Long-Term Forest Plot Monitoring in Parque Natural Metropolitano

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PARQUE NATURAL METROPOLITANO
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McGill

Smithsonian Institution

Executive Summary

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Long-term ecological research is necessary in identifying and understanding complex ecological processes. Despite an expansive amount of literature dedicated to the importance of long-term studies and their design, many projects are abandoned or the results are not diffused throughout the scientific and non-scientific communities. However, the Center for Tropical Forest Science (CTFS) at the Smithsonian Tropical Research Institute (STRI) has been developing a multi-institutional network of long-term forest research plots around the globe for over 30 years. The partnerships formed by this network contribute to the resilience of this type of long-term study. An association between the Parque Natural Metropolitano (PNM) and the Smithsonian in Panama City has allowed for the development of long-term environmental research using forest plots within the park, in addition to being accessible to the urban population.

Our project focuses on reinforcing and expanding the link between these two organizations, as well as providing PNM with the appropriate resources to support their overall objectives and the pursuit of long-term forest research. As proposed by PNM and STRI, we thus established a 1-ha forest research plot in the southeastern portion of the park while following the standardized methods of CTFS. This included physically establishing the plot, measuring and tagging all trees above 10cm in diameter at breast height, entering the data into the CTFS database, and evaluating the plot in terms of the park's objectives. We then produced a forest plot methodology guide directed at a universal audience, in order to capacitate the park in addressing their own research questions, ensuring continuation of long-term monitoring, and increasing research opportunities overall. The guide was produced in both English and Spanish versions. Finally we addressed PNM's priority in public environmental awareness with a promotional and educational video about long-term forest research, targeted at the non-scientific public and accessible for viewing at the park and online. The video was made in English and available with Spanish sub-titles.

The three products compliment each other in supporting the institutional objectives of both PNM and STRI, in providing many future research opportunities, and in the integration of long-term ecological research within scientific and non-scientific communities. Our results from the plot evaluation indicate that a 1-ha plot may not be ideal if PNM wishes to obtain a more complete representation of the tree composition throughout the park. To address this issue, we recommend beginning a series of smaller plots (20x20m), randomly placed throughout the park. However, the new 1-ha plot still has its place in many other useful long-term studies. Overall,

this project provides a starting platform for many different long-term forest research projects, through theoretical and practical resources, and also an avenue towards reaching out to the public.

Resumen Ejecutivo

Monitoreo de una parcela de investigación forestal a largo plazo en el Parque Natural Metropolitano

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La investigación ecológica a largo plazo es necesaria para identificar y entender los procesos ecológicos complejos. Pese a una cantidad extensa de la literatura dedicada a la importancia de los estudios a largo plazo, muchos proyectos están abandonadas o los resultados no se llegaron a las comunidades científicas o el publico. Sin embargo, el *Center for Tropical Forest Science* (CTFS) en el Instituto Smithsonian de Investigaciones Tropicales (STRI) ha estado desarrollando una red multi-institucional de parcelas de investigación forestal a largo plazo alrededor del mundo desde hace 30 años. Las asociaciones formadas por esta red contribuyen a la resistencia de este tipo de estudio a largo plazo. Una asociación entre el Parque Natural Metropolitano (PNM) y el Smithsonian en Panamá ha permitido el desarrollo de investigación ambiental a largo plazo usando parcelas de bosque dentro del parque, además de ser accesible a la población urbana.

Nuestro proyecto se centra en reforzar y ampliar la relación entre estas dos organizaciones, así como proporcionando PNM con los recursos adecuados para apoyar sus objetivos generales y la búsqueda de la investigación forestal a largo plazo. Según lo propuesto por el PNM y STRI, establecimos una parcela de investigación forestal de 1-hectarea en tamaño en la porción sureste del parque siguiendo los métodos estandarizados del CTFS. Esto incluye establecer físicamente la parcela, medir y etiquetar todos los árboles por encima de 10cm de diámetro a la altura del pecho, entrar los datos en la base de datos del CTFS, y evaluar la parcela en cuanto a los objetivos del parque. Luego, hicimos una guía de metodología para hacer una parcela, con el fin de capacitar el parque en sus propias propuestas de investigación, además de asegurar la continuación de los estudios forestales a largo plazo y aumentar las oportunidades de investigación en general. La guía fue producida en dos versiones, en inglés y en español. Finalmente, hicimos un video promocional y educativo sobre la investigación forestal a largo plazo para apoyar a la prioridad del parque en la concientización ambiental. El video está dirigido al público no científico y puede verse en el parque y en línea. El video fue hecho en inglés y está disponible con subtítulos en español.

Los tres productos se complementan mutuamente en el apoyo a los objetivos institucionales del PNM y STRI. Además, ofrecen muchas oportunidades de investigación futura, y integran la investigación ecológica a largo plazo dentro de las comunidades científicas y no científicas. Los resultados de la evaluación de la parcela indican que una parcela de 1-hectarea puede no ser ideal si PNM desea obtener una representación más completo de la composición de los árboles por todo

el parque. En este caso, recomendamos iniciando una serie de pequeñas parcelas (20x20m), colocados al azar en todo el parque. Sin embargo, la nueva parcela de 1-hectarea tiene todavía una importancia en muchos otros estudios útiles a largo plazo. Este proyecto en su totalidad ofrece un punto de partida para muchos diferentes proyectos de investigación forestal a largo plazo, a través de recursos teóricos y prácticos, y también un modo para unir el publico y la ciencia.

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Timeline of the project

Table 1. Number of days dedicated to the internship where one day corresponds to 8 hours of work.

Time dedicated in the field (Including plot and video in the park)	Time dedicated out of the field (Including writing of Methodology Guide and Final Report)	Total
6,4	18,8	25.2

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Introduction

General context: Long-term ecological research

In recent decades, there has been a growing realization throughout the scientific community that long-term ecological monitoring is critical in understanding complex ecological processes (Likens 1989; Rees et al. 2001; Lindenmayer & Likens 2010). Understanding these processes is important for reasons of scientific curiosity, but also in addressing critical environmental problems such as climate change and the associated influence from human activities (Lovett et al. 2007; Lindenmayer & Likens 2010). Long-term monitoring is a multi-valued research tool, capable of identifying processes with slow response times, in addition to its use in simulation models, testing ecological theories, and monitoring unexpected events such as natural disturbances (Lindenmayer & Likens 2010). These uses can guide evidence-based environmental decision-making and further evaluate the effectiveness of those decisions (Scott 2011).

For these reasons, long-term ecological research is essential to resource management agencies, scientific research institutions, and policy-makers, and should involve all parties throughout the research process. Short funding cycles, slow time to first publication, and the brevity of professional careers often constrain the successful completion of long-term studies; however all of which further the demand for an integrated partnership between researchers, resource managers, and decision-makers (Strayer et al. 1986; Lovett et al. 2007; Lindenmayer & Likens 2010). These long-term partnerships ultimately depend on the capability and

willingness of each member to participate. Part of this project is therefor dedicated to a particular dimension within this integrated approach, which is to capacitate a managerial agency with the appropriate knowledge and scientific method for long-term ecological monitoring in order to strengthen the relationship with the associated scientific body and help sustain such research.

A complimentary approach towards institutionalizing long-term ecological research focuses on educating the general public and providing them with accessible and intelligible information. This process begins with public outreach and awareness efforts through specific educational resources that are interesting and attractive to the general population. Another part of this project is thus devoted to bringing together the scientific and non-scientific communities within the context of long-term ecology at the outreach level.

Overall, this project looks to develop the scientific discipline of long-term environmental research and the linkages between the scientific community, the non-specialist environmental professionals and natural resource managers, and the general public.

Project background information: Long-term forest studies in Panama

Since the 1980s, long-term environmental monitoring in Panama has been rigorously developing within the field of forest ecology. Ecologists at the Smithsonian Tropical Research Institute (STRI) in Panama City have been studying tropical forest diversity and dynamics via long-term research plots (Condit 1995). The concept of large-scale permanent plots stems from Dr. Stephen Hubbell's ideas on dispersion patterns, density dependence and sustainable extractions of tropical

tree species. To establish and analyze a plot, a standardized methodology is used to census all trees above a desired diameter at breast height within a distinctly marked area of forest. For instance, the 50-hectare plot at STRI's field station on Barro Colorado Island, established in 1980, was pivotal in the development of this research domain. A census of the BCI plot includes over 300 species and over 200,000 stems above 1 centimeter in diameter (Condit 1995).

This plot technique has allowed researchers to gather demographic data on individual tree species, to study long-term changes in forest composition, to evaluate the economic value of extractable forest resources, to generate models for sustainable forms of extraction, and to study underused native species for possible uses in reforestation (Condit 1995; Bakker et al. 1996; Condit et al. 2000). In addition, research plots provide comparative data between undisturbed forested areas and human-influenced forests for management studies (Condit 1995).

Over the years, STRI researchers in collaboration with numerous organizations around the world have formed the Center for Tropical Forest Science (CTFS) and developed a multi-institutional network of permanent forest research plots. All plots in this network are connected by the standardized methodology, which allows for large-scale comparisons of different forest types around the globe. In Panama, there are currently 3 main plots in different locations that are a part of CTFS: a 6-hectare plot in Fort Sherman, the 50-hectare plot in BCI, and a 4-hectare plot in Cocoli (CTFS 2014). There exist numerous other plots throughout the country, most of 1-hectare in size, which are also used in long-term studies and for species diversity research. However, few plots are accessible to the public for

educational and awareness opportunities such as the 1-hectare plot in Parque Natural Metropolitano (PNM), located in the heart of Panama City. This project relates to the PNM site, in which STRI and the park's administration had agreed to establish a new plot within park limits. The reasons for doing so were not made explicit, however these are discussed further in the "Methods" section. Nevertheless, this plot is noteworthy to the field of long-term ecological monitoring in Panama for three reasons: (1) It is situated in a tropical dry forest on the Pacific coast, which is a rare type of tropical forest that is not thoroughly studied compared to others; (2) Unlike other plots in the country, it involves the collaboration of a natural resource management agency such as PNM, and a scientific institution such as STRI; (3) It is readily accessible to the public, within a park that promotes public environmental education.

Host institution: Parque Natural Metropolitano

The Parque Natural Metropolitano was first formed as a protected area for the Canal Zone in compliance with the Soil Management Plan of 1974, and officially established in 1985 (PNM 2010). Today, PNM covers 232 hectares of protected secondary growth forest with mixed tropical humid and tropical dry characteristics. The land is dedicated to the conservation of biodiversity and the canal watershed, and the promotion of eco-tourism development, outdoor recreation, and environmental education. The park's Management Plan identifies these specific objectives, which include:

- *Increase environmental awareness for all visitors and the general public so they may participate in the conservation of natural resources in PNM and in Panama*
- *Strengthen the understanding of environmental management with technically qualified personnel*
- *Implement more scientific research on the park's natural resources through collaborations with universities, institutions, and NGOs in order to improve methods for protection and management*
- *Make available the current information on the park's natural resources with reference documents for future activities, and basic formats that can facilitate the understanding for the general population*

Through these objectives and other various projects, PNM has developed an association with STRI that helps implement forest research within the park. The first long-term forest research plot in PNM was established in 1998, however it will most likely be discontinued for reasons discussed below. The focus of this project and the new proposed plot is to support both PNM and STRI's institutional goals while providing PNM with new resources that can expand their knowledge of conservation and their means for public environmental education.

Objectives, Products, and Justifications

There are three main objectives with three associated products for this project, all related to the park's management plan, and STRI's involvement in the forest plot network.

