

STRUCTURE AND SPECIES COMPOSITION OF PRIMARY AND SECONDARY
TROPICAL FOREST IN COSTA RICA: A CASE STUDY USING ECOSYSTEM
SERVICE PAYMENTS FOR CONSERVATION OF BIODIVERSITY

by

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1.0 INTRODUCTION

Costanza et al (2007) argued that if the importance of nature's benefits could be properly quantified in economic terms, then policy decisions would better reflect the value of ecosystem services and natural capital. In the last 30 years, valuation of ecosystem services and land use change has become one of the most significant and fastest evolving areas of research in ecological economics (Turner et al 2003). Over the past decade, more than 250 studies have been done in the field of ecosystem services (Fisher et al 2009). Since Costanza et al developed a method to evaluate the value of the world's ecosystems and natural capital, much of the literature has focused on the idea of an economic "valuation" method in order to make strides in conservation strategies. Many studies have focused on developing and testing methods for evaluating the economic cost and true ecological "price" of ecosystem services to justify the importance of these natural systems (Gatto et al 2000). The 2005 Millennium Ecosystem Assessment (MA) opened up avenues for new research, focusing on the basic science needed to properly assess, project, and manage flows of ecosystem services and the overall effects on human welfare (Carpenter et al 2009). When making policy decisions regarding ecosystem management, human well being, economic gain, and proper price of natural capital must be weighed and determined. For society to understand the worth of natural capital, value and non-value based goods and services, must be prioritized by markets or by human perception. Non-value based goods and services, such as any ecological intangible, have to be quantified to a monetary standard value to properly develop effective management frameworks if efficient conservation measurements are going to succeed. Different

stakeholders, local versus global, must also be identified to properly calculate and measure the benefits and overall value of any ecosystem service or good.

There is no agreement as to how policy makers, economists and ecologists assess ecosystem goods and services for economic valuation. This lack of consensus results in an inability to make any significant strides towards achieving conservation and sustainable land management solutions (Fisher et al 2009). A key question is how do we ensure economic stability while trying to protect ecological intangibles, such as biodiversity, when there is no market or value weight given to species diversity? Many ecosystem services have indirect values (clean water, oxygen production, pollination, etc) but lack a market to determine a value for these services.

Many nations are starting to explore avenues to use ecosystem services to raise capital and aid in conservation. As an example, Costa Rica has seen success selling Carbon Trading Offsets (CTO) that created a new market for carbon credits. This established a commodity market that can be valued, which can be traded on a global scale (Fisher et al 2009). Yet assigning a value on an intangible, such as biodiversity, has multiple variables and inherent uncertainties associated with it (Chomitz et al 1999). Unlike timber products, which have a direct cost and market value, biodiversity is a non-timber forest product (NTFP) that cannot be easily assigned value; however, it should still be counted and prioritized (Turner et al 2003). Biodiversity assigns value to landscapes and is considered the “glue” of ecosystems reflecting on the overall health of resources supplied to humanity (Turner et al 2003).

Tropical forests, home to the highest levels of terrestrial biodiversity, are often located in poor developing nations that struggle with political and economic stability, giving way to socio-economic issues with conservation and sustainable management, especially when regulation is involved. In the past, most conservation has been in the form of reserves dictated and managed directly by governments, but recently the trend has moved toward private landownership. In the late 1990s, a system was established where developed country investors finance developing country activities that reduce greenhouse gas emissions (GHG). This was put into place to help mitigate degradation and deforestation issues in tropical nations (Chomitz et al. 1999). One of the byproducts of this was Costa Rica's *Pago de Servicios Ambientales* (PSA in Spanish, or Payments for Ecosystem Services, PES in English) program (Russo et al 2006). PES is Costa Rica's forestry law that explicitly recognizes four external ecosystem services (Chomitz et al 1999):

- Watershed protection
- Biodiversity protection
- GHG mitigation
- Aesthetic values

Private landowners are compensated for one of the four services they provide, thus producing a financial incentive for individuals to conserve. This incentive aids in estimating an economic value on ecological intangibles, which is argued as the proper way to manage natural capital and conserve ecosystems on the planet (Daily et al 2009). Most conservation strategies only become feasible when those in the global community who perceive benefits from conservation provide incentives for individuals who lose

locally (Turner et al 2003). Ecosystems service payments have influenced land management and conservation practices in Costa Rica and are providing a unique method for managing tropical landscapes and conserving areas of high biodiversity.

Although the immense biodiversity of tropical rainforests have been recognized, the full extent of the biodiversity has only begun to be assessed. Quantifying biodiversity will create ways to properly assign value to these systems by calculating and analyzing scientific data. In remote areas, most species remain to be identified, and the ranges and biology of many identified species remain to be determined. In the last 15 years the intensive exploration of Costa Rica has uncovered an average of 57 species per year (new to science or to the country), indicating that many species are yet to be discovered (Zamora et al 2009). Questions also remain concerning how long, if ever, it will take for clear-cut or selectively harvest forests to regain their initial composition and complexity and whether these forests are of any less value than largely undisturbed old growth.

This thesis presents the results of extensive fieldwork conducted in a tropical forest in Costa Rica. The overall objective of the research was to assess:

- Whether a parcel of land adjacent to an existing private reserve (the San Ramon Tropical Research Station: SRTRS) was sufficiently ecologically diverse to be purchased and added to the existing reserve *and*
- Whether this diversity could be quantified into monetary values, to justify or finance the purchase.

If all ecological intangibles could be properly quantified, and with the help of the current payments for ecosystem service program (PES), would investing in the land 1) significantly increase the biodiversity being preserved and 2) provide financial resources to help sustain and preserve the current reserve, the San Ramon Tropical Research Station (SRTRS) in the San Lorenzo Valley of Costa Rica. To evaluate whether this parcel should be purchased and added to the existing reserve, two alternative issues were considered, first, would an initial assessment of the forest composition and structure on the parcel indicate that its purchase would substantially increase the biodiversity of the existing reserve. Second, whether the biodiversity, natural capital and ecosystem services of adding the parcel would result in an acceptable cost/benefit ratio based upon the current payments for ecosystem services (PES) program in Costa Rica. The data collected in a field study, along side a review on valuation methods, aided in addressing the questions of whether tropical forests are truly given an appropriate value and whether their provided benefits constitute enough precedence for investment in conservation. The fundamental question addressed by this study thus becomes: “Is the current value of purchasing the adjacent parcel of forest (Site “O”), which has the potential to measurably increase the ecological and economic value of the current reserve’s tropical forests, an appropriate indicator for conservation?”

2.0 METHODOLOGY

2.1 Field Study Site

Field-work for the study was carried out on a 100-hectare research station located in the *Cordilla de Tilaran* region of the province *Alajuela*, in north central Costa Rica (Figure 1). The *Cordilla de Tilaran* is a wet region geographically characterized by rain forest, with an elevational band of 700-1500m (Zamora et al 2009). The station encompasses primary and secondary forests and a newly abandoned grazed pasture (Schlipmann 2009). The study site (-84.555368°W, 10.253130°N, 600-800 m elevation range on the Caribbean Slope of the *Cordilla de Tilaran*) is located within 3-5 km of the Alberto Manuel Brenes Biological Reserve in San Ramon (Zamora et al 2009). Adjacent to the private reserve, is an approximately 800 ha parcel of land that is currently for sale which consists of a mix of young and old growth primary forest and may contain forest significantly older and more mature than those on SRTRS. Because this parcel borders the 21,853 ha Children's Eternal Rainforest Reserve, an area of tremendous biodiversity and potential scientific study (www.mclus.org), adding this parcel to the SRTRS would create a continuous area of roughly 23,000 ha of tropical forest dedicated to conservation and research.

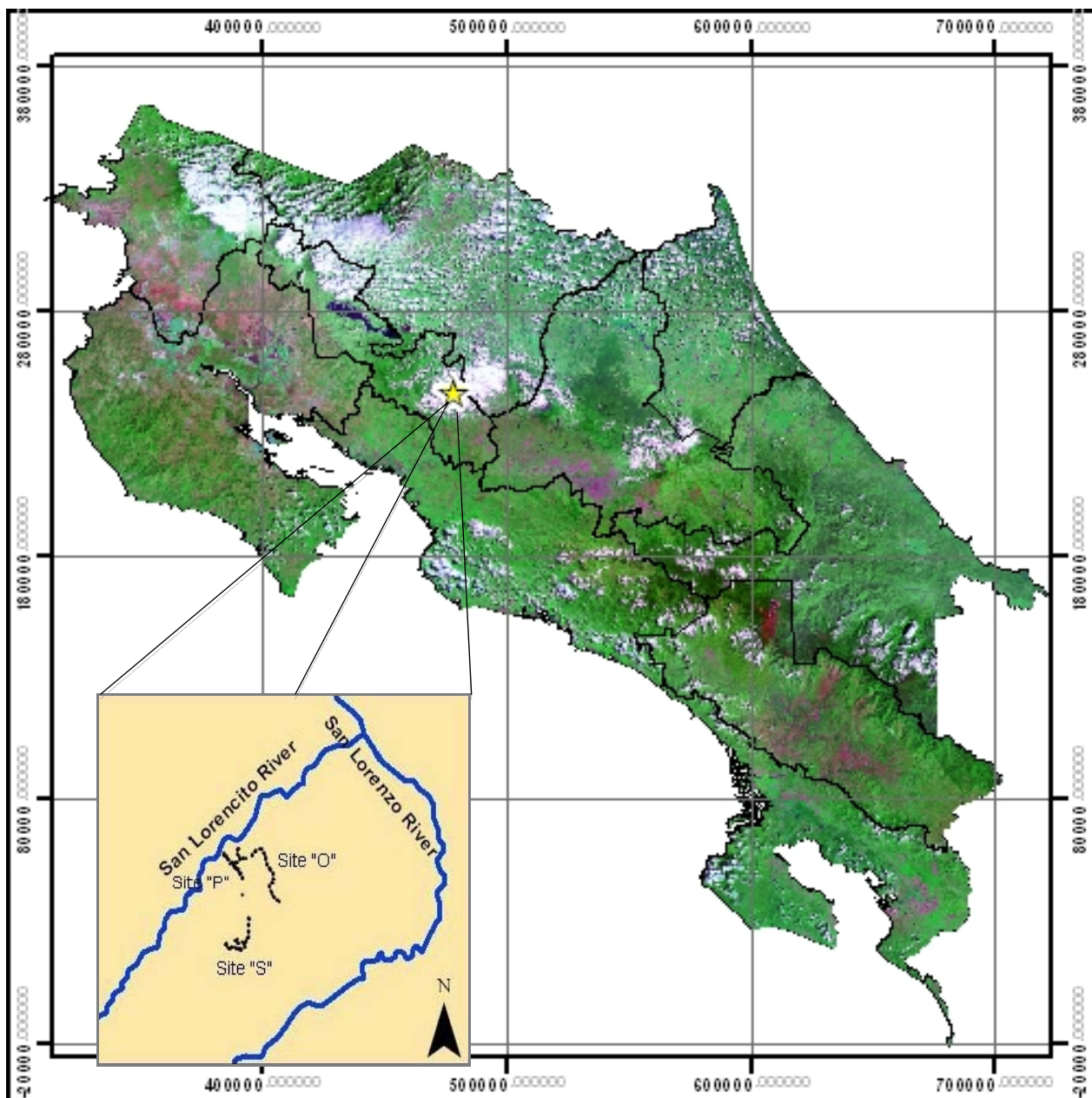


Figure 1: Costa Rica study site location map. The yellow star indicates study site location. Imagery obtained from Landsat circa 1999/2000.

2. 2 Initial Assessment of Forest Structures and Biodiversity

The forest assessment compared secondary (S) and primary (P) forest study sites on the current reserve (SRTRS), with a third study site located on the adjacent property (O) (Figure 1). The (P) site is an older forest than the (S) site, but their absolute ages are unknown as is the age of the (O) site, which has been documented as a mix of young and potentially old growth primary forest (Rodriguez 2009). Within each site, 15, 8m wide by 25m long plots were established 8m away from existing trail (Keel et al 1993). The plots were oriented parallel to the slope, with a distance of 50m between successive plots (Keel et al 1993). The sampling plan was largely dictated by the limited access to the difficult terrain. For each plot a 25m center line was established, and all trees within 4m of the center line with diameter at breast height (DBH) at 1.37m of greater than or equal to 10cm were identified to species, measured for DBH and height and their latitude, longitude, elevation recorded (Keel et al 1993, Chazdon 1992). Tree DBH's were measured with DBH meter tapes, and tree heights were measured using a *TruPulse 360° Professional Laser Rangefinder, Laser Technology Inc.* Spatial locations were measured using a Trimble GeoXH GPS with normal accuracy of $\leq 1\text{m}$. Maps of tree positions across the P, S, and O sites were generated using *ArcGIS 9 Version 9.3*. All trees were either identified to species onsite or collections were taken to the herbarium at the *Instituto Nacional de Biodiversidad (INBio)* in Heredia, Costa Rica for further identification (Appendix 1).

2.3 Statistical Analyses and Spatial Mapping

A one-way analysis of variance (ANOVA) was used to compare total plot basal area and mean plot tree heights among the study sites. In tropical ecology and forestry studies, basal area and height measurements have been identified and debated as indicators of forest succession stages (Chazdon et al 1997). Overall species compositions among the three sites were calculated through using a *G*-test goodness of fit and Venn diagrams. A Species Importance Value (SIV) of each site was also calculated (Keel et al 1993). The SIV is the sum of the relative frequency, relative density, and relative dominance of a species. Adapted from Keel et al (1993), the values were calculated by the following three equations:

$$1. \text{Relative Frequency} = (\text{Number of plots in which a species occurs} / \text{Total number of occurrences of all species}) \times 100$$

$$2. \text{Relative Density} = (\text{Number of individuals of a species} / \text{Total number of individuals of all species}) \times 100$$

$$3. \text{Relative Dominance} = (\text{Basal area of a species} / \text{Total basal area of all species}) \times 100$$

2.4 Economic Valuation Approaches

A review was done on the literature concerning valuation methods of ecosystem services, natural capital, and the current Payments for Ecosystem Services (PES) program in Costa Rica. Economic and ecological approaches were both considered, and a cost benefit analysis was calculated for all three sites to analyze whether this approach was

appropriate in determining a value for a parcel of land. Analyzing the payments received from Costa Rica's PES program aided in determining the efficiency of PES as a form of conservation. These PES costs were calculated alongside the rest of the cost and benefits both properties harbor. The results for study site "O" were weighed against the results for sites "S" and "P" (the existing reserve, SRTRS). This was done since site "O" potentially could be purchased if the indirect ecological intangibles and direct economic costs/benefits of the services and goods the land provides can outweigh any cost that might be incurred in investing.

3.0 RESULTS

3.1 Forest Structure/Species Composition

Study Site	Area Sampled (m ²)	Total # of Tree Individuals	Total # of Species	Total # of Timber Tree Species	Total # of Endemics species	Species Richness (% amount of species per area)	Altitude range (m)
S	3000	187	16	24	4	0.08	500-800
P	3000	186	37	31	7	0.185	560-660
O	3000	217	31	30	4	0.155	600- 800
Total	9000	590	84	85	15	x	x

Table 1: Study sites and associated field data collected. Total of 590 trees were sampled. Of those 590 trees there were 84 species classified, 15 being endemic to Costa Rica and 85 different species of timber tree distributed equaling 0.9 ha between three different study sites.

A total of 590 trees were measured, mapped and identified with site “S”, “P”, and “O” containing 187, 186, and 217 trees, respectively (Table 1).

Species compositions of each study site were calculated using Venn diagrams and a *G*-test was conducted to determine the probability of distribution across the three sites (Figure 2 and Table 2).

THREE-WAY VENN DIAGRAM COMPUTATIONS				
ANALYSIS FOR: FORESTS SITES				
	TYPE CLASSES	ASSIGNED CLASS NUMBER	NO. OF SAMPLES	PROPORTION OF SAMPLES
100	SECONDARY	1	15	0.333
010	PRIMARY	2	15	0.333
001	OUTSIDE	3	15	0.333
TOTAL =			45	1.000

G-TEST OF RANDOM DISTRIBUTION AMONG 3 FOREST SITES									
	100	110	101	010	011	001	111	Total	
OBSERVED N =	16	8	13	37	19	31	21	145	
EXPECTED N =	5.37	32.22	32.22	5.37	32.22	5.370	32.22	145	
OBS TO EXP RATIO =	2.979	0.248	0.403	6.890	0.590	5.772	0.652		
G-Test Terms =	17.46706953	-11.145718	-11.80019085	71.4107783	-10.03613	54.3458002	-8.99081		
G-Test =	202.50								
df =	6								
PROB =	0.000								

Table 2: Three-way Venn diagram computations and G-test of random distribution among sites “O”, “S” and “P”

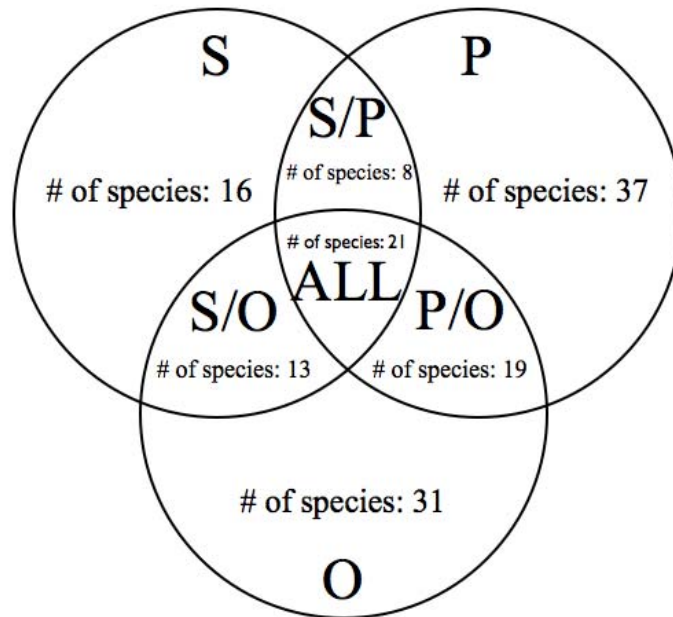


Figure 2: Venn diagram of species occurrence in study sites (P, O, S). Diagram displays that study site “P” and “O” had similar amounts of species diversity.

