

Forest Dynamics Monitoring in Palau



The Pacific Context

December 2014



Traditional meeting house for the chiefs, Melekeok village, Palau

The islands of Micronesia are globally recognized as a biodiversity hotspot that supports the Earth's richest endemic flora (per total land area). The Micronesia region contains thousands of small islands that are home to many thriving indigenous cultures that are predicted to be disproportionately impacted by climate change — with especially large effects of rising sea level and ocean acidification on ecosystems and people. Pacific Island conservation and restoration needs have been identified within each nation's Statewide Assessment and Resource Strategies (SWARS) as well as the Micronesian Challenge, a region-wide program where Pacific Island nations have committed to conserving at least 30% of their nearshore marine environments and 20% of their terrestrial resources by 2020. Specific needs identified in these documents as well as in community meetings with Pacific Island leaders include terrestrial monitoring protocols to be implemented by the Micronesian Challenge. Mechanisms identified to meet these needs include partnerships, training and educational opportunities for local students, and assisting communities in developing and implementing restoration/conservation projects. Such projects would also help nations meet the Micronesian Challenge.

Project Description

In partnership with Palauan State, Government and Non-Government Organizations (NGOs) we have implemented upland forest monitoring protocols within a permanent plot network in Palau that will help meet the terrestrial monitoring objectives of the Micronesian Challenge. The Palauan Island of Babeldaob contains the largest intact area of native tropical



Coastline and forest of Babeldaob Island, Palau

lowland rainforest in the Pacific and contains the most diverse forests in Micronesia. The Ngardok Nature Reserve on Babeldaob was selected as the site for the first permanent forest dynamic plot in Palau following the methodology developed as part of the Smithsonian's Center for Tropical Forest Science (CTFS) Permanent Plot Network. This methodology provides detailed information on the growth, survivorship and mortality of individual plants. Plots are typically 1- 4 hectares in size and all plant stems that are > 1cm width are identified, tagged, mapped, and followed over time within the plot. This very high resolution measurement program gives baseline information on forest changes and allows for detection of sensitivities of recruitment, growth and death to stressors like climate warming and drought.

The permanent forest dynamic plot sites will have a strong beneficial effect on Palau's forests in perpetuity. Not only will a stream of immensely valuable data be generated (forest dynamics, climate), but this infrastructure project will serve as the necessary platform to understand forest issues such as:

- **Global change:** climate impacts, community dynamics, invasive species
- **Ecosystem services:** services vital to Palau's economy, security, and well-being, including abundant supply of freshwater, control of flooding and erosion, forest products, carbon pools, wildlife habitats, recreational activities, and many other aesthetic and cultural values
- **Comparative forest ecology:** comparison of ecological properties of Palauan forests with those of forest plots in tropical and temperate forests around the world
- **Ecohydrology:** linkages between forest-water-atmosphere
- **Remote sensing:** modeling of ecosystem dynamics
- **Restoration potential** and trajectories



Staff from Ngardok Nature Reserve and Palau Forestry collecting data in the permanent plot in Ngardok



Establishing a Permanent Plot Network in Palau



Palauan interns training in the permanent plot in Laupahoehoe, Hawaii

Professional staff from Palau Forestry and the Ngardok Nature Reserve participated in a 4 week internship in Hawaii in Spring 2014, where they were mentored by staff from the USDA Forest Service and the Hawaii Permanent Plot Network (HIPNET) <http://www.hippnet.hawaii.edu/>. Following the internship, the professional staff returned to Palau to begin the establishment of the Pacific Island Permanent Plot Network (PIPPNET) in Ngardok Nature Reserve (NNR).



The professional interns preparing for plot establishment in Palau



Location of the 1 hectare permanent plot in the Ngardok Nature Reserve of the Protected Area Network (PAN). Lake Ngardok, the largest fresh water body in Micronesia, can be seen in the upper left. NNR was the first PAN site for Palau and is also an internationally recognized Ramsar wetland site of international importance.

Characteristics of the Forest Dynamics Plot in Palau

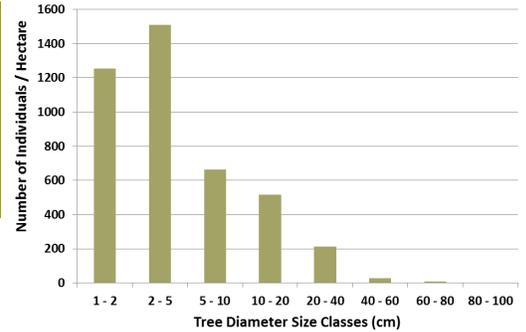
Features of the Ngardok site

The Center for Tropical Forest Science has for decades focused on establishing plots in intact primary forest. This forest dynamics plot will be the first in the network to focus on forest recovery within an officially protected area. This type of plot will fill a very important gap in our understanding of tropical forests recovering from human disturbance.

