Preliminary Report:
Bird Conservation & Tree Plantations
"Conservation for Profit"
Panamá, Central America

Prepared by: Ezekiel S. Jakub
Director of Ornithology
Conservación Panamá

PLANTING EMPOWERMENT

Conservación Panamá

ABC

INTRODUCTION

Conservation in the neo-tropics for many species of migrant and resident birds is of the utmost importance at minimum for the ecosystem services they provide, maintaining biodiversity and ecosystem resilience. There are many conservation efforts that play a major role in Panamá including, but not limited to: land conservation, environmentally friendly agricultural systems, and environmental education.

Tree plantations providing highly desirable wood products such as Mahogany, Teak, Cocobolo with various ground cover plants could possibly create a new paradigm of "conservation for profit" in the neo-tropics. The question we must respond to primarily is, can tree plantations provide adequate resources and protection for bird populations? Secondarily, what type of habitat structure and resources must be available to sustain a population within a tree plantation and surrounding area? Thirdly, can this be provided by the tree plantation agricultural paradigm so as not to impede on the profit motive of a business?

The following preliminary data results are derived from a cooperative effort with "Planting Empowerment", a small community oriented and sustainable tree plantation organization operating in the Darien, Panamá, Conservación Panamá, a small U.S. – Panamanian conservation organization and American Bird Conservancy. The scope, initially, in our data collection is small yet we are hoping to expand on these results with more surveys, additional participatory plantations, and supplemental programs to encourage participation. The following data is limited in statistical extrapolation although it does give us a small viewpoint of one plantation in one location as a baseline.

METHODOLOGY & MATERIALS

We used a mixed methodology to rapidly assess the general forest structure and species presence in the community of Arimae in the province of Darien, Panama on an active tree plantation plot managed by Planting Empowerment (See Appendix for **Overview map 1**). Over the period of one morning we surveyed three points within the tree plantation, with a start time of 0700 and an end time of approximately 1545.

Rapid Vegetation Assessment:

The forest type will first be identified as Forest, Forest Edge, Plantation or Other. In the case of the initial four points surveyed, each is defined as Plantation; as they were completely within the tree plantation plot itself. Next, a random point, using random point generation software, was identified and designated the centroid of the survey plot. After the centroid was defined a measured distance of 12.5 meters was measured to designate the plot circle with a complete radius of 25 meters. At the centroid, utilizing a standard Spherical Densiometer, each cardinal direction was measured as per forest overstory coverage. Following the horizontal matrix and structure were measured utilizing a siting quadrant. The siting quadrant is a 50cm x 30cm cloth with alternating Black/Yellow 10cm x 10cm squares. From the centroid, a field assistant walked a straight line in each cardinal direction from centroid, until primary observer saw less than 50% of

squares. At this point a standard 100-meter fiberglass tape measure was utilized to measure the distance. The shorter the measured distance represents a more complex horizontal matrix. The longer distance measured is representative of a less complex horizontal horizon. Next, using additional random sampling techniques, each cardinal direction quadrant ground cover percentage was measured within a 1m x 1m square. Finally, each stem within the quadrant was counted and a random selection of ten was measured for diameter at breast height (DBH).

Bird Survey:

A timed point count was made from each centroid identified within the tree plantation. There was an initial 5-minute silent wait period at the centroid. Following, all species were identified within and without of the survey circle for a period of 20-minutes. Individuals and species were counted during the survey.

Materials Required:

Following is a list of the materials required for this these surveys: Standard "Rite in Rain" field notebook and pen (x2), 100-meter fiberglass tape measure, 2-meter measuring rule (x2), Garmin GPS Oregon 300 (x2), binoculars 8.5x42, spotting scope/tripod, spherical Densiometer, horizontal matrix siting cloth, Brunton field compass, chronograph, Gerber field machete, Swiss Army multi-tool, field backpack, standard rain gear (poncho) and umbrella, field guide to the birds of Panamá and a digital SLR camera. Photographs of the survey and budget for field expenses can be seen in the Appendix, **Budget 1.**

