ST. LUKE'S COLLEGE
True Love and True Companionship

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 trees located in "Haras Santa María", Loma Verde, Escobar, Buenos Aires, Argentina. 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 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. (Fig. 1).

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 neighborhood.

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 (CO_2) by fixing carbon during photosynthesis and storing carbon as biomass. The net long-term CO_2 source/sink dynamics of forests change through time as trees grow, die, and decay. Human influences on forests (e.g., management) can further affect CO_2 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.

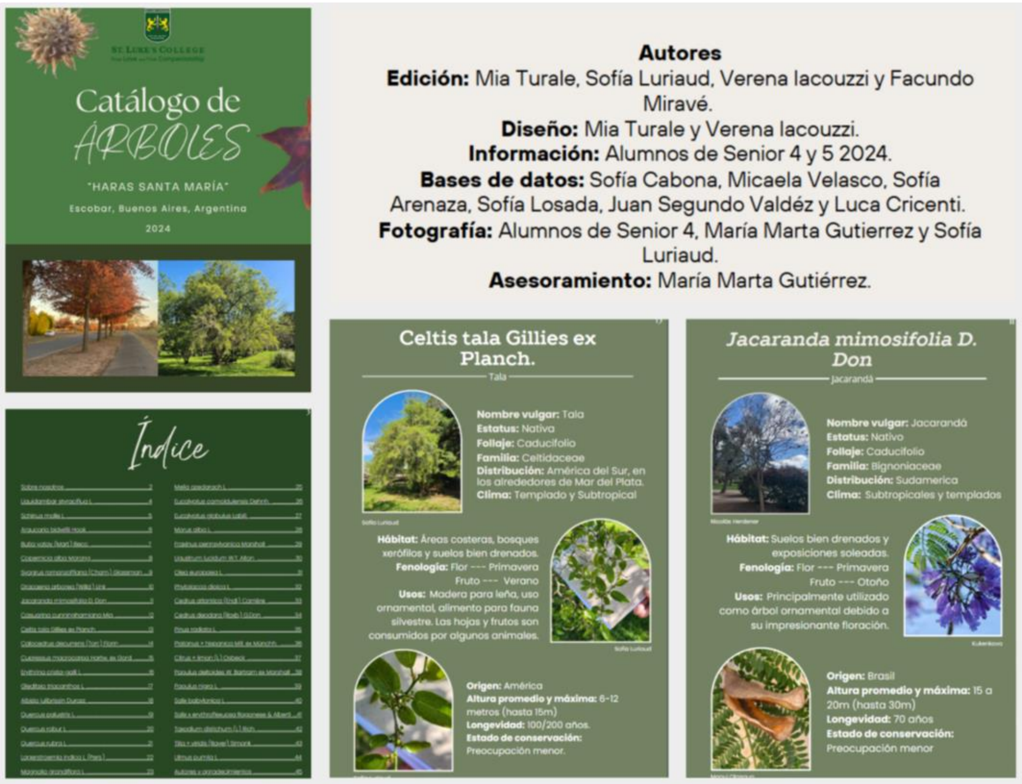

Fig.1: Published Catalog Collage

Methodology

1) 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).

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

Latitude: 34°20'32,6" S Longitude:58°51'04,7 W Altitude:13 m.s.m

The climate is temperate and humid (annual averages of 17,2 °C and 1104 mm).

Originally this area was a grassland but in the last 20 years it has developed into private urbanization. Actually land cover could be considered MUC 821 (Parks and athletic field).

2) Sampling:

Random sampling was made by 31 students. We walked in pairs during the fieldwork as a safety precaution. Each pair took photos and measurements in different areas and located each sample in a collaborative GOOGLE Earth map . (Fig.3)

https://earth.google.com/earth/d/1lcirIxjU3BMBJ7aJHb17ez0Ed6KNnmLN?usp=sharing

Each of us had to take at least 10 measurements of trees near our homes. We had to give the exact location and map the measurements in order not to repeat the same tree. Each sample received a specific ID : “Surname # number #.” For example: “Gonzalez#3” = the Tree N° 3 studied by Tomás González. Photos were also identified with the same ID.

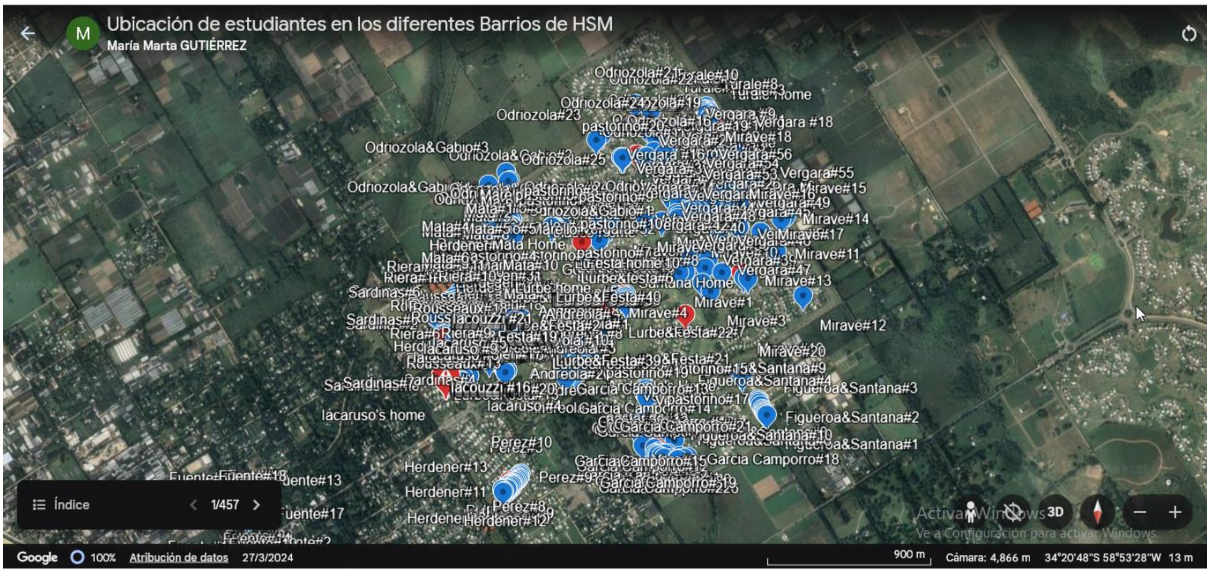

Fig.3: Location of studied trees

Each student when returning home must upload data in the GLOBE Observer App (Sometimes in the field we do not have wifi 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. (Fig. 4)

Scientific name	Tree height (m)	Circumference (cm)	Carbon Storage gc/m^2	Total Biomass g/m^2	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 table in order to show it as an example of the process.

3) Protocols:

GLOBE Biosphere protocols were used : Tree Biometry (Fig .5) and Carbon Cycle (Fig.6) were used for measurements and uploaded into the GLOBE Observer app .

