Agumbe Rainforest Research Station:
Karnataka,India

Permanent Sample Plot Establishment Report

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Introduction

This report is to give a simple outline of the fieldwork performed over three days in November 2009 at Agumbe Research Station. At the time of our visit, no permanent sample plots had been placed in the Agumbe Forest to measure tree growth and composition. These plots, or "PSP"s, are a standard tool in forest ecology, and the most basic measurements are standardized throughout the world of science research and forestry. They can serve as the foundation for studies on forest dynamics, biodiversity, and ecology, and are a critical link in linking study results at different spatial scales (e.g. branch, tree, hectare, landscape). Especially when combined with photo-monitoring points, these can also be used as a tool to illustrate and share information about the forest.

Photo 1: Agumbe Rainforest Research Station

Our work was intended to provide a "year zero" baseline data set and create a resource for future ecologists to work in Agumbe. It is hoped that more PSPs will be established, and equally importantly, that all PSPs begun will be monitored into the future. As a snapshot, these can provide a picture of how the forest is composed taxonomically and structurally. As time progresses, these will allow a view into how the forest changes over time. When linked with other research sample plots, such as the French Institute Pondicherry's site at Uppangala-Subramanya or the Indian Institute of Science 50 ha plot at Mudumalai, comparisons can be made between this forest and others. It should be stressed that our work provides only the barest minimum for any sort of statistical claims at a large scale, but can be used as a resource for establishing studies at a small forest patch scale. It is of the utmost importance that future PSPs are established in an appropriate manner, ideally either systematically in representative forests or randomly in locations throughout the forest. There are many scientists at IISc, French Institute Pondicherry, NCBS, ATREE, and other institutions with extensive experience in establishing this type of project. Should ARRS be able to enlist their aid in a large-scale project, then much more detailed and extensive work can be combined with the quick project described here.

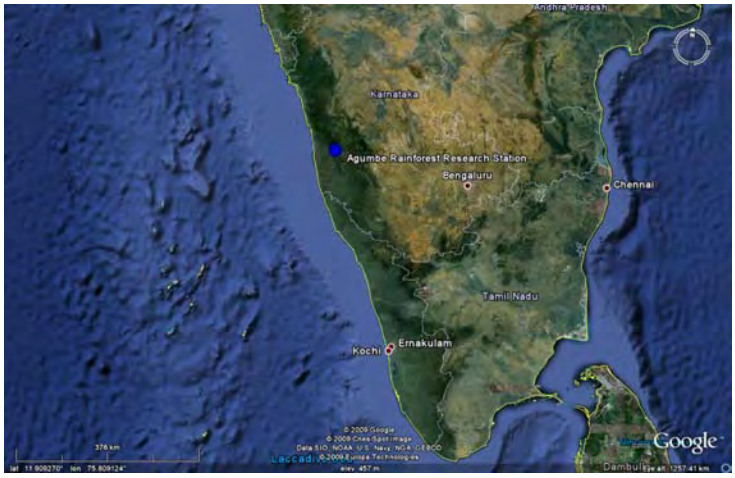
Site overview

Photo 2: Buttresses on an Elaecarpus tree, near plot 2

From http://www.agumbe.com/AgumbeRainforestResearchStation_ARRS.asp :

Agumbe situated 560 meters above sea level on the Sahyadri ranges (Western Ghats), a World bio-diversity hotspot is aptly called the Cherapunji of South India as it receives an average rainfall of 7000-8000mm annually. However not many know that these pristine forests are home to the longest venomous snake of the world - The King Cobra. Romulus Whitaker, the Snake Man of India fell in love with this place 35 years back where he caught his first King Cobra. After setting up the Madras Crocodile Bank Trust (MCBT- 1976) and Andaman and Nicobar Island Environmental Team (ANET- 1983) he returned back to Agumbe to setup the Agumbe Rainforest Research Station.

The main objective of ARRS is to study and conserve the rainforests of south India. Using the King Cobra as the flagship species ARRS attempts to establish the world's first King Cobra Sanctuary at Agumbe.



South India satellite view–Agumbe marked in blue on west coast

Forest region overview

From http://en.wikipedia.org/wiki/North_Western_Ghats_moist_deciduous_forests :

The North Western Ghats moist deciduous forests is a tropical moist broadleaf forest ecoregion of southwestern India. It lies between 250 and 1000 meters elevation in the northern portion of the Western Ghats range, from their northern end in Maharashtra state, through

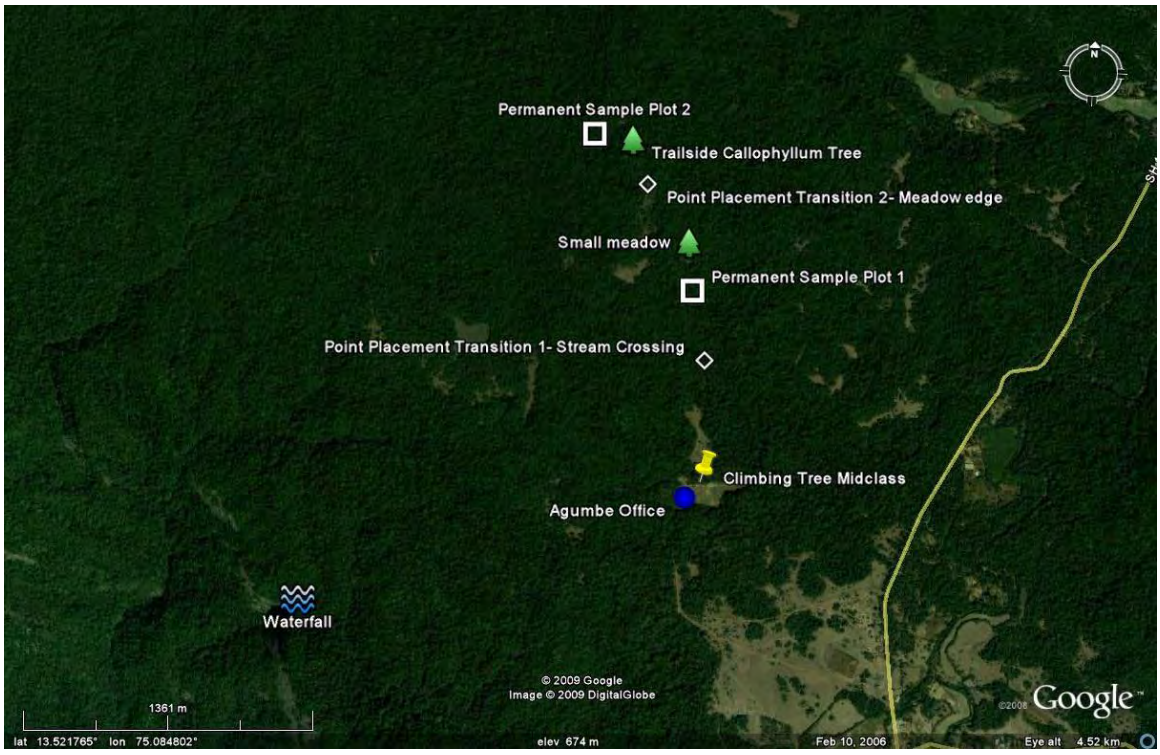
Karnataka to the transitional forests of Wayanad in Kerala. It surrounds the North Western Ghats montane rain forests ecoregion, which lies above 1000 meters elevation. The ecoregion has an area of 48,200 square kilometers (18,600 square miles). It is bounded on the west by the Malabar Coast moist forests ecoregion, which lies between the 250 meter elevation and the Malabar Coast. At the northern end of the Western Ghats range in southeastern Gujarat, the ecoregion borders the Kathiawar-Gir dry deciduous forests to the west and the Narmada Valley dry deciduous forests to the northeast. The Wayanad forests at the southern end of the ecoregion mark the transition to the South Western Ghats moist deciduous forests to the south. To the east, in the rain shadow of the Ghats, lies the South Deccan Plateau dry deciduous forests ecoregion, whose tropical dry forests cover the Ghats' eastern foothills.

