Trees in Our Community: Using GLOBE to Contribute with Primary and Secondary Data Analysis

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Abstract

For the last two years, we’ve been studying the taxonomy and biometry of our community trees. Concerned about the removal of trees and planting of foreign species, our objective was to increase knowledge about the trees in our community.
Specific objectives: 1) Identification and mapping of species and creation of a physical and digital catalog for the community. 2) Collection of primary data (biometric measurements) and the creation of a standard database. 3) Analysis of carbon capture to evaluate future planting choices 4) How GLOBE data helps in the monitoring of this project over the years. 5) Are our methods apt for interregional studies?
Research questions are about the composition of species, the frequency of height and circumference, and the carbon captured by native and exotic species. We sampled 608 specimens, identified 468 and determined 41 species (compared to last year’s 25) belonging to 27 families. The most frequent species is Fraxinus pennsylvanica Marshall. Biometric data (height and circumference) was obtained. Most specimens are exotic (91.03 %) and deciduous (83.76 %). Native species represent 8% of total carbon capture. We recommend these native trees for future plantations: Handroanthus impetiginosus Mart.ex DC), Peltophorum dubium (Spreng.)Taub. and Jacaranda mimosifolia D. Don. Also, we highly advocate for the conservation of the pristine “Talar area” in this neighborhood.
GLOBE Observer Tree biometry and Carbon Cycle protocols were used for measurements and uploaded into GLOBE Observer App. For taxonomy identifications Botanists were consulted. Random sampling was held by 31 students. GLOBE ADAT and the Visualization System were used to compare results obtained in three completely different biomes using data from GLOBE v-School Croatia and Colegio Montessori de Cartagena Colombia. This added 1050 data samples to our study.

Keywords: Trees; Taxonomy; Biometry; Carbon Cycle; Monitoring; GLOBE databases; Catalog.

Research Questions

1. **How obtaining "Primary data" could contribute to increasing knowledge about the trees in our community?**
   a. Which species grow in our neighborhood?
   b. Which is the frequency of species?
   c. Which is the frequency of height and circumference of these trees?
   d. Which is the samples’ total carbon capture?

2. **How could GLOBE databases help monitor our trees over the years?**
   a. How could GLOBE databases contribute to deciding future actions?
   b. How could we use GLOBE Visualization systems in order to compare them with trees from other regions ?

Introduction

This research paper is a follow up of our studies about Trees in Haras Santa Maria. Now, including an analysis of primary data (height, circumference, carbon storage) and a comparison of said data with figures from X site using GLOBE ADAT. The purpose of this investigation is to analyse the differences between data from 2023 and 2024 of the same site, and data from two different schools: GLOBE V-School Croatia and Colegio Montessori de Cartagena Colombia and used their GLOBE uploaded sites.
This project began in April 2023 and was followed up until October 2024. As we participated in both GLOBE LAC Trees Campaigns, we trained ourselves in the use of tree protocols and how to use them in the GLOBE Observer App. We wanted to study the trees of our neighborhood as seriously as possible. Doing so, we realized that citizen identification of specimens was difficult, as there are no previous studies done on this area. Thus, we collected primary data (including biometry, species and carbon capture) in our own database in order to improve knowledge and create a catalog for the local community.
This year, we included the Carbon Cycle Protocol in order to calculate carbon capture and could analyse this forestation’s ecosystemic service. Forest ecosystems are capable of storing large quantities of carbon through biomass accumulation in trees (Goodale et al., 2002; Pan et al., 2011). The amount of carbon stored by a tree depends on its size, but roughly 25% of its wet weight is carbon (Lieth, 1963). We set ourselves to find out whether the current tree choices in our urbanization and our urban forests are useful in the ongoing battle against climate change and our community’s carbon footprint, and come up with recommendations for future planting to solve the imbalance of native and exotic species in our developing neighbourhood.
Urban trees and forests affect climate change, but are often disregarded because their ecosystem services are not well understood or quantified. Trees act as a sink for carbon dioxide (CO2) by fixing carbon during photosynthesis and storing carbon as biomass. The net long-term CO2 source/sink dynamics of forests change through time as trees grow, die, and decay. Human influences on forests (e.g., management) can further affect CO2 source/sink dynamics of forests through such factors as fossil fuel emissions and harvesting/utilization of biomass (Nowak et al., 2002). Trees in urban areas (i.e., urban forests) currently store carbon, which can be emitted back to the atmosphere after tree death, and sequester carbon as they grow. Urban trees also influence air temperatures and building energy use, and consequently alter carbon emissions from numerous urban sources (e.g., power plants) (Nowak, 1993). Thus, urban trees influence local climate, carbon cycles, energy use and climate change (e.g., Abdollahi et al., 2000; Wilby and Perry, 2006; Gill et al., 2007; Nowak, 2010; Lal and Augustine, 2012).
“Continuous increasing carbon dioxide (CO2) has aggravated global warming and promoted urban tree planting projects for many countries. So it’s imperative to select high carbon sequestering landscape tree species while considering their aesthetic values of urban green space.”
Building on these foundational studies, our project focuses on the practical application of these principles to a local context, Haras Santa Maria. As there have been many recent studies done on carbon sequestration worldwide, but none in our area, we stood on the shoulders of scientists before us to contribute to world science using GLOBE protocols.

