

Establishment of the Wanang CTFS/SIGEO Plot

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CTFS/SIGEO (Smithsonian Tropical Research Institute) to study forests of Papua New Guinea: October 20, 2008



STRI's Center for Tropical Forest Science/Smithsonian Institution Global Earth Observatories (CTFS/SIGEO) is pleased to announce a new partnership for the establishment of a 50-hectare plot in PNG.

Recognizing the importance of PNG's rain forests to climate regulation, carbon storage and global biodiversity conservation, John Swire & Sons and Steamships Trading have

committed US\$250,000 to support a long-term study of PNG's rainforests. These funds, coupled with a recent US National Science Foundation grant to George Weiblen and colleagues at the University of Minnesota, will enable the establishment of a 50-hectare plot, several satellite one-ha plots, and detailed surveys of insect diversity in the Wanang area of northern PNG.

The new project, known as "The Swire Papua New Guinea Rainforest Study" (SPRS), brings together researchers from the New Guinea Binatang Research Center, the PNG Forest Research Institute, the University of Minnesota, Harvard, SIGEO, CTFS, and several other PNG government agencies.

The research team will work in partnership with Wanang community landowners committed to the long-term protection of their forest and subsistence livelihoods. Community members will receive scientific training, employment as field biological assistants, and community development opportunities through the research activities of the SPRS project.

The project represents the first large-scale study of biodiversity and carbon dynamics in PNG forests and will increase our ability to assess the response of Pacific forests to global climate change. In addition to funding for the plot, Steamships Trading will sponsor postgraduate fellowships to help build PNG science capacity in the areas of forestry and climate change.

CTFS/SIGEO Plots

More than 25 years ago the Smithsonian Tropical Research Institute (STRI) established a large-scale forest research plot on 50 ha of lowland tropical forest on Barro Colorado Island (BCI), in Panama. Every tree with a diameter at breast height of at least one cm in the plot was tagged, measured, mapped, and identified to species. The scope and methods of forest inventory developed on BCI provided an unprecedented opportunity to study tropical forest dynamics. As researchers around the world replicated the BCI methodology, a global network of research plots emerged in 1990.

The network administered by the STRI's CTFS (<http://www.ctfs.si.edu/>) consists of individual plots managed by one or more partner institutions in each country. The CTFS

coordinates research activities using standardized methods on forest plots ranging from 2–52 ha that today include 22 sites in 15 tropical countries of Latin America, Africa, and Asia. This international collaboration is now monitoring the growth and survival of 3.5 million trees and >6,500 species, a remarkable 12% of all known tropical species. The network has matured to the point where there is a unique opportunity to expand the program into a truly interdisciplinary research endeavor that will enable the world's scientists to investigate key indicators of global environmental health. In this spirit the network of tropical forest plots has merged with SIGEO. The SIGEO program aims to establish: (a) global carbon research providing in situ measures of above- and below-ground carbon and how it responds to rising CO₂, (b) a series of large-scale temperate plots that will permit direct comparison to the expanding tropical plot network, and (c) expanded biotic monitoring to assess the impact of global change on biodiversity through focused surveys of vertebrates, invertebrates, and microbes. The third objective includes an arthropod initiative to monitor key assemblages over the long term and to study insect-plant interactions across the network.

Global Carbon Research Program

Human activities have caused a 15% increase in atmospheric carbon dioxide in the past 40 years and are set to increase atmospheric CO₂ levels even more dramatically in the coming decades. This increase, coupled with equally dramatic increases in other greenhouse gases, is having a profound effect on global climate, and ecosystems. Regrettably, there is a tremendous gap in our understanding of the role of forests in the global carbon budget, and insufficient evidence on whether temperate and tropical forests behave differently under changing global conditions. Long-term objective analysis of global forests can fill the gaps in our knowledge and provide data for informing policy regarding the means and the markets for decreasing atmospheric CO₂. Owing to long-term monitoring across the CTFS/SIGEO network, the Earth Observatories will inform decision makers about the efficacy of local, regional and global policy initiatives.