RESULTS

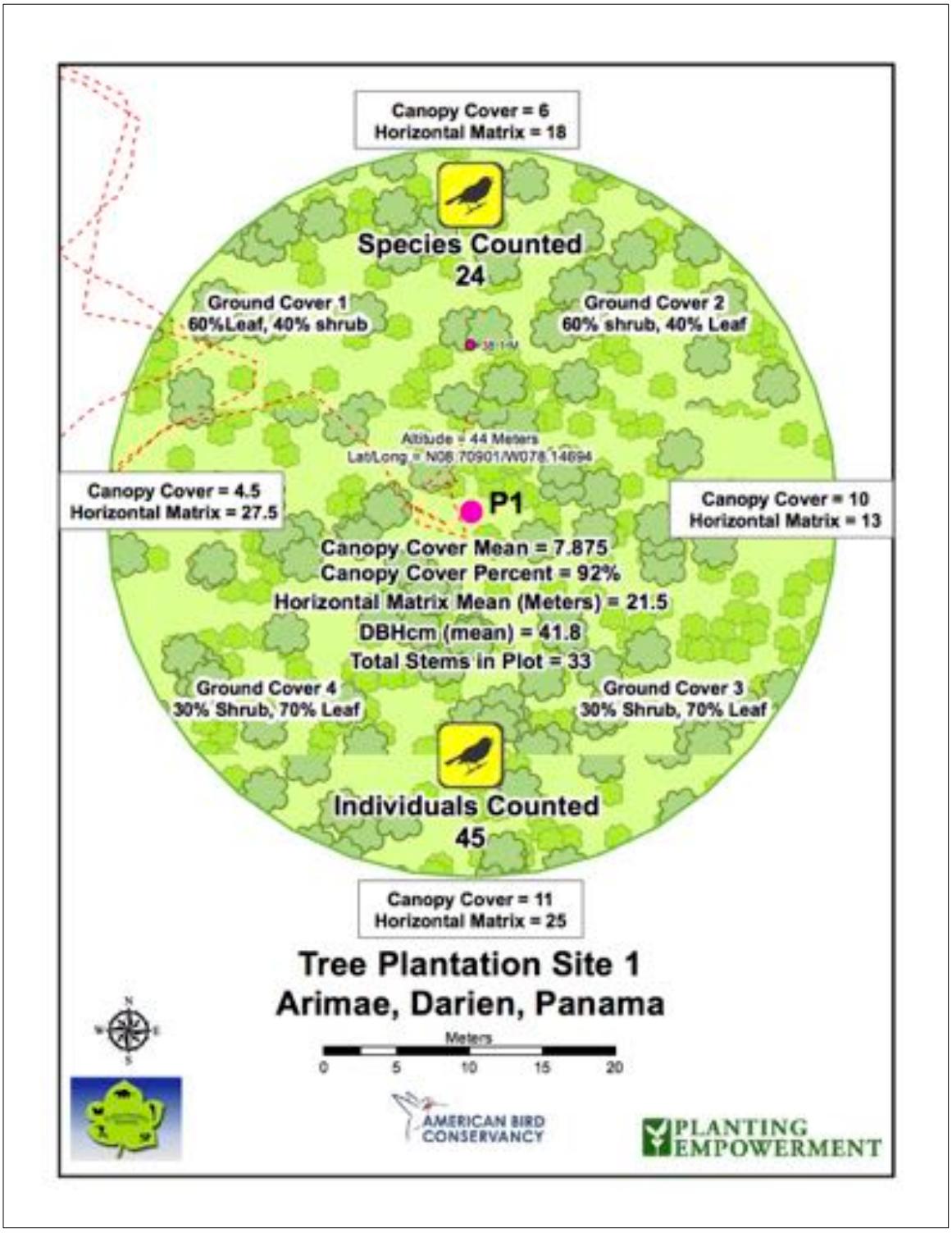
Plot 1:

Located at N 8.70900996, W 78.14694101 at 44-meters above sea level (see **Map Plot 1**) this centroid is located near the path entrance to plantation within 100-meters of the Inter-American Highway. At all plots the primary tree species are: Mahogany, Cocobolo, Cedro Espino, Cedro Amargo, Teak with an understory of Plantains, Guandú, Otoe, and Ñame. Plot one consisted of 33 stems with an average DBH of 41.8cm, corrected error of 38.1cm. The corrected error discounts one tree that had an overly large DBH of 2.09-meters. The corrected error represents the average DBH discounting this large stem. The canopy coverage is measured at 91.81%. The horizontal matrix mean distance is measured at 21.5 meters. The ground cover measured can be seen in **Table 1.**

Ground Cover 1	Ground Cover 2	Ground Cover 3	Ground Cover 4
60% leaf, 40% shrub	60% shrub, 40% leaf	70% leaf, 30% shrub	70% leaf, 30% shrub

Table 1. Plot 1, ground cover percentages.

There were no bird species or individuals counted during the 5-minute timed quiet period. Following there was a total of 24 species identified in this plot of 45 unique individuals.



Map Plot 1. Overview with included data of plot 1, Arimae, Darien, Panama.

Plot 2:

Located at N 08.70901 W 078.14694 at 48-meters above sea level (see **Map Plot 2)** this plot is located north by northwest of Plot 1. Tree species recorded include: Mahogany, Cocobolo, Cedro Espino, Cedro Amargo & Teak. The understory consists of Plantains, Guandú, Otoe, and Ñame. Plot 2 consists of a total of 70 stems with a mean DBH of 53.1cm. The canopy coverage is measured at 95.12%. The horizontal matrix mean is measured at 25 meters. The ground cover measured can be seen in **Table 2.**

There were no bird species or individuals counted during the 5-minute timed quiet period. Following there was a total of 22 species counted including 37 individuals.

Ground Cover 1	Ground Cover 2	Ground Cover 3	Ground Cover 4
60% shrub, 40% leaf	80% leaf, 20% shrub	50% shrub, 50% leaf	60% shrub, 40% leaf

Table 2. Plot 2, ground cover percentages.