Fig.1: Published Catalog Collage

Methodology

Study site:
Our research was located in a private urbanization called “Haras Santa María” which is a private urbanization in Loma Verde. Escobar. Provincia de Buenos Aires. Argentina

Fig.2: Study site maps showing Haras Santa Maria in Argentina.

Sampling:
Each of us had to take at least 10 measurements of trees near our homes.

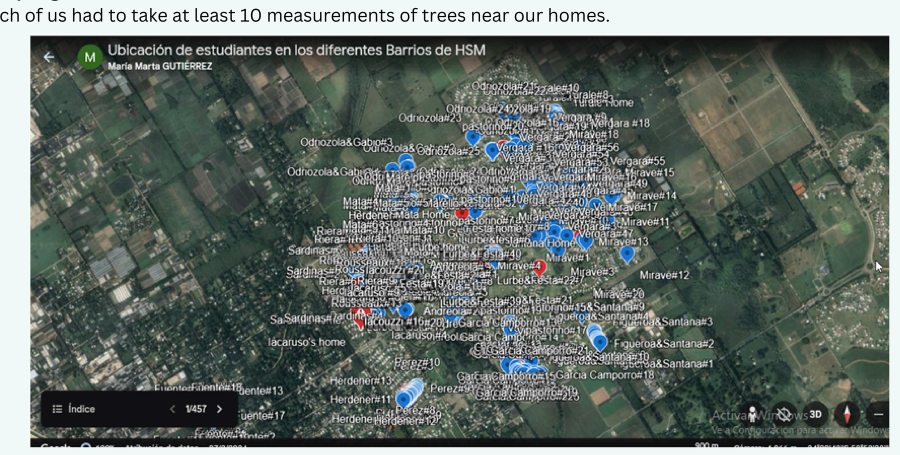
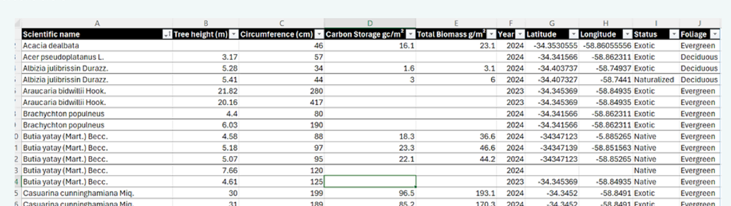


Fig.3: Location of studied trees

Each student when returning home must upload data in the GLOBE Observer App (Sometimes in the field we do not have Wi-Fi signal) or in the GLOBE website (data entry) and then create an individual chart with collected data. Those charts were revised by our teacher, and after that, all the charts were gathered in a single database.