Google terrain map of India- Agumbe in blue on west coast

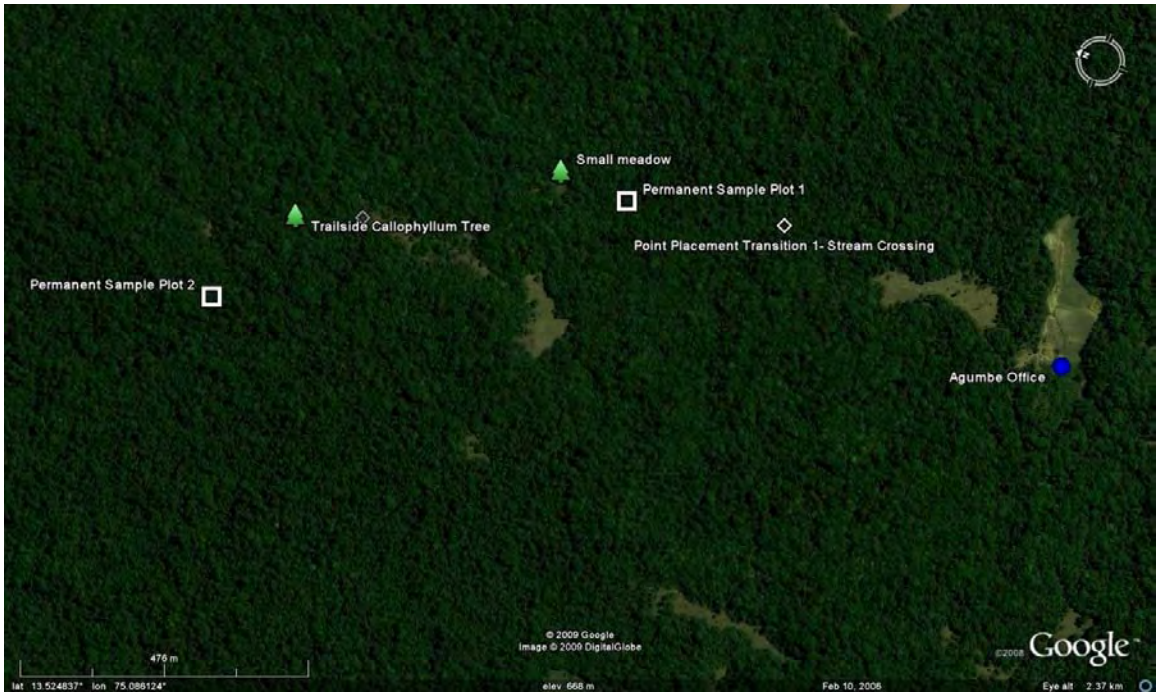
Plot establishment methods- placement

The overarching goal of establishing any sample is to gain a representative sample. The twWe began with an overview of the study site on Google Earth. Establishing a study design first, we could begin our measurements and hope that future efforts could complete the work. Our initial plan was to systematically survey the complete extent of remaining forest: to create a series of parallel lines of evenly spaced PSP's perpendicular to the escarpment west of Agumbe forest. This idea was quickly abandoned when we realized time constraints limited our ability to access interior forest. The rejected design can be seen on the Google Earth file under "Unused Study Design Ideas". It is hoped that we or others will be able to conduct this survey in the future.

Following that, we elected to use the major northwards trail from Agumbe for access. Two plots were established. For each. we followed the trail for random distance (50-150 m) from a major landmark forest transition (stream crossing or open field). The precise location was established by randomly selecting a distance between 50-100 meters into the forest perpendicular to the trail. The direction (right or left) was selected randomly. See Aerial Maps 1 and 2 for a map view.



Aerial Map 1- Agumbe Overview



Aerial Map 2- Agumbe Rainforest Research Station PSP

Future work- plot placement

We strongly encourage Agumbe and its collaborators to place additional plots on the landscape. These can be done in a variety of fashions. Systematic sampling is best, but time-intensive. Our randomization technique was characterized by the need for access. Using the trail for access means that the limited resources available are more likely to be used for monitoring and using the plots. We recommend additional plots be placed a far distance away from the trail only if it is feasible to continue to maintain them in the future.