Plot 3:

Located at N 08.70734 W 078.14924 at an elevation of 43-meteres above sea level (see **Map Plot 3**), this plot is located south of Plot 1 within the same section of approximately 5Ha. Tree species recorded include: Mahogany, Cocobolo, Cedro Espino, Cedro Amargo, & Teak. The understory consists of Plantains, Guandú, Otoe, and Ñame. Plot 3 consists of 33 stems with an average DBH of 22.65cm. The canopy coverage is measured at 93.89%. The horizontal matrix mean is measured at 27.5 meters. The ground cover measured can be seen in **Table 3.**

Ground Cover 1	Ground Cover 2	Ground Cover 3	Ground Cover 4
90% shrub, 10% leaf	100% shrub	80% shrub, 20% leaf	70% shrub, 30% leaf

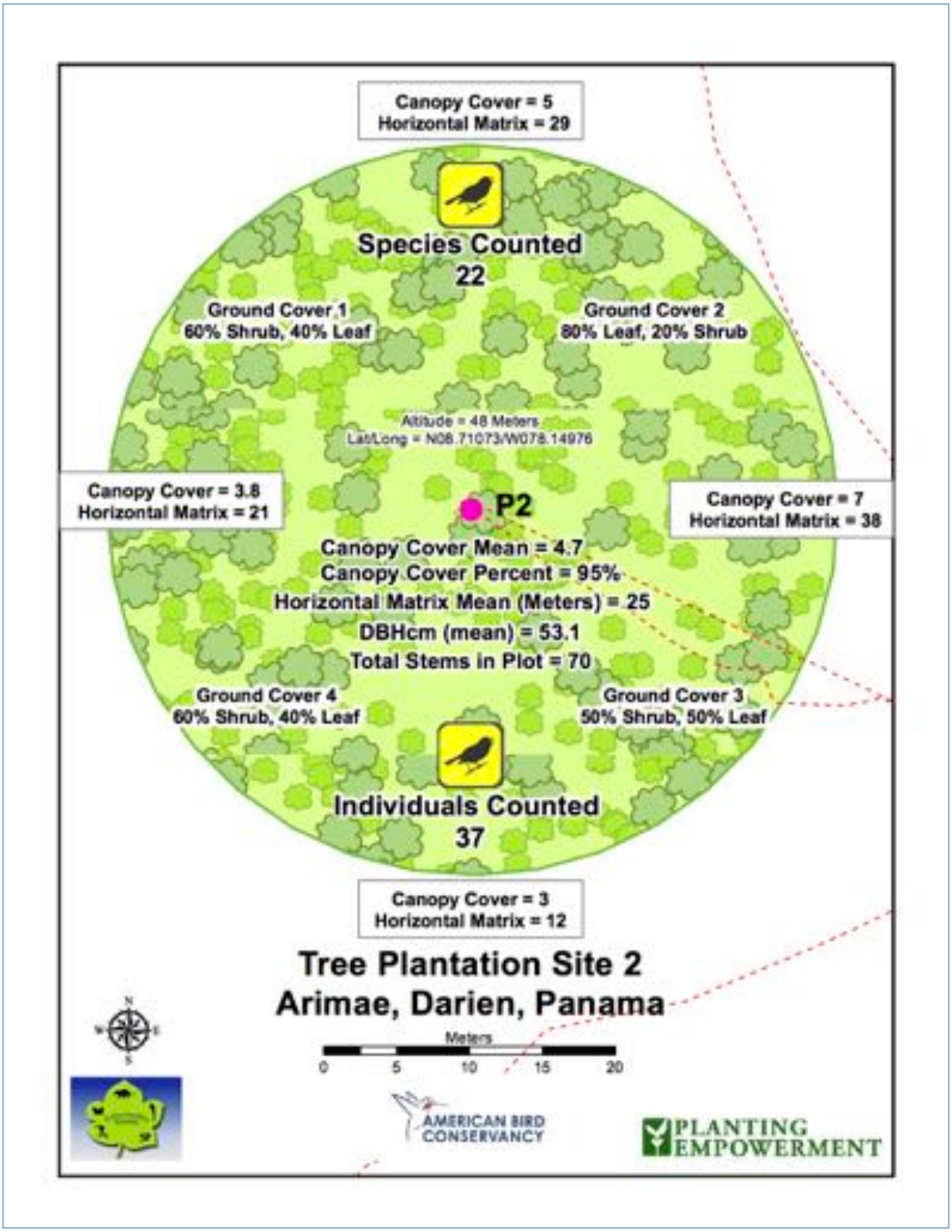
Table 3. Plot 3, ground cover percentages.

There were no bird species or individuals counted during the 5-minute timed quiet period. Following there was a total of 21 species counted including 25 individuals.