A total of 145 species were identified from all three sites with 21 species occurring in all three of the sites and 61 species occurring in more than one site. There were 84 species that occurred in only one of the tree sites with 16, 37 and 31 of these occurring in only the P, S and O sites, respectively. Approximately 30% of the species are considered to be timber species and could be harvested for economic gain if not protected (Figure 4). The 31 species found only in site “O” indicates that the addition of site “O” to the existing reserve (SRTRS) would increase overall biodiversity by 23%. Of the 84 species observed at site “O” only 8 were species endemic to Costa Rica, represented by a total of 15 individuals.

Species Importance Values (SIV) for Site "O", "P" and "S"

Site	Species	SIV
"S"	<i>Miconia punctata</i>	16.73
	<i>Miconia smaragdina</i>	21.86
	<i>Hedyosmum bonpladianum</i>	22.54
	<i>Cecropia insignis</i>	26.35
	<i>Columbrina spinosa</i>	33.7
"P"	<i>Pterocarpus sp1</i>	8.75
	<i>Lonchocarpus oliganthus</i>	11.69
	<i>Chimarrhis parviflora</i>	12.9
	<i>Iriartea deltoidea</i>	12.92
	<i>Guettarda turrialbana</i>	22.56
"O"	<i>Columbrina spinosa</i>	8.95
	<i>Pausandra trianae</i>	10.65
	<i>Miconia punctata</i>	13.6
	<i>Hampea appendiculata</i>	14.49
	<i>Hieronyma alchorneoidea</i>	15.52

Table 2: Species importance values (SIV) were calculated for each study site, "S". "P" and "O" using the above listed equations in Section 2.3

The results of the 'species importance values' (SIV) calculated are displayed in Table 3.

The single most important species represented by the SIV are *Columbrina spinosa* (S), *Guettarda turrialbana* (P) and *Hieronyma alchorneoidea* (O). Both *Guettarda turrialbana* (P) and *Hieronyma alchorneoidea* (O) are timber species. For those species with SIV > 10 in any of the three sites, there was little overlap in species composition among the sites. Only *Miconia punctata* occurred in two sites, the "S" and "O" sites.

There were only two species of the 145 observed that were listed as either endangered or threatened. The endangered species (Convention on International Trade in Endangered Species; CITES list) *Oreomunnea pterocarpa* was present in sites "P" and "S" and one

IUCN (International Union of Conservation of Nature) listed vulnerable species, *Cedrela odorata* was identified in site “O” as indicated by Table 4.

Site	Species	Number of Individuals	Conservation Status
"S"	<i>Oreomunnea pterocarpa</i>	1	Endangered (CITES list)
"P"	<i>Oreomunnea pterocarpa</i>	1	Endangered (CITES list)
"O"	<i>Cedrela odorata</i>	1	Vulnerable (UICN list)

Table 4: Conservation status for species located in sites “O”, “P” and “S”

The analysis of variance (ANOVA) calculated indicated that the total basal area, and mean heights among the three forests did not differ significantly ($p > 0.05$). Therefore the basal area and height data collected from all 3 sites does not aid in determining forest age and assessing value for conservation priorities. These results indicate that forest structure alone is not a good indicator of age in this instance. The height data across all three sites remains constant and there is no correlation between height and tree basal area (Table 5).

Site	Height			Basal Area		
	Mean	SD	Max	Mean	SD	Max
O	11.528	4.972	35.4	578	1588	15131
P	12.596	5.601	30.6	757.9	1247.80	7948.5
S	11.897	4.49	29	534.7	867	7329

Table 5: The table above lists the mean, standard deviation (SD), and the maximum amount from the height and basal area data of each forest study site “O”, “P” and “S”

3.2 Spatial Analyses of Tree Attributes

While there was no statistically significant differences in displayed from the forest structure data, there were differences in the spatial data. Due to the lack of cloud free aerial photography and high-resolution satellite imagery, spatial patterns were based on a digital elevation model (DEM) constructed from digitized 20-m contours from a standard topographical map of Costa Rica.

Using *ArcMap 9, Version 9.3*, the spatial analysis does indicate a difference in size densities of the basal area between the sites (Figure 3). The basal areas are based on a range of 5 category natural breaks. Study site “P” displays a greater density of higher basal areas when compared to Study site “O” and “S”. Study site “P” also has a greater number of endemic species at 7, while sites “O” and “S” have a total of 4 endemic species.

The endemics in site “O” range evenly along the plots while endemics in site “P” are highly clustered over the many of the plots. Site “S” displays very few endemic species. Spatially, timber species appear to exist at the same densities across sites “O” with 30 species and “P” with 31 species (Figure 4).

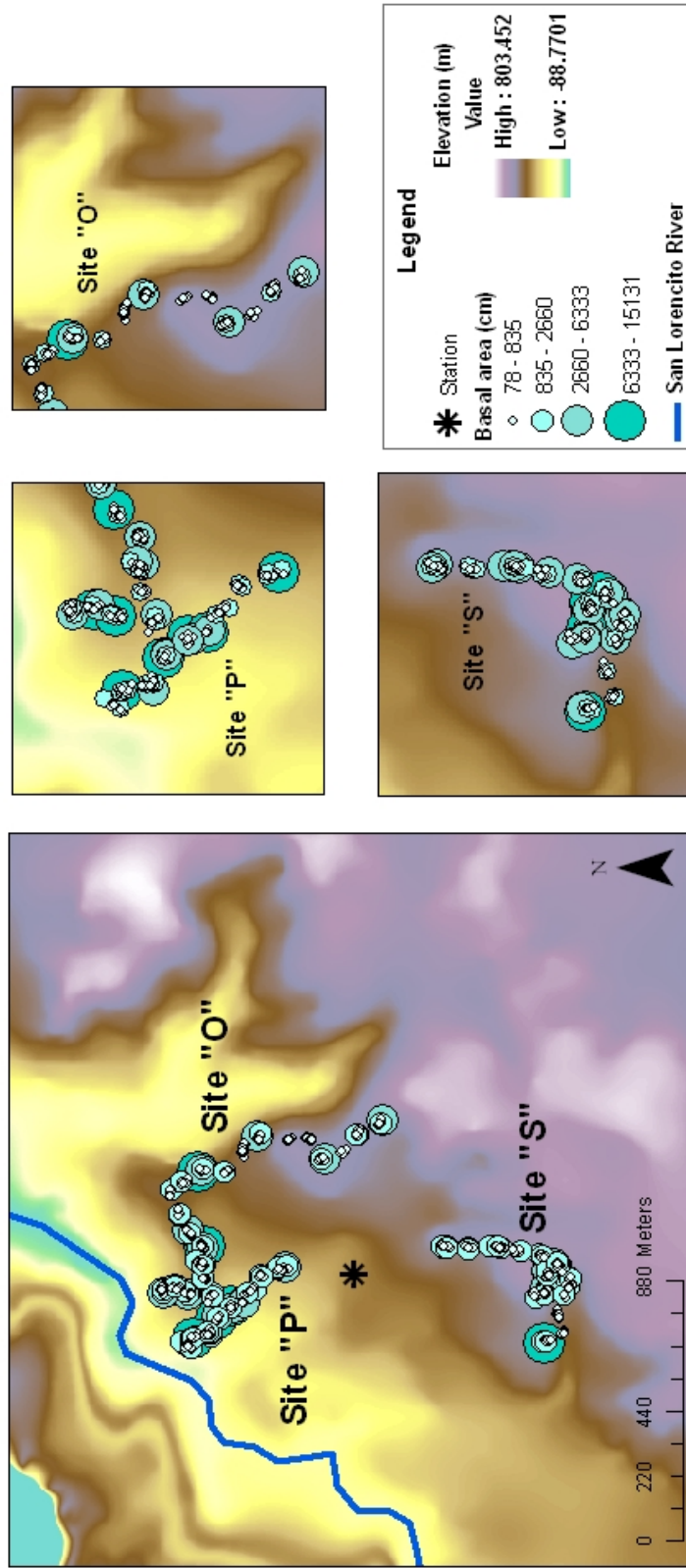


Figure 3: Basal area of tree individuals for study sites "O" (adjacent property), "P" and "S" (existing reserve: San Ramon Tropical Research Station, Costa Rica). (All data and locations were collected and obtained through extensive onsite fieldwork)

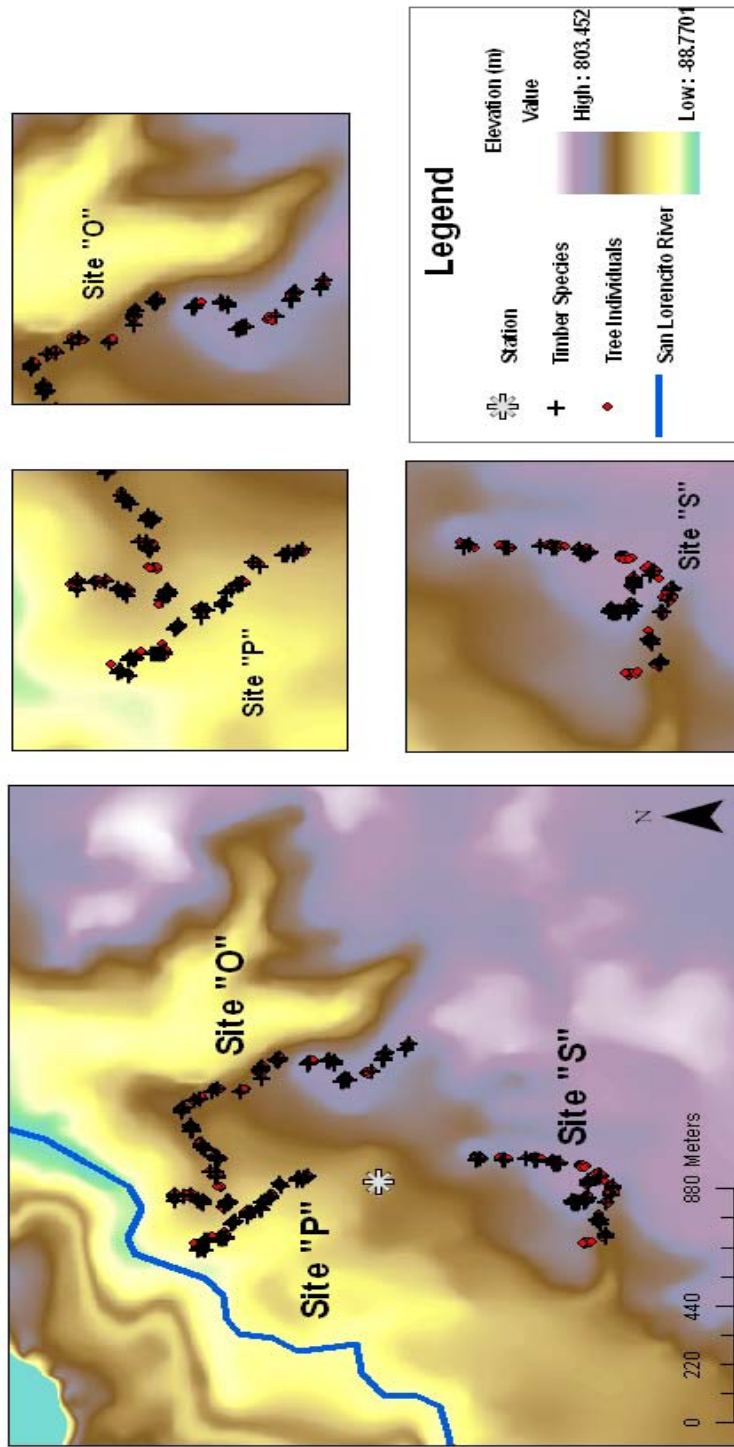


Figure 4: Map of timber species in study sites "O" (adjacent property) and sites "P" and "S" (existing reserve: San Ramon Tropical Research Station, Costa Rica). (All data and locations were collected and obtained through extensive onsite fieldwork)

Sites “P” and “O” also display more shade tolerant (*Esciofitas*) species and site “S” contains high densities of short lived shade intolerant (*Heliophyte ephemeral*) species indicating it is primarily a younger forest when compared to sites “O” and “P” (Figure 5). The abundance of shade tolerant species in Site “O” indicates that this forest may be comprised of many long-lived species. An additional survey of the property would have to be conducted in order to deem the entire forests primary or old growth. A brief summary of species attributes is listed in Appendix 2.

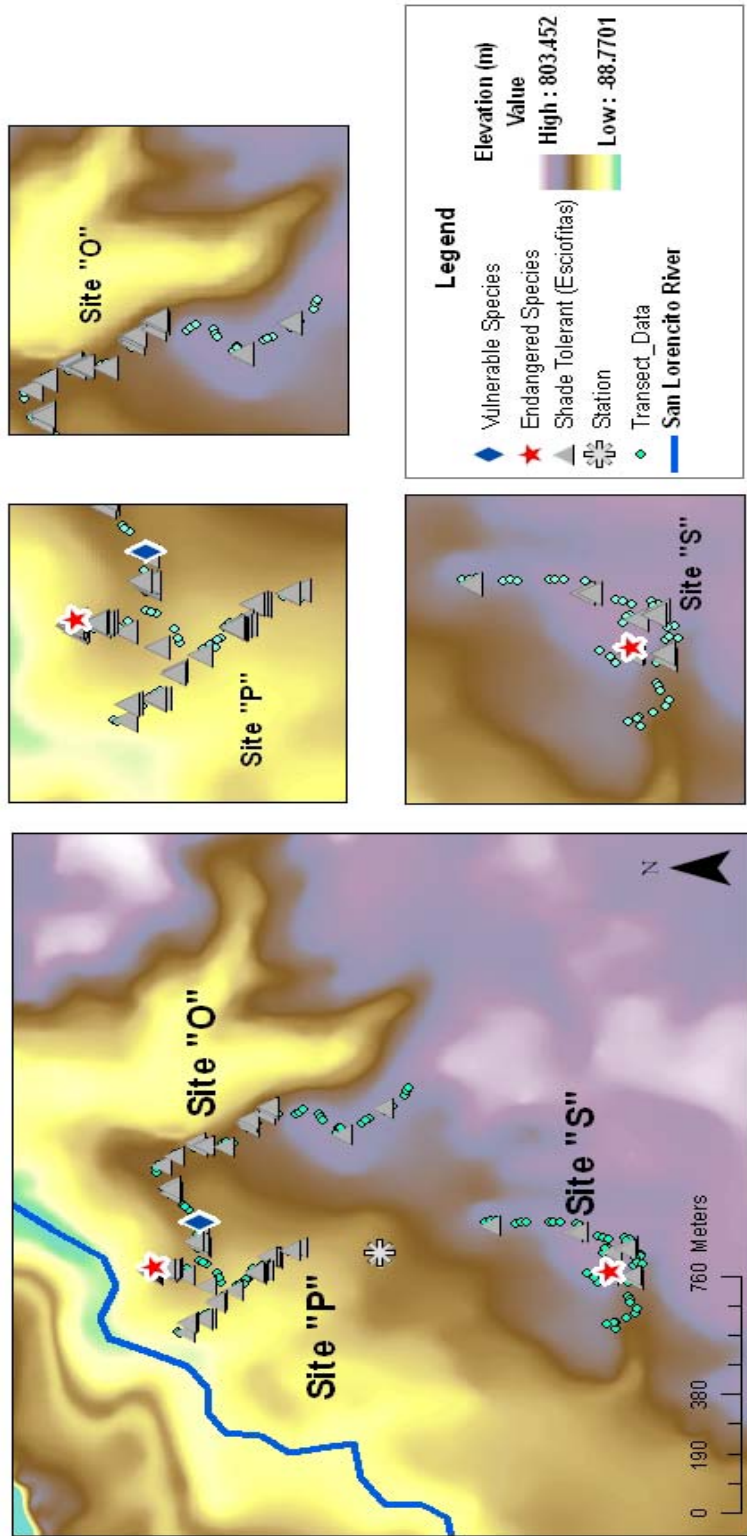


Figure 5: Map of endangered, vulnerable and shade tolerant species for study sites "O" (adjacent reserve), "P" and "S" (current reserve: San Ramon Tropical Research Station, Costa Rica). (All data and locations were collected and obtained through extensive onsite field work.)

Costs were obtained from the present landowner to give indication of land prices for sites “S” and “P” comparatively with sites “O”. The adjacent property, site “O”, is listed at a purchase price of approximately \$400,000 USD (assumption: the price is discounted for an in-country citizen opposed to an outside investor), for 800 ha (approximately 1200 acres). The direct cost was weighed against the direct benefits obtained from PES at \$75 per ha for a 5-year contract. A standard cost benefit analysis (CBA) was calculated for site “O” which was then compared to site “P” and “S” (these two sites were combined into one category since they both exist on the current reserve, SRTRS). Ecological intangibles for all sites were listed including different ecosystem services that do not have listed monetary value but display significant ecological importance. The CBA displays the direct cost and benefits (items that have a market price) associated with conserving the property from a financial/economics perspective. Due to lack of markets and associated monetary values, the ecological intangibles (*secondary factors*) were taking into consideration after the primary CBA was calculated. These intangible costs were not actually determined due to insufficient data associated with indirect (not having a direct value, indirectly impacts the system) services/benefits, but instead they were theorized by using the existing data collected throughout the study. These additional *secondary factors* and benefits would significantly increase the value of the property from an ecological purpose and can be argued to increase total economic value as well.

For the other property, site “O”, PES compensates the owner \$75 USD per ha, at 800 ha, for a total of \$60,000 USD per year for 5 years. Cash flow out would be a one-time investment cost of \$400,000 USD. The break-even point occurs 6.66 years after the initial

investment of \$60,000 USD per year from PES. A renewal of the PES contract after 5 years results in a positive return on the investment. There is risk involved with the decision of purchasing site “O”, but the benefits would outweigh the risks due to ownership of an asset opposed to leasing. One may conclude that, at the end of the contract, the investor would have received approximately \$300,000 USD from PES. If the investors no longer wished to retain ownership of the land it could be sold at the end of the contract. Assuming the price of the land does not decrease, and as a worse case scenario, did not increase in value but stayed constant then capital lost would be \$100,000 USD. Therefore, if the PES contract for site “P/S” was cancelled after 5 years the investor would not have a potential capital gain from selling the property. Instead they would have spent \$37,500 USD in renting fees.

For Site “P” and “S”, the CBA display costs of \$30,000/year (operating costs) for 5 years at USD \$150,000. Over the course of a 5-year contract, the PES program would bring in total benefits of US \$37,500 at \$75/ha (100 ha) for 5years. Since this option is a lease option and no ownership exists, a return would never be made. Instead there would be a loss of potential income (LPI). The LPI would be \$90,000 USD (PES of \$60,000 USD and operations cost of \$30,000 USD). This is the amount lost due to renting land instead of ownership and over the course of 5 years the total LPI would be around \$450,000, more than the one time investment cost of \$400,000 to purchase site “O”. Table 6 illustrates the cost benefit analysis in more detail.

