



Smithsonian Institution



El Eden EcoReserve

**HabitatNet: A Global Biodiversity Project @ El Eden Ecological Reserve,
Quintana Roo, Mexico**

Author / Submittal Date: Daniel J. Bisaccio, February 10, 2006

**HabitatNet – Conservation Biology at Souhegan High School, Amherst, New Hampshire USA
SIMAB Code: EE01 (El Eden, BioPlot 1)**

“A Preliminary Report of Post-Hurricane Disturbance on a Yucatan Forest”

Author: Daniel J. Bisaccio; HabitatNet – Conservation Biology - SHS

Abstract:

Using the Smithsonian Institution's Monitoring & Assessment of Biodiversity (SI/MAB) permanent biodiversity research protocols, Souhegan High School “HabitatNet – Conservation Biology” students and teachers began collecting biological diversity research data at a field site located in Quintana Roo, Mexico. The site was established at the El Eden Ecological Reserve – Quintana Roo, Mexico in October, 1995. Since 1995, two to three groups of students and teachers per year have returned to that site completing a one hectare set of data on a mature forest at the reserve. The pre-hurricane data was completed in year 2004.

The overall goals of HabitatNet are to (1) develop conservation biological literacy in high school students by affording them an opportunity to learn field methods and applications while collecting and interpreting biological diversity data and (2) establish baseline biological diversity data for HabitatNet / SIMAB field sites.

During October, 2005, Hurricane Wilma was recorded to be the most powerful Caribbean hurricane measured since accurate records were established in 1886 (NOAA). Hurricane Wilma crossed the biodiversity site with sustained winds of 140 mph and precipitation amounts totaling 60 inches over a three day period - October 21 – 23, 2005 (NOAA). This paper examines the initial post-hurricane effects with the pre-hurricane data collected at the site. Additionally, a comparison was made to hurricane damage in younger seral stage forest located at Ranchos El Eden.

Section 1 – Methods & Pre-Hurricane Wilma Data

Commencing with the first October, 1995 field assessment by HabitatNet students and teachers, several distinct habitat types at the El Eden Ecological Reserve were observed. Biodiversity Plot “*EE01*” was defined and established based on the relative mature stand of forest tree species found at the location GPS: N 21.21025, W 87.20620 – point corner 1 for the hectare plot. The focus of that field session and subsequent field sessions were to develop a permanent long-term SIMAB Biodiversity Plot at the reserve for student, teacher, and environmental organizations to begin long-term biodiversity data research.

- Plot Selection and Establishment

Selection of the plot site was crucial for both the educational and research values. Thus, the site selection was based on the following criteria:

- The area contained species representative and endemic to the ecosystem.
- Common or dominant species were represented.
- The plot was located within one vegetation type to give a true representation of the area's diversity.
- The plot had access for future student groups.

The forest plot was established using SIMAB protocols (Dallmeier, SIMAB,1992). As a new site, we first surveyed and delineate a one hectare plot (100 X 100 meters) into 25 quadrats, each 20 x 20 meters in size.

- Field Measurements

Tree tagging and identification began after the corner stakes of the quadrants were set. The process included locating, measuring, marking, and mapping all trees with a diameter at breast height (DBH) of 10 cm or greater. Diameter tape was used to measure DBH, avoiding any protrusions on the trunk. Where multiple stems occurred on a tree, all individual stem diameters of 1 cm were measured. Trees were tagged with an aluminum label facing toward the base line of the plot and set with a nail 1.3 M above the ground. The nails thus serve as a general guide for future measurements.

Trees were tagged with an individual number consisting of a sequence of two digits. Using (20-24) as an example, the first pair of numbers (20) identified the quadrat within the plot in which the tree was located, while the second pair (24) identified an individual tree within the quadrat. No other tree received that number. In each quadrat the tree numbers started at one and continued until the last tree was labeled.

Tree identifications have been verified by Juan Castillo (El Eden Ecological Reserve staff: botanist) with collections of all leaf types for each species of tree submitted to El Eden Ecological Reserve for future verification.

Table A (appendix) is a compilation and analysis of tree species found in the hectare plot, completed in 2003. A near-by second hectare plot was begun in 2004.

