Fundación Mi Terruño [FMT], Culebra, Puerto Rico

Culebra Flora & Fauna Digital Database and Indexes

Use of the Database Plant Identification Album & Digital Material

Introduction

The tropical **Flora and Fauna of Culebra digital photography database** afford the visitors and residents of **Culebra** a unique opportunity to enjoy a very special personal experience of both visual and spiritual dimensions. Nature is a God given gift to be enjoyed shared and conserved for our future generations. **FMT** publishes this digital photographic website to offer **Culebra** residents, our visitors and guest from Puerto Rico or afar a visual experience to enjoy the **Flora of Culebra in all its splendor**. The **Flora Digital Database** will also allow students and professional and amateur naturalist to search a specialized photographic database of the **Flora of Culebra with ample references.**

To date this digital database of the **Flora of Culebra** is the only specialized and organized flora digital photographic database available in the web for Puerto Rico flora**.** The species in the database are designated for plant classification purposes as ***tropical Caribbean dry forest flora*** and form part of the larger universe of the **Flora de Puerto Rico, No specialized organized digital database has been found for the Flora of Puerto Rico other than informal sights that have some photographs or tourism general descriptions**

Photos of the Plants

The work product of the **FMT Culebra Flora Digital Database** and the photographs in the **Plant Identification Album** have been licensed to **FMT** by one of its founders, Manuel H. Dubón, for public scientific and educational use and display. Mr. Dubón, an amateur photographer and self-taught amateur botanist, has been systematically taking picture of the flora of **Culebra** and attempting its botanical identification with the family and scientific name of each plant. Ample web address cross reference for research and educational purposes for each plant species is imbedded into the page of each plant.

Mr. Dubón is not a professional photographer, plant expert or a botanist nor claims to be one, or has he received any formal training in botany. His subject knowledge is self-taught by reading from and reviewing flora books in his extensive Caribbean and Tropical Flora library and researching internet sites. It is a pastime and committed labor of love of nature. Over the past years while engaged in the Master Planning for the **Villa Mi Terruño [VMT]** sustainable development model project of advanced planning and organizing the **Foundation**, he has been taking, classifying and accumulating the photographic database both inside the **VMT** property and in **Culebra** and its cays, as a personal hobby. To be able to handle and use the large volume of material he has organized his digital photo database by botanical name, family and other plant features. The **FMT Culebra Flora Digital Database** provides a more searchable way to manage the extensive photographic data base.

This never ending task and search has been shared with the **VMT** design team to provide the **VMT** architects, engineers and consultants a better understanding of the biota of plant specimens, biology and ecosystems within the **VMT** site. This botanical knowledge and detailed understanding of the site ecology and ecosystems is essential to implement, as a team, the sustainable design and conservation guidelines and goals requested from the design team by the owner developer.

Mr. Dubon's appreciation and interest for nature and its flora was nurtured during his early years while helping his mother in her garden. During his High School years in Massachusetts he learned more about gardening and landscaping doing garden maintenance and planting work after school. He requests that any errors or corrections in name or descriptions of the plant species in his never ending quest for classification be reported to the **Foundation** for proper action.

Plant digital photography captures a moment in the life cycle of a plant. The plant species has to be revisited during various years to follow and fully appreciate its life and flowering cycle. This follow up also enables the observer to capture plant features such as its leaves, growth habit, trunk, branching, flowers, seeds and fruits into an identification set. It is a time consuming hobby since the visual quality of digital photos needs frequently to be improved with **©Photoshop**, and classified and identified by its features into a manageable data base before the plant identifications task can be completed.

Use of the Digital and Photographic Plant Database Material and Plant List Indexes

The **FMT Culebra Flora Digital Database** is published by the foundation and its author for the viewer's enjoyment and to assist other scientific and research endeavors. It is an effort and pursuit to share systematic botanical knowledge of the **Flora of Culebra, Puerto Rico** in keeping with the foundation's scientific and public educational and conservation goals. The database will be part of the knowledge base that will be used in youth and adult nature appreciation and conservation courses that will be offered once the **Villa Mi Terruño** long term development project commences construction and the ***Youth Camp Cabins*** and ***Nature Appreciation Lodge*** become operational. The **Foundation** has been licensed and intends in the future to publish and sale, in one or more series, the content of the **VMT Flora Photo Database**. All **Foundation** revenues and receipts are and will be used for its scientific, educational conservation purposes.