4.0 DISCUSSION

The main limitation associated with conservation and payments for ecosystem services is the question of how these goods and services should be valued. Methods for analyses vary among stakeholders, location and which services and goods are assessed. Problems arise from a policy perspective due to debates, uncertainty and lack of standardization in the scientific and economic communities. This lack of standardization and knowledge has been motivation for valuation studies, to generate a better and more comprehensive informational base for policy formulation and decision making process (Turner et al 2003). To properly place an actual value, from the capitalist perspective, the ecosystem services that the land provides must be rigorously assessed and evaluated using sound scientific and economic criteria. The present study attempted to place value from these two approaches, obtaining a value of cost/benefits from quantitative ecological data collected in the field then applying the data to an economic model.

Conservation programs in Costa Rica have seen success since the late 1999's when the PES program was first implemented. The success of the PES program can be associated with using this idea of an economic incentive as a model for conservation. Creation of markets for ecosystem services and goods along with proper economic incentive-based policies can deter land use change and ultimately create more precedence for conservation (Kremen et al 2000).

This study suggests that the PES program has been an efficient method of conservation in Costa Rica but it has yet to truly assess the real value of each ecosystem service. An important question in this context is how do these services influence overall human well being? From the conservationist perspective, PES does not clearly address which forest community is of most importance since contracts are set for a flat rate of \$75 per hectare for 5 years.. The PES falls short in addressing whether primary forests are worth more to conserve than secondary forests, as seen through the lack of additional compensation. The intangibles associated with each forest community have to be assessed and valued to determine from an economic view whether there is a monetary difference between primary and secondary forest. The argument against PES is the absence of actual value placed on the individual ecosystem service the land supplies. An appropriate valuation method has to be assigned to each ecosystem service to estimate the true value of the good or service. This can be determined by estimating the “Total Economic Value” (TEV) (Turner et al 2003). This value is calculated by the sum of the *use value* and *non use value* of any good or service (Figure 6).

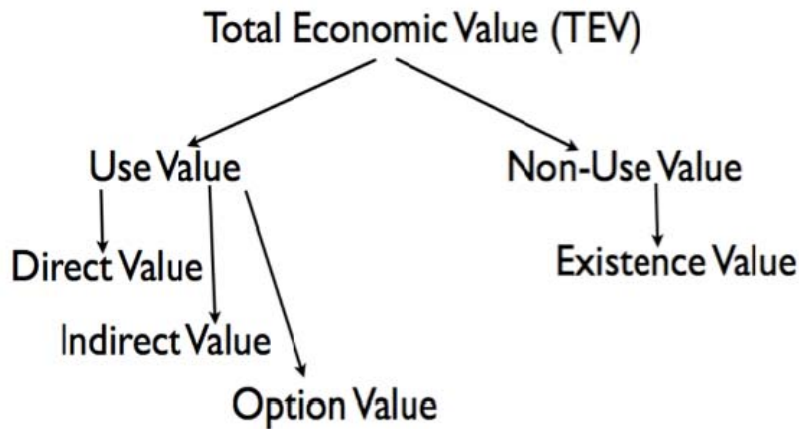


Figure 6: Total Economic Value graphic (TEV). Source: adapted from Pagiola et al 2004

Economists have acknowledged the need for assessing value for ecological intangibles since these variables are the most difficult to assign value to. But there is apprehension towards this idea due to fear that if an ecosystem has an assigned monetary worth this might prevent humans from valuing the environment as a commodity and eventually exploited it (Gatto et al 2000).

A preferred method of assigning monetary worth is through a typical Cost Benefit Analysis (CBA). Basic economic valuation of systems is framed, theoretically, in welfare economics and practicality as CBA (Gutman 2002). Therefore, a CBA is frequently used for most standard economic assessments. For the case study presented here, a CBA was applied and the direct costs and benefits were calculated. The CBA was used because of

its applicability to all four-ecosystem services provided under the PES contract. The downfall and the biggest argument to the CBA is that if any of the benefits do not display a direct tradable market price, such as biodiversity, it cannot be properly measured (Gatto et al 2000). Therefore, whenever there are no explicit markets for services, one must resort to an indirect method of assessment, which can be expressed by numerous ecosystem economic valuation techniques as seen in Table 7 (Pagiola et al 2004; Farber et al 2002; Chee 2004; Heal 2000).

Methodologies	Approach	Ecosystem service Costa Rica PES contract	Application	Quantitative calculation	Limitations/Problems
Revealed Preference					
Hedonic Pricing (HP)	Examine an effect of environmental factors on price of goods that include those factors	Aesthetic value		Any prices and characteristic of goods	Requires large quantities of data; Specific sensitive
Travel costs (TCM)	Determine a demand amount from data on travel costs	Aesthetic value and Biodiversity Production	Costs associate with travel to visit landscape	Survey conducted to sum costs associated with travel to destination	Lack of accuracy with multiple destinations. Must assume one.
Production Function (PF)	Determine the impact from the change in the ecosystem service on produced goods	Carbon Sequestration	Any impact that affects produced goods	Degree of impact on service; Produced goods total value; Change in service	Data lacking for change and services and their actual impact on production
Cost of Illness (CI)	Estimate the impact of change on ecosystem services on human health	Protection of Watershed	Any impact that affects health	Costs associated with illness or value of life	Value of health not easily determined; Is illness associated with ecosystem changes
Replacement Cost (RC)	Calculate cost of replacing lost good/ service	Varies	Any loss of service and/ or good	Determine degree of loss and cost of replacement	Over-estimation occurs
Stated Preference					
Contingent Valuation (CV)	Survey asking the "Willingness to Pay" (WTP) for specified service	Biodiversity Protection and Aesthetic value	Can be applied to all ecosystem services	Survey predicts value from the WTP	Stakeholder bias; Inconsistency with price
Other methods					
Cost Benefit Analysis (CBA)	Determine direct market based costs and benefits	Varies	Applied to costs and benefits associate with services and goods with direct cost/benefits	Calculate costs minus benefits, gives direct primary monetary value	Cannot be directly applied to intangibles; Intangibles calculated as secondary costs/benefits

Table 7: Economic valuation methods. Adapted from Pagiola et al 2004, Chee 2004, Heal 2000

These methods are the most prevalent and cited in the literature, but it is debatable as to which method is the most appropriate. The use of the cost benefit analysis (CBA) is widely accepted, but issues arise with this standard method due to the uncertainty in estimating an intangible. The treatment of intangibles in CBA can be problematic and recommendations on how to incorporate non-market priced costs and benefit is still very vague (Chee 2004). Until markets are created to better estimate prices for ecosystem service benefits and costs, the associated intangibles or *secondary factors* can be temporarily estimated using one of the above listed economic valuation techniques (Table 7).

These *secondary factors* associated with each ecosystem service have an indirect value. To assess the indirect value of watershed protection a cost of illness or replacement costs is estimated. This value estimates the impact to downstream users of that particular watershed. A zero cost is first assumed for no land use change in site “O” and “P/S”. Once land is converted costs start to incur. If sites “O” and “P/S” were converted to a cattle ranch then a loss of vegetation increases the probability of poor water quality downstream. To counteract these adverse affects, a more efficient water treatment facility would need to be installed costing the downstream municipality millions of dollars. Decreases in human health due to poor water quality would also result in costs associated with medical expenses. The lack of vegetation could also cause rapid downstream flooding, creating monetary damage to infrastructure. The sum of all these potential costs would displays a rough estimate of the value of sites “O”, “P”, and “S”. These two methods of economic valuation, cost of illness and replacement costs, still have errors

associated with them. However, directly linking water quality to various illnesses poses inherent issues in proving causation. Determining replacement costs also poses problems, such as overestimating costs. Stakeholders play major roles in what these costs are which can result in over and under estimation.

Determining a price for the aesthetic characteristics of a property also can be done by many different economic valuation methods. Aesthetic beauty is typically valued by means of travel costs, hedonic pricing or by use of a contingent valuation method (Pagiola 2004). For sites “O” and “P/S”, benefits were estimated first by travel costs and by asking the question; how much money does a person spend to get to a desired destination? These costs would first be calculated by assuming a zero price for both the sites, assuming no current land use change. Costs of airfare, in country travel, and other miscellaneous costs that would be given up to visit the current site from a tourism aspect would then be estimated to an overall value. Some economist’s believe this to be a proper estimate of how much the property is worth. Others argue that a contingent valuation (CV) method is more appropriate. CV determines value by use of a survey asking an individual what the willingness to pay (WTP) is for the conservation of the property. The main error associated with the CV method is that different stakeholders will have different WTP values resulting in an inconsistent price.

Greenhouse gas (GHG) mitigation is one of the few ecosystem services that can be better estimated due to the availability of carbon markets, where carbon credits are traded. In 2008 carbon credits traded on the Chicago Climate Exchange (CCX) ranged in value

from \$1.00 to \$7.40 t/CO₂e (Murray et al 2009). The Lieberman-Warner climate change bill estimated a price range of \$20/tCO₂e to \$30 /tCO₂e (Murray et al 2009). Murray et al (2009) assumed a \$30 /tCO₂e upper end price for the market which generated a low end price of \$59 USD and a potential high end price of \$419. Benefits from GHG mitigation for site “O” and “P/S” would be estimated from the current carbon trading price ranges if the total amount of carbon stored in both sites were determined. A simple estimate of the minimum carbon (C) storage per ha could be extracted from the available forest structure data (Table 5) assuming a conical shape to a tree trunk where:

$$4). Vol = 1/3 (basal\ area \times height \times conical\ shape\ of\ wood/cm^3)$$

A further refinement of this estimate could be obtained from other studies of tropical forests that provide estimates of carbon stored in tree trunks/total carbon stored in the ecosystem.

The development of the carbon market has created more opportunity for financial security in conservation. Development of Cap and Trade policies for GHG emissions could create a niche for forest conservation. While there is debate about whether Cap and Trade is the right answer for solving CO₂ emissions, it might further conservation efforts if corporations were given the incentive to purchase land to offset their emissions. The addition of site “O” could also generate capital not only from PES but also from the trading of carbon credits. These carbon benefits could likely increase as the value of carbon credits increases. The estimated value of both sites would increase over time due to an opportunity to earn capital through carbon offsetting investments.

The Millennium Ecosystem Assessment (MA) played a large role in identifying the importance of biodiversity to ecosystems. The MA displayed that genetic and species diversity is declining at very high rates (Carpenter et al 2009). Biodiversity protection is, by far, the most difficult intangible to assign value to. With population numbers rising, additional pressures on habitats are contributing to a decline in biodiversity that gives precedence to more data that needs to be valued. Biodiversity needs to be valued by assessing each forests type and whether or not the difference in diversity really affects the potential monetary value of that system. Since the basal area and height data for all three sites did not display a statistical significance ($p>0.05$), the species data collected was examined to determine forest structure. The next step was examining how a specific species could impact human well-being and economic growth. Characteristics associated with each individual species such as timber, endemics, ecological guilds and conservation status were noted. Prices can be extrapolated from each timber species by researching current timber markets (ITTO). An exact price for Costa Rica is difficult to compute due to the virtual cessation downfall of trade in timber resources, from concerted government conservation practices (ITTO). Using prices from the timber trade, could give a rough estimate of what the cost is of a particular species. Figure 4 gives an indication of the abundance of timber species located on both sites “P/S” and site “O”.

Endemics are species that are only found in a given place and losing an endemic species is risking losing genetic diversity. Therefore, *replacement costs* and *contingent valuation* methods are seen as an appropriate measure. The value could be estimated by examining the numbers of endemic species (Table 1) and whether or not endangered and/or

vulnerable species occurred on sites “P/S” and “O” (Figure 5). A total of 15 endemic species, one CITES listed endangered species, occurred in both site “P” and site “S” and one IUCN listed vulnerable species was found in site “O”. The presence of these rare protected species gives precedence from an ecological perspective that site “O” and “P/S” should be conserved. Another potential benefit would be from pharmaceutical bioprospecting. The discovery of a tree species that has medicinal purposes could yield large gains in capital along with the pressing need of conservation (ITTO). These factors associated with greater biodiversity would account for positive increases in capital and potentially bring in different streams of revenue for local landowners and outside investors.

Costa Rica’s attempt to standardize conservation efforts through PES still needs evaluating. Since 1997 the price compensated to landowners has increased from US \$40/ha/yr to US\$75/ha/yr in 2009 (Pagiola 2006), but this price does not capture the total net worth of benefits from the listed ecosystem services. In some cases, the net value of the land at the installment of the initial PES contract could actually be less than the face value due to a 15% assessed fee to cover initial monitoring and management fees (Pagiola 2006). This initial fee would not apply to Site “P/S” since it has already been paid for in its first contract but may apply to Site “O”, which could cause apprehension towards future investments. The TEV of Sites “O” and “P/S” would encompass not only the Use Value (direct, indirect and option value) benefits/costs but also the Non-Use Value (existence value) benefits/costs, any NTFP such as biodiversity and aesthetic values. These Non-Use items (any non-marketed item and intangible) however calculated

(refer back to Table 7) would indicate an additional range of increased capital that could potentially be accrued.

Therefore, it is inferred that the benefits associated with any ecosystem intangible, such as GHG mitigation, species diversity etc would only increase current land value. It is still necessary to determine the actual costs of these benefits. The study only attempted to examine the overall intangibles to estimate a value. In the PES contract this estimated increase in capital from intangibles is not reflected on the current US\$75/ha/yr price indicating that an appropriate value is not adequately determined. Under the current PES plan in order to determine a more accurate price numerous amounts of ecological data must be quantified. Tree species must be identified to assign a value to each of their attributes such as endemics (genetic complexities), medicinal capabilities, timber value, old growth vs. new growth, and ultimately how these characteristics affect human well being. Until all of these items are addressed and assigned a proper monetary value accurate markets for ecological intangibles, can not be properly created and used as an effective method of conservation.

5.0 CONCLUSION

The overall objective of the research was again to assess:

- Whether a parcel of land adjacent to an existing private reserve (the San Ramon Tropical Research Station: SRTRS) was sufficiently ecologically diverse to be purchased and added to the existing reserve and
- Whether this diversity could be quantified into monetary values, to justify or finance the purchase. That is, do the ecological and economic benefits gained from the adjacent property, site “O”, when compared to the existing property, site “P/S”, give precedents for conservation?

From the perspective of an investor focused on the initial CBA, the adjacent property, site “O”, should be conserved due to the potential economic gain from ownership. The species data also indicates ecological worth and the potential worth of increased biodiversity which would give appeal to the conservationist. This investment would lead to an ecological gain that would benefit conservation and future endeavors such as research opportunities while making sound economic sense.

Economic gain will happen when the future potential market for ecosystem services for the world’s tropical forests have been recognized from outside investors, such as non-government organizations (NGO’s) and global corporations (ITTO 2004). Markets for benefits associated with carbon mitigation and watershed protection are already developing due to rising demands on subsequent services and goods both, locally and globally. In the past, smaller investments have been made towards biodiversity

protection, usually from NGO's and some government agencies. In the mean time, most direct responsibility for conservation is seen locally, in the hands of the landowners. There has been progress made in the creation of conservation frameworks but the need for additional research is crucial to better assign value on ecosystems. Costa Rica's PES program has made great strides in paving the way for tropical forest conservation but additional hurdles still exist. While Costa Rica has made great strides, countries in other tropical nations where conservation is not an efficient economic means of living similar PES implementation will be difficult.

It appears that the PES and other economic valuation methodologies are still too general and fail when numerous stakeholders are involved. A concise framework must be developed to better identify benefits and costs for other tropical nations. As for this case study, by simply weighing the direct cost and benefits of site "O", from the CBA, pressing reasons to invest are found. The species composition of site "O" should be weighed heavily in an investment decision but the existing PES program does not weigh an importance value on specific species. Even though these secondary costs and benefits associated from ecosystem services cannot be directly valued on one standard method, these intangibles may increase stakeholder value due to future potential market and through the loss of potential income, as seen through the CBA for the adjacent property (site "O"). When markets are established for ecosystem services and are assigned appropriate monetary value, landowners will be given a more secure financial alternative to degradation. Truly understanding the ecological and economic importance of these

ecosystem services to everyday life will push standardized framework and methods for economic valuation, which can ultimately lead to better conservation strategies

APPENDIX

Appendix 1: Species identification datasheet

Tree tag number	Transect	Habitat	Family	Genus	Species
13	2	O	Actinidiaceae	Saurauria	yasicae
11	4	O	Anacardiaceae	Tapirira	mexicana
13	7	O	Anacardiaceae	Tapirira	mexicana
6	1	P	Anacardiaceae	Tapirira	mexicana
12	15	P	Anacardiaceae	Tapirira	mexicana
8	2	S	Anacardiaceae	Tapirira	mexicana
8	15	O	Annonaceae	Rollinia	membranacea
9	10	O	Annonaceae	Xylopia	bocatorena
7	1	P	Annonaceae	Xylopia	bocatorena
11	12	P	Annonaceae	Xylopia	bocatorena
9	13	S	Annonaceae	Xylopia	bocatorena
10	3	P	Araliaceae	Dendropanax	arboreus
12	12	P	Araliaceae	Dendropanax	arboreus
3	2	O	Arecaceae	Euterpe	precatorea
7	5	O	Arecaceae	Euterpe	precatorea
7	6	O	Arecaceae	Euterpe	precatorea
10	6	O	Arecaceae	Euterpe	precatorea
18	6	O	Arecaceae	Euterpe	precatorea
7	15	P	Arecaceae	Euterpe	precatorea
9	15	P	Arecaceae	Euterpe	precatorea
10	15	P	Arecaceae	Euterpe	precatorea
13	15	P	Arecaceae	Euterpe	precatorea
14	15	P	Arecaceae	Euterpe	precatorea
18	15	P	Arecaceae	Euterpe	precatorea
10	6	S	Arecaceae	Euterpe	precatorea
11	6	S	Arecaceae	Euterpe	precatorea
12	6	S	Arecaceae	Euterpe	precatorea
3	9	S	Arecaceae	Euterpe	precatorea
4	9	S	Arecaceae	Euterpe	precatorea
11	1	O	Arecaceae	Iriarteia	deltoidea
15	1	O	Arecaceae	Iriarteia	deltoidea
1	4	O	Arecaceae	Iriarteia	deltoidea
6	4	O	Arecaceae	Iriarteia	deltoidea
16	4	O	Arecaceae	Iriarteia	deltoidea
3	6	O	Arecaceae	Iriarteia	deltoidea
4	6	O	Arecaceae	Iriarteia	deltoidea