It appears that the mature forest has been influenced by relatively modern anthropogenic disturbance. Two species (*Metotopium browneii* and *Manilkara sapota*), an *Annacardiaceae* / human skin irritant and the “chicle” tree, respectively, are the most pervasively large (greatest DBH) trees measured in the BioPlot EEF1.

Canopy Density in the quadrats surveyed during field sessions (January, April, July: Table 1.1) for the years 1996- 2004 indicate that the average canopy density for the biodiversity plot EEF1 is 83% during the month of January. Complete canopy density coverage for the BioPlot EEF1, by month and quadrat, is included in the appendix (Table B).

January (n=9)	April (n=6)	July (n=10)
Canopy Density = 83%	Canopy Density = 77%	Canopy Density = 76%

Table 1.1 Canopy Density of the El Eden Ecological Reserve Mature Forest by Month with n = number of quadrats surveyed during that month.

Section 2: Post Hurricane Wilma Data at BioPlot EEF1

An initial pre-survey of Hurricane Wilma disturbance was began December 27 – 29 by two SHS students and me funded by a UC/Riverside – MEXUS grant. Follow-up work done by two groups of Conservation Biology SHS students, myself, and colleagues completed the survey January 14 – 21 and January 21 - 28, 2006 on BioPlot EEF1. Additionally, a concurrent study (discussed in Section 3) included a survey of a secondary successional plot that was disturbed by fire within the past 10 years at *Ranchos El Eden* (GPS N 21.00, W 87.9.984).

BioPlot EEF1 sustained significant damage by winds. The compass direction for trees that were either completely blown-down (roots exposed) or snapped off between ground and 1 meter were taken. Additionally, the DBH of each fallen or snapped tree was recorded. During the survey period, 40 trees were measured. Most of the fallen trees were facing South / South-West (220⁰) indicating winds from the North / North-East.

Number of Trees (Windblown or snapped at 1m or less)	Compass Direction (Tree Fall)
5	Less than 160 degrees (E/SE)
12	160 – 199 degrees (S)
16	200 – 230 degrees (S/SW)
4	231 – 260 degrees (S/SW)
3	261 – 290 degrees (W)
Total Trees: 40	Average DBH of Trees = 18 cm

Table 2.1 Windblown Trees or snapped at 1 m or less (EEF1)

Additionally, trees that were snapped off at heights greater than 1 meter were measured noting “snap height” and DBH.

Number of Trees	Snap Height
9	3 – 5 meters (avg. DBH = 10 cm)
11	5 – 7 meters (avg. DBH = 20 cm)
Total Trees Snapped = 20	Overall Average DBH = 15 cm

Table 2.2 Snap Height and DBH of Trees (EEF1)

Six Canopy Density transects were taken. The average Canopy Density for the six transects was 50%, significantly less than the pre-hurricane average (83%) for the month of January.

Transect Number	Canopy Density
1	40%
2	45%
3	55%
4	55%
5	60%
6	45%

Table 2.3 – Canopy Density EEF1 – Post Hurricane Wilma January, 2006

Section 3: Early Successional Forest at Ranchos El Eden

A second study included a survey of a secondary successional plot that was disturbed by fire within the past 10 years at *Ranchos El Eden* (GPS N 21.00, W 87.9.984). Two, 200 hundred meter by two meter quadrats were established. Trees have a DBH of 3.5 cm or greater were included in this study.

Tree species and DBH are included in Appendix – Table C.

A total of 132 trees were measured. Thus, the overall tree density for trees with a DBH of 3.5 cm or greater is .33 (compared to .057 in the mature plot EEF1).

Canopy Density was measured along three transects with the average density being 54%.

Transect Number	Canopy Density
1	60%
2	38%
3	63%

Table 3.1 – Canopy Density Ranchos El Eden Secondary Growth Forest

Along one 50 meter transect, blown down or snapped trees were counted. As measured in bioplot EEF1, the compass direction for trees that were either completely blown-down (roots exposed) or snapped off between ground and 1 meter were taken. Additionally, the DBH of each fallen or snapped tree was recorded. During the survey period, 34 trees were measured. Most of the fallen trees were facing South / South-West (200⁰-220⁰) indicating winds from the North / North-East.