Plot and data evaluation

The first objective is to create a long-term monitoring data set of a forest plot within PNM, which can serve two purposes. Firstly, it is useful to PNM in revealing the changes in composition and growth of the parks forest community over time. Secondly, this plot is used by STRI as part of the network of permanent plots in Panama for long-term comparison of different tropical forest types. This is important seeing as there aren't many plots in tropical pacific dry forests. We thus established a 1-hectare plot following the standardized methodology provided by CTFS. For the park's benefit, we also wanted to confirm if the plot area is large enough to encompass an appropriate representation of the total number of species present in the region. This is evaluated using a species accumulation curve. The results demonstrate if the current plot is in agreement with the park's research goals, such as obtaining a good representation of the overall forest community for long-term study.

Ensuring long-term plot monitoring

The second objective is to encourage the progression of the long-term data collection in the permanent plot, as well as to help the park initiate other forest research projects of interest independently. To do so, we produced a methodology

guide in both English and Spanish detailing how to setup and survey a forest research plot, in an accessible format for non-specialists. We also provide examples of preliminary results and analysis in order to demonstrate what kind of information can be obtained from a research plot. Furthermore, we suggest future recommendations for possible questions and pertinent research within the park, and how these can be integrated into educational and professional training opportunities in Panama City. The urban setting of the park provides the advantage of accessibility to many types of people as an outdoor classroom or lab.

Public education

The third goal is to promote public awareness and interest of long-term ecological research and its accessibility to citizens. This is done via an educational video aimed at the non-scientific audience. It will be available for viewing in PNM facilities and online. This product is meant to support PNM's priority in public environmental education, as detailed in their management plan.

Methods

McGill's code of ethics

This project was carried out in accordance with the *Code of Ethics* of McGill University. This was particularly important for the making of the video in which all people included or involved were consulted and asked for their free consent prior to any filming.

Study Site

The 1-ha plot is situated in the southeastern part of the park (GPS coordinates: 7 UTM 0659904 0993320, altitude 77m) along the "Los Momótides" trail (Appendix 1). This region is characteristic of a dry tropical forest in that it receives an approximate annual precipitation of 1600mm/year with a mean temperature of 27°C (Pyke et al. 2001; ETESA 2014). The precise location was selected January the 31st by the STRI researchers Rolando Pérez and Salomón Aguilar in company of some PNM employee and the interns. The site-selection was based on two main criteria: (1) It had to contain a good representation of the tree species richness found in the dry forest areas of the park, and (2) It had to be relatively accessible in order to facilitate sampling and promote public awareness.

"Los Momótides" trail crosses the plot twice along the North-South axis. The eastern portion of the plot has a very steep slope (≈ 50°) whereas the western portion of the plot is relatively flat. Due to the topography, the upper-slope is slightly drier than the lower-slope, which increases complexity in the community composition. However, relative to other areas in the park, the forest along "Los Momótides" trail is drier in general (Pérez 2014a).

Preliminary investigation

Prior to beginning plot set-up, we received information about a previous 1-ha plot situated under the canopy crane in PNM (Appendix 1). However, according to several STRI ecologists and botanists, this plot is more representative of a tropical humid forest in Panama because it contains an abnormal species composition, such

as the irregular abundance of *Anacardium esculentum* (Espavé). This is mainly related to heavy human perturbation during American military presence, construction and the proximity to the road, and an accidental fire that occurred a few years ago (Pérez 2014a; Schnitzer 2014). This is partly why STRI scientists were interested in establishing a new plot in PNM.

Establishment of the plot

The establishment and data collection of the 1-ha plot follows CTFS's standardized methodology, as described in "Métodos para el estudio de la vegetación" (Pérez et al. 2014).

The first step consisted of physically establishing the plot following a square grid-map of 100mX100m (Appendix 2). The plot was oriented along the North-South axis. Using a compass and a transect measuring tape, we drove PVC tubes at every 10 meters of the length and width, which totalled 121 tubes over the entire 1-ha. This required a full day of work with 6 people.

The second step was to measure and mark every tree with a diameter at breast height (DBH) over 10 cm. The trees were thus measured with a DBH-tape at a measured 1,30 m above the ground. Every stem was marked with fluorescent spray paint where the measurement was taken. They were then tagged with a numbered metal plate nailed into the trunk above the paint. We completed the full plot census in five days. A final day in the field was dedicated to the revision of data, identification of trees, and the measurement of the trees with buttress roots using a ladder. The reason for this last step is that these trees have to be measured at a height where the trunk is more cylindrical.

Revision of the plot and data entry

The revision was made in company of Dr. Rolando Pérez and Salomon Aguilar. During this half-day, we revised every tree in order to verify any mistakes in annotation or measurement method, as well as identified all the trees on site. The data entry was done the following day at STRI using the CTFS online database, with the help of Suzanne Lao, the research team statistician and data manager.

Data analysis

Species accumulation curve

The species accumulation curve (SAC) was done with the package "Vegan" in R. A SAC is the richness related to the sampling effort. If the curve forms a plateau, it is an indication that almost all, if not all, the targeted species were collected. If not, the sampling effort was not sufficient, meaning that sampling effort should have been more extensive (Simberloff 1978). The randomized mathematical analysis, Jacknife, reiterates sub-samples within a given database and creates the accumulation of species richness in relation to sampling effort. In our case, the sub-samples are the 20mX20m quadrats, from 1 to 25.

Production of methodology guide and promotional video

The methodology guide was written based on the methodology given by CTFS named "Methods For the Study of the Vegetation", as well as the field training given by Dr. Perez and Dr. Aguilar (Pérez et al. 2014). The draft took approximately a week. Templates and final copies were made using Microsoft Word.

The video was filmed during an 8-hour day in the park and a half-day at STRI. Prior to filming, a 2-pages script was prepared with scene descriptions and desired outcomes in order to facilitate the filming and editing stages (Appendix 3). Will Miller, a fellow PFSS student an experienced filmmaker with Developing Pictures, executed the filming and editing. A second PFSS student, Courtney Quinn, performed the English narration, which was supplemented with sub-titles in Spanish.

Results

Plot Details

The research plot contains 385 stems, including trees with multiple stems, and 318 individual trees (DBH>100mm). There were 44 tree species identified. It is dominated by *Trichilia martiana* (tri2to), *Antitrrhoea trichantha* (antitr) and *Guazuma ulmifolia* (guazul), which together represent a third of the total individual abundance (Fig 1, Appendix 4). In terms of tree diameter, smaller trees are the most abundant (Fig 2, Appendix 4). The plot facts are summarized in Table 2 (Appendix 4).

Species accumulation curve

We can observe the inflection point of the curve at approximately quadrat 6, however the curve does not appear to reach a plateau even after the accumulation of all 25 quadrats (Fig 3, Appendix 4). A total of 44 species were sampled, but the chaos index of the species accumulation curve statistic in R estimates a total of 72

species. This number indicates where the curve would plateau if the sampling effort was extrapolated forward.

Methodology guide and promotional video

The methodology guide is a 20-page booklet dedicated to the park employees and anyone who would like to establish their own forest research plot. The guide was made in both English and Spanish versions. It contains a section dedicated to the relevance of forest research plots, followed by a detailed protocol with all required material for selecting an appropriate research site, physically setting up the plot, performing a complete tree census, and how to handle the possible complications. A hard copy of both versions was printed in colour and given to our host institution. A second copy of both versions was printed in black and white and is available as a separate document attached to this report.

The accompanied short video (≈3.00 min) is a promotional product available for viewing at the Park, but will also be online via the Developing Pictures website (www.developingpictures.org) and YouTube channel (www.youtube.com/user/DevelopingPictures). We encourage the park to post the video and methodology guide together on their website (www.parquemetropolitano.org) in order to reach the largest public possible. The video exists in an English version with Spanish sub-titles.

Discussion and Recommendations

Plot analysis and species accumulation curve

Our initial impression of this project was that PNM wanted a permanent research plot in order to monitor the compositional and structural changes of the secondary dry tropical forest found within the park. This was based on unclear evidence that the vegetative structure of the forest had been experiencing noticeable changes over the last 25 years. The long-term research question in this case was implicit towards studying the forest changes throughout the entire park versus only a particular section. Our results thus indicate that the current 1-ha plot is not necessarily the most effective tool for addressing this question.

During our preliminary investigation, an informal discussion with Dr. Stefan Schnitzer helped us realize the different uses, advantages and disadvantages of a forest research plots depending on the purpose of the study. For instance, a 50-ha plot can be advantageous for sampling a forest in a particular region in order to obtain a more accurate understanding of the vegetative species composition and the long-term changes specific to that region. However, this plot-size evidently requires an extremely high-level of maintenance and resources (materials, people, time) and is not easily replicable. A 1-ha plot is also good for monitoring long-term changes, but its size is small enough to allow for many replicates at large geographic scales, such as a country or continent, for useful comparative studies between regions. A single 20mX20m plot is too small to encompass all tree species in an area, but many replicates may be useful for comparative studies at smaller localized geographic

scales, such as the size of a park or conservation area. Also, this method is likely better than a single 1-ha in the same area if the goal is to obtain a representative data set of the forest community and ecological dynamic within the given territory.

In the case of the new PNM plot, according to the species accumulation curve, the sampling method is not sufficient to sample all tree species within the park but is still arguably representative enough to conduct valid scientific research. The curve's inflection point seems to occur around 6 quadrats, although the curve does not fully plateau even after 25 quadrats are reached. Sampling could be increased in two ways: either increasing the plot-area, or increasing the criteria limits to which trees are considered, in this case meaning measuring all trees above 1 cm in diameter at breast height as opposed to 10 cm (Pérez 2014b). It is possible that some species within the plot were not collected because the individuals were smaller in size than what was being considered. On the other hand, considering the high tree species diversity at low density in the tropics, as well as the wide gap between the total number of sampled species (44) and the estimated species abundance by the statistical model (72), increasing the sampling area may be necessary in order to achieve a suitable representation (Condit et al. 2000).

Another alternative is to establish many smaller plots of 20mX20m in a randomly dispersed fashion throughout the park. A randomized site-selection ensures a better sample of the variations in species composition at small geographic scales. This may reduce the required number of quadrats and total sampling area needed to obtain the same representation as a normal 1-ha plot. In other words, many small plots allow a large proportional area of the park to be sampled while the

small size of the plots mitigates resource limitations. For these reasons, in order to address the initial long-term research question of overall representation, we recommend that PNM establishes at least 6, but ideally close to 15-20 plots of 20mX20m using a randomized selection of locations within the park. To do so, all the necessary information can be found in our Methodology Guide (see attached document).

Methodology guide and promotional video

The guide and the video directly support PNM's management goals, as described in the introduction. The guide will facilitate future data collection and persistence of the 1-ha plot, while equally encouraging PNM to take on other permanent plot research projects of interest. The implication are thus not only for park staff, but also for people who receive technical training within the park such as students or other environmental technicians. It was designed to be as accessible and easy to use as possible, for the most universal audience possible. In addition to being an online resource, we are suggesting that the park keeps the guide open to the public for viewing from the front office, welcome center, or ecological gift shop. They are also encouraged to print more copies if they wish to distribute them further, or store a copy in the Corotú environmental library.

The video will add to the park's promotional and educational tools, and will also be diffused to a much broader audience as an online resource. We are suggesting that the video be made available for public viewing in a designated area in the park's main facilities, and that it be incorporated into some of the environmental education programs and events, such as the "My school is near the

forest" program and the summer workshops for children, or the frequent academic tours at many different levels.