12	6	O	Arecaceae	Iriarte	deltoidea
5	2	P	Arecaceae	Iriarte	deltoidea
5	3	P	Arecaceae	Iriarte	deltoidea
6	3	P	Arecaceae	Iriarte	deltoidea
13	3	P	Arecaceae	Iriarte	deltoidea
15	3	P	Arecaceae	Iriarte	deltoidea
5	4	P	Arecaceae	Iriarte	deltoidea
6	6	P	Arecaceae	Iriarte	deltoidea
15	7	P	Arecaceae	Iriarte	deltoidea
8	8	P	Arecaceae	Iriarte	deltoidea
1	14	P	Arecaceae	Iriarte	deltoidea
5	14	P	Arecaceae	Iriarte	deltoidea
4	15	S	Arecaceae	Iriarte	deltoidea
6	2	O	Asteraceae	Koanophyllon	hylonoma
11	2	O	Asteraceae	Koanophyllon	hylonoma
15	2	O	Asteraceae	Koanophyllon	hylonoma
10	3	O	Asteraceae	Koanophyllon	hylonoma
11	3	O	Asteraceae	Koanophyllon	hylonoma
1	5	O	Asteraceae	Koanophyllon	hylonoma
2	5	O	Asteraceae	Koanophyllon	hylonoma
3	5	O	Asteraceae	Koanophyllon	hylonoma
4	5	O	Asteraceae	Koanophyllon	hylonoma
5	5	O	Asteraceae	Koanophyllon	hylonoma
3	8	O	Asteraceae	Koanophyllon	hylonoma
8	8	O	Asteraceae	Koanophyllon	hylonoma
4	10	O	Asteraceae	Koanophyllon	hylonoma
5	10	O	Asteraceae	Koanophyllon	hylonoma
6	11	O	Asteraceae	Koanophyllon	hylonoma
7	11	O	Asteraceae	Koanophyllon	hylonoma
5	12	O	Asteraceae	Koanophyllon	hylonoma
3	13	O	Asteraceae	Koanophyllon	hylonoma
5	13	O	Asteraceae	Koanophyllon	hylonoma
6	13	O	Asteraceae	Koanophyllon	hylonoma
7	13	O	Asteraceae	Koanophyllon	hylonoma
8	13	O	Asteraceae	Koanophyllon	hylonoma
9	13	O	Asteraceae	Koanophyllon	hylonoma
10	13	O	Asteraceae	Koanophyllon	hylonoma
11	13	O	Asteraceae	Koanophyllon	hylonoma
13	13	O	Asteraceae	Koanophyllon	hylonoma
14	13	O	Asteraceae	Koanophyllon	hylonoma
7	1	S	Asteraceae	Koanophyllon	hylonoma
11	1	S	Asteraceae	Koanophyllon	hylonoma
2	2	S	Asteraceae	Koanophyllon	hylonoma

244	5	S	Asteraceae	Koanophyllon	hylonoma
247	5	S	Asteraceae	Koanophyllon	hylonoma
10	11	S	Asteraceae	Koanophyllon	hylonoma
12	7	O	Bignoniaceae	Tabebuia	rosea
1	14	O	Bombacaceae	Pachira	aquatica
2	3	P	Bombacaceae	Pachira	aquatica
9	7	P	Bombacaceae	Pachira	aquatica
5	15	P	Bombacaceae	Pachira	aquatica
13	13	S	Bombacaceae	Pachira	aquatica
12	1	P	Bombacaceae	Quararibea	costaricensis
3	8	P	Bombacaceae	Quararibea	costaricensis
10	8	P	Bombacaceae	Quararibea	costaricensis
4	9	P	Bombacaceae	Quararibea	costaricensis
7	12	P	Bombacaceae	Quararibea	costaricensis
2	13	P	Bombacaceae	Quararibea	costaricensis
5	15	S	Bombacaceae	Quararibea	costaricensis
2	2	O	Boraginaceae	Cordia	cymosa
8	2	O	Boraginaceae	Cordia	cymosa
1	3	O	Boraginaceae	Cordia	cymosa
4	11	O	Boraginaceae	Cordia	cymosa
4	13	O	Boraginaceae	Cordia	cymosa
5	1	P	Boraginaceae	Cordia	cymosa
5	12	P	Boraginaceae	Cordia	cymosa
7	15	S	Boraginaceae	Cordia	cymosa
8	1	P	Boraginaceae	Cordia	porcata
10	7	P	Boraginaceae	Cordia	porcata
8	14	S	Burseraceae	Protium	ravenii
13	4	S	Burseraceae	Protium	sp1
3	9	P	Caricaceae	Jacaratia	spinosa
8	3	O	Cecropiaceae	Cecropia	insignis
5	11	O	Cecropiaceae	Cecropia	insignis
1	13	O	Cecropiaceae	Cecropia	insignis
8	7	P	Cecropiaceae	Cecropia	insignis
9	2	S	Cecropiaceae	Cecropia	insignis
1	3	S	Cecropiaceae	Cecropia	insignis
9	3	S	Cecropiaceae	Cecropia	insignis
10	3	S	Cecropiaceae	Cecropia	insignis
253	5	S	Cecropiaceae	Cecropia	insignis
255	5	S	Cecropiaceae	Cecropia	insignis
257	5	S	Cecropiaceae	Cecropia	insignis
5	6	S	Cecropiaceae	Cecropia	insignis
13	6	S	Cecropiaceae	Cecropia	insignis
7	10	S	Cecropiaceae	Cecropia	insignis

3	14	S	Cecropiaceae	Cecropia	insignis
2	15	S	Cecropiaceae	Cecropia	insignis
11	15	S	Cecropiaceae	Cecropia	insignis
245	5	S	Cecropiaceae	Cecropia	obtusifolia
6	10	S	Cecropiaceae	Cecropia	obtusifolia
8	10	S	Cecropiaceae	Cecropia	obtusifolia
8	6	O	Cecropiaceae	Pourouma	bicolor
14	8	O	Cecropiaceae	Pourouma	bicolor
6	9	O	Cecropiaceae	Pourouma	bicolor
7	15	O	Cecropiaceae	Pourouma	bicolor
2	2	P	Cecropiaceae	Pourouma	bicolor
14	3	P	Cecropiaceae	Pourouma	bicolor
16	7	P	Cecropiaceae	Pourouma	bicolor
5	13	S	Cecropiaceae	Pourouma	bicolor
7	14	S	Cecropiaceae	Pourouma	bicolor
9	15	S	Cecropiaceae	Pourouma	bicolor
2	14	S	Cecropiaceae	Pourouma	minor
3	3	O	Chloranthaceae	Hedyosmum	bonplandianum
10	7	O	Chloranthaceae	Hedyosmum	bonplandianum
15	7	O	Chloranthaceae	Hedyosmum	bonplandianum
4	9	O	Chloranthaceae	Hedyosmum	bonplandianum
9	9	O	Chloranthaceae	Hedyosmum	bonplandianum
9	4	S	Chloranthaceae	Hedyosmum	bonplandianum
249	5	S	Chloranthaceae	Hedyosmum	bonplandianum
250	5	S	Chloranthaceae	Hedyosmum	bonplandianum
251	5	S	Chloranthaceae	Hedyosmum	bonplandianum
252	5	S	Chloranthaceae	Hedyosmum	bonplandianum
254	5	S	Chloranthaceae	Hedyosmum	bonplandianum
256	5	S	Chloranthaceae	Hedyosmum	bonplandianum
2	7	S	Chloranthaceae	Hedyosmum	bonplandianum
3	7	S	Chloranthaceae	Hedyosmum	bonplandianum
4	7	S	Chloranthaceae	Hedyosmum	bonplandianum
2	8	S	Chloranthaceae	Hedyosmum	bonplandianum
3	8	S	Chloranthaceae	Hedyosmum	bonplandianum
9	8	S	Chloranthaceae	Hedyosmum	bonplandianum
2	10	S	Chloranthaceae	Hedyosmum	bonplandianum
11	10	S	Chloranthaceae	Hedyosmum	bonplandianum
9	11	S	Chloranthaceae	Hedyosmum	bonplandianum
15	2	P	Chrysobalanaceae	Hirtella	triandra
15	15	P	Chrysobalanaceae	Licania	sparsipilis
12	3	O	Clethraceae	Clethra	-cf costaricensis
4	5	P	Clethraceae	Clethra	-cf costaricensis
248	5	S	Clethraceae	Clethra	-cf costaricensis

258	5	S	Clethraceae	Clethra	-cf costaricensis
3	6	S	Clethraceae	Clethra	-cf costaricensis
4	2	O	Clusiaceae	Calophyllum	brasiliense
6	6	O	Clusiaceae	Calophyllum	brasiliense
6	15	O	Clusiaceae	Calophyllum	brasiliense
10	2	P	Clusiaceae	Calophyllum	brasiliense
6	14	P	Clusiaceae	Calophyllum	brasiliense
10	10	O	Clusiaceae	Garcinia	intermedia
4	2	P	Clusiaceae	Garcinia	intermedia
6	15	P	Clusiaceae	Garcinia	intermedia
7	6	P	Euphorbiaceae	Adelia	triloba
4	11	P	Euphorbiaceae	Adelia	triloba
8	12	P	Euphorbiaceae	Adelia	triloba
3	12	P	Euphorbiaceae	Alchornea	latifolia
4	7	P	Euphorbiaceae	Croton	megistocarpus
7	12	O	Euphorbiaceae	Croton	schiedeanus
10	14	O	Euphorbiaceae	Croton	schiedeanus
9	15	O	Euphorbiaceae	Croton	schiedeanus
5	7	P	Euphorbiaceae	Croton	schiedeanus
17	7	P	Euphorbiaceae	Croton	schiedeanus
4	8	P	Euphorbiaceae	Croton	schiedeanus
8	10	P	Euphorbiaceae	Croton	schiedeanus
3	11	P	Euphorbiaceae	Croton	schiedeanus
5	4	S	Euphorbiaceae	Croton	schiedeanus
12	14	S	Euphorbiaceae	Croton	schiedeanus
12	15	S	Euphorbiaceae	Croton	schiedeanus
1	13	P	Euphorbiaceae	Drypetes	brownii
5	13	P	Euphorbiaceae	Drypetes	brownii
14	13	P	Euphorbiaceae	Drypetes	brownii
22	6	O	Euphorbiaceae	Gymnathes	riparia
3	15	P	Euphorbiaceae	Gymnathes	riparia
11	15	P	Euphorbiaceae	Gymnathes	riparia
9	2	O	Euphorbiaceae	Hieronyma	alchorneoides
17	4	O	Euphorbiaceae	Hieronyma	alchorneoides
1	10	O	Euphorbiaceae	Hieronyma	alchorneoides
16	6	O	Euphorbiaceae	Mabea	-cf klugii
13	2	P	Euphorbiaceae	Margaritaria	nobilis
4	1	O	Euphorbiaceae	Pausandra	trianae
8	1	O	Euphorbiaceae	Pausandra	trianae
13	1	O	Euphorbiaceae	Pausandra	trianae
5	4	O	Euphorbiaceae	Pausandra	trianae
13	4	O	Euphorbiaceae	Pausandra	trianae
18	4	O	Euphorbiaceae	Pausandra	trianae

5	7	O	Euphorbiaceae	Pausandra	trianae
9	7	O	Euphorbiaceae	Pausandra	trianae
12	15	O	Euphorbiaceae	Pausandra	trianae
1	2	P	Euphorbiaceae	Pausandra	trianae
12	2	P	Euphorbiaceae	Pausandra	trianae
1	3	P	Euphorbiaceae	Pausandra	trianae
1	15	P	Euphorbiaceae	Pausandra	trianae
11	2	P	Euphorbiaceae	Richeria	obovata
2	3	O	Euphorbiaceae	Sapium	glandulosum
1	11	O	Euphorbiaceae	Sapium	glandulosum
10	12	O	Euphorbiaceae	Sapium	glandulosum
7	2	S	Euphorbiaceae	Sapium	glandulosum
8	11	O	Euphorbiaceae	Tetrorchidium	euryphyllum
9	11	O	Euphorbiaceae	Tetrorchidium	euryphyllum
11	11	O	Euphorbiaceae	Tetrorchidium	euryphyllum
6	3	S	Euphorbiaceae	Tetrorchidium	euryphyllum
14	3	S	Euphorbiaceae	Tetrorchidium	euryphyllum
15	3	S	Euphorbiaceae	Tetrorchidium	euryphyllum
17	3	S	Euphorbiaceae	Tetrorchidium	euryphyllum
246	5	S	Euphorbiaceae	Tetrorchidium	euryphyllum
9	10	S	Euphorbiaceae	Tetrorchidium	euryphyllum
4	11	S	Euphorbiaceae	Tetrorchidium	euryphyllum
8	11	S	Euphorbiaceae	Tetrorchidium	euryphyllum
1	11	P	Fabaceae/Caes	Macrolobium	costaricense
1	1	O	Fabaceae/Pap	Lonchocarpus	oliganthus
14	2	O	Fabaceae/Pap	Lonchocarpus	oliganthus
2	11	O	Fabaceae/Pap	Lonchocarpus	oliganthus
14	15	O	Fabaceae/Pap	Lonchocarpus	oliganthus
1	4	P	Fabaceae/Pap	Lonchocarpus	oliganthus
3	6	P	Fabaceae/Pap	Lonchocarpus	oliganthus
3	7	P	Fabaceae/Pap	Lonchocarpus	oliganthus
7	7	P	Fabaceae/Pap	Lonchocarpus	oliganthus
14	7	P	Fabaceae/Pap	Lonchocarpus	oliganthus
7	9	P	Fabaceae/Pap	Lonchocarpus	oliganthus
10	9	P	Fabaceae/Pap	Lonchocarpus	oliganthus
1	10	P	Fabaceae/Pap	Lonchocarpus	oliganthus
3	10	P	Fabaceae/Pap	Lonchocarpus	oliganthus
10	10	P	Fabaceae/Pap	Lonchocarpus	oliganthus
4	3	S	Fabaceae/Pap	Lonchocarpus	oliganthus
7	3	S	Fabaceae/Pap	Lonchocarpus	oliganthus
16	3	S	Fabaceae/Pap	Lonchocarpus	oliganthus
8	6	S	Fabaceae/Pap	Lonchocarpus	oliganthus
9	6	S	Fabaceae/Pap	Lonchocarpus	oliganthus

12	1	O	Fabaceae/Pap	Lonchocarpus	pentaphyllus
12	10	O	Fabaceae/Pap	Lonchocarpus	pentaphyllus
9	8	P	Fabaceae/Pap	Lonchocarpus	pentaphyllus
4	8	O	Fabaceae/Caes	Senna	papillosa
5	8	O	Fabaceae/Caes	Senna	papillosa
1	9	O	Fabaceae/Mim	Acacia	ruddiae
8	9	P	Fabaceae/Mim	Inga	-cf densiflora
2	12	O	Fabaceae/Mim	Inga	leioalycina
7	13	P	Fabaceae/Mim	Inga	leioalycina
10	4	S	Fabaceae/Mim	Inga	leioalycina
6	1	O	Fabaceae/Mim	Inga	leonis
4	4	O	Fabaceae/Mim	Inga	leonis
11	15	O	Fabaceae/Mim	Inga	leonis
2	7	P	Fabaceae/Mim	Inga	leonis
6	8	P	Fabaceae/Mim	Inga	leonis
6	10	P	Fabaceae/Mim	Inga	leonis
9	11	P	Fabaceae/Mim	Inga	leonis
8	2	P	Fabaceae/Mim	Inga	punctata
5	11	P	Fabaceae/Mim	Inga	punctata
10	11	P	Fabaceae/Mim	Inga	punctata
9	3	P	Fabaceae/Mim	Inga	sp2
6	4	P	Fabaceae/Mim	Inga	sp3
1	6	P	Fabaceae/Mim	Inga	sp3
9	8	O	Fabaceae/Mim	Inga	sp4
15	15	O	Fabaceae/Mim	Inga	thibaudiana
10	4	P	Fabaceae/Pap	Dalbergia	tilarana
11	14	O	Fabaceae/Pap	Dussia	atropurpurea
1	12	P	Fabaceae/Pap	Dussia	atropurpurea
15	14	S	Fabaceae/Pap	Dussia	atropurpurea
15	10	O	Fabaceae/Pap.	Swartzia	simplex
9	1	O	Fabaceae/Papilionoideae	Pterocarpus	sp1
2	10	O	Fabaceae/Papilionoideae	Pterocarpus	sp1
6	12	O	Fabaceae/Papilionoideae	Pterocarpus	sp1
4	14	O	Fabaceae/Papilionoideae	Pterocarpus	sp1
13	15	O	Fabaceae/Papilionoideae	Pterocarpus	sp1
4	1	P	Fabaceae/Papilionoideae	Pterocarpus	sp1
4	3	P	Fabaceae/Papilionoideae	Pterocarpus	sp1
12	3	P	Fabaceae/Papilionoideae	Pterocarpus	sp1
3	4	P	Fabaceae/Papilionoideae	Pterocarpus	sp1
11	5	P	Fabaceae/Papilionoideae	Pterocarpus	sp1
4	6	P	Fabaceae/Papilionoideae	Pterocarpus	sp1
7	7	S	Fabaceae/Papilionoideae	Pterocarpus	sp1
8	15	S	Fabaceae/Papilionoideae	Pterocarpus	sp1