Measured Date:	2024-05-21
Organization Name:	St. Luke's College-Haras Santa María
Site ID:	323777
Site Name:	21HUB288978
Latitude:	-34.346991
Longitude:	-58.861344
Elevation:	22.2m
Measured At:	2024-05-21T20:47:00
Leaves On Trees:	true
Tree Height Average:	7.44 m
Circumference:	52 cm
Dry Ground:	true
Data Source:	GLOBE Observer App
GLOBE Teams:	BIOLOGY Team St Lukes College HSM,TeamGeography

Measured Date:	2024-08-05
Organization Name:	St. Luke's College-Haras Santa María
Site ID:	333038
Site Name:	21HUB295982
Latitude:	-34.343501
Longitude:	-58.853657
Elevation:	17.4m
Measured At:	2024-08-05T20:25:00
Leaves On Trees:	true
Tree Height Average:	13.54 m
Circumference:	25 cm
Dry Ground:	true
Data Source:	GLOBE Observer App
GLOBE Teams:	BIOLOGY Team St Lukes College HSM,TeamGeography
Comments:	árbol 12

Fig.5 : Screenshots of Tree measurements using GLOBE Observer App

Carbon Cycle	
Measured Date:	2024-07-10
Organization Name:	St. Luke's College-Haras Santa María
Site ID:	358717
Site Name:	Barrio Haras Santa María . Loma Verde .
Latitude:	-34.3452
Longitude:	-58.8491
Elevation:	18.6m
Measured On:	2024-07-10T14:36:00
Plot Size:	10000 m^2
Site Type:	non-standard
Total Biomass:	8.9 g/m^2
Total Carbon Storage Size:	4.5 gc/m^2
Tree Biomass:	8.9 g/m^2
Tree Carbon Storage:	4.5 gc/m^2
Tree Sample Number:	1
Tree Species Group:	medium wood density species
Tree Cbh:	52 cm
Tree Plot Biomass:	89119.4 g/plot
Tree Aboveground Biomass:	89119.4 g
Tree Foliage Biomass:	2146.9 g
Tree Stem Biomass:	58022.6 g
Tree Branch Biomass:	28949.9 g
Tree Coarse Root Biomass:	17256.3 g
Tree Comments:	Festa&Lurbe#1

Carbon Cycle	
Measured Date:	2024-07-10
Organization Name:	St. Luke's College-Haras Santa María
Site ID:	358717
Site Name:	Barrio Haras Santa María . Loma Verde .
Latitude:	-34.3452
Longitude:	-58.8491
Elevation:	18.6m
Measured On:	2024-07-10T14:36:00
Plot Size:	10000 m^2
Site Type:	non-standard
Total Biomass:	53.5 g/m^2
Total Carbon Storage Size:	26.7 gc/m^2
Tree Biomass:	53.5 g/m^2
Tree Carbon Storage:	26.7 gc/m^2
Tree Sample Number:	1
Tree Species Group:	medium wood density species
Tree Cbh:	107 cm
Tree Plot Biomass:	534875.4 g/plot
Tree Aboveground Biomass:	534875.4 g
Tree Foliage Biomass:	10734.1 g
Tree Stem Biomass:	403740.7 g
Tree Branch Biomass:	120400.6 g
Tree Coarse Root Biomass:	100976.9 g
Tree Comments:	Festa&Lurbe#5

Fig.6 Screenshots of Carbon Cycle data from GLOBE Observer App

4) 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

5) 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.

We based our ADAT search on 'Sites', 'Teams' and 'Schools' selecting for Carbon cycle and Tree Biometry (height) protocols. (Fig.7) We decided to use ADAT because it allows us to download two variables simultaneously more easily, unlike the visualization system alone.

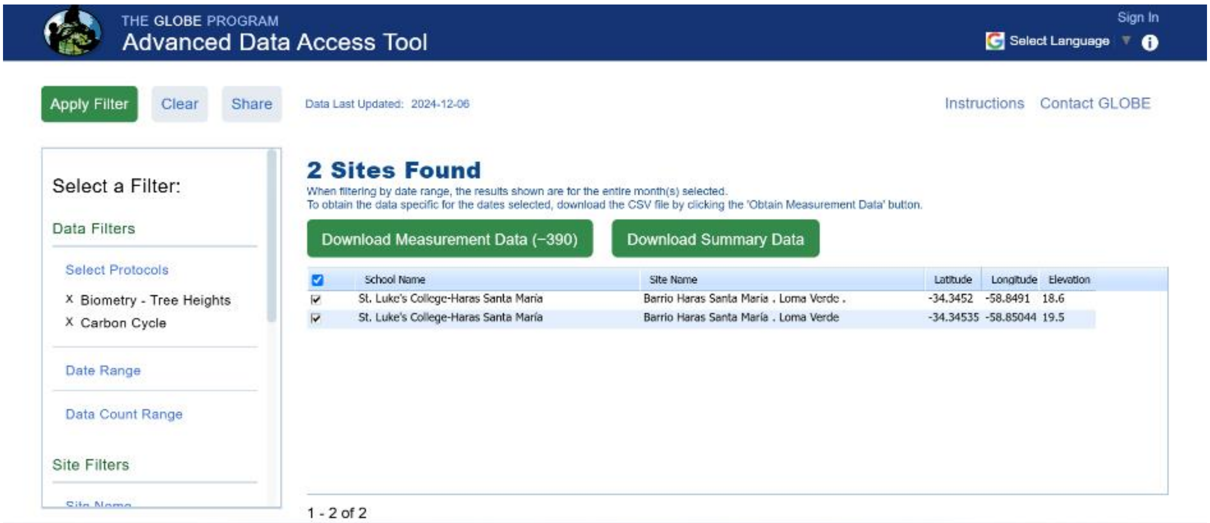

Fig.7: Demonstration of ADAT usage

Using the download summary option and only the protocols, we selected a region (Croatia) that had approximately the same amount of biometry measurements to effectuate our methods on a similar sample size. (Fig.8)

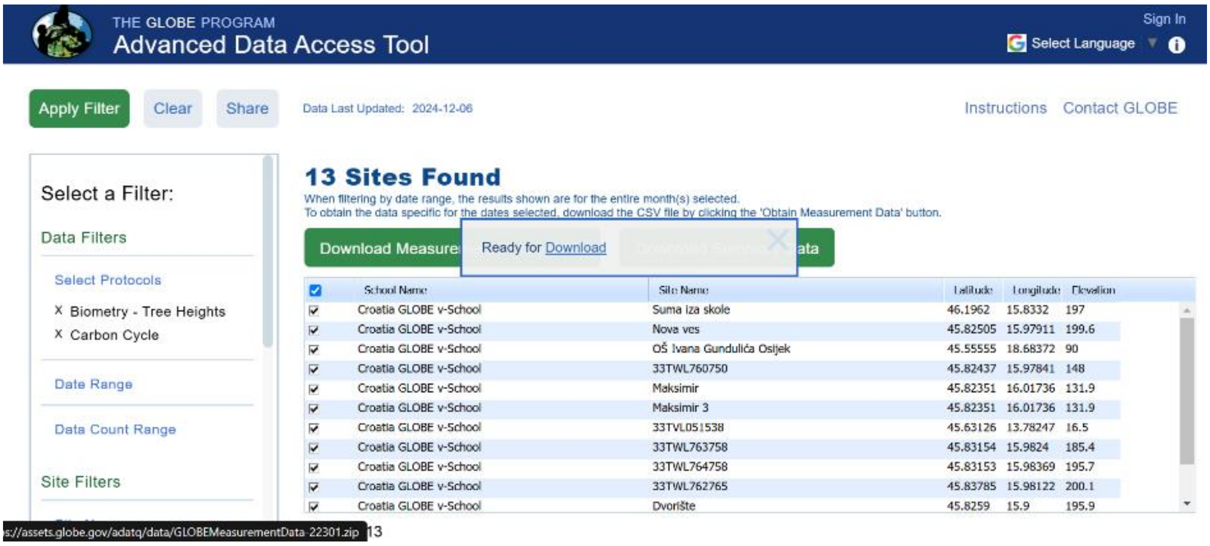

Fig.8: Downloading data from Croatia using ADAT

Visualization systems were used to download all data pertaining to the specific area of interest. (Fig.9)