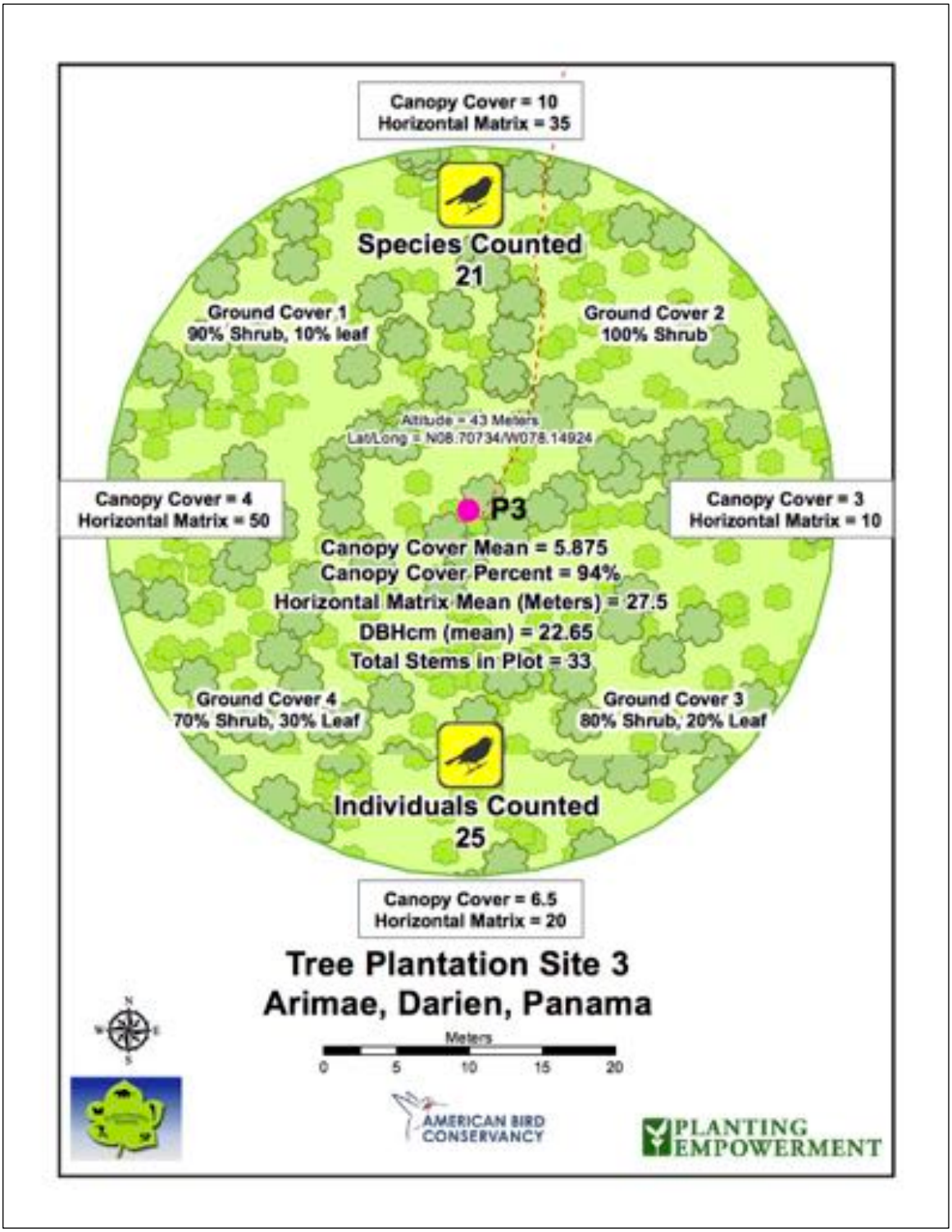
Plot 4:

Located at N 08.60943 W 82.443433 at an elevation of 1354-meters above sea level. This plot is located in the Province of Chiriquí in the District of Dolega. This plot is less than 2Ha is total size and was unofficially surveyed, as the owners were not present. The tree specie observed was Teak and there were no secondary shrub layers present. Plot 4 consisted of approximately 25 stems with an average DBH of 20.34cm. The canopy coverage measured at 83%. The horizontal matrix, in two cardinal directions, was measured at (+) 100-meters. The measurement was unable to be taken accurately as only a single 100-meter tape was available for use. There was a monotypic ground cover, which included a highly managed grass, which seemed to be regularly cleared.

There were no bird species or individuals counted during the 5-minute timed quiet period. Following there was a total of 4 species recorded including 6 individuals. See Appendix **Table 7**.



Map Plot 2. Overview with included data of plot 2, Arimae, Darien, Panama.



Map Plot 3. Overview with included data of plot 3, Arimae, Darien, Panama.

DISCUSSION

Environmental Data:

The preliminary data collected in Arimae, Daríen on the "Planting Empowerment" project sites showed similarity in the number of bird species present while the maturity of the tree stems relative to one another were clearly different. The Dolega plot (Plot 4) should be observed as "reference only" as the full set of data was not taken for an adequate number of sites/area and we did not have adequate ownership present, time, and equipment to accurately measure the horizontal matrix.

