australian Weed Management. (duncanr@lincoln.ac.nz).*

**Abstract:** Plant invasions can be studied by comparing the historical behaviour of different groups of introduced species. We compared the probabilities of naturalization in the floras introduced to Australia and New Zealand. Becoming naturalized involves escaping from cultivation and establishing self-sustaining populations in the wild. We used lists of the 24 452 seed plants (i.e. gymnosperms and angiosperms) introduced into Australia and 24 739 introduced into New Zealand, along with whether they were naturalized or not to test several hypotheses. First, the naturalization rate for the entire introduced floras is higher in Australia than in New Zealand. Second, naturalization rate of individual families in Australia and New Zealand is highly correlated which indicates that some families are better able to naturalize than others for whatever reason. Third, genera native to certain regions, notably Europe, are more likely to naturalize in both Australia and New Zealand. For New Zealand genera, we determined whether the number of species widely introduced via agriculture or other means (e.g., erosion control) as an indicator of propagule pressure accounted for the observed differences in naturalization rates among genera from different regions. Genera native to Europe have been significantly more widely introduced than genera native to other regions, which accounts for the higher naturalization rates in native European genera.

## MAPPING POND APPLE (*ANNONA GLABRA*) IN NORTHEAST QUEENSLAND USING A HABITAT SUITABILITY MAP AND LANDSAT ETM DATA

EDMONDS, T. and PHINN, S.

*University of Queensland, Brisbane, QLD, Australia. (tedmonds@hawaii.edu)*

**Abstract:** We investigated the efficacy of mapping Pond Apple (*Annona glabra*), an invasive small tree widespread in Northeast Queensland, Australia, using Landsat Enhanced Thematic Mapper data and a digital habitat suitability map.

A logistic regression model of habitat suitability was generated using geospatial presence and 'pseudo' absence data with climatic and terrain potential predictor surfaces inside a geographic information system. Analysis indicated that areas of low slope and high rainfall created the most ideal habitat; an ecologically feasible outcome given this species' physiological tolerances. Accuracy assessment of a thresholded version of the habitat suitability map indicated an overall map accuracy of 98% and a  $K_{\text{hat}}$  coefficient of 96%.

Supervised land cover classification of a composite image, composed of Landsat bands 1-5 and 7, the habitat suitability map, and an Enhanced Vegetation Index, was performed using a maximum likelihood algorithm. A shortage of field data prevented a full quantitative accuracy assessment; however, a qualitative assessment indicated reduced commission errors due to classification of the target species being limited to green woody vegetation within areas of suitable habitat.

Inclusion of habitat suitability layers within a species specific image classification may provide higher classification accuracies than simple image stratification using ancillary data.

## CONCEPTUAL APPROACH TO EXAMINING THE SPATIAL AND TEMPORAL INTERACTIONS OF DISTURBANCE ON MILITARY TRAINING LANDS

EMRICK, V.R., and DORR, J.L.

*Conservation Management Institute, Virginia Polytechnic Institute and State University,  
Blacksburg, VA 24061; USA. (vemrick@vt.edu)*

**Abstract:** Worldwide there are millions of acres of land reserved for the purpose of training military forces. These lands are subjected to a variety of landscape-level disturbances related directly or indirectly to military training. The result of these landscape-level disturbances is a combination of biological communities that are unique and often rare.

Military training results in two primary types of disturbance; physical impacts from military vehicle maneuvers and wildland fire. The physical impact of vehicles on ecosystem processes can differ substantially due to significant differences in the size and weight of military vehicles. In addition, many maneuver areas are subjected to frequent low intensity fires caused by live fire exercises, detonated munitions, or as a result of fire management prescriptions. Wildland fire and vehicle disturbance thus interact spatially and temporally. Data from several U.S. military installations indicate that these interactions are critically important factors in understanding community structure and dynamics. As a result, we have derived a conceptual approach to study the spatial and temporal interaction of military disturbance. Examination of the spatial and temporal interactions of separate, identifiable disturbances will result in a greater understanding of the role of natural and anthropogenic disturbance on community dynamics.

## TOPOGRAPHICAL VARIATION OF TREE SPECIES DOMINANCE IN A SUBTROPICAL EVERGREEN BROAD-LEAVED FOREST

ENOKI, T. and YAMADA, S.

University of the Ryukyus, Japan. (enoki@agr.u-ryukyu.ac.jp)

**Abstract:** We examined a variation of species dominance with topography in relation to tree traits in a subtropical evergreen broad-leaved forest in the northern part of Okinawa Island, Japan. Distribution pattern of each species depends on the microtopography, though *Castanopsis sieboldii* (Fagaceae) dominates in the forest. Species dominance also differed with microtopography such as slope aspect and position. *Castanopsis sieboldii* dominated mainly on ridge and upper slope. *Schima wallichii* (Theaceae), secondary dominant species in the forest, mainly dominated on lower slope than *C. sieboldii* did. The maximum height of each species correlated with the species dominance in each microtopography, while the shade tolerance of species did not. Maximum tree heights of most species increased downslope. The downslope increase in maximum height of *C. sieboldii* was smaller than that of *S. wallichii*. These results suggest that the variation in species dominance with microtopography could be explained by the change in maximum tree height of each species along a topographic gradient. In climax forests, shade tolerance is one of the most important factors determining the species dominance. The dependence of species dominance on the maximum tree height suggests that the forest was developing affected by disturbances, though the forest has not been affected by human impact for 50 years at least. Natural disturbances such as typhoon and monsoon are very important factor to determine the forest structure.

## A POSITIVE ROLE OF CASUARINA ON THE CONSERVATION OF NATIVE SPECIES ON THE SHORELINE OF THE GULF OF MEXICO

EQUIHUA M., BENÍTEZ, G., VILLEGAS, R., PALESTINA, R., HERNÁNDEZ, A., ÁLVAREZ, J. L.

*Instituto de Ecología, A.C., Apartado Postal 63, 91000 Xalapa, Ver., Mexico.*  
([equihua@ecologia.edu.mx](mailto:equihua@ecologia.edu.mx))

**Abstract:** We report on the effects of *Casuarina cunninghamiana* Miq. windbreaker stripes on native plants and birds. The stripes of this exotic species were originally planted for coastal dune stabilization. Now they span almost continuously the shoreline of the Gulf of Mexico. The original landscape of the vegetation along the Gulf of Mexico included sand dune vegetation with scattered shrubs and small trees. A seaside community dominated by trees is not the usual native physiognomy. Inland there were tropical forests that had mostly been replaced by cattle ranges and croplands.

We studied five *Casuarina* sites along the Mexican shoreline. The stripes were several km long but only about 20 m wide. Plants were sampled with 10x10 m plots and birds with “bird points”.

Up to 108 native plant species (many having forest affinity) were recorded within *Casuarina* stripes, a relatively high diversity given the size of the stripes. Bird diversity increased with complexity of understorey, although bird species richness (68 species) did not differ from surrounding communities. However, bird composition was not the same. Species within *Casuarina* showed the largest number of sensitive species (mostly migratory). We reckon *Casuarina* may be playing a relevant role at hosting native plants and sensitive birds. Thus, it may be an “emerging corridor” for this biota. These results should be contemplated against concerns on its invasive potential. There are reports on *Casuarina* invading mangroves.



## CYCLONE DISTURBANCE OF SAMOAN FOREST

FALETOESE, F.<sup>1</sup>, FOLIGA, T.<sup>2</sup>

<sup>1</sup>*METI (NGO), P.O. Box 1878, Apia, Samoa ([ffaletoesse@yahoo.com](mailto:ffaletoesse@yahoo.com))*. <sup>2</sup>*MNRE (Parks and Research) Apia, Samoa ([tfoliga@yahoo.com](mailto:tfoliga@yahoo.com))*.

**Abstract:** In 1990 and 1991, Samoa was struck by severe tropical cyclones, Ofa and Val, causing extensive damage to the archipelago's rainforest. This paper investigates post cyclone regeneration in Samoa, focusing on the hypothesis that native forests appear more resilient to cyclones than replanted forests and that the preservation of the few remaining stands of native forest is vital for the recovery of native vegetation. In disturbed rainforests, large living remnant trees are of significant importance for post disturbance revegetation either directly by producing large quantities of seeds, or indirectly by attracting vertebrate seed. Instantly, Uafato and Tiavea forests in the Aleipata area had high potential for recovery because most of the trees were still standing and the canopy was re-sprouting. Fruit bats and pigeons are important pollinators (seed dispersers) of native trees, they play a critical role in forest regeneration after cyclones. Of significant concern is the impact of aggressive invasive species on the natural vegetation in Samoa, such as *Mikania micrantha* and *Merremia peltata* (invasive vines), form a dense mantle over the fallen logs and smother the understorey, blotting out the light required for successful germination of most plant species. To ensure rapid and successful regeneration of Samoan forest flora, it is essential that native forest stands are conserved, that native birds and fruit bats are protected and that the spread of invasive tree and weed species is controlled. While current efforts in these areas are underway, much more work remains to be done.

## **ANALYSIS OF SPATIAL PATTERN IN EARLY STAGES OF PRIMARY SUCCESSION ON FORMER LIGNITE MINING SITES IN EASTERN GERMANY**

FELINKS, B.<sup>1</sup> and WIEGAND, T.<sup>2</sup>

<sup>1</sup>UFZ-Environmental Research Center, Department of Conservation Biology, D-04318 Leipzig, Germany, <sup>2</sup>UFZ-Environmental Research Center, Department of Ecological Modeling, D-04318 Leipzig, Germany, [birgit.felinks@ufz.de](mailto:birgit.felinks@ufz.de)

**Abstract:** During three successive years we mapped individual plants on fourteen 4m<sup>2</sup> plots in early stages of recolonization on former lignite mining areas. The species were classified into two groups: (1) the pioneer *Corynephorus canescens* and (2) all other species. We hypothesized that competitive pioneer species have an influence on the development of spatial pattern and that independent patterns change to attraction with ongoing succession. Using the O-ring statistic (Wiegand & Moloney 2004) we analyzed the spatial relationship between the locations of the plants of the two groups separately for each year, as well as the relationship between the spatial patterns of group 2 at year  $t$  and the pioneers from last year ( $t-1$ ). Confidence envelopes for independence of the two patterns were determined using 99 simulations of a toroidal shift null model (Wiegand & Moloney 2004). The analyses of the separate years revealed significant attraction at spatial scales of 4 – 15 cm, with a slightly increasing radius over the three years. The consideration of antecedent conditions showed a change from independence to attraction, again at spatial scales of 4 – 15 cm, which represent the radius of *Corynephorus* tufts. Thus, the early recolonization on our sites follows a successional dynamic where pioneers facilitate establishment of further species.

**References:** Wiegand, T. & K. A. Moloney (2004): Rings, circles, and null-models for point pattern analysis in ecology. *Oikos* 104: 209-229.

## **EFFECTS OF DISTURBANCE ON THE POPULATION BIOLOGY OF ERYNGIUM HORRIDUM IN GRASSLANDS IN SOUTHERN BRAZIL: THE USE OF PLANT FUNCTIONAL TYPES**

FIDELIS, A.<sup>1</sup>, OVERBECK, G.<sup>1</sup>, SOSINSKI, E.<sup>2</sup>, PILLAR, V.D.<sup>2</sup> and  
PFADENHAUER, J.

<sup>1</sup>*Technische Universität München, Freising-Weihenstephan, Germany;* <sup>2</sup>*Universidade  
Federal do Rio Grande do Sul, Porto Alegre, Brazil. (atfidelis@gmx.net)*

**Abstract:** Plant functional types (PFTs) have lately been used to characterize disturbance responses in plant communities. In our study, PFTs were analysed for populations of *Eryngium horridum* (Apiaceae), in order to investigate the effects of fire, grazing and abandonment on the population biology of this rosette species in grasslands in southern Brazil. Plots were established in abandoned areas (protected since 1992 and 1999) and in pastures (with and without fire). The populations were described by recording the number of individuals per stage-class, as well as by recording morphological traits. PFTs were found by numerical analysis with the program SYNCOSA. Four morphological traits gave a high congruency (0.74) between plant traits and disturbance regime: number of leaves, height of inflorescence, height of rosette and stage-class (14 PFTs). Six distinct groups could be observed in the cluster analysis, showing a clear difference between the abandoned and the pasture areas with and without fire. Moreover, the populations from the pasture with fire could be divide in three groups. Our study shows the efficiency of PFT analysis as a tool for the characterization of populations under disturbance.

## SOME CLARIFICATIONS ON THE COLCHIC FORESTS (WESTERN GEORGIA, FORMER SSSR)

FILIBECK, G.<sup>1</sup>, ARRIGONI, P.V.<sup>2</sup> and BLASI, C..

<sup>1</sup>Università La Sapienza, Roma, Italy; <sup>2</sup>Università di Firenze, Firenze, Italy.  
(goffredo.filibeck@uniroma1.it)

**Abstract:** The forest vegetation of Colchis (Georgia, former SSSR) has been quoted by some Western European phytogeographers as broad-leaved evergreen, and sometimes confused with the Macaronesian *laurisilvae*. This was due to a lack of information - no paper in English on Western Georgia was available until 1999.

We present some phytogeographical observations on the Colchic forest based on a study trip undertaken in Colchis and on recent papers by Georgian authors. We show that the Colchic forest is a deciduous forest dominated by *Fagus orientalis*, *Castanea sativa* and *Carpinus betulus* in varying proportions depending on altitude and soil, with a thick evergreen shrub layer composed mainly of *Rhododendron ponticum*, *Prunus laurocerasus* and *Ilex colchica*. No evergreen species reach the tree layer, except the lianas *Smilax excelsa* and *Hedera colchica* and, at higher altitudes, the conifers *Abies nordmanniana* and *Picea orientalis*. The floristic composition shares most genera and many species with European deciduous forests and belongs to *Quercus robur-Fagetum sylvaticae*.

Thus there is no “laurisilva” in Colchis, nor is there any floristic, physiognomic or bioclimatic similarity between the Colchic forest and the Macaronesian laurel forests.

## THE APN-PABITRA-NUS BIODIVERSITY TRAINING WORKSHOP IN SAMOA

FOLIGA, T..<sup>1</sup> and FALETOESE, F.<sup>2</sup>

<sup>1</sup>*Ministry of Natural Resources & Environment, Apia, Samoa* [tfoliga@yahoo.com](mailto:tfoliga@yahoo.com) <sup>2</sup>*METI (NGO), Apia, Samoa.*

**Abstract:** The PABITRA (Pacific-Asia Biodiversity Transect) Network conducted a biodiversity training workshop on Savai'i Island from November 25 to December 5, 2003 with funding from APN (the Asia-Pacific Network for Global Change Research) and support from NUS (the National University of Samoa) in Apia on Upolu Island. Participants from seven Pacific Island countries came together for an initial conference day at NUS. An intensive seven-day field training workshop followed a pre-determined course along three coast to mountain transects (Matavanu, A'opo, and Taga/Salailua) and into a lowland rainforest preserve with canopy walkway at Falealupo. The Aopo transect in central Savai'i was the most diverse with the greatest number of plant species. We made an important finding here when, with the assistance of Dr. Art Whistler, the leading authority on Samoan plants, we found an orchid that was last recorded in 1895 and assumed by some to have become extinct. The senior author actually grew up as a young boy in Aopo and was sad to see the effect of logging on the water resources as the creek that they used to utilize for drinking and washing 30 years ago had dried up and is no longer flowing. All other findings made and conclusions reached will be discussed in this presentation – including a description of the workshop program and activities undertaken.

## ENVIRONMENTAL GRADIENTS AND SECONDARY SUCCESSION AFFECT FOREST COMPOSITION IN TONGA, WESTERN POLYNESIA

FRANKLIN, J.<sup>1</sup>, WISER, S.<sup>2</sup>, DRAKE, D.<sup>3</sup>, BURROWS, L.<sup>2</sup> and SYKES, W.<sup>2</sup>

<sup>1</sup>San Diego State University, San Diego CA, USA; <sup>2</sup>Landcare Research, Christchurch, New Zealand; <sup>3</sup>University of Hawaii, Honolulu, HI, USA.. ([janet@sciences.sdsu.edu](mailto:janet@sciences.sdsu.edu))

**Abstract:** We combined data from three studies of forest plant communities in the Kingdom of Tonga, Western Polynesia, in order to examine patterns of species composition along environmental and disturbance gradients on the major raised limestone islands in the archipelago. Previous studies of Tongatapu, 'Eua and the Vava'u Group suggested that species composition is related to substrate and coastal proximity, and to successional dynamics following anthropogenic and natural disturbance. Our objective was to determine, using a comprehensive dataset, whether coastal versus lowland rain forest formed distinctive vegetation types, and if differences in composition among successional stages showed a consistent pattern across all islands. Relative basal area of 138 tree species from 179 plots (600 m<sup>2</sup>) was analyzed using clustering and ordination. Species associated with coastal locations and certain substrates (sand, swamp) did form discrete groups. However, environmental gradients are short and steep on these low islands, and another group of species was broadly associated with both coastal and lowland sites. Pioneer tree species were among these, and sites diverged in their species composition with inferred time since disturbance owing to differences in species dominance. However, environmental gradients and land use history are unavoidably confounded with island group in Tonga, and differentiating the effects of disturbance versus habitat and biogeography on species distributions will be aided by comparisons with other archipelagoes in Western Polynesia.

## ON ONE RARITY IN THE NORWAY SPRUCE PROVENANCES

FREY, T.<sup>1</sup>, FREY, J.<sup>2</sup>, KASK, P.<sup>3</sup>, ERIK, A.<sup>3,1</sup>

<sup>1</sup>*Estonian Agricultural University, Tartu, Estonia*; <sup>2</sup>*Tartu University, Tartu, Estonia*; <sup>3</sup>*State Forestry Management Centrum, Tallinn, Estonia*. ([Toomas.Frey@mail.ee](mailto:Toomas.Frey@mail.ee))

**Abstract:** Several growth forms of the Norway spruce, including varieties of stem bark, have been described by foresters and silviculturists. Occurrence of smooth, limb (with plaques) or furrow bark has been attributed to age, habitat, radial growth intensity and hereditary characteristics of trees. Several authors (cf. E. Rohmeder, 1965: *Allg. Forstztg.* 76, 81-86; W. Liese, N. Parameswaran, 1971: *Forstwiss. Cbl.* 90, 370-375) have demonstrated, using vegetative propagules, the existence of genetic mutations.

Practical forestry does not consider these varieties, but biologically-minded authors suggest that thick-barked trees are less affected by fungus and insects. Special attention to the thick-barked Norway spruce was paid by C. Schröter, who described two modifications – *mammilosa*, characterised by thickening of stem bark around branches, and *tuberculata*, with corky bark on the lower part of stem (1935: *Schweitz. Z. Forstwes.* 85, 33-46, 46-57). These varieties have generally disappeared due to intensive thinning and logging.

However, recently we have found at least three trees belonging to the variety *tuberculata* in Estonia. The focus of our study is on the habitat and community characteristics of the thick-barked Norway spruce (infrequent, somewhat paludified mixed hemiboreal community, untouched for at least 60 years).

## CHANGES IN LANDSCAPE DIVERSITY (1954-2001) IN THE MUNICIPALITY OF ROME, ITALY

FRONDONI R.<sup>1</sup>, CARRANZA, M.L.<sup>2</sup>, CAPOTORTI<sup>1</sup>, G. AND BLASI, C.<sup>1</sup>

<sup>1</sup>University "La Sapienza", Rome, Italy; <sup>2</sup>University of Molise, Isernia, Italy.  
([blasilab@uniroma1.it](mailto:blasilab@uniroma1.it))

**Abstract:** We present the results of a landscape change analysis (1954 to 2001) of the Municipality of Rome at scale 1:25,000. Aim of the analysis was to detect and quantify temporal and spatial changes, in order to understand the state of conservation of the territory and the impact of urbanization at patch and landscape level.

Landscape changes have been analysed within land units, defined and mapped by a hierarchical land classification approach (Blasi et alii, 2000. *Applied Vegetation Science*, 3:233-242). These units represent ecologically meaningful sample areas for applying and comparing pattern indices (Carranza et alii, 2003. *Phytocoenologia*, 33(4): 591-601).

We developed a GIS database, which included primarily two land cover maps (1954 and 2001) derived from photo-interpretation and geomorphological, lithological and climatic layers. A transformation layer and a land unit map were derived. Successively, transition matrices and pattern indices (e.g. richness, entropy, dominance, mean nearest neighbour) were computed for each land unit type over the time period.

From 1954 to 2001, the extent and density of built-up areas grew dramatically, because of urbanisation processes (mainly on agricultural land and coastal areas) and the compaction of formerly discontinuous urban fabric. However, woods were generally maintained and even increased by natural dynamical processes, particularly broad-leaved woods.

The analysis at land unit level helped identify relationships between land use dynamics and environmental frames, and recognize most vulnerable typologies for land management.



## **NORTHERN AND SOUTHERN LIMIT OF BEECH FORESTS IN EAST ASIA: WHAT IS DIFFERENT IN LANDSCAPES AND SPECIES RICHNESS?**

FUJIWARA, K. and WANG, Z.X.

*Yokohama National University, Yokohama, Japan. ([kazue@ynu.ac.jp](mailto:kazue@ynu.ac.jp))*

**Abstract:** The development of beech forests has been studied near their northern limit in East Asia but not differences in location and species richness. For this, a phytosociological study was carried out in beech forests in Japan and China, in which sampling data were compared to determine distributions, species composition under human impact, and species richness. The areas studied were the Oshima Peninsula in Hokkaido (northern limit) and Kyushu (southern limit) in Japan; and Hubei (northern limit) and Guangxi (southern limit) provinces in China, as well as the eastern limit in Zhejiang. Results were as follow: 1. Forests at the northern limit become patchy and occur discontinuously. Under a humid climate (Japan) the regeneration is very good, but species richness in these forests becomes less. Under drier climates (China), patches of beech forest occur in humid areas such as valleys and on foggy but well drained upper slopes. Regeneration here is poor, with species richness depending on soil conditions. 2. Forests at the southern limit also occur discontinuously as patches if they are at lower elevations. Species richness is higher in forests at the southern limit. 3. Species richness in beech forests also differs depending on the bamboo cover on the forest floor.

## UNDERSTANDING AND USE OF NATURAL DISTURBANCE DYNAMICS IN SUSTAINABLE FOREST MANAGEMENT: AN EXAMPLE FROM THE QUEBEC BOREAL FOREST

GAUTHIER, S.<sup>1,2</sup>, NGUYEN, T.-X.<sup>2</sup>, BERGERON, Y.<sup>2</sup>, LEDUC, A.Z.<sup>2</sup>,  
DRAPEAU, P.<sup>2</sup> and GRONDIN, P.<sup>3</sup>

<sup>1</sup>NRCan, CFS, Sainte-Foy, Québec, Canada [sgauthier@cfl.forestry.ca](mailto:sgauthier@cfl.forestry.ca); <sup>2</sup>UQAT-UQAM  
NSERC Industrial Chair in Sustainable Forest Management, Montréal, Québec, Canada;  
<sup>3</sup>MRNQ, Sainte-Foy, Québec, Canada

**Abstract:** Forest ecosystem management has recently been suggested as a means to maintain biological diversity and productivity in forest systems. In this paper, we will illustrate how a management strategy based on the understanding of natural disturbance dynamics was developed and implemented in the coniferous boreal ecoregion of north-western Quebec. We have demonstrated a large variation in fire pattern over time over the last 300 years. Together with the surficial geology, the intervals between successive fires on a particular site have been shown to exert a strong influence on forest structure and tree composition. This understanding has enabled us to propose a number of objectives that can serve as targets at different phases of management planning. At the landscape level, the objectives are aimed at maintaining observed natural diversity resulting from fire variability whereas at the stand level, we propose to apply a diversity of treatments to respect the natural forest dynamics. We will outline the proposed implementation strategy and its impact on timber yield and maintenance of biodiversity.

## WHAT IS THE FUTURE OF URBAN NATURE IN A DEVELOPING WORLD?

GODEFROID, S. and KOEDAM, N.

*Free University of Brussels (VUB), Laboratory of General Botany and Nature Management (APNA), Brussels, Belgium, (sagodef@vub.ac.be)*

**Abstract:** Urbanization has dramatically transformed the European landscape during the 19<sup>th</sup> and 20<sup>th</sup> centuries. This process raises some questions as to its effects. What are the impacts of urbanization on biodiversity and how can it be studied? Can we predict the distribution and persistence of plant species in constantly expanding cities? To explore these questions, the present contribution aims at: (1) analysing spatial and temporal patterns of the flora of urbanized areas; and (2) investigating the effects of habitat fragmentation, disturbance and land use on plant species and communities. Results are presented here for the town of Brussels for which a large database has been built over the past decades. The methods used consist of recording the species' presence/absence or cover/abundance in a grid of 187 1km<sup>2</sup>-cells and in a network of permanent plots, inferring environmental characteristics from Ellenberg's indicator values, and overlaying field data with digital maps in a GIS-environment. Results indicate that the urban ecosystem undergoes a constant increase in the number of nitrophilous and alien and invasive species. Urban land cover clearly influences the species distribution pattern. Different plant functional groups respond differently to habitat fragmentation. The integration of our own data to other European case studies makes it possible to give an overview of the past and current trends. A view on what the future holds and how society could create a sustainable urban environment is presented.

## DYNAMICS OF PROTECTED AND DISTURBED FOREST-SAVANNA MOSAICS IN NORTHEASTERN IVORY COAST

GOETZE, D.<sup>1</sup>, GURLIN, D.<sup>1</sup>, HÖRSCH, B.<sup>2</sup>, KERSTING, P.<sup>3</sup>, KOULIBALY, A.<sup>4</sup> AND POREMBSKI, S.<sup>1</sup>

<sup>1</sup>University of Rostock, Botany, Germany; <sup>2</sup>German Aerospace Center, Köln, Germany; <sup>3</sup>University of Mainz, Geography, Germany; <sup>4</sup>University of Cocody, Botany, Abidjan 22, Ivory Coast. (dethardt.goetze@biologie.uni-rostock.de)

**Abstract:** The Guineo-Sudanian transition zone of West Africa is characterized by a mosaic of forest islands and savanna. It comprises high natural biodiversity as an important natural resource that nowadays is underlying increasing human pressure and climate shifts. Their effects on pattern and dynamics of this landscape mosaic were studied by direct comparison of protected areas in the Comoé National Park (CNP) and adjacent utilized land with botanical assessments, soil analyses, and GIS-processing of remote sensing data.

Aerial photographs revealed that the pattern of 95% of all 653 studied forest islands remained stable also in extensively utilized areas between 1954 and 1996. Soil properties do not directly account for this distribution of forests and savanna but reflect their long-term formation under the prevailing type of vegetation cover instead. A digital elevation model was generated, showing forests mainly on hilltops and in land depressions, and areas of varying surface textures that enable differentiating forests and savannas of varying physiognomy of the top woody layer. The forest-island pattern is concluded to have been stabilized on the long run by annual savanna fires, which might apply to many tropical forest-savanna mosaics in the world. However, forest islands outside the CNP have recently been severely fragmented through selective wood cutting within the remaining forest outlines (Landsat-image change detection).

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## **HAWAII: A VISUAL EXPLORATION OF ECOSYSTEM DIVERSITY**

GON, S.

*The Nature Conservancy of Hawaii, Honolulu, HI, USA*

**Abstract:** The Hawaiian Biogeographic Province offers a wide range of habitats from dry coastal, through montane fluvial, to aeolian nival. In a visual and narrative sequence, the conditions, natural communities, and constituent biodiversity are sampled and presented in a manner designed to demonstrate their ecological amplitude as well as provide a glimpse of their influence on Hawaiian culture. Coastal, lowland, montane, subalpine, and alpine systems are characterized, as well as the subterranean and freshwater aquatic communities associated with the adjacent vegetated landscape.

## **DISTURBANCE OF VEGETATION UNDER POLLUTION IMPACT: FROM MOLECULAR TO ECOSYSTEM LEVEL**

GOVOROVA, A., GOLUBEVA, E.

*Moscow State University, Russia, [anna\\_govorova@mtu-net.ru](mailto:anna_govorova@mtu-net.ru)*

**Abstract:** The interaction between modifications of photosynthetic apparatus of plants at different levels of the organisation and structure of vegetation under pollution impact was studied.

Investigations were carried out in the impact zone of the metallurgical complex in boreal ecosystems of the Northern Europe. As a test-object we used *Betula pendula*, *Betula pubescence*, *Picea obovata*, *Pinus sylvestris*, *Vaccinium myrtillis*, *Vaccinium vitis-idaea*, *Empetrum nigrum*.

The following research topics were investigated:

- Intensity of oxidation processes in membranes of chloroplasts, pigment composition, photosynthetic activity;
- Structural features of cells of assimilation parenchyma and ultrastructure of chloroplasts;
- Morphological features of leaves;
- Population structure;
- Biodiversity, floristic and phytocenotic structure of plant communities.

Results show:

1. Changes of the vegetation structure under pollution impact are related to modifications of photosynthetic apparatus.

2. We discovered three types of adaptation mechanisms:

The downsizing of structures of photosynthetic apparatus supports high functional activity of photosynthesis. Increasing variety of population parameters contributes the stability of plant communities.

The upsizing of structures of photosynthetic apparatus causes the energy losses. More resistant eurybiontic species take the dominating position, processes of the unification of flora prevail.

The synphase damage of all parameters of photosynthetic apparatus causes the degradation of plant communities.

3. Parameters of photosynthetic apparatus, floristic and phytocenotic structure of plant communities can be used for the diagnostic of different stages of the disturbance of ecosystems.

## **THE APPLICATION OF MULTIVARIATE HYPOTHESIS TESTING (MHT) TO VEGETATION STUDIES**

GRACE, J.B.

*U.S. Geological Survey, Lafayette, LA, USA ([Jim\\_Grace@usgs.gov](mailto:Jim_Grace@usgs.gov))*

**Abstract:** Multivariate hypothesis testing (MHT) represents an approach to studying systems that has great potential utility for the study of vegetation. The most familiar form of MHT for most ecologists, path analysis, constitutes only a small fraction of the capability of MHT. The essential thesis of this talk is that the understanding of systems requires multivariate hypotheses. Further, MHT allows us to go beyond descriptive analyses to the development of empirically grounded, theoretically meaningful models. In this talk, the basic elements of MHT are presented, along with examples that illustrate the unique insights that can be obtained using this approach.