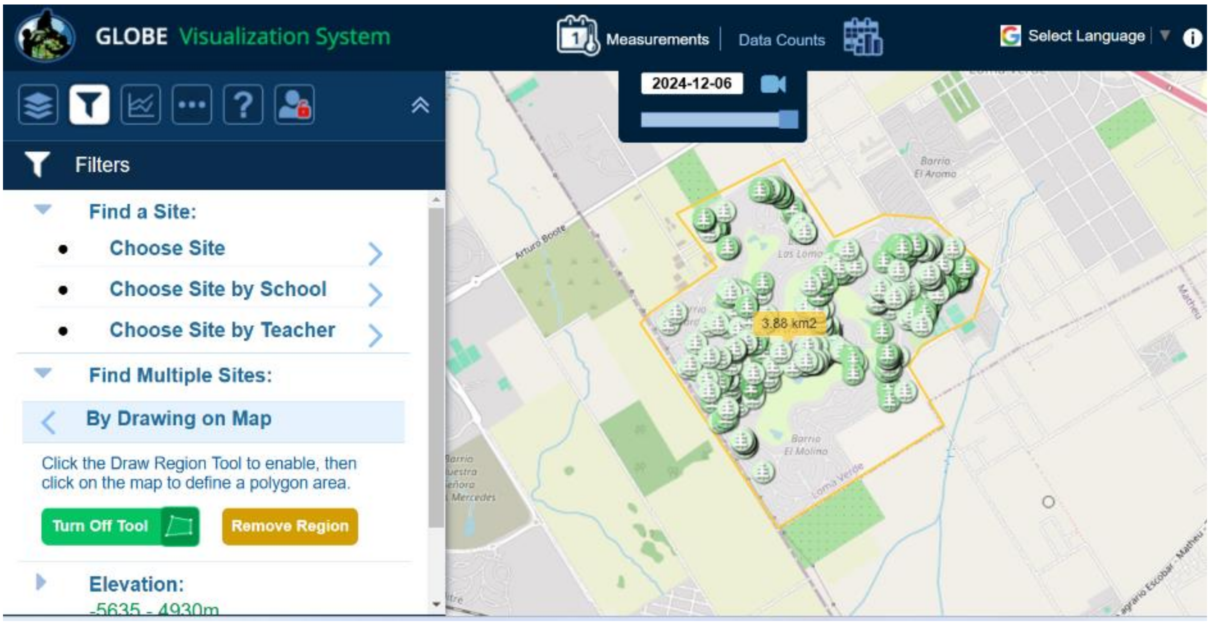

Fig.9: Demonstration of area delimitation in Globe Visualization System.

We coupled these tools when downloading data from Colegio Montessori de Cartagena from Colombia. We mapped the school sites in GLOBE visualizer as seen in figure 10.

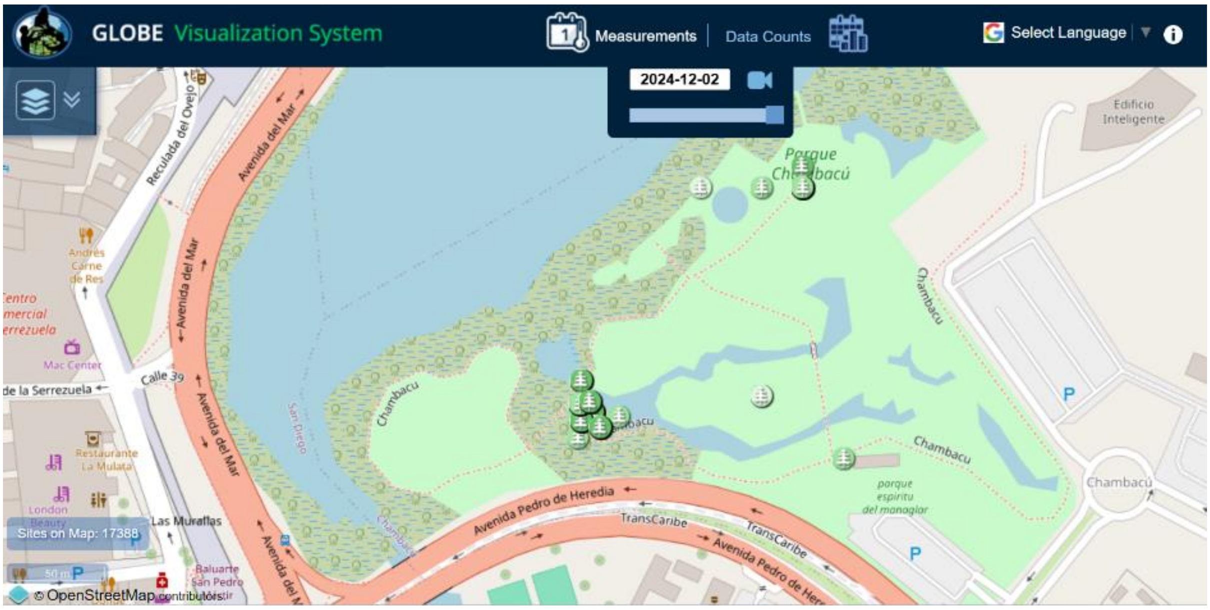

Fig.10: Locating sites in GLOBE Visualizer.

We later referred to the chosen sites in ADAT and downloaded their data as seen in figure 11 below.