CTFS/SIGEO plots are expanding their *in situ* measures of above-ground carbon to include below-ground measurements to see if trees are sequestering carbon in their root systems in response to rising CO₂. Objective, long-term data of high quality collected from the global CTFS/SIGEO network of forest plots will provide critical empirical data for modeling carbon dynamics in the future and directly measure whether efforts to reduce carbon emissions are effective.

SIGEO has identified the Wanang Conservation Area in PNG as a location for expanding the plot network (<http://biogeodb.stri.si.edu/bioinformatics/sigeo/>). NSF and CTFS are funding the coordinated survey and inventory of PNG forest trees and arthropods according to protocols replicating plots worldwide. Replicated inventories can at the same time catalyze taxonomic discovery and address important questions on the global distribution of species diversity.

Status of Wanang Conservation Area

PNG is unique among nations in that 98% of land is under customary ownership and unavailable for sale. The absence of public lands designated for conservation means that involvement of tribal clans is necessary for the protection of reserves. Recognizing the need to preserve a core forest area, clan leaders in and around Wanang have

repeatedly asserted their right to conserve 10,018 ha of primary lowland. The conservation area is located within the Middle Ramu Block 1 logging concession. PNG Forest Authority regulations require that 10% of the 158,000 ha timber concession be excluded from logging operations. The process of gazetting the 10,018 ha as a protected area under PNG law has progressed to the point where the Madang Provincial Government is now considering support for Wanang.

We believe that the long-term prospects for forest preservation are excellent where long-term scientific research provides local employment and a source of pride in the community. Wanang plot research infrastructure for PNG, and the associated synergistic activities fill a major gap in the global network of forest monitoring sites. A network including PNG is needed to characterize global biodiversity, estimate the contribution of tropical forests to the global carbon budget, and understand the potential for new forests to offset CO₂ emissions. The proposed survey has a direct impact on biodiversity conservation by providing specimens and data to establish a baseline for monitoring the response of tropical forests to global change.

Taxonomy

A decade of biodiversity research in New Guinea by Dr. Miller and his close colleagues, Dr. George Weiblen of the University of Minnesota and Dr. Vojtech of the BRC in Madang PNG, has produced an array of plant and insect taxonomic products including specimens, databases, checklists, species descriptions and generic revisions. Over the years a total of 98,228 Lepidoptera, 35,016 Coleoptera, and 8,321 orthopteroid specimens have been made available to the collections of the PNG National Agricultural Research Institute (NARI), the Smithsonian Institution, and the Bishop Museum. Specimens are linked to host plant records through an MS Access database and, for Lepidoptera, caterpillar images are linked to adults and hosts in a searchable on-line database.

Taxonomic progress was also made on New Guinea Coleoptera, Formicidae, Orthoptera, Phasmida, Tachinidae, and Tephritidae through PhD student training and the distribution of specimens to more than 30 taxonomists worldwide. Student projects have focused on weevils, bark beetles, ants, and parasitic wasps. Major student contributions thus far include a catalog of 2,955 New Guinea weevil species and a checklist of 741 New Guinea ant species. Other products incorporating this material include a digital image database of New Guinea insects, supported by the PNG ICBG, and regional monographs of Lepidoptera in Borneo and Tortricidae in Australia. Collaboration with other specialists has also produced descriptions of new Braconidae and Thysanoptera.