## TESTING THE CONTINUUM CONCEPT WITH A SPECIES POOL APPROACH

GRAMLING, JOEL M.

*University of North Carolina, Chapel Hill, NC, USA ([joel@unc.edu](mailto:joel@unc.edu))*

**Abstract:** The continuum concept (sensu Austin and Whittaker) suggests that environmental gradients can be studied to reveal the niches of plant species. A primary distinction is made between resource and regulatory gradients. Resource gradients are characterized by factors that are consumed as a part of plant growth, while regulatory gradients influence plant growth but are non-consumed factors. Theory suggests that resource gradients should exhibit a convergent pattern of species niche optima, while regulatory gradients would be expected to have more regularly spaced niche optima. Across a gradient the pool of observed species would be expected to exhibit the patterns and biases of the component species' niches with respect to the gradient type. I tested whether species pools exhibit different patterns along resource and regulatory gradients by pooling species occurrences along gradients using a dataset of 100 m<sup>2</sup> vegetation plots from two fundamental different plant communities in the Southeastern United States. Cumulative pools of species capable of occupying any point along each gradient were derived from the observed species occurrences for each community type. Regardless of community type, the collective responses of species across resource and regulatory gradients did not appear fundamentally different from each other. The initial results of this species pool analysis do not support the continuum concept.



## COMMUNITY-LEVEL TEMPORAL RESPONSES TO FIRE FREQUENCY, POPULATION SIZE, AND SPATIAL ARRANGEMENT FOR RARE VASCULAR FLORA OF THE LONGLEAF PINE-WIREGRASS ECOSYSTEM

GRAY, J.<sup>1</sup>, WENTWORTH, T.<sup>2</sup> and BROWNIE, C.<sup>2</sup>

<sup>1</sup>Department of the Army, Fort Bragg, NC 28310, USA; <sup>2</sup>North Carolina State University, Raleigh, NC 27695, USA. ([grayjb@bragg.army.mil](mailto:grayjb@bragg.army.mil))

**Abstract:** We examined factors likely to be important for community-level management of rare flora occurring in the longleaf pine-wiregrass ecosystem on Fort Bragg and Camp Mackall Military Reservations in North Carolina. Thirty-six rare plant taxa, represented by 1,268 subpopulations, were documented during the course of two inventories conducted during 1991-93 and 1998-99. Among temporal responses of these subpopulations, there were 891 records of persistence, 258 records of extinction, and 119 records of colonization. Using logistic regression, we tested hypotheses concerning temporal responses of subpopulations at the community level (irrespective of taxonomic identity) to fire frequency, population size, and spatial arrangement. Extinctions declined and colonizations increased with increasing fire frequency, extinctions declined and persistences increased with both increasing area occupied and increasing stem number, and extinctions increased and persistences declined with increasing distance from the nearest conspecific subpopulation. Metapopulation analyses conducted at the community level for rare flora have several advantages. Taxa with insufficient data for separate study can be incorporated into community-level analyses. Significant results detected through such analyses are also likely to be robust, and these results are applicable to development of community-level conservation strategies.

## SPECIES COMPOSITION AND DISTRIBUTION OF COASTAL SAND-DUNE PLANTS IN SOUTHEAST ASIA (MALAY PENINSULA IN THAILAND AND TAIPEI IN TAIWAN) AND THEIR REGIONAL NATURE

HAYASAKA, D.<sup>1</sup>, FUJIWARA, K.<sup>1</sup>

Graduate School of Environment and Information Sciences, Yokohama National University, Yokohama 240-8501, Japan, ([d03ta013@ynu.ac.jp](mailto:d03ta013@ynu.ac.jp))

**Abstract:** A phytosociological survey was carried out in coastal sand-dune vegetation of southern Thailand to construct a fundamental data-base and simulate the vegetation dynamics. The regional occurrences of coastal sand-dune species were clarified, based on species composition, by the percentage of similarity of **Sørensen** (*PS*), percentage of distance (*PD*), and by Bray-Curtis ordination (1957).

$$PS = \frac{2 \sum_i \min(x_i, y_i)}{\sum_i (x_i + y_i)},$$

$$PD = 100 \square PD$$

Comparison of coastal sand-dune vegetation of Thailand and Taiwan showed that the following four vegetation units were common to both countries: 1) Vigno-*Ipomeeetum pedis-caprae*, 2) *Glehnio-Spinificetum littorei*, 3) *Thuario-Viticetum rotundifoliae*, and 4) *Messerschmidio – Scaevoletum taccadae*. *Wedelietum biflorae* and *Pandanetum tectorii* were found in Thailand but not Taiwan, while *Messerschmidio–Pandanetum odoratissimi* was found at Taipei but not in the study areas in southern Thailand. The similarity methods (*PS*, *PD* and Bray-Curtis) showed that the coastlines of southern Thailand and Taipei were regionally distinct. We suggest that this “regionality” may be due to different cleaning methods, such as collecting trash by machines, by humans, or not at all.

Investigations by phytosociological methods were conducted in southern Thailand in order to construct fundamental data-bases to simulate the dynamics of coastal vegetation. To integrate the data of Thailand and existing data of Taiwan, it was cleared that coastal plant communities of tropical Asia occur in Taiwan too.

## IS THERE A RELATIONSHIP BETWEEN THE NUMBER OF ALIEN SPECIES AND SPECIES RICHNESS OF A COMMUNITY?

HERBEN, T.<sup>1,2</sup>, MANDÁK, B.<sup>1,3</sup>, BÍMOVÁ, K.<sup>1</sup>, and MÜNZBERGOVÁ, Z.<sup>1,2</sup>

<sup>1</sup>Institute of Botany, Academy of Sciences of the Czech Republic, CZ-252 43 Průhonice, Czech Republic, <sup>2</sup>Department of Botany, Faculty of Science, Charles University, Benátská 2, CZ-128 01 Praha 2, Czech Republic, <sup>3</sup>Institute of Applied Ecology, Czech Agricultural University Prague, CZ-281 63 Kostelec nad Černými lesy, Czech Republic. ([herben@site.cas.cz](mailto:herben@site.cas.cz))

**Abstract:** One of the widespread but controversial ideas in ecology states that the number of invaders of a species assemblage is a function of its species richness. Both negative and positive relationships have been reported. We examine whether this relationship can be generated by a simple neutral model where species assemblages are generated by drawing individuals from two pools of identical species (native species and aliens). The neutral model shows that in communities with low and fixed number of individuals, the relationship between number of aliens and native species is strong and negative; it becomes weaker with the increasing proportion of species from both pools being already present in the community. It becomes positive when the number of individuals is allowed to vary.

The scale-dependence results from general dependence of the number of species on number of individuals and/or area. Metaanalysis of published data showed that scale-dependence of the relationship between number of aliens and native species is universal and is compatible with the neutral model. Unless more evidence is available to refute this statement, the relationship between number of native and alien species should be considered result of a neutral process due to constraints on the number of individuals in the community.

## WOODY SPECIES INVADING GRASSLAND ON THE PLANALTO DAS ARAUCARIAS, RIO GRANDE DO SUL, BRAZIL

HERMANN, J.-M.<sup>1</sup>, PFADENHAUER, J.<sup>1</sup> and DE PATTA PILLAR, V.<sup>2</sup>

<sup>1</sup>Technische Universität München, Chair of Vegetation Ecology, 85350 Freising, Germany. ([Julia-Maria.Hermann@gmx.de](mailto:Julia-Maria.Hermann@gmx.de)); <sup>2</sup>Universidade Federal Rio Grande do Sul, Departamento da Ecologia, 91540-000 Porto Alegre, Brazil

**Abstract:** Woody species have increased in frequency and cover in temperate grasslands of the Research Center Pró-Mata, Rio Grande do Sul, Brazil, since exclusion of cattle grazing and annual burning in 1994. We wish to elucidate the process of colonisation by three shrub and one tree species (*Baccharis uncinella* DC., *Calea phyllolepis* Baker, *Agarista nummularia* G.Don.; *Myrsine lorentziana* Arech.). We expect that traits and strategies of germination, establishment, persistence and reproduction differ between these species, enabling each to successfully colonise grassland in certain structural types of grassland, in a certain stage of succession. Ongoing experiments focus on extent and causes of seed losses, and on seedling emergence and growth, under different light conditions, in grassland of different height and cover inside Pró-Mata, and in annually burned and cattle-grazed grassland on an adjacent ranch. First results indicate high losses of *Myrsine* fruit and *Baccharis* seed (as high as 100% within 10-12 days) e.g. due to rodent and ant predation. Next steps are: Mapping of field populations; assessment of survival and growth of pot-grown plants after planting in the field; cutting and burning of pot- and field-grown plants to assess regenerative ability.

The project is co-financed by Deutsche Forschungsgemeinschaft (DFG) and CAPES-Bavaria.

## ENVIRONMENTAL CONTROLS ON FLORISTIC VARIABILITY IN BLACK SPRUCE COMMUNITIES OF INTERIOR ALASKA

HOLLINGSWORTH, T.N.<sup>1,2</sup>, WALKER, M.D.<sup>2</sup>, and PARSONS, A.<sup>1</sup>

*1 Boreal Ecology Cooperative Research Unit University of Alaska Fairbanks Fairbanks, AK, USA 2 USDA Forest Service, Pacific Northwest Research Station [ftkn@uaf.edu](mailto:ftkn@uaf.edu)*

**Abstract:** Although the boreal forest is the second largest terrestrial biome, it has one of the lowest plant diversities. Consequently, in the face of climate change, changes to the structure and functioning of boreal forest communities will be closely linked to landscape-scale shifts in plant distributions. Therefore, understanding current vegetation distribution is critical to predicting future patterns. In interior Alaska, *Picea mariana* (black spruce) is the predominant tree species. Previous classifications of black spruce communities in interior Alaska have not fully incorporated floristic data, and instead relied on dominant species, functional types, physiognomic similarities, and moisture status to separate black spruce vegetation types. Here we present results from our Braun-blauquet classification of black spruce community types, correlations in environmental gradients to the floristic variability within black spruce communities, and differences in diversity along important environmental gradients. Three community types are described, with five subtypes. Our results indicate that a soil temperature/moisture gradient, corresponding to topography, is important within 100km<sup>2</sup> around Fairbanks. When expanded to incorporate the entire interior Alaska, soil mineral pH is the driving environmental control over floristic variability. Vascular species diversity patterns change significantly across an acidity gradient, whereas nonvascular diversity is more tightly linked to a topographic gradient. It is hypothesized that soil pH is driving landscape scale floristic variability due to a complex interaction between fire history, soil drainage, and glacial history of a site.

## OPTIMIZING SEAGRASS MONITORING BY ASSESSING PREVIOUS MAPPING UNCERTAINTY

HOLMES, K.W., VAN NIEL, K., KENDRICK, G.A.

*Cooperative Research Centre for Coastal Zone, Estuary and Waterway Management,  
University of Western Australia, Crawley, WA, Australia. ([kholmes@segs.uwa.edu.au](mailto:kholmes@segs.uwa.edu.au))*

**Abstract:** Seagrass monitoring is often used to identify where human activities are increasing sediment loads and turbidity in coastal environments, leading to near shore habitat degradation. Seagrass presence and type are typically mapped using a combination of remote sensing and field work, then resurveyed every few years to record changes in distribution, extent, and species composition. However, most monitoring efforts include little information on mapping error, which makes the quantification of temporal change extremely difficult. Error is introduced from a variety of sources including image and sample georeferencing, image misclassification, mapping resolution, number and distribution of ground-truth samples, and interpolation methods used. We show that by analyzing previous or anticipated map uncertainty and generating empirical models of seagrass specie spatial dependence, we can improve follow-on surveys and produce more robust, quantifiable estimates of the temporal changes in these important habitats than are commonly available. We tested this approach for a 2004 monitoring program using data from a 1999 survey in Owen Anchorage, Western Australia, where huge losses of seagrasses in the 1970s raised concerns over human activities in the coastal zone. Geostatistical techniques were used for interpolation in areas with lower density sample coverage, and provide insight both for field sampling design and interpretation of the spatial distribution of distinct seagrass species. Only by calculating the uncertainty in the mapping effort can temporal changes be distinguished from methodological noise.

## TREE DIVERSITY AND FOREST DYNAMICS ALONG AN ALTITUDINAL GRADIENT IN A SOUTHERN ECUADORIAN MONTANE FOREST

HOMEIER, J., DALITZ, H. and BRECKLE, S.W.

*University of Bielefeld, Department of Ecology, PO Box 100131, 33501 Bielefeld, Germany.  
(juergen.homeier@uni-bielefeld.de)*

**Abstract:** The field research for this study was carried out in the reserve of the Estación Científica San Francisco (S 3° 58', W 79° 04') which is located on the eastern slope of the Cordillera El Consuelo in Southern Ecuador. On 15 permanent plots of 400 m<sup>2</sup> situated in altitudes between 1850 and 2450 m above sea level all trees with a DBH (diameter at breast height) of 5 cm or more were inventoried. Site parameters like air temperature and soil nutrients (K, Mg, Ca, Mn) were quantified. Radial tree growth was measured with dendrometer bands over a period of three years. Most important tree families are Lauraceae, Melastomataceae, Rubiaceae and Euphorbiaceae. With ordination methods based on tree species composition of the permanent plots five forest types could be distinguished. These types are not only distinct in species composition, but also in diversity, structural features and growth rates. Structure and species composition are closely related to elevation and topography. Highest species diversity was found on lower slopes and in ravines, together with highest basal area and highest growth rates. Tree diversity and growth are correlated with each other and with nutrient supply.

## LANDSCAPE FRAGMENTATION AND VEGETATION DYNAMICS OF RURAL AREA

HONG, S.-K.<sup>1</sup>, KIM, J.-E.<sup>2</sup>, and NAKAGOSHI, N.<sup>2</sup>

<sup>1</sup>Forest Research Institute, Kookmin University, 861-1 Chongnung-dong, Songbuk-gu, Seoul 131-702, Korea; <sup>2</sup>Graduate School for International Development and Cooperation, Hiroshima University, 1-5-1 Kagamiyama, Higashi-Hiroshima 739-8529, Japan. ([pingehong@soback.kornet.net](mailto:pingehong@soback.kornet.net))

**Abstract:** Pattern and process of vegetation change of the three agro-forested regions that influenced by different land-use intensity (Teokseong-ri, TS, Teokdong-ri, TD and Yangwha-ri, YH) in Korea. Spatio-temporal data from landscape mosaics and vegetation maps (1988 and 2002) of three regions were analyzed for cause and consequence of vegetation dynamics and landscape fragmentation. As results of this research, the different intensity of human impacts on the landscape management has been concerned in pattern and process of vegetation dynamics in different ways. Total edge and diversity of landscape was increased because of fragmentation and patchiness. One reason of patchiness was introduction of alien vegetation types such as *Larix leptolepis*. Landscape diversity of these three areas is depended on dominant vegetation such as *Quercus* spp.. Changes of patch shape and connectivity of vegetation landscape by shifting human impact were influence on vegetation structure and floristic composition. For example, in TD, vegetation structure and species composition in *P. densiflora* forest was similar to neighborhood *Quercus* forest by long-term abandonment of vegetation landscape. Moreover, original graveyard vegetation of *Zoysia japonica* in 1988 was changed to different vegetation types. We conclude that changes of landscape diversity, floristic composition of rural vegetation were influenced by decline of human impacts. Currently, conservation and restoration of biodiversity and remnant forest are emerging issues in landscape ecology in Korea, and therefore, our spatio-temporal research will contribute to solve these issues.



## **GEOGRAPHICAL VARIATION OF SPINE DENSITY AND LENGTH IN JUVENILES OF \_ZANTHOXYLUM AILANTHOIDES\_ IN THE IZU ISLANDS AND ADJACENT AREA, CENTRAL JAPAN**

HOSHINO, Y. and SASAJIMA, M.

*Tokyo University of Agriculture and Technology, FUCHU, TOKYO, JAPAN,  
(hoshino@cc.tuat.ac.jp)*

**Abstract:** Decrease of spine density and length in some spiny plants has been observed in the Izu Islands. This seems to be an example of the evolution under the absence of mammalian herbivores because the fauna of the Izu Islands is characterized by the lack of large and medium mammals such as deer and boar which distribute in adjacent area called southern Kanto district. But there is little scientific knowledge about this phenomenon. We choose juvenile of *Zanthoxylum ailanthoides*, one of the spiny trees for examining the geographical variation of spine morphology. Its spines attach to rachis of pinnate compound leaf and trunk. Result from the samples collected in the adjacent area, density of spine on both trunk and leaf within a juvenile decreased according to increase of attached height, especially little spine was observed on leaves over 1.5m in height. This suggests that spine of *Z. ailanthoides* has developed as an armament against mammalian herbivores. Geographical variation of spine density and length showed clear differences between the Izu Islands and the adjacent area. Spine density on trunk in Izu Islands is lower and spine length is shorter than these in the southern Kanto. Variation of spine density and length within the islands could explain the climatic factor and island size. This suggests that the variation in spine relates to not only existence of mammals but climatic factor and island size.

## USING SOIL SEED BANKS TO PREDICT RESPONSE TO DISTURBANCE IN AN OAK- DOMINATED FOREST IN PENNSYLVANIA, USA

HUEBNER, C.<sup>1</sup>., GOTTSCHALK, K.<sup>1</sup>, and REBBECK, J.<sup>2</sup>

<sup>1</sup>USDA Forest Service, Morgantown, WV, USA; <sup>2</sup>USDA Forest Service, Delaware, OH, USA.  
([chuebner@fs.fed.us](mailto:chuebner@fs.fed.us)).

**Abstract:** Plots within an oak-dominated forest (~36,000 m<sup>2</sup>) with a fern-dominated understory were treated with one of three levels of harvesting, two levels of herbicide, and all combinations. Pre-treatment, soil samples were randomly taken from each of the 72 plots, cold stratified, mixed, spread at a depth of 1 cm, and kept in a controlled environment for 5 months. Vegetation surveys were conducted pre- (125 species) and post-treatment (112 species). The seed bank was most similar to the herbicide plus 40-50% harvesting treatment. Twenty-six of the 48 species in the seed bank were not present in the surveys. These 26 were weedier species that may require more extensive soil disturbance. Most of the missing species from the seed bank were masting or sprouting tree species, perennial herbs, or uncommon. Colonization from roadside species was evident. The fern was important in the seed bank and the post-treatment flora, but the spores took 2 weeks longer to germinate than most of the other species in the seed bank, putting the fern at a disadvantage in this and similar environments. The most diverse pre-treatment area had the least diverse seed bank, possibly indicative of fewer historic disturbances.

## **INVASION BY THE N-FIXING TREE, *FALCATARIA MOLUCCANA*, ALTERS ECOSYSTEM FUNCTION AND STRUCTURE OF LOWLAND WET FORESTS IN HAWAII**

HUGHES, R.F. and DENSLOW, J. S.

*Institute of Pacific Islands Forestry, USDA Forest Service, 23 East Kawili Street, Hilo, HI 96720, USA*

**Abstract:** Invasive species pose major threats to the integrity of native ecosystems. Here we describe impacts of an invasive N-fixing tree, *Falcataria moluccana*, on the function and structure of wet lowland forests in Hawaii. Study sites were established in native-dominated and *Falcataria*-invaded stands on three lava flows ranging in age from 48 to 300 years and representing a gradient of native forest stand development. N inputs via litterfall were 4 to 55 times greater, and P inputs 2 to 28 times greater, in invaded stands relative to native-dominated counterparts on each lava flow. Rates of litter decomposition were 2 to 7 times higher in invaded stands relative to native-dominated counterparts. Invasion by *Falcataria* increased soil NO<sub>3</sub>-N and NH<sub>4</sub>-N availability from 12 to 46 times, and soil P from 2 to 57 times, relative to native-dominated stands. *Falcataria*-mediated functional changes were accompanied by structural and compositional changes as well. While *Metrosideros* individuals dominated native forest stands, this species suffered 85 to 100% mortality in invaded stands. In contrast, the invasive, non-native tree, *Psidium cattleianum*, was nearly absent from native-dominated stands, but reached densities as high as 14,000 stems ha<sup>-1</sup> within invaded stands.

## **EFFECTS OF RICE HERBICIDES ON SEED GERMINATION AND SEEDLING GROWTH OF A THREATENED PLANT SPECIES *PENTHORUM CHINENSE***

IKEDA, H. and LUO, X.-Y.

*National Institute for Agro-Environmental Sciences, Tsukuba, Ibaraki 305-8604, JAPAN.  
(ikedah@affrc.go.jp)*

**Abstract:** *Penthorum chinense* Pursh is an aquatic perennial plant distributed in eastern Asia, but its population has been decreasing in Japan and thus listed in the Red Data Book as being a 'vulnerable' species. We investigated the effects of rice herbicides, bensulfuron-methyl, mefenacet, simetryn and thiobencarb, on seed germination and seedling growth of this species using exposure experiments under laboratory conditions. All herbicides markedly reduced radicle elongation and seedling growth at the 3rd-leaf stage, whereas only bensulfuron-methyl reduced seed germination. Bensulfuron-methyl showed the greatest inhibitory effects on seedling growth, and simetryn killed all seedlings soon after germination at and above 85 µg/L. We used effective concentrations of herbicides resulting in 50% inhibition (EC<sub>50</sub>) of radicle elongation to bensulfuron-methyl (0.58 µg/L), mefenacet (120 µg/L) and thiobencarb (350 µg/L), and a 50% lethal concentration (LC<sub>50</sub>) of germinating seeds to simetryn (28 µg/L) as endpoints for ecological risk assessment of these herbicides, and compared them with maximum concentrations in river water in Japan which had been previously reported. As a result, it is suggested that runoffs of bensulfuron-methyl and simetryn from paddy fields in some of major rice-cropping areas in Japan may cause adverse effects on seedling establishment of *P. chinense*.

## THE ROLE OF SECONDARY COMPOUNDS IN PLANT - POLLINATOR MUTUALISM

IZHAKI, I.<sup>1</sup>, MELAMED-TADMORE, H.<sup>1,2</sup>, SINGARAVELAN, N.<sup>1</sup>,  
NE'EMAN, G.<sup>1</sup>, INBAR, M.<sup>1</sup>, and ARIELI, A.<sup>2</sup>

<sup>1</sup>Department of Biology, University of Haifa at Oranim, Tivon 36006, Israel; <sup>2</sup>Department of Animal Science, Faculty of Agricultural, Food and Environmental Quality Sciences, The Hebrew University of Jerusalem, Rehovot 76100, Israel. ([izhaki@research.haifa.ac.il](mailto:izhaki@research.haifa.ac.il))

**Abstract:** The hypothesis of our study is that the interactions between plants and nectar consumers (legitimate pollinators as well as nectar robbers) are mediated by secondary compounds in the nectar. Consequently, the levels of secondary compounds in the nectar should be inducible and animal-sensitive, with differential effects on pollinators versus non-pollinators and thus may affect plant fitness. We explored the role of two pyridine alkaloids (anabasine and nicotine) in pollination of tree tobacco *Nicotiana glauca*. Sunbirds, pollinators of *N. glauca* in east Mediterranean ecosystems, were not deterred by the lowest naturally occurring concentrations of these alkaloids in nectar but they were significantly deterred by the average concentrations detected in nectar. The two pyridine alkaloids reduced sunbirds' gut transit time (by 30-42%) and sugar assimilation efficiency (by 9-17%) in comparison to control alkaloid-free diet. Thus, sunbirds are able to cope with low concentrations of nicotine and anabasine in *N. glauca* nectar but not with the average concentrations. A different pattern was observed in honeybees as they were attracted to both alkaloids in naturally occurring concentrations. In light of the fact that pyridine alkaloids such as nicotine are an addictive drugs that reinforces self-administration, increase locomotion and reinforce place preference in animals, we will evaluate the ecological consequences of these findings with respect to plant pollination and reproductive success.

## **BIOPOP – AN EXPERT SYSTEM FOR LANDSCAPE PLANNING AND NATURE CONSERVATION BASED ON A DATABASE OF PLANT TRAITS**

JACKEL, A.-K.<sup>1</sup>, DANNEMANN, A.<sup>2</sup>, POSCHLOD, P.<sup>1</sup> and KLEYER, M.<sup>2</sup>  
<sup>1</sup>*Institute of Botany, University of Regensburg, 93040 Regensburg, Germany;* <sup>2</sup>*University of  
Oldenburg, Postfach 2503, 26111 Oldenburg, Germany.* ([anne-kathrin.jackel@biologie.uni-regensburg.de](mailto:anne-kathrin.jackel@biologie.uni-regensburg.de))

**Abstract:** Information about functional traits of plant species could be an important tool for landscape planning and nature conservation as they allow a risk assessment for plant species as well as predictions of a plant species' response to management or restoration measures. In published and unpublished literature there is a wealth of information on traits of Mid-European plant species, but it is widely spread and hardly accessible to stakeholders working in applied science, planning and nature conservation.

We are developing an expert system answering questions on functional traits of plant species and on their probable response to succession, habitat management or restoration measures (Poschlod et al. 2003). The answers are based on a database of 60 functional and life-history traits of the German flora compiled from published and unpublished literature sources. In this database each attribute of each plant taxon is stored in an individual record. Records are fully referenced and contain additional information (if available) about the habitat where data were collected and methods used. Our aim is to make the database and the expert system freely accessible in the internet.

Poschlod, P., M. Kleyer, A.-K. Jackel, A. Dannemann and O. Tackenberg (2003). "BIOPOP - A database of plant traits and internet application for nature conservation." *Folia Geobotanica* **38**: 263-271.

## CHANGE IN TREE POPULATION STRUCTURE OVER 30 YEARS IN A MONTANE RAINFOREST IN HAWAII

JACOBI, J.<sup>1</sup>, BIO, K.<sup>2</sup> and MUELLER-DOMBOIS, D.<sup>3</sup>

*1*U.S. Geological Survey, Pacific Island Ecosystems Research Center, Hawai'i National Park, HI, USA; *2*Pacific Cooperative Studies Unit, University of Hawai'i, Honolulu HI, USA; *3*PABITRA Coordinator, University of Hawai'i, Honolulu, HI, USA. ([jim\\_jacobi@usgs.gov](mailto:jim_jacobi@usgs.gov))

**Abstract:** A major study of the ecosystems of the Hawaiian Islands was conducted in the early 1970's under the auspices of the UNESCO's International Biological Program (IBP). One component of the Hawai'i IBP project was a detailed look at the composition, structure, and dynamics of a montane koa-`ohi`a (*Acacia koa-Metrosideros polymorpha*) forest in the Kilauea Forest section of lands owned by Kamehameha Schools the island of Hawai'i. This area has been proposed as one of the Hawai'i study areas under the Pacific-Asia Biodiversity Transect (PABITRA) program. In the current study we resurveyed the plant communities in the Kilauea Forest study area to evaluate changes in vegetation characteristics and plant population dynamics of this forest after 30 years. The results allow us to take a long-term view of the dynamics of the vegetation within this community, specifically looking at changes in population structure and species diversity, as well as assessing the impacts of invasive plants and animals on this ecosystem. The results will be used to refine management strategies to enhance conservation of this important native ecosystem.

## EVOLUTIONARY CHANGES IN INTRODUCED SPECIES

JAKOBS, G., WEBER, E. and EDWARDS, P. J.

Swiss Federal Institute of Technology, Geobotanical Institute, Zürichbergstr. 38, 8044 Zurich, Switzerland. ([gabi.jakobs@env.ethz.ch](mailto:gabi.jakobs@env.ethz.ch))

**Abstract:** Plant invasiveness can be described by various plant traits, but the intrinsic ability of an introduced species may not always be a good predictor of its invasion success. Due to changed selection pressures, the species may evolve towards higher stress tolerance, plasticity or competitive ability in the new range.

We present results of an experimental study with giant goldenrods *Solidago gigantea* Ait., an aggressive plant invader in Europe. To investigate whether differences between naturally grown populations in the native and the introduced range are due to phenotypic plasticity or evolutionary changes, we set up common garden experiments with plants from both provenances and recorded life-history traits throughout two seasons. In most traits measured, introduced plants clearly outperformed their native conspecifics; continental differences were most pronounced in the reproductive traits, the relative growth rate in spring and the plasticity in varying environmental conditions. The experiments strongly indicated a genetic basis for the larger size and plasticity of introduced plants.

Founder effects and selection during the introduction may partly explain the higher vigor of native plants in comparison to their native conspecifics, but there were also indications for an evolution of new genotype combinations in the introduced range. To evaluate the significance of founder effects and post-introduction evolution, we will present preliminary data of genetic analyses (with the amplified fragment length polymorphism technique) of fifty native and introduced *S. gigantea* populations.



## APPLIED INFORMATICS FOR STUDIES OF VEGETATION ALLIANCES

JENNINGS, M.

*U.S. Geological Survey / University of Idaho, Moscow, ID, 83843, USA.  
(jennings@uidaho.edu)*

**Abstract:** Little is known about ecological characteristics of alliances described in the U.S. National Vegetation Classification, either generally or individually. Few descriptions are based directly on original field plot data, and such data are rarely available for reexamination. Plot data do not exist in the quantity or over the geographic extents necessary, and new field work for this purpose is unlikely. This study explores how to develop the data that are needed by integrating existing information from multiple sources. Almost 40,000 field plot records of 11 different sources were collected from across the northwestern USA to generate a single standardized database from which plots were classified a priori as members of alliances. Additional data sets of climate, biomass productivity, and morphological traits of plant species were integrated with the field plot data. Species names were standardized and the plot records were filtered for eight univariate parameters. Initial sets of plot records were extracted from the data with SQL statements based on existing descriptions of alliances. Then multivariate outliers of species composition were identified in each alliance data set and outlier plots were removed. These subsets were tested against a null model using a Mantel test. Ultimately 21% of the plots were classified to 49 vegetation alliances and these were corroborated with a nonmetric multidimensional scaling ordination. This study resulted in a massive set of primary data critical for the study of vegetation alliances, demonstrating methods for synthesizing field plot data sets from multiple heterogeneous sources.

