Report of the External Scientific Advisory Committee to the University of Puerto Rico Botanical Garden

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Contents

Title Page ……..... 1
Contents …….. 2
Executive Summary …… 3
Charge to External Scientific Advisory Committee to the UPR Botanical Garden ….... 4
Background ……. 5
Review and Assessment of Current Institutional Assets …… 7
Recommendations
Personnel and Recruitment ……. 9
Scientific Vision and Infrastructure …… 9
Needs of an Integrated Public/Research/University Botanical Garden …….. 16
Possible Organizational Structure for the UPR Botanical Garden
Overall Structure …… 19
Operations Department …….. 19
Development and Special Events Department ……... 20
Science Department ……... 20
Horticulture and Living Collections Department ……... 21
Education Department …… 21
Appendix I. Current Example of Director Posting for a University-Based Botanical Garden: Director of the University of Tennessee Gardens …….. 22

Appendix II. Mission/Vision Statements of Selected Botanical Gardens, Arboreta & Environmental Organizations with an Academic/Scientific Research Focus ……... 23

- Arnold Arboretum, Harvard University
- Connecticut College Arboretum
- Cornell Plantations
- The Fell Arboretum at Illinois State
- Instituto Nacional de Biodiversidad (INBIO) and INBioparque
- Lyon Arboretum and Botanical Garden (University of Hawaii)
- J.C. Raulston Arboretum (NC State University)
- Linnaeus Arboretum (Gustavus Adolphus College)
- The Lynn R. Lowrey Arboretum (Rice University)
- Matthaei Botanical Gardens and Nichols Arboretum (Univ. of Michigan)
- Mount Holyoke College Botanic Garden
- North Carolina Botanical Garden
- The Edith J. Carrier Arboretum (George Madison University)
- The Morris Arboretum of the University of Pennsylvania
- The University of California Botanical Garden at Berkeley
- The University of South Florida Botanical Gardens
- The University of Washington Botanic Gardens

Appendix III. Examples of University-based Botanical Garden and Arboreta Friends Groups: Friends of the University of Tennessee Gardens, Friends of Linnaeus Arboretum, and Friends of Fullerton Arboretum ……...…… 29

Executive Summary

The External Scientific Advisory Committee to the University of Puerto Rico Botanical Garden (UPR-BG) conducted a site visit, September 26-28, 2007, and consulted with more than a dozen senior administrative and academic UPR personnel and associates through meetings, presentations, tours, and discussions concerning the future scientific agenda for the UPR-BG. The materials on which this report was based are reviewed herein, and the *recommendations of the Committee are then presented, constituting seven main points, organized within three main thematic areas:*

I. Personnel and Recruitment

1. Recruit and hire key programmatic, managerial, and support staff

II. Scientific Vision and Infrastructure

2. Develop joint projects with other UPR units and outside organizations
3. Create incentives for researchers to collaborate with UPR Botanical Garden
4. Establish a *UPR Botanical Garden Science Center*

III. Needs of an Integrated Public/Research/University Botanical Garden

5. Re-brand the image and enhance publicity for the UPR Botanical Garden
6. Diversify and increase funding base for the UPR Botanical Garden
7. Achieve AAM accreditation as soon as possible

The University of Puerto Rico has a unique opportunity to create a world-class botanical garden. It is well on its way towards this goal with an inspirational architectural design for the site. The UPR Botanical Garden is fortunate in having a surprisingly large footprint and location at the intersection of the San Juan Knowledge Corridor and the Ecological Corridor. The challenge now is to devise scientific, horticultural, cultural, educational programs, and also provide a managerial and fundraising infrastructure that could support and sustain those programs. This report, while focusing on scientific concerns, the specific charge to the Committee, makes recommendations that touch upon the entire UPR Botanical Garden's enterprise because the scientific components cannot succeed without a successful overall operation.

Charge to the External Scientific Advisory Committee to the University of Puerto Rico Botanical Garden

The three-member External Scientific Advisory Committee to the University of Puerto Rico Botanical Garden (UPR-BG) was charged with the following responsibilities by Dr. Emma Fernández-Repollet, Vice President for Research and Technology for the University of Puerto Rico (UPR):

- Provide advice and guidance on planning, implementing and evaluating UPR-BG research-related activities
- Recommend research priorities and development plans
- Propose and critique organizational structure
- Help identify collaborators and funding resources
- Assure that programmatic issues and concerns are addressed
- Perform periodic evaluations of research progress

The Committee felt that in addition to making recommendations on the strictly scientific matters related to the UPR Botanical Garden, it would extend its comments to include other aspects of the UPR Botanical Garden that are relevant to the execution of a robust and modern scientific agenda. A powerful, sustainable scientific program at the UPR Botanical Garden will require a solid but nimble business plan that integrates all three programmatic areas (science, education, and horticulture) with public outreach and revenue-generating components (e.g., café, gift shop, parking fees, patents on scientific discoveries and new horticultural varieties, etc.).

The first site visit was made on September 26-28, 2007, and this report is based on the presentations, meetings, discussions, tours, and observations made during this visit, involving the following senior and relevant academic personnel:

- Antonio García Padilla, President, UPR
- Dr. Celeste Freytes, VP for Academic Affairs, UPR
- Dr. Emma Fernández-Repollet, VP for Research and Technology, UPR
- Dr. Gladys Escalona, