

# Smithsonian Institution Global Earth Observatories (SIGEO)

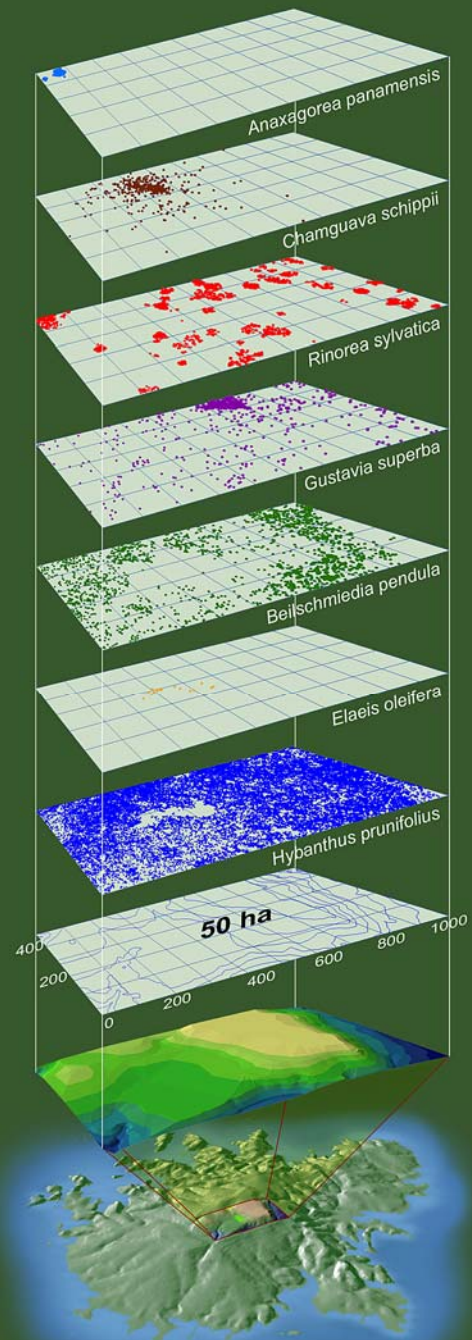
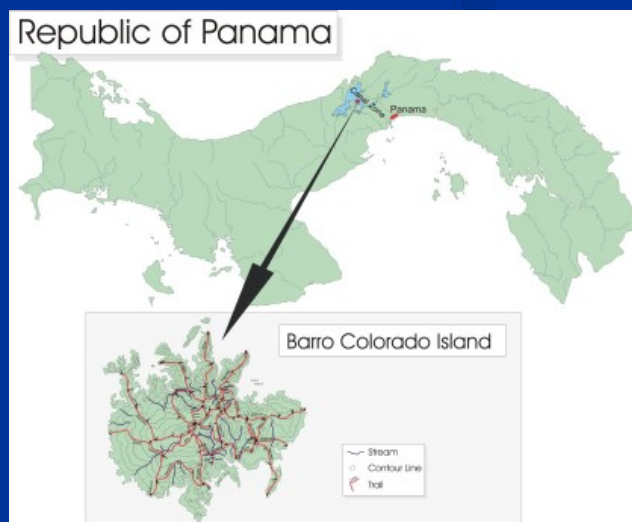
A research platform for measuring the  
global impact of climate change

# Smithsonian Tropical Research Institute (STRI)

- In 1980, Steve Hubbell and Robin Foster established a 50 ha forest plot (ca. 124 acres)
- Every tree  $> 1\text{cm}$  diameter was identified, measured, tagged, and mapped.
- Unprecedented scale and scope!