Future opportunities

There remain many ways in which this project could be expanded, or new long-term projects could be developed. Firstly, the data set of the new 1-ha plot could be expanded to include all trees above 1cm in DBH in order to obtain a more complete sample of the species and individual abundances. If this is too resource intensive, a series of quadrats within the plot may be targeted instead. The technical skills for identification would be required for identification, however this would also open many doors to training and research opportunities. Although there are many others, a few possible research themes that could be studied using this plot include:

A) A comparison of vegetative composition and / or distribution with other CTFS 1-ha plots in Panama or internationally in different types of tropical forests.

B) A comparison of tree species composition with the previous plot in PNM beneath the canopy crane, in order to demonstrate the drastic changes in tropical diversity at small geographic scales. As was previously mentioned, the forest near the crane is noticeably more humid than the forest along "Los Momótides" trail, yet they are only 1-km away from one another. The data for this question is already available, but remains to be analyzed. Preliminary data that we collected can be seen in Appendix 4 (Fig. 1 & Fig. 4). Interestingly, the most common species found beneath the crane *Castilla elastica* (castel) is not found at all in the new plot.

C) Estimating the carbon stock through above-ground biomass (AGB), based on allometric equations that incorporate stem diameter (Chave et al. 2003; Zianis & Mencuccini 2004). Other analyses may include tree height and wood specific gravity, which would require height measurements and a literature search of wood densities for the species present in the plot. With a long-term data set, these calculations could be made over time in order to study the temporal variation in AGB (Chave et al. 2003).

Secondly, new research plots could be used to study other pertinent questions within the park, such as the 20X20m plots previously discussed. This smaller plot method could also be used for comparing specific areas of the park. For example, in the context of human influence on long-term forest dynamics, one could establish a randomized series of plots along the roads to a randomized series of plots in a portion of isolated forest.

Lastly and more importantly, all of these future projects give PNM the chance to strengthen ties with its associated organizations such as STRI, la Universidad de Panamá, la Universidad Tecnológica de Panamá, McGill University, and others. With these projects, students have the opportunity to gain practical field experience, apply their knowledge, and develop professional and technical skills alongside qualified researchers and their peers. This will surely increase resilience of long-term monitoring and support PNM's goals for public education, awareness, and networking.

Conclusion

The three products we provide to the park compliment each other and are meant to built credibility, interest, and ultimately promote long-term maintenance of plot surveying. The new 1-ha plot in PNM is useful in many different ways, for both the park's management goals and to STRI's network of research plots. However, we also recommend that park establishes multiple 20X20m quadrats in order to obtain a better representation of the inhabiting tree community.

The components of this project relate directly to the broader perspective of long-term ecological research, which has been gaining in interest in the last few decades. In the context of environmental science, long-term studies provide us with important insight about large-scale trends. Their uses span over a wide variety of areas, from population ecology and environmental change to resource management. Results obtained from these studies should return to the public, and be integrated in the process of policy making so they may influence practices in the realm of natural resource managers. In this way, long-term ecological study should involve the participation of organizations at the research, management, and political levels. The association between PNM and STRI is a perfect example of the types of partnerships that should continue to develop in order to ensure the institutionalization and persistence of long-term ecological monitoring.

There exists a vast amount of literature that describes in detail the many ways to designing effective and resilient long-term ecological studies, for instance: "Adaptive Monitoring: a new paradigm for long-term research and monitoring" (Lindenmayer & Likens 2009), "Effective Ecological Monitoring" (Lindenmayer &

Likens 2010), and “Design and Analysis of Long-term Ecological Monitoring Studies” (Gitzen et al. 2012). This year was only the first step in the long-term process.

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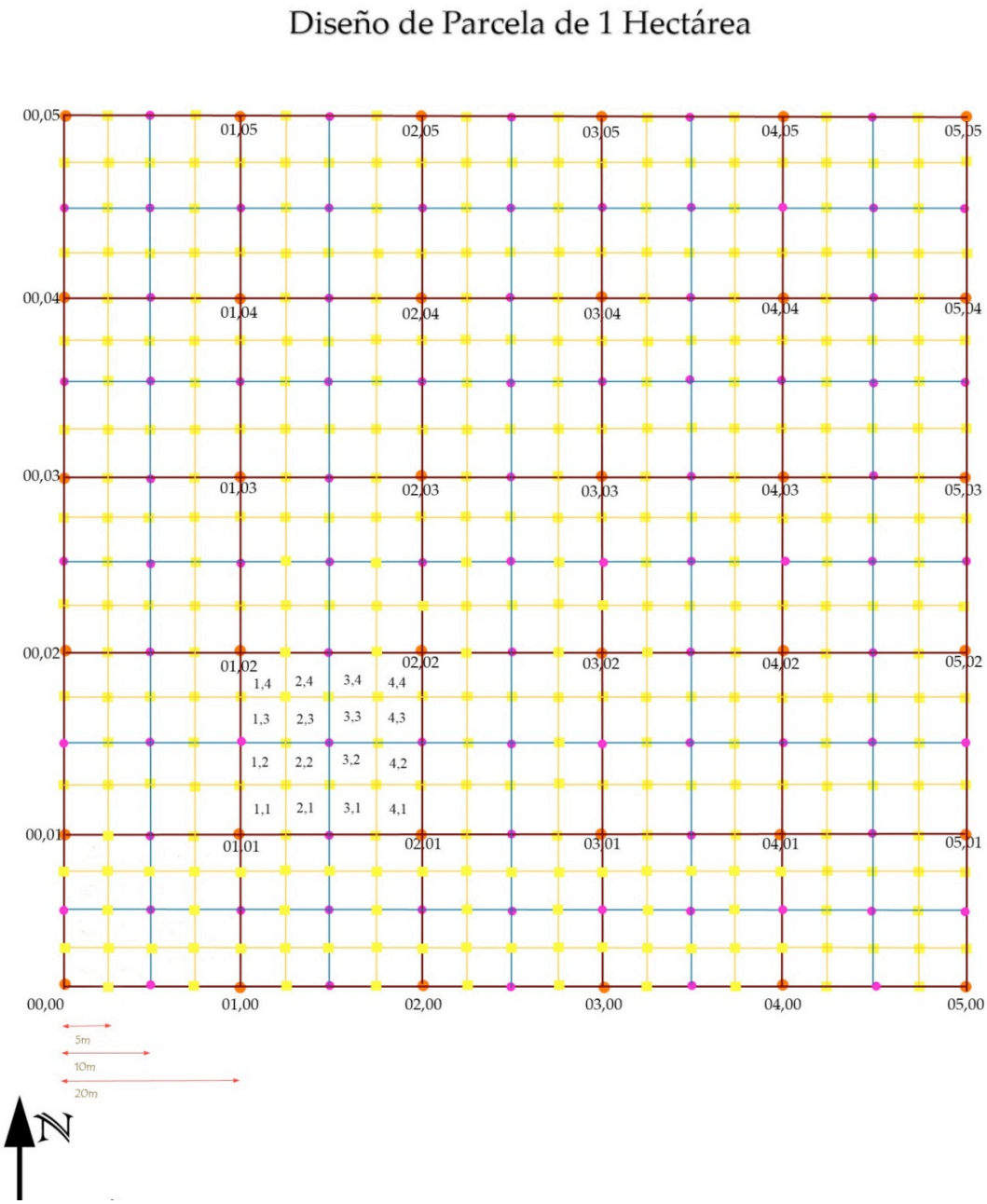
Appendices

Appendix 1: Map of Parque Naural Metropolitano and location of the research plots.

Appendix 2: Plan of a 1-ha plot. Each corner of a 20X20m quadrat is identified with a four-digit code (e.g.: 00,00). Each 5X5m sub-quadrat in every quadrat is identified with a two-digits code (e.g.: 1,1)



Appendix 3: Template of video script and panels (English and Spanish)

Video Panels

*subtitles for Spanish version
* Narrated parts for majority of things that need to be said
* Dialogue kept to a minimum, use only for putting narration in context and relate to jokes

SCRIPT

Scene 1: theme = intro
David and Philippe
Entering park on bikes, passing by, focus after on Park sign
Appear Title: "Outdoor classrooms: Long-term forest research" – need to revise
No narration needed

Scene 2: theme = STRI, forest ecology
"In recent decades, scientists have realized the importance of long-term studies in forest ecology. "
Show STRI, show MAP of research plots

Scene 3: theme = CTFS, long-term ecology
Narration: "Since the 1980s, the Center for Tropical Forest Science at the Smithsonian Tropical Research Institute has been developing a global network of permanent forest research plots. This network is connected by a standard methodology in order to analyze ecological changes in different types of forest communities around the world"
Show Rolando's office, data usage on computer screens, more shots of forest communities

Scene 4: theme = David and Philippe show their plot and what they do.
Show tourist walking down trail, come across PVC tubes, notice D and P in the forest, tagging trees.

Question: "So what goes into setting up a forest plot?" (Could be asked through text?)

Scene 5: *Montages for gearing up*

Scene 6: Answers to question
Answer: "Well, it takes patience and persistence…"
Show hammering a nail into a hard tree, frustratingly, bend the nail

"And also a bit of problem-solving…"

Show trying to get around a tree with measuring tape, undecidedly

"Sometimes nature isn't necessarily on your side…"
Show ants, either getting bit (not literally), or cleaning them off your shoes
"Tagging trees is really where it gets interesting…"
Show problem tree, David with confused facial expression
David: "Hey Phil, what do we do when-"
Phil: "Just check the guide!"
David flips through the guide quickly…

"It usually helps to know the local tree species or to have someone qualified who can easily identify them for you"
Show comparing leaf specimen to tree species guide, not easily identified, confused and frustrated, show species code form with list of hundreds of species.
Dave can't figure it out; Phil comes over his shoulder and simply points out the right out, leaves without notice.

Scene 7: theme = interview describing what a plot entails
(sub-title in corner: *David Hageraats and Philippe Heine – PNM interns*)
"Forest plots are everywhere! We've just set one up in the heart of Panama City, which will be producing data for decades. It's exciting because it is a dry tropical forest, which is a pretty rare/unique/interesting/understudied type of ecosystem"

Scene 8: theme = actually showing work
Narration: "A typical 1 ha in Panama can include between 300 to 500 stems and about 30-50 species, where all trees above 10 cm in diameter are measured. Some of the biggest research plots in the world hold more than 200,000 stem, which are measured every 5 years by a team of researchers."
Show sped-up shots of tagging trees
Show taking dbh, show tags and paint, etc…

Scene 9: theme = entering and analysing the data.
"Once all the data is collected, we can start to use computer programming in order to analyze what we've got"
Show David and Philippe with lap-top, graphics, thumbs up to results
Show CTFS lab / office, and the data being entered

Scene 10: theme = the larger idea
"The cool thing about this type of research is that it offers a great opportunity for education at all levels. For example, this plot here in Panama is in the middle of the city, so anyone can come and check it out. Really, the forest is its own classroom"
Show Park, public, accessibility etc..

SPANISH SUBTITLES

En las últimas décadas, los científicos han dado cuenta de la importancia de los estudios a largo plazo en ecología forestal.

Desde los años 1980, el Centro de Investigaciones de Bosque Tropicales en el Instituto Smithsonian de Investigaciones Tropicales ha desarrollado una red global de parcelas de investigación forestal permanente. Esta red está conectada por una metodología estándar para analizar cambios ecológicos en diferentes tipos de comunidades forestales del mundo.

Parcelas de bosque están por todas partes! Hemos configurado uno en el corazón de la ciudad de Panamá, que producirá datos durante décadas. Es muy chevere porque es un bosque tropical seco, que es un tipo bastante raro y menos estudiado del ecosistema.

Como estas personas, puede estar pensando, ¿como se hace una parcela del investigación forestal?

Se necesita paciencia y perseverancia.