Botanical contributions of past projects include specimens, keys, checklists, digital image databases, and molecular phylogenetic studies of PNG flora. Beta-diversity surveys led to the distribution of 2,208 herbarium specimens to ten major herbaria (including MIN, LAE, US, A, K, L, CANB, SING, MO, and NY). The pilot Wanang study resulted in 12,136 herbarium specimens representing 5,519 plants and at least 536 species now available online (<http://ng.brit.org/>). An online checklist of New Guinea woody plant genera has been produced. The list includes 1,073 taxa, their respective families, growth habits, and status as endemic, native, introduced or cultivated plants. Outdated nomenclature has been updated to reflect currently accepted generic names and the latest published classification of flowering plants according to the Angiosperm Phylogeny Group. In addition, the Binatang collaborators have published a review of

New Guinea Moraceae and molecular phylogenetic studies of the family. An interactive key to 151 species of New Guinea *Ficus* is online.

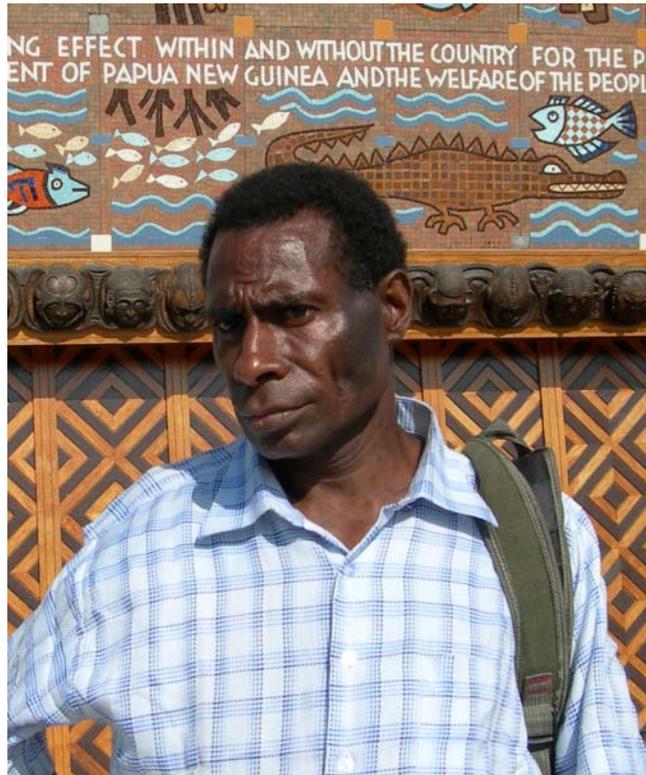
Dr. Weiblen and the BRC also participate in the application of Atrium® (a revolutionary biodiversity information system developed at the Botanical Research Institute of Texas, currently supported by an award from the BSI program; DEB-0717453), to the flora of New Guinea (<http://ng.brit.org/>). Atrium provides on-line access to digital collection data and a team of computer programmers at BRIT is continuing to expand the system. Lists of PNG plant names including 309 families, 1,882 genera, and 8,367 species that set the rules of nomenclature for New Guinea Atrium were prepared to enable this application.

Plot Establishment

In the 1990s the CTFS, in conjunction with the Africa ICBG headed by Professor Maurice Iwu, established the Korup Forest Dynamics Plot in Cameroon. Through his participation in the Africa ICBG, Dr. Barrows became acquainted with the pioneering activities of the CTFS program as it sought to apply forest science to answer basic questions relevant to climate change. Subsequently, as plans began to develop for the current PNG ICBG, one objective Dr. Barrows pursued was the feasibility of facilitating the establishment of a similar plot in PNG. He contacted Elizabeth Losos, then director of CTFS for advice and an introduction to Dr. Scott Miller, then head of systematic biology at the Smithsonian Museum of Natural History.

Dr. Miller is an internationally recognized expert in PNG biological research, and has spent many years conducting continually funded research into insect communities and insect plant interactions in PNG. Dr. Miller led Associate Program 2 for the PNG ICBG in the first five years of funding, one of his goals being to promote the possibility of a CTFS plot in PNG. As the CTFS began to expand its global network of long term study plots, Dr. Miller's efforts within the Smithsonian Institutions and his collaborations with scientists on the ground in PNG, resulted in the discussions that ultimately led to serious considerations of sites within PNG for plot location.