## **IMPACT OF LAND USE ON PLANT BIODIVERSITY AND MEASURES FOR BIODIVERSITY CONSERVATION IN THE LOESS PLATEAU IN CHINA**

JIANG, Y., KANG, M.Y., GAO, Q.Z. and HE, L.H.

*Beijing Normal University, Beijing, 100875, P.R. China. ([jnagv@bnu.edu.cn](mailto:jnagv@bnu.edu.cn))*

**Abstract:** Aims of this research address the following questions: What are the impacts of forestation and grass-planting carried out in the last few decades on local plant biodiversity, as well as different land use patterns on local vegetation, and what measures should be promoted for biodiversity conservation in future on the Loess Plateau?

Through comparative and statistic analyses to the floristic data of 3 sample sites with different land use practices, the land use data of 22 land use pattern sample plots and the data of 208 vegetation quadrats over the study area, the following results have been drawn:

1. Forestation appears to have a positive influence on the species diversity, but has contributed little to the native vegetation in terms of conserving its floristic features.
2. The grasslands and *Caragana intermedia* artificial shrub land have the highest scores of species richness.
3. There is a significant positive correlation between land use diversity and species richness.
4. Concrete measures for biodiversity conservation in the area can include setting up small nature reserves and diversifying land use patterns.

## **SPATIAL PATTERNS OF PLANT DIVERSITY AND THEIR RELATION TO DISTURBANCE AND SITE – THE HEXGRID-APPROACH**

JURASINSKI, G.<sup>1</sup>, BEIERKUHNLEIN, C.<sup>1</sup>

<sup>1</sup>University of Bayreuth, Bayreuth, D-95440, Germany. ([gerald.jurasinski@uni-bayreuth.de](mailto:gerald.jurasinski@uni-bayreuth.de))

**Abstract:** The documentation of biodiversity is lacking quantitative and comprehensible methods to detect and quantify changes at the level of ecosystems and landscapes (Loreau et al. 2001). Major factors for the expected losses are changes in land-use (Sala et al. 2000). Thus, it is crucial to examine the influence of disturbances on spatial patterns of diversity. Our motivation is to develop applicable methods to reveal the impacts of land-use onto spatial patterns of floristic diversity.

Ecological monitoring of biodiversity patterns has to be spatially and temporally explicit (Beierkuhnlein 2000). Our approach is based on a systematic grid of hexagonal plots. We apply a spatially nested design at several spatial scales and levels to examine these patterns. The hexagonal grid provides several advantages compared to other methods. Most important are equal distances and borders to neighbouring plots. This facilitates data analyses and circumvents geostatistical problems (compared to squared or circle plots). In the field, the plots are marked and subdivided into six sections, respectively. This provides an easy method to assess semi-quantitative data on structure and disturbance in a standardized way.

The hexagonal plot approach also optimizes the relationship between workload for marking, area-perimeter-ratio, accuracy, consistency of statistical analyses and grid consistency. The identified biodiversity patterns can be explained by site conditions and disturbance effects. The method is widely applicable in ecological patterns analysis.

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## **PREDICTING STAND STRUCTURE AND DYNAMICS IN A SYLVO-PASTORAL LANDSCAPE USING TIME-SERIES OF AERIAL PHOTOGRAPHS AND LIDAR DATA**

KALWIJ, J.M., WAGNER, H.H. and WILDI, O.

*Swiss Federal Institute for Forest, Snow and Landscape Research WSL, CH-8903 Birmensdorf, Switzerland. (jesse.kalwij@wsl.ch)*

**Abstract:** Sylvo-pastoral landscapes consist of a mosaic of land-use types, induced by the interaction among a variety of factors, e.g. site conditions, disturbance and land-use. Together, these factors lead to forest heterogeneity at multiple spatial and temporal scales. This study aimed to predict patterns of forest dynamics from land-use types (grazed, abandoned pasture, closed-canopy forest) using modern techniques. Therefore, we quantified spatial patterns of gap dynamics and tree regeneration in a Swiss pasture-woodland and compared these to land-use types over time. Digital canopy surface models (DSM) were extracted from aerial photographs (1954, 1980, 1998) using a high-resolution digital terrain (elevation) model as a reference. LiDAR (airborne laser scanning) DSM and data of a long-term permanent plot were used for verification purposes. Indices of spatial distribution patterns, e.g. forest-gap geometry, connectivity and density, were calculated for each land-use type. Results show that in grazed areas, trees were over dispersed within homogeneous stands. Tree density remained constant at larger spatial extents, but individuals became more aggregated. On abandoned pastures, tree cover increased, but not tree density. Neither tree density nor gap dynamics of closed forests showed significant changes over the time period studied. This approach allowed reliable quantification of forest dynamics at the landscape level. Differences between land-use specific patterns of tree distribution within the considered landscape can be explained by the predominance of plant-herbivore interactions, replacement mechanisms, forest growth and edaphic factors.

Loreau M et al. (2001) Ecology - Biodiversity and ecosystem functioning: Current knowledge and future challenges. *Science* 294: 804-808.

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## INVADING PATTERN OF *ERAGROSTIS CURVULA* AT GRAVEL BAR IN RELATION TO HYDRO-GEOMORPHIC CHANGE IN THE YOSHINO RIVER, SHIKOKU, JAPAN

KAMADA, M., KOJIMA, M. and OKABE, T.

Dept. of Civil Eng., University of Tokushima, 2-1 Minami-Josanjima, Tokushima 770-8506, Japan. (kamada@ce.tokushima-u.ac.jp)

**Abstract:** *Eragrostis curvula*, which perennial grass was introduced from South Africa as green-material for trapping soil of steep slope, is now rapidly invading on gravel bars of many Japanese rivers, and has seriously altered riparian ecosystems. We examined expanding process of the species in relation to hydro-geomorphic change at bars of the Yoshino River, Shikoku, Japan.

*E. curvula* communities appear on the area where non-dimensional tractive force is less than 0.05 under the flood of 6000 m<sup>3</sup>/sec discharge, which flood occur with two-year interval. The value of the force indicates that riverbed-surface is hard to be moved during the flood in the area.

Seedlings were removed by floods, if its discharge occurs over 0.05 non-dimensional tractive force on the riverbed. While 0.08 non-dimensional tractive force is needed to remove mature plants. If shrubs of willow trees are distributed in front of the seedlings and/or mature plants, larger flood is needed to remove them. Because shrubs preserve *E. curvula* from flood current.

*E. curvula* becomes to enhance the sediment deposition during the floods, in accordance with the plant growing. With increase of plant size, volume of trapped sediment has increased and particle size of the sediment has been reduced.

When fine-sand has covered the gravel bar-surface due to sedimentation by *E. curvula*, vegetative reproduction becomes superior to reproduction from seeds. The flexibility in reproduction is beneficial for expansion of *E. curvula* community.

## VEGETATION DYNAMICS AFTER THE 2000-YEAR ERUPTION ON MIYAKE-JIMA ISLAND, IZU ISLANDS, JAPAN

KAMIJO, T.<sup>1</sup>, TSUNEKAWA, A.<sup>2</sup>, KIYOHARA, Y.<sup>3</sup>, YAMANISHI, A.<sup>2</sup>, KATO, T.<sup>3</sup>, HASHIBA, K.<sup>3</sup> and HIGUCHI, H.<sup>2</sup>

<sup>1</sup>Institute of Agriculture and Forestry, University of Tsukuba, Tsukuba, Ibaraki□305-8572, Japan; <sup>2</sup>School of Agriculture and Life Science, University of Tokyo; <sup>3</sup>University of Tsukuba. (machilus@sakura.cc.tsukuba.ac.jp)

**Abstract:** Miyake-jima Island (55 km<sup>2</sup>) is situated in Pacific Ocean, about 180km south of Tokyo, Japan. In 2000, Miyake-jima erupted and ejected large amounts of volcanic ash. Since the formation of a new crater, a large quantity of SO<sub>2</sub> gas (10,000 ton/day) has been emitted. In this study, we describe the damage and recovery of vegetation by analysis of satellite images (2000 to 2002) and by field investigation (2001 to 2003). We placed 11 plots on southwestern slope of the island in 2001 for direct monitoring, and placed 135 plots to grasp the damage of vegetation throughout the island.

About 50 % of the vegetation was heavily damaged. In 2001, the damaged areas extended toward the eastern leeward side, which was more frequently exposed to SO<sub>2</sub> gas. The vegetation cover and species diversity were extremely low in heavily damaged area. However, some species (e.g., *Histiopteris incisa*) which can tolerate SO<sub>2</sub> gas were found in the area. Recovery from root crowns once buried in volcanic ash was found relatively often in such perennial species as *Carex oshimensis*. In direct monitoring plots, covers of *Carex oshimensis* increased after the eruption.

The current volcanic activity is characterized by long duration of activity (SO<sub>2</sub> gas) after the eruption. The vegetation on this island now seems to undergo recovery and decline concurrently.

## TRENDS IN PLANT SPECIES TRAITS DURING SUCCESSION OF ABANDONED OF MEADOWS NEARBY VIENNA, AUSTRIA

KARRER, G.

*University of Natural Resources and Applied Life Sciences, Gregor-Mendel-Str. 33, A-1180  
Vienna, AUSTRIA; ([gerhard.karrer@boku.ac.at](mailto:gerhard.karrer@boku.ac.at))*

**Abstract:** We surveyed successional trends in anthropogenous grasslands nearby Vienna documenting changes in species abundance and vitality aspects (seed production, seed rain, biomass) on permanent plots in communities differing in nutrient supply. Effects of continuous abandonment on species composition and corresponding general trends in species traits for a 5-years period are presented here.

The hayfield plots are situated in a nature reserve and were cut once a year irrespective of the soil nutrient status before the experiment. We found compositional and structural changes happening more rapidly on nutrient rich sites than on nutrient poor ones. Generally, communities on dry sites suffered not so much from species loss like those on well supplied sites. Plants with adaptive traits to utilize spatial or temporal gaps in grassland communities like annuals, root suckers, short-lived semirosette and rosette species vanished on nutrient rich plots within 2 years of abandonment. On the other hand, such growth form types survived for a longer period in dry nutrient poor meadows, however numbering less individuals.

Obviously, facultative abandonment favours grassland species with high biomass production against less competitive opportunists. Conservation managers must provide every year biomass extraction from the very productive meadows to stabilize the high level of biodiversity.

## **FIRE AND LAND USE IN TROPICAL ECOSYSTEMS**

KAUFFMAN, J. BOONE

*USDA Forest Service, Institute of Pacific Islands Forestry, Honolulu HI, 96813*

*([boonekauffman@fs.fed.us](mailto:boonekauffman@fs.fed.us))*

**Abstract:** The biota of tropical ecosystems are adapted to the natural occurrence (or absence) of fire in their environment. Naturally occurring fires in tropical ecosystems vary from an almost continual presence in tropical savannas (return-intervals of every few years) to a virtual absence in tropical rain forests (return-intervals at millennial scales). In areas with frequent fire-return intervals, fire plays an important role in nutrient cycling, ecosystem structure, and biotic processes such as reproduction, germination, and establishment. In contrast, the biota may show few apparent adaptations to survival when fire is an extremely rare event (i.e., in tropical rain forests). Altering natural fire regimes can have far reaching effects on tropical ecosystems. Livestock grazing, cropland development, urbanization, and desertification may decrease fire occurrence in tropical savannas and woodlands and change ecosystem structure and function. In contrast, fire occurrence has dramatically increased in tropical forests due to deforestation and land use/land cover change. These fires are significant contributors to the unprecedented rates of species extinctions and losses of ecosystem integrity in the tropics. In addition, these ecosystems become significant sources of greenhouse gasses as global C pools are shifted from storage in tropical forests to the atmosphere. Fires set in disturbed areas may carry into adjacent standing forests further degrading the tropical landscape. A number of social, economic, and political barriers must be overcome to reverse current trends.



## **SAMPLING DESIGN AND PLOT SHAPE EFFECTS ON PLANT DIVERSITY MEASUREMENTS**

KEELEY, JON E.

*U.S. Geological Survey, Sequoia National Park, Three Rivers, CA 93271 and University of California, Los Angeles, CA USA (jon\_keeley@usgs.gov)*

**Abstract:** Empirical and theoretical evidence points to rectangular plots as superior to squares in recording species richness. I tested this hypothesis by comparing three Whittaker-type sample plots that differed in the shape and dispersion of nested subplots and found that earlier reports of greater richness with rectangles was due to the confusion of shape effects with spatial effects. Species richness was not significantly different between square and 1:4 rectangular plots at 1-100- or 400-m<sup>2</sup> total area. I hypothesize that rectangles do not record greater richness than squares on my sites because species turnover varies along complex environmental gradients that are both parallel and perpendicular to the long axis of the rectangular plots. It is expected that when species are distributed homogenously or when species follow environmental gradients parallel to the long axis of the rectangular sample plot, then rectangular plots will exhibit greater richness. Reports of greater species richness from elongated rectangular strips are not fair comparisons with squares because of the dramatically different periphery/area ratio, which includes a greater proportion of species using both above and belowground space outside the sample area.

## USING SEEDLING DISTRIBUTION IN DIFFERENT DISTURBANCE STAGES IN KAKAMEGA FOREST, WEST KENYA AS MEANS FOR THE CHARACTERIZATION OF REGENERATION STRATEGIES

KIEFER, S.<sup>1</sup> and BUSSMANN, R. W.<sup>2</sup>

<sup>1</sup> *University of Bayreuth, Department of Plantphysiology, Universitaetsstrasse 30, 95440 Bayreuth, Germany*<sup>2</sup> *University of Hawai'i at Manoa, Lyon Arboretum, 3860 Manoa Road, Honolulu, Hawaii 96822-1180*

**Abstract:** The extension of the gap phase regeneration sensu WHITMORE (1989) by the dendrocentric approach of LIEBERMAN ET AL (1989) allowed a new perception of regeneration strategies. We conducted a survey of tree offspring to identify the strategies of regeneration, under particular consideration of disturbances. The survey was conducted by circular frequency analysis. The Plots were arranged around specific trees as well as on gaps. Taking the paradigms of gap phase regeneration by WHITMORE (1989) and the dendrocentric approach by LIEBERMAN ET AL (1989) into account, the trees and also the gaps were selected as representatives for certain succession stages. A seed survey contributed data for the seed intake under certain trees. Transect frequency analysis was carried out for a structural characterization of the forest, supported by point quarter sampling and stand profile diagrams.

The seedling structure records showed the applicability of both the paradigms mentioned, and lead to the identification of the regeneration strategies. The dendrocentric approach leads to the general assumption, that the best parameter for characterization of regeneration conditions is the light (or shadow) availability.

## **THE ROLE OF POLYNESIANS IN HAWAIIAN ECODYNAMICS, A.D. 800-1800**

KIRCH, P. V.

*University of California, Berkeley, CA 94720. [kirch@sscl.berkeley.edu](mailto:kirch@sscl.berkeley.edu)*

**Abstract:** Polynesian colonization of the Hawaiian Islands, occurring by A.D. 800, was the first significant event to break the barrier of isolation which had been key to the evolution of a highly endemic terrestrial biota. The Polynesian voyagers introduced a variety of crops, economically useful plants, and domestic animals, along with a number of other inadvertently-introduced species. Over the following 1,000 years, as the Polynesian population grew to an estimated 400-500,000 persons, and agricultural fields and settlements expanded correspondingly, a significant portion of the archipelago was converted from a pristine natural ecosystem to a highly managed anthropogenic landscape. Over the past several decades, archaeological research (close collaboration with paleoecological research) has begun to define the chronology and sequence of this major phase of Polynesian modification of the Hawaiian ecosystem. This paper summarizes the results of such research, and assesses the role of human ecodynamics in changing the Hawaiian ecosystem prior to the advent of Europeans.

## RESTORATION OF SPECIES-RICH GRASSLANDS IN A CULTURAL LANDSCAPE USING A TRANSFER OF MEADOW BLOCKS

KLIMES, L.

*Institute of Botany, Section of Plant Ecology, CZ-379 01 Trebon, Czech Republic  
(klimes@butbn.cas.cz)*

**Abstract:** Meadows in the Bile Karpaty Mountains, Czech Republic, developed in the course of several centuries under a regular disturbance regime of mowing. Due to a lack of regular management during last three decades some meadows were abandoned or converted into arable land. However, in the 90s a reverse process started. Unfortunately, these restoration was not always successful due to a limited dispersal of meadow plants. To promote and speed up species accumulation I transferred 25 meadow blocks, 0.16 m<sup>2</sup> in size each and 30 cm deep, from a species rich meadow to an experimental plot situated in a fallow land. After three years several meadow species spread out of the transferred blocks whereas few plants invaded them. In contrast to similar experiments carried out in mesic and wet conditions, the transferred blocks were not overgrown by weeds. The significantly higher species richness in the transferred blocks ( $P < 0.001$ ), in comparisons with the surroundings, persisted during the experiment. However, extinction rate in the blocks was higher than immigration rate in the surroundings ( $P < 0.01$ ). Small and rare plants did not spread out of the transferred blocks and disappeared from them with a higher probability than large and abundant species ( $P < 0.05$ ). This implies that for small and rare plants the applied method is not appropriate.

## THE FLORA AND VEGETATION OF URBAN AREAS: A REVIEW

KLOTZ, S., KUEHN, I.

*UFZ – Centre for Environmental Research Leipzig-Halle, Dept. Community Ecology,  
Theodor-Lieser-Str. 4, 06120 Halle, Germany ([stefan.klotz@ufz.de](mailto:stefan.klotz@ufz.de))*

**Abstract:** Nearly half of the world's population lives in urban areas. The accumulation of people, their economy, gardening activities etc. have a large impact on plant life. The influence of urbanization on the flora is a relatively new subject. A search of Web of Science™ in March 2004 for the terms: urban flora and urban vegetation for the last five years produced 32 records only. In previous years this number was significant lower. But the number of records in local journals is much higher.

We analyzed the history of botanical research in urban areas within the last 125 years. Methods used in the study of flora and vegetation are evaluated. We demonstrate the different approaches and characterize the change in the general subjects. Geographical hot spots of case studies are characterized and compared, showing different attempts. Further investigations should focus on history of urbanization, differences in the urbanization processes in different parts of the world, the differences of urban land use and vegetation management and the relationships between urban floras and species pools. The growing number of case studies and data can be used for new analysis of urban plant biodiversity to get more general results.

## THE LEDA TRAITBASE – A DATABASE ON LIFE HISTORY TRAITS OF PLANTS

KNEVEL, I.C.<sup>1,2</sup>, BEKKER, R.M.<sup>1</sup>

<sup>1</sup>Community and Conservation Ecology Group, University of Groningen, PO Box 14, NL-9750AA Haren, NL; <sup>2</sup>Landscape Ecology Group, Carl von Ossietzky University, PO Box 2503, D-26111, Oldenburg, DE. ([I.C.Knevel@biol.rug.nl](mailto:I.C.Knevel@biol.rug.nl))

**Abstract:** The effort to build databases on plant characteristics (or plant traits) is currently growing fast, however only few are relatively comprehensive as most sources are too regional or of heterogeneous nature. To pool the transnational expertise and to predict plant biodiversity in changing landscapes, the life-history database project LEDA was started in 2002. This database focuses on plant traits that describe three key features of plant dynamics (persistence, regeneration, and dispersability) of the Northwest European flora. The Traitbase can be used as a tool in planning, nature conservation and restoration, as well as in other applied research concerning climate change and also ecoinformatics. The internet-based LEDA Traitbase uses a user-friendly data interface and includes data mining and retrieval techniques for aggregation of extracted data. With case studies on various ecological scales the Traitbase will be tested and this will be realized through a species-trait matrix, comprised from referenced information under control of an editorial board. The Traitbase is built by combining existing information (databases, literature) and additional measurements, the latter based on firm protocols and data standards, developed by the LEDA consortium.

Currently 35% of the species-trait matrix has been filled; however, as LEDA aims to deliver a open www-based database as complete as possible, all input from the scientific community is welcome. E-networking will be established to encourage the user community to continuously update and add to the database during and after the project.

## **STAND STRUCTURE AND SPECIES DIVERSITY IN SECONDARY FORESTS INVADED BY GIANT BAMBOOS (*PHYLLOSTACHYS* SPP.) AT SHIKOKU ISLAND, WESTERN JAPAN**

KOBAYASHI, T. and KOUKI, A.

*Faculty of Agriculture, Kagawa University, Miki 761-0795, Japan. \*E-mail: t-koba@ag.kagawa-u.ac.jp*

**Abstract:** In the Seto-Inland Sea area, western Japan, secondary forests of Japanese red pine (*Pinus densiflora*, a typical pioneer coniferous tree) have been developed for the last century. However, interruption of management and pine wilt diseases have caused declines of pine forests during the last few decades. Recently, giant bamboos (e.g. native *Phyllostachys bambusoides* and naturalized *P. pubescens* from China, which are both clonal evergreen plants) often invade and then dominate such forest ecosystems.

Several studies have demonstrated that rapid clonal formation and height growth of bamboo shoots enable bamboo to invade new areas. The dense bamboo shoots reduce the light incidence in the stands and shade other plants, resulting in depressed species diversity. In the present study, we surveyed the trunk size structure of secondary forests dominated by bamboo and discuss the potential transitional processes of bamboo stands into other stands at Kagawa prefecture on the Seto-Inland Sea side of Shikoku Island.

The stands dominated by bamboo have very simple structures. However, they always include the 'Oskers' (stunted juveniles) of shade-tolerant evergreen oak (*Quercus glauca*), which is a potential dominant species of climax vegetation in this area. This suggests that bamboo stands will change into stands of broad-leaved trees in the future. Selective removal of bamboo shoots from the stands dramatically ameliorated light conditions in the stands. We propose that appropriate management of bamboo can promote the shift of stands into the 'natural' vegetation.

## RECRUITMENT VERSUS MAXIMUM SIZE TRADEOFF WITHIN RAINFOREST TREE COMMUNITY

KOHYAMA, T.<sup>1</sup>, KUBO, T.<sup>1</sup>, POTTS, M.D.<sup>2</sup>, and ASHTON, P.S.<sup>3</sup>

<sup>1</sup>Hokkaido University, Japan; <sup>2</sup>University of California, San Diego, CA, USA; <sup>3</sup>Harvard University, Cambridge, MA, USA. □ ([kohyama@ees.hokudai.ac.jp](mailto:kohyama@ees.hokudai.ac.jp))

**Abstract:** It is an important decision for rainforest trees how to exploit their niche along persistently, vertically developed canopy architecture. Theoretical consideration suggests that tree species with a low adult stature need to have higher recruitment capacity compared to species growing up to upper canopy. This tradeoff relationship between upper height and recruitment capacity has been observed for abundant species in warm-temperate rain forests in southern Japan, and in lowland mixed dipterocarp forests in western Borneo. These results provides, however, not strong evidence, because there is a common tendency that basal area density of species is higher for taller species among abundants, and because species' recruitment capacity is defined by the per-land-area species recruitment rate divided by species basal area. We examined this relationship for the 50-ha permanent plot of Pasoh Nature Reserve. All species  $> 50$  trees ( $> 1$  tree/ha), accounted for 467 spp., were estimated for recruitment rate at 2-cm diameter at breast height (dbh), and maximum dbh as upper 95-percentile of dbh distribution. The tradeoff relationship was obvious, and that was independent of the possible explanation that basal-area is large for large species. We detected that less abundant species had lower recruitment rate, which suggests that species abundance can be explained by the recruitment capacity.



## RESTORATION OF NEW ALLUVIAL LANDSCAPES IN NORTHWESTERN GERMANY

KRATOCHWIL, A.<sup>1</sup>, STROH, M.<sup>2</sup>, REMY, D.<sup>1</sup> and SCHWABE, A.<sup>2</sup>

<sup>1</sup>University of Osnabrück, D-49069 Osnabrück, Germany; <sup>2</sup>Darmstadt University of Technology, D-64287 Darmstadt, Germany (kratochwil@biologie.uni-osnabrueck.de)

**Abstract:** In the north-western German lowland riverine habitats often are under intensive agricultural management. As part of a project it was possible to restore an alluvial landscape characterized by pioneer stands, wetlands and inland sand dune complexes on a formerly intensively managed maize field area. In order to create a dynamic system with high biodiversity the concept also includes winter floods and extensive grazing. In a pilot study we examined the restoration of target communities by inoculation with mown, raked material or sods and the impact of special grazing systems. Under extensive grazing, site-typical plant communities should develop from remnants of populations, from the persistent seed bank, from transferred diaspores or immigrate from the surrounding areas. In October 2001 the wetland-dune complex in the river Ems region (70 ha) was modelled. After having finished the restoration measures we established a raster-based permanent plot system which covers all habitat types of the riverine stands, a system which has also been built up in target landscapes serving as references. Additionally an enclosure system was established in target and restored areas to investigate the influence of the grazing cattle. This was combined with CIR-Aerial Pictures (pixel size 7 cm) to study the dynamics of the vegetation pattern. DCA diagrams of the analyzed plots in target and restored areas show a first success.

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## EPIPHYTE DIVERSITY ALONG ELEVATIONAL AND DISTURBANCE GRADIENTS IN THE ANDES OF BOLIVIA

KRÖMER, THORSTEN<sup>1</sup>, GRADSTEIN, S. ROBBERT<sup>1</sup> and ACEBEY, AMPARO<sup>2</sup>

<sup>1</sup>*Institute of Plant Sciences, University of Göttingen, Untere Karspüle 2, 37073 Göttingen, Germany;* <sup>2</sup>*Herbario Nacional de Bolivia, Casilla 10077, La Paz, Bolivia.*  
([tkroeme@gwdg.de](mailto:tkroeme@gwdg.de))

**Abstract:** This study for the first time analyses hypsometric changes in total vascular epiphyte diversity in tropical mountains based on inventories of 1.0 hectare plots sampled at  $\pm 300$  m intervals between 300-2200 m in the Andes of La Paz, Bolivia. More than 500 species of epiphytes, in 25 families and 113 genera, were recorded and very high alpha- and beta-diversity values were obtained. Alpha-diversity increased linearly from Andean foothill (89 ssp.) over submontane (101-125 ssp.) to mid-montane forest, peaked at ca. 1600 m (175 ssp.), ranking among the highest nrs. in the world in terms of epiphyte diversity), and then gradually decreased to ca. 150 ssp. Orchids were the most important family in terms of species number, followed by ferns. Fern diversity relative to orchids, however, was unusually high, much higher than recorded elsewhere. Aroids, bromeliads, piperoids and other groups contribute less than 10% each, except for aroids at 300 m (21%). A comparison of epiphyte diversity in primary and secondary vegetation indicated major losses of epiphytic diversity after deforestation. Species numbers of orchids, bromeliads, Hymenophyllaceae, and Grammitidaceae were much lower in fallows than in primary forest, but were not reduced for hemiepiphytic aroids, Polypodiaceae, and Aspleniaceae. Reduction of epiphytic species diversity in fallows may be explained by structural characteristics of the fallow trees, the lack of a dense moss cover, and the drier microclimate in the fallows.

## THE FLORA OF CITIES IS NATURALLY SPECIES RICH

KUEHN, I.<sup>1</sup>, BRANDL, R.<sup>2</sup>, KLOTZ, S.<sup>1</sup>

<sup>1</sup>UFZ – Centre for Environmental Research Leipzig-Halle, Dept. Community Ecology, Theodor-Lieser-Str. 4, 06120 Halle, Germany (ingolf.kuehn@ufz.de); <sup>2</sup>University of Marburg, Dept. General and Animal Ecology, Karl-von-Frisch-Str., 35032 Marburg, Germany

**Abstract:** For over 20 years it is documented from several regions of the world and for several spatial scales that cities harbor more plant species than their surroundings. It has been argued that the higher number of plant species is usually caused by a high number of alien plants promoted by human influence. We analyzed native and naturalized alien species in Germany from a comprehensive mapping database comparing 68 city and 1856 non-city grid cells (10 minutes latitude x 6 minutes longitude). By using resampling techniques of comparison and Analysis of Covariance (ANCOVA), we will show that species richness not only of alien species but also of native species is significantly higher within city grid cells than outwith. We furthermore will demonstrate that geological heterogeneity is the most important environmental correlate with species richness and that cities are not randomly located but in areas of high geological heterogeneity. Alien species are promoted additionally by human land use. We argue that cities are located in natural hot-spots of plant species diversity and that this diversity is maintained albeit of possible adverse human influence. Therefore, conservation of species diversity should take the species richness of cities into account.

## AGE AND SPATIAL DISPERSION STRUCTURES OF EVERGREEN PERENNIAL FERN DICRANOPTERIS LINEARIS (GLEICHENIACEAE)

KURODA, A., MUKAI, S., TOYOHARA, G.

Miyajima Natural Botanical Garden, Graduate School of Science, Hiroshima University,  
Hiroshima 739-0543, Japan ([asumo@hiroshima-u.ac.jp](mailto:asumo@hiroshima-u.ac.jp))

**Abstract:** A mat-forming evergreen perennial fern *Dicranopteris linearis* (Gleicheniaceae) frequently form monospecific stands on disturbed sites. For a better understanding of its regeneration process, we investigated the age and spatial dispersion structures of *Dicranopteris linearis* in a 2 m × 2 m area within the fern stand of Miyajima Island, SW Japan. The age of each *Dicranopteris linearis* leaf was estimated by counting the number of segments in its main rachis, each of which was defined as the part of main rachis derived from single bud. Using Morishita's index of dispersion, the spatial dispersion structure of each of *Dicranopteris linearis* leaves categorized according to the number of segments was analyzed at 400 cm<sup>2</sup>, 1,600 cm<sup>2</sup>, and 10,000 cm<sup>2</sup> grid sizes. The number of segments in a total of 530 *Dicranopteris linearis* leaves examined ranged between one and five. The leaves with only one segment were most abundant among the leaves, suggesting that *Dicranopteris linearis* yearly produced many new leaves so as to compensate for the mortality of the senescent leaves. Most  $I_{\delta}$  values for each of *Dicranopteris linearis* leaves categorized according to the number of segments were approximately unity at given grid sizes, indicating that each of them was not contagiously but randomly distributed over the area examined. It was inferred that *Dicranopteris linearis* thickets steadily regenerated without producing spatial space enough for other species to invade.