Number of Trees (Windblown or snapped at 1m or less)	Compass Direction (Tree Fall)
4	Less than 160 degrees (E/SE)
13	160 – 199 degrees (S)
11	200 – 230 degrees (S/SW)
6	231 – 260 degrees (S/SW)
0	261 – 290 degrees (W)
Total Trees: 34	Average DBH of Trees = 5 cm

Table 3.2 Windblown Trees or snapped at 1 m or less (Ranchos El Eden)

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Literature Cited:

Bisaccio, D. “Field Report Numbers. 1-5: El Eden Ecological Reserve -1997-2004; HabitatNet website (<http://www.sprise.com/shs/habitatnet.html>)

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NOAA websites; <http://www.nhc.noaa.gov> , <http://www.nws.noaa.gov>

Appendix:**Table A: Pre-hurricane Tree Data on BioPlot EEF1**

El Eden Ecological Reserve: HabitatNet Hectare Data SIMAB Code: EEF1
Quintana Roo, Mexico GPS (SW Corner Point/ Line 1 & 2) 21° 12'N, 87° 20'W
Minimum DBH of 10 cm

Species	No. Trees	Average DBH (M)	Relative Density (10 ⁻²)	Relative Frequency	Basal Area	Importance Value
<i>Metopium brownei</i>	107	.201	1.07	.186	3.174	4.24
<i>Manilkara sapota</i>	43	.217	.043	.074	3.69	3.73
<i>Ficus yucateensis</i>	61	.180	.061	.106	2.54	2.60
<i>Bursera simaruba</i>	63	.155	.063	.109	1.87	1.93
<i>Lysiloma latisilquum</i>	16	.236	.002	.028	4.37	4.37
<i>Vitex gaumeri</i>	25	.151	.003	.044	1.79	1.79
<i>Caesalpinia gaumeri</i>	33	.158	.003	.057	1.79	1.79
<i>Thrinax radiata</i>	43	.121	.004	.074	1.15	1.15
<i>Guettarda gaumeri</i>	13	.198	.001	.023	3.08	3.08
<i>Lonchocarpus castilloi</i>	25	.142	.003	.044	1.58	1.58
<i>Gymnopodium floribundum</i>	17	.149	.002	.030	1.75	1.75
<i>Thouinia paucidentata</i>	2	.150	.0002	.003	1.77	1.77
<i>Brosimum alicastrum</i>	3	.208	.0003	.005	3.40	3.40
<i>Coccoloba diversifolia</i>	3	.130	.0003	.005	1.32	1.32
<i>Coccoloba acapulcensis</i>	4	.110	.0004	.007	0.09	0.09
<i>Hippocratea celastroides</i>	4	.140	.0004	.007	1.5	1.54
<i>Hamphea trilobata</i>	3	.100	.0003	.005	.078	.078
<i>Drypetes laterifolia</i>	2	.140	.0002	.003	1.54	1.54
<i>Guettarda combsii</i>	7	.198	.0007	.012	3.08	3.08
<i>Piscidia piscipula</i>	13	.200	.0013	.023	3.14	3.14
<i>Chrysophyllum mexicanum</i>	2	.150	.0002	.003	1.79	1.79
<i>Ficus cotinifolia</i>	6	.130	.0006	.010	1.32	1.32
<i>Cordia alliodora</i>	1	.110	.0001	.002	0.09	0.09
<i>Esembeckia pentaphylla</i>	9	.110	.0009	.016	0.09	0.09
<i>Eugenia</i>	6	.110	.0006	.010	0.09	0.09

mayana						
Thalasia olivaeformis	1	.110	.0001	.002	0.09	0.09
Parmentiera millsbaughiana	9	.123	.0009	.016	1.19	1.19
Glyricidia sepium	1	.100	.0001	.002	.078	0.07
Thevetia gaumeri	2	.100	.0002	.003	.078	0.08
Saphranthus campechianum	1	.100	.0001	.002	.078	0.08
Ficus maxima	2	.110	.0002	.003	0.09	0.09
Swartzia cubensis	6	.110	.0006	.010	0.09	0.09
Glyricidia sepium	1	.100	.0001	.002	.078	0.08
Cercropia obtusifolia	1	.110	.0001	.002	0.09	0.09
Anonna glabra	1	.100	.0001	.002	.078	0.08
Jatropha gaumeri	5	.110	.0005	.009	0.09	0.09
Alvaradoa amorphoides	1	.100	.0001	.002	.078	0.08
Randia aculeata	2	.100	.0002	.003	.078	0.08
Brysonima bucidaefolia	1	.100	.0001	.002	.078	0.08
Jatropha gaumeri	2	.100	.0002	.003	.078	0.08
Diphysa carthaginensis	1	.100	.0001	.002	.078	0.08
Bumelia sp.	8	.100	.0008	.013	.078	0.08