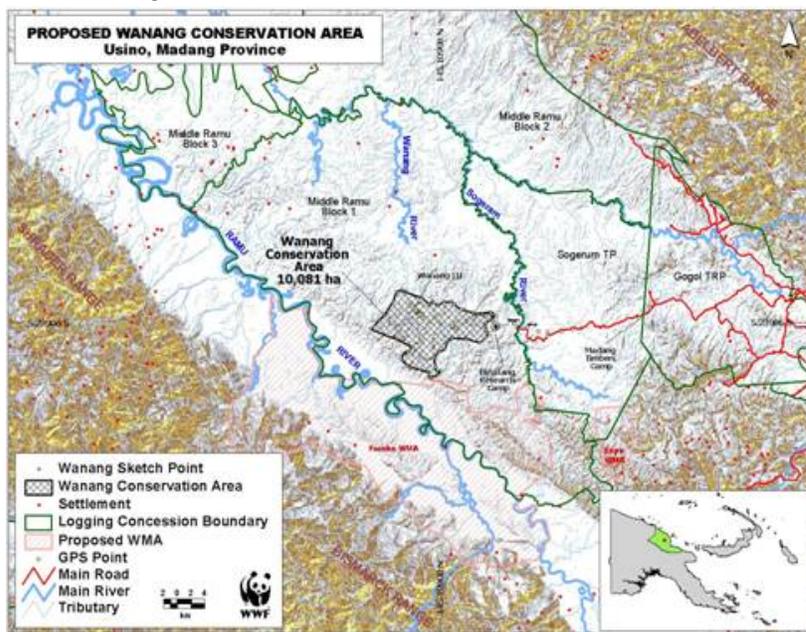
Collaborations between the PNG Forest Research Institute (FRI), National Agricultural Research Institute, the Department of Environment and Conservation, and the non-governmental BRC, WWF and others provided the network required to begin serious discussions concerning establishment of a 50 ha plot in PNG. Surveys of eight



Fiip Damen Wanang Community Leader

regions across the Ramu and Sepik river basins lasted four months each and suggested two or three suitable sites. One of the sites under consideration by FRI and BRC was proposed by the customary landowners in the Wanang area.

