2 Global Change & Ecosystem: Biodiversity, Landscape Systems, Ecosystem Services, Coupled Human-Natural Systems, Invasive Species, Museum Collection and Barcoding

2.1 Biodiversity Studies across Pacific Island Ecosystem and PABITRA Network

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2.1.1

Recent Work on the Botany of Romonum Island, Chuuk Lagoon, FSM

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During recent field work on Romonum (Ulalu), a small volcanic island in Chuuk Lagoon, Federated States of Micronesia, 41 new species of vascular plants were found. This paper details the botanic history of Romonum Island. In 1965, Stone found 121 species of vascular plants on the island. Fosberg, Sachet and Oliver's geographical checklists listed only 30 species there. For unexplained reasons, the initial collection work of Clarence Y.C. Wong, who in 1946 collected 151 species, has been largely ignored. This study points out that much remains to be discovered in defining the biotic diversity of the Pacific Islands. Finally, this study suggests that digital images may be a very appropriate tool for documenting the diversity of the islands.

Keywords: Romonum (Ulalu) Island, Micronesia, Flora

2.1.2

A Warming Tropical Mountain: C3 and C4 Grass Distribution Responses along an Elevation Gradient in Hawai'i

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Many high mountain regions in the tropics still harbor unique ecosystems that have been relatively little impacted by anthropogenic activity or invasion, but they are unlikely to be immune to impacts of global change, including climate change. Shifts of plant distributions in response to warming trends have been well documented in many temperate regions, but plant distribution shifts on tropical mountains have been little studied. Grasses are an important group to track in the tropics because of their ecological diversity (including plants with C_3 and C_4 photosynthetic pathways), and because they include invaders that can transform ecosystems. The aim of this study was to compare grass distributions along an elevational gradient in Hawai'i between 1968 and 2008 to determine whether C_4 and C_3 grass distributions are shifting upward in elevation. Field plots were surveyed for grass species and cover at ~150m elevation intervals. The 2008 transition point marking a shift in dominance between C_4 and C_3 grasses along this elevation transect was determined from the inflection point of a best fit logistic model and compared to the transition point 40 years earlier. Individual species distributions were also compared between 1968 and 2008. We found that the transition point between C_4 and C_3 grasses based on relative cover was significantly higher in 2008, indicating that C_4 grasses are now dominating at higher elevations. Additionally, we found that significantly more fire adapted grasses have moved up in elevation, compared to grasses not associated with fire. Our study documents an upward expansion of dominance by C_4 and fire-adapted grasses as an important threat that will be compounded by further warming trends.

Keywords: Global Change, High Elevation, Plant Invasion

2.1.3

Geographic Variation in the Impact of an Invasive Plant Species On Subtropical Pacific Islands

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The impacts of biological invasion on Pacific Island ecosystems could vary among islands, even when considering the same invasive plant species. We compared the successional patterns in abandoned fields that were invaded by *Leucaena leucocephala* on three subtropical archipelagoes (Ryukyu, Ogasawara, and Hawai□i), to examine geographical variation in the impact of invasion. The *Leucaena* forests were established in lowland areas of all three archipelagos. There was, however, a significant difference among the regions in the successional pattern following invasion. In the Ryukyu Islands, dense thickets of *Leucaena leucocephala* were replaced directly by the native species of fast-growing secondary trees. On the other hand, in the Ogasawara and Hawaiian Islands invasion by *Leucaena* substantially altered successional patterns. . Alien tree species replaced *Leucaena* forests in around 30-40 years in the Ogasawara Islands, because of the restricted establishments of native tree species. In the Hawaiian Islands, there was very few tree species in the *Leucaena* forests, and almost all *Leucaena* forests persisted continuously for more than 30 years. Most of the tree species that established in *Leucaena* forest were fast-growing secondary trees derived from humid tropical regions. Some of them were common across these islands as native species on Ryukyu and as alien species on Ogasawara and Hawai□i. Susceptibility to invasion by *Leucaena leucocephala* was geographically varied among the subtropical Pacific islands, and this variation may be caused by the absence of native species in the functional group that can replace dense *Leucaena* forests.