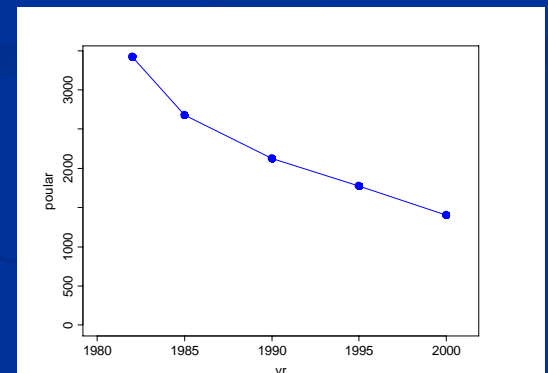


Smithsonian Institution



# STRI – Barro Colorado Island (BCI) re-census after 5 years

- More than 40% of the tree species in the plot changed by more than 10% in total abundance, apparently as a result of a severe El Niño drought that elevated death rates up to 20 times those of non-drought years.
- The findings shattered conventional wisdom that tropical forests are highly stable environments and inspired others to establish their own forest dynamics plots using the same methodology.



Population decline *Poulsonia armata* from 1980 to 2000  
**\*value of long-term data!**

# Center for Tropical Forest Science (CTFS)

20 Forest Plots in 15 Countries



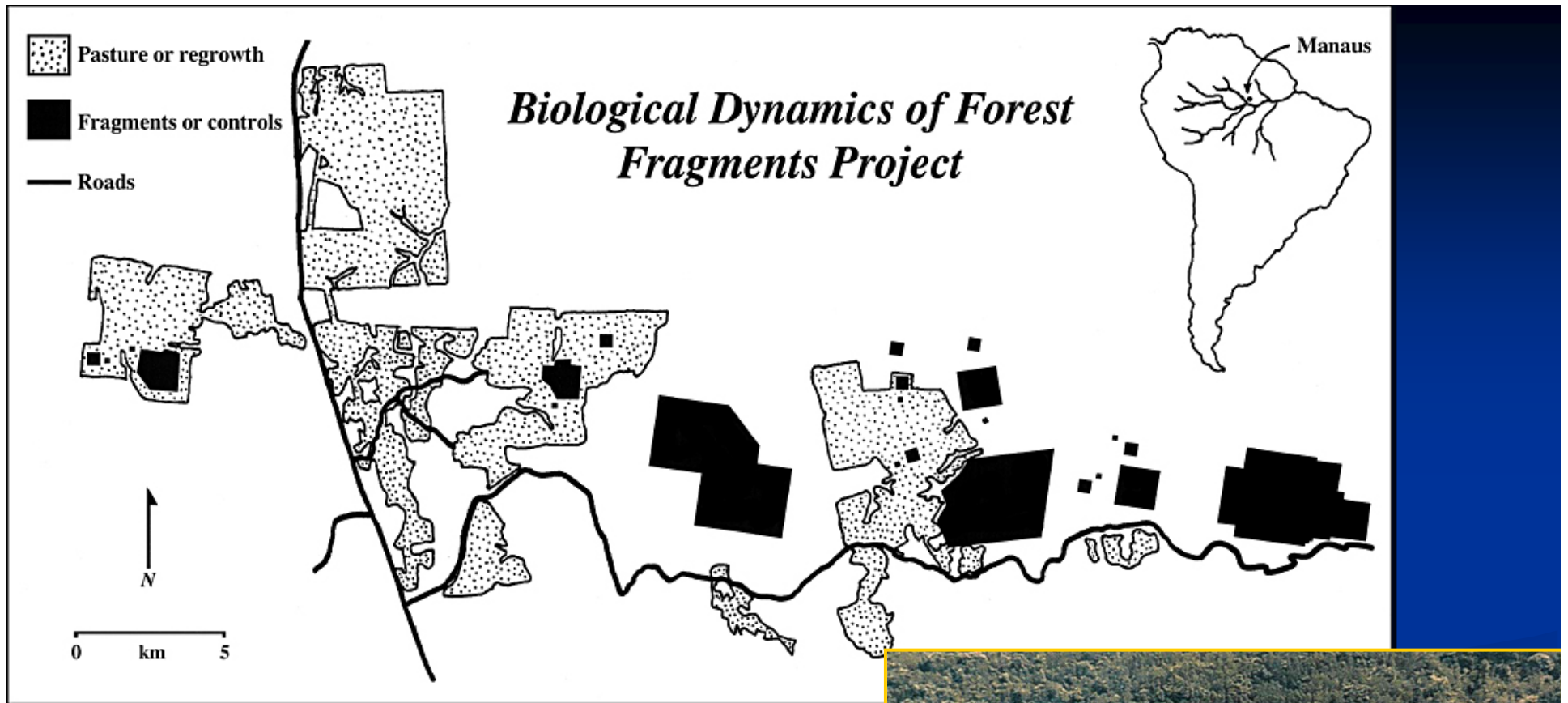
# CTFS Forest Plots: 20 sites in 15 countries