Attribute	PLOT 1	PLOT 2	PLOT 3	Arimae mean	PLOT 4
Stems	33	70	33	45	20
DBH(cm)	41.8 (38.1)	53.1	22.65	39.18	20.34
Canopy %	91.81	95.12%%	93.89%	93.60%	83%
Horizontal Matrix(m)	21.5	25	27.5	24.66	+100m
Bird Species	24	22	21	22.33	4

Table 4. Arimae Plot overview, compared to Dolega Plot(Plot 4).

At first glance, the data summarized in **Table 4** show many similarities in the Arimae plot including canopy coverage, horizontal matrix, & number of species counted. The maximum difference in canopy coverage between the three plots in Arimae is only 3.31%. Additionally, the maximum difference between the horizontal matrix is 6-meters. Finally, the maximum difference in bird species recorded is 3 species. The number of stems was consistent between Plot 1 and Plot 3 although the 70-stem anomaly of Plot 2 suggests a recount may be required or a different planting strategy/species utilized. This measurement should be field checked. Finally, the difference between the DBH was representative of the relative growth cycle of the stems, Plot 3 being the youngest, Plot 1 being the intermediate and Plot 2 being the oldest. The ground cover summary, seen in **Table 5** shows no clear consistency except for the type of ground cover encountered. In the field notes from the data collection it was interesting to note, in each plot, there were recorded individual birds that were actively utilizing the ground layer, searching for food resources. The only definable layers were leaf litter (detritus) and shrub layer (herbaceous). There was observed dead wood in some areas although none were recorded in the random ground cover squares delineated. We were unable to measure ground cover at Dolega site due to time constraints although the ground cover was monotypic.

	Ground Cover 1	Ground Cover 2	Ground Cover 3	Ground Cover 4
PLOT 1	60% leaf, 40% shrub	60% shrub, 40% leaf	70% leaf, 30% shrub	70% leaf, 30% shrub
PLOT 2	60% shrub, 40% leaf	80% leaf, 20% shrub	50% shrub, 50% leaf	60% shrub, 40% leaf
PLOT3	90% shrub, 10% leaf	100% shrub	80% shrub, 20% leaf	70% shrub, 30% leaf

Table 5. Summary of Arimae ground cover percentages.

It was interesting to note the bird species index did not change significantly between the three plots in Arimae. The only significant difference observed is in the Dolega plot with only 4 species accounted for, with 6 individuals. I am very reluctant to attribute this to the physical structure of the plantation in Dolega without a more complete and accurate survey. Even with my reluctance it must be noted that there were no natural forest or forest edge within visible range of the Dolega plot. This preliminary data could suggest a correlation to bird species presence as it relates to forest structural attributes such as: the number of stems/area, the relative age of stems (DBH), canopy coverage, horizontal forest structure (matrix), ground cover and another attribute not measured here, distance to forest or forest edge.

Clearly more data is required. Additional data that should be considered for collection would include the measured distance to a forest or forest edge for a comparison of bird species presence within a plantation itself. In addition, at least a estimate, of the forest patch size (>5ha or < 5ha). Are there more species countable within x-meters from the forest edge? Are there less species observed within the centroid of a plantation plot? How large are the forest patches that abut a tree plantation and what correlation to bird species diversity could this suggest? Are Plantations a source or sink of bird populations? This additional data could help with future designs of tree plantations. On the Arimae plots there was a forest edge observable from each centroid although a measurement was not taken. On the Dolega plot, there was not forest or forest edge viewable from the centroid and with further investigations we were unable to find any forest fragments that were not highly impacted by agriculture or human inhabitation within the vicinity.

There is a complete bird species list and number of individuals of each species listed in the Appendix (**Table 6 and Table 7**). There were several migrants, which were recorded, none with a special IUCN status above "Least Concern": American Redstart (*Setophaga ruticilla*), Baltimore Oriole (*Icterus galbula*), Black-and-White Warbler (*Mniotilta varia*), Chestnut-sided Warbler (*Setophaga pensylvanica*), Great-crested Flycatcher (*Myiarchus crinitus*), Red-eyed Vireo (*Vireo olivaceus*), & Yellow Warbler (*Setophaga petechial*). A more complete survey is required to gather a more complete list of avifauna at each plot centroid. One error that must be accounted for is time of collection. The Arimae plot counts took place during one single day. The plot data collection started at approximately 0700 and ended at 1545. This certainly introduced a bias as per time of day. Further investigations should include plot data collection (vegetative and mapping) and bird counts on separate days. As the morning represents the most active time of day for bird activity (between 0615 and 0900) and the afternoon

represents the slowest time of day for bird activity (between 1100 – 1300) bird counts should be taken at 0645 and 1200 per plot centroid.

The overall impression of each site was considerably positive (in Arimae) but inadequate for any solid conclusions. There is clearly more data that must be collected along a gradient of tree plantation operations and management styles to decipher the best practices for bird conservation. Furthermore, tree plantation operations and management must be considered in the final design of a "bird friendly tree plantation" so as not to impede the management and profit margin of the harvest cycle. Similar to what shade-grown coffee has demonstrated in the neo-tropics, it is possible to both serve the needs of migratory and resident bird conservation and the needs of a business for profit.