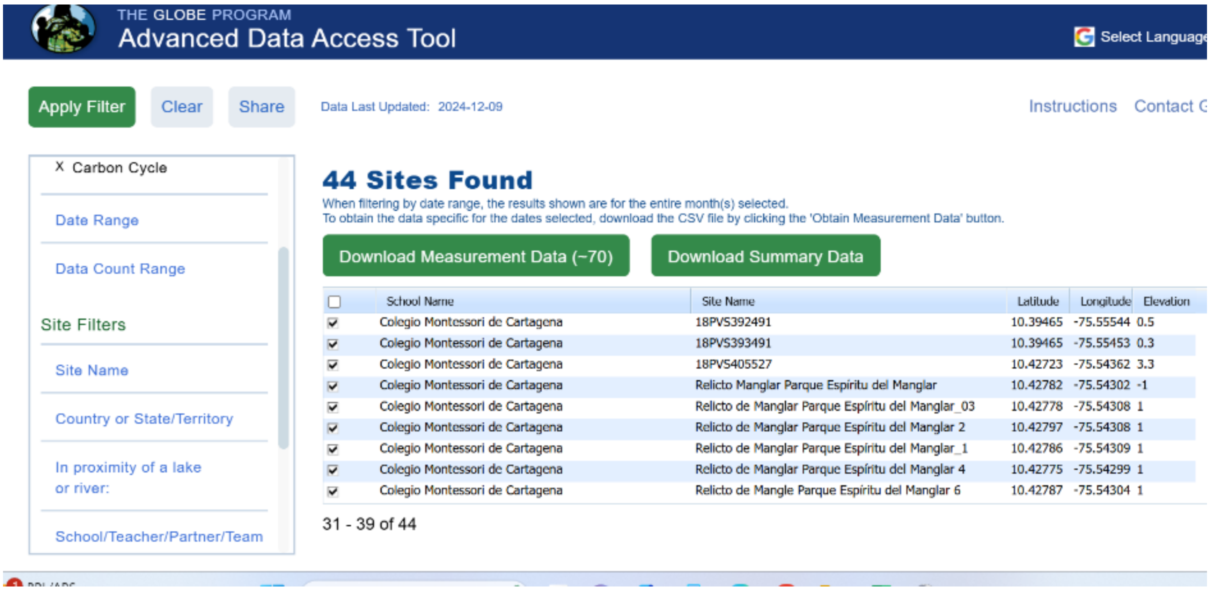

Fig.11: Downloading site specific data from GLOBE ADAT

Results

We have sampled 608 specimens and identified 468 of them due to the extremely meticulous work that takes the identification of species. In some cases, photos did not appear in "my observations" so we had to go back to the field. This project is still going on because it is a large area (360has) to register. We have sampled nearly 264 has.

1) Taxonomy. Floristic composition:

1a) Richness of species: 41 species belonging to 27 families were identified. (Table 1)

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
Araucariaceae	***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
Fagaceae	***Quercus palustris L.***	Roble palustre	Exotic	Deciduous
Fagaceae	***Quercus robur L.***	Roble europeo	Exotic	Deciduous
Fagaceae	***Quercus rubra L.***	Roble rojo	Exotic	Deciduous
Lythraceae	***Lagerstroemia indica L. (Pers.)***	Crespón	Exotic	Deciduous

Magnoliaceae	***Magnolia grandiflora L.***	Magnolia	Exotic	Deciduous
Malvaceae	***Ceiba speciosa (A.St.-Hil.) Ravenna***	Palo borracho	Native	Evergreen
Meliaceae	***Melia azedarach L.***	Paraíso	Exotic	Deciduous
Mirtaceae	***Eucalyptus camaldulensis Dehnh.***	Eucalipto	Exotic	Deciduous
Mirtaceae	***Eucalyptus globulus Labill.***	Eucalipto azul	Exotic	Evergreen
Moraceae	***Morus alba L.***	Mora blanca	Exotic	Evergreen
Oleaceae	***Fraxinus pennsylvanica Marshall***	Fresno	Exotic	Deciduous
Oleaceae	***Ligustrum lucidum W.T. Aiton***	Ligustro	Exotic	Deciduous
Oleaceae	***Olea europaea L.***	Olivo	Exotic	Evergreen
Phytolaccaceae	***Phytolacca dioica L.***	Ombú	Native	Evergreen
Pinaceae	***Cedrus atlantica (Endl.) Carrière***	Cedro plateado	Exotic	Evergreen
Pinaceae	***Cedrus deodara (Roxb.) G.Don***	Cedro deodara	Exotic	Evergreen
Pinaceae	***Pinus radiata D.Don***	Pino	Exotic	Evergreen
Platanaceae	***Platanus × hispanica Mill. ex Münchh.***	Plátano	Hybrid	Deciduous
Rutaceae	***Citrus × limon (L.) Osbeck***	Limonero	Hybrid	Evergreen
Salicaceae	***Populus deltoides W. Bartram ex Marshall***	Alamo	Exotic	Deciduous
Salicaceae	***Populus nigra L.***	Alamo de Lombardía	Exotic	Deciduous
Salicaceae	***Salix babylonica L.***	Sauce llorón	Exotic	Deciduous
Salicaceae	***Salix x erythroflexuosa Ragonese & Alberti***	Sauce mimbre	Hybrid	Deciduous
Taxodiaceae	***Taxodium distichum (L.) Rich.***	Ciprés calvo	Exotic	Deciduous
Tiliaceae	***Tilia × viridis (Bayer) Simonk.***	Tilo	Hybrid	Deciduous
Ulmaceae	***Ulmus pumila L.***	Olmo	Exotic	Deciduous

1b) Species frequency: The most frequent species is *Fraxinus pennsylvanica Marshall* (Fig10).

Fig.10: Species frequency

1c) Status: Most specimens (91.03%) are exotic.

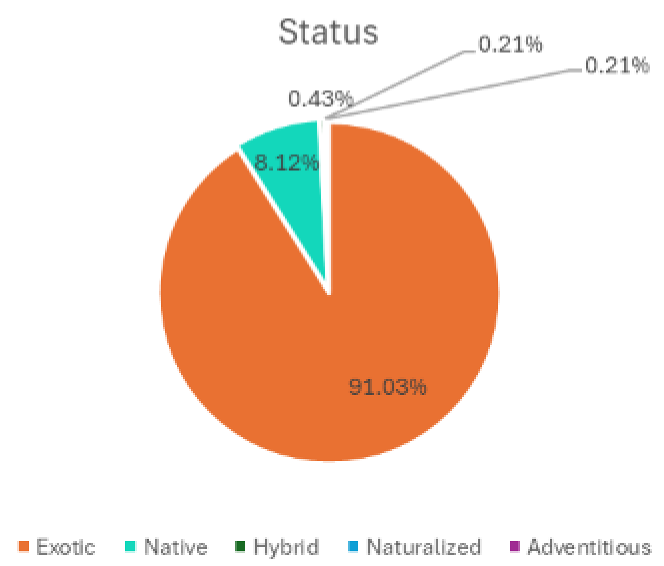

Fig.11: Status

1d) Foliage: Most specimens are deciduous (84%)

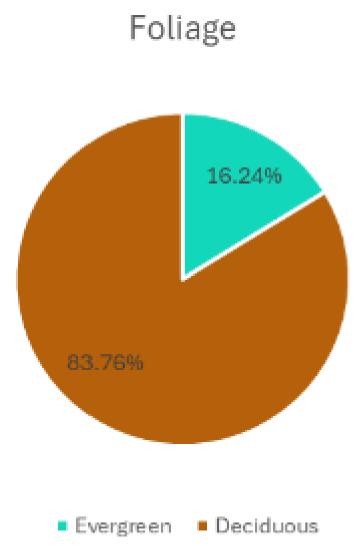

Fig.12: Foliage

2)Biometry:

2a) Height frequency

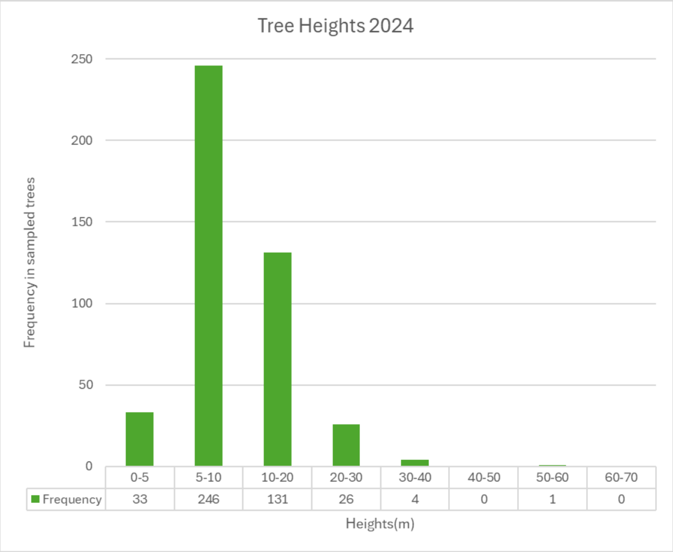

Fig.13: Height frequency

2b) Circumference frequency

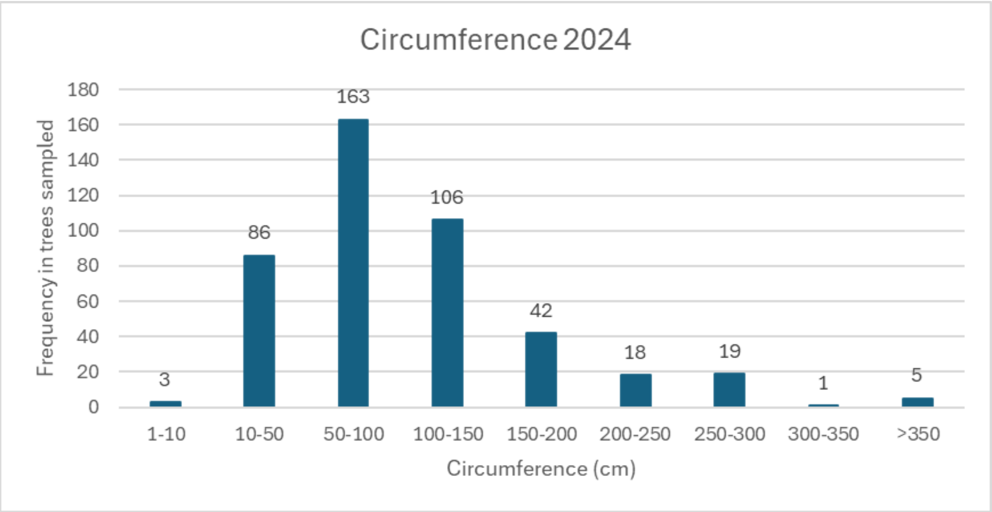

Fig.14: Circumference frequency

3) Carbon Capture

The total carbon capture obtained from the whole sample was 9197.8 gc/m^2

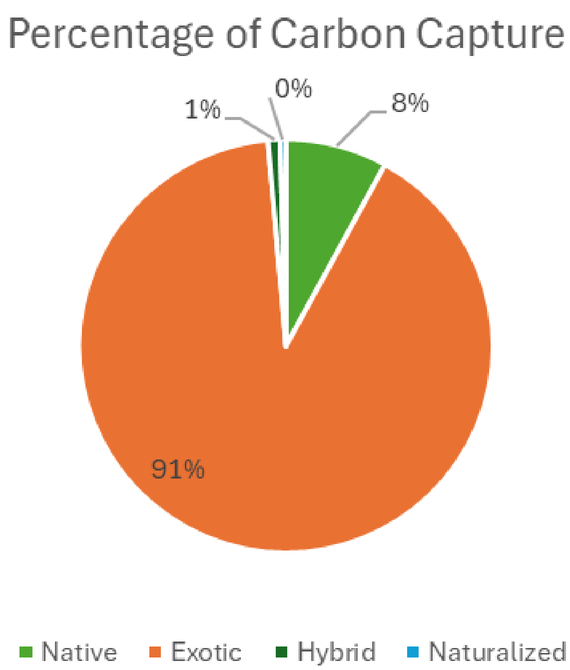

Fig.15 Graph showing percentage of carbon capture by status

4) Location in a Map:

All the trees measured were located by us in the following link.

https://earth.google.com/earth/d/1lcirIxjU3BMBJ7aJHb17ez0Ed6KNnmLN?usp=sharing

4) Forestation progression:

The following link leads to a series of images showing the changes in land cover and forestation progression in Haras Santa María's talar since 2003:

https://docs.google.com/presentation/d/1-KGCaViuUd7KAUngN5LLqZ9oRGrGSDLE4Zu4Fs0xQwM/edit?usp=sharing

Fig. 16: Google Earth images showing the area where the Tala trees were located in the study site.

Comparing images (Fig.16) allowed us to confirm the antiquity of the 'talar' which contains some of the older trees (in the "marked" area) because they were present before the urbanization took place. These specimens are regionally endemic and represent a significant finding worth preserving.

5) Tree catalog for our community

After going to the field and identifying sampled individuals, we used our images to build a virtual (printable) catalog for our community. We organized specimens according to their family and we shared information about their identification, status, foliage, family, distribution, habitat, phenology, uses, origin, height, longevity and conservation status. As seen in fig.17

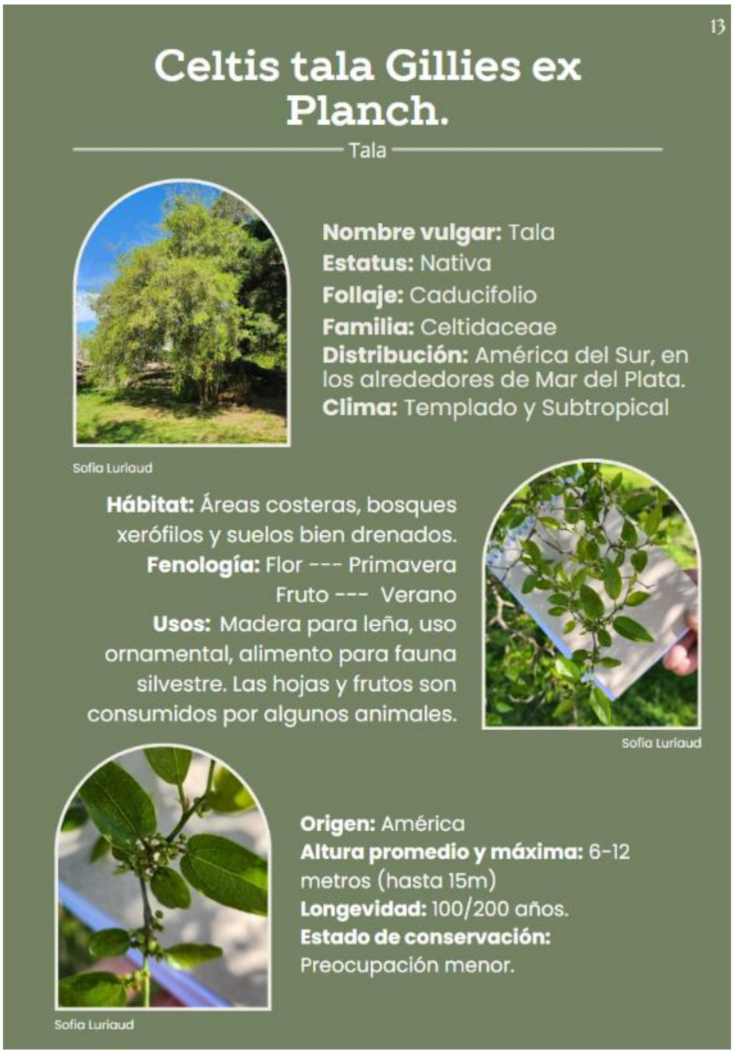

Fig.17 Catalog page sample from Celtis tala Gillies ex Planch.