Plot establishment methods- measurement

We used standard forest measurement practices as previously encountered by us (YDB and NP). Each PSP was 30m by 30m, oriented along magnetic north. The southwest corner of the plot was the origin 0,0 point of a 2-d coordinate system. The northeast corner was therefore 30,30. We used a combination of a 30m tape measure, brightly colored ribbons, and kite strings to mark off the plot temporarily. Dividing the plot temporarily into fourths or sixths greatly aided our ability to work quickly and accurately. A GPS point was collected for each site, but low accuracies due to thick forest canopy cover meant that these points are useful only for locating the plots (i.e. we cannot plot our data directly and precisely onto a large-scale map)

Photo 3: Two tagged trees

All trees taller than 1.3 greater than 30 cm girth at chest height (1.3m tall) were tagged, spatially plotted, girthed, and when possible, identified to species. Tagging trees was done by hammering in a stainless steel nail, at 1.3 m height, into the tree trunk through an aluminium tag with a unique identification number. Each tree thus tagged was spatially plotted onto the 30m x 30 coordinate square using grid paper, thus forming a map. At 1.3 m, the circumference of the trunk was measured with a tape. Buttresses and the empty space between buttresses were included in this measure. Species splitting into several trunks below this height were measured first around all trunks combined, and then the girth of each trunk separately was recorded in the notes section. Lianas, when thicker than 30cm girth, where measured at their widest reachable point and the tag was placed there.

The ability to recognize and identify the trees of the forest was the limiting factor to our work. For plot 1, we identified the majority of species and were able to assign temporary morphospecies to the remainder. For plot 2, we only tagged the trees in the hopes that a future team would have the ability to collect this botanical data with the help of the spatial plots and metal tags

At each corner of the plot, a series of photographs was taken. Photos were taken facing N, S, E, W, up, and down (in that order) from the NW, NE, SE, and SW corners (in that order).

Future work- monitoring

As soon as possible, a visit to PSP 2 should be made by a team with the botanical identification skills to complete identify the trees.

Remeasuring the plots should be done as often as possible, although this is a lower priority than establishing a more robust study design (either systematically or with increased sites chosen randomly). A team should head to the site, following the directions on the study map PDFs. At the plot, they should search for each tagged tree and remeasure each tree's girth. They should locate any missing trees, which may be dead and fallen. Tags may also have come out of the tree and can sometimes be found on the forest floor. Nails can be checked, replaced, or reinforced. Additionally, new trees may have grown of size to be included in the plot, and these should be given a new tag and added to the data sheet. Any trees found to be missing from or misplaced on the map can be marked on the paper and the XY coordinates later modified on the computer data file.

Future work- field materials list

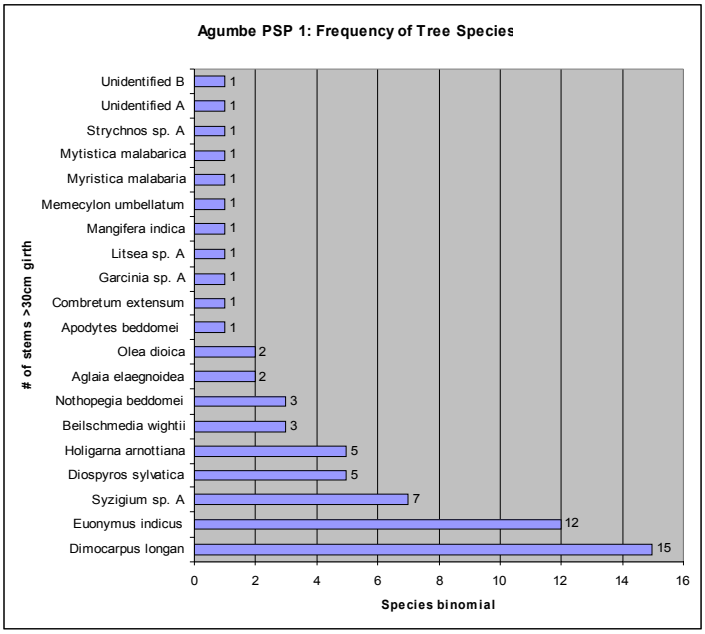
- GPS
- Compass
- Tape Measures for plotting (30m)
- Tape Measures for girth (1-5m)
- String for plot marking
- Ribbons and marker for plot marking
- PSP tree maps printout
- PSP tree data printout
- Blank grid paper for new site establishment
- Writing utensils
- Field gear for safety, rain
- Hammer
- Aluminum tags
- Ballpoint pen for tagmarking
- Nails (2 inch)
- Digital camera for photomonitoring points
- Tell people at station where you are headed and when you'll return

Potential use: analysis of forest PSP data

A large segment of forest ecology specialises in the analysis and use of PSP data. We present here some very simple data analysis to give a concept of what can be done, but stress that two sample plots (and only one with botanical data) can offer only the most minimal insight. But with more sites established and a longer time period, these plots can provide the foundation for knowledge about the rainforest at Agumbe.

Species distribution

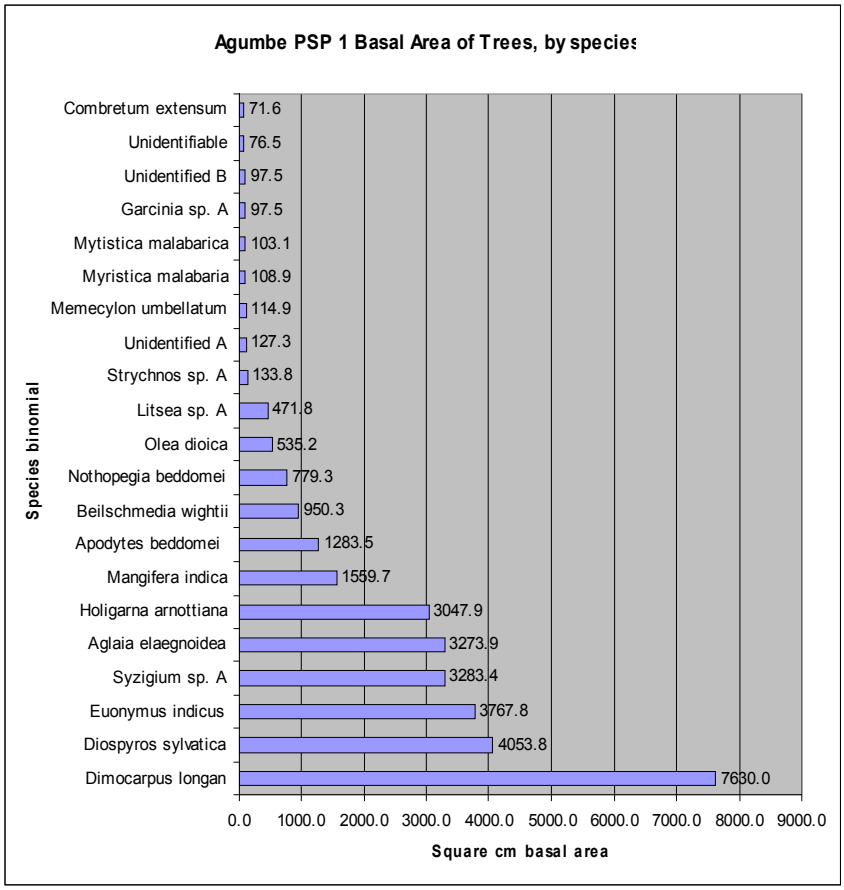
The count of tree stems for each species was plotted to compare the relative abundance of each tree species (*Graph 1*). 65 tree stems were recorded on PSP 1. *Dimocarpus longan* was the most abundant, with 15, or 23% of the total stems. It was followed by *Euonymus indicus,* with 12, or 18% of the total stems.