Plant Identification and the Binomial Classification System

Plants are classified using a binomial system developed by a Swedish botanist ***Carl von Linne which name he Latinized to Carl Linnaeus*** in his pivotal and monumental work published in 1753, ***Species Plantarum*****. In his monumental work Linnaeus created a new binomial naming system for plants (the first name being the genus or family and the second the species) to replace the then existing more burdensome polynomial (descriptive phrase) name.** The binomial system uses Latin as the language of classification for historical reasons but its use nevertheless resolves the problem of using common names from different languages and regions where one plant can have no name or more than one name. After the end of the plants name the biologist or recognized author who correctly identified the plant is added and generally abbreviated to the extent possible. When more than one name appears the

first name in parenthesis (L.) is the name of the biologist or author who first incorrectly identified the plant and the next is the name of the person credited with proper identification. If the plant has three names the third name is the name of a subspecies or varietal, generally preceded by "ss. or "v.". If the plant has been modified with a resulting cultivar, the cultivar's name is added at the end of the name between quotation marks, ie. *Nephrrolepis falcate cv. "Furcans".*

In **Linnaeus's** mid eighteen century endeavor to classify and name *all plants of the world*, he listed and named, using his new binomial system, 7,700 species of plants of which 239 were species that grew in the West Indies, Only two species listed were from **Puerto Rico**.

Plants are classified by arranging them into groups of shared characteristics. Flora classification is a never ending task with frequent changes in the plant classification universe which has been made more complex with the advent of molecular phylogenetic and DNA research. Flowering plants comprise the largest group and they are arranged by related characteristic into ***Monocotyledons*** and **Dicotyledons.** The ***finer details of the flower structure by itself*** are the mayor consideration in assigning family or genus. Over 300 related groups are recognized. This introduction is not meant to be a class in plant biology but attempts to offer some introductory knowledge of plant families to facilitate the use of the **FMT Culebra Flora Digital Database.**

Monocotyledons are flowering plants that have ***more linear elongated leaves*** with ***lengthwise running veins***. The ***flower petals are in multiple of threes***. Some well-known flower families such as grasses [**Poaceae**), palms (**Aracaceae**), orchids (**Orchideceae**) bromeliads **(Bromeliaceae**), Amarilis (**Amaryllidaceae**) and lilies (**Lililiaceae**) as well as the aroid (**Araceae**) and **Tradescantia** family (and **Commelinaceae**) are ***Monocotyledons.***

Dicotyledons are flowering plants that account by far for the majority of plants that grow on the planet and no general identification characteristic can be offered to describe them. You are left with learning the general characteristics of some of the larger or key families. The ***Cactus family***, for example, has 19 species identified in the **FMT Culebra Flora Digital Database** and has a set of known characteristic. Plants with bean pods belong to three prime families, ***Fabaceae, Caeselpiniceae and Mimosaseae*** each family with a different flower characteristics. In **Culebra** half of the identified plants in the database belong to a few families.

The **Department of Botany of the Smithsonian Institute** publishes in the internet a ***Catalogue of Seed Plants of the West Indies ("SI Catalogue of WI")*** In this site we find a most importance and scientific flora index of the **West Indies, [http://botany.si.edu/Antilles/WestIndies/checklist.htm].** The site has listed and classified for **Culebra** 56 genera (family) and 225 taxa (species) records of flowering [**http://botany.si.edu/Antilles/WestIndies/results.cfm?formid=Culebra**] plants as of May of 2014. The ***SI Catalogue of WI*** internet site has listed and classified for **Culebrita** 11 genera and 14 taxa of flowering plants. **The *SI Catalogue of WI*** is the ***most specialized subset index of flora species*** of the **Northeastern Geologic Platform Bank of the Greater Antilles Arc.**