## FACTORS EXPLAINING PLANT DEFENSIVE INVESTMENTS IN TROPICAL RAIN FORESTS IN BORNEO

KUROKAWA, H.<sup>1</sup>, NAGAMASU, H.<sup>2</sup> and NAKASHIZUKA, T.<sup>3</sup>

<sup>1</sup>*Center for Ecological Research, Kyoto University, Otsu, Shiga, Japan;* <sup>2</sup>*The Kyoto University Museum, Kyoto 606-8501, Japan;* <sup>3</sup>*Research Institute for Humanity and Nature, Kyoto 602-0878, Japan. ([hiro@ecology.kyoto-u.ac.jp](mailto:hiro@ecology.kyoto-u.ac.jp))*

**Abstract:** Factors determining the defensive characteristics of tree communities can involve species composition, the developmental stages of communities, and soil nutrient availability. In this paper, we examined, in Bornean tropical rain forests, what factors explain the differences of plant defensive investments as manifested in the production of foliar phenolic compounds. We found that the concentrations of foliar phenolic compounds of forest communities was correlated significantly with soil nutrient availability, but insignificantly with forest development or forest composition at family level, suggesting that soil nutrients determine forest compositions at species level, resulting in the different concentrations of foliar phenolic compounds among communities. The concentrations of foliar total phenolics were higher in sites with low nutrient availability than in those with high nutrient availability. The concentrations of foliar condensed tannins showed a similar, but statistically insignificant, trend. On the other hand, foliar lignin concentrations showed an opposite trend being higher in sites with high nutrient availability. These different responses to nutrient availability among foliar phenolic compounds might reflect that total phenolics and condensed tannins are used specifically as anti-herbivore defenses in nutrient poor conditions, but lignins serve not only as defensive substances but also as important structural substances to which plants increase their investments in nutrient rich conditions. The different responses of total phenolics and lignins to nutrient availability suggest their different roles in ecosystem functionings, such as the feedback of nutrient cycling.

## **NATURAL DISTURBANCE DYNAMICS OF BOREAL FORESTS IN FINLAND: NEW FINDINGS AND IMPLICATIONS FOR MANAGEMENT**

KUULUVAINEN, T., LARJAVAARA, M., PENNANEN, J. and WALLENIOUS, T.

*Department of Forest Ecology, P.O. Box 27, FIN-00014 University of Helsinki, Finland.*  
[Timo.Kuuluvainen@helsinki.fi](mailto:Timo.Kuuluvainen@helsinki.fi)

**Abstract:** New research results are revising many long-held beliefs about the ecology of the natural boreal forest and imposing a need for change in forest management to achieve ecological sustainability. In Finland the utilization of forests has been and continues to be intensive. Silvicultural treatments such as planting and thinning are widely used to create homogeneous even-aged stands. The dominant harvesting method is clear-cutting, currently with retention trees left in groups. The cutting rotation is ca. 100 years which has traditionally been considered to represent the natural fire cycle. Our results suggest that natural fire rotations have varied notably within the country and have especially in the north been longer than hitherto assumed, up to several hundreds years. In pine dominated forests the fire regimes have been characterized by mixed severity fires, where total stand-replacement seldom occurs. In spruce forest, where fires occur less frequently, stand-replacement has been more common. In general, secondary disturbances in the form of mortality of individual trees and small groups of trees due to various causes plays a significant role in the natural forest dynamics. Our results point out that restoring and maintaining some of the natural forest structures at multiple scales require a shift from clear-cutting to a range of partial harvesting methods, inspired by the variability of natural tree mortality patterns, which better maintain structural features important for biodiversity than current management methods.

## SPATIALLY ANALYSING GENETIC AND TAXONOMIC VARIABILITY AT REGIONAL AND CONTINENTAL SCALES

LAFFAN, S. W.<sup>1</sup>, BICKFORD, S.<sup>2</sup>

<sup>1</sup>University of New South Wales, Sydney, Australia, 2052; <sup>2</sup>CSIRO Centre for Plant Biodiversity Research, CSIRO Plant Industry, GPO Box 1600 Canberra ACT 2601 Australia.  
[Shawn.Laffan@unsw.edu.au](mailto:Shawn.Laffan@unsw.edu.au)

**Abstract:** The aim of this research is to develop methods for the spatial analysis of genetic and taxonomic diversity at regional and continental scales. Such analyses are important tools for conservation and for understanding evolutionary histories.

There is an enormous wealth of available museum data (e.g. herbaria) which provide information about the spatial distribution of species. However, these data are recorded using taxonomic systems. While useful in their own right, taxonomies have some limitations when analysing diversity. Analyses of taxonomic similarity treat each species as being equally similar, when clearly they are not. This is likely to conceal important patterns of diversity. Taxonomies are also constantly being revised, so any analyses of taxonomic diversity need to be reconsidered after each revision. The recent explosion of genetic data provides an opportunity to assess diversity at a lower level than the taxonomic. Genetic similarity between species is readily coupled with museum records to elucidate new patterns of diversity. While this approach does not remove the effect of taxonomy, it can soften its effects by providing a weighting scheme between species.

We demonstrate the approach using eastern Australian species from the *Pultenaea* genus, using them to aid in the interpretation of evolutionary histories.

## **COMMUNITY ECOLOGY OF XERIC LIMESTONE PRAIRIES IN KENTUCKY: SCALE-DEPENDENCE AND SPECIES-AREA RELATIONSHIPS**

LAWLESS, P., BASKIN, J. and BASKIN, C.

*University of Kentucky, Lexington, KY, USA. ([pjlawl2@uky.edu](mailto:pjlawl2@uky.edu))*

**Abstract:** Xeric limestone prairies are widely distributed in the deciduous forest biome of eastern North America and are characterized by shallow rocky soils, rock outcrops and dominance of C<sub>4</sub> perennial prairie grasses. Despite the rarity of xeric limestone prairies (XLP's) in Kentucky and the occurrence of 25 state-listed taxa in this habitat, no quantitative vegetation analyses of these grasslands have been conducted to determine variability in community composition and structure. The primary objective of this study was to identify and characterize XLP community types at multiple spatial scales and to determine their physiographic distribution and conservation status. Eighteen XLP's in five physiographic regions were sampled using a nested quadrat sampling design. Species presence values were determined at five spatial scales and species cover estimated in the largest quadrat (100 m<sup>2</sup>). Ward's method was used to identify and characterize clusters (i.e. community types) over the range of scales sampled. Fifteen community types were identified at the 100 m<sup>2</sup> scale, and four of those 15 currently are not protected. Further, species-area relationships were assessed with both convex and sigmoid models, and the latter determined the best descriptor in all sample sites and community types.



## INTERPRETING VEGETATION DYNAMICS WITH POLLEN DATA FROM DISTURBED AND UNDISTURBED SITES IN NEW ZEALAND

LI, X.<sup>1</sup>, and RAPSON, G.L.<sup>2</sup>

<sup>1</sup>*School of People, Environment and Planning, and* <sup>2</sup>*Ecology Group, Institute of Natural Resources, Massey University, Palmerston North, New Zealand. (G.Rapson@massey.ac.nz)*

**Abstract:** The importance of non-equilibrium dynamics in vegetation is often stressed. Here two contrasting sites, stable and unstable, were examined to compare their dynamics. Pollen profiles were constructed from cores at each of the sites, representing up to 7500 years of vegetation change, and the data examined by ordination and autocorrelation analysis.

Both cores show comparable rates of floristic change over time, though the more disturbed site exhibits perturbations in response to disturbance events such as fire, but is largely unaffected by tephra deposition. The stable site shows a long-term trend in vegetation over time, while the unstable site shows chaotic change, but much less vegetation variation over time. Autocorrelation indicates the unstable site is usually undergoing successional processes, while the stable site exhibits a long-term trend.

Despite appearances, non-equilibrium dynamics characterise both sites, although the stable site is responsive to subtle climate changes, while this trend at the unstable site is frequently disrupted by catastrophic disturbances, which reset successions.

## AN INVASIVE GRASS SPECIES AFFECTS CARBON CYCLING IN HAWAIIAN DRY FOREST

LITTON, C.M.<sup>1,2</sup>, SANDQUIST, D.R.<sup>1</sup> and CORDELL, S.<sup>2</sup>

<sup>1</sup>California State University Fullerton, Fullerton, CA, USA; <sup>2</sup>USDA Forest Service, Institute of Pacific Islands Forestry, Hilo, HI, USA. (clitton@fullerton.edu)

**Abstract:** At lower elevations on the leeward side of Hawai'i, remnant native forests are heavily invaded by fountain grass (*Pennisetum setaceum*). Our research is designed to determine the consequences of this invasion for carbon (C) cycling in Hawaiian dry forest. We examined above- and belowground C pools and fluxes in 400 m<sup>2</sup> replicated plots with and without fountain grass ( $n = 4$ ). C pools in live biomass were estimated with direct sampling and allometric equations developed *in situ* for dominant tree species. Aboveground net primary productivity (ANPP) was estimated as aboveground biomass increment plus fine litterfall, and total belowground carbon allocation (TBCA) was estimated using a mass balance approach. Our results indicate that the presence of an invasive grass has considerable impacts on C fluxes. Notably, tree foliage NPP was significantly higher (62%) in grass removal plots ( $P = 0.04$ ). However, total foliar NPP (Tree+Grass NPP) did not differ with treatments ( $P = 0.15$ ). Removal of grass also resulted in a 42% increase in aboveground basal area increment (i.e., wood production) for native trees. Belowground, grass plots exhibited significantly higher values (30%) of TBCA ( $P = 0.04$ ). These difference in above- and belowground C pools and fluxes are particularly important in light of the ubiquitous presence of invasive species in most terrestrial ecosystems and the need for a better understanding of the role that they will play in global climate change.

## UNDERSTORY SUCCESSION FOLLOWING EXPERIMENTAL REMOVAL OF INVASIVE MORELLA FAYA STANDS IN A HAWAIIAN RAIN FOREST

LOH, R.K.<sup>1,2</sup>, DAEHLER, C.C.<sup>1</sup>, TUNISON, J.T.<sup>2</sup>

<sup>1</sup>University of Hawaii, Manoa, HI, USA; <sup>2</sup>USDI National Park Service, Hawaii Volcanoes National Park, HI 96718. ([rhonda\\_loh@nps.gov](mailto:rhonda_loh@nps.gov))

**Abstract:** Restoring Hawaiian rain forest displaced by invasive *Morella faya* presents a daunting challenge to conservation managers. In Summer 1999, we began experiments to remove *M. faya* stands in thirty 30x30 m plots located in two sites using three methods and measured the microclimate, extractable soil nitrogen, seed rain, soil seed bank and understory vegetation in treated stands for three years. The environments created by the different removal methods modified patterns of plant establishment. Rapid tree kill caused by logging+herbicide (log) resulted in instantaneous opening of the forest canopy followed by rapid invasion of alien shrub and herbaceous species. Intermediate (girdle) and slow (incremental girdle) tree kill caused by herbicide application to girdled trunks at different rates resulted in slow canopy defoliation followed by slower rates of alien species establishment. Plant establishment was chiefly by a handful of species that had formed a small, persistent soil seed bank that was able to express itself upon removal of *M. faya*. Once established, individuals grew quickly, reproduced and dramatically increased the seed supply, thus dominating the early stages of plant colonization. There was a strong positive association between light availability and alien plant establishment. The partial shade environments created by girdle and incremental girdle treatments facilitated some native tree and fern establishment. Future monitoring will determine whether alien species will continue to dominate plots or eventually be replaced by native forest species.

## **EFFECTS OF NON-INDIGENOUS GRASSES ON *SOPHORA CHRYSOPHYLLA* FOREST ON MAUNA KEA**

Longbrake, A.C.W.

*Washington & Jefferson College, Washington, PA, 15301, USA ([longbrake@washjeff.edu](mailto:longbrake@washjeff.edu))*

**Abstract:** Many non-indigenous grasses have been introduced into the Hawaiian Islands for animal grazing. Once established, these grasses can find very suitable niches in areas outside of agricultural use. The purpose of this study was to determine the pattern of non-indigenous grass abundance in the *Sophora chrysophylla* (Mamane) forest ecosystem and assess the impact of these grasses on the native tree. The *Sophora chrysophylla* forest on Mauna Kea is an important sanctuary for endemic bird species, specifically *Loxioides bailleui* (Palila) that almost exclusively use its seeds for food and the forest trees for shelter. Non-indigenous grass species tend to be found in the understory of *S. chrysophylla* trees. Since trees are nitrogen fixing, the understory is rich in nitrogen. The area away from trees seems to be a sanctuary for native grasses while there is little grazing pressure. Unfortunately, not only is there greater abundance of non-native grasses in the tree understory, but this is also a site where more *S. chrysophylla* seedlings are found. Competition with non-indigenous grasses reduces recruitment of tree seedlings. However, surveys in 1993 showed slow but steady recruitment of *S. chrysophylla* despite the presence and abundance of non-indigenous grasses. An update of the state of the *S. chrysophylla* forest, *S. chrysophylla* recruitment, and non-indigenous grass abundance will be provided.

## **BURNED AREA MAPPING USING LANDSAT TM DATA AND ASSESSMENT OF THE ASSOCIATED LANDSCAPE CHANGE IN THREE SPANISH NATURAL PARKS**

LOZANO, J.<sup>1</sup>, SUAREZ-SEOANE, S.<sup>1</sup>, LUIS, E.<sup>1</sup>

<sup>1</sup>Area de Ecología, Universidad de León, León, Spain. [degelc@unileon.es](mailto:degelc@unileon.es).

**Abstract:** Wildfire events are one of the most important environmental problems in Spain and the Mediterranean Basin. The study area is comprised by three natural parks with different natural and socioeconomic characteristics located along a climatic gradient. Objectives include the use of remote sensing for burned areas mapping and evaluation of relationship between landscape change and natural, climatic and socioeconomic characteristics of the natural parks. We produced burned area cartography for the period 1991-2002 using Landsat TM data, testing several methodologies: vegetation indexes, band subtraction, burned areas algorithms and logistic regression. Results were validated with field data and then integrated into a database GIS in a topologically structured vector format in order to consult several environmental and spatial parameters inherent to each fire.

Several landscape indexes were calculated focusing in detecting change after fire taking into account fire recurrence. Two different scales (local and regional) were used in the assessment. Spatial heterogeneity was found to increase in all the areas, but following different patterns and calculated indexes differed when changing scale. Socioeconomic features were found as the most important factor affecting fire regimes and land organization scheme when concerning spatial patterns created by the wild fires.

## **VEGETATION ON NATURAL AND ANTHROPOGENIC LANDSLIDES AT THE EASTERN PART OF PODOCARPUS NATIONAL PARK**

LOZANO, P. and BUSSMAN, R.

*University of Bayreuth, Department of Plant Physiology, Bayreuth, Germany.  
([pablo\\_lozano@hotmail.com](mailto:pablo_lozano@hotmail.com))*

**Abstract:** Plant recovery after perturbations has few tradition research on Andes, this topic has been studied as an important roll at plant ecology environment, keeping biodiversity. Natural and anthropogenic landslides produce serious and continuous damage on Ecuadorian Andes, they are influenced by a series of factors like pendent, soil type, earthquake and principally roads building. Preliminary data exist from Podocarpus National Park, were natural landslides have been selected among 1900 to 2800 masl, (80 plots), taking account the altitudinal range for plots distribution, here the high percentage of landslides was found among 2200 to 2400 mals, while anthropogenic landslides was studied using perturbation by roads, among 1900 masl to 2800 m. (123 plots), Specialist families are Asteraceae, Gleicheniaceae, Poaceae, Lycopodiaceae, Melastomataceae and Ericaceae among others, no difference between antropogenic and natural landslide pioneer vegetation was found but structure and gradient has more influence. Plant diversity before landslides (18 plots), found this area as extremely rich, with high endemism.

## RELATIONSHIPS OF ALIEN PLANT SPECIES ABUNDANCE TO RIPARIAN VEGETATION, ENVIRONMENT, AND DISTURBANCE

MAGEE, T.<sup>1</sup>, RINGOLD, P.<sup>2</sup>, and BOLLMAN, M.<sup>1</sup>

<sup>1</sup>Dynamac Corporation, Corvallis, Oregon 97333, USA; <sup>2</sup>U.S. Environmental Protection Agency, Corvallis, Oregon 97333, USA. ([magee.teresa@epa.gov](mailto:magee.teresa@epa.gov))

**Abstract:** Riparian ecosystems are often invaded by alien species. We evaluated vegetation, environment, and disturbance conditions and their interrelationships with alien species abundance along reaches of 29 streams in eastern Oregon, USA. Using flexible-beta clustering, indicator species analysis, and non-metric multidimensional scaling (NMS), we characterized four vegetation series (Lodgepole pine/shrub/meadow, Engelmann spruce-Grand-fir-Douglas-fir, Ponderosa pine/Snowberry, Sagebrush/Juniper/Cheatgrass-Bluebunch wheatgrass) and their assemblages. Correlation of environmental (n = 31) and disturbance (n = 31) variables with NMS axis scores showed vegetation distributed along complex gradients associated with elevation, precipitation, landform, watershed area, disturbance, grazing, and buffer condition. Comparing NMS for native species only and for all species demonstrated homogenization of species composition with addition of alien species. Differences in alien cover were observed between vegetation types (Kruskal-Wallis, p # 0.000). Spearman correlations (p # 0.006) identified negative relationships between alien cover and elevation, precipitation, tree basal area, distance to road, buffer condition, and native species diversity, while positive relationships occurred with watershed area, disturbance, agriculture, and grazing. Differences in species composition and native diversity illustrate negative effects associated with alien cover. The vegetation types vary in intensity of invasion. Environmental and disturbance metrics may serve as predictors of potential invasion intensity.

## ADVANCE OF TREE SPECIES INTO ALPINE TUNDRA

MALANSON, G.P.<sup>1</sup>, BROWN, D.G.<sup>2</sup>, BUTLER, D.R.<sup>3</sup>, CAIRNS, D.M.<sup>4</sup>, FAGRE, D.F.<sup>5</sup>, and WALSH, S.J.<sup>6</sup>

<sup>1</sup>University of Iowa; <sup>2</sup>University of Michigan; <sup>3</sup>Texas State University; <sup>4</sup>Texas A&M University; <sup>5</sup>USGS; <sup>6</sup>University of North Carolina ([george-malanson@uiowa.edu](mailto:george-malanson@uiowa.edu))

**Abstract:** To examine the invasion of alpine tundra by trees we take a plant's-eye-view at the seed and seedling stages.

At the seed stage barriers include landing on an impenetrable surface or snow. Many tundra sites are underlain by active or relict solifluction, and data show that these sites present opportunities for the exposure of fine soil through turf exfoliation on tread-riser boundaries.

At the seedling stage negative feedback, in the form of shading and lower soil temperatures may be crucial to the development of upright trees, but it cannot explain the invasion of tundra by seedlings because they do not cast enough shade. Instead, positive feedbacks in which snow plays a role, later joined by more spatially limited negative feedbacks, operate.

In Glacier National Park, MT, tree rings show a nonlinear relation to snow and the Pacific Decadal Oscillation. A simulation with negative and positive feedbacks with neighboring trees produces an advance of trees in which the rates correlate with a fractal spatial pattern, not climatic change. Tree advances into tundra will be related to climatic change nonlinearly. Geomorphic conditions, themselves subject to change, may be tipping points.



## **VEGETATION CHANGES IN THE LANDSCAPE OF THE TEIDE NATIONAL PARK IN THE LAST 50 YEARS USING A GEBOTANIC INFORMATION SYSTEM (G.I.S.)**

MARTÍN OSORIO, V. E., WILDPRET DE LA TORRE, W. HERNÁNDEZ BOLAÑOS, B. and SÁNCHEZ-PINTO GONZÁLEZ, I.  
*Universidad de La Laguna, Avda. Astrofísico Francisco Sánchez s/n, La Laguna, 38271 Tenerife, Islas Canarias, Spain. ([vemartin@ull.es](mailto:vemartin@ull.es))*

**Abstract:** We present an analysis of the changes that have taken place in the vegetation landscape of the Teide National Park, Canary Islands, Spain, since it was declared a protected area 50 years ago. Graphic and bibliographical references of the area from the past 300 years were recompiled and a Geobotanic Information System was used for photo-interpreting, orthophoto-interpreting and analysing the vegetation.

A new vascular flora catalogue was developed together with an updated cartography -using the Geobotanic Information System- of the Vegetation Series that make up the vegetation landscape of the National Park.

The results reveal that the floristic catalogue has augmented by a considerable number of species. Populations of some taxons that were considered as endangered have increased significantly. However, some species are still receding considerably due to the predating herbivores that have been introduced in the National Park in recent years. A syntaxonomic schema of the vegetation units within the Park was created and the new phytosociologic communities were typified.

## RETROSPECTIVE ANALYSIS OF FUEL TREATMENT PERFORMANCE UNDER EXTREME WILDFIRE CONDITIONS

MARTINSON, E.<sup>1</sup>, OMI1, P. POLLET, J.<sup>2</sup>, WHITE-HAT, E.<sup>1</sup>, and CHONG, G.<sup>3</sup>.

<sup>1</sup>Colorado State University, Fort Collins, CO, USA; <sup>2</sup>USDI Bureau of Land Management, Salt Lake City, UT, USA; <sup>3</sup>USDI Geological Survey, Fort Collins, CO, USA. [erikm@cnr.colostate.edu](mailto:erikm@cnr.colostate.edu)

**Abstract:** Federal land management agencies have greatly expanded fuel treatment programs in response to increased public attention on wildfire hazards. Though treatments to mitigate fuel accumulation and fire hazard have long been advocated, the effectiveness of these activities has received surprisingly little scientific inquiry. We sampled 9 recent wildfires that burned over fuel treatment areas and evaluated fire severity with standardized methods in adjacent treated and untreated stands. Sampled sites occurred in a variety of dry conifer forests throughout the western continental US. Treatments included reduction of surface fuels and crown fuels, both in isolation and in combination. Our results indicate that fuel treatments generally reduce both canopy damage (t-test p-values range from <0.0001 to 0.0636 with median 0.0012) and depth of ground char (median p-value = 0.0315, range = 0.0001 to 0.1754). Our presentation will discuss these results and their relationship to the type, intensity, and age of treatments, as well as weather conditions and the historic fire regimes of the treated ecosystems.

## CLIMATIC ENVELOPES AND REALIZED CLIMATIC NICHE SIZES OF TREE SPECIES IN EUROPE AND EASTERN NORTH AMERICA

MANTHEY, M., and BOX, E. O.

*University of Georgia, Department of Geography, Athens, GA, 30602-2502 USA;  
(manthey@uga.edu)*

**Abstract:** Due to different climatic and orographic conditions during the Pliocene, Pleistocene, and the Holocene, the plant diversity of tree species differs between the deciduous forest regions in eastern North America and Europe. We calculated the climatic envelopes of species sets from both continents to study differences in diversity and the effects of overall ranges of limiting climatic factors on the average sizes of realized climatic niches. The average niche width for major temperature variables and annual moisture balance are positively correlated with the absolute ranges of these variables over the two datasets. Only weak relationship and no consistent trends were observed between diversity and realized climatic niche sizes.

A cluster analysis including all climatic envelopes shows a group of American species with southern distribution and no European counterparts. A second group contains mainly American and only a few European species with very broad climatic tolerances. The southern European species are grouped together with American trees with western and more continental ranges. The species from Central Europe are combined with American counterparts from the northern hardwood forests.

## **ECOSYSTEM RESISTANCE AND RESILIENCE: MEASURING ECOLOGICAL PROCESSES IN APPLIED SITUATIONS**

MARRS, R.H.<sup>1</sup>, GHORBANI, J.<sup>1</sup>, PAKEMAN, R.J.<sup>2</sup> and LE DUC, M.G.<sup>1</sup>

<sup>1</sup>*Applied Vegetation Dynamics Laboratory, School of Biological Sciences, University of Liverpool, Liverpool L69 3GS, UK;* <sup>2</sup>*Macaulay Land Use Research Institute, Craigiebuckler, Aberdeen, UK. ([calluna@liv.ac.uk](mailto:calluna@liv.ac.uk))*

**Abstract:** We carried out an experiment over a 10 year period on moorland infested with *Pteridium aquilinum*, where we applied a range of bracken control and moorland restoration treatments. We have analysed the data with a combination of univariate anova with repeated measures, multivariate analysis of variance using constrained ordinations and the use of bivariate SD-ellipses to chart treatments in species ordinations space. The study has highlighted the most suitable treatments for restoring moorland, but it has also provided an insight into the resilience and resistance of the different communities over this period. The implications of these results for restoration ecology will be discussed.

## PHYLOGENETIC ANALYSIS OF SSU RDNA SEQUENCES OF ARBUSCULAR MYCORRHIZAL FUNGI IN EAST TEXAS

MARTYNOVA-VAN KLEY, ALEXANDRA, WANG, HAILUN, NALIAN, ARMEN, VAN KLEY, JAMES

Austin State University, TX, USA. ([avankley@sfasu.edu](mailto:avankley@sfasu.edu)).

**Abstract:** Arbuscular mycorrhizal fungi (AMF) from the order Glomales, Phylum Glomeromycota, (Helgason et al. 2003) form mutualistic symbiotic associations with the roots of 80-90% of all terrestrial plant species. Despite their importance, AMF have been neglected in most field studies because of difficulties in isolating and identifying them using traditional methods. The small subunit ribosomal rRNA (SSU rRNA) gene was chosen for PCR because it has variable portions that have been proven to provide phylogenetic information while also possessing highly conserved regions that enable the use of universal primers to amplify. PCR amplification of a region of the SSU gene sequence with Glomales-specific primers was used to detect AMF in the roots of *Chasmanthium sessiliflorum* (Poir.) Yates growing in a natural forest in the eastern Texas Pineywoods. Twenty two amplified sequences along with sequences from fifty five other AMF species reported from previous studies outside Texas with >97% pairwise sequence identity were used to build a Phylogenetic tree. The east Texas sequences appear to belong to the genus *Glomus* along with *G. manihotis*, *G. interadices*, and *G. fasciculatum*. At least six groups were identified from east Texas clones.

## EARLY VEGETATION CHANGES AFTER FIRE IN SEASONALLY DRY METROSIDEROS POLYMORPHA WOODLANDS AT HAWAII VOLCANOES NATIONAL PARK

MCDANIEL, SIERRA<sup>1</sup>, BENETIZ, DAVID<sup>2</sup>, LOH, RHONDA<sup>3</sup>, and  
TUNISON, TIM<sup>3</sup>

<sup>1</sup>National Park Service, Fire Management Office, Hawaii Volcanoes National Park, HI 96718; <sup>2</sup>University of Hawaii, Pacific Cooperative Studies Unit, Hawaii Volcanoes National Park, 96718; <sup>3</sup>National Park Service, Division of Resource Management, Hawaii Volcanoes National Park, HI 96718. (Sierra\_McDaniel@nps.gov)

**Abstract:** On June 30, 2000 the Broomsedge Fire burned 858 acres of *Metrosideros polymorpha* woodlands (3,800-4,100 ft elevation) in Hawaii. Thirty 20x30m plots were established in once burned (2000), twice burned (1977, 2000) areas, and adjacent unburned areas in June 2001 to quantify plant recovery after wildfire(s). Alien plants quickly re-established and dominated burned areas. Within three years, cover of alien species in the burned areas was equal to unburned areas (>60% cover). Also, average alien species richness was 2x greater in the burned areas than in the unburned area. Native plant abundance was significantly reduced by fire. The burned areas had one-fifth the native plant cover than in unburned areas, largely due to the loss of native trees and shrubs. There was evidence of slow recovery by some woody species. Native seedling recruitment in the burned areas was comparable to or greater than in the unburned area. Also, 72% of the burned *Metrosideros polymorpha* trees had basal or epicormic resprouts. Plant abundance did not differ between the once and twice burned areas. The relatively high rates of native plant recovery in this burn compared to other studies may be partially explained by the site location at the wet end of the seasonally dry *Metrosideros polymorpha* ecosystem that created conditions more favorable to plant recovery. Future monitoring will determine whether these early signs of native plant recovery are long lasting.

## RELATIONSHIP BETWEEN MECHANICAL CHARACTERISTICS AND THE ECOLOGY AMONG FAGACEAE TREE SPECIES IN JAPAN

MEGURO, S.<sup>1</sup>, MAKIGUCHI, N.<sup>2</sup>, KAMIJO, T.<sup>2</sup> NAKAMURA, T.<sup>2</sup>

<sup>1</sup>Japanese Center for International Studies in Ecology (JISE), Yokohama City, 231-0023, Japan. (e-mail: [smeg@jise.or.jp](mailto:smeg@jise.or.jp)), <sup>2</sup>Tsukuba University, Ibaraki 305-8572, Japan

**Abstract:** Most potential natural vegetation in Japan is basically occupied by evergreen broad-leaved forest and summer green broad-leaved forest. Evergreen broad-leaved forests belong to *Camellietea japonicae* and summer green broad-leaved forests belong to *Fagetea crenatae*. The main species composing the canopies are trees species, especially Fagaceae species. The original habitats and the growth behaviors of Fagaceae trees are different from each other. It would appear that mechanical properties are as important as physiological characters for a strategy to acquire the habitat.

Species of Fagaceae used for mechanical test are as follows:

*Fagus crenata*, *Quercus crispula*, *Q. serrata*, *Q. acutissima* (summer green)

*Q. glauca*, *Q. acuta*, *Q. gilva*, *Q. myrsinaefolia*, *Q. salicina*, *Q. phillyraeoides* (evergreen)

*Persea thunbergii*, *Zelkova serrata* and *Celtis sinensis* var. *japonica* were also examined for comparison with the Fagaceae species.

Fracture stress, strain, strain energy gravity and moisture content were measured as mechanical properties. As tree form is thought to relate to mechanical properties, number, length and girth were measured.

Evergreen tree species were stronger than summer green tree species in fracture stress. Evergreen species had more bifurcation at branching system than summer green species.