Graph 1: Tree species frequency distribution on Agumbe PSP 1

Basal area distribution by species

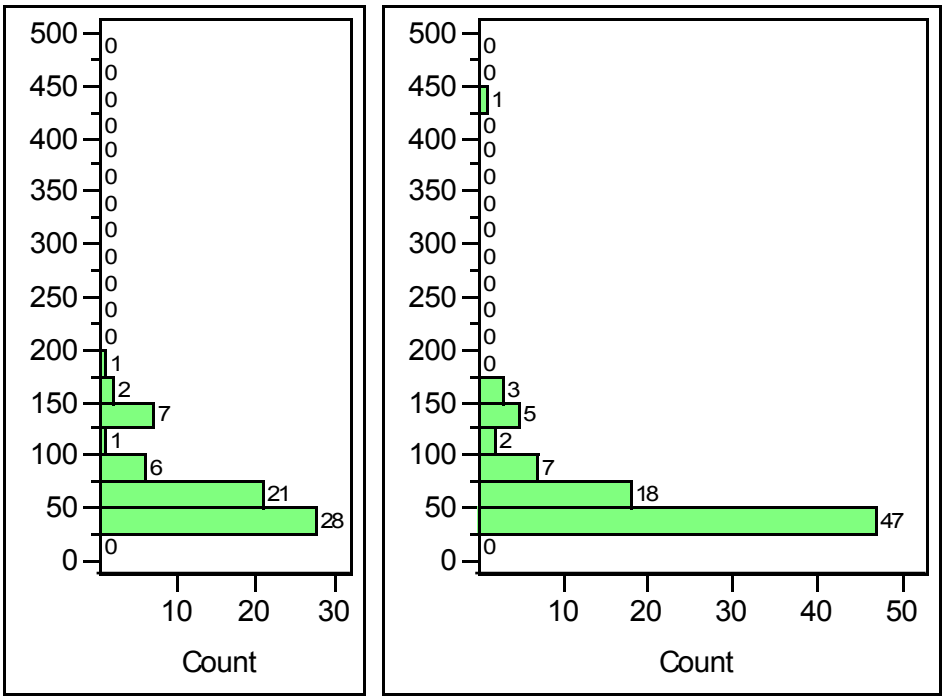
Using the girths of each tree (i.e. circumference), the basal area of each tree was calculated and compared across species. *(Graph 2)* Imagining a cross-sectional slice through the forest plot at 1.3 m in height, 0.353%, or 31567.8cm sq of the 9 million cm sq of the plot, was comprised of tree stems. When combined with more detailed measurements of tree structure, such as tree height, branch size, and leaf count, this data can provide information on biomass sequestration per 900 sq m of forest.



Graph 2: Basal area of trees at Agumbe PSP 1, by species

Frequency distribution of girths

Using a histogram at intervals of 25ms, the girths of each tree, regardless of species, was charted for both PSP 1 and PSP 2 *(Graph 3).* Using this display, it is readily apparent that there were more small trees (~25-50cm girth) in PSP 2 than in PSP 1. Additionally, it can be seen that in both sites, 3-4 trees stand out as larger than the rest.



Agumbe PSP 1 ***Agumbe PSP 2***

Graph 3: Basal area of trees in square cm (y axis), frequency by 25m intervals, for Agumbe PSPs 1 and 2

Potential use: additional data sets

Future visits to the PSPs can add unlimited types of new information to the plots. Provided it is all at an appropriate spatial scale, combining these data can allow for new comparisons to be made, hypotheses tested and concepts to be explored. Just as the plots themselves are a sample of the forest, so can additional measurements be subsampled within the PSPs. For example, a measurement of leaf litter biomass could be performed by randomly selecting 10 square meters from the plot.

Some suggestions are included below, arranged from simple structural measurements to more detailed studies:

Simpler....

1. More precise GPS locations, especially for the four corners of the plot
2. Measurement of tree heights, using trigonometry or laser tools
3. Classification of the tree by canopy position (dominant, subdominiant, suppressed) can be collected.
4. Spatial plotting and measurement of downed logs

...mid- complicated...

5. Fallen leaf count and biomass estimation
6. Soil characteristics
7. Light environment measurement

   ...more complicated....
8. Canopy structure
9. Insect biodiversity survey
10. Fungal survey

Potential directions

It is important to let other scientists know of the beginnings of a sample plot network, and to consider this initial effort as the seed of a scientific infrastructure resources.. It may be that they will direct their efforts to the same locations so as to make use of, or add to, the PSP data. We would recommend that as much future ecology work as possible be linked to the PSP network at Agumbe, and subsequently, the Agumbe PSP network be used in comparison with other PSP sites in India and abroad..