Business & Management (short overview):

The design, management and social responsibility that "Planting Empowerment" (PE) has created are already parallel to many of the same objectives of bird conservation needs in Panama: Appropriate land management for agriculture (agroforestry), community empowerment, land conservation, reforestation. There are a total of 25 hectares of mixed-species plots operated by PE in the Darien, on lands previously deforested. The species replanted include not only the greatly demanded Teak but many local Panamanian species as well (i.e. Cocobolo, Cedro Espino, Cedro Amargo, Almendro, Amarillo, Mahogany). Furthermore, as the data clearly shows, other herbaceous layers are also planted which have created a horizontal forest matrix, important for use by the bird population for food and protection. PE has opted to work directly with local landowners and communities, as partners, using a land-lease agreement that spans 25 years. The term of the lease program includes the growth to harvest cycle. This suggests that with proper management these plots could be effective bird conservation areas for up to 25 years as well as profitable, where after the harvest cycle, they would again continue through a "managed" succession for bird populations to utilize again as a replanted forest. Clearly, data collection would be required as to the effect of the harvest on bird populations although with a pre-planned strategy of "managed" forest fragments, it may be possible to limit any major negative effects on bird populations.

From the PE website (http://www.plantingempowerment.com) they have summarized core accomplishments to date, which should be considered: 27,500 trees have been planted, 25-ha has been reforested, and over $40,000 paid to smallholder supplier individuals. The Panamanian government and international census´s have independently shown that over 40% of rural residents of Panamá are poor and over 60% of rural indigenous groups are living in extreme poverty. Programs that bring large amounts of cash flow to rural communities by encouraging reforestation projects for profit, if tied with proper conservation planning, has the potential of creating a new paradigm of conservation for profit in the neo-tropics.

The investment strategy is clearly long-term with a stated target by PE of a 5% return (for investors). The organization PE offers three investor options: Trailblazer ($1000, 70 trees, .06-ha reforested, & 0.7 tons of carbon sequestration), Pioneer ($5,000, 350 trees, 0.3-ha reforested, & 3.6 tons of carbon sequestered), and Visionary ($15,000, 1100 trees, 1-ha reforested, & 11.9 tons of carbon sequestered). As PE states on their

website, the average returns on timber investment from 1990 – 2009 on the Timberland Index (published by the National Council of Real Estate Investment Fiduciaries) outperformed the S&P500 by 3% with lower volatility.

Current management is described as experimental and multi-faceted. The participatory community in cooperation with PE is utilizing natural ground cover plants such as Guandú to assist in pest reduction and protection for principle tree species. Furthermore, with the addition of plants such as: Plantains, Guandú, Otoe, and Ñame, allows the land to provide further resources (food stuffs) to the communities during the 25-year growth to harvest cycle. This mixed methodology also could be highly beneficial to bird populations, although more data is required. Each plot is "cleaned" at or about eight years, seventeen years and harvested at or about 25- 30 years. Trees that are stunted in growth or otherwise not growing at potential are cleaned (harvested early) to allow neighbors maximum growth potential.

The major risks observed and made transparent by PE field staff were pests (insects), flooding, and possible product poaching. Utilizing Guandú as a pest suppressant is a good example of "green friendly" methods. Furthermore, if the plantation forest structure can be maintained or magnified, the presence of bird and bat populations would further assist with natural pest reduction. Most importantly, using a mixed planting methodology the site would be relatively less vulnerable and more resilient to a pest or fungal attack in comparison to a mono-cropped plantation. Other pest/fungal infestations should be researched and a ready response prepared, but to the knowledge of the field staff interviewed there has been no major issues to date.

There is a current flood risk that can be resolved with a planting methodology including flood tolerant trees or herbaceous species at the limit of rivers, creeks, and streams. Furthermore, a rapid assessment of any waterways (soil, observed erosion, flood limits) could set a safe proximity distance to each water source to protect trees vulnerable to flooding events. There was a recent flood event reported by PE, so this should be resolved, where necessary as soon as possible to prevent losses.

Finally, the risk of poachers accessing and cutting tree products illegally before they are harvest ready seems remote. PE, opting to work with the local community has partners and staff on the ground living in the community. With an entire community present at each site that has a clear economic incentive to protect each plot, any encroachment of poachers or illegal cutting seems improbable.

CONCLUSION

There seems to be a possible correlation between forest structure and bird species presence and diversity although more data is required. There were a number of migrant and resident species, reported as present, that were clearly utilizing the plantation plots as a resource. This is greatly encouraging. This area could be described as "birdy", enough for the possible inclusion of eco-tourism projects for additional cash inflow. More accurate bird surveys at appropriate times on multiple days should be completed for a more accurate sample of the full cadre of bird species presence.