Our published volume can be seen in this link

6) GLOBE and Future Actions

GLOBE databases aided us in the creation of the catalog by providing us a platform to upload photographs and biometric data. Because of the GLOBE IOPs many more trees were sampled in a short conclusive period of time. This in turn, sped up the creation of the catalog which is already being used by families to identify trees around them. For this branch of the investigation, we relied mostly on our own primary data taken from GLOBE's protocols and "my observations" because loaded GLOBE databases both in the Visualization and ADAT systems were faulty (missing uploads and decimal points) and methodological errors we made exacerbated these problems losing many samplings in one system or the other. Since information from both systems was heterogeneous we chose to use GLOBE data manually for this section of the study. We were able to compare last year's results with current numbers and monitor our community trees. (Table 2)

Table 2: Comparison between 2023 and 2024; Haras Santa Maria data.

Criteria	2023	2024
Area coevered (ha)	36	264
Specimens sampled	234	608
Carbon Capture Calculated gc/m^2	N/A	9197.8
Natives (%)	10.2	8.12
Exotic (%)	89.8	91.03
Species	25	41
Families	19	27
Deciduous (%)	76.6	83.73
Evergreeen (%)	23.4	16.24

Furthermore, the investigation showed us the need to introduce more carbon storing species preferably regionally endemic. Our suggestions therefore are: Handroanthus impetiginosus Mart.ex DC), Peltophorum dubium (Spreng.)Taub. and Jacaranda mimosifolia D. Don.

7) Interregional Comparisons

Using ADAT and GLOBE Visualization systems we obtained and downloaded the CSV with data from two countries (Croatia and Colombia) to compare our results. We filtered and analysed data in Microsoft Excel (fig.18) from the database International Data from GLOBE.xlsx found in Appendix to obtain these results as seen in figure 19.

H27 | sylvatica

	A	B	C	D	E	F	G
1	org_name	site_name	measured_on	tree heights:measured at	tree heights:tree height avg (m)	tree heights:circumference (cm)	tree heights:genus
2	Croatia GLOBE v-School	33TVL051538	2019-10-23	23/10/2019 15:06	14.81		
3	Croatia GLOBE v-School	33TWJ142810	2023-03-02	2/3/2023 10:27	9.56		
4	Croatia GLOBE v-School	33TWJ142810	2023-03-02	2/3/2023 10:28	14.04	116.00	
5	Croatia GLOBE v-School	33TWJ142810	2023-03-22	22/3/2023 10:43	11.70		
6	Croatia GLOBE v-School	33TWJ207821	2023-03-02	2/3/2023 10:20	10.08	160.00	
7	Croatia GLOBE v-School	33TWL760750	2019-05-08	8/5/2019 15:28	5.42		
8	Croatia GLOBE v-School	33TWL760750	2019-10-17	17/10/2019 04:46	6.09		
9	Croatia GLOBE v-School	33TWL760750	2021-03-19	19/3/2021 07:31	6.61		
10	Croatia GLOBE v-School	33TWL760750	2021-08-25	25/8/2021 17:16	6.58		
11	Croatia GLOBE v-School	33TWL762765	2021-04-22	22/4/2021 17:11	8.37		
12	Croatia GLOBE v-School	33TWL763758	2021-04-22	22/4/2021 16:49	6.34		
13	Croatia GLOBE v-School	33TWL764758	2021-04-22	22/4/2021 16:54	10.40		
14	Croatia GLOBE v-School	Dvorište	2021-08-22	22/8/2021 00:00			
15	Croatia GLOBE v-School	Maksimir	2019-10-28	28/10/2019 00:00	21.69	340.00	Quercus
16	Croatia GLOBE v-School	Maksimir	2019-10-28	28/10/2019 00:00	19.82	290.00	Quercus
17	Croatia GLOBE v-School	Maksimir	2019-10-28	28/10/2019 00:00	20.29	230.00	Quercus
18	Croatia GLOBE v-School	Maksimir	2019-10-28	28/10/2019 00:00	19.15	168.00	Quercus
19	Croatia GLOBE v-School	Maksimir	2019-10-28	28/10/2019 00:00	20.46	253.00	Quercus
20	Croatia GLOBE v-School	Maksimir 3	2019-10-28	28/10/2019 00:00	21.69	340.00	Quercus

Colombia Montessori data GLOBE | Croatia data GLOBE | Sheet1

Select destination and press ENTER or choose Paste

Fig.18 Analyzing GLOBE Data in Microsoft Excel.

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.19 Interregional comparison using GLOBE Databases to answer research questions.

This proves that GLOBE databases can indeed help with the comparison of tree species across the globe even in very distinct environments. For future research we intend to make use of GLOBE Protocol Bundles to further this investigation.

Thanks to GLOBE resources we could do an in depth analysis of tree height and circumference frequency for all three areas of study (See figures 20, 21, 22, 23)