Scientific name	Tree height (m)	Circumference (cm)	Carbon Storage gc/m²	Total Biomass g/m²	Year	Latitude	Longitude	Status	Foliage
Acacia dealbata		46	16.1	23.1	2024	-34.3530555	-58.86055556	Exotic	Evergreen
Acer pseudoplatanus L.	3.17	57			2024	-34.341566	-58.862311	Exotic	Deciduous
Albizia julibrissin Durazz.	5.28	34	1.6	3.1	2024	-34.403737	-58.74937	Exotic	Deciduous
Albizia julibrissin Durazz.	5.41	44	3	6	2024	-34.407327	-58.7441	Naturalized	Deciduous
Araucaria bidwillii Hook.	21.82	280			2023	-34.345369	-58.84935	Exotic	Evergreen
Araucaria bidwillii Hook.	20.16	417			2023	-34.345369	-58.84935	Exotic	Evergreen
Brachychton populneus	4.4	80			2024	-34.341566	-58.862311	Exotic	Evergreen
Brachychton populneus	6.03	190			2024	-34.341566	-58.862311	Exotic	Evergreen
Butia yatay (Mart.) Becc.	4.58	88	18.3	36.6	2024	-34347123	-5.885265	Native	Evergreen
Butia yatay (Mart.) Becc.	5.18	97	23.3	46.6	2024	-34347139	-58.851563	Native	Evergreen
Butia yatay (Mart.) Becc.	5.07	95	22.1	44.2	2024	-34347123	-58.85265	Native	Evergreen
Butia yatay (Mart.) Becc.	7.66	120			2024			Native	Evergreen
Butia yatay (Mart.) Becc.	4.61	125			2023	-34.345369	-58.84935	Native	Evergreen
Casuarina cunninghamiana Miq.	30	199	96.5	193.1	2024	-34.3452	-58.8491	Exotic	Evergreen
Casuarina cunninghamiana Miq.	31	189	85.2	170.3	2024	-34.3452	-58.8491	Exotic	Evergreen
Casuarina cunninghamiana Miq.	20	140	41	82	2024	-34.3452	-58.8491	Exotic	Evergreen

Fig.4: Fraction of the finished database.

Protocols: GLOBE Biosphere protocols were used, Tree Biometry and Carbon Cycle

Materials and tools:
- Metric flexible tape for circumference measurements.
- Mobile phones with GLOBE Observer App.
- Excel data sheet specially designed for the project in order to create our own database.
- Guides and apps in order to identify species.
- Airbus satellite images from Google Earth.
- Historical satellite images (from 2003 to 2023) from Google Earth Pro to research about changes in Land Cover during the last 20 years.
- Copernicus Sentinel Hub images

Method used to obtain data from GLOBE database
Both Globe ADAT and GLOBE Visualization System were used to retrieve data when obtaining figures from schools in other regions to test our models, and to compare how these tools aided our investigation.

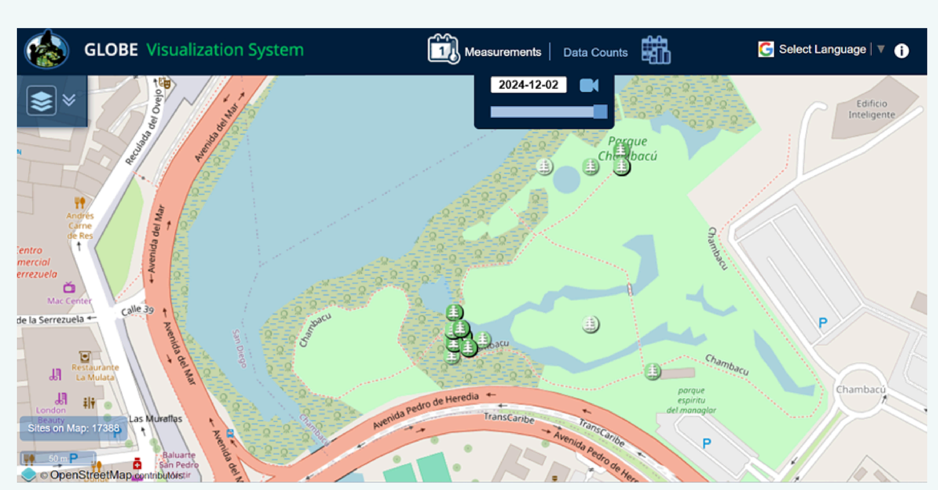


Fig.5: Locating sites in GLOBE Vizualizer.