For some studies, such as canopy arthropod studies, the PSP allows an entry point for designing a project. The fine scale decision about which tree to study requires knowledge about the composition and abundance of the trees within a forest; and the PSPs

Contacting other scientists about advice and future usages of the PSP network can be of great service. Navendu Page, at the Center for Ecological Studies at the Indian Institute of Science, has conducted many PSP establishments and was responsible for the botany on PSP 1. He is intending to return to use the plots established in his PhD research on plant distributions. The IISc also maintains a 50 ha PSP at Mudumalai National Park (http://ces.iisc.ernet.in/)

The ecology group at the French Institute of Pondicherry has conducted work in the Western Ghats, including a large scale forest typing map and a detailed, intensive PSP at Uppangala, near Subramanya. (http://www.ifpindia.org/-Ecology-.html)

Lastly, a bit of research online can offer a wealth of tips and useful information on establishing and monitoring PSPs.

http://www.gov.ns.ca/natr/forestry/inventory/reports/InvReport2004.pdf

http://www.springerlink.com/index/W72T532X52V9214P.pdf

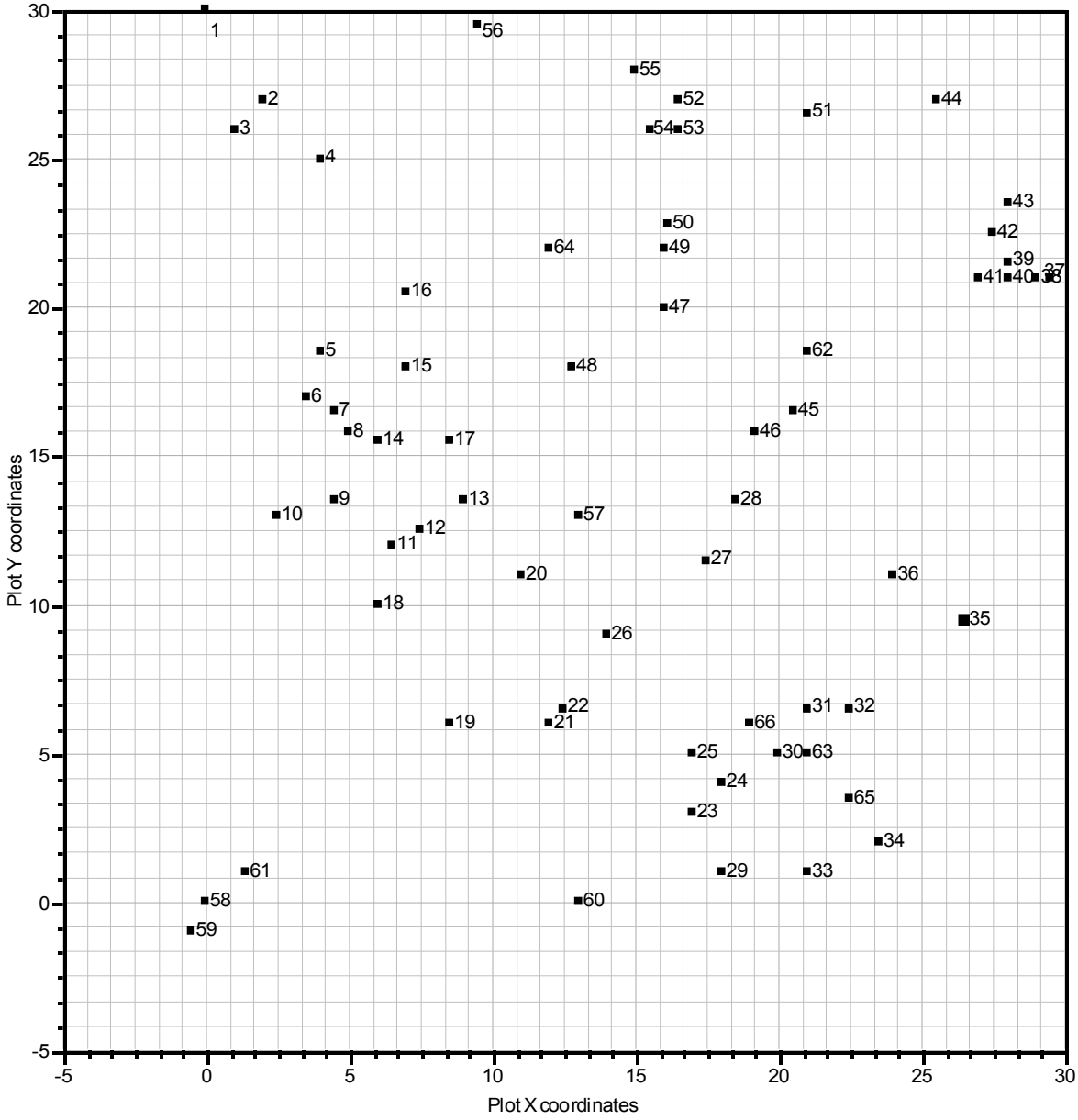
http://www.nhbs.com/permanent_sample_plot_techniques_for_mixed_tropical_forest_tefno_26543.html

Photo 4: In the first meadow, just north of ARRS

Conclusions

We greatly enjoyed the opportunity to contribute to Agumbe's scientific infrastructure and visit the forest. We look forward to seeing how the Permanent Sample Plot network here progresses. Even if our small efforts are not picked up in the short term, there should be nails in the tree for several years, allowing future forest ecologists to use our data from November 2009. While we realise that the immediate value of these 2 simple forest plots is limited at the immediate moment, we also assert that long term data on forest composition and structure when replicated across the forest landscape, is invaluable to the mission of Agumbe Rainforest Research Station. Please let other ecologists know that the forest measurement work has begun, and we assure you that other work will be gladly linked to these data sets. We hope to contribute to these efforts in the future, and even more hope that they will be adopted as an integral part of Agumbe Rainforest Research Station's ecological work..