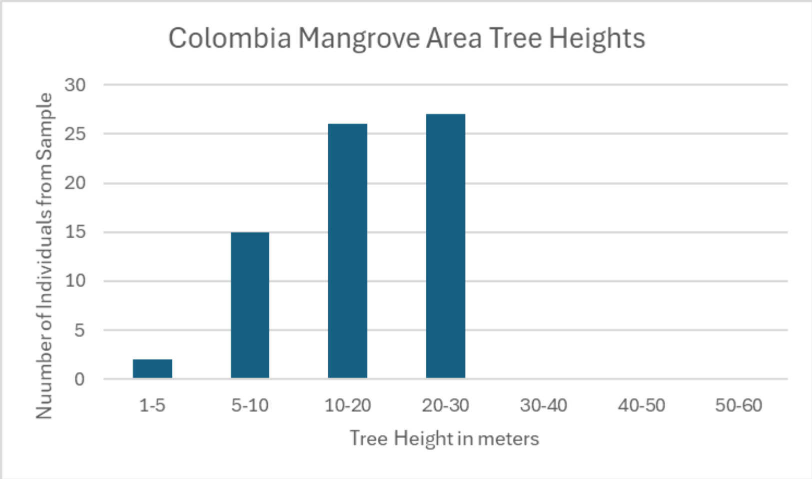

Fig.20 Colombia Mangrove tree height frequency study

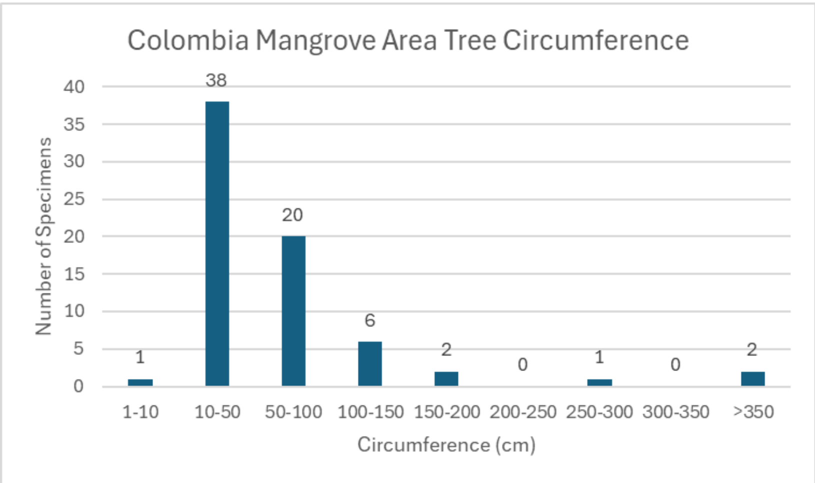

Fig.21 Colombia Mangrove circumference frequency study

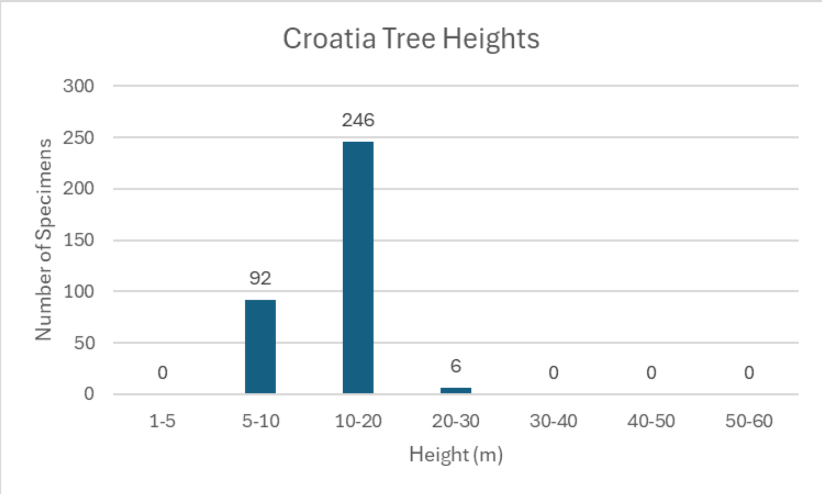

Fig.22 Croatia tree height frequency study

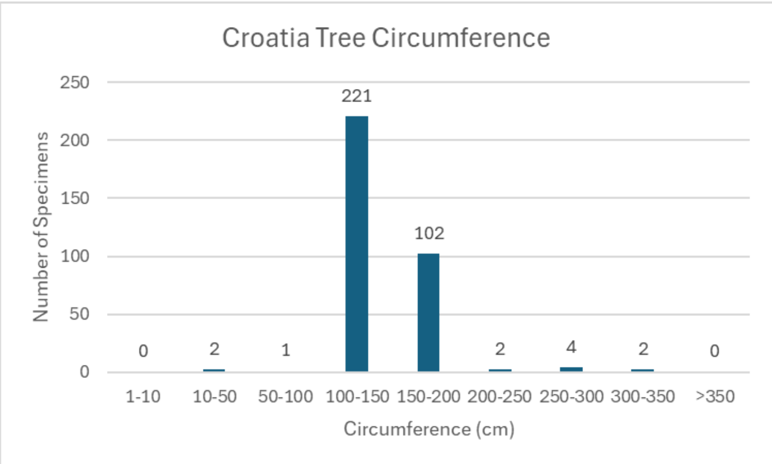

Fig.23 Croatia circumference frequency study

Both the tallest tree with a height of 56.98 m an *Ulmus americana*, and the oldest tree (largest circumference of 488cm an *Eucalyptus camaldulensis Dehnh*.) were found in Haras Santa Maria.

Discussion

Before “Haras Santa María" was created, it was a rural area (grassland) with few cultivated trees around. Land cover is in constant transformation. Satellite images allow us to confirm that the Talar area precedes urbanization. This urbanization impacts the environment. However, the neighborhood did a good job in compensating, by planting a huge amount of trees. Our data reveals recent forestry (Trees height average: 10.31m and Trees circumference average: 106.6 cm).

For future studies we plan on taking phenological data while collecting biometric data and create a Bundle of Protocols (Tree Biometry , Phenology and Carbon Cycle)

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 also decrease air and surface temperature. Finally, 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 planting efforts to come. We hope that our contributions push our community towards a greener and more sustainable future.

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 (fig.23 and fig.24) 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. It would also be very beneficial to be able to download the KSV from GLOBE visualizer only from selected trees, either from Site/School filters or from space selection.

We also noticed, in part due to our own experience, that it is extremely easy to upload twice the same tree specimen and that there is no way of preventing that in the app as coordinates are not always exact. 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.

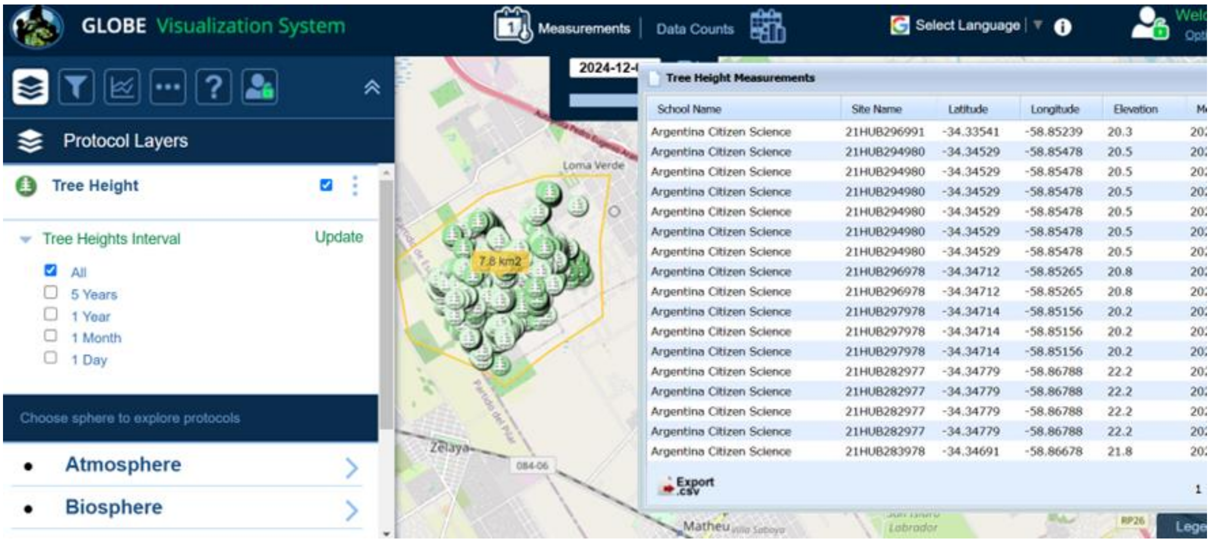

Fig.24 School name appears to be incorrect ‘Argentina Citizen Science’ but data is present.