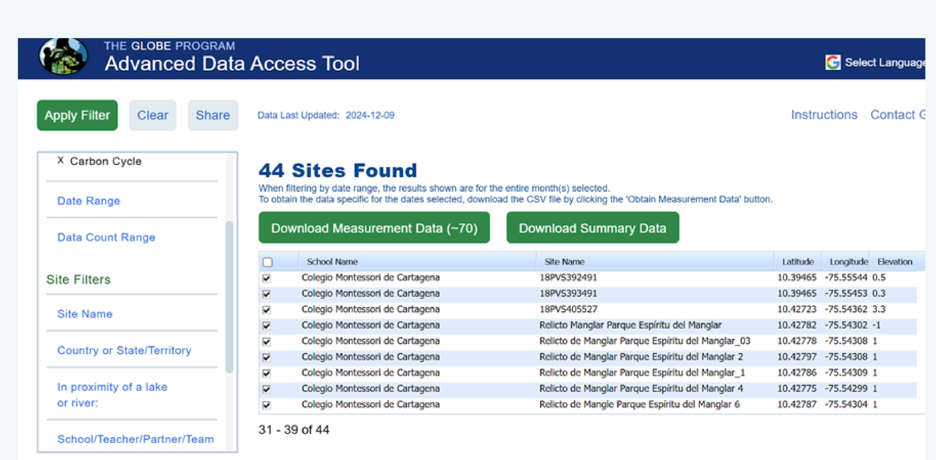


Fig.6: Downloading site specific data from GLOBE ADAT

Results

1a) Richness of species: 41 species belonging to 27 families were identified in Haras Santa Maria.

Table 1: Richness of species

Family	Species	Vulgar name	Status	Foliage
Altingiaceae	**Liquidambar styraciflua L.**	Liquidambar	Exotic	Deciduous
Anacardiaceae	**Schinus molle L.**	Aguaribay	Native	Evergreen
Araucariacae	**Araucaria bidwillii Hook.**	Araucaria	Exotic	Evergreen
Arecaceae	**Butia yatay (Mart.) Becc.**	Yatay	Native	Evergreen
Arecaceae	**Copernicia alba Morong**	Caranday	Native	Evergreen
Arecaceae	**Syagrus romanzoffiana (Cham.) Glassman**	Pindó	Native	Evergreen
Asparagaceae	**Dracaena arborea (Willd.) Link**	Dracaena	Exotic	Evergreen
Bignoniaceae	**Jacaranda mimosifolia D. Don**	Jacarandá	Native	Deciduous
Casuarinacea	**Casuarina cunninghamiana Miq.**	Casuarina	Exotic	Evergreen
Celtidaceae	**Celtis tala Gillies ex Planch.**	Tala	Native	Evergreen
Cupressaceae	**Calocedrus decurrens (Torr.) Florin**	Tuya disciplinada	Exotic	Deciduous
Cupressaceae	**Cupressus macrocarpa Hartw. ex Gord.**	Ciprés	Exotic	Evergreen
Fabaceae	**Erythrina crista-galli L.**	Ceibo	Native	Deciduous
Fabaceae	**Gleditsia triacanthos L.**	Acacia negra	Exotic	Deciduous
Fabaceae	**Albizia julibrissin Durazz.**	Acacia de Constantinopla	Naturalized	Deciduous