According to an article by P. Acevedo Rodriguez and Mark T. Strong of the **Department of Botany of the Smithsonian Institute [SI],** the flora of the West Indies has 231 families of seed plants listed as identified, with 1,945 genera (genus or sub-group of a family) of seed plants and 12,847 taxa (species and at infrared species level). In Puerto Rico, 163 families, 792 genera and 3,092 taxa have been listed as identified by the **SI** the Department of Botany as of May 12, 2012. The **US Department of Agriculture (USDA)** internet catalogue or **USDA Plant List** site has listing for both Puerto Rico and the Virgin Island.

Another **authoritative master index** is the one published by the **US Department of Agriculture (USDA).** These two specialized indexes and catalogues in the **USDA State Plant List [http://plants.usda.gov/checklist.html],**provide the amateur and professional biologist with a subset of the identified and published plant universe of the **US West Indies** islands. The lists contain photographs for many of its listed species. By selecting either one for the taxa of all of **Puerto Rico - 8,809** taxa (species) records of flowering plants or the **US Virgin Islands** - **4,147** taxa (species) records of flowering plants, search areas or by selecting them both **Rico - 9,040** taxa (species) records of flowering plants as of May 22,2014, you will be provide a separate Plant List for each of the two island subsets categories or a combined and larger subset of the two island groups by clicking both Puerto Rico and the US Virgin Islands. Many of the species appear in both lists. Our area of focus is the ***Puerto Rico Platform*.**

The **USDA Puerto Rico catalogue or index** lists 8,809 records as of May 22, 2014 with scientific and common names when available. The native **Puerto Rico** species or taxa sort lists 2,335 species or taxa with 1,897 paired photos and 438 line drawings. The introduced species into Puerto Rico species or taxa sort lists 1,857 species or taxa with 1,700 paired photos and 157 line drawings as of May 11, 2012. The Scientific name lists the current accepted name and synonyms or me-too names given by different biologist over time for the same plant.

The

USDA US Virgin Island catalogue or index lists 4,147 records as of May 22, 2014 with scientific and common names when available. The native **US Virgin Islands** species or taxa sort lists 1,292 species or taxa with 1,148 paired photos and 144 line drawings as of May 11, 2012. The introduced into the US Virgin Islands species or taxa sort lists 1,094 species or taxa with 1,006 paired photos and 88 line drawings as of May 11, 2012.

The **Department of Botany of the Smithsonian Institute** publishes in the internet a ***Catalogue of Seed Plants of the West Indies ("SI Catalogue of WI")***, this site or flora index of the **West Indies** has listed and classified for **Culebra** 56 genera (family) and 225 taxa (species) of flowering plants as of May 22, 2014. The **US Department of Agriculture (USDA)** internet site has listed and classified for **Culebrita** 11 genera and 14 taxa of flowering plants. Some of the species appear in both lists. SI and USDA listing were enhanced by publish Flora and Fauna Studies and Survey in the Non-Time-Critical Removal actions of Munitions by USCE in Culebra. The **FMT Culebra Flora Digital Database** indexes as of May 22, 2014 have listed and classified 147 genera and **491 separate species or taxa** of flowering plants with another 22 species pending classification.

The **Department of Botany of the Smithsonian Institute** published in the internet a ***Catalogue of Seed Plants of the West Indies*** island specific catalogue list are summarized as of May 22, 2014 as follows:

Puerto Rico Spanish Virgin Islands	Species/taxa Records
Icaco	138
Palomino	19
Cayo Santiago	145
Vieques	746
Culebra	225
Cayo Lobo (USCE)	61
Cerro Balcón (USCE)	14
Culebrita	14
Culebrita (USCE)	97
US Virgin Islands	
St. Thomas	866
St. Johns	722
British Virgin Islands	
Jost Van Dyke	79
Tortola	719
Guana	351
Virgen Gorda	474
Anegada	181