It was clarified that mechanical properties of trees were involved to the ecology and the habitat and succession stage. *Q. glauca* has the highest fracture strength among tested species. The property makes it possible to have faster and slender young branches on shallow

## ECOLOGICAL TRAITS OF WOODY INVADER AND NATIVE SPECIES IN SUBTROPICAL OCEANIC ISLAND

MIKAMI, KOICHI and KOIKE, FUMITO

Graduate School of Environment and Information Sciences, Yokohama National University,  
Yokohama 240-8501, Japan

**Abstract:** The flora in the Ocean Island is susceptible to human disturbance, especially to biological invasion. Some introduced species have the strong impacts on their regional ecosystem to change dramatically. In the Hahajima Island of the Bonin Islands, introduced woody species of *Bischofia javanica* dominates the forests. The Hahajima Island is the subtropical Ocean Island which is located in the western Pacific Ocean. *B. javanica* has introduced as a chacoal tree about 80 years ago. Currently, distribution of *B. javanica* expands the most area of the Hahajima Island. In order to define the factor that the population of *B. javanica* increased more preferentially than the native woody species (*Elaeocarpus photiniifolius*, *Schima mertensiana* and *Pouteria obovate*), we focused the three characteristics (size of first reproduction, growth rate of DBH and seedling production) of *B. javanica* and native species. Two native species (*S. mertensiana* and *P. obovate*) started reproduction when their DBH get 9.5cm and 7.5cm, in contrast *B. javanica* gets 23cm. There was no significant difference between their growth rates of DBH. The number of seedling produced by *B. javanica* is approximately 30 times greater than that of native. Therefore, we concluded that it would be the advantage for *B. javanica* to increase the population in the restatement stage. Moreover, We discuss recruitment ability for above these species.



## UNTANGLING THE ROLES OF HABITAT SUSCEPTIBILITY AND PROPAGULE PRESSURE IN THE SPREAD OF AN EXOTIC HERB IN NEW ZEALAND'S MOUNTAIN VEGETATION

MILLER, A.<sup>1</sup>, DUNCAN, R.<sup>1</sup>, SULLIVAN, J.<sup>1</sup>, WISER, S.<sup>2</sup> and NEWELL, C.<sup>2</sup>

<sup>1</sup> Lincoln University, Canterbury, New Zealand; <sup>2</sup>Landcare Research, Lincoln, Canterbury, New Zealand. (Miller3@lincoln.ac.nz)

**Abstract:** Both habitat susceptibility and propagule pressure can determine the spatial pattern of spread of invasive plants. Untangling the two processes is necessary to make future predictions of spatial spread. We surveyed density and measured reproductive output of the invasive exotic herb *Hieracium lepidulum* (Asteraceae) in creeks and adjacent forest and alpine vegetation in the Southern Alps, New Zealand, as part of a study designed to determine how habitat susceptibility and propagule pressure interact to determine the relative abundance and distribution of *H. lepidulum* in these habitats. Density of *H. lepidulum* declined with increasing distance from creeks into forest. Density of *H. lepidulum* in creeks was positively correlated with *H. lepidulum* density in adjacent forest and alpine vegetation. Creeks appear to act as focal points for *H. lepidulum* invasion into the forest, with invasion in the alpine driven by propagule pressure from lower altitudes. Reproductive output was not higher in creeks than adjacent vegetation, indicating that creeks are not necessarily more suitable for *H. lepidulum* invasion. The spread of *H. lepidulum* in New Zealand's mountains appears to be primarily driven by propagule pressure and dispersal limitation, rather than by habitat susceptibility.

## AMERICAN SAMOA AND PABITRA

MISA, M. M.<sup>1</sup>

<sup>1</sup>*ASCC-CNR, Forestry Department, PO Box 9037, Pago Pago, AS (misa@yahoo.com)*

**Abstract:** The Samoan archipelago is one of the PABITRA sites and although politically divided, the US Territory of American Samoa to the East, and the independent nation of Samoa to the West, it is biologically one unit. The island of Savai'i, the westernmost island of the archipelago, has been identified as the major site for PABITRA studies. In this paper, I suggest that it would be worthwhile to compare the vegetation of the westernmost island to the easternmost island of the archipelago.

The island of Ta'u, located about 100km east of Tutuila, the easternmost island in the Samoan archipelago, is found to be compatible with the aims of PABITRA. It has an area of 39km<sup>2</sup> and a maximum elevation of 966 m. Despite having only 224 species of vascular plants, it has interesting and unique vegetation. Particularly the vegetation on the summit of Ta'u, Mt. Lata, is considered a summit scrub community instead of montane or cloud forest. Ferns, climbing vines, shrubs and stunted trees covered by epiphytes, dominate this vegetation. . The above and the relative scarcity of invasive species compared to other Samoan islands make Ta'u a good candidate for PABITRA transect site.

## VEGETATION OF LOWLAND TROPICAL FOREST AND ECOLOGICAL CHARACTERISTICS OF THE COMPONENT TREES AT ESTUARY REGION IN AMAZON

MIYAWAKI, A. & MEGURO, S.

Japanese Center for International Studies in Ecology (JISE), Yokohama City, 231-0023, Japan. (e-mail: [miyawaki@jise.or.jp](mailto:miyawaki@jise.or.jp))

**Abstract:** We have conducted a rehabilitation project on Amazon forest ecosystem, degraded by human activity, in Brazil since 1992. We have been investigating around estuary region in Amazon River. Indigenous species had been used to rehabilitate the lowland tropical forests under cooperation with a plywood manufacturing company, *Eidai do Brasil* at Belem in Para State.

Vegetation types and ecology of tree species composing the forests are still known little in the strict sense. One main purpose on the projects is to analyze correlations between growth behavior of planted major indigenous species at the experimental sites and the manner of species occurrence in vegetation type, which were based on data collected in natural stands.

*Dipteryx odorata*, *Sterculia speciosa*, *Virola cuspidate* and *Carapa guianensis* occurred on wet habitat. *Virola melinoni* appeared on dry habitat. These species were differential species on hydrosere and xerosere. *Eschweilera parvifolia* spread widely and showed low selectivity to the habitat. It would seem that *E. parvifolia* is a companion species. *Tabebuia serratifolia* grew slowly due to the higher specific gravity.

The variety of tree characters in Amazon was thought to be higher than in Southeast Asia. The diversified habitats make it possible to coexist by many species involving extreme fast growing species such as *Schizolobium amazonicum*, *Ochroma pyramidale* and *Ceiba pentandra*.

## **SPECIAL SESSION. THE PABITRA NETWORK: ITS ROLE AND RECENT DEVELOPMENTS**

MUELLER-DOMBOIS, D.

*University of Hawai'i at Manoa, Botany Department, 3190 Maile Way, Honolulu, HI 96822,  
USA. Tel. (808) 245-1873, [amdhawaii@aol.com](mailto:amdhawaii@aol.com)*

**Abstract:** PABITRA (the Pacific-Asia Biodiversity Transect) is an international network of sites and scientists, as well as other conservation professionals, concerned with biodiversity research and management throughout the tropical Pacific island region. PABITRA is also the sister network of DIWPA (DIVERSITAS in the Western Pacific and Asia) and the official program of the Ecosystem Division in the Biodiversity Task Force of the Pacific Science Association (PSA). The PSA holds congresses in different Pacific countries every two years. It thereby provides a stable forum for PABITRA activities. A major objective of the PSA is to promote cooperation and communication in science and technology among the communities of the Pacific region. PABITRA's role is to apply this objective to biodiversity assessment and ecosystem conservation. The PABITRA concept originated at the 1997 Pacific Science Inter-Congress in Suva, Fiji. It developed subsequently through workshops and symposia held in Taipei 1997 and 1998, Sydney 1999, Nagano 2000, Guam 2001, Fiji 2002, Bangkok 2003, and Samoa 2003. The PABITRA research strategy is twofold, to develop a methodology for cross-ocean comparisons of island ecosystems that belong to the same biomes (the horizontal strategy) and to develop a mountain-to-ocean landscape transect approach within islands that require a multi-disciplinary team approach (the vertical strategy). Aspects of both strategies will be displayed in this IAVS session as they evolved primarily from the recent field workshops in Fiji (2002) and Samoa (2003) and earlier research elsewhere. The essential role of PABITRA coincides with the main objective of the PSA as stated above. This involves mutual capacity building as a major outcome.

## THE KAHANA VALLEY AHUPUA`A – A PABITRA SITE ON O`AHU, HAWAIIAN ISLANDS

MUELLER-DOMBOIS, D.<sup>1</sup>, WIRAWAN, N.<sup>2</sup>, JACOBI, J. D.<sup>3</sup>

<sup>1</sup>University of Hawai`i at Manoa, Botany Department, 3190 Maile Way, Honolulu, HI 96822, USA. Tel. (808) 254-1873, [amdhawaii@aol.com](mailto:amdhawaii@aol.com)

<sup>2</sup>Former Director, WWF (Indonesia),

<sup>3</sup>U.S.G.S. Pacific Island Ecosystems Research Center, Kilauea Field Station, Bldg. 344, P.O. Box 44, Hawai`i National Park, HI 96718, USA

**Abstract:** The acronym PABITRA stands for Pacific-Asia Biodiversity Transect, a network of island sites and conservation professionals collaborating throughout the Pacific-Asia region. An ideal PABITRA site is a broad landscape transect from sea-to-summit. Such a landscape is the Kahana Valley on Windward O`ahu. Kahana Valley served during prior centuries as an ahupua`a, a Polynesian unit of land management that integrated the three biological resource zones into a sustainable human support system. In spite of the many former human-induced modifications of the Kahana Valley landscape, the natural structure and function of its ecosystems are well preserved. The distribution patterns of vegetation can be interpreted in terms of Hawaiian ecological zones in combination with the valley's precipitation, topography, stream system, and archeological features. Currently, efforts are underway to restore the Kahana State Park as a functional ahupua`a. Additionally focused collaborative research can yield helpful information for further restoration and integrated management of the Kahana ahupua`a as a historic Hawaiian Heritage Site.

## FOREST AND WOODLAND COMMUNITIES OF THE JEMEZ MOUNTAINS, NEW MEXICO, USA

MULDAVIN, E. H.<sup>1</sup>, ALLEN, C. D.<sup>2</sup>, and BALICE, R. G.<sup>3</sup>

<sup>1</sup>University of New Mexico, Albuquerque, NM, 87131, USA; <sup>2</sup>U.S. Geological Survey, Jemez Mountains Field Station, Bandelier National Monument, NM, 87544, USA; <sup>3</sup>Ecology Group, Los Alamos National Laboratory, Los Alamos, NM 87545, USA. (muldavin@sevilleta.unm.edu)

**Abstract:** We present a forest and woodland vegetation classification for the eastern portion of the Jemez Mountains in northern New Mexico, USA. The classification was based on over 500 plots and encompassed over 80 new and previously described plant associations organized by 18 ecological systems per the National Vegetation Classification System. The plant associations were distributed across a diverse volcanic landscape of cones, ash deposits, lava flows, and alluvial sediments. Along the elevation gradient from 5,500 ft to 11,000 ft, communities varied from *Pinus edulis* and *Juniperus monosperma* woodlands at low elevations, through *Quercus gambelii* woodlands, *Pinus ponderosa*, *Pseudotsuga menziesii*, *Abies concolor*, and *Picea pungens* forests of mid-elevations, to *Picea engelmannii*, *Abies lasiocarpa* var. *arizonica* and *Populus tremuloides* forests at the highest reaches. Besides floristic differences, these woodlands and forests had distinct stand structures that reflect different fire regimes across the elevation gradient.

## FACTORS LIMITING DISTRIBUTION OF DRY GRASSLAND SPECIES AT DIFFERENT SPATIAL SCALES

MÜNZBERGOVÁ, ZUZANA<sup>1,2</sup>

<sup>1</sup>*Institute of Botany, Academy of Sciences of the Czech Republic, CZ-252 43 Průhonice, Czech Republic; fax +420267750031, email: [zuzmun@natur.cuni.cz](mailto:zuzmun@natur.cuni.cz), <sup>2</sup>Department of Botany, Faculty of Science, Charles University, Benátská 2, CZ-12801 Praha 2, Czech Republic*

**Abstract:** Distribution of species in fragmented landscapes is a result of combined seed and microsite availability. While the importance of these is directly dependent on the spatial scale used, traditionally it is studied on one spatial scale only, without explicitly defining the scale. It is thus not known how does the importance of seed and microsite availability differ among different spatial scales. I will present result of an experiment sowing seeds of seven species of dry grasslands into twenty-two localities that differed in occupancy by these species. In this experiment I followed seedling establishment of these species over three years and compared number of emerging seedlings at three scales: between occupied and unoccupied localities, between occupied and unoccupied blocks within occupied localities and between plots with and without seed addition within occupied blocks. Furthermore, I related the number of seedlings and distributions of adult plants at the two larger scales to environmental factors.

The results show that both seed and site availability are important in structuring the distribution of these plant species. Their relative importance however depends on the spatial scale considered. Also the relationship between environmental factors and pattern of seedling recruitment and adult occurrence is clearly scale dependent. The result imply that conclusions on importance of seed and microsite limitation in natural communities is scale dependent and the studies of these thus need to explicitly considered it.

## CLIMBER SPECIES COMPOSITION, ABUNDANCE AND RELATIONSHIP WITH TREES IN A NIGERIA SECONDARY FOREST

MUOGHALU, J.I. and OKEESAN, O.O.

*Department of Botany, Obafemi Awolowo University, Ile-Ife, Nigeria.*  
([jmuoghal@yahoo.com](mailto:jmuoghal@yahoo.com))

**Abstract:** The species composition, abundance and tree relationship of climbers were examined along altitudinal gradient in four 0.06 ha plots in a secondary forest at Ile-Ife, Nigeria. All trees > 10 cm girth at breast height were examined for the presence of climbers in the plots. There were 53 tree species distributed over 45 genera and 25 families and 49 climber species consisting of 35 liana and 14 vine species distributed over 41 genera and 28 families in the forest. Lianas contributed 34 % and vines 13.7 % of these species (climber, shrub, tree) in the forest. The commonest climber families are Ampelidaceae (8.5 %) Apocynaceae (12.8 %), Connaraceae (4.3 %), Menispermaceae (6.4 %) and Papilionaceae (6.4 %). The basal area, density and the number of species, genera and families increased with altitude. Climbers contributed from 1.5 to 4.6 % of woody basal area in the plots. Forty-two per cent (42 %) of the trees in the forest carried climbers. Some tree species hosted climbers with great frequency while several other species never hosted climbers. The mean number of climbers per tree species was  $2.83 \pm 0.84$  and per individual tree was  $1.53 \pm 0.08$  for trees with climbers. There was significant positive correlation ( $p < 0.05$ ) between girth sizes at breast height of host trees of 31-50 cm with the girths of climbers on them indicating that trees of these girth sizes are highly susceptible to climber infestation. The density of climber host tree species is important in the infestation of climbers on trees because it determines the availability of support for climbers.



## VEGETATION DYNAMICS ON THE ISLANDS IN THE SETO INLAND SEA, JAPAN

NAKAGOSHI, N.<sup>1</sup>, OHTA, Y.<sup>1</sup> and SAKAI, M.<sup>1</sup>

<sup>1</sup>*Hiroshima University, Higashihirosima city, Hiroshima, Japan ([nobu@hiroshima-u.ac.jp](mailto:nobu@hiroshima-u.ac.jp))*

**Abstract:** The island vegetation in the Seto Inland Sea, the largest thalassic sea in Japan: 21,800km<sup>2</sup> has unique characteristics. It is summarized to three significant features. Firstly in the warm temperate zone: *Camellietea japoniae*, vegetation and flora are influenced by dry climate: av. temp. 15 degrees and precipitation 720-1,805mm due to basin-like topography inhibiting monsoon rainfall. Secondly, even shortage of water, the agri-activities has developed to produce dry field crops: sweet potato and barley and oranges in terraced field on hill slopes. This human influence had been changed the original forests to the substitutional vegetation in the last millennium. The secondary forest of Japanese red pine dominates in this region. Lastly, this pine forest is often disturbed by accidental forest fires and pine wilting disease at the present. We summarized the vegetation dynamics on islands: 1,050 island including 160 people settled islands. From the results, we propose the proper vegetation and landscape management. In addition, the management strategy of island vegetation will be suggested because the many parts of islands: 628 km<sup>2</sup> are designated as Seto Inland Sea National Parks which is the oldest national park in Japan since 1934. We wish to show the different type island vegetation dynamics compared to the oceanic islands.

## **PINUS HALEPENSIS, A MEDITERRANEAN PINE, IN THE LIGHT OF FIRE**

NE'EMAN, G.

*Department of Biology, the University of Haifa – Oranim, Tivon 36006, Israel.*

*([gneeman@research.haifa.ac.il](mailto:gneeman@research.haifa.ac.il))*

**Abstract:** Fire is a major factor shaping plants. Many traits have been described as adaptations to fire, but might be also advantageous for exploiting other disturbances. *Pinus halepensis* is a short living post-fire obligate seeder species, but also an invading species. This, and the notion that fire in the Mediterranean Basin has been almost exclusively of anthropogenic origin, cast doubt on the possibility of fire to act as selective force in the Mediterranean. I aim to examine major traits of *Pinus halepensis*, fire history, and the possibility of direct selection by fire. The seedlings grow fast producing highly serotinous female cones at early age, thereby reducing the 'immaturity risk' in a case of an early successive fire. Serotiny in post-fire stands is higher than in unburned ones. Seeds from serotinous cones germinate better under simulated post-fire conditions than those from non-serotinous cones. The non-self pruning of dead branches and empty seed cones increase the probability of high intensity deadly fire, which facilitate rapid post-fire establishment. The evidence for the first hominid-controlled fire in the Mediterranean basin is 780,000 years ago, and the fire-return interval, which is similar to average generation, is 125 years. Therefore, the estimated number of post-fire generations is about 6000. Such a high number of generations can be sufficient for the direct selection by fire of fire adaptive traits such as serotiny and non-self pruning in *P. halepensis*.

## WHY ARE THERE SO MANY PLANT SPECIES IN RURAL HILLY AREA, SATOYAMA?

*Explanation through the relationships between plant species  
richness and plant community diversity*

NEMOTO, M. and HOSHINO, Y.□

*Tokyo University of Agriculture and Technology, Fuchuu-city, Tokyo, Japan.  
([nemoma@cc.tuat.ac.jp](mailto:nemoma@cc.tuat.ac.jp))□*

**Abstract:** The purpose of this study is to examine the relationships between species richness and some factors concerning to community diversity, such as number of community type and floristic distinctiveness of communities, and to explain why so many plant species have sustained in rural hilly area, generally called SATOYAMA in Japanese.

In two SATOYAMA in Kanto districts, central Japan, field survey was conducted in several small catchments. The flora lists of every catchment were completed. After collecting phytosociological data, identification of plant communities was completed by table comparison. The recognized plant communities were arranged by DCA ordination, and some indicators of community diversity were calculated for each catchment. These indices and the area of catchments were tested for correlation with species richness.

Totally, 673 and 672 plant species, and 53 and 45 community types were found in each area respectively. An increase of the area of catchments was not correlated with increases of species richness. Species richness in catchments increased in correlating with increases of the plant community types and the other community diversity indices. Some of these relationships were recognized in both areas.

We found that indices representing the number and the floristic distinctiveness of community have greatly influenced on species richness. Community diversity increase with human activities such as management or land use, therefore human impacts seem to be one of the important factors determining species richness in SATOYAMA.

## THE EFFECT OF FIRE ON SEED VIABILITY OF FOUNTAIN GRASS (*PENNISETUM SETACEUM*)

NONNER, E.

University of Hawaii, USA. ([nonner@hawaii.edu](mailto:nonner@hawaii.edu))

**Abstract:** In Hawaii, fountain grass (*Pennisetum setaceum*) is an aggressive, fire prone invader that out-competes native flora and forms monotypic stands with large amounts of dead mass which fuel fires. Fires eliminate native species and contribute to further spread of alien grasses creating a grass/fire cycle. A seed bank can increase the possibility of fountain grass reestablishment. Prior to prescribed burns at Puu Anahulu, Hawaii, the fountain grass seed bank was 58 seeds per m<sup>2</sup>. Seed density ranged from 0-4 seeds per 20 cm<sup>2</sup>, indicating a heterogeneous distribution of seeds throughout the site. Seeds and temperature indicators were placed at 0, 2.5, and 5 cm depths to test the effect of fire on seed viability. Seeds at 0 cm showed 0% germination while those at 2.5 and 5 cm showed a soil buffering effect with mean 60% germination. Temperatures at 0 cm ranged from 107- 204° C, while temperatures at depths of 2.5 and 5 cm remained ambient. Buried seeds are buffered from temperatures generated by fire; thus, prescribed burns are ineffective at removing seed buried in the soil. However, awns on the dispersal unit imply fountain grass may form predominantly surface layer seed banks that show 0 % germination after fire.

## **CHANGES IN STRUCTURE, COMPOSITION AND CLUSTERING PATTERN OF SIERRAN MIXED CONIFER FOLLOWING FIRE AND THINNING RESTORATION TREATMENTS**

NORTH, M.

*USFS Sierra Nevada Research Center, Davis, CA, USA. ([mnorth@ucdavis.edu](mailto:mnorth@ucdavis.edu))*

**Abstract:** After a century of fire suppression, thinning and prescribed fire are widely used in western forest restoration, yet there is little information about their different effects on forest structure, composition and spatial pattern. Using 18 replicated 4 ha plots in old-growth Sierran mixed conifer, I examined changes in tree basal area, density, composition and clustering following 6 treatments in a full factorial design: prescribed burn/no burn was crossed with no harvest, understory thinning and overstory or shelterwood thinning. I measured treated stand structure against hypothesized pre-European structure developed from on-site age reconstruction and active-fire regime old-growth in Yosemite National Park. Thinning intensity had the most significant impact on basal area and density while fire had little impact. Fire, however, significantly shifted composition toward more shade-intolerant species. Current southern Sierra mixed-conifer spatial pattern is highly patchy and fire reduced tree clump/gap contrast more than thinning toward a more random distribution. Thinning markedly changed spatial patterns, particularly shelterwood spacing which significantly departed from historic forest patch pattern. The burn/no thin treatment had little effect on forest conditions because fire intensity and extent was limited due to late-fall weather conditions. In this study, the understory thinning and prescribed fire treatment produced a structure and composition closest to hypothesized pre-European conditions.

## **PLEISTOCENE, HOLOCENE AND PRESENT: THE DYNAMICS OF LONG-LIVED CONIFERS IN A CHANGING ENVIRONMENT**

OGDEN, J.

*School of Geography and Environmental Science, University of Auckland, Auckland, New Zealand. (j.ogden@auckland.ac.nz).*

**Abstract:** Change through time has been a dominant theme in plant community ecology. Palaeoecology provides a wider perspective on extant ecosystems. The Late Pleistocene was a period of climatic oscillations when species and the communities they comprised, repeatedly migrated or adapted. Changing island size, coastal geomorphology and disturbance regimes were crucial for some species. The Last Glacial Maximum and Holocene history of New Zealand vegetation is briefly reviewed. Paleoecological work on kauri (*Agathis australis*) in northern New Zealand provides evidence of climate and sea-level shifts over the last 50ka. During warming periods, with rising sea-levels and coastal water-tables, kauri was preserved in lowland swamps. Cooling periods with dropping sea-levels caused vegetation shifts and kauri decline. The Last Glacial Maximum may have been a crucial bottleneck for this species. The Late Holocene history of *Libocedrus bidwillii* in Tongariro National Park, demonstrates the dynamic nature of the altitudinal forest sequence, and the role of disturbance. The temporal changes in the apparent realised niches of *Agathis* and *Libocedrus* suggest that such long-lived species persist in their 'niche centre' in small populations during 'stable' periods, but expand following landscape-scale disturbances.

## **EFFECT OF SIKA DEER (*CERVUS NIPPON*) ON SPECIES COMPOSITION AND PLANT SPECIES DIVERSITY OF FOREST VEGETATION**

OHASHI, H. & HOSHINO, Y.

*Tokyo University of Agriculture and Technology, Fuchu city, Tokyo 183-1509, JAPAN  
(haru2001@cc.tuat.ac.jp)*

**Abstract:** Sika deer (*Cervus nippon*) is the well-known invasive mammal in the US, UK, and New Zealand. In Japan, native population of Sika deer has been increasing since early 1990s, and heavy grazing caused the drastic change of vegetation. The purpose of this study was to compare the species composition and the plant species diversity of forest vegetation before and after the increase of deer population. From 1999 to 2003, we corrected 49 phytosociological relevés at the same place where previous records were taken in 1980-1985, when population of deer was not so dense. In 1980-1985, a total of 392 species were recorded in whole relevés, but in 1999-2003, a total species number was decreased to 294 species. Occurrences of broad-leaved forbs, such as *Ainsliaea acerifolia* v. *subapoda*, *Cimicifuga simplex*, *Trillium tchonoskii*, have significantly decreased. Mean species richness in each relevé decreased 38.3 ± 17.5 species to 25.1 ± 9.1 species per relevé. Dissimilarity between all pairs of relevés have not changed significantly, because both the number of shared species in two relevés and the number of unshared species in two relevés have decreased together. We discuss about the change of vegetation caused by increased Sika deer population from the view of alpha diversity of forest community and the beta diversity of regional vegetation.

## STRUCTURAL CHARACTERISTICS OF A REMNANT LOWLAND HAWAIIAN WET FOREST

OSTERTAG, R., LIKE, R., and CHANG, H.K.

University of Hawaii at Hilo, Hilo, HI 96720, USA. ([ostertag@hawaii.edu](mailto:ostertag@hawaii.edu))

**Abstract:** Lowland wet forests in Hawai'i face threats from development and invasive species and are currently only left in remnant patches. We examined the forest structure at a 30 m elevation lowland forest on a 750-1500 year old lava flow at Keaukaha Military Reservation to determine degree of invasion and to serve as a starting point for the development of restoration strategies. Using circular plots ranging in radius from 6-18 m, we identified and measured all trees greater than 2 cm diameter at breast height (dbh), determined abundance for species with a smaller diameter, and measured percent cover for herbaceous vegetation. For trees, non-native species are excessively abundant (80%) and frequent, particularly *Melastoma candidum*, but their relative dominance is low (33%). Most of the < 2 cm dbh stems (96%) were non-native, suggesting lack of regeneration of native species. Similarly, in the herbaceous sampling, the frequency of native species (12%) was lower than that of nonnative species (68%) as well as abundance (2% vs. 25%). Although native trees such as *Metrosideros polymorpha* and *Diospyros sandwicensis* persist in the overstory, there is little evidence of their regeneration and they are likely to decline if removal of the invasive understory and mid-story species is not undertaken.



## **FIRE PROMOTES SPECIES DIVERSITY IN SUBTROPICAL GRASSLANDS**

OVERBECK, G.<sup>1</sup>, MÜLLER, S. C.<sup>2</sup>, PFADENHAUER, J.<sup>1</sup> and PILLAR, V.D.<sup>2</sup>

<sup>1</sup>*Technische Universität München, Freising-Weihenstephan, Germany;* <sup>2</sup>*Universidade Federal do Rio Grande do Sul, Porto Alegre, Brazil (overbeck@wzw.tum.de)*

**Abstract:** In a regularly burned grassland in Porto Alegre, southern Brazil, we studied small scale plant species dynamics in relation to fire events. In four transects recently burned by experimental fires, four transects burned one year before, and four transects burned more than 2 years before, we investigated species turnover over two consecutive years, using twelve plots of 50 by 50 cm in each transect.

Species number increased from the first to the second study period in recently burned plots, remained approximately the same in plots with medium time since fire and decreased where more time had passed since the last burn. We conclude that a relatively high fire frequency will lead to an increase in species richness as the burns create open soil and thus recruitment opportunities, while suppressing competition by caespitose grasses and grassland shrubs. In the absence of fire over longer periods, caespitose grasses will achieve dominance and prevent species recruitment by litter accumulation, at the same time building up biomass for future burns. The grasslands in the region appear to be resilient to fire with a high elasticity and depend on regular fires for their persistence under a climate suitable for forest development.

## VEGETATION PATTERNS OF THE MONSOON AFFECTED MOUNTAINS IN SOUTHERN OMAN, ARABIA, AND THEIR IMPORTANCE AS A CENTER OF ARABIAN PLANT DIVERSITY

PATZELT, A.

*Sultan Qaboos University, P.O. Box 36, Al-Khod 123, Sultanate of Oman. (e-mail [apatzelt@squ.edu.om](mailto:apatzelt@squ.edu.om))*

**Abstract:** The province of Dhofar, southern Oman, has been classified as a center of plant diversity in the Arabian Peninsula, with c. 7% of endemic plants. This study contributes to the analysis and classification of a unique vegetation, dominated by endemics and regional endemics, of a long isolated part of southern Arabia. For the first time, the species diversity, zonation and plant communities as well as the underlying ecological factors that shape the local distribution of species and plant communities were studied.

The vegetation analysis revealed new plant communities, which form clearly defined belts following a strong edaphical gradient and geomorphological characteristics. The woodlands are dominated by the drought-deciduous, semi-sclerophyllous regional-endemic Combretaceae *Anogeissus dhofarica*. The higher plateaus are dominated by annual tall-grass savannah, which is probably derived from degraded deciduous bushland. The woodlands and grasslands are transitional to afro-montane vegetation at higher altitudes. Away from the influence of the monsoon winds, drought-deciduous shrub and succulent communities are prevailing. Alpha-diversity, habitat diversity and floristic resources (endemics) for the woodlands are high compared to the other habitats.

Large-scale degradation is affecting the area but recent measurements taken by the government aim in preserving the biodiversity.

## AN INFORMATION INFRASTRUCTURE FOR VEGETATION SCIENCE IN NORTH AMERICA

PEET, R.K.

*University of North Carolina, Chapel Hill, NC 27599-3280 USA ([peet@unc.edu](mailto:peet@unc.edu))*

**Abstract:** The Ecological Society of America Vegetation Panel, NatureServe, and other partner organizations are assembling the information infrastructure to support a comprehensive vegetation classification for North America. A comprehensive set of guidelines for directing the process has been released and is likely to be adopted by federal agencies. A key element is that there is one authoritative list of vegetation types intended to perfectly tile the universe of variation. Plot data used in the classification enterprise will be submitted to a public archive, VegBank, for documentation and future reanalysis. The archive will be available for numerous other forms of ecoinformatics research. The archive will support diverse plot data types and could ultimately exist as a distributed international system. The taxonomy of both organisms and communities will be based on taxon concepts to allow for semantic mediation of taxa where one name can apply to multiple taxa and a single taxon can have multiple names. Proposals for changes in the National Vegetation Classification will be prepared, submitted, and processed using a web-based peer review system. The results of the peer review process will be published in online Proceedings. The full classification will continue to be available through the NatureServe Explorer website with click-through access to typical plots.