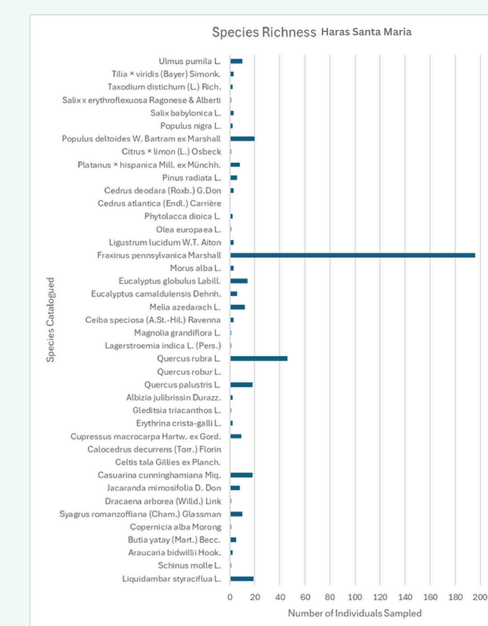


Fig. 7: Species frequency in HSM

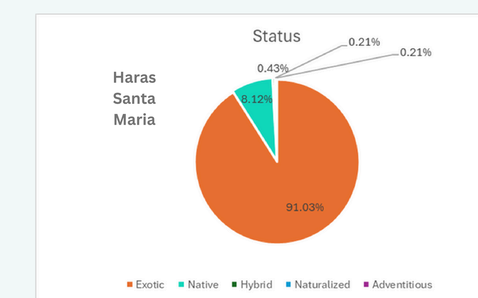


Fig.8: Status frequency HSM

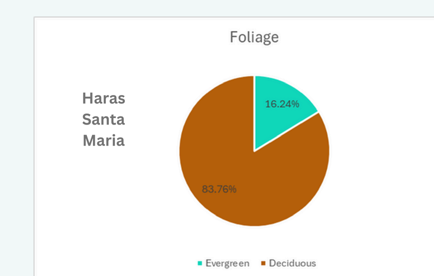


Fig.9: Foliage frequency HSM

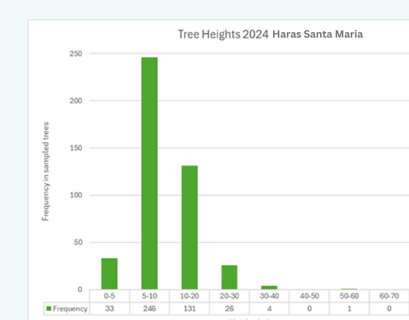


Fig.10: Height frequency HSM

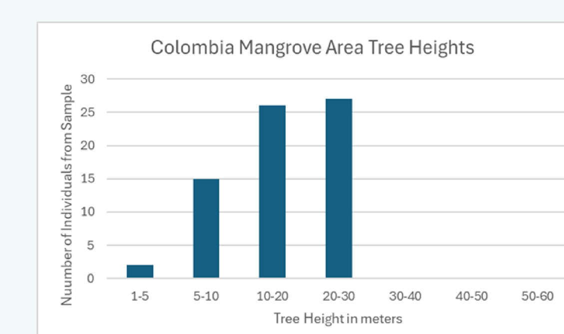


Fig. 11: Height frequency Colombia

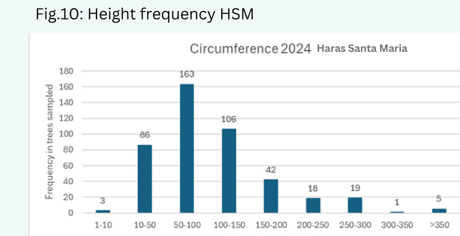


Fig.12: Circumference frequency HSM

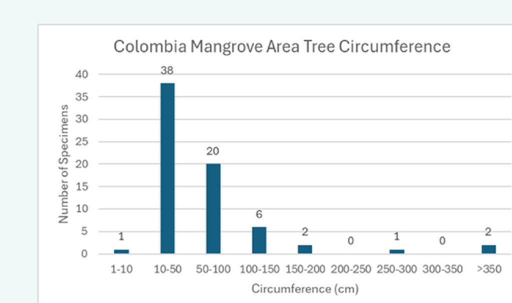


Fig.13: Circumference frequency Colombia

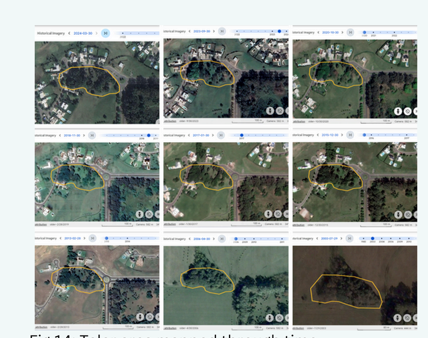


Fig.14: Talar area mapped through time

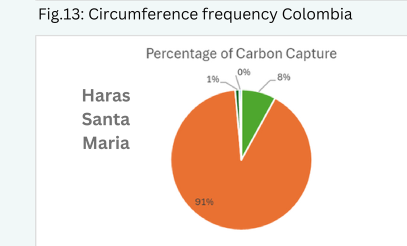


Fig.15: Graph showing percentage of carbon capture by status

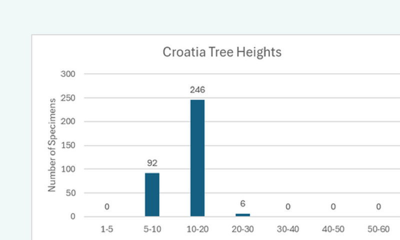


Fig.16: Height frequency Croatia

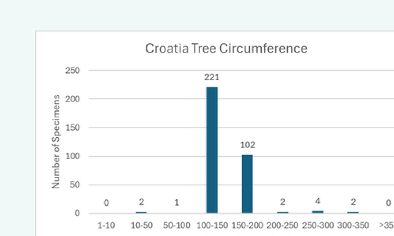


Fig.17: Circumference frequency Croatia

Site	Tree height average m	Circumference average cm	Most frequent species
Croatia	12.77	144.51	Fagus sylvatica
Colegio Montessori de Cartagena	17.31	72.54	Rhizophora mangle
Haras Santa Maria	10.31	106.6	Fraxinus pennsylvanica Marshall

Fig.18: Interregional comparison using GLOBE Databases to answer research questions.

Discussion

We hope this research will help people understand the importance of native arboreal specimens, think twice before getting rid of them and stimulate sustainable management of this forestry. Trees not only provide better air quality and beautify landscapes, but they offset human carbon footprint.