Y también un poco de resolución de problemas.

A veces la naturaleza no es necesariamente de su lado.

Generalmente es mejor a conocer las especies arbóreas locales o que hay alguien cualificado que puede identificarlos fácilmente para ti.

Una parcela típica de 1-hectarea en Panamá puede incluir entre 300 a 500 tallos y unos 30-50 especies, donde se miden todos los árboles por encima de 10 cm de diámetro. Algunas de las parcelas de investigación más grandes del mundo espera más de 200.000 tallos, que miden cada 5 años por un equipo de investigadores.

Una vez que todos los datos son recolectados, podemos empezar a utilizar programaciones para analizar lo que tenemos.

La cosa interesante de este tipo de investigación es que ofrece una gran oportunidad para la educación en todos los niveles. Por ejemplo, este terreno aquí en Panamá está en el centro de la ciudad, así que cualquiera puede venir y comprobarlo. El bosque es realmente su propio salón de clases.

Appendix 4: Plot Results and Analysis

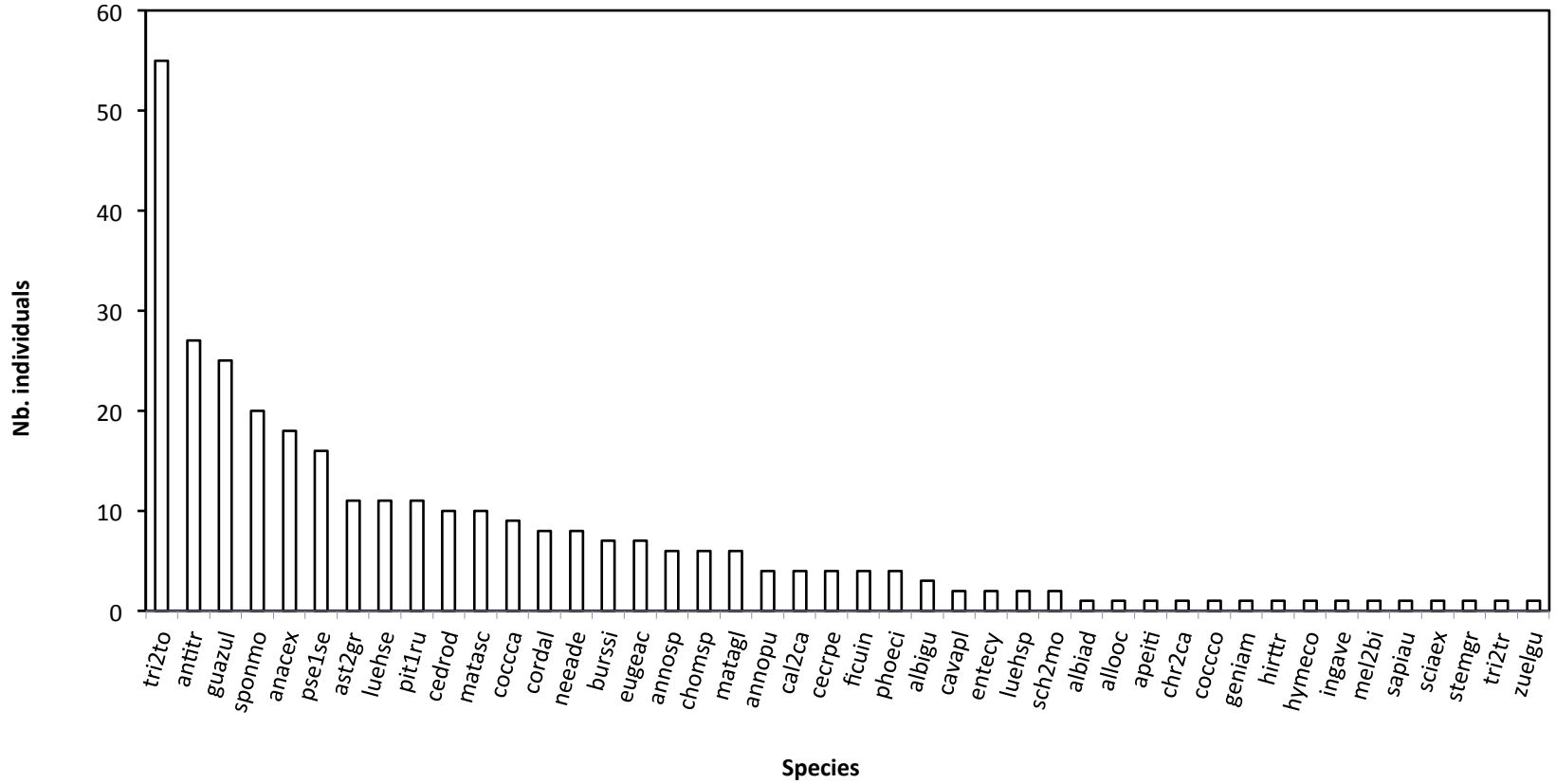


Figure 1. Distribution of abundances for all trees (DBH>10mm) in the 1-ha plot situated along “Los Momótides” trail in Parque Natural Metropolitano

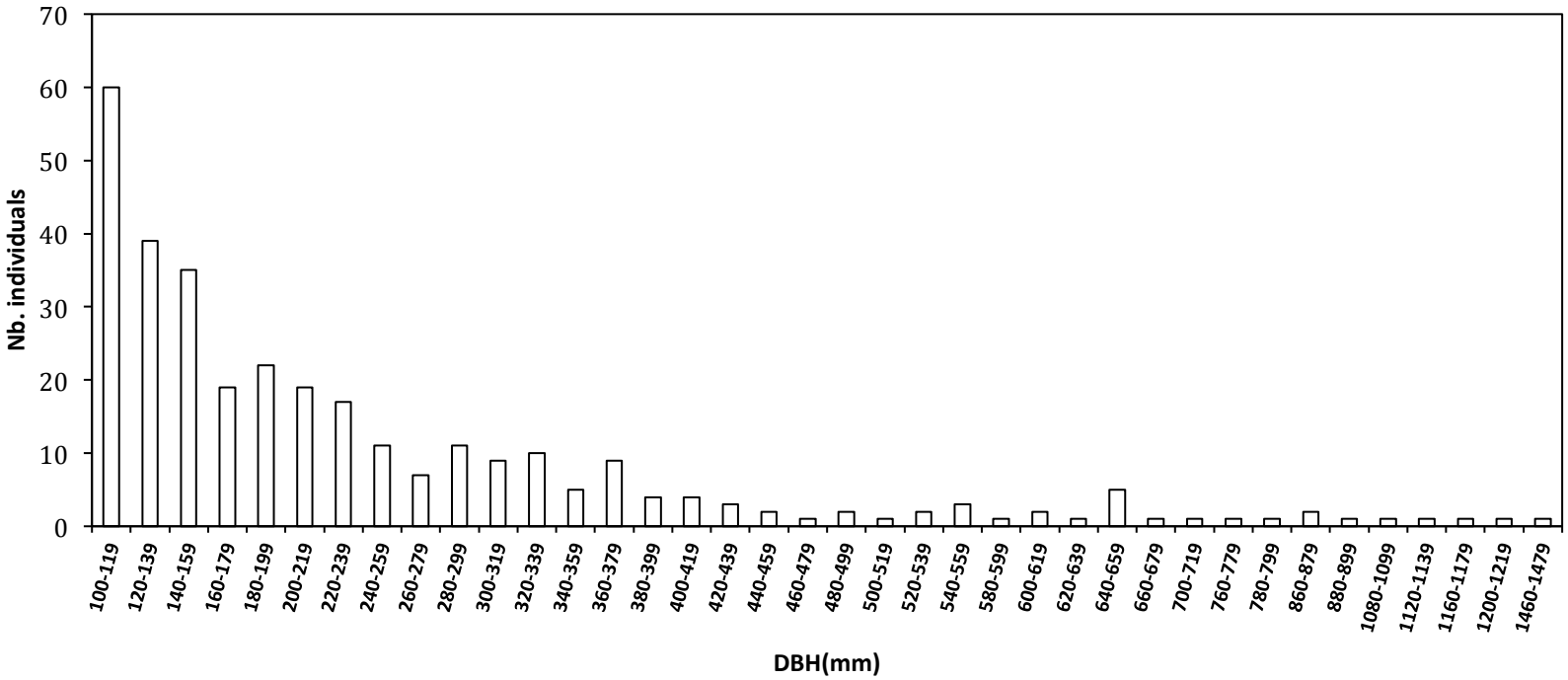


Figure 2. Distribution of diameter at breast height for all trees (DBH>100mm) in the 1-ha plot situated along "Los Momótides" trail in Parque Natural Metropolitano

Table 2. Summary of plot facts with regards to individuals, species, and diameter at breast height

Min (mm)	100
Max (mm)	1474
Mean (mm)	248
Median (mm)	182
Nb. Individuals with multiples	385
Nb. Individuals without multiples	318
Nb species	44
Basal area (m^2ha^{-1})	24,6

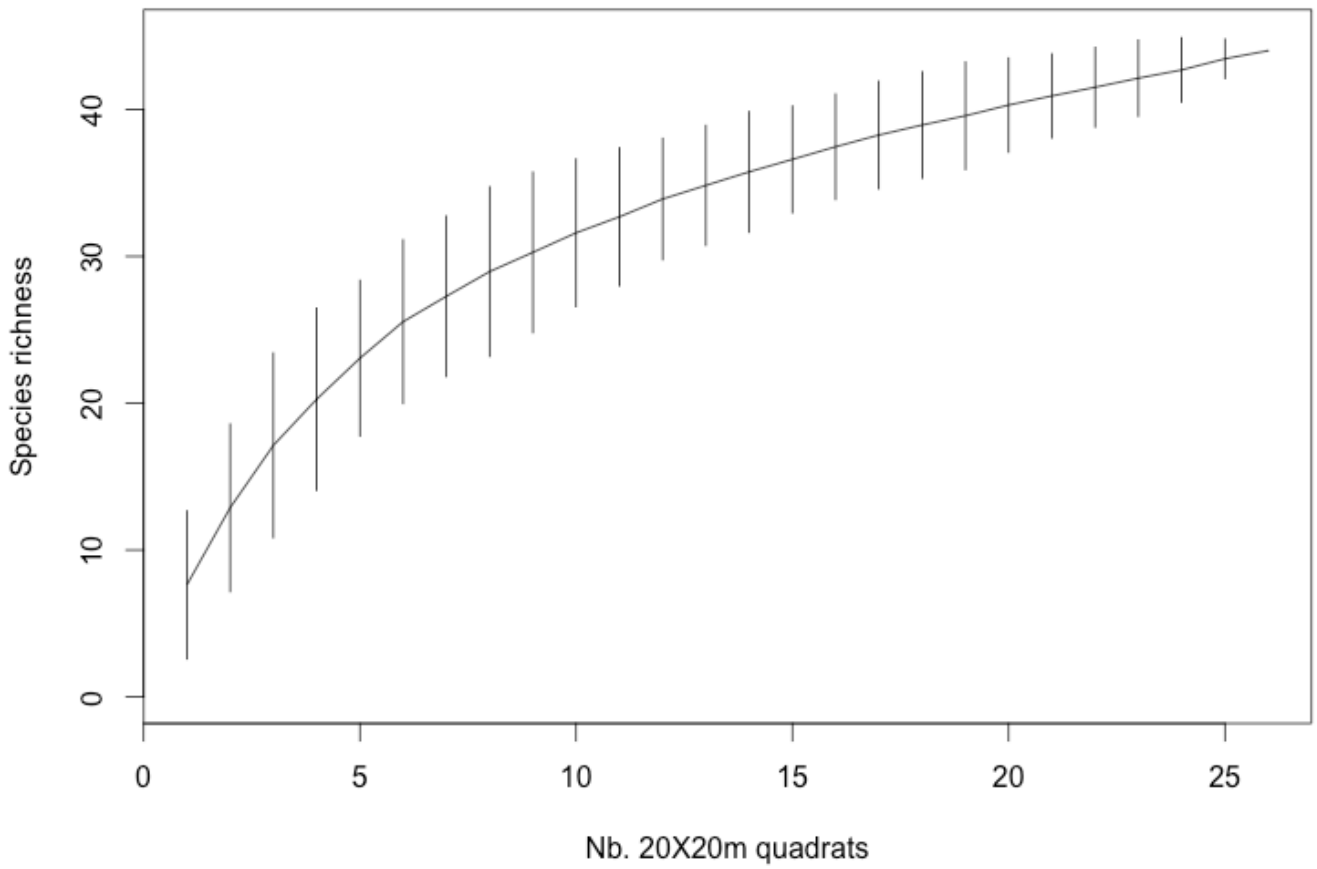


Fig. 3. Species accumulation curve of the 1-ha plot situated along “Los Momótides” trail in Parque Natural Metropolitano. The species richness accumulates from 1 to 25 quadrats (20X20m) to sum up for a total of 1-ha.