	First census	Number of Censuses	Plot area	Number of species
<b>LATIN AMERICA</b>				
BRAZIL (BDFFP)	1979	6	66	1261
COLOMBIA (ANDES)	1996	2	25	240
COLOMBIA (AMAZON)	2007	1	25	counting
ECUADOR	1995	2	25	1114
PANAMA	1980	6	50	299
PUERTO RICO	1990	3	16	138
<b>AFRICA</b>				
CAMEROON	1997	1	50	494
DEMOCRATIC REPUBLIC OF CONGO	1994	2	40	434
<b>ASIA</b>				
INDIA	1988	5	50	72
MALAYSIA (PENINSULA)	1986	5	50	814
MALAYSIA (BORNEO)	1992	3	52	1182
PHILIPPINES	1994	3	16	345
SINGAPORE	1993	4	2	335
SRI LANKA	1993	2	25	204
TAIWAN (SOUTH)	1989	3	6	125
TAIWAN (NORTH)	2002	1	25	110
THAILAND (CENTRAL)	1992	3	50	259
THAILAND (MONTANE)	1996	1	15	162
THAILAND (PENINSULA)	1998	2	16	593
CHINA (YUNNAN)	2007	1	20	counting

~ 8,200 species

~ 3 million trees monitored globally





*Applied Ecology Program* – largest and longest-running experimental study of forest fragments including studies of carbon balance



# CTFS Network Partners

## Latin America

**Brazil** – INPA, Universidade de Sao Paulo; Louisiana State University (USA).

**Columbia** - Instituto Humboldt, SINCHI, Institute for the Amazon, University of Medellin, UNALMED.

**Ecuador** - Universidad Catolica de Ecuador, University of Aarhus (Denmark), Chicago Field Museum (USA)

**Panama** – STRI (USA), Canal Authority (Panama), University of Georgia (USA)

**Puerto Rico** - University of Puerto Rico, USDA Forest Service

## Africa

**Cameroon** – Bioresources Development and Conservation Program, Oregon State University (USA), University of Buea (Cameroon).

**Democratic Republic of Congo** – CEFRECOF, Wildlife Conservation Society.

# CTFS Network Partners cont.

## Asia

**China** – Chinese Academy of Sciences, Sishuangbanna Tropical Botanical Garden.

**India** - Indian Institute of Science.

**Malaysia** - Forest Research Institute of Malaysia, Sarawak Forest Department, Osaka City University (Japan), Kyoto University (Japan), National Institute of Environmental Studies (Japan), Harvard University (USA).

**Philippines** – University of Philippines, Diliman Campus, Manila, (Philippines), Isabela State University, PLAN International, Conservation International (Philippines), Harvard University (USA).

**Singapore** – National Institute for Education at Nanyang Technological University, Singapore National Parks Board, National University Singapore.

**Sri Lanka** - University of Peradeniya, Sri Lanka Forest Department, University of Sri Jayawardenepura.

**Taiwan** – Tunghai University, Taiwan Forestry Research Institute.

**Thailand** - Royal Forest Department, National Institute of Environmental Studies (Japan), Harvard University (USA), National Parks and Wildlife Department, Kyoto University (Japan).