1	8	O	Flacourtiaceae	Casearia	arborea
9	4	P	Flacourtiaceae	Casearia	arborea
3	5	P	Flacourtiaceae	Casearia	arborea
1	8	P	Flacourtiaceae	Casearia	arborea
9	6	P	Flacourtiaceae	Casearia	sylvestris
13	12	P	Flacourtiaceae	Casearia	sylvestris
9	7	S	Flacourtiaceae	Casearia	sylvestris
2	6	S	Flacourtiaceae	Casearia	tacanensis
9	14	S	Flacourtiaceae	Casearia	tacanensis
7	11	P	Flacourtiaceae	Prockia	costaricensis
14	12	P	Flacourtiaceae	Prockia	costaricensis
17	7	O	Flacourtiaceae	Xylosma	-cf intermedia
5	2	S	Flacourtiaceae	Lacistema	aggregatum
11	13	S	Flacourtiaceae	Lozania	pittieri
10	11	O	Hypericaceae	Vismia	baccifera
2	9	O	Hypericaceae	Vismia	billbergiana
12	11	O	Hypericaceae	Vismia	billbergiana
8	7	S	Hypericaceae	Vismia	billbergiana
8	8	S	Hypericaceae	Vismia	billbergiana
10	1	P	Icacinaceae	Calatola	costaricensis
19	15	P	Juglandaceae	Oreomunnea	pterocarpa
6	14	S	Juglandaceae	Oreomunnea	pterocarpa
7	4	P	Lauracea	Cinnamomum	hammelianum
5	1	S	Lauracea	Cinnamomum	hammelianum
6	1	S	Lauracea	Cinnamomum	hammelianum
4	2	S	Lauracea	Cinnamomum	hammelianum
1	4	S	Lauracea	Cinnamomum	hammelianum
4	6	S	Lauracea	Cinnamomum	hammelianum
4	14	S	Lauracea	Cinnamomum	hammelianum
10	15	S	Lauracea	Cinnamomum	hammelianum
9	13	P	Lauracea	Ocotea	-cf brenesii
12	2	O	Lauraceae	Beilschmiedia	sp1
13	15	S	Lauraceae	Beilschmiedia	sp1
2	15	P	Lauraceae	Cryptocaria	sp
3	1	P	Lauraceae	Licaria	excelsa
5	5	P	Lauraceae	Licaria	excelsa
9	12	P	Lauraceae	Licaria	excelsa
11	8	O	Lauraceae	Ocotea	-cf brenesii
8	12	O	Lauraceae	Ocotea	-cf brenesii
17	15	P	Lauraceae	Ocotea	-cf brenesii
7	3	P	Lauraceae	Ocotea	insularis
6	7	O	Lauraceae	Ocotea	mollifolia
11	10	O	Lauraceae	Ocotea	mollifolia

14	12	O	Lauraceae	Ocotea	mollifolia
3	15	S	Lauraceae	Ocotea	mollifolia
3	10	O	Lauraceae	Ocotea	morae
9	1	P	Lauraceae	Ocotea	sp1
1	6	O	Lauraceae	Ocotea	sp2
14	6	O	Lauraceae	Ocotea	sp2
9	6	O	Lauraceae	Ocotea	sp3
12	3	S	Lauraceae	Ocotea	sp3
1	15	S	Lauraceae	Ocotea	sp3
23	6	O	Lauraceae	Ocotea	sp4
4	10	S	Lauraceae	Ocotea	sp4
5	14	S	Lauraceae	Ocotea	sp4
2	8	P	Lauraceae	Persea	schiedeana
8	13	S	Magnoliaceae	Talauma	gloriensis
8	4	P	Malpighiaceae	Bunchosia	macrophylla
7	8	O	Malvaceae	Hampea	appendiculata
10	8	O	Malvaceae	Hampea	appendiculata
5	9	O	Malvaceae	Hampea	appendiculata
10	9	O	Malvaceae	Hampea	appendiculata
11	9	O	Malvaceae	Hampea	appendiculata
12	9	O	Malvaceae	Hampea	appendiculata
13	9	O	Malvaceae	Hampea	appendiculata
6	10	O	Malvaceae	Hampea	appendiculata
1	12	O	Malvaceae	Hampea	appendiculata
9	12	O	Malvaceae	Hampea	appendiculata
13	12	O	Malvaceae	Hampea	appendiculata
12	13	O	Malvaceae	Hampea	appendiculata
6	14	O	Malvaceae	Hampea	appendiculata
7	14	O	Malvaceae	Hampea	appendiculata
5	10	P	Malvaceae	Hampea	appendiculata
15	13	P	Malvaceae	Hampea	appendiculata
1	7	S	Malvaceae	Hampea	appendiculata
7	9	S	Malvaceae	Hampea	appendiculata
3	10	S	Malvaceae	Hampea	appendiculata
10	10	S	Malvaceae	Hampea	appendiculata
1	11	S	Malvaceae	Hampea	appendiculata
2	11	S	Malvaceae	Hampea	appendiculata
3	11	S	Malvaceae	Hampea	appendiculata
7	11	S	Malvaceae	Hampea	appendiculata
15	12	O	Melastomataceae	Conostegia	micrantha
1	1	S	Melastomataceae	Conostegia	micrantha
7	10	P	Melastomataceae	Conostegia	sp1
8	3	P	Melastomataceae	Henriettea	tuberculosa

16	2	O	Melastomataceae	Miconia	smaragdina
1	2	O	Melastomataceae	Miconia	-cf punctata
3	4	O	Melastomataceae	Miconia	-cf punctata
2	6	O	Melastomataceae	Miconia	-cf punctata
11	6	O	Melastomataceae	Miconia	-cf punctata
6	8	O	Melastomataceae	Miconia	-cf punctata
13	8	O	Melastomataceae	Miconia	-cf punctata
3	9	O	Melastomataceae	Miconia	-cf punctata
7	9	O	Melastomataceae	Miconia	-cf punctata
8	9	O	Melastomataceae	Miconia	-cf punctata
7	10	O	Melastomataceae	Miconia	-cf punctata
13	10	O	Melastomataceae	Miconia	-cf punctata
3	11	O	Melastomataceae	Miconia	-cf punctata
3	12	O	Melastomataceae	Miconia	-cf punctata
4	12	O	Melastomataceae	Miconia	-cf punctata
8	15	P	Melastomataceae	Miconia	-cf punctata
20	15	P	Melastomataceae	Miconia	-cf punctata
2	1	S	Melastomataceae	Miconia	-cf punctata
3	1	S	Melastomataceae	Miconia	-cf punctata
4	1	S	Melastomataceae	Miconia	-cf punctata
8	1	S	Melastomataceae	Miconia	-cf punctata
9	1	S	Melastomataceae	Miconia	-cf punctata
10	1	S	Melastomataceae	Miconia	-cf punctata
12	1	S	Melastomataceae	Miconia	-cf punctata
13	1	S	Melastomataceae	Miconia	-cf punctata
1	2	S	Melastomataceae	Miconia	-cf punctata
1	10	S	Melastomataceae	Miconia	-cf punctata
9	12	S	Melastomataceae	Miconia	-cf punctata
11	14	S	Melastomataceae	Miconia	-cf punctata
15	15	S	Melastomataceae	Miconia	smaragdina
7	3	O	Melastomataceae	Miconia	smaragdina
9	3	O	Melastomataceae	Miconia	smaragdina
6	7	S	Melastomataceae	Miconia	smaragdina
11	7	S	Melastomataceae	Miconia	smaragdina
10	8	S	Melastomataceae	Miconia	smaragdina
6	11	S	Melastomataceae	Miconia	smaragdina
11	11	S	Melastomataceae	Miconia	smaragdina
1	12	S	Melastomataceae	Miconia	smaragdina
2	12	S	Melastomataceae	Miconia	smaragdina
4	12	S	Melastomataceae	Miconia	smaragdina
6	12	S	Melastomataceae	Miconia	smaragdina
7	12	S	Melastomataceae	Miconia	smaragdina
8	12	S	Melastomataceae	Miconia	smaragdina

10	12	S	Melastomataceae	Miconia	smaragdina
4	13	S	Melastomataceae	Miconia	smaragdina
16	15	O	Meliaceae	Cedrela	odorata
14	1	O	Meliaceae	Guarea	adenophylla
7	8	P	Meliaceae	Guarea	adenophylla
7	4	S	Meliaceae	Guarea	microcarpa
10	12	P	Meliaceae	Guarea	pterorhachis
2	4	S	Meliaceae	Guarea	rhopalocarpa
6	7	P	Meliaceae	Trichilia	adolphi
2	13	S	Meliaceae	Trichilia	adolphi
6	4	S	Monimiaceae	Mollinedia	costaricensis
11	4	S	Monimiaceae	Mollinedia	costaricensis
16	14	S	Monimiaceae	Mollinedia	costaricensis
9	4	O	Moraceae	Brosimum	guianense
8	4	O	Moraceae	Ficus	brevibracteata
7	2	O	Moraceae	Ficus	glaucescens
7	5	P	Moraceae	Ficus	hartwegii
10	2	O	Moraceae	Ficus	cervantesiana
2	7	O	Moraceae	Ficus	cervantesiana
14	15	S	Moraceae	Pseudolmedia	mollis
15	4	O	Moraceae	Pseudolmedia	spuria
17	6	O	Moraceae	Pseudolmedia	spuria
8	7	O	Myristicaceae	Otoba	novogranatensis
2	15	O	Myristicaceae	Otoba	novogranatensis
2	1	P	Myristicaceae	Otoba	novogranatensis
6	5	P	Myristicaceae	Otoba	novogranatensis
8	13	P	Myristicaceae	Otoba	novogranatensis
7	1	O	Myristicaceae	Virola	koschnyi
5	14	O	Myristicaceae	Virola	koschnyi
4	4	P	Myristicaceae	Virola	koschnyi
10	5	P	Myristicaceae	Virola	koschnyi
12	4	S	Myristicaceae	Virola	koschnyi
1	8	S	Myristicaceae	Virola	koschnyi
5	9	S	Myristicaceae	Virola	koschnyi
7	13	S	Myristicaceae	Virola	sebifera
7	4	O	Myrsinaceae	Ardisia	capitellata
7	14	P	Myrsinaceae	Ardisia	capitellata
14	14	S	Myrsinaceae	Ardisia	capitellata
14	1	S	Myrsinaceae	Parathesis	trychogyne
6	2	P	Myrtaceae	Eugenia	austin-smithii
16	15	P	Myrtaceae	Eugenia	austin-smithii
8	14	O	Myrtaceae	Plinia	sp1
5	11	S	Myrtaceae	Psidium	guajava

2	4	O	Oleaceae	Chionanthus	panamensis
8	10	O	Piperaceae	Piper	barbulatum
3	2	S	Piperaceae	Piper	barbulatum
8	14	P	Polygonaceae	Coccoloba	sp1
9	5	P	Polygonaceae	Coccoloba	tuerckheimii
5	12	S	Polygonaceae	Coccoloba	tuerckheimii
13	3	O	Proteaceae	Roupala	glaberrima
5	1	O	Rhamnaceae	Colubrina	spinosa
6	3	O	Rhamnaceae	Colubrina	spinosa
2	14	O	Rhamnaceae	Colubrina	spinosa
12	14	O	Rhamnaceae	Colubrina	spinosa
1	15	O	Rhamnaceae	Colubrina	spinosa
3	15	O	Rhamnaceae	Colubrina	spinosa
5	15	O	Rhamnaceae	Colubrina	spinosa
1	7	P	Rhamnaceae	Colubrina	spinosa
2	9	P	Rhamnaceae	Colubrina	spinosa
6	2	S	Rhamnaceae	Colubrina	spinosa
10	2	S	Rhamnaceae	Colubrina	spinosa
2	3	S	Rhamnaceae	Colubrina	spinosa
3	3	S	Rhamnaceae	Colubrina	spinosa
5	3	S	Rhamnaceae	Colubrina	spinosa
8	3	S	Rhamnaceae	Colubrina	spinosa
11	3	S	Rhamnaceae	Colubrina	spinosa
13	3	S	Rhamnaceae	Colubrina	spinosa
3	4	S	Rhamnaceae	Colubrina	spinosa
4	4	S	Rhamnaceae	Colubrina	spinosa
1	6	S	Rhamnaceae	Colubrina	spinosa
6	6	S	Rhamnaceae	Colubrina	spinosa
7	6	S	Rhamnaceae	Colubrina	spinosa
14	6	S	Rhamnaceae	Colubrina	spinosa
10	7	S	Rhamnaceae	Colubrina	spinosa
4	8	S	Rhamnaceae	Colubrina	spinosa
5	8	S	Rhamnaceae	Colubrina	spinosa
6	8	S	Rhamnaceae	Colubrina	spinosa
7	8	S	Rhamnaceae	Colubrina	spinosa
1	9	S	Rhamnaceae	Colubrina	spinosa
2	9	S	Rhamnaceae	Colubrina	spinosa
6	9	S	Rhamnaceae	Colubrina	spinosa
8	9	S	Rhamnaceae	Colubrina	spinosa
3	12	S	Rhamnaceae	Colubrina	spinosa
6	15	S	Rhamnaceae	Colubrina	spinosa
12	4	O	Rubiaceae	Alseis	-cf costaricensis
3	13	P	Rubiaceae	Alseis	-cf costaricensis

15	6	O	Rubiaceae	Arachnothryx	costaricensis
3	7	O	Rubiaceae	Arachnothryx	costaricensis
4	7	O	Rubiaceae	Arachnothryx	costaricensis
8	11	P	Rubiaceae	Arachnothryx	costaricensis
4	12	P	Rubiaceae	Arachnothryx	costaricensis
3	14	P	Rubiaceae	Arachnothryx	costaricensis
10	14	S	Rubiaceae	Arachnothryx	costaricensis
10	1	O	Rubiaceae	Chimarrhis	parviflora
2	4	P	Rubiaceae	Chimarrhis	parviflora
1	5	P	Rubiaceae	Chimarrhis	parviflora
2	6	P	Rubiaceae	Chimarrhis	parviflora
12	7	P	Rubiaceae	Chimarrhis	parviflora
9	9	P	Rubiaceae	Chimarrhis	parviflora
2	10	P	Rubiaceae	Chimarrhis	parviflora
9	10	P	Rubiaceae	Chimarrhis	parviflora
5	7	S	Rubiaceae	Chimarrhis	parviflora
3	13	S	Rubiaceae	Chimarrhis	parviflora
1	14	S	Rubiaceae	Chimarrhis	parviflora
3	14	O	Rubiaceae	Chione	venosa
11	12	O	Rubiaceae	Chomelia	venulosa
4	15	P	Rubiaceae	Chomelia	venulosa
12	13	S	Rubiaceae	Cinchona	pubescens
14	4	O	Rubiaceae	Faramea	sp1
11	7	P	Rubiaceae	Faramea	sp1
11	9	P	Rubiaceae	Guettarda	turrialbana
13	13	P	Rubiaceae	Guettarda	turrialbana
2	14	P	Rubiaceae	Guettarda	turrialbana
1	13	S	Rubiaceae	Guettarda	turrialbana
4	15	O	Rubiaceae	Pentagonia	costaricensis
11	1	P	Rubiaceae	Pentagonia	costaricensis
8	6	P	Rubiaceae	Pentagonia	costaricensis
5	8	P	Rubiaceae	Pentagonia	costaricensis
6	9	P	Rubiaceae	Pentagonia	costaricensis
10	13	P	Rubiaceae	Pentagonia	costaricensis
11	14	P	Rubiaceae	Pentagonia	costaricensis
5	3	O	Rubiaceae	Psychotria	berteroana
7	7	O	Rubiaceae	Psychotria	beachiana
1	1	P	Rubiaceae	Psychotria	beachiana
2	11	P	Rubiaceae	Psychotria	beachiana
24	6	O	Rubiaceae	Psychotria	eurycarpa
11	7	O	Rutaceae	Galipea	dasysperma
3	2	P	Rutaceae	Galipea	dasysperma
11	3	P	Rutaceae	Galipea	dasysperma

4	10	P	Sabiaceae	Meliosma	glabrata
7	2	P	Sapindaceae	Allophylus	psilospermus
2	5	P	Sapindaceae	Allophylus	psilospermus
6	13	S	Sapindaceae	Allophylus	psilospermus
9	2	P	Sapindaceae	Cupania	cubensis
14	2	P	Sapindaceae	Cupania	cubensis
20	6	O	Sapotaceae	Chrysophyllum	brenesii
8	4	S	Sapotaceae	Chrysophyllum	brenesii
13	14	S	Sapotaceae	Chrysophyllum	brenesii
16	7	O	Sapotaceae	Pouteria	congestifolia
2	1	O	Sapotaceae	Pouteria	sp1
1	7	O	Sapotaceae	Pouteria	sp1
12	12	O	Sapotaceae	Pouteria	sp1
3	3	P	Sapotaceae	Pouteria	sp1
13	7	P	Sapotaceae	Pouteria	sp1
12	13	P	Sapotaceae	Pouteria	sp1
16	13	P	Sapotaceae	Pouteria	sp1
9	14	P	Sapotaceae	Pouteria	sp2
10	14	P	Sapotaceae	Pouteria	sp2
4	14	P	Sapotaceae	Pouteria	sp3
14	3	O	Sapotaceae	Pouteria	sp4
10	4	O	Sapotaceae	Pouteria	torta
6	13	P	Staphyleaceae	Turpinia	occidentalis
14	10	O	Tiliaceae	Apeiba	membranacea
9	14	O	Tiliaceae	Apeiba	membranacea
5	6	P	Tiliaceae	Apeiba	membranacea
12	8	O	Tiliaceae	Heliocarpus	appendiculatus
2	13	O	Tiliaceae	Heliocarpus	appendiculatus
5	10	S	Tiliaceae	Heliocarpus	appendiculatus
8	5	P	Tiliaceae	Mortoniiodendron	anisophyllum
4	3	O	Tiliaceae	Trichospermum	grewiifolium
6	5	O	Tiliaceae	Trichospermum	grewiifolium
3	1	O	Violaceae	Rinorea	deflexiflora
5	6	O	Violaceae	Rinorea	deflexiflora
13	6	O	Violaceae	Rinorea	deflexiflora
14	7	O	Violaceae	Rinorea	deflexiflora
4	13	P	Violaceae	Rinorea	deflexiflora
11	13	P	Violaceae	Rinorea	deflexiflora
5	2	O		DEAD!	
19	6	O		DEAD!	
21	6	O		DEAD!	
2	8	O		DEAD!	
10	15	O		DEAD!	

17	15	O		DEAD!	
1	9	P		DEAD!	
5	9	P		DEAD!	
6	11	P		DEAD!	
2	12	P		DEAD!	
6	12	P		DEAD!	
10	13	S		DEAD!	