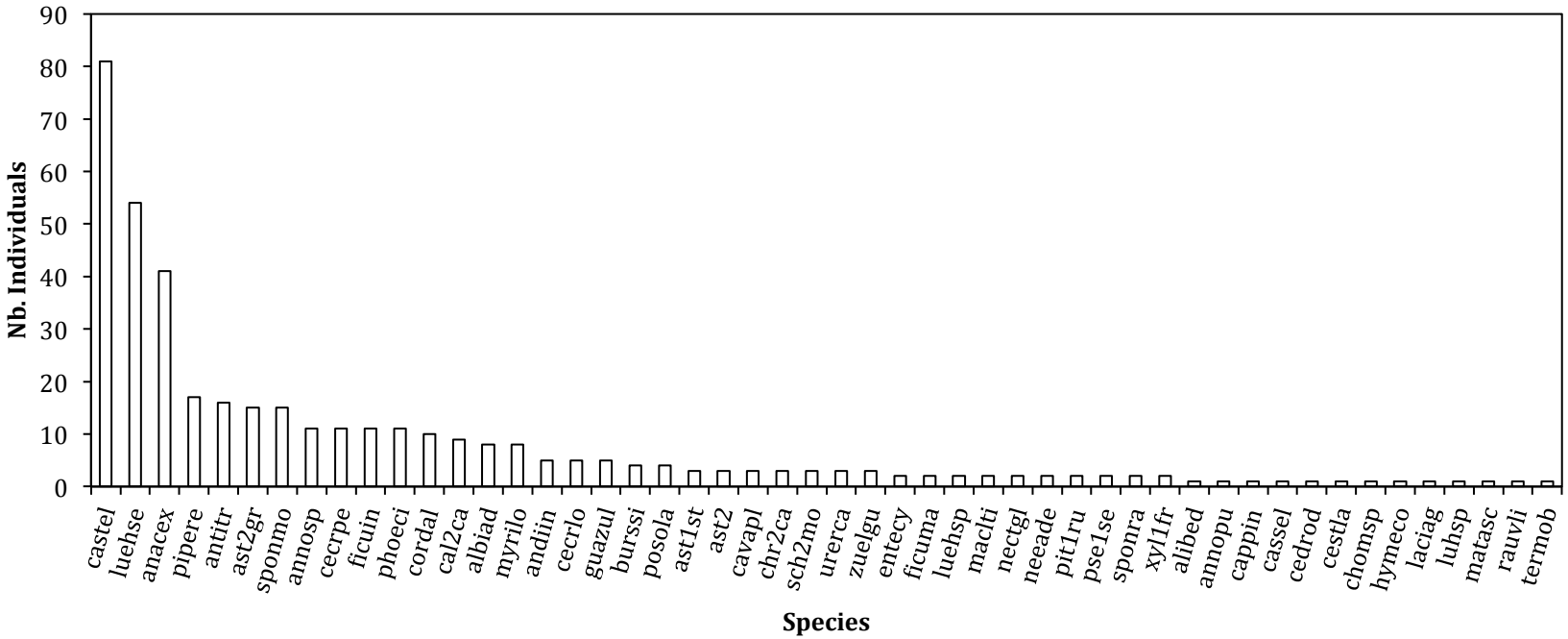


Fig. 4: Distribution of abundances for all trees (DBH>10mm) in the 1-ha plot situated under the canopy crane in Parque Natural Metropolitano, data surveyed in 2008.

Appendix 5: Species name observed and associated code.

SPCODE	speciesid	Family	Genus	SpeciesName
albiad	19	Fabaceae-mimosoideae	Albizia	adinocephala
albigu	833	Fabaceae-mimosoideae	Pseudosamanea	guachapele
allooc	32	Sapindaceae	Allophylus	racemosus
anacex	42	Anacardiaceae	Anacardium	excelsum
annopu	56	Annonaceae	Annona	purpurea
annosp	58	Annonaceae	Annona	spraguei
antitr	789	Rubiaceae	Pittoniotis	trichantha
apeiti	61	Malvaceae	Apeiba	tibourbou
ast2gr	84	Anacardiaceae	Astronium	graveolens
burssi	122	Burseraceae	Bursera	simaruba
cal2ca	138	Rubiaceae	Calycophyllum	candidissimum
cavapl	174	Malvaceae	Cavanillesia	platanifolia
cecrpe	180	Urticaceae	Cecropia	peltata
cedrod	182	Meliaceae	Cedrela	odorata
chomsp	195	Rubiaceae	Chomelia	spinosa
chr2ca	203	Sapotaceae	Chrysophyllum	cainito
coccca	233	Polygonaceae	Coccoloba	caracasana
coccco	234	Polygonaceae	Coccoloba	coronata
cordal	262	Boraginaceae	Cordia	alliodora
entecy	339	Fabaceae-mimosoideae	Enterolobium	cyclocarpum
eugeac		Myrtaceae	Eugenia	acapulcensis
ficuin	391	Moraceae	Ficus	insipida
geniam	409	Rubiaceae	Genipa	americana
guazul	450	Malvaceae	Guazuma	ulmifolia
hirttr	487	Chrysobalanaceae	Hirtella	triandra
hymeco	495	Fabaceae-caesalpinioideae	Hymenaea	courbaril
ingave	533	Fabaceae-mimosoideae	Inga	vera
luehse	582	Malvaceae	Luehea	seemannii
luehsp	583	Malvaceae	Luehea	speciosa
matagl	613	Sapindaceae	Matayba	glaberrima
matasc	614	Sapindaceae	Matayba	scrobiculata
mel2bi	625	Sapindaceae	Melicoccus	bijugatus
neeade	696	Nyctaginaceae	Neea	delicatula
phoeci	208	Lauraceae	Cinnamomum	triplinerve
pit1ru	1119	Fabaceae-mimosoideae	Cojoba	rufescens
pse1se	831	Malvaceae	Pseudobombax	septenatum
sapiau	921	Euphorbiaceae	Sapium	glandulosum
sch2mo	1160	Araliaceae	Schefflera	morototoni
sciaex	927	Araliaceae	Sciadodendron	excelsum
sponmo	964	Anacardiaceae	Spondias	mombin
stemgr	970	Apocynaceae	Stemmadenia	grandiflora
tri2to	1026	Meliaceae	Trichilia	martiana
tri2tr	1034	Meliaceae	Trichilia	trifolia
uniden	1054	Unknown	Unidentified	species
zuelgu	1105	Salicaceae	Zuelania	guidonia

Appendix 6: Raw dataset from the plot

TempID	Tag	StemTag	QuadratName	Subquad	Mnemonic	PlotCensusNumber	DBH	HOM	Codes	Comments	ExactDate
41	27001	NULL	0000	24	neeade	1	124	1,3	NULL	NULL	2014-02-11
42	27002	NULL	0000	31	uniden	1	143	1,3	NULL	EUGEAC	2014-02-11
43	27003	NULL	0000	31	uniden	1	165	1,3	NULL	EUGECA	2014-02-11
44	27004	NULL	0000	33	entecy	1	1474	1,3	NULL	NULL	2014-02-11
45	27005	NULL	0000	33	uniden	1	141	1,3	NULL	EUGEAC	2014-02-11
46	27006	NULL	0000	33	antitr	1	155	1,3	NULL	NULL	2014-02-11
47	27007	NULL	0000	33	annosp	1	240	1,3	NULL	NULL	2014-02-11
48	27008	1	0000	34	neeade	1	128	1,3	M	NULL	2014-02-11
49	27008	2	0000	34	neeade	1	65	1,3	NULL	NULL	2014-02-11
50	27009	NULL	0000	41	antitr	1	111	1,3	NULL	NULL	2014-02-11
170	27010	NULL	0001	11	sponmo	1	175	1,3	NULL	NULL	2014-02-11
171	27011	NULL	0001	12	sponmo	1	375	1,3	NULL	NULL	2014-02-11
172	27012	NULL	0001	23	antitr	1	279	1,3	NULL	NULL	2014-02-11
173	27013	NULL	0001	34	uniden	1	166	1,3	NULL	EUGEAC	2014-02-11
174	27014	NULL	0001	44	ast2gr	1	301	1,3	NULL	NULL	2014-02-11
175	27015	NULL	0001	43	neeade	1	127	1,3	NULL	NULL	2014-02-11
176	27016	NULL	0001	42	ast2gr	1	157	1,3	NULL	NULL	2014-02-11
177	27017	NULL	0001	41	cordal	1	336	1,3	NULL	NULL	2014-02-11
178	27018	NULL	0001	21	pit1ru	1	359	1,3	NULL	NULL	2014-02-11
86	27019	NULL	0002	12	zuelgu	1	297	1,3	NULL	NULL	2014-02-11
87	27020	NULL	0002	12	luehse	1	486	NULL	B;cylN	NULL	2014-02-11
88	27021	NULL	0002	14	guazul	1	185	1,3	NULL	NULL	2014-02-11
89	27022	NULL	0002	32	antitr	1	141	1,3	NULL	NULL	2014-02-11
90	27023	NULL	0002	32	anacex	1	605	1,3	NULL	NULL	2014-02-11
91	27024	NULL	0002	42	guazul	1	240	1,3	NULL	NULL	2014-02-11
92	27026	NULL	0002	34	luehse	1	120	1,3	NULL	NULL	2014-02-11