# Scientific Support and Training

## Number of researchers and students from the United States who visited STRI in 2005-2006

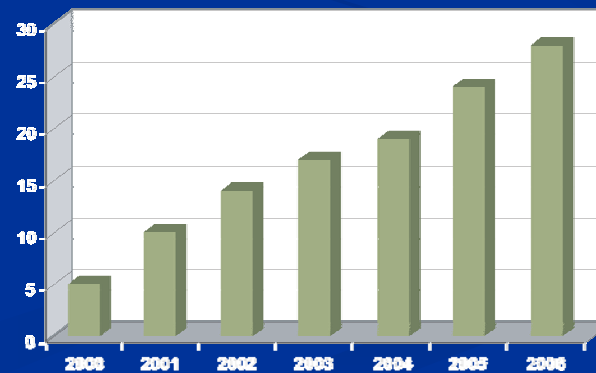
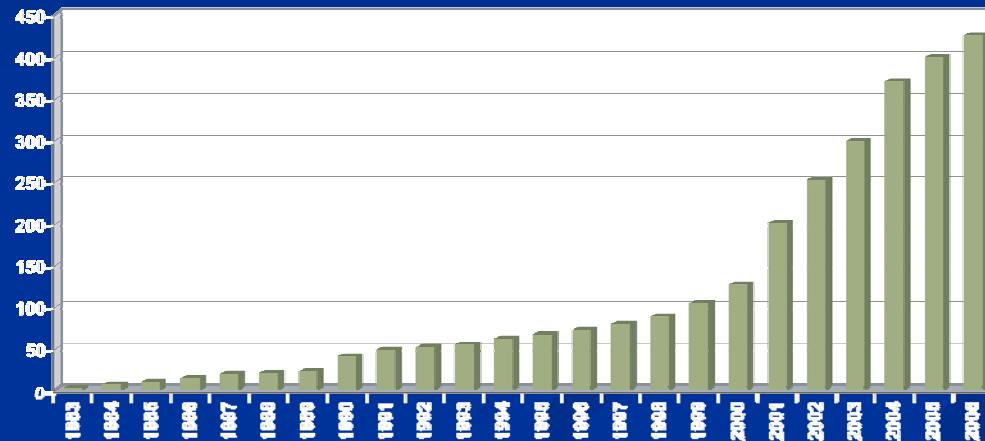


# CTFS Accomplishments

## Scientific Impact

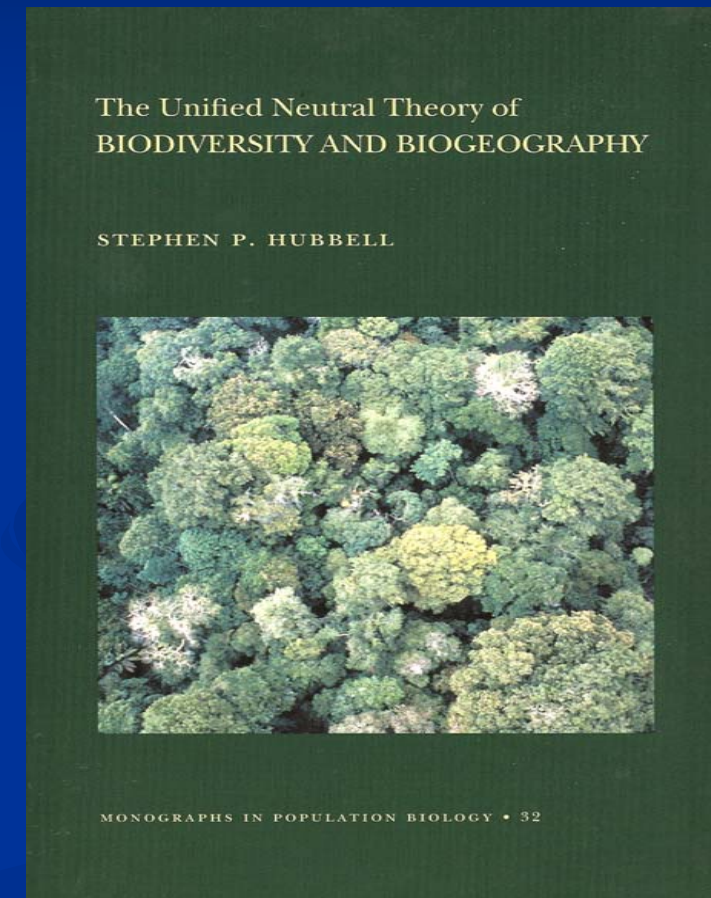
Peer-reviewed  
articles in high  
impact journals +  
book chapters