The tree catalog is an important part of the project because as Cobas (2021) said “No solo se trata de juntar números y saber cuántos árboles tiene un municipio, sino que también que esto sirva para planificar las acciones a realizar en el corto, mediano y largo plazo”. The catalog’s purpose is to show our current situation and empower citizens to make informed choices regarding their gardens and opinions for community-wide planting efforts to come.

This was a pioneering year for us, as we not only involved all 31 10th grade (Senior 4) students in the investigation but we also incorporated the ‘GLOBE Alumni role’. Given these circumstances, we made some methodological mistakes which we plan on correcting for future research.
One of the most important lessons we learned from this project is the efficient use of the GLOBE Observer app and the need for project specific loading protocols and double number checking when manually copying data to and from the platforms provided by GLOBE. Misinterpreting site names, usernames, and plots made the process of analyzing the results harder and longer. For future years, we may do training sessions before diving into new projects to resolve these issues.

When attempting to download data from GLOBE databases (ADAT and Visualization system) we encountered some difficulties. Data from both systems wasn’t the same; sometimes these systems presented different numbers, samples and site names and that forced us to rely on individual ‘My Observations’ data. Because of the methodological mistakes mentioned earlier we tried downloading from selection in GLOBE Visualizer and downloaded data was deformed: no decimal points or units were present and it impeded our use of it.

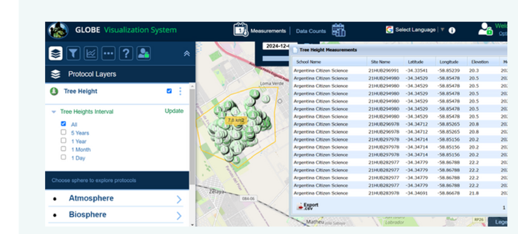


Fig.19: School name appears to be incorrect ‘Argentina Citizen Science’ but data is present.