These specialized, island specific, geographic catalogues or indexes give the reader a perspective of the variety and size of the plants that grow and have been identified in the different islands. **The *SI Catalogue of WI*** is the ***most specialized subset index of flora species*** of the **Northeastern Geologic Platform Bank of the Greater Antilles Arc (see next topic).** These specialized indexes and catalogues provide the amateur and professional biologist with a subset of the identified and published plant universe of the islands. The **USDA Plant List** combines the island subsets in two mayor categories to provide a larger subset for each of **Puerto Rico** and the **US Virgin Islands.** No such combined subset is presently available for the **British Virgin Islands.** Let us consider next why these subsets of the flora species or taxa are important.

The Flora Study Area of the Eastern Geologic Platform Bank of the Greater Antilles Arc

To better understand our focus or study area of the **FMT Culebra Flora and Fauna Digital Photo Database** we must look back millions of years and get a better understanding of **Culebra's** geological formation and location in our planet. The digital photo database covers a very specific subset of the universe of tropical plants in our world.

The user of the **Flora of Culebra Digital Photo Database** will first find two flora indexes in alphabetic and taxonomic family format that describe the **Flora of the Puerto Rico Northeastern Geologic Platform Bank of the Greater Antilles Arc** also known as the "**Puerto Rico Platform**". **These two master database**

indexes establish a base *subset* of the vascular plants taxonomic universe of the Puerto Rico Platform islands and cays within the West Indies Flora and tropical vascular plants general universe. The indexes list the currently accepted scientific names of vascular plants from the **West Indies**, including taxonomy and distribution by island. **These master indexes** focus on the botanical names of identified flora found in the geographic island belt zone that starts at **Icaco's Island**, off the eastern coast of Puerto Rico, and continues to move east to the end of the **Northeastern Greater Antilles Arc** to the island of **Anegada** in the **BVI.** The master indexes compile a subset of the botanical names of identified flora found in the ***Smithsonian Institute ("SI") Catalogue of the flora of the West Indies*** for the island belt. The plant list has been enriched by the Flora list in two ***EIS Flora and Fauna Studies and one Flora and Fauna Field Surveys*** conducted on behalf of the US Corps of Engineers by the Ellis Environmental Group, LC on Culebra's cerro Balcon in September, 2006, **Cayo Lobo** in August 2006 and on **Culebrita** in November 2006. It has also been enriched by the **List of Vascular Plants** or **Flora Guanae** published by James Lazell in his book **Island**[1] on the fauna and flora of **Guana** Island, BVI.

These studies include the flora species or taxa of the vascular plants of the geographic platform that extends east from the offshore **islands Vieques, Culebra, Icaco, Palomino** and **Culebrita** that are part of **Puerto Rico**, also referred as the ***Spanish Virgins***, east to the ***US Virgin Island*** with the flora of **St. Thomas and St. Johns**. It continues east again to the **British Virgin Islands** with the flora of **Jost Van Dyke, Tortola, Guana, Virgen Gorda** and lastly **Anegada,** the last outpost of the **BVI**. **St. Croix**, in the **USVI**, is excluded from this master index for it was a vertical outcropping formation from the ocean floor that did not form part of the historical process of volcanic formations and settlement of the **Puerto Rico Northeastern Greater Antilles Arc** of islands. ***Puerto Rico's*** mainland ***SI*** flora index, which contains some 3,111 as of May 22, 2014 records, is not incorporated due to the fact that the islands of the **Puerto Rico Platform** have a narrower band of similar life zones. These master subset indexes contain close to 1,510 records of identified plants as of August of 2013. The subset list facilitates the study and classification and identification of unknown plants found in **Culebra** and other islands in the subset by offering the user the universe of already identified species of the area.