93	27027	NULL	0002	34	cecrpe	1	261	1,3	NULL	NULL	2014-02-11
1	27028	NULL	0003	21	ficuin	1	290	1,3	NULL	NULL	2014-02-11
2	27029	NULL	0003	21	ficuin	1	551	NULL	B;cylN	NULL	2014-02-11
3	27030	NULL	0003	13	tri2to	1	305	1,3	NULL	NULL	2014-02-11
4	27031	NULL	0003	14	luehse	1	215	NULL	B;cylN	NULL	2014-02-11
5	27032	1	0003	14	matasc	1	255	1,3	NULL	NULL	2014-02-11
6	27032	2	0003	14	matasc	1	147	1,3	NULL	NULL	2014-02-11
7	27033	NULL	0003	33	hirttr	1	110	1,3	NULL	NULL	2014-02-11
213	27034	NULL	0004	14	luehse	1	117	1,3	NULL	NULL	2014-02-11
214	27035	1	0004	34	phoeci	1	128	1,3	NULL	NULL	2014-02-11
215	27035	2	0004	34	phoeci	1	76	1,3	NULL	NULL	2014-02-11
216	27036	1	0004	44	luehsp	1	178	NULL	B;cylY	NULL	2014-02-11
217	27036	2	0004	44	luehsp	1	63	NULL	NULL	NULL	2014-02-11
218	27037	NULL	0004	42	stemgr	1	103	1,3	NULL	NULL	2014-02-11
219	27038	1	0004	42	neeade	1	116	1,3	NULL	NULL	2014-02-11
220	27038	2	0004	42	neeade	1	50	1,3	NULL	NULL	2014-02-11
221	27039	NULL	0004	24	annosp	1	233	1,3	NULL	NULL	2014-02-11
222	27040	NULL	0004	41	annosp	1	247	1,3	NULL	NULL	2014-02-11
223	27041	NULL	0004	31	chr2ca	1	414	NULL	B;cylY	NULL	2014-02-11
154	27101	NULL	0100	11	apeiti	1	239	1,3	NULL	NULL	2014-02-11
155	27102	NULL	0100	12	ast2gr	1	134	1,3	NULL	NULL	2014-02-11
156	27103	NULL	0100	12	luehsp	1	216	2,6	B;cylN	NULL	2014-02-11
157	27104	NULL	0100	22	sapiau	1	112	1,3	L;Q	NULL	2014-02-11
158	27105	1	0100	22	matagl	1	105	1,3	NULL	NULL	2014-02-11
159	27105	2	0100	22	matagl	1	44	1,3	NULL	NULL	2014-02-11
160	27105	3	0100	22	matagl	1	32	1,3	NULL	NULL	2014-02-11
161	27105	4	0100	22	matagl	1	23	1,3	NULL	NULL	2014-02-11
162	27105	5	0100	22	matagl	1	18	1,3	NULL	NULL	2014-02-11
163	27106	1	0100	23	cecrpe	1	244	1,3	NULL	NULL	2014-02-11
164	27106	2	0100	23	cecrpe	1	125	1,3	NULL	NULL	2014-02-11

165	27107	NULL	0100	34	cordal	1	156	1,3	NULL	NULL	2014-02-11
166	27108	NULL	0100	44	guazul	1	182	1,3	NULL	NULL	2014-02-11
167	27109	NULL	0100	44	guazul	1	290	1,3	NULL	NULL	2014-02-11
168	27110	NULL	0100	41	ficuin	1	NULL	NULL	B;P	med=hormigas	2014-02-11
169	27111	NULL	0100	41	anacex	1	128	1,3	NULL	NULL	2014-02-11
245	27112	NULL	0101	31	antitr	1	200	1,3	NULL	NULL	2014-02-15
246	27113	1	0101	42	phoeci	1	313	1,3	Q;M	NULL	2014-02-15
247	27113	2	0101	42	phoeci	1	40	1,3	NULL	NULL	2014-02-15
248	27113	3	0101	42	phoeci	1	34	1,3	NULL	NULL	2014-02-15
249	27114	NULL	0101	34	uniden	1	198	1,3	NULL	EUGEAC	2014-02-15
250	27115	NULL	0101	43	albigu	1	792	1,3	NULL	NULL	2014-02-15
251	27116	NULL	0101	34	anacex	1	176	1,3	NULL	NULL	2014-02-15
252	27117	NULL	0101	34	anacex	1	162	1,3	NULL	NULL	2014-02-15
253	27118	NULL	0101	34	ast2gr	1	255	1,3	NULL	NULL	2014-02-15
254	27119	NULL	0101	24	luehse	1	422	2,2	B;cylN	NULL	2014-02-15
255	27120	NULL	0101	12	sch2mo	1	125	1,3	NULL	NULL	2014-02-15
322	27121	NULL	0102	11	chomsp	1	117	1,7	B;cylY	NULL	2014-02-15
323	27122	NULL	0102	21	anacex	1	149	1,3	NULL	NULL	2014-02-15
324	27123	NULL	0102	22	chomsp	1	179	1		Deformed	2014-02-15
325	27124	NULL	0102	22	luehse	1	371	NULL	B	NULL	2014-02-15
326	27125	NULL	0102	12	burssi	1	238	1,3	NULL	NULL	2014-02-15
327	27126	NULL	0102	12	luehse	1	653	2,7	B;cylN	NULL	2014-02-15
328	27127	NULL	0102	24	cal2ca	1	214	1,3	Q	NULL	2014-02-15
329	27128	NULL	0102	24	uniden	1	269	1,3	NULL	ANTTR	2014-02-15
330	27129	NULL	0102	44	sponmo	1	445	1,3	NULL	NULL	2014-02-15
331	27130	NULL	0102	44	tri2to	1	146	1,3	NULL	NULL	2014-02-15
332	27131	1	0102	43	guazul	1	338	NULL	B;cylY;M	NULL	2014-02-15
333	27131	2	0102	43	guazul	1	283	NULL	NULL	NULL	2014-02-15
74	27068	NULL	0103	21	luehse	1	120	1,3	P	Planta agregada en el	2014-02-15

										chequeo	
51	27132	1	0103	21	coccca	1	239	1,3	M	NULL	2014-02-15
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53	27133	NULL	0103	22	annosp	1	366	1,3	NULL	NULL	2014-02-15
54	27134	NULL	0103	23	guazul	1	302	1,3	NULL	NULL	2014-02-15
55	27135	NULL	0103	22	ast2gr	1	162	1,3	NULL	NULL	2014-02-15
56	27136	NULL	0103	21	anacex	1	606	1,3	NULL	NULL	2014-02-15
57	27137	NULL	0103	12	burssi	1	303	1,3	NULL	NULL	2014-02-15
58	27138	NULL	0103	11	ast2gr	1	236	1,3	NULL	NULL	2014-02-15
59	27139	NULL	0103	13	sponmo	1	239	1,3	NULL	NULL	2014-02-15
60	27140	1	0103	42	coccca	1	333	1,3	M	NULL	2014-02-15
61	27140	2	0103	42	coccca	1	150	1,3	NULL	NULL	2014-02-15
62	27140	3	0103	42	coccca	1	132	1,3	NULL	NULL	2014-02-15
63	27140	4	0103	42	coccca	1	137	1,3	NULL	NULL	2014-02-15
64	27140	5	0103	42	coccca	1	100	1,3	NULL	NULL	2014-02-15
65	27140	6	0103	42	coccca	1	98	1,3	NULL	NULL	2014-02-15
66	27140	7	0103	42	coccca	1	67	1,3	NULL	NULL	2014-02-15
67	27140	8	0103	42	coccca	1	43	1,3	NULL	NULL	2014-02-15
68	27141	NULL	0103	43	sponmo	1	372	1,3	NULL	NULL	2014-02-15
69	27142	NULL	0103	43	chomsp	1	139	1,3	NULL	NULL	2014-02-15
70	27143	1	0103	33	coccca	1	127	1,3	M	NULL	2014-02-15
71	27143	2	0103	33	coccca	1	120	1,3	NULL	NULL	2014-02-15
72	27143	3	0103	33	coccca	1	59	1,3	NULL	NULL	2014-02-15
73	27143	4	0103	33	coccca	1	55	1,3	NULL	NULL	2014-02-15
193	27179	NULL	0104	11	cal2ca	1	203	1,3	NULL	NULL	2014-03-20
194	27180	NULL	0104	21	pse1se	1	126	1,3	NULL	NULL	2014-03-20
195	27181	NULL	0104	21	pse1se	1	162	1,3	NULL	NULL	2014-03-20
196	27182	NULL	0104	22	anacex	1	863	1,3	NULL	NULL	2014-03-20
197	27183	NULL	0104	23	hymeco	1	212	1,3	NULL	NULL	2014-03-20
198	27184	NULL	0104	23	pse1se	1	168	1,3	NULL	NULL	2014-03-20

199	27185	NULL	0104	23	sponmo	1	341	1,3	NULL	NULL	2014-03-20
200	27186	NULL	0104	13	anacex	1	443	1,3	NULL	NULL	2014-03-20
201	27187	NULL	0104	24	sponmo	1	482	1,3	NULL	NULL	2014-03-20
202	27188	NULL	0104	24	tri2to	1	147	1,3	NULL	NULL	2014-03-20
203	27189	NULL	0104	44	pse1se	1	117	1,3	NULL	NULL	2014-03-20
204	27190	NULL	0104	44	phoeci	1	105	1,3	NULL	NULL	2014-03-20
205	27191	NULL	0104	33	anacex	1	1139	1,2	B;cylY	NULL	2014-03-20
206	27192	NULL	0104	43	pse1se	1	141	1,3	NULL	NULL	2014-03-20
207	27193	NULL	0104	32	pse1se	1	146	1,3	NULL	NULL	2014-03-20
208	27194	NULL	0104	41	pse1se	1	115	1,3	NULL	NULL	2014-03-20
209	27195	NULL	0104	42	pse1se	1	103	1,3	NULL	NULL	2014-03-20
210	27196	NULL	0104	41	pse1se	1	119	1,3	NULL	NULL	2014-03-20
211	27197	NULL	0104	31	pse1se	1	144	1,3	NULL	NULL	2014-03-20
212	27198	NULL	0104	42	pse1se	1	101	1,3	NULL	NULL	2014-03-20
366	27042	NULL	0200	12	annopu	1	158	1,3	NULL	NULL	2014-02-15
367	27043	1	0200	23	chomsp	1	215	1,3	M	NULL	2014-02-15
368	27043	2	0200	23	chomsp	1	121	1,3	NULL	NULL	2014-02-15
369	27043	3	0200	23	chomsp	1	113	1,3	NULL	NULL	2014-02-15
370	27044	NULL	0200	23	sponmo	1	280	1,3	NULL	NULL	2014-02-15
371	27046	NULL	0200	24	luehse	1	150	1,3	NULL	NULL	2014-02-15
372	27047	NULL	0200	24	cordal	1	113	1,3	NULL	NULL	2014-02-15
373	27048	NULL	0200	34	cedrod	1	599	1,3	NULL	NULL	2014-02-15
374	27049	1	0200	43	geniam	1	157	1,3	M	NULL	2014-02-15
375	27049	2	0200	43	geniam	1	10	1,3	NULL	NULL	2014-02-15
376	27050	1	0200	42	matagl	1	107	1,3	M	NULL	2014-02-15
385	27050	10	0200	42	matagl	1	7	1,3	NULL	NULL	2014-02-15
386	27050	11	0200	42	matagl	1	6	1,3	NULL	NULL	2014-02-15
377	27050	2	0200	42	matagl	1	70	1,3	NULL	NULL	2014-02-15
378	27050	3	0200	42	matagl	1	34	1,3	NULL	NULL	2014-02-15
379	27050	4	0200	42	matagl	1	21	1,3	NULL	NULL	2014-02-15