Appendix 2: Table of Species Attributes

Habitat	Family	Genus	Species	Timber	Ecological Guild	Endemic	Conservation Status
P HABITAT							
P	Rubiaceae	Psychotria	cf eurycarpa	0	Heliophyte durable	0	No
P	Myristicaceae	Otoba	novogranatensis	1	Heliophyte durable	0	No
P	Chrysobalanaceae	Licania	sparsipilis	0	Esciofitas	0	No
P	Fabaceae/Papilionoideae	Pterocarpus	sp1	1	Heliophyte durable	1	No
P	Boraginaceae	Cordia	cymosa	0	Heliophyte durable	0	No
P	Anacardiaceae	Tapirira	mexicana	1	Heliophyte durable	0	No
P	Annonaceae	Xylopia	bocatorena	0	Heliophyte durable	0	No
P	Boraginaceae	Cordia	porcata	0	Heliophyte ephemeral	0	No
P	Lauraceae	Ocotea	insularis	1	Heliophyte durable	0	No
P	Icacinaceae	Calatola	costaricensis	1	Heliophyte durable	0	No
P	Rubiaceae	Pentagonia	costaricensis	0	Esciofitas	0	No
P	Bombacaceae	Quararibea	costaricensis	1	Heliophyte durable	1	No
P	Euphorbiaceae	Pausandra	trianae	0	Esciofitas	0	No
P	Cecropiaceae	Pourouma	bicolor	1	Heliophyte durable	0	No
P	Rutaceae	Galipea	dasysperma	0	Esciofitas	0	No
P	Clusiaceae	Garcinia	intermedia	0	Esciofitas	0	No
P	Arecaceae	Iriartea	deltoidea	0	Esciofitas	0	No
P	Myrtaceae	Eugenia	austin-smithii	0	Esciofitas	0	No
P	Sapindaceae	Allophylus	psilospermus	0	Heliophyte ephemeral	0	No
P	Fabaceae/Mim	Inga	cf punctata	0	Heliophyte ephemeral	0	No
P	Sapindaceae	Cupania	cupensis	0	Heliophyte durable	0	No
P	Clusiaceae	Calophyllum	brasiliense	1	Heliophyte durable	0	No
P	Euphorbiaceae	Richeria	obovata	0	Heliophyte durable	0	No
P	Euphorbiaceae	Pausandra	trianae	0	Esciofitas	0	No
P	Euphorbiaceae	Margaritaria	nobilis	0	Heliophyte ephemeral	0	No
P	Sapindaceae	Cupania	cupensis	0	Heliophyte durable	0	No
P	Chrysobalanaceae	Hirtella	triandra	0	Esciofitas	0	No
P	Euphorbiaceae	Pausandra	trianae	0	Esciofitas	0	No
P	Bombacaceae	Pachira	aquatica	1	Heliophyte durable	0	No

P	Sapotaceae	Pouteria	sp1	0	Esciofitas	0	No
P	Fabaceae/Papilionoideae	Pterocarpus	sp1	1	Heliophyte durable	1	No
P	Arecaceae	Iriartea	deltoidea	0	Esciofitas	0	No
P	Arecaceae	Iriartea	deltoidea	0	Esciofitas	0	No
P	Lauraceae	Ocotea	insularis	1	Heliophyte durable	0	No
P	Melastomataceae	Henriettea	tuberculosa	0	Esciofitas	0	No
P	Fabaceae/Mim	Inga	sp2	0	Heliophyte durable	0	No
P	Araliaceae	Dendropanax	arboreus	1	Heliophyte durable	0	No
P	Rutaceae	Galipea	dasysperma	0	Esciofitas	0	No
P	Fabaceae/Papilionoideae	Pterocarpus	sp1	1	Heliophyte durable	1	No
P	Arecaceae	Iriartea	deltoidea	0	Esciofitas	0	No
P	Cecropiaceae	Pourouma	bicolor	1	Heliophyte durable	0	No
P	Arecaceae	Iriartea	deltoidea	0	Esciofitas	0	No
P	Fabaceae/Pap	Lonchocarpus	oliganthus	1	Heliophyte durable	0	No
P	Rubiaceae	Chimarrhis	parviflora	1	Heliophyte durable	0	No
P	Fabaceae/Papilionoideae	Pterocarpus	sp1	1	Heliophyte durable	1	No
P	Myristicaceae	Virola	koschnyi	1	Heliophyte durable	0	No
P	Arecaceae	Iriartea	deltoidea	0	Esciofitas	0	No
P	Fabaceae/Mim	Inga	sp3	0	Heliophyte durable	0	No
P	Lauracea	Cinnamomum	cf neurophyllum	1	Heliophyte durable	0	No
P	Malpighiaceae	Bunchosia	macrophylla	0	Heliophyte durable	0	No
P	Flacourtiaceae	Casearia	arborea	0	Heliophyte ephemeral	0	No
P	Fabaceae/Pap	Dalbergia	tilarana	1	Heliophyte durable	0	No
P	Rubiaceae	Chimarrhis	parviflora	1	Heliophyte durable	0	No
P	Sapindaceae	Allophylus	psilospermus	0	Heliophyte ephemeral	0	No
P	Flacourtiaceae	Casearia	arborea	0	Heliophyte ephemeral	0	No
P	Clethraceae	Clethra	cf costaricensis	0	Heliophyte durable	0	No
P	Chrysobalanaceae	Licania	sparsipilis	0	Esciofitas	0	No
P	Myristicaceae	Otoba	novogranatensis	1	Heliophyte durable	0	No
P	Moraceae	Ficus	hartwegii	0	Heliophyte durable	0	No
P	Tiliaceae	Mortonioidendron	anisophyllum	1	Heliophyte durable	0	No
P	Polygonaceae	Coccoloba	tuerckheimii	0	Heliophyte durable	0	No
P	Myristicaceae	Virola	koschnyi	1	Heliophyte durable	0	No
P	Fabaceae/Papilionoideae	Pterocarpus	sp1	1	Heliophyte durable	1	No
P	Fabaceae/Mim	Inga	sp3	0	Heliophyte durable	0	No
P	Rubiaceae	Chimarrhis	parviflora	1	Heliophyte	0	No

					durable		
P	Fabaceae/Pap	Lonchocarpus	oliganthus	1	Heliophyte durable	0	No
P	Fabaceae/Papilionoideae	Pterocarpus	sp1	1	Heliophyte durable	1	No
P	Tiliaceae	Apeiba	membranacea	1	Heliophyte durable	0	No
P	Arecaceae	Iriartea	deltoidea	0	Esciofitas	0	No
P	Euphorbiaceae	Adelia	triloba	0	Heliophyte ephemeral	0	No
P	Rubiaceae	Pentagonia	costaricensis	0	Esciofitas	0	No
P	Flacourtiaceae	Casearia	sylvestris	0	Heliophyte ephemeral	0	No
P	Rhamnaceae	Colubrina	spinosa	0	Heliophyte ephemeral	0	No
P	Fabaceae/Mim	Inga	leonis	0	Heliophyte durable	0	No
P	Fabaceae/Pap	Lonchocarpus	oliganthus	1	Heliophyte durable	0	No
P	Euphorbiaceae	Croton	megistocarpus	0	Heliophyte durable	1	No
P	Euphorbiaceae	Croton	schiedeanus	0	Heliophyte ephemeral	0	No
P	Meliaceae	Trichilia	adolphi	0	Heliophyte durable	0	No
P	Fabaceae/Pap	Lonchocarpus	oliganthus	1	Heliophyte durable	0	No
P	Cecropiaceae	Cecropia	insignis	0	Heliophyte ephemeral	0	No
P	Bombacaceae	Pachira	aquatica	1	Heliophyte durable	0	No
P	Boraginaceae	Cordia	porcata	0	Heliophyte ephemeral	0	No
P	Rubiaceae	Faramea	sp1	0	Esciofitas	0	No
P	Rubiaceae	Chimarrhis	parviflora	1	Heliophyte durable	0	No
P	Sapotaceae	Pouteria	sp1	0	Esciofitas	0	No
P	Fabaceae/Pap	Lonchocarpus	oliganthus	1	Heliophyte durable	0	No
P	Arecaceae	Iriartea	deltoidea	0	Esciofitas	0	No
P	Cecropiaceae	Pourouma	bicolor	1	Heliophyte durable	0	No
P	Euphorbiaceae	Croton	schiedeanus	0	Heliophyte ephemeral	0	No
P	Flacourtiaceae	Casearia	arborea	0	Heliophyte ephemeral	0	No
P	Lauraceae	Persea	schiedeana	1	Heliophyte durable	0	No
P	Bombacaceae	Quararibea	costaricensis	1	Heliophyte durable	1	No
P	Euphorbiaceae	Croton	schiedeanus	0	Heliophyte ephemeral	0	No
P	Rubiaceae	Pentagonia	costaricensis	0	Esciofitas	0	No
P	Fabaceae/Mim	Inga	leonis	0	Heliophyte durable	0	No
P	Meliaceae	Guarea	adenophylla	1	Heliophyte durable	0	No
P	Arecaceae	Iriartea	deltoidea	0	Esciofitas	0	No
P	Fabaceae/Pap	Lonchocarpus	pentaphyllus	1	Heliophyte durable	0	No
P	Bombacaceae	Quararibea	costaricensis	1	Heliophyte durable	1	No

P		DEAD!					
P	Rhamnaceae	Colubrina	spinosa	0	Heliophyte ephemeral	0	No
P	Caricaceae	Jacaratia	spinosa	0	Heliophyte ephemeral	0	No
P	Bombacaceae	Quararibea	costaricensis	1	Heliophyte durable	1	No
P		DEAD!					
P	Rubiaceae	Pentagonia	costaricensis	0	Esciofitas	0	No
P	Fabaceae/Pap	Lonchocarpus	oliganthus	1	Heliophyte durable	0	No
P	Fabaceae/Mim	Inga	densiflora	0	Heliophyte durable	0	No
P	Rubiaceae	Chimarrhis	parviflora	1	Heliophyte durable	0	No
P	Fabaceae/Pap	Lonchocarpus	oliganthus	1	Heliophyte durable	0	No
P	Rubiaceae	Guettarda	turrialbana	1	Heliophyte durable	0	No
P	Fabaceae/Pap	Lonchocarpus	oliganthus	1	Heliophyte durable	0	No
P	Rubiaceae	Chimarrhis	parviflora	1	Heliophyte durable	0	No
P	Fabaceae/Pap	Lonchocarpus	oliganthus	1	Heliophyte durable	0	No
P	Sabiaceae	Meliosma	glabrata	0	Esciofitas	0	No
P	Malvaceae	Hampea	appendiculata	1	Heliophyte ephemeral	0	No
P	Fabaceae/Mim	Inga	leonis	0	Heliophyte durable	0	No
P	Melastomataceae	Conostegia	sp1	0	Heliophyte durable	0	No
P	Euphorbiaceae	Croton	schiedeanus	0	Heliophyte ephemeral	0	No
P	Rubiaceae	Chimarrhis	parviflora	1	Heliophyte durable	0	No
P	Fabaceae/Pap	Lonchocarpus	oliganthus	1	Heliophyte durable	0	No
P	Fabaceae/Caes	Macrolobium	costaricense	0	Heliophyte durable	0	No
P	Rubiaceae	Psychotria	cf eurycarpa	0	Heliophyte ephemeral	0	No
P	Euphorbiaceae	Croton	schiedeanus	0	Heliophyte ephemeral	0	No
P	Euphorbiaceae	Adelia	triloba	0	Heliophyte ephemeral	0	No
P	Fabaceae/Mim	Inga	cf punctata	0	Heliophyte durable	0	No
P		DEAD!					
P		Prockia	cf costaricensis	0	Heliophyte ephemeral	1	No
P	Rubiaceae	Arachnothrynx	costaricensis	0	Heliophyte ephemeral	1	No
P	Fabaceae/Mim	Inga	leonis	0	Heliophyte durable	0	No
P	Fabaceae/Mim	Inga	cf punctata	0	Heliophyte durable	0	No
P	Fabaceae/Pap	Dussia	atropurpurea	1	Heliophyte durable	0	No
P		DEAD!					
P	Euphorbiaceae	Alchornea	latifolia	1	Heliophyte durable	0	No
P	Rubiaceae	Arachnothrynx	costaricensis	0	Heliophyte ephemeral	1	No

P	Boraginaceae	Cordia	cymosa	0	Heliophyte durable	0	No
P		DEAD!					
P	Bombacaceae	Quararibea	costaricensis	1	Heliophyte durable	1	No
P	Euphorbiaceae	Adelia	triloba	0	Heliophyte ephemeral	0	No
P	Chrysobalanaceae	Licania	sparsipilis	0	Esciofitas	0	No
P	Meliaceae	Guarea	pterorhachis	1	Heliophyte durable	0	No
P	Annonaceae	Xylopia	bocatorena	0	Heliophyte durable	0	No
P	Araliaceae	Dendropanax	arboreus	1	Heliophyte durable	0	No
P	Flacourtiaceae	Casearia	sylvestris	0	Heliophyte ephemeral	0	No
P	Flacourtiaceae	Prockia	cf costaricensis	0	Heliophyte ephemeral	1	No
P	Euphorbiaceae	Drypetes	brownii	0	Heliophyte durable	0	No
P	Bombacaceae	Quararibea	costaricensis	1	Heliophyte durable	1	No
P	Rubiaceae	Alseis	costaricensis	0	Esciofitas	0	No
P	Violaceae	Rinorea	deflexiflora	0	Heliophyte durable	0	No
P	Euphorbiaceae	Drypetes	brownii	0	Heliophyte durable	0	No
P	Staphyleaceae	Turpinia	occidentalis	0	Heliophyte ephemeral	0	No
P	Fabaceae/Mim	Inga	leiocalycina	1	Heliophyte durable	0	No
P	Myristicaceae	Otoba	novogranatensis	1	Heliophyte durable	0	No
P	Lauracea	Ocotea	brenesii	1	Heliophyte durable	0	No
P	Rubiaceae	Pentagonia	costaricensis	0	Esciofitas	0	No
P	Violaceae	Rinorea	deflexiflora	0	Heliophyte durable	0	No
P	Sapotaceae	Pouteria	sp1	0	Esciofitas	0	No
P	Rubiaceae	Guettarda	turrialbana	1	Heliophyte durable	0	No
P	Euphorbiaceae	Drypetes	brownii	0	Heliophyte durable	0	No
P	Malvaceae	Hampea	appendiculata	1	Heliophyte ephemeral	0	No
P	Sapotaceae	Pouteria	sp1	0	Esciofitas	0	No
P	Arecaceae	Iriartea	deltoidea	0	Esciofitas	0	No
P	Rubiaceae	Guettarda	turrialbana	1	Heliophyte durable	0	No
P	Rubiaceae	Arachnothrynx	costaricensis	0	Heliophyte ephemeral	1	No
P	Sapotaceae	Pouteria	sp3	0	Esciofitas	0	No
P	Arecaceae	Iriartea	deltoidea	0	Esciofitas	0	No
P	Clusiaceae	Calophyllum	brasiliense	1	Heliophyte durable	0	No
P	Myrsinaceae	Ardisia	capitellata	0	Esciofitas	1	No
P	Polygonaceae	Coccoloba	sp1	0	Esciofitas	0	No
P	Sapotaceae	Pouteria	sp2	0	Esciofitas	0	No
P	Sapotaceae	Pouteria	sp2	0	Esciofitas	0	No

P	Rubiaceae	Pentagonia	costaricensis	0	Esciofitas	0	No
P	Euphorbiaceae	Pausandra	trianae	0	Esciofitas	0	No
P	Celastraceae	Clethra	cf costaricensis	0	Heliophyte durable	0	No
P	Euphorbiaceae	Gymnathes	riparia	0	Heliophyte durable	0	No
P	Rubiaceae	Chomelia	venulosa	0	Heliophyte durable	0	No
P	Bombacaceae	Pachira	aquatica	1	Heliophyte durable	0	No
P	Clusiaceae	Garcinia	intermedia	0	Esciofitas	0	No
P	Arecaceae	Euterpe	precatória	0	Esciofitas	0	No
P	Melastomataceae	Miconia	punctata	0	Heliophyte ephemeral	0	No
P	Arecaceae	Euterpe	precatória	0	Esciofitas	0	No
P	Arecaceae	Euterpe	precatória	0	Esciofitas	0	No
P	Euphorbiaceae	Gymnathes	riparia	0	Heliophyte durable	0	No
P	Anacardiaceae	Tapirira	mexicana	1	Heliophyte durable	0	No
P	Arecaceae	Euterpe	precatória	0	Esciofitas	0	No
P	Arecaceae	Euterpe	precatória	0	Esciofitas	0	No
P	Chrysobalanaceae	Licania	sparsipilis	0	Esciofitas	0	No
P	Myrtaceae	Eugenia	austin-smithii	0	Esciofitas	0	No
P	Chrysobalanaceae	Licania	sparsipilis	0	Esciofitas	0	No
P	Arecaceae	Euterpe	precatória	0	Esciofitas	0	No
P	Juglandaceae	Oreomunnea	pterocarpa	1	Heliophyte durable		EN
P	Melastomataceae	Miconia	punctata	0	Heliophyte ephemeral	0	No
S HABITAT							
S	Asteraceae	Koanophyllon	hylonoma	0	Heliophyte ephemeral	0	No
S	Cecropiaceae	Cecropia	obtusifolia	0	Heliophyte ephemeral	0	No
S	Euphorbiaceae	Tetrorchidium	euryphyllum	0	Heliophyte ephemeral	0	No
S	Asteraceae	Koanophyllon	hylonoma	0	Heliophyte ephemeral	0	No
S	Clethraceae	Clethra	cf costaricensis	0	Heliophyte durable	0	No
S	Chloranthaceae	Hedyosmum	bonplandianum	0	Heliophyte ephemeral	0	No
S	Chloranthaceae	Hedyosmum	bonplandianum	0	Heliophyte ephemeral	0	No
S	Chloranthaceae	Hedyosmum	bonplandianum	0	Heliophyte ephemeral	0	No
S	Chloranthaceae	Hedyosmum	bonplandianum	0	Heliophyte ephemeral	0	No
S	Cecropiaceae	Cecropia	insignis	0	Heliophyte ephemeral	0	No
S	Chloranthaceae	Hedyosmum	bonplandianum	0	Heliophyte ephemeral	0	No
S	Cecropiaceae	Cecropia	insignis	0	Heliophyte ephemeral	0	No
S	Chloranthaceae	Hedyosmum	bonplandianum	0	Heliophyte ephemeral	0	No
S	Cecropiaceae	Cecropia	insignis	0	Heliophyte ephemeral	0	No