The entire island arc area once formed a single land mass with Puerto Rico, in what is commonly referred as the **Puerto Rico Platform**, the integration and interchange of flora between islands was significant during these single land mass periods and thereafter by other means of dispersion including waif dispersal[2] and storms. "Waif dispersal is long-distance movement of organisms across a barrier of inhospitable habitat that results in the establishment of a new population."[3] This interchange was naturally regulated by the natural barriers of the different receiving life zones that generally delimited the species that could survive in a specific life zone and particularly in a **dry tropical forest habitat** prevalent in the **Puerto Rico Platform.** Only certain plants could naturally establish themselves in the specific life zone or selective microclimates such as those found in the higher elevations of hills and mountains and in

[1] Lazell, James, Islands Facts and Theory of Nature , 2005, University of California Press, Berkeley, (pgs. 159-174)

Frey, Jennifer K., Modes of Peripheral Isolate Formation and Speciation, 1993, Syst. Biol. 42(3):373-381, 1993. P. 374

[3] Ibid

mangrove and other wetland areas found in the different islands and cays. Some islands because of the height of the hills or mountain or specific different or wider array of microclimates can sustain a larger, smaller or different set of plants as for example those that may be found in a tropical rain forest.

For more information on the geological history of the **Northeastern Geologic Platform Bank of the Greater Antilles Arc** also known as the "**Puerto Rico Platform"** please refer and the paper enclosed in this site entitled **Introduction to the Geography, Geology, Climate, and Habitats of Culebra.**

This is the neighborhood, geographic setting and geology of our area of focus and study: **Culebra**, **Puerto Rico** and its neighboring **Spanish Virgins, U.S. Virgins and British Virgin Islands**. In addition to being located in a hot and humid zone 18 degrees north of the equator, the island arc is subject to severe periodic earthquakes with infrequent but possible tsunami waves and annual hurricane events. The last major earthquake event was recorded offshore the **USVI** in 1867, resulting in a tsunami on **St. Croix** that supposedly produced waves ranging in height from 9 to 12 meters.

How to Use the Database Indexes

The FMT Flora Digital Database Indexes

The **FMT Culebra Flora Digital Database** photographic directories and subdirectories facilitate handling by summarizing in five distinct Microsoft Excel master indexes, plant catalogue or lists of the database content to assist with its handling and use. As of August 15, 2013 **the data base contained 465 identified species of plants**. The author still has some 33 additional plants pending classification. The plant list enhancements, identification and classification are continuous task and the digital photographic database expanded in every trip Mr. Dubón makes to **Culebra** since 2005. The **VMT** site also includes historical and land site project development data. As of August 2013 the working master database has some 573 gigabytes of data and the Classified Flora Database had 37.3 GB of data.

Flora of the Puerto Rico Northeastern Geologic Platform Bank of the Greater Antilles Arc

The **first two indexes** designated as ***Master Puerto Rico Geological Platform Bank Indexes*** classify the universe of flora plant list of the ***Puerto Rico Northeastern Geologic Platform Bank of the Greater Antilles Arc*** that extends offshore from the eastern geographic limits of the island of Puerto Rico to the island of Virgin Gorda and Anegada in the eastern end of the British Virgin Island. In effect the Indexes provide a plant classification universe for the Puerto Rico offshore eastern island and Cays as well as the islands and cays of the US. And British Virgin Islands with the exception off the flora of Saint Croix which does not form part of the ***Puerto Rico geological platform bank***. It is an effort to create a base line flora catalogue or plant list of said universe by assembling into one master list different plant list published and obtained in his research efforts by Mr. Dubón of all offshore cays and island of the ***Puerto Rico geological platform bank.*** The core components of the combined indexes are the flora and plant list published by the ***US Department of Agriculture*** (http://plant.usda.gov/gallery.hmtl/) and the ***Department of Botany of the National Museum of Natural History, Smithsonian Institute (***http://botany.si.edu/Antilles/West_Indies/catalog.htm) and the Flora and Fauna Study plant list of some of ***Culebra Cays*** published by The US Corps of Engineers and other authors.