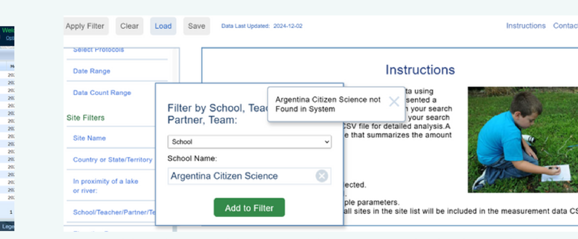


Fig.20: Although ‘Argentina Citizen Science’ was posited to be a school name in GLOBE visualizer it’s not recognized by ADAT.

We also noticed, in part due to our own experience, that it is extremely easy to upload twice the same tree specimen. That’s why we came up with an additional protocol we’d like to implement in future years: the use of a ‘GLOBE Uploaded Tree Sign’ made of recycled bottles, a small device attached to a low branch that shows that this individual has already been sampled.

Using these tools however, we were able to download data pertaining to three different countries with distinct biomes each, thus answering our questions by proving useful in monitoring trees not only through time but also through space unifying sites and people across the globe.

After carefully creating a domestic catalog of tree species, a database and analizing Haras Santa Maria’s neighbourhood specimens we would like to contribute with future plan replacements. We recommend planting the following native species: Handroanthus impetiginosus Mart.ex DC), Peltophorum dubium (Spreng.)Taub. and Jacaranda mimosifolia D. Don. Also, we highly advocate for the Conservation of the pristine “Talar area” in this neighbourhood that we have studied this year because Celtis tala Gillies ex Planch (vulgar name "Tala") is an emblematic native species of this ecoregion.

Conclusion

Our taxonomic and biometric studies improve knowledge in local biodiversity data.
We were able to calculate carbon capture because of this in depth work of recognizing each tree individually.
Species richness (41 species were identified) and measurements of height and circumference helped in the creation of a catalog of trees for this neighborhood’s community.
This year, deepening in bibliographic revisions, we found in a paper from Achinelli F. G. & Delucchi G. (2000) that previously called “Fresnos Americanos” in Buenos Aires Province are actually Fraxinus pennsylvanica Marshall and they reveal themselves to be the most frequent species this year as well.
To improve our methods for years to come we may implement a ‘training period’ in which students, guided by a project mentor, will learn the appropriate uses of GLOBE protocols and tools to avoid sampling mistakes. For future studies we plan creating a Bundle of Protocols (Tree Biometry , Phenology and Carbon Cycle)
The guidance of a GLOBE teacher has significantly improved our understanding of the weight of our investigation, the impact of sample taking, the importance of citizen science and how to think critically and deeply about environmental matters to come up with solutions and work on our resolutions.
Finally, the ‘key’ conclusion is that if it weren't for GLOBE we wouldn’t have been able to obtain any kind of data either primary (608 samples) or secondary (1050 samples from Colegio Montessori de Cartagena Colombia and GLOBE v-School Croatia) Thanks to GLOBE observer as a measurement and calculation tool and GLOBE’s Visualization System and ADAT we were able to do comparison research with other world regions we haven’t set our foot in. This is the true marvel of the world-wide GLOBE community. This connection also enables phytogeographic and evolutionary studies of species, among other things worldwide.

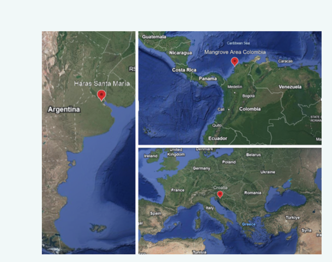


Fig.21: Maps showing the location of the three sites.

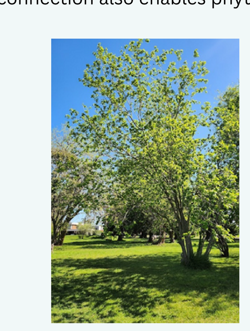


Fig.22: Celtis tala Gillies ex Planch specimens in a protected area.

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