## **SUCCESSION AND SITE CONDITIONS IN THE POST MINING LANDSCAPES IN LUSATIA (GERMANY)**

PIETSCH, W.H.O.

*BUNW, D-01159 Dresden, Germany. (e-mail:w.pietsch@gmx.de)*

**Abstract:** The vegetation development was studied on different raw dump substrates in the open landscapes in the terrestrial, semiaquatic and aquatic areas of the Lusatian lignite mining district.

On dump substrates outside of the groundwater area with mainly quaternary condition characteristic stages of first and subsequent colonization can be differentiated.

However, higher proportions of tertiary material have an increasingly restricting effect on the development of vegetation. These mining substrates are characterized by high acidification and salinisation potentials caused by pyrite weathering.

On dump substrates inside of the groundwater area with high proportions of tertiary material, the succession in the semiaquatic and aquatic areas is characterized by poor-species dominance stands.

On the base of 1286 phytosociological records from 164 permanent observation areas a classification in numerous species groups was carried out by TWINSpan.

The physico-chemical quality of the dump substrates and waterbodies are characterized by the most important parameters: Grain size fraction, pH, EC, total C, N, S content, C/N, DOC, CaCO<sub>3</sub>.

Multivariate techniques are used to demonstrate and statistically verify the correlation between changes in the vegetation structure and the site factors causing them: regression, calibration, ordination DCA, CCA and DCCA. The vegetation development is essentially determined by the physico-chemical condition of the raw dump substrates.

## QUANTIFYING WILD *BRASSICAS* DISTRIBUTION AT THE LANDSCAPE SCALE IN NEW ZEALAND: A MODEL SYSTEM FOR UNDERSTANDING GENE-FLOW RISK

PELTZER, D.A., FITZJOHN, R., HEENAN, P., FERRISS, S.,  
NEWSTROM, L.E.

Landcare Research, PO Box 69, Lincoln 8152, New Zealand.  
([PeltzerD@landcareresearch.co.nz](mailto:PeltzerD@landcareresearch.co.nz))

**Abstract:** Quantifying gene-flow at a landscape scale is a major challenge for agronomists, weed scientists and ecologists, and is critical for understanding the impacts of environmental weeds or assessing risks of releasing genetically-modified plants. Here, we describe a survey to quantify wild (i.e., both crop escapes and feral) populations of *Brassica* species at a landscape scale in New Zealand. Brassicas are an excellent model system for assessing gene flow because they are widely cultivated for both seed production and forage in New Zealand, are known to hybridize in the wild, and form feral populations. We used GIS to randomly generate fifty 3 x 3 km sample plots in the Canterbury Plains region. All roadside *Brassica* populations were recorded during peak flowering in late 2003, and the identity of *Brassica* species and potential hybrids was confirmed using flow cytometry. Additional environmental information was generated for each plot using GIS. Logistic regression revealed that the presence of Brassicas was strongly, positively related to distance to the nearest town, railway, major road or *Brassica* seed storage facility. In contrast to findings from the UK, the presence of *Brassica* populations was negatively related to distance to water (both lakes and to the coast). These results point to the overwhelming importance of disturbance and human-mediated dispersal controlling the distribution of weedy *Brassica* species.

## ACCURACY AND POWER OF RANDOMIZATION TESTS IN MULTIVARIATE ANALYSIS OF VARIANCE WITH VEGETATION DATA

PILLAR, V.D.

*Departamento de Ecologia, Universidade Federal do Rio Grande do Sul, Porto Alegre, Brazil.*  
[vpillar@ecologia.ufrgs.br](mailto:vpillar@ecologia.ufrgs.br)

**Abstract:** Group comparison in vegetation data analysis often requires hypothesis testing, for which computer-intensive, distribution-free methods may be the most appropriate. A test is accurate if the proportion of tests rejecting  $H_0$  equals the significance level when  $H_0$  is knowingly true. Power is the probability of detecting differences when  $H_0$  is knowingly false. I evaluated accuracy and power of randomization tests in multivariate analysis of variance, involving one or two factors and interaction, with simulated data having a priori distributional properties or based on vegetation data. As test criterion a distance-based sum of squares between groups ( $Q_b$ ) or the ratio of between and within groups sum of squares (F-ratio) was used. I assessed in one-factor analyses the effects of variable number, sample size, variance inequality between groups and type of error distribution and, in two-factor analyses, restricted permutations or unrestricted permutations of raw data or residuals. The results with one-factor designs evidenced a high level of accuracy in the tests evaluated, irrespective of test criterion. For testing factor main effects an exact test, with restricted permutations, with  $Q_b$  or F-ratio, gave equivalent accuracy and power compared to using residuals. For testing interaction in two-factor, crossed designs, however, the use of F-ratio, with residuals, improved accuracy and power.

## FOREST AND SHRUB VEGETATION AFTER FIRE ON MT. ETNA (SOUTHERN ITALY)

POLI MARCHESE, E., GRILLO, M., MARCHESE, M.

*Sez. Biologia ecologia vegetale, DACPA, Università di Catania, via Valdisavoia,5 -95123  
Catania-Italia e-mail:epolimar@unict.it*

**Abstract:** Fire on the Mt. Etna, as on the other Mediterranean areas, is a very important ecological factor. It is caused by man and many hectares of forests yearly are destroyed.

This work aims to point out the post-fire plant communities recovery.

Several areas burned by fire have been selected. The “synchronic” method was chosen; the study was carried out through phytosociological relevées, according to the Braun-Blanquet’s method.

The data collected allow to point out:

- fire is an important factor in the vegetation dynamics;
- the action of fire is responsible for a visible effect on vegetation regression;
- the post-fire plant cover is to correlate with fire intensity and with the vegetation type. Fire intensity can impact the community recovery in different ways: it can alter soil properties; heat could diminish soil seed banks; heat could increase mortality of resprouting organs.
- The vegetation recovery is depending on the type of the pre-fire vegetation and particularly on its structure and its dynamic stage.
- On steep slopes with erodible soils and vegetation subjected to man’s disturbance there is a high post-fire erosion risk.

In general, the post-fire community recovery does not request man’s intervention; therefore, in the most degraded soils and on steep slopes, where plant regeneration rates are low and the risk of soil erosion is high, a restoration for a short-term response is to be suggested.

## **KALIJ PHEASANT (*LOPHURA LEUCOMELANOS*) SEED DISPERSAL AND PREDATION IN A MESIC FOREST**

POSTELLI, K.

*US Geological Survey, Pacific Island Ecosystems Research Center, PO Box 44, Hawaii National Park, HI 96718, and Department of Botany and Graduate Program in Ecology, Evolution and Conservation Biology (EECB), University of Hawaii at Manoa Pacific Cooperative Studies Unit (UH), Pacific Island Ecosystems Research Center, National Park Service, Hawaii National Park, HI 96718-0052, USA. ([postelli@hawaii.edu](mailto:postelli@hawaii.edu))*

**Abstract:** The Kalij pheasant (*Lophura leucomelanos*) is an introduced game bird distributed in diverse forest types from sea level to 2450 m elevation on the Island of Hawaii. Although Kalij feed on fruits of many native and alien plant species, little is known about the fate of seeds they consume. We made weekly foraging observations and collections of Kalij droppings (n = 300) in Kipuka Puaulu in Hawaii Volcanoes National Park for six months. Kalij were observed eating fruits and/or seeds of 14 species (79% native). Intact seeds of sixteen species (44% native) and seed fragments of thirteen species (54% native) were extracted from droppings. Seeds of native and alien species were found in 61% and 34% of droppings, respectively. Of native species consumed by Kalij, some (*Pipturus albidus*, *Leptecophylla tameiameiae*, *Osteomeles anthyllidifolia*) usually occurred as whole seeds; while others (*Coprosma rhynchocarpa*, *Myrsine lessertiana*, *Nestegis sandwicensis*, *Sapindus saponaria*) usually occurred as seed fragments. Of alien species ingested by Kalij, four (*Fragaria vesca*, *Kyllinga brevifolia*, *Rubus argutus*, *Rubus rosifolius*) typically emerged intact, while seeds of the grass, *Ehrharta stipoides*, were always destroyed. Due to their abundance and the diversity of seed species they consume, Kalij may have lasting impacts on plant species dynamics in Hawaiian forests through dispersal and predation of native and alien seeds. Evaluation of Kalij interactions with native and alien plant species will enable land managers to respond appropriately to the spread of this invasive alien vertebrate.



## LIFE HISTORY TRADE-OFFS CHARACTERIZE SPECIES ABUNDANCE AND PERFORMANCE IN A HYPER-DIVERSE TROPICAL RAINFOREST

POTTS, M.<sup>1</sup>, KOHYAMA, T.<sup>1</sup>, KUBO, T.<sup>1</sup>, SUPARDI, M. N.<sup>2</sup> and ASHTON, P.<sup>3</sup>

<sup>1</sup>Graduate School of Environmental Earth Science, Hokkaido University, Sapporo 060-0810, Japan; <sup>2</sup>Forest Research Institute of Malaysia, Kepong, 52109 Kuala Lumpur, Malaysia; <sup>3</sup>Harvard University, Cambridge, MA 02138. ([potts@ucsd.edu](mailto:potts@ucsd.edu)).

**Abstract:** Empirical and theoretical studies have demonstrated that the effects of forest architecture, particularly the size-structures of stands, on species performance can lead to the stable coexistence of tree species. An implicit assumption of this hypothesis is the existence of trade-offs in life history strategies. In this presentation, using data drawn from the large-scale Pasoh Forest Dynamics plot, we provide empirical evidence for the existence of life history tradeoffs among tropical tree species. For 467 species with abundance greater than 50 individuals, we parameterized growth, mortality, and recruitment as function of an individuals size and local crowding. In addition, we collected information on species life history parameters such as local abundance, phylogenetic position, maximum size, spatial aggregation, dispersal syndrome and seed size. We also calculated a size-distribution-corrected light condition preference for each species. Using multivariate statistical techniques, we then related demographic parameters to life history parameters. We found evidence of performance tradeoffs affecting local species abundance and a number of life history traits including maximum size. These results suggest that life history tradeoffs are probably widespread among tropical tree species and must be incorporated into analyses and models of the impact of disturbance on tropical tree communities.

## LONG-TERM DYNAMICS OF URBAN FLORA IN CENTRAL EUROPEAN CITIES

PYŠEK, P.<sup>1</sup>, CHYTRÝ, M.<sup>2</sup>, JAROŠÍK, V.<sup>3</sup>, CHOCHOLOUŠKOVÁ, Z.<sup>4</sup> and TICHÝ, L.<sup>2</sup>

<sup>1</sup>*Institute of Botany, AS CR, Pruhonice, Czech Republic;* <sup>2</sup>*Masaryk University Brno, Czech Republic;* <sup>3</sup>*Charles University, Prague, Czech Republic;* <sup>4</sup>*University of West Bohemia, Plzeň, Czech Republic. (pysek@ibot.cas.cz)*

**Abstract:** Alien plants in urban habitats are reviewed for 54 Central European cities. On average, aliens constitute 40% of city floras; 15% are archaeophytes, introduced before the year 1500, and 25% neophytes, introduced after that date. Richness of aliens increases with city size, the species-area relationship being steeper for neophytes. City size, latitude and temperature were significant predictors of alien species representation. For a detailed case study of the city of Plzeň, Czech Republic, and its surroundings, floristic lists were compiled for the last 120 years. Total number of species decreased from 1173 at the end of 19th century to 1043 in 1990s. Species number was gradually increasing in the city but decreasing in its surroundings. Over 120 years, 805 species remained permanently present, 368 disappeared and 238 immigrated as new. Neophytes increased from 6.2% of the total number at the beginning to 13.2% in 1960s to 17.0% in 1990s. A phytosociological study, conducted in the 1960s, was repeated using the same methods in 1990s. Over three decades, urban vegetation of Plzeň developed towards a more uniform, with a general trend of decrease in species number, evenness and species diversity. When controlling for relevé size, the proportion of both neophytes and archaeophytes decreased. The results indicate a temporal trend in alien species to lower local diversity and at the same time, to an increase in species numbers at a larger scale.

## **CROSSING THE FBT (FEN-BOG TRANSITION ZONE) IN THE SOUTHERN HEMISPHERE REQUIRES THE RESTIAD, EMPODISMA MINUS, AS ENGINEER**

RAPSON, G.L. and HODGES, T.

*Ecology Group, Institute of Natural Resources, Massey University, Palmerston North, New Zealand. (G.Rapson@massey.ac.nz)*

**Abstract:** The fen-bog transition is a well-established process for bogs, developing via either allogenic (e.g. climatic limits) or autogenic (i.e. ecosystem engineers) pathways. *Sphagnum* species are the most common Northern Hemisphere engineers, but this genus appears to have no role in crossing the FBT in the Southern Hemisphere. Instead wirerush (*Empodisma minus*), a member of the southern family Restionaceae, is the only known candidate for engineer. We review allogenic and autogenic models of bog development, and assess the evidence for *Sphagnum* and *Empodisma* as engineers.

The second most common species occurring around the FBT zone in New Zealand is red tussock, *Chionochloa rubra*. We present evidence of the relative competitive abilities of *Chionochloa* and *Empodisma* in experimental microcosms along parts of the FBT's nutrient and water gradients. Our results demonstrate that while conditions at the bog end of the gradient decrease productivity in both species, *Empodisma* is less affected. *Empodisma* has greater ability to pre-empt scarce nutrients supplied by aerosol to mimic nutrient input into bogs, especially at water tables which permit aerial development of its web of negatively geotropic, nutrient-scavenging roots. *Empodisma* is a remarkably efficacious ecosystem engineer.

## LINKING SPECTRAL HETEROGENEITY TO SPECIES DIVERSITY IN A WETLAND AREA

ROCCHINI, D.<sup>1</sup>, CHIARUCCI, A.<sup>1</sup>, BODDI, M.<sup>1</sup>, CASINI, F.<sup>1</sup>, ANGIOLINI, C.<sup>1</sup>, DE DOMINICIS, V.<sup>1</sup> and LOISELLE, S.A.<sup>2</sup>

<sup>1</sup>Dipartimento di Scienze Ambientali "G. Sarfatti" Università di Siena, Via P.A. Mattioli 4, 53100 Siena, Italy. <sup>2</sup>Dipartimento di Scienze e Tecnologie Chimiche e dei Biosistemi, Università di Siena, Via A. Moro 2, 53100 Siena, Italy. ([rocchini@unisi.it](mailto:rocchini@unisi.it))

**Abstract:** This paper explores the use of three different approaches for estimating species diversity in wetland plant communities by using remotely sensed information. Such a study was performed in the "Montepulciano Lake" reserve, Central Italy. The monitoring program for plant communities started in 2002 and it is based on the analysis of plots of 1 m<sup>2</sup>, 100 m<sup>2</sup> and 1 ha of size. The differently sized plots were organized such that four of the smaller size plots are nested within the larger size. Data on species composition were collected in the plots and stored in a GIS-linked archive.

Species richness at the local scale (ALPHA-diversity) was related to the spectral heterogeneity of a multispectral image (Quickbird satellite sensor). A second test was performed to verify the relation of the spectral heterogeneity within sampling units to the mean resemblance of the species composition among the inner sub-units (BETA-diversity). The latter test was carried out by comparing species accumulation curves obtained with plot sequences obtained by using spectral information with those obtained by random sequences of plots, in order to maximize species richness in a given pooled number of plots.

All the analyses were performed at both 100 m<sup>2</sup> and 1 ha spatial scales and demonstrated the high potential of using spectral information to get accurate estimates of species diversity in wetland plant communities.

## **NUTRIENT RELATIONSHIPS IN THE “RIDGE-AND-SLOUGH” VEGETATION MOSAIC OF THE SOUTHERN EVERGLADES, FLORIDA, USA**

ROSS, M., RUIZ, P.L., JAYACHANDRAN, K., COULTAS, C.L., and SAH, J.P.

*Florida International University, Miami, FL 33199, USA. ([rossm@fiu.edu](mailto:rossm@fiu.edu))*

**Abstract:** Vegetation pattern in Shark Slough, the central drainage of the southern Everglades, is characterized by elongated strands of tall sawgrass or woody vegetation on slightly raised substrate, oriented strongly in the predominant flow direction, separated by floating or shorter emergent marsh types on lower surfaces. In 1998-1999 we examined vegetation along six 4-11 km transects, and used concurrent water level measurements to tie the data for all plots into records from long-term water level stations. In 2000 we described soils at a representative subset of each major vegetation type, and collected soil, porewater, and plant tissue for analysis of N and P. Soils of the study area were primarily organic, sometimes with inter-layered marl strata. The vegetation could be distinguished into four major types, arranged neatly along a gradient of annual flooding duration; in this sequence, macrophyte biomass decreased with period of inundation. Pore water nutrient concentrations varied with vegetation type, with highest molar N:P ratios in those types flooded the longest. High leaf N:P ratios were indicative of strong phosphorus limitation in all Shark Slough marsh communities. N:P ratios of one dominant macrophyte species, *Cladium jamaicense*, paralleled those of the pore water, but tissue nutrients of a second species, *Eleocharis cellulosa*, did not vary with pore water concentrations. Patterning in the production and composition of Everglades wetlands involves feedbacks among hydrology, nutrient availability, and species' capacities to utilize resources.

## TREE SPECIES ASSOCIATIONS OVER A LARGE-SCALE SAMPLING REGIME ON THE LOWER MISSISSIPPI RIVER ALLUVIAL PLAIN, USA

ROSSON, J.F., JR.

USDA Forest Service, Southern Research Station, Knoxville, TN 37919, USA.  
([jrosson@fs.fed.us](mailto:jrosson@fs.fed.us))

**Abstract:** Co-occurrence of plant species has typically been studied at small sampling scales. I used continuous forest inventory data from the USDA Forest Service, Forest Inventory and Analysis (FIA) to study tree species associations across a much larger scale. The study area consisted of approximately 1,400 sample plots measured in the 1970's and dispersed over 103,000 km<sup>2</sup> of the Alluvial Plain of Tennessee, Arkansas, Mississippi, and Louisiana. There were 82 tree species >12.7 cm in diameter recorded in the sample. *Taxodium distichum* was the most dominant, accounting for 11.1 percent of the total basal area in the sample. Other ranking dominants were *Nyssa aquatica* (9.2 percent), *Celtis laevigata* (8.1 percent), *Liquidambar styraciflua* (7.9 percent), and *Fraxinus pennsylvanica* (7.8 percent). When ranked by occurrence, *F. pennsylvanica* was the most wide spread, occurring on 450 sample plots. Following were *C. laevigata* (426 plots), *L. styraciflua* (408 plots), and *Ulmus americana* (366 plots). I used Chi-square to test for significant associations between the dominants and to test for positive and negative associations. For example, the association between *T. distichum* and *C. laevigata* was not significant ( $\chi^2=2.61$ ; 1df) but the association between *T. distichum* and *N. aquatica* was highly significant ( $\chi^2=362.9$ ; 1df). Comparing the observed (126 plots) with the expected (33.88 plots) frequency showed these two species to be positively associated. These preliminary results demonstrate that the Chi-square test of association is effective even on the larger scales of sampling where lack of sample homogeneity may sometimes complicate analysis.

## **MODELLING LANDSCAPE CHANGE: IDENTIFYING THE DRIVING FORCES OF FOREST REGENERATION ON ABANDONED LAND**

RUTHERFORD, G. N., ZIMMERMANN, N.E., and BEBI, P.

*Swiss Federal Research Institute WSL, 8903 Birmensdorf, Switzerland*  
([gillian.rutherford@wsl.ch](mailto:gillian.rutherford@wsl.ch))

**Abstract:** The forest area of Switzerland has increased by approximately 30% in the last 150 years, predominantly on abandoned alpine agricultural land. Our research aims to describe, understand and explain spatial and temporal patterns of observed forest expansion over a 13 year time step. We present methods for and the results of modelling the transformation of a long-disturbed cultural landscape, focussing specifically on identifying the environmental characteristics driving secondary forest succession on a nationwide scale. National datasets including land cover, climate, soil, topographical aspects and basic socio-economic variables were combined in a GIS to create a database for every hectare in Switzerland falling into one of the following classes from 1979/85 to 1992/97: (i) closed forest, (ii) open forest; (iii) shrub phase; (iv) extensive grazing; (v) intensive grazing/mowing. Using a combination of univariate statistics, generalised additive modelling (GAM's) and generalised linear modelling (GLM's), we developed spatially explicit statistical models explaining each of the 25 transitions between the 5 land-cover classes. Results indicate that the most important variables increasing the likelihood of forest expansion occurring are the number of shrub and forest neighbours, representing seed source potential, and where elevation-related factors such as number of degree days in the growing season, soil depth and soil permeability are favourable. The models represent a powerful tool in understanding and predicting landscape change for every hectare pixel at the landscape level.

## ON THE BOUNDARY BETWEEN THE STEPPE AND DESERT ZONES IN THE CASPIAN LOWLAND

SAFRONOVA, I.

Komarov Botanical Institute, St.-Petersburg, Russia. E-mail: irinasaf@is1189.spb.edu

**Abstract:** On the boundary between the Steppe and Desert zones in the Caspian Lowland.

The Caspian Lowland lies within the limits of the Steppe and Desert zones. To the South of 48° N. in the northern desert subzone the dwarf-semishrub wormwood communities (*Artemisia lerchiana*; *A. pauciflora*; *A. arenaria*) dominate from the Kuma river up to the Ural river whereas to the east of Ural river the large areas are occupied by the communities of perennial saltworts (*Anabasis salsa*; *A. aphylla*) together with wormwood communities.

The southern steppe subzone, between 50° and 48° N, is occupied by dwarf-semishrub-bunchgrass steppes where bunchgrasses (*Stipa sareptana*, *S. lessingiana*, *Festuca valesiaca*, *Koeleria cristata*, *Agropyron desertorum*) predominate and xerophilous dwarf-semishrubs (*Artemisia lerchiana*, *Camphorosma monspeliaca*, *Kochia prostrata*) always participate as codominants.

The dwarf-semishrub communities are characteristic of this subzone on wide spread saline soils and sand massifs. So, on the steppe loam strong saline soils and solonetz the communities of *Artemisia lerchiana* and of *Artemisia pauciflora* are formed. They are similar to deserts in appearance but differ from them in structure and seasonal rhythm. On the ridge-dune sands both in the southern steppes and in the northern deserts the *A. arenaria* coenosis are common. In the Steppe zone they include some species which are absent in deserts. By this means, the distribution of dwarf-semishrub communities along the zonal boundary presents the certain difficulties for delimitation the Steppe and Desert zones in the Caspian Lowland.



## HIGH MOUNTAIN VEGETATION AND SNOW COVER: A SUBMEDITERRANEAN MODEL FROM THE IBERIAN CENTRAL RANGE

SÁNCHEZ-MATA, D.<sup>1</sup>, SANCHO, L.G.<sup>1</sup>, GAVILÁN, R.<sup>1</sup>, PINTADO, A.<sup>1</sup> and PALACIOS, D.<sup>2</sup>

<sup>1</sup>*Departamento de Biología Vegetal II, Universidad Complutense, Madrid, Spain;*

<sup>2</sup>*Departamento de Análisis Geográfico Regional y Geografía Física, Universidad Complutense, Madrid, Spain ([dsmata@farm.ucm.es](mailto:dsmata@farm.ucm.es)).*

**Abstract:** Seasonal variation in snow cover is an extremely important factor that determines the structure of vegetation in the high mountain territories. Floristic richness and biomass are largely controlled by snow distribution, which varies greatly with topography and wind patterns. The summer rainfall in the most Iberian high mountain territories forces that plant communities which remain under the snow during the winter show a remarkable summer growing season in comparison with the foothills vegetation (submediterranean character).

Our work tries to provide a baseline for measuring long-term changes in submediterranean high mountain vegetation. We studied the microclimate of different plant communities in a snow patch of the Iberian Central Range (Peñalara Natural Park at the Madrid region). The area is confined to the eastern slope of Peñalara Peak where snow patches have the longest duration (2300 m a.s.l.). Three different plant communities were studied along a transient beginning from the edge of a late-melting snow patch towards a wind exposed locality of a ridge top. Temperature, radiation and humidity of characteristic species from these communities were continuously recorded during a year (July 2001 - July 2002).

The contrasted results show marked differences in temperature between and among the different recorded plant communities and microhabitats.

## **WATER AND CARBON-USE RESPONSES TO REMOVAL OF NON-NATIVE FOUNTAIN GRASS IN A HAWAIIAN LOWLAND DRY FOREST**

SANDQUIST, D.R.<sup>1</sup>, CORDELL, S.<sup>2</sup> and LITTON, C.<sup>1,2</sup>

<sup>1</sup>*California State University, Fullerton, CA, 92834, USA;* <sup>2</sup>*USDA Forest Service, Hilo, HA 96720, USA ([dsandquist@fullerton.edu](mailto:dsandquist@fullerton.edu))*

**Abstract:** Invasion by non-native fountain grass, *Pennisetum setaceum*, in Hawaii's lowland dry forests has caused a visible decline in forest health and regeneration, although direct effects due to fountain grass are yet unknown. We assessed the impacts of fountain grass on water use and productivity of the dominant native-tree, *Lama* (*Diospyros sandwicensis*) based on the hypothesis that fountain grass increases competition for shallow-soil resources and thus negatively affects native-tree productivity. Assessments were made in winters and summers over the course of two years by comparing trees in control plots to those in grass removal plots. Water availability was significantly greater in grass removal plots and trees in these plots utilized up to 20% more water from shallow sources than trees in grass removal plots. These water-use differences were most pronounced in periods of intermediate water stress, and were largely absent when soil water was either very high or very low. Concordantly, tree growth was significantly greater in grass removal plots, however leaf-level photosynthesis was not. The discrepancy appears to be balanced by a decrease of leaf mass per area and greater canopy leaf area (i.e., higher litterfall) in removal plots. Our findings provide the first evidence of direct mechanisms by which fountain grass negatively impacts native-tree function in these forests, and affords important information for future management strategies therein.

## **ALTITUDINAL GRADIENTS OF PLANT SPECIES RICHNESS IN ARID HIGH MOUNTAINS: A CASE STUDY OF JARGALANT, MONGOLIAN ALTAI**

SCHICKHOFF, U.

*University of Bonn, Germany. [schickhoff@giub.uni-bonn.de](mailto:schickhoff@giub.uni-bonn.de)*

**Abstract:** Our knowledge of vertical ecological gradients in arid high mountains is still fragmentary. I analysed vascular plant species richness, diversity and evenness along an elevational transect from semi-desert vegetation at 1200 m (Great Lakes Basin, W-Mongolia) up to alpine Carex-Kobresia mats at 3300 m a.s.l. in adjacent Jargalant Mts., Mongolian Altai. 60 vegetation plots of 25 m<sup>2</sup> were spaced at intervals of 100 altimeters, covering north- and facing slopes and areas of high and low human impact. Analyses included plant species composition, cover, numbers, soil physical and chemical parameters, climatic observations and grazing influence.

Results show a sharp increase in species richness and diversity from Stipa-Anabasis semi-desert to about 2200 m (Caragana shrub semi-desert/Agropyron-Koeleria mountain steppe). Between 2200 and 2600 m species richness and diversity decreases again. This decrease has to be attributed to the severe grazing impact in this altitudinal range where the huts of the local nomad families and their livestock concentrate in summer and partially also in winter. Above 2600 m richness and diversity increase again up to c. 3000 m (in accordance to more favourable hygric and edaphic conditions) and then show again a reverse trend. The results highlight that human impact considerably influences vertical eco-gradients in old-world high mountains.

## **FOUNTAIN GRASS CONTROL WITHIN INTENSIVE MANAGEMENT UNITS AT POHAKULOA TRAINING AREA, HAWAII ISLAND**

SCHNELL, L., EVANS, S., BELT, T., KELLY, A., TOMINAGA, L.,  
TUCKER, B., YORK, D.

*Colorado State University, Center for Ecological Management of Military Lands, Pohakuloa  
Training Area, HI, USA. [Lena.Schnell@us.army.mil](mailto:Lena.Schnell@us.army.mil)*

**Abstract:** Pohakuloa Training Area, which is located in the saddle region on the island of Hawaii Island, has fountain grass (*Pennisetum setaceum*) densities that are among the highest on the island. The fire potential created by high fountain grass densities is one of the major threats to the 12 federally listed plant species at PTA. Native species are negatively impacted by fountain grass through competition for space and underground resources. Because of the flammable and competitive nature of fountain grass, PTA has begun a management program centered on federally listed plant populations located within Intensive Management Units (IMU). The short-term goal is a 50-meter buffer around federally listed plants where all fountain grass is removed from the buffer. The long-term goal is to remove fountain grass entirely from each of the IMU. Management sites for the short-term goal were prioritized according to the rarity of the species and the fire potential of its location and habitat. Information on daily management activity was gathered with GPS units and incorporated into a GIS database to better track work progress toward the short-term goal. A combination of techniques was employed to manage the grass at various growth stages including hand-pulling and mechanical and chemical removal. By determining management efforts for different densities of fountain grass, we are better able to plan management projects, allocate personnel hours, and track progress toward our management goals.

## **SUCCESSIONAL PROCESSES IN SUBCONTINENTAL SAND ECOSYSTEMS: ARE THERE TRENDS OF REDYNAMIZATION BY RESTORATIVE GRAZING?\***

SCHWABE, A., SÜSS, K. and STORM, C.