It would be extremely beneficial to thoroughly survey all the PE plantations along with 2-3 additional plantations (in minimum) in different regions using different methods

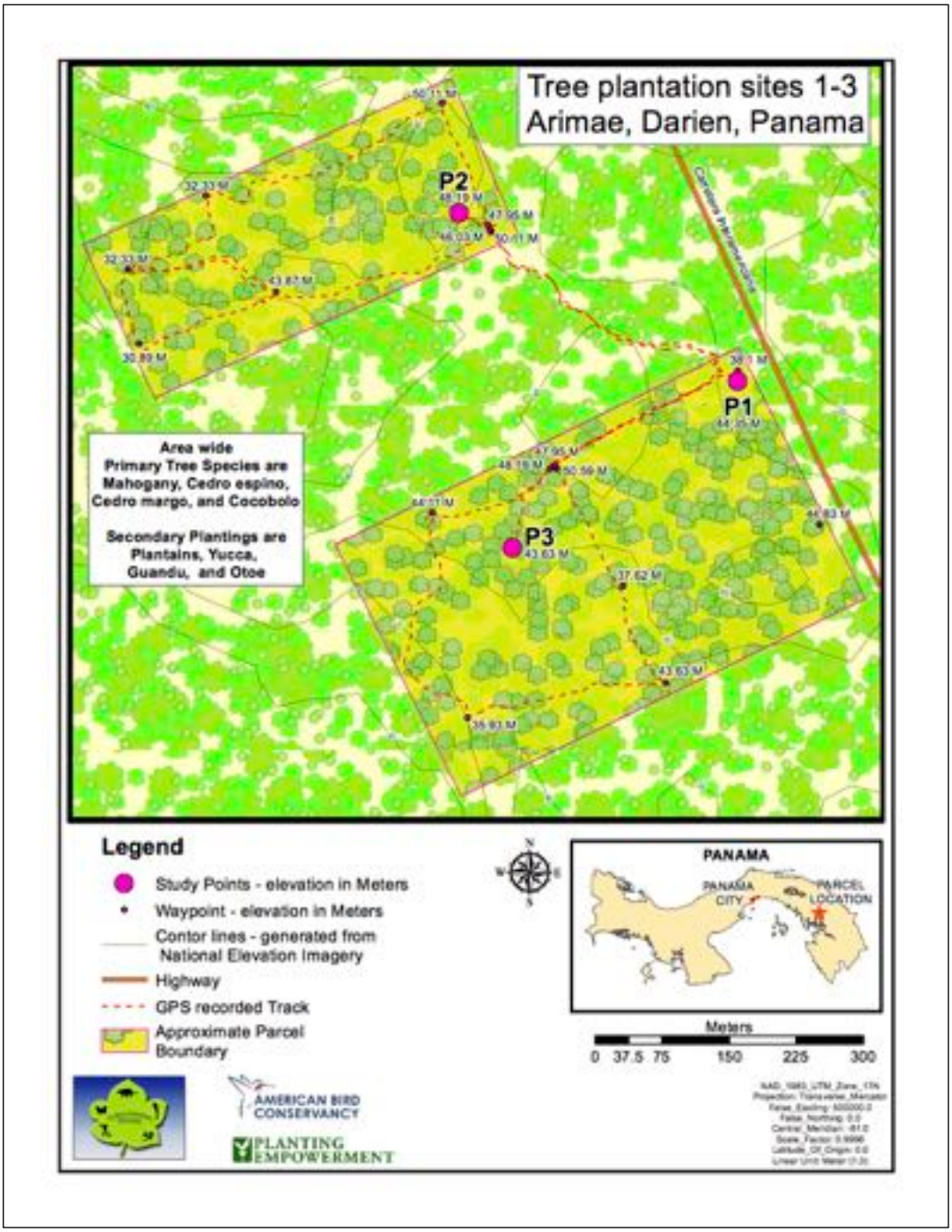
for direct comparison. This could be beneficial in identifying the best practices for both bird conservation and plantation management.

The methods utilized for this survey were adequate for a rapid assessment although require changes in field collection schedule, equipment, and time required for a more thorough and precise survey.

The business and plantation management seems possibly beneficial to bird populations and conservation efforts, although clearly, much more data is required for statistical significance. The return on investment is long-term and estimated at 5% (for the investor) and is reported to be a stable non-volatile renewable green investment. With demand trends on the rise for wood products, the potential for conservation for profit utilizing tree plantations is possible, although again, more data is required.

There is a clear opportunity to merge the interests of bird conservation and tropical tree plantations. Furthermore, it is greatly encouraging that we have a willing partner with PE who has opened their properties, without condition, for assessment. In conclusion I would recommend further and more complete investigations on the PE properties and at minimum 2-3 different plantations.

APPENDIX



Map 1. Overview map, Arimae, Panamá.