Total Trees (n) 574 Total Species 42 Tree Density (all species) = .057

Table B: Canopy Density for BioPlot EEF1 (pre-Hurricane Wilma)
Canopy Density
El Eden Ecological Reserve: HabitatNet Hectare Data SIMAB Code: EEF1
Quintana Roo, Mexico GPS (SW Corner Point/ Line 1 & 2) 21° 12'N, 87° 20'W

Date Surveyed: 1/00	Date Surveyed: 1/00	Date Surveyed: 7/00	Date Surveyed: 1/01	Date Surveyed: 1/01
Quadrat No: 5	Quadrat No: 10	Quadrat No: 15	Quadrat No: 20	Quadrat No: 25
Canopy Cover: 80%	Canopy Cover:75%	Canopy Cover: 70%	Canopy Cover: 80%	Canopy Cover: 100%
Date Surveyed: 6/98	Date Surveyed: 7/98	Date Surveyed: 7/00	Date Surveyed: 7/97	Date Surveyed: 1/02
Quadrat No: 4	Quadrat No: 9	Quadrat No: 14	Quadrat No: 19	Quadrat No: 24
Canopy Cover: 80%	Canopy Cover: 85%	Canopy Cover: 75%	Canopy Cover: 75%	Canopy Cover: 85%
Date Surveyed: 4/98	Date Surveyed: 7/98	Date Surveyed: 7/97	Date Surveyed: 1/02	Date Surveyed: 7/99
Quadrat No: 3	Quadrat No: 8	Quadrat No: 13	Quadrat No: 18	Quadrat No: 23
Canopy Cover: 60%	Canopy Cover: 85%	Canopy Cover: 65%	Canopy Cover: 75%	Canopy Cover: 70%
Date Surveyed: 4/98	Date Surveyed: 4/97	Date Surveyed: 1/99	Date Surveyed: 1/99	Date Surveyed: 7/99
Quadrat No: 2	Quadrat No: 7	Quadrat No: 12	Quadrat No: 17	Quadrat No: 22
Canopy Cover: 85%	Canopy Cover: 85%	Canopy Cover: 90%	Canopy Cover: 90%	Canopy Cover: 80%
Date Surveyed: 4/97	Date Surveyed: 7/97	Date Surveyed: 7/97	Date Surveyed: 3/98	Date Surveyed: 3/98
Quadrat No: 1	Quadrat No: 6	Quadrat No: 11	Quadrat No: 16	Quadrat No: 21
Canopy Cover: 90%	Canopy Cover: 75%	Canopy Cover: 75%	Canopy Cover: 70%	Canopy Cover: 70%

Average Canopy Density By Month:

January (n = 9)	April (n = 6)	July (n = 10)
Canopy Density = 83%	Canopy Density = 77%	Canopy Density = 76%

Table C: Ranchos El Eden Secondary Growth Forest Data

**El Eden Ecological Reserve / HabitatNet
Secondary Growth Forest at Ranchos El Eden (400 m²)
GPS: N 21 11.659 , W 87 9.964**

Minimum DBH = 3.5 cm

Species	No. Trees	Relative Density	Relative Frequency
Metopium brownei	1		.007
Bursera simaruba	1		.007
Croton flavens	71	.17	.53
Lonchocarpus castilloi	26	.06	.19
Jatropha gaumeri	7	.01	.05
Calesalpinia sp.	11	.02	.08
Delomix revia	2		.015
Unk Taxon 1	5		.037
Unk Taxon 2	4		.030
Unk Taxon 3	4		.030

Total Trees: 132

Number of Species: 10 Tree Density (all species) = .33

Average DBH = 5 cm