*Darmstadt University of Technology, D-64287 Darmstadt, Germany ([Schwabe@bio.tu-darmstadt.de](mailto:Schwabe@bio.tu-darmstadt.de))*

**Abstract:** According to our 9-years investigations of permanent plots in the upper Rhine valley (Germany), the species-rich Koelerion glaucae- and Festucetalia/Valesiaca communities of endangered subcontinental sand-ecosystems are more and more characterized by increasing grass-encroachment. The main tall grass species is Calamagrostis epigejos. According to our soil investigations, Calamagrostis epigejos stands (with low phytodiversity) are restricted to sites with higher N; P, K soil concentrations and higher moisture indicator values than Stipa capillata stands (the latter with high phytodiversity). The hypothesis was, that Calamagrostis stands might be “redynamized” by special grazing systems to restore, for nature conservation purposes, vegetation complexes with open stands (Koelerion glaucae) in a 4-years field experiment fenced and sheep grazed areas have been analyzed. Only sheep breeds with low demands of energy feed were used. Strong effects were observed in the case of small paddocks (about 1 ha) being grazed for short periods (a few days) by 400-500 sheep. Important significant effects were e.g. litter reduction, increase of small endangered plant species and in general first steps to restore the endangered target communities. Additional studies with non-ruminants (donkeys) show stronger effects and important gap formation.

Süß, K.; Storm, C.; Zehm, A.; Schwabe, A. (accepted): Succession in inland sand-ecosystems: Which factors determine the occurrence of the tall grass species Calamagrostis epigejos (L.) Roth and Stipa Capitata L.? – Plant Biology.

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## **SUBMONTANE RAIN FORESTS OF THE ATLANTIC CENTRAL AFRICAN CENTRE OF DIVERSITY: GEOGRAPHICAL DISTRIBUTION AND ECOLOGY, AFFINITIES AND ORIGINS**

SENTERRE, B.

*Université Libre de Bruxelles, Laboratoire de Botanique systématique et de Phytosociologie, CP 169, Av. F. Roosevelt 50, 1050 Bruxelles, BELGIUM. ([bsenterr@ulb.ac.be](mailto:bsenterr@ulb.ac.be))*

**Abstract:** Many persons have discussed the presence and extent of rain forest refuges during the past glacials, in central Africa. During these glacials, lowland rain forests extent reduced and submontane vegetation descended at lower altitudes. Most of these refuges are centred on mountain regions. This contribution tries to answer the following questions, focussing on the Atlantic central African centre of diversity, from South-western Cameroon to Southern Gabon. What is exactly the actual extent of the montane, and mainly submontane, rain forests? Which combinations of environmental variables determine this geographical distribution? What are the affinities and dissimilarities between the different montane regions? Starting data are phytosociological relevés realised in the Monte Alén National Park, in Equatorial Guinea, from lowland up to 1300m high. This region is the Northern prolongation of the Cristal Mountain range. A first description of this submontane rain forest vegetation is proposed and differential characteristic species are listed for the main forest strata, from herbs to higher trees. The exact distribution of the differential montane species group is drawn. This vegetation presents an archipelago like distribution and altitudinal range is different from one region to another according to ecological equalizations.

## INVASION OF *BISHOFIA JAVANICA* AND RECENT ERADICATION EFFORTS IN THE BONIN (OGASAWARA) ISLANDS

SHIMIZU, Y.

*Komazawa University, Tokyo, JAPAN. ([ys@komazawa-u.ac.jp](mailto:ys@komazawa-u.ac.jp))*

**Abstract:** *Bischofia javanica* of SE Asian origin was introduced to the Bonins before 1905. It extended its distribution gradually from the afforestation sites, and after the large typhoon disturbance of 1983 rapidly spread to a wide range of Hahajima. I studied the invasion process and mechanism of *Bischofia* since 1977. *Bischofia* has favorable features in competition with native species, such as rapid growth of seedlings and saplings, vigorous sprouting ability, shade-tolerant ability of juveniles, a large quantity of seeds for bird dispersal and allelopathy. Therefore, seedlings which germinate in canopy gaps grow rapidly and occupy the place securely. Native species are driven out gradually from the forest, and a pure *Bischofia* forest finally comes into being. *Bischofia* does not become a dominant tree in SE Asian forests, maybe because competition with herbivore insects, parasitic diseases and more shade-tolerant species control the number of *Bischofia* individuals. The Bonin branch of Forestry Agency set up a test area to eradicate *Bischofia* in 1994. Large *Bischofia* trees were girdled instead of felling to avoid rapid environmental change. The trees made many sprouts from the treated portion and it was necessary to cut them to kill the trees completely. Juveniles of native species raised in a nursery were transplanted under the canopy of dead *Bischofia* trees. The formal eradication project just started in 2002, but the method includes several problems to be solved.

## CLIMATE AND SUBSTRATES, AND THEIR EFFECT ON THE SAMOAN FLORA

SILIKO, S.<sup>1</sup> and TUIVAVALAGI, N.<sup>2</sup>

<sup>1</sup>Faculty of Science and <sup>2</sup>Institute of Samoan Studies, National University of Samoa, Apia, Samoa. [S\\_Siliko@yahoo.com](mailto:S_Siliko@yahoo.com)

**Abstract:** Samoa's climate is tropical. The country is in the southern hemisphere but because of its proximity to the equator, there is no major seasonal difference such as the difference between summer and winter in temperate regions. A literature review and personal experiences show that the rainy season in Samoa is centered around January and the dry season around July and August. Because the interior of the island is mountainous there is also a considerable difference between the rainfall on the coast and that in the jungle further inland. During the recent PABITRA workshop in Savaii, we found that weather data is not being collected from the montane forest areas of the country. This is an issue we would like to address soon by installing a weather station in the montane forest area of Aopo which could help us in understanding some of the plant dynamics in the area. On the other hand, the Samoan soil is mostly highly weathered and clayey while its fertility is mostly due to its organic matter content. We also found that the age or, more accurately, the degree of weathering or break-up of the volcanic substrate also has a significant effect on the Samoan flora. This presentation will explore these and other effects of climate and substrate on the Samoan flora based on published literature, unpublished results of recent investigations, and personal findings.



## **PHYTOINDICATION OF THE DISTURBED STATE OF ECOSYSTEMS IN THE LAKE BAIKAL'S SHORE TERRITORIES (WESTERN SHORE AREA)**

SIZYKH, A.

*Institute of Geography, Siberian Branch, Russian Academy of Sciences. Irkutsk, 664033, 1, Ulanbatorskaya str., P.O.Box 4027, Russia.*

**Abstract:** The challenging problems of the territories of the Baikal Lake's shore areas include issues of diagnosing the state of ecosystems in order to take appropriate action to avoid their degradation. A special challenge is the problem of rehabilitating the ecosystems that have already been disturbed. This brings up the questions as to defining the methods for monitoring the state and trends of natural complexes and to regulate anthropogenic loads for particular environmental conditions in the region's areas. One of the criteria for assessing the disturbed state of ecosystems includes data of phytoindication acquired in the process of identifying the back reactions of certain plants to the influence of factors of a different nature. In this case, changes of the ambient environment and internal conditions of ecotopes of communities are factors that trigger dynamic trends of ecosystems. The composition and structure of the vegetative cover serve as highly effective indicators not only of the present state but also of the history of development of particular ecosystems. This is a reliable diagnostic attribute in the monitoring system for the character of disturbance of ecosystems. Phytoindication can have many levels: according to the species and population composition, the vertical and spatial structures, dynamics, the character of functioning and peculiarities of rehabilitation of cenoses, and the genesis of communities under particular conditions of the region's environment.

## PRIMARY SUCCESSION OF PÁRAMO VEGETATION ON VOLCÁN COTOPAXI (ECUADOR): PATTERNS OF DIVERSITY AT DIFFERENT SAMPLING SCALES

SKLENÁŘ, P.<sup>1</sup>, KOVÁŘ, P.<sup>1</sup>, SOLDÁN, Z.<sup>1</sup>, STANČÍK, D.<sup>1</sup>, PALICE, Z.<sup>2</sup>,  
KULÍŠEK, P.<sup>1</sup>

<sup>1</sup>Department of Botany, Charles University, Benátská 2, Prague 2, CZ-128 01, Czech Republic; <sup>2</sup>Institute of Botany, Czech Academy of Sciences, Průhonice, CZ-252 43, Czech Republic (petr@natur.cuni.cz)

**Abstract:** Volcanic disturbance belongs to the major factors which determine the species composition and vegetation structure in the Ecuadorian páramo. We studied the development of the pioneer páramo vegetation on the Volcán Cotopaxi and were particularly interested in the changes of diversity patterns with time and sampling scales. At an altitude of 3800 m, series of nestedly arranged permanent plots of different sizes (5x5 cm, 50x50 cm, 6x2 m) were established on three adjacent lahars of different age (1530, 1740, 1877 A.D.). Abundance of plants was recorded in the smallest plots, by pooling them we obtained abundance scores for the higher sampling scales. The youngest vegetation is dominated by lichens (both, by species richness and abundance) and there is a change towards the dicotyleds in the oldest lahar. We document a progressional increase in species richness with the age at any scale, although there is only minor difference between the two older lahars. Equitability is highest at the smallest scale and strongly declines at the two higher scales, as a result of increasing dominance of the most common species. Using direct ordinations we partitioned the variability of vegetation among the hierarchical sampling scales. Most variability is accounted for by the age of the lahar, and much less variability is contained at lower scales. Patterns of species diversity are obviously a function of the time since disturbance and the sampling scale.

## LANDSCAPE QUALITY AND LANDSCAPE MANAGEMENT MODEL

SMIRAGLIA, D.<sup>1</sup>, CARRANZA, M.L.<sup>2</sup>, PRESTI, G.<sup>2</sup>, BLASI, C.<sup>1</sup>

<sup>1</sup>University of Rome "La Sapienza", Rome, Italy; <sup>2</sup>University of Molise, Isernia, Italy.  
([daniela.smiraglia@uniroma1.it](mailto:daniela.smiraglia@uniroma1.it))

**Abstract:** The aim of this study is to propose a bidimensional index of landscape quality as a basis for a landscape management model. In the present work the distribution pattern of Potential Natural Vegetation (PNV) is used as an ecological baseline for the evaluation of landscape conservation status. The comparison between Actual Vegetation (ACV) and PNV distribution allows us to evaluate landscape structure and to analyze the environmental fragmentation inside homogeneous land units (PNV units). As an example a test site in Central Italy was selected. A hierarchical landscape classification approach was used to define PNV units. Using GIS technologies the ACV map and the PNV map were analyzed (scale 1:25.000). Landscape composition and structure indexes (mean patch size, class area, mean nearest neighbor, number of patches) for each PNV unit were calculated. Moreover, we simulated the entire combinations of indexes. The matrix of simulated PNV units by landscape indexes was analyzed through multivariate techniques in order to define homogeneous clusters. Each cluster projected in a bidimensional ordination space of landscape indexes was associated to different land quality levels. This simulated bidimensional space summarizes all the possible PNV unit cases. In this way it allows us to evaluate the conservation status of any PNV unit and forecast its situation in different management initiatives. The results show that the proposed model can represent a promising tool for environmental monitoring and assessment.

## VEGETATION COMMUNITY PARAMETERS IN RESERVE DESIGN MODELING, KINGDOM OF TONGA

SMITH, L.<sup>1</sup>, FRANKLIN, J.

<sup>1</sup>*San Diego State University, San Diego, CA, USA. ([lsmith@mail.sdsu.edu](mailto:lsmith@mail.sdsu.edu))*

**Abstract:** The science of reserve design provides a framework for conservation that is particularly applicable to small islands since limited resources require conservation solutions that optimize biological goals and cost. This research analyzed spatial patterns of plant species composition, richness and rarity in Tonga in order to evaluate the relative contribution of these parameters to reserve design models, and assess the value of a reserve design approach to conservation in Tonga. Qualitative and quantitative vegetation data from all published surveys in Tonga were evaluated. Classification and ordination analysis together with land use mapping showed that vegetation in Tonga is a mosaic of mature forest, successional forest, and active agricultural plantation. Mature forest types include coastal and lowland rainforest, the latter of which occurs as distinctive subtypes on 'Eua, Tofua and Kao. Highest native species richness occurs on higher, larger and less-accessible patches and islands in 'Eua and Vava'u. Rare and endemic plant species are restricted to certain vegetation types, certain islands or both. Preliminary reserve design models using species composition, richness and rarity as parameters, vary in the extent and location of reserve boundaries and in conservation goals met. The reserve design approach to conservation in Tonga is promising yet several important data gaps need to be filled.

## CLASSIFICATION AND RECONSTRUCTION OF CALIFORNIA NATIVE GRASSLANDS

SOLOMESHCH, A.I.<sup>1,2</sup>, BARBOUR, M.G.<sup>1</sup>.

<sup>1</sup> University of California, Davis, CA, USA; <sup>2</sup> Institute of Biology Ufa Scientific Center Russian Academy of Sciences, Ufa, Russia. ([aizsolomeshch@ucdavis.edu](mailto:aizsolomeshch@ucdavis.edu))

**Abstract:** Native California grassland represent one of the most dramatic examples of large-scale species replacement in the world, and considered to be one of the most endangered vegetation types in the US. Clements (1920; 1934) was the first to postulate that the former, natural grasslands were dominated by perennial bunchgrasses (*Nasella cernua*, *Nasella pulchra*). Because of the virtual extinction of the pristine prairie there are several hypotheses about what the original vegetation consisted of. Even though none of the hypotheses have been convincingly supported, current research and conservation activities generally choose bunchgrass prairie as the pre-contact cover. Understanding the pre-contact nature of California grasslands is critical to their successful restoration. We suggest that the debate about the pre-contact landscape has remained so long unresolved, because of a past focus on dominants, all of which have become displaced by exotics. Little attention was paid to those native species, which still remain, although at low abundance. We sampled complete floristic assemblages of 118 plots 100 m<sup>2</sup> each from seven sites in the California Central Valley. Data were classified using the Braun-Blanquet approach, and 10 community types were recognized. We show that the native species assemblages in modern grasslands could not have been derived from only bunchgrass prairie; that vegetation in the past included also annual-dominated communities.

## **A STUDY ON PASTURE VERSUS ACACIA KOA-FOREST PRODUCTIVITY FOR THE KEAUHOU RANCH ON HAWAII**

SPATZ, G.

*University of Kassel, Witzenhausen, Germany. bspatz @kreilhof.de*

**Abstract:** The area of the Keauhou Ranch originally was covered by endemic Acacia koa and Ohio polymorpha forest but has been converted into pasture successively. The vegetation of the whole area was mapped. 50 fenced parcels were set up within representative pasture communities which had developed depending on soil properties and age of utilisation. The parcels were harvested 4 times the year and soil was sampled. The forage samples were analysed for yield and quality. The diameters at breast height ranging from 2 to 100 cm of 100 Koa trees were measured on two different locations over one year. The growth curves for the two locations were estimated from growth rates per day in relation to diameters by a regression equation. An integration of the growth curve allowed to calculate the age of a tree representing a certain diameter. The profitability of beef production versus Koa timber production was calculated for the different vegetations types of the Keauhou Ranch. The results clearly showed that Koa forestry could be as economic as beef production on a large part of the ranch. As a conclusion, pasture management on productive grassland vegetation should be improved. A sustainable Koa forestry should be practiced on suitable locations. The rest of the farm with less productive soil should be left unutilised as a resource for wildlife and recreation.

## **METADATA MANAGEMENT FOR NEW ZEALAND'S NATIONAL VEGETATION PLOT DATABANK**

SPENCER, N. and WISER, S.

*Landcare Research, Lincoln, New Zealand, [spencern@landcareresearch.co.nz](mailto:spencern@landcareresearch.co.nz).*

**Abstract:** Growing volumes of ecological research data, and the need to use this data in new ways, push the boundaries of traditional approaches to data management. While mostly meeting restricted project scale goals, these traditional approaches may become limiting over time or when scaled to national and global questions. Managing these growing data volumes and facilitating their re-synthesis can be aided by a number of 'best practice' data management and custodial options. One facet of these options is the provision of comprehensive data set descriptions and documentation. These ensure data set longevity as knowledge is maintained, and allows fitness for use to be determined for future synthesis.

We present a case study that demonstrates the application and subsequent benefits of implementing a comprehensive metadata profile and system for its management for a longitudinal vegetation survey data archive in New Zealand. The National Vegetation Survey databank (NVS) is New Zealand's largest archive for plot-based vegetation data concentrating on indigenous plant communities. The metadata schema follows international based standards and was developed as an XML Schema to maximise portability. This metadata system allows the databank to provide a high quality service to depositors and maintains its ability to contribute to global data sets addressing large-scale issues (e.g. the New Zealand Carbon Monitoring System project).

## CAUSES AND DYNAMICS OF THE TROPICAL MOUNTAIN GRASSLANDS EROSION: VOLCÁN CHIMBORAZO (ECUADOR) STUDY CASE

STANČÍK, D.<sup>1</sup>, SKLENÁŘ, P.<sup>1</sup>, KOVÁŘ, P.<sup>1</sup>, SOLDÁN, Z.<sup>1</sup>, PALICE, Z.<sup>2</sup> and KULÍŠEK, P.<sup>1</sup>

<sup>1</sup>Charles University, Prague, Czech Republic; <sup>2</sup>Institute of Botany, Academy of Sciences, Czech Republic (e-mail: dan\_stancik@yahoo.com)

**Abstract:** Páramo vegetation on the SW slopes of Chimborazo occurs in the rain shadow, which together with human impact lead to development of a waste-land called „Arenal“. The transitional zone between the original grasspáramo and arenal is very prone to erosion.

The aim of this project is to characterize the vegetation changes along this active transitional zone and estimate the rate of boundary shift. Ten permanent transects, intersecting the transitions zones, were established at 4000–4200 m. Along these ca 100 m long transects permanent plots of 1x1 m were established at 2 m intervals where phytocenological relevés (using Br.-Bl. abundance-dominance scale) were recorded. We also drawn micro-maps of distribution of dominant species. The data were analysed using cluster and ordination analyses.

Some species (from 149 of total) present a broad distribution along the transects (*Baccharis caespitosa*, *Calamagrostis mollis*, *Poa subspicata*), but we can distinguish a clear difference between the grassland (*Festuca subulifolia*, *Calamagrostis intermedia*, *Gentianella cerastoides*, *Geranium* cf. *reptans*, *Lupinus microphyllus*) and the arenal (*Geranium ecuadoriense*, *Eudema nubigena*, *Plantago nubigena*) flora. Some species (*Festuca vaginalis*, *Stipa hans-meyeri*, *Luzula racemosa*, *Oreomyrrhis andicola*) are characteristic only to the narrow eroded transitional zone. The bryophytes abundance positively correlates to abundance of herbs, but species composition does not show significant differentiation along the transect.

Data that will be collected in 15-20 years will enable us to quantify the temporal dynamics of this degradation process.



## VEGETATION RECOVERY FOLLOWING LONG-TERM CATTLE GRAZING AT SIMEONOF ISLAND, SOUTHWESTERN ALASKA

TALBOT, S. S.<sup>1</sup> and TALBOT, S. L.<sup>2</sup>

<sup>1</sup>U.S. Fish and Wildlife Service, 1011 East Tudor Road, Anchorage, AK 99503, USA; <sup>2</sup>U.S. Geological Survey, Alaska Science Center, 1011 East Tudor Road, Anchorage, AK 99503 USA. Email: [stephen\\_talbot@fws.gov](mailto:stephen_talbot@fws.gov).

**Abstract:** Ecosystem conditions at Simeonof Island, Alaska were studied to document recovery of vegetation following the removal of cattle. To record changes in the vegetation, data were analyzed using photo-documentation, permanent plots, multivariate analysis and comparative analysis with undisturbed ecosystems. Nine major community types are distinguished according to species composition using the MULVA-5 computer package. Results indicate that recovery differs in the various community types; these types are listed from the most to least impacted: 1) total plant cover increased during the past fourteen years in sandy, coastal *Leymus mollis* communities, which were originally the most impacted, and natural successional processes are stabilizing these sites; 2) a successional shift occurred from *Festuca rubra* grasslands to *Heracleum lanatum*-*Epilobium angustifolium* forb meadows with corresponding changes in floristic composition; and 3) in the previously least-impacted sites – *Empetrum nigrum* heaths and *Eriophorum angustifolium*-*Carex lyngbyei* mires – little floristic change occurred. Disturbance caused by cattle overgrazing and by extrapolation other grazing herbivores on other maritime islands in southwestern Alaska may also be alleviated through removal of herbivores and subsequent promotion of natural successional processes.

## EFFECTS OF FOREST FLOOR DISTURBANCE ON STRUCTURE AND DYNAMICS OF SUBALPINE LARCH FORESTS NEAR THE TREELINE OF NORTHERN SLOPE OF MT. FUJI

TANAKA, A.<sup>1</sup>, NAKANO, T.<sup>2</sup> and YAMAMURA, Y.<sup>1</sup>

<sup>1</sup>Ibaraki University, Mito, Ibaraki, Japan, <sup>2</sup>Yamanashi Institute of Environmental Sciences,  
Fuji-Yoshida, Yamanashi, Japan ([nakano@yies.pref.yamanashi.jp](mailto:nakano@yies.pref.yamanashi.jp))

**Abstract:** In subalpine regions of Mt. Fuji, slush avalanches sometimes occurs and affect vegetation structure and succession. Along slopes, we settled two quadrats in larch forests that have suffered the soil disturbance and an undisturbed forest, to evaluate the effect of destruction of forest floor on the forest structure and succession. DBH or basal diameter, height, age and spatial distribution were measured for all the trees. The thickness of the deposited scoria was measured in the disturbed site. The saplings of a larch (*Larix kaempferi*) occurred in the disturbed site, but not in the undisturbed site. In the disturbed site, age structure of *L. kaempferi* was divided into three groups: old trees, young trees and saplings. The old trees appeared in the entire quadrat, but young trees and saplings appeared only in upper part of the quadrat covered with thickly deposited scoria. On the other hand, such a bias was not observed in the undisturbed site. The saplings of *Abies veitchii* were abundant in the both quadrat, and age structure of *A. veitchii* in each quadrat has stable structure. The distribution of *A. veitchii* along the slope showed similar pattern in both quadrat; only younger trees appeared in the upper part of quadrats, but the trees of various ages in the lower part of those.

## POTENTIAL IMPACT OF CLIMATE CHANGES ON DWARF-BAMBOO SPECIES IN JAPAN

TANAKA, NOBUYUKI

Forestry and Forest Products Research Institute (FFPRI), Tsukuba, Ibaraki 305-8687, Japan  
([ntanaka@ffpri.affrc.go.jp](mailto:ntanaka@ffpri.affrc.go.jp))

**Abstract:** The objective of the paper is to review distributions and ecophysiological traits of some major dwarf-bamboo species and to discuss their relationships to environmental factors and the potential impact on the species. Distributions of dwarf-bamboos can be explained by relationships between ecophysiological traits (maximum height, resistance to snow cover and cold, recovery after damage to aboveground organs) and winter climate (cold, wind and snow cover). Distribution of dwarf-bamboos of the sections *Macrochlamys* and *Sasa* is confined in snowy areas because they have prostrate culms and are low in freezing tolerance on leaves, culms and buds. *Macrochlamys* with slightly higher freezing tolerance than *Sasa* dominates at higher elevations, reaching the alpine zone. The section *Crassinodi* and the genus *Sasamorpha* are distributed in light-snow areas. *Sasamorpha* is higher in freezing tolerance on aboveground organs than *Crassinodi*. But *Crassinodi* occurs in colder zone than *Sasamorpha*. *Crassinodi* avoids serious damages caused by the severe cold in winter because of the short longevity and relatively small allocation of dry matter to the aboveground organs. Changes in snow conditions caused by the climate change in the future possibly affect the distribution and growth of dwarf-bamboos since they are well related to the present climate, especially snow conditions. The dwarf-bamboo species may be good indicators for the impact of climate change. The effects of climate change can be detected earliest by recording damages appearing in dwarf-bamboo communities in winter.

## **FIRE INTENSITY AFFECTS POPULATION DYNAMICS OF A RHIZOMATOUS SHRUB IN A FREQUENTLY-BURNED LONGLEAF PINE SAVANNA**

THAXTON, J. M.<sup>1\*</sup> and PLATT, W. J.<sup>2</sup>

<sup>1</sup>USDA Forest Service, Hilo, HI, <sup>2</sup>Louisiana State University, Baton Rouge, LA.  
([jthaxton@fs.fed.us](mailto:jthaxton@fs.fed.us))

**Abstract:** We developed stage-based matrix models to examine the effects of fire intensity on *Rhus copallinum*, flameleaf sumac, in Louisiana, USA. Models were developed from 3 years of demographic data on ramets that experienced fires of different intensity. We manipulated fire intensity by applying one of four fuel load treatments: fine fuel removal, pine needle addition, wood addition or unaltered control to 1-m<sup>2</sup> plots prior to fires. We considered all ramets that received a particular fuel load treatment to be a single population. Thus we developed matrices for four populations. Periodic matrices indicated that over the three years of the study, population growth rate ( $\lambda$ ) was positive ( $>1$ ) in the control treatment, nearly stable ( $\sim 1$ ) in the pine needle addition treatment, and negative ( $<1$ ) in the fuel removal and wood addition treatments. Annual matrices indicated that relative differences in population growth rates varied between fire and non-fire years. Elasticity analyses indicated that stasis of large ramets was the largest contributor to observed population growth rates. Our results suggest that local differences in fire intensity may be an important source of variation in *R. copallinum* population growth in frequently-burned pine savannas.

## COMPOSITION AND STRUCTURE OF THE CLOUD FOREST ON MT. DELACO, GAU, FIJI

THOMAS, N.T.<sup>1</sup> and KEPPEL, G.<sup>2</sup>

<sup>1</sup>University of the South Pacific, Institute of Applied Sciences, P.O. Box 1168, Suva, Fiji Islands. Tel. (679) 3212975. [nunia.thomas@yahoo.com](mailto:nunia.thomas@yahoo.com). <sup>2</sup>University of the South Pacific, Biology Department, P.O. Box 1168, Suva, Fiji Islands

**Abstract:** The island of Gau is the fifth-largest island (140 km<sup>2</sup>) in the Fiji archipelago. This study investigates the composition and structure of the cloud forest on the island's highest peak Mt. Delaco (715m) using a transect following a ridge. Dbh, height, epiphyte cover and distance to the nearest neighbor were measured for each plant of 5 or more cm in dbh. All vascular species present were identified. The most abundant tree species was the tree fern *Dicksonia brackenridgei* with occasional occurrences of *Astronidium* cf. *parviflorum* and *Ascarina diffusa*. Epiphytes were abundant and epiphyte cover for most trees was more than 50%. Some of the common epiphytes were *Nephrolepis tuberosa*, *Nephrolepis saligna*, *Collospermum montanum*, *Pepperomia* spp., *Bulbophyllum betchei*, *Freycinetia* spp., mosses and filmy ferns (Hymenophyllaceae). TWINSpan analysis indicates that the cloud forest on Mt. Delaco is similar to the cloud forests on Mt. Koroturaga on Taveuni, Fiji, but less diverse.

## THE UPLAND WATERSHED FORESTS OF THE PABITRA GATEWAY TRANSECT ON VITI LEVU, FIJI

TUIWAWA, M.<sup>1</sup> and NAIKATINI, A.<sup>1</sup>

<sup>1</sup>*South Pacific Regional Herbarium, Institute of Applied Sciences, University of the South Pacific, Suva, Fiji. ([tuiwawa\\_m@usp.ac.fj](mailto:tuiwawa_m@usp.ac.fj))*

**Abstract:** The Monasavu Water Catchment and the Wabu Nature Reserve are focal sites in the PABITRA Gateway Transect. The area is the major water catchment for the Waimimala River and Monasavu Dam and as such the forest area becomes Protection Forest under the Forestry Act of the Fiji Republic. Both focal sites are in the upland and montane cloud forest ecosystem. Recent baseline biological survey in Wabu provides preliminary information on two distinctive forest communities, and its unique flora and fauna. Qualitative observation on the impacts of development in the two focal sites reveals the presence of more invasive species in the more developed Monasavu catchment – hydro electricity development, as compared to a more pristine Wabu Reserve. This result of habitat fragmentation brought about by development in the Monasavu/Wabu corridor makes these PABITRA sites an exciting area for research.

## THE APN-PABITRA-USP BIODIVERSITY TRAINING WORKSHOP IN FIJI

TUIWAWA, M.<sup>1</sup>, KEPPEL, G.<sup>2</sup> and THOMAS, N.<sup>2</sup>

<sup>1</sup>*Institute of Applied Sciences*, <sup>2</sup>*University of the South Pacific, Suva, Fiji*

**Abstract:** The PABITRA (Pacific-Asia Biodiversity Transect) Network concluded a biodiversity training workshop on the island of Viti Levu from November 18 to December 3, 2002, with funding from APN (the Asia-Pacific Network for Global Change Research) and support from USP (The University of the south Pacific) in Suva, Fiji. An initial planning meeting in June 2002 resulted in drafting a broad landscape transect from Mt. Tomaniivi (1340 m) to the Rewa River Delta with a selection of seven biodiversity focal sites. The subsequent training workshop included 25 USP students with several USP faculty members, Fiji government officials, NGO professionals, and overseas PABITRA scientists. The training workshop began in the Savura lowland rain forest, it then continued on Nasoata Mangrove Island. From there, we visited inland agricultural settings and discussed assessment methods. We proceeded to the Monasavu watershed forest and selected cloud forest sites for subsequent instrumentation. Some insect trapping methods were demonstrated and plant- and bird check listing was advanced for this area. The Fiji PABITRA group then did a follow-up vegetation, bird, herpetology, and habitat study in Savura forest, which was selected as one of the more remote sites on the PABITRA Gateway Transects. Two illustrated Technical Reports were produced as an outcome of these biodiversity assessment activities with standardized PABITRA methodology now on the Internet under [www.botany.hawaii.edu/pabitra](http://www.botany.hawaii.edu/pabitra).

## PLANT SUCCESSION ON AND SURROUNDING THE KULA VOLCANO(TURKEY)

UGURLU, E.<sup>1</sup>

<sup>1</sup>University of Ege, Science Faculty, Bornova-IZMIR, TURKEY. ([ugurlu@sci.ege.edu.tr](mailto:ugurlu@sci.ege.edu.tr))

**Abstract:** This study was carried out at the Kula Volcano and the surrounding area between 2002-2003. Plants were collected and dried and their names were determined according to the Flora of Turkey(Davis, 1965-1988). They are being kept in Ege University Herbarium. The Kula Volcano was active in the Quaternary period. However now it is inactive. The site(38, 58 N and 28, 52 E) is 12 km to the west of the town of Kula and 1,5 km north of the the Izmir-Ankara highway at an elevation of 750 m. This area covers about 400 km<sup>2</sup> and is generally bare. However there is plant cover in some areas. It consists of three basins and the schistose ridges separating them are covered with volcanic cones and lava streams and fields. The vegetation occurring on the volcanic cone and its surrounding area where this survey was performed displays some difference depending on the altitude and aspect. The following successional stages were observed on the Kula Volcano and the surrounding area: 1- Crustose-lichen stage 2- Foliose lichen stage 3- Moss stage 4- Herbaceous stage 5- Shrub stage 6- Climax. *Pinus brutia* is dominant at the climax stage. In this study the developmental stages of succession and their plants using the Braun-Blanquet method is given. Attention was paid to endemic plants.