Species	Individual count
American Redstart	2
Baltimore Oriole	1
Bananaquit	5
Barred Antshrike	2
Bay Wren	2
Black and White Warbler	2
Black Antbird	4
Black-chested Jay	8
Black-tailed Trogon	1
Blue Dacnis	1
Blue-black Grasquit	1
Blue-crowned Motmot (Whooping)	2
Blue-gray Tanager	6
Brown Hooded Parrot	6
Brown-capped Tyrannulet	1
Buff-throated Saltator	1
Chestnut-headed Oropendula	6
Chestnut-sided Warbler	1
Cocoa Woodcreeper	1
Common Tody Flycatcher	1
Golden-hooded Tanager	1
Great Kiskadee	2
Great-crested Flycatcher	1
Great-tailed Grackle	3
Green-crowned Woodnymph	2
Hummingbird s.p.	5
Lesser Goldfinch	1
Lesser Greenlet	1
Little Tinamou	2
Long-billed Gnatwren	1

Long-billed Hermit	6
Long-billed Starthroat	1
Orange-chinned Parakeet	1
Palm Tanager	2
Paltry Tyrannulet	1
Pied Puffbird	1
Plain Brown Woodcreeper	1
Red-Crowned Woodpecker	2
Red-eyed Vireo	1
Red-legged Honeycreeper	1
Roadside Hawk	1
Ruddy Ground Dove	5
Snowy-bellied Hummingbird	1
Tropical Kingbird	3
Tropical Pewee	1
Western Slaty Antshrike	2
White-throated Crake	1
White-tipped Dove	1
Yellow Warbler	1
Yellow-olive Flycatcher	1
Total individuals	107

Table 6. Total bird species and counts for Arimae, Daríen.

Species	**Individual Count**
Lesser Elaenia	1
White-collared Seedeater	1
Blue and Grey Tanager	2
Great Kiskadee	2
Total Individuals	6

Table 7. Total bird species and counts for Dolega, Chiriquí.

Budget Item	Cost ($ U.S.)	Notes
Travel		
Gas, Panama – Arimae	40	Round-trip
Lodging (Tortí)/night. Hotel	50	w. Cooperation with the community of Arimae, this cost can be reduced significantly.
Travel Sub-total	90	
Living Expenses		
Food/field team (2persons)/day	30	
Living Expenses Sub-total	30	
Associated Research Costs		
Field assistant/day/assistant	35	We worked 2 days. We can utilize students –or- local community members. Only one field assistant is required.
Insurance/person	20	This is a minimum payment which covers 3 months of covereage.
Mapping service/map product received	30	4 map products produced.
Assoc. Research Cost Sub-total	190	
Supplies & Equipment		
"Rite in Rain" field notebook (2)	15	
"Rite in Rain" field pen (2)	13	
100-meter fiberglass tape measure (2)	15	
2-meter measuring rule (2)	3	
Spherical Densiometer (1)	55	
Horizontal Siting Cloth (1)	7	* Cost of production for (1)
Garmin GPS Oregon 300 (2)	350	
Binoculars, 8.5x42 (1)	2700	
Spotting Scope (1)	3000	
Tripod (1)	600	
Laptop, Mac Power-book pro	2300	
Nikon DSLR	1500	

Brunton Field Compass	150	
Chronograph	50	
Gerber Field Machete	30	
Swiss Army multi-tool	80	
Standard field backpack	230	
Rain poncho	30	
Umbrella	20	
Field Guide to the Birds of Panama	30	
Supplies and Field Equipment Sub-Total	11,224	*Please not, this is only a total value of the equipment required.
Supplied and Field Equipment Sub-total (non-reusable)	464	* This is a total of the field equipment that often-receives heavy wear & requires replacement annually.
Primary Field Researcher Cost (Field Scientist) / day	250	
Primary Field Scientist Sub-total	500	
TOTAL (discounting Permanent equipment)	1,3714	

Budget 1. Conservación Panamá cost for fieldwork completed.

Photo 1 and 2 (right to left). Photo 1 Plot 1 Arimae, Photo 2 Plot 2 Arimae.

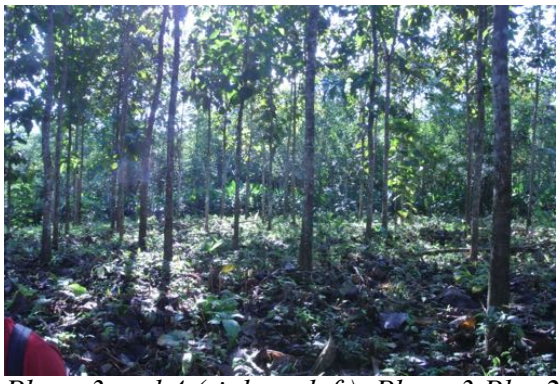



Photo 3 and 4 (right to left). Photo 3 Plot 2 Arimae, Photo 4 Plot 2 Arimae


Photo 5 and 6 (rigt to left). Photo 5, Arimae Plot 3 Densiometer, Photo 6 Ezekiel measuring canopy cover at Plot 2.


Photo 7 and 8 (right to left). Photo 7, collaboration on Plot 2, Photo 8, Keel-billed Toucan.

Photo 9 and 10 (right to left). Photo 9 Blue-crowned Motmot, Photo 10 Red-legged Honeycreeper.