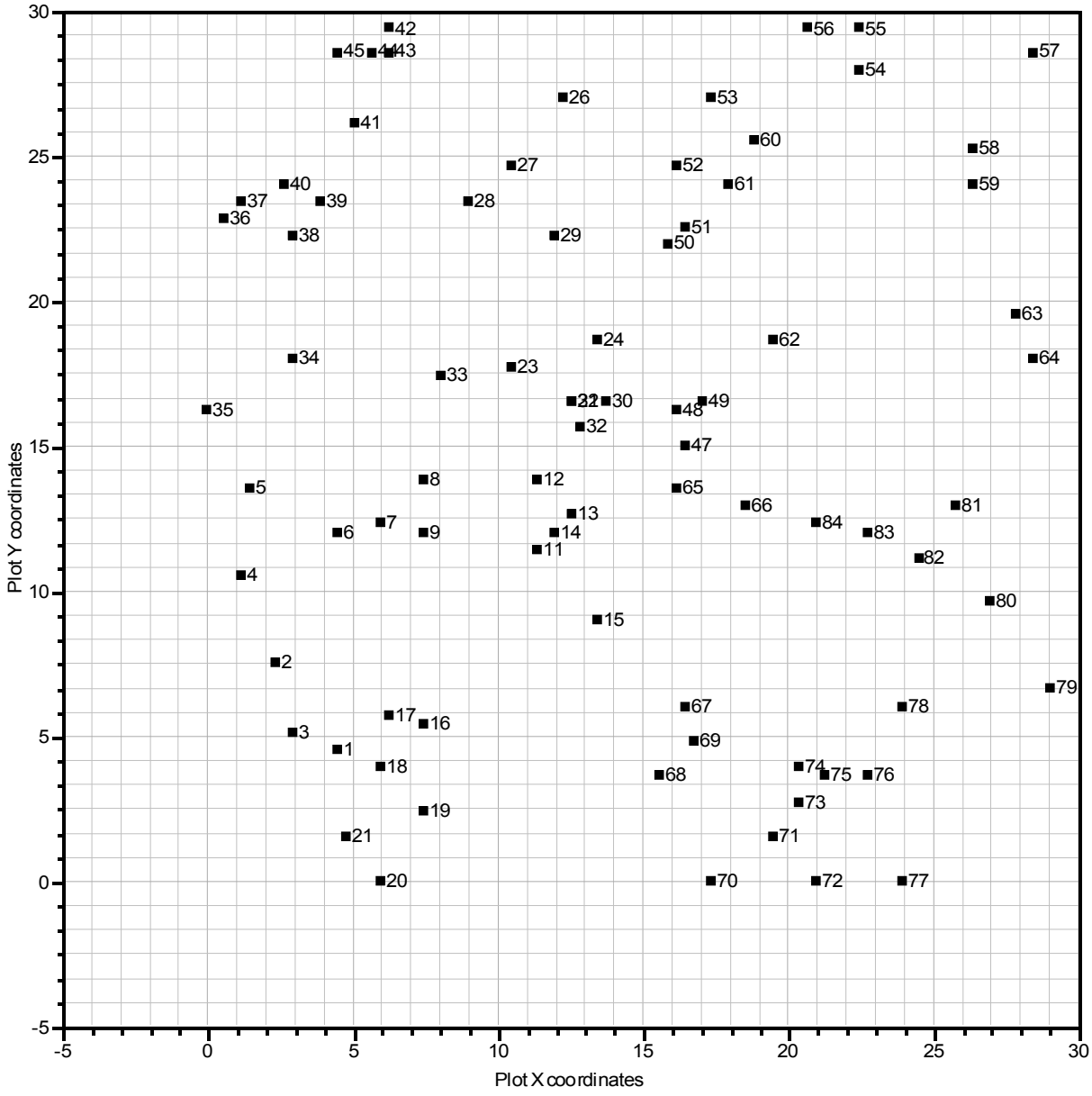
Agumbe Permanent Sample Plot 1 11/16/09 Latitude N 13.525010° Longitude E 75.088570°



Agumbe Permanent Sample Plot 1 11/16/09 Latitude N 13.525010° Longitude E 75.088570°

**Head north from Agumbe field station past the stream crossing at ~ 13.522604° / 75.089143°
Continue approx. 250 m. A small trail to the right from the main trail leads toward a small meadow at (13.526039°/ 75.088396°). About 30 m before the meadow, another smaller trail leads rightward directly into the north end of the plots. Tags are facing SE.**

Agumbe Permanent Sample Plot 2 11/17/09 Latitude N 13.530350° Longitude E 75.084750°



Agumbe Permanent Sample Plot 2 11/17/09 Latitude N 13.530350° Longitude E 75.084750°

Directions- walk north on the trail through the second meadow at 13.528661°/ 75.086771°. Enter into the forest approx. 120m.

At around 100m in, look for the prominent striped trunk of a Calophyllum tree at approx. 13.529530° / 75.086180°

Head left, or WNW, into the forest for approximately 60m. Tags are facing into the center of the plot at 15, 15.

Plot	Date of Establishmen	Plot Latitude N	Plot Longi	Plot X coo	Plot Y coo	Tree Tag	Girth cm
1	11/16/09	13.525010°	75.0885700	30	1	99
1	11/16/09	13.525010°	75.0885702	27	2	40
1	11/16/09	13.525010°	75.0885701	26	3	38
1	11/16/09	13.525010°	75.0885704	25	4	62
1	11/16/09	13.525010°	75.0885704	18.5	5	50
1	11/16/09	13.525010°	75.08857003.5	17	6	160
1	11/16/09	13.525010°	75.08857004.5	16.5	7	65
1	11/16/09	13.525010°	75.0885705	15.8	8	98
1	11/16/09	13.525010°	75.08857004.5	13.5	9	40
1	11/16/09	13.525010°	75.0885702.5	13	10	46
1	11/16/09	13.525010°	75.0885706.5	12	11	64
1	11/16/09	13.525010°	75.0885707.5	12.5	12	130
1	11/16/09	13.525010°	75.0885709	13.5	13	67
1	11/16/09	13.525010°	75.0885706	15.5	14	140
1	11/16/09	13.525010°	75.0885707	18	15	77
1	11/16/09	13.525010°	75.0885707	20.5	16	68
1	11/16/09	13.525010°	75.0885708.5	15.5	17	35
1	11/16/09	13.525010°	75.0885706	10	18	127
1	11/16/09	13.525010°	75.0885708.5	6	19	54
1	11/16/09	13.525010°	75.08857011	11	20	67
1	11/16/09	13.525010°	75.08857012	6	21	71
1	11/16/09	13.525010°	75.08857012.5	6.5	22	61
1	11/16/09	13.525010°	75.08857017	3	23	37
1	11/16/09	13.525010°	75.08857018	4	24	36
1	11/16/09	13.525010°	75.08857017	5	25	37
1	11/16/09	13.525010°	75.08857014	9	26	49
1	11/16/09	13.525010°	75.08857017.5	11.5	27	78
1	11/16/09	13.525010°	75.08857018.5	13.5	28	35
1	11/16/09	13.525010°	75.08857018	1	29	31
1	11/16/09	13.525010°	75.08857020	5	30	190
1	11/16/09	13.525010°	75.08857021	6.5	31	30
1	11/16/09	13.525010°	75.08857022.5	6.5	32	71
1	11/16/09	13.525010°	75.08857021	1	33	66
1	11/16/09	13.525010°	75.08857023.5	2	34	73
1	11/16/09	13.525010°	75.08857026.5	9.5	35	140
1	11/16/09	13.525010°	75.08857024	11	36	77
1	11/16/09	13.525010°	75.08857029.5	21	37	125
1	11/16/09	13.525010°	75.08857029	21	38	70
1	11/16/09	13.525010°	75.08857028	21.5	39	37
1	11/16/09	13.525010°	75.08857028	21	40	58
1	11/16/09	13.525010°	75.08857027	21	41	69
1	11/16/09	13.525010°	75.08857027.5	22.5	42	96
1	11/16/09	13.525010°	75.08857028	23.5	43	36
1	11/16/09	13.525010°	75.08857025.5	27	44	32
1	11/16/09	13.525010°	75.08857020.5	16.5	45	36
1	11/16/09	13.525010°	75.08857019.2	15.8	46	69
1	11/16/09	13.525010°	75.08857016	20	47	103
1	11/16/09	13.525010°	75.08857012.8	18	48	48
1	11/16/09	13.525010°	75.08857016	22	49	50