**Keywords:** West Anatolia, Succession, Volcano, Turkey.



## VEGETATION CHANGE IN THE WEST GULF COASTAL PLAIN, USA

VAN KLEY, J. E., and EVANS, R. E.

*Department of Biology, PO Box 13003, Stephen F. Austin State University, Nacogdoches, Texas, 75962, USA. ([fvankley@sfasu.edu](mailto:fvankley@sfasu.edu))*

**Abstract:** Nearly 450 intensively sampled natural forest stands in eastern Texas and western Louisiana were used to describe a series of natural community types including various pine-dominated uplands, hardwood-dominated slopes, minor stream floodplains, and river floodplains. Here we compare modern communities based on these data with those inferred from early 20<sup>th</sup> century timber company inventories, historical literature, and literature based on early witness tree surveys. While many historical community types have a modern equivalent as indicated by a DCA ordination combining both early timber inventory and modern data, comparison of modern data sets with historical information from the same landscape suggests major changes. Extensive upland areas in Sabine and San Augustine Counties, Texas, formerly dominated by longleaf pine are now largely mixed forests of loblolly pine and broad-leaved species. In the northern portion of the region, formerly dominant shortleaf pine/ oak communities are now rare; most current uplands support loblolly pine stands. These observations are consistent with the literature for the southeastern US, which implicates disruption of the natural fire regime in addition to massive logging and other human disturbances as important agents of change.

## TEMPORAL BIOMASS ANALYSIS FOR ASSESSING THE IMPACT OF DISTURBANCE ON SPECIES EQUILIBRIUM

VAN NIEL, K. P.<sup>1</sup> and DAVEY, S. M.<sup>2</sup>

<sup>1</sup>University of Western Australia, Crawley, WA, Australia, <sup>2</sup>Bureau of Rural Sciences, Canberra ACT Australia. ([kvn@segs.uwa.edu.au](mailto:kvn@segs.uwa.edu.au))

**Abstract:** Modelling of vegetation species presence/absence is a commonly employed method for conservation, which relies on the assumption of a species being at equilibrium with its environment. When a presence/absence model for a species exhibits a poor fit, it is often difficult to attribute the cause of the problem, which could be related to missing environmental variables, poor methodology, or a violation of assumptions. Specifically for the case of disturbed sites, a poor model fit can be linked to false absence values. Defining a simple, yet independent, method for determining species that are not in equilibrium due to disturbance is an important step to understanding presence/absence model results. In this study, we test whether temporal biomass data collected in the field are related to poor presence/absence model fits. Specifically, we examined whether biomass change over a 19-year period for tree species in south-eastern NSW, Australia, was attributable to environmental conditions or disturbance effects (fire and logging). It was found that those species with biomass change attributed to disturbance also exhibited poor presence/absence model fits, while species with biomass change attributed to environmental effects had better presence/absence model fits. These results confirm that for these models, species equilibrium was a major factor in the ability or inability to model species presence/absence.

## THE HAWAIIAN ISLANDS AS A MODEL SYSTEM FOR ECOSYSTEM STUDIES

VITOUSEK, P.

*Stanford University, Stanford. CA 94305 USA. ([vitousek@stanford.edu](mailto:vitousek@stanford.edu))*

**Abstract:** Islands in general – and the Hawaiian Islands in particular – have long been used as model systems for understanding topics as diverse as evolution and speciation, the development of cultures, and ecosystem structure and functioning. With many colleagues, I have been making use of well-controlled environmental gradients to understand the causes, nature and consequences of nutrient limitation to primary productivity and other ecosystem processes. Nitrogen limits production on young substrates, where heterotrophic N fixation is constrained by the low tissue quality of the dominant vegetation. In contrast, P limits production on old substrates, in part because other lithophilic nutrients (Ca, Mg, etc) are supplied via marine aerosol. P limitation would be even more severe, were it not for long-distance transport of continental dust to the Hawaiian archipelago.

## DO WE UNDERSTAND THE CAUSES OF SHRUB ENCROACHMENT IN AFRICAN SAVANNAS ?

WARD, D.

*Department of Conservation Ecology, University of Stellenbosch, P. Bag X01, Matieland 7602, South Africa. ([dward@sun.ac.za](mailto:dward@sun.ac.za))*

**Abstract:** Do we understand the causes of shrub encroachment in African savannas?

Shrub encroachment affects the agricultural productivity and biodiversity of 10-20 million ha of South Africa. Many researchers believe that either heavy grazing by domestic livestock or fire is the sole cause of shrub encroachment. This is wrong. Shrub encroachment occurs in many arid regions where fuel loads are insufficient for fires to be an important causal factor. Belief in grazing as the sole cause of shrub encroachment stems from Walter's two-layer model, which states that grasses typically outcompete trees in open savannas by growing fast and intercepting moisture from the upper soil layers, thereby preventing trees from gaining access to precipitation in the lower soil layers where their roots are mostly found. When heavy grazing occurs, grasses are removed and soil moisture then becomes available to the trees, allowing them to recruit en masse. However, Walter's model fails to explain why shrub encroachment is also widespread in areas where grazing is infrequent and light. If we are to understand the causes of shrub encroachment, we need mechanistic models to guide us and multi-factorial experiments to tease out the interactions among causal factors. Variations on David Tilman's resource ratio models, as well as some spatially-explicit models, appear to hold great promise in this regard. Field experiments in semi-arid and arid savannas show that many interacting factors contribute to encroachment, and that rainfall amount and frequency may drive this phenomenon.

## **PHYLOGENETIC FLORISTICS: A NEW APPROACH TO VEGETATION ANALYSIS**

WEBB, C. O.<sup>1</sup>, and ACKERLY, D. D.<sup>2</sup>

<sup>1</sup>*Yale University, New Haven, CT, USA,* <sup>2</sup>*Stanford University, Stanford, CA, USA,*  
([campbell.webb@yale.edu](mailto:campbell.webb@yale.edu))

**Abstract:** The recent availability and continual refinement of plant phylogenies permits plant communities to be analyzed in new ways that take into account the evolutionary relationships of member species. Such analyses provide alternative means for describing vegetation composition, and may both reveal the contemporary ecological processes structuring communities and provide insight into their historical assembly. I will review methods for constructing community phylogenies, for describing community phylogenetic structure (phylogenetic clustering indices, phylordination, node-habitat association), for incorporating species-level characters, and will discuss interpretation of the results. Examples will be drawn from vegetation types around the world, including Bornean rain forest and California chaparral.

## **DEFOLIATION OF KOA (*ACACIA KOA*) AT HALEAKALA NATIONAL PARK, MAUI, DUE TO THE VASCULAR WILT FUNGUS *FUSARIUM OXYSPORUM* F.SP *KOAE* AND OR THE ENDEMIC MOTH, *SCOTORYTHRA PALUDICOLA*?**

WELTON, P.<sup>1</sup>, ANDERSON, K.D.<sup>1</sup>, DEL REAL, C.<sup>1</sup>, EISENBERG, B.<sup>1</sup>,  
ERICKSON, A.<sup>1</sup>, HAUS, B.<sup>1</sup>, PARRY, R.<sup>1</sup>, RITCHIE, R.<sup>1</sup>, SCHULTZ, M.<sup>1</sup>  
and VACEK, M.<sup>1</sup>

<sup>1</sup>Haleakala National Park, Vegetation Management, Resources Management Division, PO  
Box 369, Makawao, HI 96768 ([Patti\\_Welton@nps.gov](mailto:Patti_Welton@nps.gov))

**Abstract:** Lamoureux (1967) regarded Haleakala National Park as having the finest remaining koa (*Acacia koa*) stands in the Hawaiian Islands. This magnificent co-dominant canopy tree is distributed over 4200 acres in Haleakala National Park on Maui from 1200-5800 feet in wet, mesic and dry forests. In 2003, koa trees of all size classes lost the majority of their phyllodes in 2600 acres within the Park. More than 50% of the koa trees monitored above 2200, feet lost more than 75% of their phyllodes (78% of which were 95% or completely defoliated). Prior to defoliation, phyllodes on trees were either predated by caterpillars of the native endemic moth, *Scotorythra paludicola* (Lepidoptera: Geometridae), or showed yellowing symptoms of a vascular wilt disease caused by the fungus, *Fusarium oxysporum* f.sp *koae*. *Scotorythra paludicola* has defoliated koa in five previous events since the 1900s, four on Maui and one on the Big Island. *Scotorythra paludicola* were reared from caterpillars predated koa phyllodes. The form *F. fusarium oxysporum* f.sp *koae* is implicated in “Koa Dieback” at Hawaii Volcanoes National Park and is a serious disease in koa plantations. *F. oxysporum* was isolated from stem samples yet confirmation of pathogenicity is not complete. This phenomenon has serious statewide ecosystem and management implications. Research is ongoing and current findings will be discussed.

Warner, R.E., ed. 1967. *Scientific report of the Kipahulu Valley expedition*.  
Sponsored by The Nature Conservancy. Honolulu

## **E NIHI KA HELENA: CONSERVATION, ECOLOGY, AND NATIVE HAWAIIAN TRADITIONAL ENVIRONMENTAL KNOWLEDGE OF WILD-PLANT GATHERING AND ASSOCIATED MANAGEMENT PRACTICES**

WHITEHEAD, A.N., FRAIOLA, H. and TICKTIN, T.

*University of Hawai'i at Mānoa, HI, USA. (awhitehe@hawaii.edu, hoala@hawaii.edu)*

**Abstract:** There exists rising pressure to recognize the rights of aboriginal peoples and a growing environmental movement searching for alternative and complementary approaches to Western science and technology. A significant focus of natural resource conservation in the Hawaiian Islands should be towards understanding the ecologically sound practices that were observed by Hawaiian kupuna and ways that this wisdom can be successfully integrated with Western scientific resource management. Utilizing a combination of indigenous scientific knowledge and quantitative ecology, the objective of this project is to quantify some of the ecological implications of traditional Hawaiian wild-plant gathering practices. Four native plant species essential to hula kahiko were selected, including pala'ā (*Sphenomeris chinensis*), palapalai (*Microlepia strigosa*), maile (*Alyxia oliviformis*), and mokihana (*Melicope anisata*). Sites were established to assess the effects of different gathering practices, as well as the variation in growth between harvested and non-harvested populations. Certain types of pala'ā and palapalai harvest did not have significant effects on individual and population growth and decreased invasive cover. Mokihana harvest may exacerbate regeneration problems caused by understory invasives, although potential solutions are presented by traditional wisdom of local kūpuna. Further results will be used to identify some of the ecological conditions and management protocols under which traditional Hawaiian wild-plant gathering practices are consistent with conservation values.

## COMPLEXITY IN VEGETATION CHANGE CAUSED BY SPECIES INVASION

WILDI, O.

*Swiss Federal Institute for Forest, Snow and Landscape Research WSL, CH-8903  
Birmensdorf, Switzerland. ([otto.wildi@wsl.ch](mailto:otto.wildi@wsl.ch))*

**Abstract:** Resemblance trajectories of vegetation records from pollen profiles generally show a complex pattern: Periods of apparent stagnation or random fluctuation alter with almost linear, directional phases of fast change. Since the pattern as a whole seems to be unpredictable, the trajectories are decomposed into components: The pattern of the trajectory may be hampered by the use of ordination for projection. I suggest using rate of change as a separate dimension in a scatter diagram. Considering postglacial vegetation change, two distinct mechanisms can be observed in the data: The invasion of species and the replacement of dominant species either caused by competition or by environmental change. I demonstrate that invasion and replacement can be expressed as a single continuous function on a separate axis. A three-dimensional functional plane with time as a first, rate of change as a second axis and a third axis expressing invasion as well as replacement effects offers detailed insight into the on-going processes. Using a data set of pollen records from Central Europe as a first example (12'500 to 6000 ad.) and a second data set of a 415 year secondary succession, allows to show that invasion over a thousand kilometre or just a few hundred meters causes complex patterns irrespective of temperature change.



## **PRESENT STATE OF THE INVASIVE SPECIES IN THE TIMANFAYA NATIONAL PARK, LANZAROTE, CANARY ISLANDS, SPAIN**

WILDPRET DE LA TORRE, W., MARTÍN OSORIO, V. E.,  
HERNÁNDEZ BOLAÑOS, B. and SÁNCHEZ-PINTO GONZÁLEZ, I.

*Universidad de La Laguna, Avda. Astrofísico Francisco Sánchez s/n, La Laguna, 38271  
Tenerife, Islas Canarias, Spain. ([vemartin@ull.es](mailto:vemartin@ull.es))*

**Abstract:** The Timanfaya National Park, situated in the island of Lanzarote, has a surface area of 51.07 Km<sup>2</sup> that corresponds to the 1730-36 volcanic eruption. The Park was created in 1974 by the Governmental Decree 2615/1974 and at present belongs to the Biosphere Reserve (1993) and the SPA for Birds (1994) networks.

Our aims were to determine the present state of the invasive species that have been recently introduced in the National Park and to propose possible elimination procedures.

Initially, a bibliography of previous studies was recompiled, this was followed by field sampling and the creation of inventories of the introduced species. The data were included in a Geobotanical Information System (G.I.S.) using the Arc View (ESRI) software and a chorologic cartography (1:25,000) was developed. Finally, the evolution of the populations was compared to the data cited in Wildpret et al. (1995).

Three of the species cited as invasive, *Launaea arborescens*, *Pelargonium capitatum* and *Rumex lunaria*, have expanded increasingly and significantly. Current distributions are presented as a contribution to the species' control and elimination without the use of herbicides or any other chemical pollutants.

WILDPRET, W., E. BELTRÁN, J.M. GONZÁLEZ MANCEBO & A. CENTELLAS. 1995. *Pelargonium capitatum* y *Rumex lunaria*, dos plantas invasoras en el Parque Nacional del Timanfaya. *Inst. Est. Canarios XXXIX*: 9-16.

## SCALE MATTERS: A COMPARISON OF ENVIRONMENTAL VARIABLES RELATED TO LICHEN COMMUNITY COMPOSITION AT REGIONAL AND SUBREGIONAL GEOGRAPHIC SCALES

WILL-WOLF, S.<sup>1</sup>, and NEITLICH, P.<sup>2</sup>

<sup>1</sup>*University of Wisconsin-Madison, Madison, WI; National Park Service, Winthrop, WA. <swwolf@wisc.edu>.*

**Abstract:** We compared correlations of environmental variables with axes of NMS ordinations based on composition of epiphytic macrolichen communities of forests at two different spatial scales. Data for two multistate regions, 1) Midatlantic states and 2) Washington and Oregon west of the Cascades divide from the USDA Forest Service F IA program, which monitors forest health across the USA, were used for the larger scale analyses. Data from the Allegheny National Forest, embedded in 1) and the Siuslaw National Forest, embedded in 2), were used for the smaller scale analyses. Major axes of community variation at the larger scales were correlated with regional air quality, climate variables, and large scale topographic variables including elevation and distance from coast. At the smaller scales, forest vegetation variables such as stand age and tree species composition, and environmental variables such as soil type and slope aspect were the more important correlates of variation in lichen species composition. The latter variables were not correlated with ordination axes at the larger scales. Elevation in the western data sets was the only variable significantly correlated with major axes at both scales.

## **DETERMINING THE EARLIEST IMPACTS OF HUMANS IN NEW ZEALAND: THE INTRODUCTION OF THE PACIFIC RAT (*RATTUS EXULANS*)**

WILMSHURST, JANET M.<sup>1</sup> & HIGHAM, THOMAS F.G.<sup>2</sup>

<sup>1</sup>Landcare Research, PO Box 69, Lincoln 8152, New Zealand. <sup>2</sup>Oxford University Radiocarbon Accelerator Unit, Research Laboratory for Archaeology and the History of Art, 6 Keble Road, Oxford OX1 3QJ, UK. (Wilmshurstj@landcareresearch.co.nz)

**Abstract:** The Pacific rat (*Rattus exulans*) dispersed throughout the Pacific with human voyaging. The earliest evidence of rat presence can therefore be used to establish first human contact. On the basis of archaeological evidence, New Zealand was permanently settled in the 13<sup>th</sup> century, and there is no evidence for earlier presence. However, radiocarbon dating of Pacific rat bone has challenged this conclusion, by placing the arrival of the Pacific rat more than 1000 before the earliest settlement date. These early bone dates have been contested in the literature on technical and stratigraphic grounds.

We use distinctive rat-gnawed woody seed cases of native trees preserved in sediments to date the introduction and earliest impacts of the Pacific rat by proxy. Pollen analysis was also used to detect potential rodent impacts on the vegetation (through seed and seedling predation). The rapidly breeding and dispersing omnivorous Pacific rat would have had an immediate impact on New Zealand's flora and fauna.

We dated over 50 seeds from widely separated coastal sites in the North Island. The oldest rat-gnawed seeds dated to the 13<sup>th</sup> century, consistent with the Pacific rat arriving at the same time as initial human settlement, expanding rapidly in numbers and range, and having an immediate and detectable impact on the biota. The pollen records show no sign of rat-induced vegetation change where rats are present in the forests before anthropogenic forest clearance.

## THE CONTROL OF COMMUNITY COMPOSITION - FROM POINT TO CONTINENTAL SCALE

WILSON, J. B.

*University of Otago, Otago, New Zealand. ([bastow@otago.ac](mailto:bastow@otago.ac))*

**Abstract:** At a small scale, species 'should' tend to occur non-randomly. This is the long-proposed but rarely demonstrated theory of limiting similarity. We have shown it by looking at a range of functional characters in a sand dune. We can also see limiting similarity in plant canopy structure: tall species tend to co-occur at a point with short ones. We have examined this in the greatest detail in a lawn, where co-occurrence can be

related to height, but not to other light capture characters. We speculate that species co-existence here is mediated by the response of the roots to defoliation. A complication is that the characters of the plants change plastically. Tall species cause their shortest associates to grow taller. However, many individualistic responses occur. All this community structure might be disrupted by disturbance. We have found that this is true in some ways, false in others. Sometimes it depends. At a larger scale, horizontal variation can be examined via spatial autocorrelation - not only in species composition but also in terms of vegetation texture, where the effects are rather different. At yet larger scales, an effective tool is the extrapolation of species-area relations. So far it seems that there is no characteristic spatial grain - large-scale variation is just small-scale variation writ large. This suggests that ecotones do not exist. Indeed, none of the properties proposed for them are secure.

## **DOES SURROUNDING VEGETATION INFLUENCE SPECIES COMPOSITION OF HABITAT ISLANDS?**

WISER, S. and BUXTON, R.

*Landcare Research, Lincoln, New Zealand. ([wisers@landcareresearch.co.nz](mailto:wisers@landcareresearch.co.nz))*

**Abstract:** Most explanations for why plant species composition and species richness vary among habitat islands are based on habitat island properties (e.g. environment, size, successional status) and proximity to similar habitats. The influence of surrounding vegetation has received less attention. To understand how both outcrop properties and surrounding vegetation influence habitat island composition, we sampled vegetation of montane rock outcrops and their surrounds in Canterbury, New Zealand. The outcrop flora represents 33% of the regional flora although outcrops comprise only 5% of the area, and this flora is richer than that of surrounding habitats. 77% of the outcrop flora is native and beta diversity is higher among natives than exotics. Of the compositional variation that can be explained, 49% is explained by outcrop properties alone, 29% by the composition of surrounding vegetation and 22% covariation between the two. Across outcrops, composition is related to altitude, bedrock type, soil chemistry and rainfall. Among faces within an outcrop, composition is influenced by whether the face is adjacent to forest, soil C:N, and steepness. Similarity to surrounding vegetation varies among outcrop sites and increases as the proportion of surrounding vegetation in grassland increases. Our work implies that surrounding vegetation must be managed appropriately to achieve a desired composition in this type of habitat island.

## VASCULAR EPIPHYTES IN ANTHROPOGENIC DISTURBED PINE-OAK FORESTS IN THE HIGHLANDS OF CHIAPAS, MEXICO

WOLF, J.H.D.

*Universiteit van Amsterdam, Institute for Biodiversity and Ecosystem Dynamics (IBED), P.O. Box 94062, 1090 GB Amsterdam, The Netherlands ([wolf@science.uva.nl](mailto:wolf@science.uva.nl))*

**Abstract:** I described the vascular epiphyte community on 35 oak trees in six trunk diameter classes in 16 stands of pine-oak forest that differed in their degree of disturbance as indicated by structural characteristics of the forest. All stands were situated within a c. 400 km<sup>2</sup> relatively flat area at c. 2200 m elevation. The explainable variation between the stands was partitioned between environmental (altitude, forest structure) and spatial variables (longitude, latitude), using multivariate analysis. Estimated epiphyte biomass on the 35 oaks varied between 0.8 and 243 kg dry-weight and richness between 13 and 34 species. Not surprisingly, logging had a negative effect on epiphyte biomass and species richness per surface area. Epiphyte biomass and richness on the remaining or re-grown trees, however, showed a similar pattern, which was sustained after corrections for differences in host-tree size were made. Yet, epiphytes showed resilience to disturbance if forests were selectively logged to spare heavily loaded large trees. This suggests the occurrence of dispersal limitation in (nearly) completely logged stands where a nearby epiphyte seed source is absent. At the landscape level, dispersal limitation may also be important since pure space explained more variation between the stands than the analysed environmental variables, 32% and 21%, respectively. Mantel's  $r$  of the autocorrelation ( $p=0.002$ ) between the sites switches from significantly positive to significantly negative ( $p<0.05$ ) at distances beyond 10 km, suggesting that dispersal over larger distances is rare.

## PLANT COMMUNITY DEVELOPMENT IN THE ARALKUM DESERT

WUCHERER, W. and BRECKLE, S.W.

*University of Bielefeld, Department of Ecology, 33501 Bielefeld, Germany.  
(walter.wucherer@uni-bielefeld.de*

**Abstract:** The Aral Sea is located in the region of temperate desert with a continental climate. Since 1960 it has experienced a drastic process of dessication. The dry sea floor of the Aral Sea covers some 44 000 km<sup>2</sup>. This is the new desert called Aralkum. It is a mosaik of sand and salt ecosystems. Unintentionally, mankind has created a huge experiment, a natural laboratory. Transects were set up at different coastal areas, stretching from the former to the present coastline. The distribution of the flora, vegetation and the soils was surveyed along these transects. The new immigration flora of the Aralkum desert counts 300 species. The dominant families are Chenopodiaceae, Polygonaceae and Brassicaceae. The main vegetation types are: halophytic-, psammophytic-, hygrophytic shrub- and salt meadow plant communities. The geomorphological, sedimentological and pedological factors determine the vegetation and succession patterns. The succession in the starting phase is caused by exogenous factors. The further development of vegetation caused by biological mechanisms, especially on the sand habitats. The diversity and variability of the habitats on the dry sea floor is, in comparison with the adjacent mainland, much higher. It leads to formation of the new and unique plant communities. The dry sea floor of the Aral Sea is a model system for studies of vegetation dynamics and ecosystem development in the deserts of Central Asia.

## SEEDLING ESTABLISHMENT AND GROWTH IN RESPONSE TO A MAJOR HURRICANE EVENT IN A CAROLINA PIEDMONT FOREST, USA

XI, W.<sup>1</sup>, PEET, R.K.<sup>1</sup> and URBAN, D. L.<sup>2</sup>

<sup>1</sup>University of North Carolina, Chapel Hill, NC 29599-3280, USA; <sup>2</sup>Duke University, Durham, NC 27708, USA. ([xi@unc.edu](mailto:xi@unc.edu))

**Abstract:** Although disturbance events have been hypothesized to control forest composition, diversity, and dynamics through episodic alteration of understory establishment and growth, few opportunities have been available to compare in detail understory dynamics before and after a major disturbance event. In 1996 Hurricane Fran significantly damaged the forest canopy above many long-term tree seedling census plots in the Duke Forest of Piedmont North Carolina. We explored seedling establishment and growth on 27 transects (50x1m) where individual seedling stems had been censused nearly annually for 15 years prior to and 5 years subsequent to Fran. We hypothesized that large canopy disturbance enhances recruitment and establishment of light-demanding species, and that growth rates of seedlings increase following disturbance although not uniformly across species. We tested these hypotheses by comparing differences in establishment and growth rates among species, and differences in release responses among size and age groups. We also examined the effect of variation of canopy openness. Our results show a positive relationship between growth and damage severity. Large gaps created by Fran resulted in release of established shade-intolerant or mid-tolerant seedlings, thereby reversing the negative correlation between growth in sequential years previously observed in undamaged plots. Large disturbances appear to be responsible for temporal variation in regeneration, which contributes to a diverse but temporally relatively stable canopy layer.



## **MIRES OF BARENTS REGION IN RUSSIAN ARCTIC**

YURKOVSKAYA, T.

*Komarov Botanical Institute, St. Petersburg, Russia. Yurkovskaya@hotmail.ru*

Abstract: The whole European Arctic of Russia is included in Barents Region fringing it on the North (Franz Josef Land), on the East (Islands Novaya Zemlya and Vaigach), on the South (the coast of Barents Sea and numerous islands located mainly close to shore). Mires constitute the significant portion of vegetation cover in the European Arctic. The distribution of mire types well correlate with latitudinal zonation and permafrost features. The most remarkable Arctic type is polygonal mires. The westernmost localities of polygonal mires were recorded in the Neruta river valley. The other characteristic type is palsa, connected with sporadic distribution of permafrost. They occur in the South of the Arctic and are the best expressed beyond the Arctic, in the Forest-tundra Subzone. Throughout the Arctic the fens are distributed. The most characteristic among them are grass-sedge fens widespread over the coast of mainland and islands. These fens are characterized by high water saturation and often merge with salted marshes forming huge wetlands. Therefore at present the considerable areas of such lands are under protection. In conclusion I would like to note that mires of the European Arctic are poorly studied. Information about mires of small arctic islands is especially scanty and thus every new study considerably enlarges our knowledge of mires diversity in the North. The work was supported by Russian Fund of Fundamental Researches, Grant 03-04-48791

## LIMITS TO SEEDLING ESTABLISHMENT OF TWO CONIFERS ALONG AN ALTITUDINAL GRADIENT OF BOREAL FOREST AND ALPINE TUNDRA

ZACKRISSON, O., SHEVTSOVA, A., HÖRNBERG, G., NILSSON, M-C., and JÄDERLUND, A.

*Department of Forest Vegetation Ecology, Swedish University of Agricultural Sciences, SE-901 83 Umeå, Sweden. ([anna.shevtsova@svek.slu.se](mailto:anna.shevtsova@svek.slu.se))*

**Abstract:** In the context of strong potential effects of the anticipated climate change on high-latitude and alpine ecosystems, it is important to understand which factors limit tree establishment at existing forest/tree lines. The main objective of the present study was to investigate the limitations to early tree seedling establishment in the altitudinal forest-tundra transition zone. We hypothesized that in addition to temperature seedling establishment along the altitudinal gradient is constrained by seed- and seedling predation, which might be particularly important in the forest-tundra ecotone. To test this hypothesis, we performed a six year experiment in which seeds of boreal conifers, *Pinus sylvestris* L. and *Picea abies* (L.) Karst, we sown in plots located along a gradient from the pristine forests to the alpine tundra; the plots were either exposed to or protected from seed predation by birds and rodents. Seedling establishment was strongly restricted by post-dispersal, mainly avian, seed predation although at the tree line and in the tundra seedling establishment was not affected by seed predation in some years. Within enclosures, early seedling establishment increased with altitude but growth of 4-year-old seedlings did not vary significantly along the altitudinal gradient. These results indicate that factors such as post-dispersal seed predation may be more important than temperature in controlling early seedling establishment of boreal conifers in the forest-tundra transition zone.

## THE STATE OF LOWLAND WET FORESTS IN HAWAII: VARIATION IN ECOSYSTEM DYNAMICS AND IMPACTS OF INVASIVE SPECIES

ZIMMERMAN, NAUPAKA<sup>1</sup>, HUGHES, R. FLINT<sup>2</sup>, CORDELL, SUSAN<sup>2</sup>, HART, PATRICK<sup>3</sup>, CHANG, HEATHER<sup>4</sup>, PEREZ, DAVID<sup>5</sup>

<sup>1</sup>Harvard University, Cambridge, MA, USA; <sup>2</sup>USDA Forest Service; <sup>3</sup>USGS-BRD; <sup>4</sup>University of Hawaii-Hilo; <sup>5</sup>Appalachian State University. (nzimmerm@fas.harvard.edu)

**Abstract:** Hawaii's lowland wet forests are in critical condition, with few remaining isolated patches primarily limited to Eastern Hawaii. To better understand these native systems, we quantified basal area (BA) and densities of woody species at seven sites in the Puna district on the Big Island representing age gradients of native stand development on both 'a'a and pahoehoe lava flows. On both flow types, BA of native species generally increased (from 5 to 50 m<sup>2</sup> ha<sup>-1</sup>), and stem densities decreased (from 3700 to 2600 stems ha<sup>-1</sup>) with increasing stand/flow age, primarily as a function of the stand dynamics of *Metrosideros polymorpha*, the dominant overstory tree. Native stand development was more rapid on 'a'a' compared to pahoehoe flows. We found that lowland wet native forests remain at least partially intact in several locations, but their functional and compositional integrity is increasingly compromised by invasion of non-native species, such as *Psidium cattleianum* and *Melastoma candidum*. Compared to native species, BA of non-native species was relatively low in each stand, but on older flows in particular non-native stem densities swamped those of their native counterparts, with values as high as 18,000 stems ha<sup>-1</sup>. We provide this information concerning lowland wet forest remnants as a framework to better understand succession patterns in these dwindling native forests, with hope that such information will induce and support efforts to preserve what is left.

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