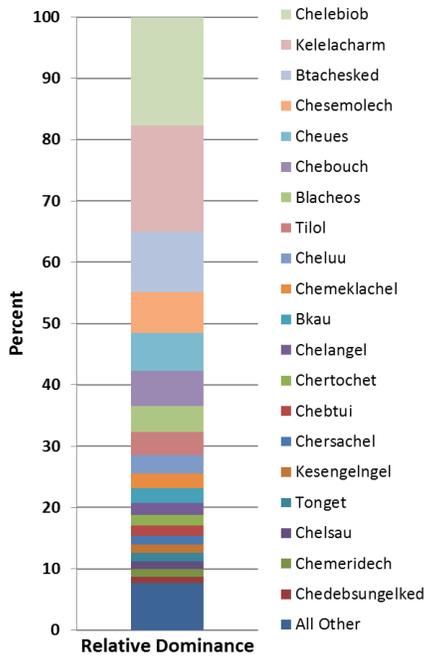


Unique ecosystems: A potentially new species to science was identified within the permanent forest dynamic plot in Ngardok. Our project botanist is working with international experts to characterize the species.

Forest Structure: The resolution of the measurements collected in the plot allow us to look at growth, recruitment, and mortality of individual trees and the abundance and size distribution of the trees for each species. These data will establish detailed baseline information that will allow us to look at how these characteristics change over time and how individual species respond to severe storms, drought, and climate change.

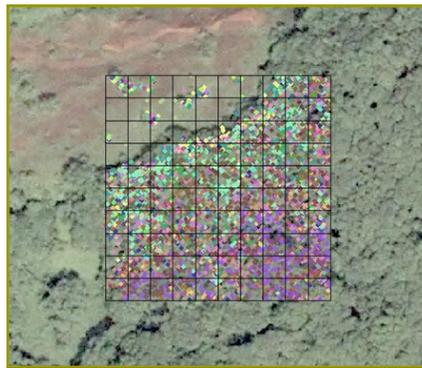


Over 250 trees in the plot are greater than 20cm in size at the diameter at breast height (DBH).

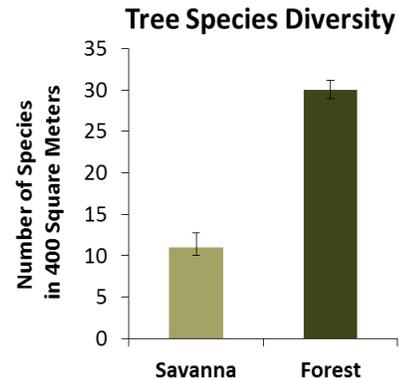


The 20 most dominant species in the plot. Relative dominance shows how much individuals species contribute to the total amount of wood in the forest.

Forest Tree Diversity: The one hectare plot contains 62 species of native woody plants, 29 of which are endemic to Micronesia and 21 endemic to Palau.



The one hectare plot grid with representation of the actual tree density by species.



The forest has much higher species diversity than the savanna.

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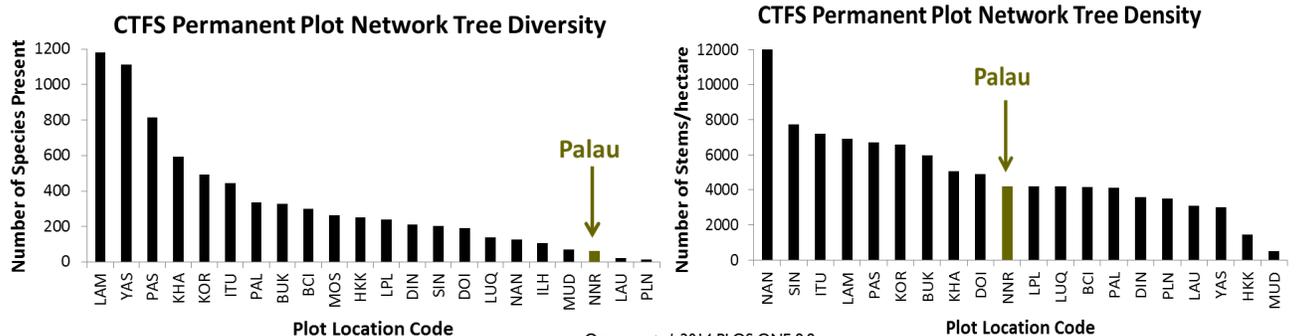
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Global Comparison

Following the protocol of the permanent plot network of the Smithsonian's Center for Tropical Forest Science allows us to compare the forest at Ngardok Nature Reserve (NNR), Palau to tropical forests around the world:



Even though the Palau plot (NNR) is four times smaller than the Hawaii permanent plot sites of LAU and PLN, it contains three times the number of tree species.

The Palau plot (NNR) contains a similar density of tree stems per hectare as other tropical forests in the CTFS network.