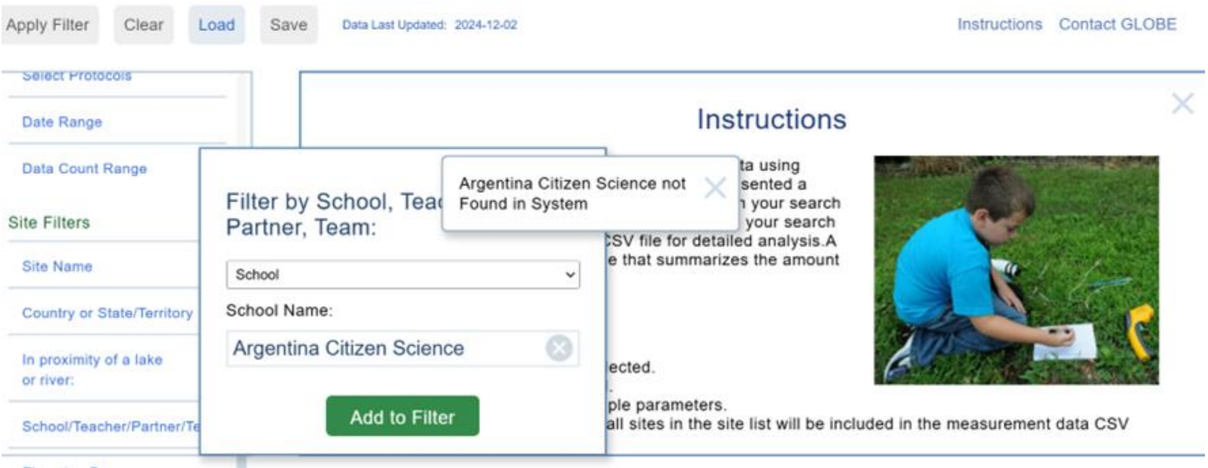

Fig.25 Although ‘Argentina Citizen Science’ was posited to be a school name in GLOBE visualizer it’s not recognized by ADAT.

Using these tools however, we were able to download data pertaining to three different countries with distinct biomes each:

Most Croatian trees were located in the **Montane Forests biome,** which is characterized by its location in higher-altitude regions with a temperate climate. There are moderate seasonal changes with cold winters and warm summers; Rainfall is distributed fairly evenly throughout the year, often with snowfall in winter at higher altitudes; Summers are mild, while winters can be cold, especially at higher elevations.

Sites in Colombia have the **Tropical Coastal Mangrove Forest biome**. Mangroves thrive in tropical and subtropical coastal areas, particularly where freshwater meets saltwater. There are warm temperatures year-round, typical of tropical regions; High humidity levels due to proximity to water bodies; Significant rainfall, especially during the wet season. The soil is often waterlogged and anaerobic, also it’s highly saline environment due to tidal influences.

Haras Santa Maria is located in the **Pampas Biome** or **Pampas Grassland Biome**. This biome is a vast region of flat, fertile plains with a temperate climate, ideal for agricultural development. It has a Temperate climate with four distinct seasons: warm summers, cold winters, and transitional spring and autumn. Average temperatures range from 16°C to 19°C (60°F to 66°F), but can reach 40°C (104°F) in summer and fall below freezing in winter. Rainfall: Fairly evenly distributed throughout the year, but with a tendency for higher rainfall during the summer months (average 900–1,200 mm per year). The soil is a fertile mollisol (prairie soil) rich in organic material.

Fig.26 Maps showing the location of the three sites.

After carefully creating a domestic catalog of tree species, a database and analyzing Haras Santa Maria’s neighborhood 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 neighborhood that we have studied this year because Celtis tala Gillies ex Planch (vulgar name "Tala") is an emblematic native species of this ecoregion.

Fig 27. Fig 28.

Celtis tala Gillies ex Planch specimens in a protected area.

Conclusions

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.

As Roic & Valverde (1998) we considered that "Green spaces, both public and private, have an important influence on life quality of people living in urban areas" so it is important to improve knowledge and awareness on local communities.

Last year *Fraxinus americana L.* was registered in this study as the most frequent species. However 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 on taking phenological data while collecting biometric data and create 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.

ACKNOWLEDGEMENTS

To Lic.Andrea Ventoso (Uruguay GLOBE National Coordinator) for her permanent assistance.

We thank Prof. María Ema Múlgura de Romero, Botanical taxonomist (ex IBODA), for her constant support, working together with our teacher María Marta Gutiérrez (also Botanist) in species identification.

To Sofía Losada, Luca Cricenti and Juan Valdez for their contribution in the 'Senior 5 database'.

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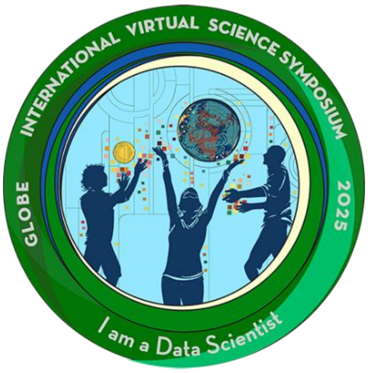
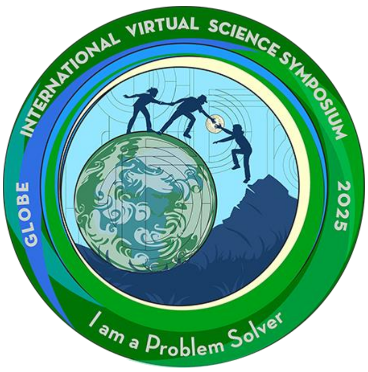
BADGE SPECIFICATION



I AM A DATA SCIENTIST

Why do we deserve it?:

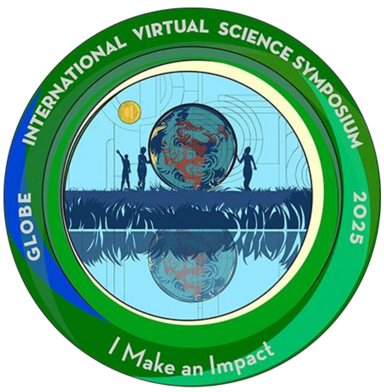
We believe that we deserve this badge because for 2 years we have obtained 608 primary data samples following GLOBE protocols. We have analyzed primary data of 468 identified specimens critically and finally shared them so they were available to the GLOBE Community. Also, as there was no data from this region to compare with past years, we decided to use GLOBE databases to visualize data from other regions and compare them with our local data. Thus, enhancing our project with the study of 1050 data samples from Croatia and Colombia.



I AM A PROBLEM SOLVER

Why do we deserve it?

We believe that we have clearly solved a great problem: there was not any information about trees in Haras Santa Maria neighborhood. For the first time since this urbanization was created a Tree catalog is available. People are now able to recognize their own trees.



I MAKE AN IMPACT

Why do we deserve it?

We believe that analyzing primary data during 2023 and 2024 was the base to have the opportunity to compare data with other countries. Without primary data nothing is possible. So, this contribution makes a great impact in opening the possibility of any present and future comparison research.

We decided to continue with our valious fieldwork sampling because if no one "produces" primary data in 2024...What kind of future are we going to have as data analysts?

Appendix

Raw data downloaded from GLOBE ADAT Raw Globe Downloads.xlsx

Filtered GLOBE ADAT databases used for this study International Data from GLOBE.xlsx

Primary DATA and graphs obtained from ‘my sightings’ section of GLOBE Observer Primary Data IVSS 2025.xlsx