As of May 16, 2014, **the master plant list data base contained some 1,512 plant species identified within the *Puerto Rico* Platform of which 491 identified species of plants had already been identified in Culebra and/or VMT and are included in the VMT Digital Database.** An additional **139 species have been identified most of which are in main Culebra** island **in the SI Catalogue of WI,** which plants, as of date, have not been photographed and/or identified by Mr. Dubón in **Culebra** or ***VMT***. Mr. Dubón has **some 24 additional plants photographs but not identified** in his **Culebra** digital database. The ***Master Puerto Rico Geological Platform Bank Indexes*** provide an organized searchable aggregate plant list database both in plant scientific name format and plant family name format in the two separate indexes. The user can also search in the internet by flower name and get extensive web and photographic content assistance and information. Goggle offers an excellent internet resource for flora identification and classification.

When we add the 491 species or taxa identified in **Culebra**, the some 24 plants pending classification and the 139 plants species have been identified, most of which are in main **Culebra** island in the **SI Catalogue of WI,** we have an aggregate universe of some 654 species or taxa possible plants of which 630 have been identified in **Culebra** to date**.** Remember that unless some of the 139 not photographed and identified are also in the photograph and unidentified database there are least some **150 plants** identified plants present in **Culebra** that have not been photographed and/or catalogued in the past**, excluding new introduced exotics**.

FMT Culebra Flora Digital Data base Indexes:

The **other three indexes, FMT Culebra Flora Digital Database Indexes,** are specific to **Culebra and Culebrita**, a small protected island east of **Culebra,** and its cays to an organized in three searchable aggregate plant list database both in (1) **plant scientific name format**, (2) **plant family name format** and (3) **type of plant format** in three separate indexes. The scientific name index also provides the Spanish and English common names where there is one known. The type of plant indexes provide the basis type of plant such as trees, bushes, cacti, succulents, vines, wayside herbs and other general descriptive flora format. It also forms the base for the total classified plant count. The database includes specimens found in the island of **Culebra** and its cays and photographed by Mr. Dubón and in a few cases others in the design team or friends. It is in effect a plant list of the **FMT Culebra Flora Digital Database** and incorporates data of type, whether it is found in **VMT** or **Culebra** and its cays, the family and has reference to plant list and flora books.

The family designation follows the Smithsonian Institute Department of Botany updated family and genera classifications and the classification authority reference is to the five volume and index systematic flora synopsis of Puerto Rico created by Henri Alain Liogier and Luis F. Martorell, 2nd Ed. (1995-2000) published by Editorial de la Universidad de Puerto Rico.

Public Use of Plant Identification Album & VMTF Plant Photo Database Material

Request for Commercial or other Non- Authorized Use of the Digital and Photographic Plant Photo Database Material

All the photographic and other material in the **FMT Culebra Flora Digital Database** is the property of its author and/or the Foundation's and copyrighted and protected by the laws of United States and Puerto Rico. The author has licensed the use of the digital and printed photographic material in this database to **FMT** and has entrusted us with the administrative handling of special use and publishing requests. The photographic material may be used and displayed for personal and non-commercial purposes including educational and scientific use provided that any user places the proper copyright notices on the photo or display material [i.e. © Manuel H. Dubón, © M. H. Dubón,© Fundacion Mi Terruno]. The Photographic digital or electronic material may not be published electronically or in printed material or other public or commercial websites use without first seeking and obtaining permission from the owner and the Foundation.

All requests for use of **FMT Culebra Flora and Fauna Digital Database** **material or content** should be addressed to the VMTF with a topic reference of Request for **Authorization to Use Photo Database** at the following email address: **infoatfundacionvillamiterruno.org**. The Foundation contact information is published in its site. [**infoatfundacionvillamiterruno.org**]. Please supply full details of the intended use, the requested date(s) of use, frequency of use, the material to be used specifying photo(s) number (s) and flower(s) name(s), the printed or electronic material or website use being considered and the contact information including name, postal and electronic address, country, and the website name and URL.

Fundación Mi Terruño and the author would appreciate and correction to classified and identified plant material or the contents of this presentation

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