380	27050	5	0200	42	matagl	1	11	1,3	NULL	NULL	2014-02-15
381	27050	6	0200	42	matagl	1	10	1,3	NULL	NULL	2014-02-15
382	27050	7	0200	42	matagl	1	9	1,3	NULL	NULL	2014-02-15
383	27050	8	0200	42	matagl	1	9	1,3	NULL	NULL	2014-02-15
384	27050	9	0200	42	matagl	1	7	1,3	NULL	NULL	2014-02-15
387	27052	NULL	0200	41	ast2gr	1	645	1,3	NULL	NULL	2014-02-15
224	27053	1	0201	12	coccca	1	150	1,3	M	NULL	2014-02-15
225	27053	2	0201	12	coccca	1	130	1,3	NULL	NULL	2014-02-15
226	27054	NULL	0201	21	chomsp	1	111	1,3	NULL	NULL	2014-02-15
227	27055	NULL	0201	13	cal2ca	1	113	1,3	NULL	NULL	2014-02-15
228	27056	NULL	0201	13	pit1ru	1	145	1,3	NULL	NULL	2014-02-15
229	27057	NULL	0201	24	matagl	1	135	1,3	NULL	NULL	2014-02-15
230	27058	NULL	0201	34	ast2gr	1	154	1,3	NULL	NULL	2014-02-15
231	27059	NULL	0201	34	coccco	1	112	1,3	NULL	NULL	2014-02-15
232	27060	NULL	0201	34	tri2to	1	147	1,3	NULL	NULL	2014-02-15
233	27061	NULL	0201	34	burssi	1	369	1,3	NULL	NULL	2014-02-15
234	27062	NULL	0201	34	tri2to	1	114	1,3	NULL	NULL	2014-02-15
235	27063	NULL	0201	44	guazul	1	271	1,3	NULL	NULL	2014-02-15
236	27064	NULL	0201	41	matasc	1	113	1,3	NULL	NULL	2014-02-15
237	27065	NULL	0201	41	sponmo	1	539	1,3	NULL	NULL	2014-02-15
238	27066	NULL	0201	32	mel2bi	1	510	1,3	NULL	NULL	2014-02-15
239	27067	1	0201	23	matagl	1	113	1,3	M	NULL	2014-02-15
240	27067	2	0201	23	matagl	1	62	1,3	NULL	NULL	2014-02-15
241	27067	3	0201	23	matagl	1	36	1,3	NULL	NULL	2014-02-15
242	27067	4	0201	23	matagl	1	16	1,3	NULL	NULL	2014-02-15
243	27067	5	0201	23	matagl	1	16	1,3	NULL	NULL	2014-02-15
244	27067	6	0201	23	matagl	1	8	1,3	NULL	NULL	2014-02-15
334	27144	NULL	0202	21	sch2mo	1	356	1,3	NULL	NULL	2014-02-28
335	27145	NULL	0202	21	tri2to	1	142	1,3	NULL	NULL	2014-02-28
336	27146	NULL	0202	14	albiad	1	105	1,3	Q	NULL	2014-02-28

337	27147	NULL	0202	14	guazul	1	295	1,3	Q	NULL	2014-02-28
338	27148	NULL	0202	31	annopu	1	186	1,3	NULL	NULL	2014-02-28
339	27149	NULL	0202	41	guazul	1	333	1,3	NULL	NULL	2014-02-28
340	27150	NULL	0202	43	guazul	1	294	1,3	NULL	NULL	2014-02-28
341	27152	NULL	0202	42	guazul	1	220	1,3	NULL	NULL	2014-02-28
342	27153	1	0202	42	pit1ru	1	135	1,3	L;M	NULL	2014-02-28
343	27153	2	0202	42	pit1ru	1	10	1,3	NULL	NULL	2014-02-28
344	27154	NULL	0202	44	tri2to	1	113	1,3	NULL	NULL	2014-02-28
345	27155	NULL	0202	44	antitr	1	189	1,3	NULL	NULL	2014-02-28
346	27350	NULL	0202	31	cordal	1	229	1,3	NULL	NULL	2014-02-28
347	27351	NULL	0202	32	pse1se	1	326	1,3	NULL	NULL	2014-02-28
348	27352	NULL	0202	12	pit1ru	1	150	1,3	NULL	NULL	2014-02-28
349	27156	NULL	0203	11	guazul	1	201	1,3	NULL	NULL	2014-02-28
350	27157	NULL	0203	21	cedrod	1	398	1,3	NULL	NULL	2014-02-28
352	27158	1	0203	12	guazul	1	214	1,3	NULL	NULL	2014-02-28
353	27158	2	0203	12	guazul	1	159	1,3	NULL	NULL	2014-02-28
354	27159	NULL	0203	24	antitr	1	168	1,3	NULL	NULL	2014-02-28
355	27160	1	0203	34	guazul	1	310	1,3	NULL	NULL	2014-02-28
356	27160	2	0203	34	guazul	1	306	1,3	NULL	NULL	2014-02-28
357	27161	NULL	0203	44	antitr	1	115	1,3	NULL	NULL	2014-02-28
358	27162	NULL	0203	42	antitr	1	108	1,3	NULL	NULL	2014-02-28
359	27163	1	0203	42	sponmo	1	471	1,3	NULL	NULL	2014-02-28
360	27163	2	0203	42	sponmo	1	193	1,3	NULL	NULL	2014-02-28
361	27164	NULL	0203	32	antitr	1	142	1,3	NULL	NULL	2014-02-28
362	27165	NULL	0203	32	annosp	1	315	1,3	NULL	NULL	2014-02-28
363	27166	NULL	0203	41	antitr	1	150	1,3	NULL	NULL	2014-02-28
364	27167	1	0203	41	pit1ru	1	195	1,3	NULL	NULL	2014-02-28
365	27167	2	0203	41	pit1ru	1	109	1,3	NULL	NULL	2014-02-28
8	27168	NULL	0204	11	guazul	1	352	1,3	NULL	NULL	2014-02-28
9	27169	NULL	0204	21	antitr	1	210	1,3	NULL	NULL	2014-02-28

10	27170	NULL	0204	12	cal2ca	1	113	1,3	NULL	NULL	2014-02-28
11	27171	NULL	0204	24	burssi	1	206	1,3	NULL	NULL	2014-02-28
12	27172	NULL	0204	14	pse1se	1	133	1,3	NULL	NULL	2014-02-28
13	27173	NULL	0204	14	pse1se	1	153	1,3	NULL	NULL	2014-02-28
14	27174	NULL	0204	33	guazul	1	337	0,55	NULL	NULL	2014-02-28
15	27175	NULL	0204	41	burssi	1	363	1,3	NULL	NULL	2014-02-28
16	27176	NULL	0204	31	sponmo	1	339	1,3	NULL	NULL	2014-02-28
17	27177	NULL	0204	34	guazul	1	145	1,3	NULL	NULL	2014-02-28
18	27178	1	0204	32	pit1ru	1	281	1,3	NULL	NULL	2014-02-28
278	27260	NULL	0300	14	tri2to	1	136	1,3	NULL	NULL	2014-03-20
279	27261	NULL	0300	13	cedrod	1	439	1,3	NULL	NULL	2014-03-20
280	27262	NULL	0300	13	pit1ru	1	234	1,3	NULL	NULL	2014-03-20
281	27263	NULL	0300	13	pse1se	1	150	1,3	NULL	NULL	2014-03-20
282	27264	NULL	0300	13	neeade	1	106	1,3	NULL	NULL	2014-03-20
283	27265	NULL	0300	12	sponmo	1	175	1,3	NULL	NULL	2014-03-20
284	27266	NULL	0300	11	guazul	1	234	1,3	NULL	NULL	2014-03-20
285	27267	1	0300	21	matagl	1	103	1,3	NULL	NULL	2014-03-20
286	27267	2	0300	21	matagl	1	42	1,3	NULL	NULL	2014-03-20
287	27267	3	0300	21	matagl	1	15	1,3	NULL	NULL	2014-03-20
288	27267	4	0300	21	matagl	1	12	1,3	NULL	NULL	2014-03-20
289	27267	5	0300	21	matagl	1	11	1,3	NULL	NULL	2014-03-20
290	27267	6	0300	21	matagl	1	10	1,3	NULL	NULL	2014-03-20
291	27268	NULL	0300	31	sponmo	1	321	1,3	NULL	NULL	2014-03-20
292	27269	NULL	0300	32	guazul	1	180	1,3	NULL	NULL	2014-03-20
293	27270	NULL	0300	22	cordal	1	192	1,3	NULL	NULL	2014-03-20
294	27271	NULL	0300	22	cecrpe	1	221	1,3	NULL	NULL	2014-03-20
295	27272	NULL	0300	24	cecrpe	1	114	1,3	NULL	NULL	2014-03-20
296	27273	NULL	0300	33	cordal	1	123	1,3	NULL	NULL	2014-03-20
297	27274	NULL	0300	33	tri2to	1	132	1,3	NULL	NULL	2014-03-20
298	27275	NULL	0300	42	tri2to	1	126	1,3	NULL	NULL	2014-03-20

299	27276	NULL	0300	31	tri2to	1	116	1,3	NULL	NULL	2014-03-20
300	27277	NULL	0300	41	tri2to	1	293	1,3	NULL	NULL	2014-03-20
301	27278	NULL	0300	42	guazul	1	194	1,3	NULL	NULL	2014-03-20
302	27279	NULL	0300	42	tri2to	1	105	1,3	NULL	NULL	2014-03-20
303	27280	NULL	0300	44	tri2to	1	147	1,3	NULL	NULL	2014-03-20
304	27281	NULL	0300	44	ficuin	1	766	1,3	B;cylN	NULL	2014-03-20
305	27282	1	0300	43	matagl	1	103	1,3	NULL	NULL	2014-03-20
306	27282	2	0300	43	matagl	1	47	1,3	NULL	NULL	2014-03-20
307	27282	3	0300	43	matagl	1	40	1,3	NULL	NULL	2014-03-20
308	27282	4	0300	43	matagl	1	35	1,3	NULL	NULL	2014-03-20
309	27282	5	0300	43	matagl	1	17	1,3	NULL	NULL	2014-03-20
310	27282	6	0300	43	matagl	1	17	1,3	NULL	NULL	2014-03-20
256	27239	NULL	0301	12	tri2to	1	183	1,3	NULL	NULL	2014-03-20
257	27240	NULL	0301	12	albigu	1	677	1,7	NULL	NULL	2014-03-20
258	27241	NULL	0301	13	tri2to	1	128	1,3	NULL	NULL	2014-03-20
259	27242	NULL	0301	23	cedrod	1	715	1,3	NULL	NULL	2014-03-20
260	27243	NULL	0301	11	cedrod	1	649	1,3	NULL	NULL	2014-03-20
261	27244	NULL	0301	22	antitr	1	194	1,3	NULL	NULL	2014-03-20
262	27245	NULL	0301	22	tri2to	1	263	1,3	NULL	NULL	2014-03-20
263	27246	NULL	0301	31	ast2gr	1	115	1,3	NULL	NULL	2014-03-20
264	27247	NULL	0301	31	ast2gr	1	223	1,3	NULL	NULL	2014-03-20
265	27248	NULL	0301	31	sponmo	1	348	1,3	NULL	NULL	2014-03-20
266	27249	NULL	0301	42	cedrod	1	375	1,3	NULL	NULL	2014-03-20
267	27250	NULL	0301	42	tri2to	1	115	1,3	NULL	NULL	2014-03-20
268	27251	NULL	0301	43	tri2to	1	101	1,3	NULL	NULL	2014-03-20
269	27252	NULL	0301	33	tri2to	1	217	1,3	NULL	NULL	2014-03-20
270	27253	NULL	0301	44	ast2gr	1	413	1,3	NULL	NULL	2014-03-20
271	27254	NULL	0301	44	tri2to	1	130	1,3	NULL	NULL	2014-03-20
272	27255	1	0301	44	guazul	1	229	1,3	NULL	NULL	2014-03-20
273	27255	2	0301	44	guazul	1	128	1,3	NULL	NULL	2014-03-20