1	11/16/09	13.525010°	75.08857016.1	22.8	50	60
1	11/16/09	13.525010°	75.0885702**1**	26.5	51	54
1	11/16/09	13.525010°	75.08857016.5	27	52	38
1	11/16/09	13.525010°	75.08857016.5	26	53	144
1	11/16/09	13.525010°	75.08857015.5	26	54	150
1	11/16/09	13.525010°	75.0885701**5**	28	55	66
1	11/16/09	13.525010°	75.0885709.5	29.5	56	30
1	11/16/09	13.525010°	75.0885701**3**	13	57	35
1	11/16/09	13.525010°	75.088570**0**	0	58	36
1	11/16/09	13.525010°	75.088570-0.5	-1	59	147
1	11/16/09	13.525010°	75.0885701**3**	0	60	46
1	11/16/09	13.525010°	75.088570**1.4**	1	61	36
1	11/16/09	13.525010°	75.0885702**1**	18.5	62	38
1	11/16/09	13.525010°	75.0885702**1**	5	63	36
1	11/16/09	13.525010°	75.0885701**2**	22	64	30
1	11/16/09	13.525010°	75.08857022.5	3.5	65	41
1	11/16/09	13.525010°	75.0885701**9**	6	66	30
2nd visit- ne?Date?		13.525010°	75.088570?_____	?_____	?_____	
2nd visit- ne?Date?		13.525010°	75.088570?_____	?_____	?_____	
2nd visit- ne?Date?		13.525010°	75.088570?_____	?_____	?_____	
2nd visit- ne?Date?		13.525010°	75.088570?_____	?_____	?_____	

Species binomial	Notes	2nd visit: Gi
Diospyros sylvatica		?_____
Unidentified A		?_____
Euonymus indicus		?_____
Dimocarpus longan		?_____
Olea dioica		?_____
Dimocarpus longan		?_____
Olea dioica		?_____
Dimocarpus longan		?_____
Dimocarpus longan		?_____
Diospyros sylvatica		?_____
Syzigium sp. A		?_____
Euonymus indicus		?_____
Holigarna arnottiana		?_____
Dimocarpus longan		?_____
Euonymus indicus		?_____
Dimocarpus longan		?_____
Dimocarpus longan		?_____
Apodytes beddomei		?_____
Nothopegia beddomei		?_____
Beilschmedia wightii		?_____
Aglaia elaegnoidea		?_____
Syzigium sp. A	Subtrunks 32-28-18	?_____
Myristica malabaria		?_____
Mytistica malabarica		?_____
Beilschmedia wightii		?_____
Holigarna arnottiana		?_____
Beilschmedia wightii		?_____
Garcinia sp. A		?_____
Unidentifiable	DEAD	?_____
Aglaia elaegnoidea		?_____
Syzigium sp. A		?_____
Holigarna arnottiana		?_____
Euonymus indicus		?_____
Euonymus indicus		?_____
Mangifera indica		?_____
Litsea sp. A		?_____
Diospyros sylvatica		?_____
Dimocarpus longan		?_____
Euonymus indicus		?_____
Dimocarpus longan		?_____
Holigarna arnottiana		?_____
Syzigium sp. A		?_____
Syzigium sp. A		?_____
Euonymus indicus		?_____
Syzigium sp. A		?_____
Nothopegia beddomei		?_____
Dimocarpus longan		?_____
Euonymus indicus		?_____
Euonymus indicus		?_____