Cumulative Publications



# CTFS Accomplishments

Hubbell and Foster's work galvanized a new theory of biodiversity and led to a spirited debate on the role forests along the Panama Canal play in regulating its water, the lifeblood of a critical waterway for world commerce.



# From CTFS to SIGEO

I. Global Carbon Research Program

II. Branching Out Into the Temperate Zone

III. Expanding the Monitoring Program:  
Looking Beyond the Trees

Air and Space Museum (NASM), Astrophysical Observatory (SAO), Environmental Research Center (SERC), Natural History Museum (NMNH), National Zoological Park (NZIP) / Conservation Research Center (CRC), and Museum Conservation Institute (MCI),  
**Tropical Research Institute (STRI)**

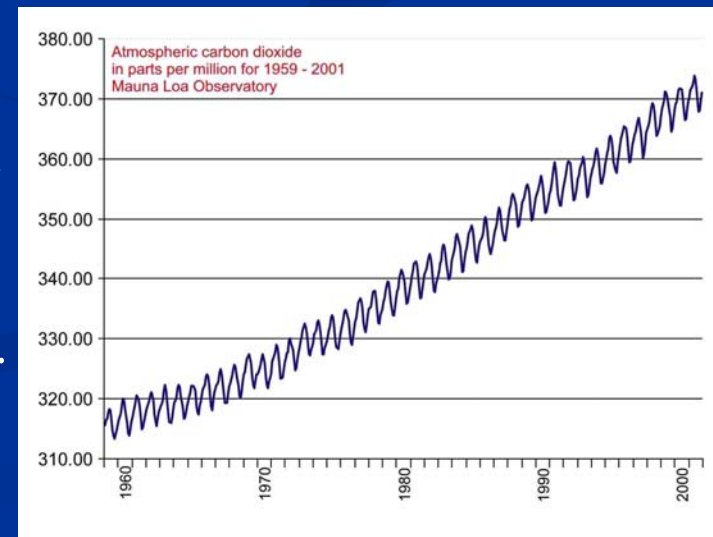
# SIGEO



## I. Global Carbon Research Program

- How do forests respond to increases in atmospheric CO<sub>2</sub> (carbon fertilization) and global warming?
- Expansion from 5-year to annual in-situ measurements of above- and below-ground carbon will provide essential data to develop rigorous models of global climate change – policy implications for reducing carbon emissions and its impact.
- Recent data from two CTFS plots (BCI, Panama and Pasoh, Malaysia) showed decelerating stem growth over the past few decades, which is strongly associated with increases in mean annual temperature.
- NZP/CRC, MCI, NASM, SERC and STRI

### Rising CO<sub>2</sub>



# SIGEO

## II. Expansion into the Temperate Zone



Temperate/Tropical Forest Comparisons – seasonality, snow cover, etc. may result in different responses to climate change