S	Clethraceae	Clethra	cf costaricensis	0	Heliophyte durable	0	No
S	Melastomataceae	Conostegia	cf micrantha	0	Heliophyte ephemeral	0	No
S	Melastomataceae	Miconia	punctata	0	Heliophyte ephemeral	0	No
S	Melastomataceae	Miconia	punctata	0	Heliophyte ephemeral	0	No
S	Melastomataceae	Miconia	punctata	0	Heliophyte ephemeral	0	No
S	Lauracea	Cinnamomum	hammelianum	1	Heliophyte durable	0	No
S	Lauracea	Cinnamomum	hammelianum	1	Heliophyte durable	0	No
S	Asteraceae	Koanophyllon	hylonoma	0	Heliophyte ephemeral	0	No
S	Melastomataceae	Miconia	punctata	0	Heliophyte ephemeral	0	No
S	Melastomataceae	Miconia	punctata	0	Heliophyte ephemeral	0	No
S	Melastomataceae	Miconia	punctata	0	Heliophyte ephemeral	0	No
S	Asteraceae	Koanophyllon	hylonoma	0	Heliophyte ephemeral	0	No
S	Melastomataceae	Miconia	punctata	0	Heliophyte ephemeral	0	No
S	Melastomataceae	Miconia	punctata	0	Heliophyte ephemeral	0	No
S	Myrsinaceae	Parathesis	trychogyne	0	Esciofitas	0	No
S	Melastomataceae	Miconia	punctata	0	Heliophyte ephemeral	0	No
S	Asteraceae	Koanophyllon	hylonoma	0	Heliophyte ephemeral	0	No
S	Piperaceae	Piper	barbulatum	0	Heliophyte ephemeral	0	No
S	Lauracea	Cinnamomum	hammelianum	1	Heliophyte durable	0	No
S	Flacoutiaceae	Lacistema	aggregatum	0	Heliophyte ephemeral	0	No
S	Rhamnaceae	Colubrina	spinosa	0	Heliophyte ephemeral	0	No
S	Euphorbiaceae	Sapium	glandulosum	0	Heliophyte durable	0	No
S	Anacardiaceae	Tapirira	mexicana	1	Heliophyte durable	0	No
S	Cecropiaceae	Cecropia	insignis	0	Heliophyte ephemeral	0	No
S	Rhamnaceae	Colubrina	spinosa	0	Heliophyte ephemeral	0	No
S	Cecropiaceae	Cecropia	insignis	0	Heliophyte ephemeral	0	No
S	Rhamnaceae	Colubrina	spinosa	0	Heliophyte ephemeral	0	No
S	Rhamnaceae	Colubrina	spinosa	0	Heliophyte ephemeral	0	No
S	Fabaceae/Pap	Lonchocarpus	oliganthus	1	Heliophyte durable	0	No
S	Rhamnaceae	Colubrina	spinosa	0	Heliophyte ephemeral	0	No
S	Euphorbiaceae	Tetrorchidium	euryphyllum	0	Heliophyte ephemeral	0	No
S	Fabaceae/Pap	Lonchocarpus	oliganthus	1	Heliophyte durable	0	No
S	Rhamnaceae	Colubrina	spinosa	0	Heliophyte ephemeral	0	No
S	Cecropiaceae	Cecropia	insignis	0	Heliophyte ephemeral	0	No

S	Cecropiaceae	Cecropia	insignis	0	Heliophyte ephemeral	0	No
S	Rhamnaceae	Colubrina	spinosa	0	Heliophyte ephemeral	0	No
S	Lauraceae	Ocotea	sp3	1	Heliophyte durable	0	No
S	Rhamnaceae	Colubrina	spinosa	0	Heliophyte ephemeral	0	No
S	Euphorbiaceae	Tetrorchidium	euryphyllum	0	Heliophyte ephemeral	0	No
S	Euphorbiaceae	Tetrorchidium	euryphyllum	0	Heliophyte ephemeral	0	No
S	Fabaceae/Pap	Lonchocarpus	oliganthus	1	Heliophyte durable	0	No
S	Euphorbiaceae	Tetrorchidium	euryphyllum	0	Heliophyte ephemeral	0	No
S	Lauracea	Cinnamomum	hammelianum	1	Heliophyte durable	0	No
S	Meliaceae	Guarea	rhopalocarpa	1	Heliophyte durable	0	No
S	Rhamnaceae	Colubrina	spinosa	0	Heliophyte ephemeral	0	No
S	Rhamnaceae	Colubrina	spinosa	0	Heliophyte ephemeral	0	No
S	Euphorbiaceae	Croton	schiedeanus	0	Heliophyte ephemeral	0	No
S	Monimiaceae	Mollinedia	costaricensis	0	Heliophyte durable	0	No
S	Meliaceae	Guarea	microcarpa	1	Heliophyte durable	0	No
S	Sapotaceae	Chrysophyllum	brenesii	0	Esciofitas	0	No
S	Chloranthaceae	Hedyosmum	bonplandianum	0	Heliophyte ephemeral	0	No
S	Fabaceae/Mim	Inga	leiocalycina	1	Heliophyte durable	0	No
S	Monimiaceae	Mollinedia	costaricensis	0	Heliophyte durable	0	No
S	Myristicaceae	Virola	koschnyi	1	Heliophyte durable	0	No
S	Burseraceae	Protium	sp1	0	Esciofitas	0	No
S	Rhamnaceae	Colubrina	spinosa	0	Heliophyte ephemeral	0	No
S	Flacoutiaceae	Casearia	tacanensis	0	Heliophyte ephemeral	0	No
S	Clethraceae	Clethra	cf costaricensis	0	Heliophyte durable	0	No
S	Lauracea	Cinnamomum	hammelianum	1	Heliophyte durable	0	No
S	Cecropiaceae	Cecropia	insignis	0	Heliophyte ephemeral	0	No
S	Rhamnaceae	Colubrina	spinosa	0	Heliophyte ephemeral	0	No
S	Rhamnaceae	Colubrina	spinosa	0	Heliophyte ephemeral	0	No
S	Fabaceae/Pap	Lonchocarpus	oliganthus	1	Heliophyte durable	0	No
S	Fabaceae/Pap	Lonchocarpus	oliganthus	1	Heliophyte durable	0	No
S	Arecaceae	Euturpe	precatória	0	Esciofitas	0	No
S	Arecaceae	Euturpe	precatória	0	Esciofitas	0	No
S	Arecaceae	Euturpe	precatória	0	Esciofitas	0	No
S	Cecropiaceae	Cecropia	insignis	0	Heliophyte ephemeral	0	No
S	Rhamnaceae	Colubrina	spinosa	0	Heliophyte ephemeral	0	No

S	Malvaceae	Hampea	appendiculata	1	Heliophyte ephemeral	0	No
S	Chloranthaceae	Hedyosmum	bonplandianum	0	Heliophyte ephemeral	0	No
S	Chloranthaceae	Hedyosmum	bonplandianum	0	Heliophyte ephemeral	0	No
S	Chloranthaceae	Hedyosmum	bonplandianum	0	Heliophyte ephemeral	0	No
S	Rubiaceae	Chimarrhis	parviflora	1	Heliophyte durable	0	No
S	Melastomataceae	Miconia	smaragdina	0	Heliophyte ephemeral	0	No
S	Fabaceae/Papilion oideae	Pterocarpus	sp1	1	Heliophyte durable	1	No
S	Hypericaceae	Vismia	billbergiana	0	Heliophyte ephemeral	0	No
S	Flacoutiaceae	Caseatia	sylvestris	0	Heliophyte ephemeral	0	No
S	Rhamnaceae	Colubrina	spinosa	0	Heliophyte ephemeral	0	No
S	Melastomataceae	Miconia	smaragdina	0	Heliophyte ephemeral	0	No
S	Myristicaceae	Virola	koschnyi	1	Heliophyte durable	0	No
S	Chloranthaceae	Hedyosmum	bonplandianum	0	Heliophyte ephemeral	0	No
S	Chloranthaceae	Hedyosmum	bonplandianum	0	Heliophyte ephemeral	0	No
S	Rhamnaceae	Colubrina	spinosa	0	Heliophyte ephemeral	0	No
S	Rhamnaceae	Colubrina	spinosa	0	Heliophyte ephemeral	0	No
S	Rhamnaceae	Colubrina	spinosa	0	Heliophyte ephemeral	0	No
S	Rhamnaceae	Colubrina	spinosa	0	Heliophyte ephemeral	0	No
S	Hypericaceae	Vismia	billbergiana	0	Heliophyte ephemeral	0	No
S	Chloranthaceae	Hedyosmum	bonplandianum	0	Heliophyte ephemeral	0	No
S	Melastomataceae	Miconia	smaragdina	0	Heliophyte ephemeral	0	No
S	Rhamnaceae	Colubrina	spinosa	0	Heliophyte ephemeral	0	No
S	Rhamnaceae	Colubrina	spinosa	0	Heliophyte ephemeral	0	No
S	Arecaceae	Euturpe	precatória	0	Esciofitas	0	No
S	Arecaceae	Euturpe	precatória	0	Esciofitas	0	No
S	Myristicaceae	Virola	koschnyi	1	Heliophyte durable	0	No
S	Rhamnaceae	Colubrina	spinosa	0	Heliophyte ephemeral	0	No
S	Malvaceae	Hampea	appendiculata	1	Heliophyte ephemeral	0	No
S	Rhamnaceae	Colubrina	spinosa	0	Heliophyte ephemeral	0	No
S	Melastomataceae	Miconia	punctata	0	Heliophyte ephemeral	0	No
S	Chloranthaceae	Hedyosmum	bonplandianum	0	Heliophyte ephemeral	0	No
S	Malvaceae	Hampea	appendiculata	1	Heliophyte ephemeral	0	No
S	Lauraceae	Ocotea	sp4	1	Heliophyte durable	0	No
S	Tiliaceae	Heliocarpus	appendiculatus	1	Heliophyte ephemeral	0	No

S	Cecropiaceae	Cecropia	obtusifolia	0	Heliophyte ephemeral	0	No
S	Cecropiaceae	Cecropia	insignis	0	Heliophyte ephemeral	0	No
S	Cecropiaceae	Cecropia	obtusifolia	0	Heliophyte ephemeral	0	No
S	Euphorbiaceae	Tetrorchidium	euryphyllum	0	Heliophyte ephemeral	0	No
S	Malvaceae	Hampea	appendiculata	1	Heliophyte ephemeral	0	No
S	Chloranthaceae	Hedyosmum	bonplandianum	0	Heliophyte ephemeral	0	No
S	Malvaceae	Hampea	appendiculata	1	Heliophyte ephemeral	0	No
S	Malvaceae	Hampea	appendiculata	1	Heliophyte ephemeral	0	No
S	Malvaceae	Hampea	appendiculata	1	Heliophyte ephemeral	0	No
S	Euphorbiaceae	Tetrorchidium	euryphyllum	0	Heliophyte ephemeral	0	No
S	Myrtaceae	Psidium	guajava	0	Heliophyte ephemeral	0	No
S	Melastomataceae	Miconia	smaragdina	0	Heliophyte ephemeral	0	No
S	Malvaceae	Hampea	appendiculata	1	Heliophyte ephemeral	0	No
S	Euphorbiaceae	Tetrorchidium	euryphyllum	0	Heliophyte ephemeral	0	No
S	Chloranthaceae	Hedyosmum	bonplandianum	0	Heliophyte ephemeral	0	No
S	Asteraceae	Koanophyllon	hylonoma	0	Heliophyte ephemeral	0	No
S	Melastomataceae	Miconia	smaragdina	0	Heliophyte ephemeral	0	No
S	Melastomataceae	Miconia	smaragdina	0	Heliophyte ephemeral	0	No
S	Melastomataceae	Miconia	smaragdina	0	Heliophyte ephemeral	0	No
S	Rhamnaceae	Colubrina	spinosa	0	Heliophyte ephemeral	0	No
S	Melastomataceae	Miconia	smaragdina	0	Heliophyte ephemeral	0	No
S	Polygonaceae	Coccoloba	tuerckheimii	0	Heliophyte durable	0	No
S	Melastomataceae	Miconia	smaragdina	0	Heliophyte ephemeral	0	No
S	Melastomataceae	Miconia	smaragdina	0	Heliophyte ephemeral	0	No
S	Melastomataceae	Miconia	smaragdina	0	Heliophyte ephemeral	0	No
S	Melastomataceae	Miconia	punctata	0	Heliophyte ephemeral	0	No
S	Melastomataceae	Miconia	smaragdina	0	Heliophyte ephemeral	0	No
S	Rubiaceae	Guettarda	turrialbana	1	Heliophyte durable	0	No
S	Meliaceae	Trichilia	adolphi	0	Heliophyte durable	0	No
S	Rubiaceae	Chimarrhis	parviflora	1	Heliophyte durable	0	No
S	Melastomataceae	Miconia	smaragdina	0	Heliophyte ephemeral	0	No
S	Cecropiaceae	Pourouma	bicolor	1	Heliophyte durable	0	No
S	Sapindaceae	Allophylus	psilospermus	0	Heliophyte ephemeral	0	No
S	Myristicaceae	Virola	sebifera	1	Heliophyte durable	0	No

S	Magnoliaceae	Talauma	gloriensis	1	Heliophyte durable	0	No
S	Annonaceae	Xylopia	bocatorena	0	Heliophyte durable	0	No
S		DEAD!					
S	Flacoutiaceae	Lozania	pittieri	0	Heliophyte ephemeral	0	No
S	Rubiaceae	Cinchona	pubescens	1	Heliophyte durable	0	No
S	Bombacaceae	Pachira	aquatica	1	Heliophyte durable	0	No
S	Rubiaceae	Chimarrhis	parviflora	1	Heliophyte durable	0	No
S	Cecropiaceae	Pourouma	minor	0	Heliophyte durable	0	No
S	Cecropiaceae	Cecropia	insignis	0	Heliophyte ephemeral	0	No
S	Lauracea	Cinnamomum	hammelianum	1	Heliophyte durable	0	No
S	Lauraceae	Ocotea	sp4	1	Heliophyte durable	0	No
S	Juglandaceae	Oreomunnea	pterocarpa	1	Heliophyte durable	0	EN
S	Cecropiaceae	Pourouma	bicolor	1	Heliophyte durable	0	No
S	Burseraceae	Protium	ravenii	0	Esciofitas	0	No
S	Flacoutiaceae	Casearia	tacanensis	0	Heliophyte ephemeral	0	No
S	Rubiaceae	Arachnothrynx	costaricensis	0	Heliophyte ephemeral	1	No
S	Melastomataceae	Miconia	punctata	0	Heliophyte ephemeral	0	No
S	Euphorbiaceae	Croton	schiedeanus	0	Heliophyte ephemeral	0	No
S	Sapotaceae	Chrysophyllum	brenesii	0	Esciofitas	0	No
S	Myrsinaceae	Ardisia	capitellata	0	Esciofitas	1	No
S	Fabaceae/Pap	Dussia	atropurpurea	1	Heliophyte durable	0	No
S	Monimiaceae	Mollinedia	costaricensis	0	Heliophyte durable	0	No
S	Lauraceae	Ocotea	sp3	1	Heliophyte durable	0	No
S	Cecropiaceae	Cecropia	insignis	0	Heliophyte ephemeral	0	No
S	Lauraceae	Ocotea	mollifolia	1	Heliophyte durable	0	No
S	Arecaceae	Iriartea	deltoidea	0	Esciofitas	0	No
S	Bombacaceae	Quararibea	costaricensis	1	Heliophyte durable	1	No
S	Rhamnaceae	Colubrina	spinosa	0	Heliophyte ephemeral	0	No
S	Boraginaceae	Cordia	cymosa	0	Heliophyte durable	0	No
S	Fabaceae/Papilionoideae	Pterocarpus	sp1	1	Heliophyte durable	1	No
S	Cecropiaceae	Pourouma	bicolor	1	Heliophyte durable	1	No
S	Lauracea	Cinnamomum	hammelianum	1	Heliophyte durable	0	No
S	Cecropiaceae	Cecropia	insignis	0	Heliophyte ephemeral	0	No
S	Euphorbiaceae	Croton	schiedeanus	0	Heliophyte ephemeral	0	No
S	Lauraceae	Persea	cf americana	1	Heliophyte durable	0	No

S	Moraceae	Pseudolmedia	mollis	0	Heliophyte durable	0	No
S	Melastomataceae	Miconia	punctata	0	Heliophyte ephemeral	0	No
O HABITAT							
O	Rhamnaceae	Colubrina	spinosa	0	Heliophyte ephemeral	0	No
O	Myristicaceae	Otoba	novogranatensis	1	Heliophyte durable	0	No
O	Rhamnaceae	Colubrina	spinosa	0	Heliophyte ephemeral	0	No
O	Rubiaceae	Pentagonia	costaricensis	0	Esciofitas	0	No
O	Rhamnaceae	Colubrina	spinosa	0	Heliophyte ephemeral	0	No
O	Clusiaceae	Calophyllum	brasiliense	1	Heliophyte durable	0	No
O	Cecropiaceae	Pourouma	bicolor	1	Heliophyte durable	0	No
O	Annonaceae	Rollinia	membranacea	0	Heliophyte ephemeral	0	No
O	Euphorbiaceae	Croton	schiedeanus	0	Heliophyte ephemeral	0	No
O		DEAD!					
O	Fabaceae/Papilionoideae	Dussia	atropurpurea	1	Heliophyte durable	0	No
O	Euphorbiaceae	Pausandra	trianae	0	Esciofitas	0	No
O	Fabaceae/Papilionoideae	Pterocarpus	sp1	1	Heliophyte durable	1	No
O	Fabaceae/Pap	Lonchocarpus	oliganthus	1	Heliophyte durable	0	No
O	Fabaceae/Mim	Inga	sp3 cf thibaudiana	0	Heliophyte durable	0	No
O	Meliaceae	Cedrela	odorata	1	Heliophyte durable	0	VU
O		DEAD!					
O	Bombacaceae	Pachira	aquatica	1	Heliophyte durable	0	No
O	Rhamnaceae	Colubrina	spinosa	0	Heliophyte ephemeral	0	No
O	Rubiaceae	Chione	venosa	0	Heliophyte durable	0	No
O	Fabaceae/Papilionoideae	Pterocarpus	sp1	1	Heliophyte durable	0	No
O	Myristicaceae	Virola	koschnyi	1	Heliophyte durable	0	No
O	Malvaceae	Hampea	appendiculata	1	Heliophyte ephemeral	0	No
O	Malvaceae	Hampea	appendiculata	1	Heliophyte ephemeral	0	No
O	Myrtaceae	Plinia	sp1	0	Heliophyte durable	0	No
O	Tiliaceae	Apeiba	membranacea	1	Heliophyte durable	0	No
O	Euphorbiaceae	Croton	schiedeanus	0	Heliophyte ephemeral	0	No
O	Fabaceae/Pap	Dussia	atropurpurea	1	Heliophyte durable	0	No
O	Rhamnaceae	Colubrina	spinosa	0	Heliophyte ephemeral	0	No
O	Fabaceae/Pap	Lonchocarpus	oliganthus	1	Heliophyte durable	0	No
O	Sapotaceae	Pouteria	sp1	0	Esciofitas	0	No
O	Violaceae	Rinorea	deflexiflora	0	Heliophyte durable	0	No