Euonymus indicus		?_____
Dimocarpus longan		?_____
Dimocarpus longan		?_____
Syzigium sp. A		?_____
Diospyros sylvatica		?_____
Dimocarpus longan		?_____
Dimocarpus longan		?_____
Unidentified B		?_____
Euonymus indicus		?_____
Holigarna arnottiana	Off PLOT	?_____
Nothopegia beddomei		?_____
Dimocarpus longan		?_____
Memecylon umbellatum		?_____
Euonymus indicus		?_____
Diospyros sylvatica		?_____
Strychnos sp. A	Marked as L01 Liana 01	?_____
Combretum extensum	Marked asa L02Liana 02	?_____
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2nd visit: Tag Status
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Plot	Date of Establishment	Plot Latitu	Plot Longi	Plot X coo	Plot Y coo	Tree Tag	Girth cm
2	11/17/09	13.530350‘	75.084750	4.5	4.5	1	46
2	11/17/09	13.530350‘	75.084750	2.4	7.5	2	46
2	11/17/09	13.530350‘	75.084750	3	5.1	3	48
2	11/17/09	13.530350‘	75.084750	1.2	10.5	4	41
2	11/17/09	13.530350‘	75.084750	1.5	13.5	5	132
2	11/17/09	13.530350‘	75.084750	4.5	12	6	33
2	11/17/09	13.530350‘	75.084750	6	12.3	7	42
2	11/17/09	13.530350‘	75.084750	7.5	13.8	8	63
2	11/17/09	13.530350‘	75.084750	7.5	12	9	45
2	11/17/09	13.530350‘	75.084750°			10	
2	11/17/09	13.530350‘	75.084750	11.4	11.4	11	40
2	11/17/09	13.530350‘	75.084750	11.4	13.8	12	35
2	11/17/09	13.530350‘	75.084750	12.6	12.6	13	30
2	11/17/09	13.530350‘	75.084750	12	12	14	58
2	11/17/09	13.530350‘	75.084750	13.5	9	15	104
2	11/17/09	13.530350‘	75.084750	7.5	5.4	16	30
2	11/17/09	13.530350‘	75.084750	6.3	5.7	17	31
2	11/17/09	13.530350‘	75.084750	6	3.9	18	55
2	11/17/09	13.530350‘	75.084750	7.5	2.4	19	136
2	11/17/09	13.530350‘	75.084750	6	0	20	38
2	11/17/09	13.530350‘	75.084750	4.8	1.5	21	39
2	11/17/09	13.530350‘	75.084750	12.6	16.5	22	37
2	11/17/09	13.530350‘	75.084750	10.5	17.7	23	52
2	11/17/09	13.530350‘	75.084750	13.5	18.6	24	68
2	11/17/09	13.530350‘	75.084750°			25	39
2	11/17/09	13.530350‘	75.084750	12.3	27	26	31
2	11/17/09	13.530350‘	75.084750	10.5	24.6	27	32
2	11/17/09	13.530350‘	75.084750	9	23.4	28	35
2	11/17/09	13.530350‘	75.084750	12	22.2	29	39
2	11/17/09	13.530350‘	75.084750	13.8	16.5	30	47
2	11/17/09	13.530350‘	75.084750	12.6	16.5	31	72
2	11/17/09	13.530350‘	75.084750	12.9	15.6	32	80
2	11/17/09	13.530350‘	75.084750	8.1	17.4	33	68
2	11/17/09	13.530350‘	75.084750	3	18	34	54
2	11/17/09	13.530350‘	75.084750	0	16.2	35	39
2	11/17/09	13.530350‘	75.084750	0.6	22.8	36	38
2	11/17/09	13.530350‘	75.084750	1.2	23.4	37	35
2	11/17/09	13.530350‘	75.084750	3	22.2	38	68
2	11/17/09	13.530350‘	75.084750	3.9	23.4	39	55
2	11/17/09	13.530350‘	75.084750	2.7	24	40	32
2	11/17/09	13.530350‘	75.084750	5.1	26.1	41	139
2	11/17/09	13.530350‘	75.084750	6.3	29.4	42	96
2	11/17/09	13.530350‘	75.084750	6.3	28.5	43	36
2	11/17/09	13.530350‘	75.084750	5.7	28.5	44	90
2	11/17/09	13.530350‘	75.084750	4.5	28.5	45	40
2	11/17/09	13.530350‘	75.084750°			46	125
2	11/17/09	13.530350‘	75.084750	16.5	15	47	80
2	11/17/09	13.530350‘	75.084750	16.2	16.2	48	31
2	11/17/09	13.530350‘	75.084750	17.1	16.5	49	164

2	11/17/09	13.530350‘ 75.08475	**15.9**	**21.9**	**50**	31
2	11/17/09	13.530350‘ 75.08475	**16.5**	**22.5**	**51**	55
2	11/17/09	13.530350‘ 75.08475	**16.2**	**24.6**	**52**	39
2	11/17/09	13.530350‘ 75.08475	**17.4**	**27**	**53**	440
2	11/17/09	13.530350‘ 75.08475	**22.5**	**27.9**	**54**	45
2	11/17/09	13.530350‘ 75.08475	**22.5**	**29.4**	**55**	45
2	11/17/09	13.530350‘ 75.08475	**20.7**	**29.4**	**56**	50
2	11/17/09	13.530350‘ 75.08475	**28.5**	**28.5**	**57**	32
2	11/17/09	13.530350‘ 75.08475	**26.4**	**25.2**	**58**	42
2	11/17/09	13.530350‘ 75.08475	**26.4**	**24**	**59**	75
2	11/17/09	13.530350‘ 75.08475	**18.9**	**25.5**	**60**	30
2	11/17/09	13.530350‘ 75.08475	**18**	**24**	**61**	45
2	11/17/09	13.530350‘ 75.08475	**19.5**	**18.6**	**62**	67
2	11/17/09	13.530350‘ 75.08475	**27.9**	**19.5**	**63**	129
2	11/17/09	13.530350‘ 75.08475	**28.5**	**18**	**64**	65
2	11/17/09	13.530350‘ 75.08475	**16.2**	**13.5**	**65**	37
2	11/17/09	13.530350‘ 75.08475	**18.6**	**12.9**	**66**	46
2	11/17/09	13.530350‘ 75.08475	**16.5**	**6**	**67**	91
2	11/17/09	13.530350‘ 75.08475	**15.6**	**3.6**	**68**	38
2	11/17/09	13.530350‘ 75.08475	**16.8**	**4.8**	**69**	36
2	11/17/09	13.530350‘ 75.08475	**17.4**	**0**	**70**	69
2	11/17/09	13.530350‘ 75.08475	**19.5**	**1.5**	**71**	38
2	11/17/09	13.530350‘ 75.08475	**21**	**0**	**72**	102
2	11/17/09	13.530350‘ 75.08475	**20.4**	**2.7**	**73**	63
2	11/17/09	13.530350‘ 75.08475	**20.4**	**3.9**	**74**	43
2	11/17/09	13.530350‘ 75.08475	**21.3**	**3.6**	**75**	160
2	11/17/09	13.530350‘ 75.08475	**22.8**	**3.6**	**76**	38
2	11/17/09	13.530350‘ 75.08475	**24**	**0**	**77**	37
2	11/17/09	13.530350‘ 75.08475	**24**	**6**	**78**	64
2	11/17/09	13.530350‘ 75.08475	**29.1**	**6.6**	**79**	74
2	11/17/09	13.530350‘ 75.08475	**27**	**9.6**	**80**	36
2	11/17/09	13.530350‘ 75.08475	**25.8**	**12.9**	**81**	33
2	11/17/09	13.530350‘ 75.08475	**24.6**	**11.1**	**82**	90
2	11/17/09	13.530350‘ 75.08475	**22.8**	**12**	**83**	161
2	11/17/09	13.530350‘ 75.08475	**21**	**12.3**	**84**	37
2nd visit- ne?Date?		13.525010‘ 75.088570?_____		?_____	?_____	
2nd visit- ne?Date?		13.525010‘ 75.088570?_____		?_____	?_____	
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2nd visit- ne?Date?		13.525010‘ 75.088570?_____		?_____	?_____	

Species binomial	**Notes**	2nd visit: Gi	2nd visit: Tag Status
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