274	27256	NULL	0301	24	tri2to	1	215	1,3	NULL	NULL	2014-03-20
275	27257	NULL	0301	14	antitr	1	124	1,3	NULL	NULL	2014-03-20
276	27258	NULL	0301	14	tri2to	1	145	1,3	NULL	NULL	2014-03-20
277	27259	NULL	0301	14	coccca	1	119	1,3	NULL	NULL	2014-03-20
119	27223	NULL	0302	13	tri2to	1	218	1,3	NULL	NULL	2014-03-20
120	27224	NULL	0302	12	sponmo	1	422	1,3	NULL	NULL	2014-03-20
121	27225	NULL	0302	11	matasc	1	147	1,3	NULL	NULL	2014-03-20
122	27226	NULL	0302	11	tri2to	1	101	1,3	NULL	NULL	2014-03-20
123	27227	NULL	0302	11	guazul	1	201	1,3	NULL	NULL	2014-03-20
124	27228	NULL	0302	11	matasc	1	134	1,3	NULL	NULL	2014-03-20
125	27229	NULL	0302	12	luehse	1	647	2	B;cylN	NULL	2014-03-20
126	27230	NULL	0302	21	anacex	1	146	1,3	NULL	NULL	2014-03-20
127	27231	NULL	0302	31	pit1ru	1	238	1,3	NULL	NULL	2014-03-20
128	27232	NULL	0302	42	guazul	1	195	1,3	NULL	NULL	2014-03-20
129	27233	NULL	0302	42	allooc	1	112	1,3	NULL	NULL	2014-03-20
130	27234	NULL	0302	33	tri2to	1	235	1,3	NULL	NULL	2014-03-20
131	27235	NULL	0302	23	tri2to	1	110	1,3	NULL	NULL	2014-03-20
132	27236	NULL	0302	24	chomsp	1	125	1,3	NULL	NULL	2014-03-20
133	27237	NULL	0302	34	coccca	1	134	1,3	NULL	NULL	2014-03-20
134	27238	NULL	0302	44	tri2to	1	172	1,3	NULL	NULL	2014-03-20
135	27353	NULL	0302	11	matasc	1	109	1,3	NULL	NULL	2014-03-20
311	27213	NULL	0303	34	sciaex	1	210	1,3	NULL	NULL	2014-03-20
312	27214	NULL	0303	44	antitr	1	138	1,3	NULL	NULL	2014-03-20
313	27215	1	0303	43	coccca	1	168	1,3	NULL	NULL	2014-03-20
314	27215	2	0303	43	coccca	1	108	1,3	NULL	NULL	2014-03-20
315	27216	NULL	0303	33	burssi	1	113	1,3	NULL	NULL	2014-03-20
316	27217	NULL	0303	23	antitr	1	149	1,3	NULL	NULL	2014-03-20
317	27218	NULL	0303	21	antitr	1	100	1,3	NULL	NULL	2014-03-20
318	27219	NULL	0303	21	cordal	1	131	1,3	NULL	NULL	2014-03-20
319	27220	NULL	0303	42	burssi	1	173	1,3	NULL	NULL	2014-03-20

320	27221	NULL	0303	42	albigu	1	405	1,3	NULL	NULL	2014-03-20
321	27222	NULL	0303	41	neeade	1	192	1,3	NULL	NULL	2014-03-20
20	27199	NULL	0304	23	antitr	1	142	1,3	NULL	NULL	2014-03-20
21	27200	NULL	0304	23	cavapl	1	106	1,3	NULL	NULL	2014-03-20
22	27201	NULL	0304	14	antitr	1	124	1,3	NULL	NULL	2014-03-20
23	27202	NULL	0304	33	anacex	1	124	1,3	NULL	NULL	2014-03-20
24	27203	NULL	0304	33	annopu	1	296	1,3	NULL	NULL	2014-03-20
25	27204	NULL	0304	43	antitr	1	119	1,44	NULL	NULL	2014-03-20
26	27205	NULL	0304	44	luehse	1	532	2,3	B;cylN	NULL	2014-03-20
27	27206	NULL	0304	44	antitr	1	114	1,3	NULL	NULL	2014-03-20
28	27207	NULL	0304	41	matasc	1	102	1,3	NULL	NULL	2014-03-20
29	27208	NULL	0304	21	cedrod	1	876	1,3	NULL	NULL	2014-03-20
30	27209	NULL	0304	21	antitr	1	112	1,3	NULL	NULL	2014-03-20
31	27210	NULL	0304	11	cordal	1	136	1,3	NULL	NULL	2014-03-20
32	27211	NULL	0304	11	cedrod	1	175	1,3	NULL	NULL	2014-03-20
33	27212	NULL	0304	22	antitr	1	137	1,3	NULL	NULL	2014-03-20
179	27336	NULL	0400	13	tri2to	1	256	1,3	NULL	NULL	2014-03-21
180	27337	NULL	0400	24	tri2to	1	217	1,3	NULL	NULL	2014-03-21
181	27338	NULL	0400	23	tri2to	1	251	1,3	NULL	NULL	2014-03-21
182	27339	NULL	0400	22	tri2to	1	416	1,3	NULL	NULL	2014-03-21
183	27340	NULL	0400	21	antitr	1	285	1,3	NULL	NULL	2014-03-21
184	27341	NULL	0400	31	tri2tr	1	216	1,3	NULL	NULL	2014-03-21
185	27342	NULL	0400	31	anacex	1	629	1,3	NULL	NULL	2014-03-21
186	27343	NULL	0400	32	anacex	1	183	1,3	NULL	NULL	2014-03-21
187	27344	NULL	0400	32	annopu	1	182	1,3	L	NULL	2014-03-21
188	27345	NULL	0400	42	tri2to	1	141	1,3	NULL	NULL	2014-03-21
189	27346	NULL	0400	43	sponmo	1	306	1,3	NULL	NULL	2014-03-21
190	27347	NULL	0400	43	cavapl	1	190	1,3	NULL	NULL	2014-03-21
191	27348	NULL	0400	33	uniden	1	101	1,3	NULL	EUGEAC	2014-03-21
192	27349	NULL	0400	34	uniden	1	164	1,3	NULL	EUGEAC	2014-03-21

94	27314	NULL	0401	44	tri2to	1	122	1,3	NULL	NULL	2014-03-21
95	27315	NULL	0401	34	tri2to	1	190	1,3	NULL	NULL	2014-03-21
96	27316	NULL	0401	43	tri2to	1	142	1,3	NULL	NULL	2014-03-21
97	27317	NULL	0401	42	pit1ru	1	116	1,3	NULL	NULL	2014-03-21
98	27318	NULL	0401	42	anacex	1	229	1,3	NULL	NULL	2014-03-21
99	27319	NULL	0401	41	cedrod	1	655	2,1	NULL	NULL	2014-03-21
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101	27321	NULL	0401	33	neeade	1	246	1,3	NULL	NULL	2014-03-21
102	27322	NULL	0401	32	coccca	1	109	1,3	NULL	NULL	2014-03-21
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104	27324	NULL	0401	12	tri2to	1	103	1,3	NULL	NULL	2014-03-21
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107	27326	2	0401	11	pit1ru	1	76	1,3	NULL	NULL	2014-03-21
108	27326	3	0401	11	pit1ru	1	15	0,7	NULL	NULL	2014-03-21
109	27326	4	0401	11	pit1ru	1	14	0,85	NULL	NULL	2014-03-21
110	27327	NULL	0401	11	entecy	1	895	1,3	NULL	NULL	2014-03-21
111	27328	NULL	0401	11	tri2to	1	293	1,3	NULL	NULL	2014-03-21
112	27329	NULL	0401	22	tri2to	1	160	1,3	NULL	NULL	2014-03-21
113	27330	NULL	0401	22	tri2to	1	125	1,3	NULL	NULL	2014-03-21
114	27331	NULL	0401	13	sponmo	1	337	1,3	NULL	NULL	2014-03-21
115	27332	NULL	0401	13	neeade	1	185	1,3	NULL	NULL	2014-03-21
116	27333	NULL	0401	13	sponmo	1	391	1,3	NULL	NULL	2014-03-21
117	27334	NULL	0401	23	annosp	1	131	1,3	NULL	NULL	2014-03-21
118	27335	NULL	0401	23	guazul	1	181	1,3	NULL	NULL	2014-03-21
136	27299	NULL	0402	24	anacex	1	1215	1,3	NULL	NULL	2014-03-21
137	27300	NULL	0402	33	tri2to	1	180	1,7	NULL	NULL	2014-03-21
138	27301	1	0402	33	tri2to	1	315	1,3	NULL	NULL	2014-03-21
139	27301	2	0402	33	tri2to	1	22	1,3	NULL	NULL	2014-03-21
140	27302	NULL	0402	42	tri2to	1	138	1,3	NULL	NULL	2014-03-21

141	27303	NULL	0402	32	tri2to	1	245	1,3	P	Liana conjuntos	2014-03-21
142	27304	1	0402	32	antitr	1	378	1,3	NULL	NULL	2014-03-21
143	27304	2	0402	32	antitr	1	176	1,3	NULL	NULL	2014-03-21
144	27305	NULL	0402	41	tri2to	1	232	1,3	NULL	NULL	2014-03-21
145	27306	NULL	0402	41	sponmo	1	367	1,3	NULL	NULL	2014-03-21
146	27307	NULL	0402	31	tri2to	1	101	1,3	NULL	NULL	2014-03-21
147	27308	NULL	0402	31	tri2to	1	106	1,3	NULL	NULL	2014-03-21
148	27309	NULL	0402	32	matasc	1	130	1,3	NULL	NULL	2014-03-21
149	27310	NULL	0402	32	guazul	1	184	1,3	L	NULL	2014-03-21
150	27311	1	0402	21	pit1ru	1	100	1,3	NULL	NULL	2014-03-21
151	27311	2	0402	21	pit1ru	1	20	1,3	NULL	NULL	2014-03-21
152	27312	NULL	0402	12	tri2to	1	103	1,3	NULL	NULL	2014-03-21
153	27313	NULL	0402	13	matasc	1	325	1,3	NULL	NULL	2014-03-21
34	27293	NULL	0403	34	tri2to	1	111	1,3	NULL	NULL	2014-03-21
35	27294	NULL	0403	44	tri2to	1	245	1,3	NULL	NULL	2014-03-21
36	27295	NULL	0403	43	tri2to	1	397	1,3	B;cylN	NULL	2014-03-21
37	27296	NULL	0403	41	sponmo	1	384	0,8	NULL	NULL	2014-03-21
38	27297	NULL	0403	32	pse1se	1	151	1,3	NULL	NULL	2014-03-21
39	27298	1	0403	13	tri2to	1	109	1,3	NULL	NULL	2014-03-21
40	27298	2	0403	13	tri2to	1	107	1,3	NULL	NULL	2014-03-21
75	27283	NULL	0404	24	anacex	1	1177	1,3	NULL	NULL	2014-03-21
76	27284	NULL	0404	12	ingave	1	171	1,3	NULL	NULL	2014-03-21
77	27285	NULL	0404	11	antitr	1	267	1,8	NULL	NULL	2014-03-21
78	27286	NULL	0404	11	phoeci	1	180	1,3	NULL	NULL	2014-03-21
79	27287	NULL	0404	11	tri2to	1	103	1,3	NULL	NULL	2014-03-21
80	27288	NULL	0404	22	anacex	1	1097	1,3	NULL	NULL	2014-03-21
81	27289	NULL	0404	34	coccca	1	130	1,3	NULL	NULL	2014-03-21
82	27290	1	0404	33	matasc	1	270	2	NULL	NULL	2014-03-21
83	27290	2	0404	33	matasc	1	142	1,3	NULL	NULL	2014-03-21

84	27291	NULL	0404	33	anacex	1	557	1,3	NULL	NULL	2014-03-21
85	27292	NULL	0404	33	matasc	1	134	1,6	NULL	NULL	2014-03-21

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