O	Euphorbiaceae	Pausandra	triana	0	Esciofitas	0	No
O	Rhamnaceae	Colubrina	spinosa	0	Heliophyte ephemeral	0	No
O	Fabaceae/Mim	Inga	leonis	0	Heliophyte durable	0	No
O	Myristicaceae	Virola	koschnyi	1	Heliophyte durable	0	No
O	Euphorbiaceae	Pausandra	triana	0	Esciofitas	0	No
O	Fabaceae/Papilion oideae	Pterocarpus	sp1	1	Heliophyte durable	1	No
O	Rubiaceae	Chimarrhis	parviflora	1	Heliophyte durable	0	No
O	Arecaceae	Iriarte	deltoidea	0	Esciofitas	0	No
O	Fabaceae/Pap	Lonchocarpus	pentaphyllus	1	Heliophyte durable	0	No
O	Euphorbiaceae	Pausandra	triana	0	Esciofitas	0	No
O	Meliaceae	Guarea	adenophylla	1	Heliophyte durable	0	No
O	Arecaceae	Iriarte	deltoidea	0	Esciofitas	0	No
O	Melastomataceae	Miconia	punctata	0	Heliophyte ephemeral	0	No
O	Boraginaceae	Cordia	cymosa	0	Heliophyte durable	0	No
O	Arecaceae	Euturpe	precatória	0	Esciofitas	0	No
O	Clusiaceae	Calophyllum	brasiliense	1	Heliophyte durable	0	No
O		DEAD!					
O	Asteraceae	Koanophyllon	hylonoma	0	Heliophyte ephemeral	0	No
O	Moraceae	Ficus	glaucescens	0	Heliophyte durable	0	No
O	Boraginaceae	Cordia	cymosa	0	Heliophyte durable	0	No
O	Euphorbiaceae	Hieronima	alchorneoides	1	Heliophyte durable	0	No
O	Moraceae	Ficus	cervantesiana	0	Heliophyte durable	0	No
O	Asteraceae	Koanophyllon	hylonoma	0	Heliophyte ephemeral	0	No
O	Lauraceae	Persea	schiedeania	1	Heliophyte durable	0	No
O	Actinidiaceae	Saurauria	yasicae	0	Heliophyte ephemeral	0	No
O	Fabaceae/Pap	Lonchocarpus	oliganthus	1	Heliophyte durable	0	No
O	Asteraceae	Koanophyllon	hylonoma	0	Heliophyte ephemeral	0	No
O	Melastomataceae	Miconia	smaragdina	0	Heliophyte ephemeral	0	No
O	Boraginaceae	Cordia	cymosa	0	Heliophyte durable	0	No
O	Euphorbiaceae	Sapium	glandulosum	0	Heliophyte durable	0	No
O	Chloranthaceae	Hedyosmum	bonplandianum	0	Heliophyte ephemeral	0	No
O	Tiliaceae	Trichospermum	grewiifolium	1	Heliophyte ephemeral	0	No
O	Rubiaceae	Psychotria	berteroana	0	Heliophyte ephemeral	0	No
O	Rhamnaceae	Colubrina	spinosa	0	Heliophyte ephemeral	0	No
O	Melastomataceae	Miconia	smaragdina	0	Heliophyte ephemeral	0	No

O	Cecropiaceae	Cecropia	insignis	0	Heliophyte ephemeral	0	No
O	Melastomataceae	Miconia	smaragdina	0	Heliophyte ephemeral	0	No
O	Asteraceae	Koanophyllon	hylonoma				
O	Asteraceae	Koanophyllon	hylonoma	0	Heliophyte ephemeral	0	No
O	Clethraceae	Clethra	cf costaricensis	0	Heliophyte durable	0	No
O	Proteaceae	Roupala	glaberrima	1	Heliophyte durable	0	No
O	Sapotaceae	Pouteria	sp4	0	Esciofitas	0	No
O	Arecaceae	Iriartea	deltoidea	0	Esciofitas	0	No
O	Oleaceae	Chionanthus	panamensis	0	Esciofitas	0	No
O	Melastomataceae	Miconia	punctata	0	Heliophyte ephemeral	0	No
O	Fabaceae/Mim	Inga	leonis	0	Heliophyte durable	0	No
O	Euphorbiaceae	Pausandra	trianae	0	Esciofitas	0	No
O	Arecaceae	Iriartea	deltoidea	0	Esciofitas	0	No
O	Myrsinaceae	Ardisia	capitellata	0	Esciofitas	1	No
O	Moraceae	Ficus	brevibracteata	0	Heliophyte durable	0	No
O	Moraceae	Brosimum	guianense	0	Heliophyte durable	0	No
O	Sapotaceae	Pouteria	torta	0	Esciofitas	0	No
O	Anacardiaceae	Tapirira	mexicana	1	Heliophyte durable	0	No
O	Rubiaceae	(Alseis?)	costaricensis	0	Heliophyte ephemeral	1	No
O	Euphorbiaceae	Pausandra	trianae	0	Esciofitas	0	No
O	Rubiaceae	Faramea	sp1	0	Esciofitas	0	No
O	Moraceae	Pseudolmedia	spuria	0	Heliophyte durable	0	No
O	Arecaceae	Iriartea	deltoidea	0	Esciofitas	0	No
O	Euphorbiaceae	Hieronyma	alchorneoidea	1	Heliophyte durable	0	No
O	Euphorbiaceae	Pausandra	trianae	0	Esciofitas	0	No
O	Asteraceae	Koanophyllon	hylonoma	0	Heliophyte ephemeral	0	No
O	Asteraceae	Koanophyllon	hylonoma	0	Heliophyte ephemeral	0	No
O	Asteraceae	Koanophyllon	hylonoma	0	Heliophyte ephemeral	0	No
O	Asteraceae	Koanophyllon	hylonoma	0	Heliophyte ephemeral	0	No
O	Asteraceae	Koanophyllon	hylonoma	0	Heliophyte ephemeral	0	No
O	Asteraceae	Koanophyllon	hylonoma	0	Heliophyte ephemeral	0	No
O	Tiliaceae	Trichospermum	grewiifolium	1	Heliophyte ephemeral	0	No
O	Arecaceae	Euturpe	precatória	0	Esciofitas	0	No
O	Lauraceae	Ocotea	sp2	1	Heliophyte durable	0	No
O	Melastomataceae	Miconia	punctata	0	Heliophyte ephemeral	0	No
O	Arecaceae	Iriartea	deltoidea	0	Esciofitas	0	No
O	Arecaceae	Iriartea	deltoidea	0	Esciofitas	0	No
O	Violaceae	Rinorea	deflexiflora	0	Heliophyte	0	No

					durable		
O	Clusiaceae	Calophyllum	brasiliense	1	Heliophyte durable	0	No
O	Arecaceae	Euturpe	precatorea	0	Esciofitas	0	No
O	Cecropiaceae	Pourouma	bicolor	1	Heliophyte durable	0	No
O	Lauraceae	Ocotea	sp3	1	Heliophyte durable	0	No
O	Arecaceae	Euturpe	precatorea	0	Esciofitas	0	No
O	Melastomataceae	Miconia	punctata	0	Heliophyte ephemeral	0	No
O	Arecaceae	Iriartea	deltoidea	0	Esciofitas	0	No
O	Violaceae	Rinorea	deflexiflora	0	Heliophyte durable	0	No
O	Lauraceae	Ocotea	sp2	1	Heliophyte durable	0	No
O	Rubiaceae	Arachnothryx	costaricensis	0	Heliophyte ephemeral	1	No
O	Euphorbiaceae	Mabea	klugii	0	Heliophyte ephemeral	1	No
O	Moraceae	Pseudolmedia	spuria	0	Heliophyte durable	0	No
O	Arecaceae	Euturpe	precatorea	0	Esciofitas	0	No
O		DEAD!					
O	Sapotaceae	Chrysophyllum	brenesii	0	Esciofitas	0	No
O		DEAD!					
O	Euphorbiaceae	Gymnathes	riparia	0	Heliophyte durable	0	No
O	Lauraceae	Ocotea	sp4	1	Heliophyte durable	0	No
O	Rubiaceae	Psychotria	eurycarpa	0	Heliophyte durable	0	No
O	Sapotaceae	Pouteria	sp1	0	Esciofitas	0	No
O	Moraceae	Ficus	cervantesiana	0	Heliophyte durable	0	No
O	Rubiaceae	Arachnothryx	costaricensis	0	Heliophyte ephemeral	1	No
O	Rubiaceae	Arachnothryx	costaricensis	0	Heliophyte ephemeral	1	No
O	Euphorbiaceae	Pausandra	trianaee	0	Esciofitas	0	No
O	Lauraceae	Ocotea	mollifolia	1	Heliophyte durable	0	No
O	Rubiaceae	Psychotria	eurycarpa	0	Heliophyte durable	0	No
O	Myristicaceae	Otoba	novogranatensis	1	Heliophyte durable	0	No
O	Euphorbiaceae	Pausandra	trianaee	0	Esciofitas	0	No
O	Chloranthaceae	Hedyosmum	bonplandianum	0	Heliophyte ephemeral	0	No
O	Rutaceae	Galipea	dasysperma	0	Heliophyte durable	0	No
O	Bignoniaceae	Tabebuia	rosea	1	Heliophyte durable	0	No
O	Anacardiaceae	Tapirira	mexicana	1	Heliophyte durable	0	No
O	Violaceae	Rinorea	deflexiflora	0	Heliophyte durable	0	No
O	Chloranthaceae	Hedyosmum	bonplandianum	0	Heliophyte ephemeral	0	No
O	Sapotaceae	Pouteria	congestifolia	0	Esciofitas	0	No

O	Flacourtiaceae	Xylosma	cf intermedia	0	Heliophyte ephemeral	0	No
O	Flacourtiaceae	Casearia	arborea	0	Heliophyte ephemeral	0	No
O		DEAD!					
O	Asteraceae	Koanophyllon	hylonoma	0	Heliophyte ephemeral	0	No
O	Fabaceae/Caes	Senna	papillosa	0	Heliophyte ephemeral	0	No
O	Fabaceae/Caes	Senna	papillosa	0	Heliophyte ephemeral	0	No
O	Melastomataceae	Miconia	punctata	0	Heliophyte ephemeral	0	No
O	Malvaceae	Hampea	appendiculata	1	Heliophyte ephemeral	0	No
O	Asteraceae	Koanophyllon	hylonoma	0	Heliophyte ephemeral	0	No
O	Fabaceae/Mim	Inga	sp4	0	Heliophyte durable	0	No
O	Malvaceae	Hampea	appendiculata	1	Heliophyte ephemeral	0	No
O	Lauraceae	Ocotea	brenesii	1	Heliophyte durable	0	No
O	Tiliaceae	Heliocarpus	appendiculatus	1	Heliophyte ephemeral	0	No
O	Melastomataceae	Miconia	punctata	0	Heliophyte ephemeral	0	No
O	Cecropiaceae	Pourouma	bicolor	1	Heliophyte durable	0	No
O	Fabaceae/Mim	Acacia	ruddiae	1	Heliophyte ephemeral	0	No
O	Hypericaceae	Vismia	billbergiana	0	Heliophyte ephemeral	0	No
O	Melastomataceae	Miconia	punctata	0	Heliophyte ephemeral	0	No
O	Chloranthaceae	Hedyosmum	bonplandianum	0	Heliophyte ephemeral	0	No
O	Malvaceae	Hampea	appendiculata	1	Heliophyte ephemeral	0	No
O	Cecropiaceae	Pourouma	bicolor	1	Heliophyte durable	0	No
O	Melastomataceae	Miconia	punctata	0	Heliophyte ephemeral	0	No
O	Melastomataceae	Miconia	punctata	0	Heliophyte ephemeral	0	No
O	Chloranthaceae	Hedyosmum	bonplandianum	0	Heliophyte ephemeral	0	No
O	Malvaceae	Hampea	appendiculata	1	Heliophyte ephemeral	0	No
O	Malvaceae	Hampea	appendiculata	1	Heliophyte ephemeral	0	No
O	Malvaceae	Hampea	appendiculata	1	Heliophyte ephemeral	0	No
O	Malvaceae	Hampea	appendiculata	1	Heliophyte ephemeral	0	No
O	Euphorbiaceae	Hieronyma	alchorneoidea	1	Heliophyte durable	0	No
O	Fabaceae/Papilion oideae	Pterocarpus	sp1	1	Heliophyte durable	1	No
O	Lauraceae	Ocotea	morae	1	Heliophyte durable	1	No
O	Asteraceae	Koanophyllon	hylonoma	0	Heliophyte ephemeral	0	No
O	Asteraceae	Koanophyllon	hylonoma	0	Heliophyte ephemeral	0	No
O	Malvaceae	Hampea	appendiculata	1	Heliophyte ephemeral	0	No

O	Melastomataceae	Miconia	punctata	0	Heliophyte ephemeral	0	No
O	Piperaceae	Piper	barbulatum	0	Heliophyte ephemeral	0	No
O	Annonaceae	Xylopia	bocatorena	0	Heliophyte durable	0	No
O	Clusiaceae	Garcinia	intermedia	0	Esciofitas	0	No
O	Lauraceae	Ocotea	mollifolia	1	Heliophyte durable	0	No
O	Fabaceae/Pap	Lonchocarpus	pentaphyllus	1	Heliophyte durable	0	No
O	Melastomataceae	Miconia	punctata	0	Heliophyte ephemeral	0	No
O	Tiliaceae	Apeiba	membranacea	1	Heliophyte durable	0	No
O	Fabaceae/Pap	Swartzia	simplex	0	Heliophyte durable	0	No
O	Euphorbiaceae	Sapium	glandulosum	0	Heliophyte durable	0	No
O	Fabaceae/Pap	Lonchocarpus	oliganthus	1	Heliophyte durable	0	No
O	Melastomataceae	Miconia	punctata	0	Heliophyte ephemeral	0	No
O	Boraginaceae	Cordia	cymosa	0	Heliophyte durable	0	No
O	Cecropiaceae	Cecropia	insignis	0	Heliophyte ephemeral	0	No
O	Asteraceae	Koanophyllon	hylonoma	0	Heliophyte ephemeral	0	No
O	Asteraceae	Koanophyllon	hylonoma	0	Heliophyte ephemeral	0	No
O	Euphorbiaceae	Tetrorchidium	euryphyllum	0	Heliophyte ephemeral	0	No
O	Euphorbiaceae	Tetrorchidium	euryphyllum	0	Heliophyte ephemeral	0	No
O	Hypericaceae	Vismia	baccifera	0	Heliophyte ephemeral	0	No
O	Euphorbiaceae	Tetrorchidium	euryphyllum	0	Heliophyte ephemeral	0	No
O	Hypericaceae	Vismia	billbergiana	0	Heliophyte ephemeral	0	No
O	Malvaceae	Hampea	appendiculata	1	Heliophyte ephemeral	0	No
O	Fabaceae/Mim	Inga	leiocalycina	1	Heliophyte durable	0	No
O	Melastomataceae	Miconia	punctata	0	Heliophyte ephemeral	0	No
O	Melastomataceae	Miconia	punctata	0	Heliophyte ephemeral	0	No
O	Asteraceae	Koanophyllon	hylonoma	0	Heliophyte ephemeral	0	No
O	Fabaceae/Papilion oideae	Pterocarpus	sp1	1	Heliophyte durable	1	No
O	Euphorbiaceae	Croton	schiedeanus	0	Heliophyte ephemeral	0	No
O	Lauraceae	Ocotea	brenesii	1	Heliophyte durable	0	No
O	Malvaceae	Hampea	appendiculata	1	Heliophyte ephemeral	0	No
O	Euphorbiaceae	Sapium	glandulosum	0	Heliophyte durable	0	No
O	Rubiaceae	Chomelia	venulosa	0	Heliophyte durable	0	No
O	Sapotaceae	Pouteria	sp1	0	Esciofitas	0	No
O	Malvaceae	Hampea	appendiculata	1	Heliophyte ephemeral	0	No

O	Lauraceae	Ocotea	mollifolia	1	Heliophyte durable	0	No
O	Melastomataceae	Conostegia	cf micrantha	0	Heliophyte ephemeral	0	No
O	Cecropiaceae	Cecropia	insignis	0	Heliophyte ephemeral	0	No
O	Tiliaceae	Heliocarpus	appendiculatus	1	Heliophyte ephemeral	0	No
O	Asteraceae	Koanophyllon	hylonoma	0	Heliophyte ephemeral	0	No
O	Boraginaceae	Cordia	cymosa	0	Heliophyte durable	0	No
O	Asteraceae	Koanophyllon	hylonoma	0	Heliophyte ephemeral	0	No
O	Asteraceae	Koanophyllon	hylonoma	0	Heliophyte ephemeral	0	No
O	Asteraceae	Koanophyllon	hylonoma	0	Heliophyte ephemeral	0	No
O	Asteraceae	Koanophyllon	hylonoma	0	Heliophyte ephemeral	0	No
O	Asteraceae	Koanophyllon	hylonoma	0	Heliophyte ephemeral	0	No
O	Asteraceae	Koanophyllon	hylonoma	0	Heliophyte ephemeral	0	No
O	Asteraceae	Koanophyllon	hylonoma	0	Heliophyte ephemeral	0	No
O	Malvaceae	Hampea	appendiculata	1	Heliophyte ephemeral	0	No
O	Asteraceae	Koanophyllon	hylonoma	0	Heliophyte ephemeral	0	No
O	Asteraceae	Koanophyllon	hylonoma	0	Heliophyte ephemeral	0	No

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VITA

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In August 2008, she enrolled in a graduate study at Texas Christian University, where she received her Master of Science degree in Environmental Science in 2010. While working on her Masters she belonged to the TCU-Oxford Sustainable Futures Group. She also received a department teaching assistantship from fall 2009 to Spring 2010, where she taught a lab for Enviro-diversity and Contemporary Issues in Environmental Science.

She currently lives in Fort Worth with her English Bulldog Winston and plans to relocate after graduation.

ABSTRACT

STRUCTURE AND SPECIES COMPOSITION OF PRIMARY AND SECONDARY TROPICAL FOREST IN COSTA RICA: A CASE STUDY USING ECOSYSTEM SERVICE PAYMENTS FOR CONSERVATION OF BIODIVERSITY

by Kimberly Mischelle Ozenick, M.S., 2010
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When making policy decisions regarding ecosystem management, human well being, economic gain, and proper price of natural capital must be weighed and determined. Many nations are starting to explore avenues to use ecosystem services to raise capital and aid in conservation. Payments for Ecosystem Services have influenced land management and conservation practices in Costa Rica and are providing a unique method for managing tropical landscapes and conserving areas of high biodiversity. The following case study attempted to assess a parcel of land adjacent to an existing reserve to determine the ultimate ecological and economic value of the land. The biodiversity of both the reserve and adjacent property were quantified, mapped and a cost –benefit analysis was calculated to determine economic value. The study determined, due to the lack of a standardized economic valuation method and tradable markets for ecosystem services, that an actual monetary value currently couldn't be assigned to an ecosystem.