Keywords: Biological Invasion, *Leucaena Leucocephala*, Secondary Succession

2.1.4

Adopting Invasives; Lessons from a Moorean Mat Fiber

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In 1769 Captain James Cook stopped in his voyage at the Society Islands. The naturalist on this voyage, Joseph Banks collected many items of material culture including a highly decorative and unique mat. This mat returned to England and eventually became interred at the Pitt Rivers Museum in Oxford. We have used microscopic analysis to compare fibers of this mat to fibers of other known Polynesian mat fiber plants. This comparative analysis later extended to other fibers known to be used in Polynesian material culture. The fiber from Cook's collection did not match fibers from any known pre-European contact Polynesian plant. Continued examination of the fibers revealed this mat to be identical to the stem fibers of *Typha angustifolia*. However, this species is thought to not have reached the Society Islands until the mid-Nineteenth century. Our recent ethnographic data from the Society Islands suggest that *T. angustifolia* is only used by a small number of residents on the island of Mo`orea.

T.domin-gensis

T.domingensis

Keywords: Moorea, *Typha Angustifolia*, Invasive Species

Typha domingensis

All mention of Typha angustifolia should read Typha domingensis.

2.1.5

Mapping Vegetation and Predicting the Distribution of Alien Invasive and Rare Endemic Plants Using Remote Sensing on the Island of Moorea, French Polynesia

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Conservation of native ecosystems and species, sustainable use of natural resources in sylvo- and agrosystems, and urban and land planning, require a good knowledge of land cover, including vegetation maps. For a long time, the main constraints on the use of remote sensing aerial photos and satellite images in small high volcanic islands (such as in the Pacific) were their small land surface *vs* the coarse spatial resolution of remotely sensed data, their rough topography (e.g. steep slopes, deep valleys) and corresponding high habitat diversity (called "mosaic landscape"), and sometimes the persistent cloud caps on the highest summits. The recent development of more diverse and precise sensors and machine learning algorithms allows new possibilities for habitat description and assessment of species distributions, not only for the dominant species but also for the less common ones. We used a SVM (Support Vector Machine) classification based on both Quickbird® and TerraSAR-X® scenes, and ground-truth surveys conducted between 2008-2010, in order to mapping the vegetation on the small island of Moorea (140 km²). This project was partially funded by the "Moorea Biocode Project", whose primary goal is the complete inventory of all living organisms, including terrestrial alien and native vascular plants. The SVM model, based on a set of physiographic data, allows us to map the potential distribution of the invasive alien *Miconia calvescens* (Melastomataceae), a small tree sometimes found in the rainforest understory, and thus not directly detectable using aerial photos. Our results show that the model perfectly matches with the "real" miconia-invaded areas. As the SVM can be trained with a small set of data, it was also tested for rare and/or threatened native and endemic plant species previously discovered during extensive field surveys in some accessible areas on Moorea. The potential habitat map of the tree *Planchonella tahitensis* (Sapotaceae), and several endemic shrubs, were predicted. Differences observed with current habitats are discussed.

2.1.6

Preliminary Analysis of Relationships between Plant Biodiversity and Language Diversity in Solomon Islands

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The geographical Solomon Islands include over 100 distinct languages and a terrestrial flora of more than 5,000 species. Language distributions have changed in the last 200 years and the flora is as yet poorly understood. Samples of information from languages and plants have been used in distributional models to develop hypotheses about biocultural relationships from the past and present in the Solomon Islands. We have examined plant introductions through time and corresponding language changes and shifting patterns and causes of language dominance. These have allowed us to develop a predictive model about the pattern of future biocultural relationships based on changes in plant and language richness. We predict a reduction in the taxonomic richness of both plants and languages in future.

Keywords: Biocomplexity, Linguistics, Culture, Ethnobotany, Species Richness

2.1.7

Biodiversity in the Rock Island Southern Lagoon

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The Rock Islands Southern Lagoon located in Koror State the Republic of Palau (134°20'34.48°E, 7°14'48.93°N) is a nominated World Heritage Site. The RISL World Heritage area is 859 square kilometres and includes 445 limestone islands. PABITRA transects are being established in the Ulong, Mecherchar, Ngeruktabel Island groups and Ngerukewid Preserve within the RISL. These transects will be used for long term monitoring of change in biodiversity. The Rock Islands of Palau are a unique geological feature of the Southern Lagoon and can be viewed as miniature island ecological sites. The porous and barren substrate of the limestone terrain is a difficult environment for plant life and should result in decreased, but unique species. Furthermore, the Rock Islands and main volcanic islands of Palau differ in substrate, in environmental factors, in the level of human impact and in size. These factors will result in significant differences in floristic diversity. In addition, human impact and geology may result in the abundance of specific species, such as those that introduced by humans and more resilient plant species. We will look at micro-island ecosystems within a Pacific archipelago and compare biodiversity with respect to three factors: proximity to large volcanic island biomass, size of island and degree of human impact.

Keywords: Palau Rock Island, Biodiversity and Ecology