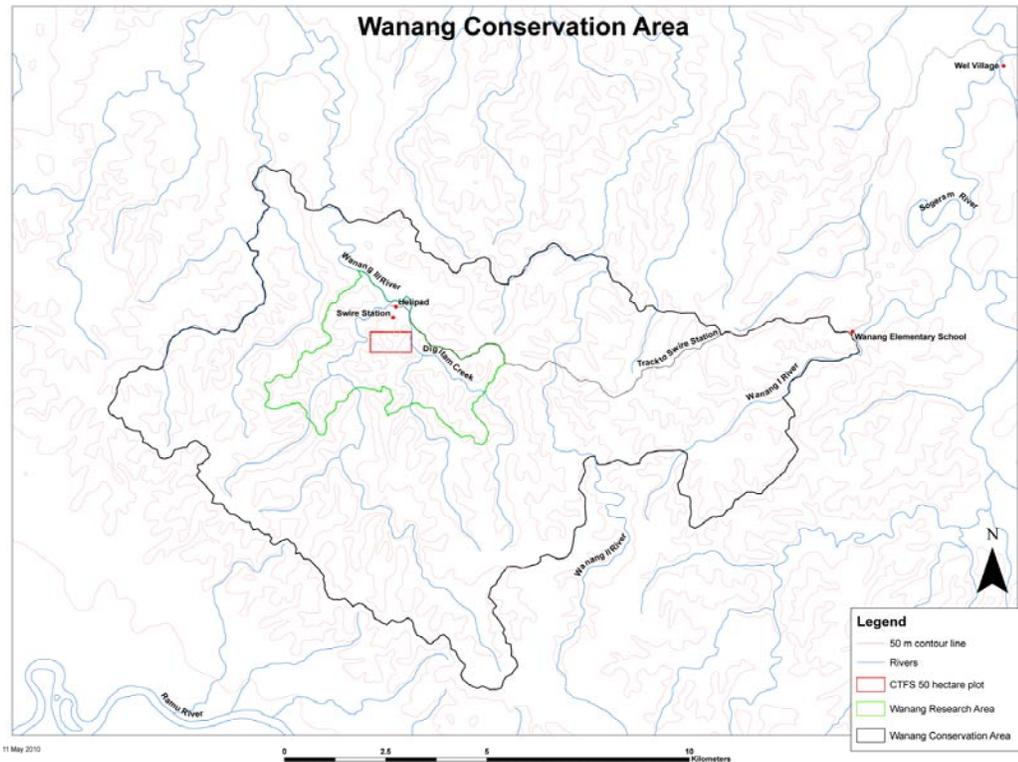
Studies conducted under the direction of Dr. Weiblen (current AP 2 leader) and his colleagues at the BRC mapped, measured, and identified all woody stems >5 cm in diameter in two hectares of lowland tropical rainforest at Wanang. These pivotal activities provided an estimate of the Wanang plot woody plant diversity including at least 70 families and 500 species. Wanang is representative of lowland rainforest north of the central ranges of New Guinea, as shown by extensive CSIRO Land Surveys and BRC work. Considering on balance the aspects of forest quality, land tenure, protection status, access, and facilities, the Madang Provincial Forestry Department, FRI and the BRC proposed the Wanang Conservation Area in Madang Province as an appropriate location for the CTFS plot and it was subsequently decided to establish the 50 ha plot at the Wanang site.



The Wanang Conservation Area (S 5°15' latitude E 145°16' longitude) includes 10,018 ha of primary lowland tropical rainforest at <500 m elevation. The area is road-less and populated by <10 people per km². The climate is lowland humid with a mean annual rainfall around 4,000 mm and a mean monthly air temperature of 26 °C. Soils are latosols. The vegetation has been classified as

mixed evergreen hill forest. It is structurally complex with numerous woody vines and a 40-55 m canopy.

The establishment of a fifty-hectare forest dynamics plot at Wanang is a major conservation achievement in PNG and offers unique opportunities for this ICBG. The ICBG is funding FRI and UPNG botanists and students to collaborate and train with CTFS and BRC scientists in the enumeration and identification of the species of woody plants in Wanang. This will involve collection of vouchers, providing a complete botanical survey of woody plants with stem diameters greater than 1 cm. ICBG biodiversity discovery will complement activities at Wanang by adding surveys of herbaceous plants and endophytic fungi to existing surveys of woody plants and herbivorous insects. The plot will also serve as the site for AP 2's terrestrial microbe isolation studies from soil and plants. Baseline data and ongoing studies at Wanang by the BRC already have



contributed to international initiatives in biodiversity discovery including International Barcode of Life project (PNG insects) and the Smithsonian initiative in plant DNA barcoding (PNG plants). ICBG sampling in the Wanang forest plot will build on this history of achievement and be cost effective because all necessary informed consent and benefit sharing agreements have already been established. Additionally, working within the plot will facilitate re-sampling at exact locations of individual plants for forest floor, epiphyte or endophyte microbe isolation. This will provide an opportunity to link the complete botanical survey and plot forest dynamics with the analyses of soil and floral microbes, including their pharmacological and chemical evaluation and possible interactions with insect communities.

At the end of this proposed grant cycle, the Wanang plot will provide the most thorough botanical inventory ever conducted in PNG. It is the first sub-equatorial plot in Asia, the first CTFS/SIGEO plot on private land, and an enduring reference location for future study of pharmacological activity and chemistry of the terrestrial systems.