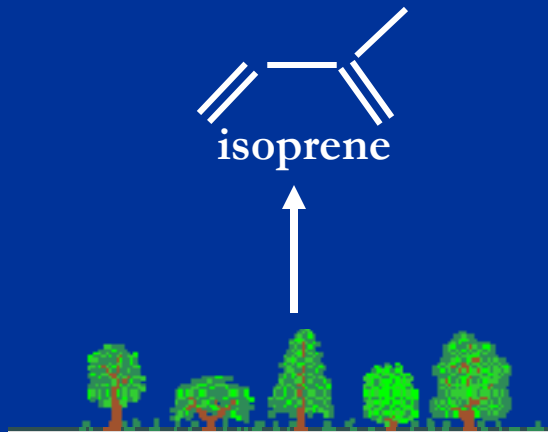


# SIGEO

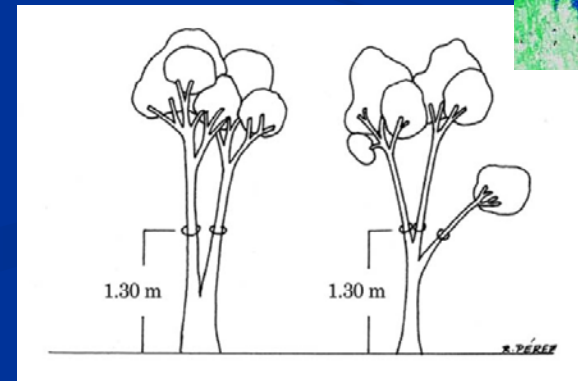
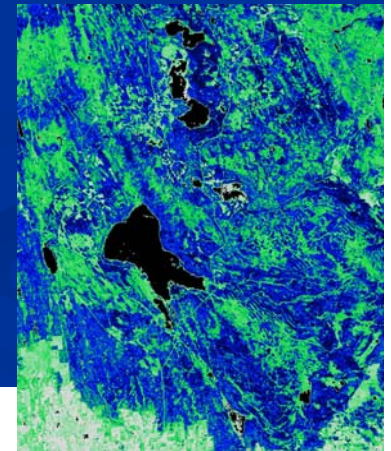
## III. Expanding the Monitoring Program: Looking Beyond the Trees

- a. Linking data on the ground (plots) to regional and global predictions through space-based assessments in collaboration with SAO and NASM.

Measuring global heat-stress on forests



Remote Sensing Techniques



# SIGEO

## III. Expanding the Monitoring Program: Looking Beyond the Trees

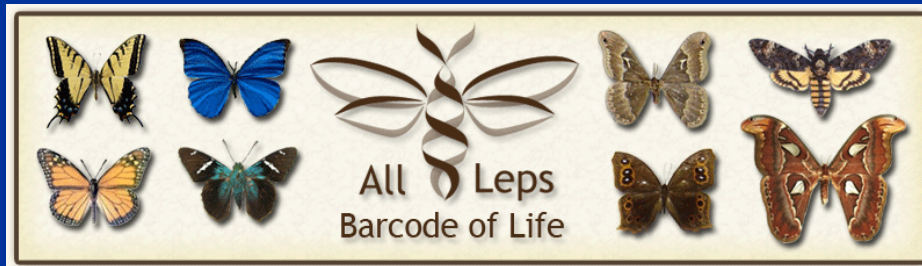
- b. Collection of data for specific groups of vertebrates, insects, and microbes to provide additional measure of the impacts of global change.



Emerging Diseases and Human Health  
Ecosystem services



- c. Expanded collection of data for assessing change through time: paleoecology and DNA particularly barcoding



NMNH, NZP/CRC, SERC, and STRI



# SIGEO – Interagency Collaborations

- SIGEO is intimately linked to the goal of implementing an integrated Global Earth Observation System of Systems (GEOSS).
- SIGEO received an Early Achievement Nomination for its accomplishments in understanding, monitoring and conserving biodiversity and understanding, assessing, predicting climate variability and change in the process of building GEOSS.

# SIGEO – interagency collaborations

- SI has established a MOU with the U.S. EPA to strengthen research ventures related to SIGEO.
- A MOA with the National Climatic Data Center (NCDC) of NOAA is being developed to establish surface-based climate observations in tropical areas.
- The 16-hectare Hurricane Recovery Plot in the Luquillo Experimental Forest is a research site of the U.S. Forest Service.
- CRC and Harvard Forest are being considered as candidate sites for NEON (National Ecological Observatory Network).
- Working agreement with USGS and NOAA with operation of seismometer at BCI as well as shared interest in monitoring vertebrates and microbes.



# SIGEO

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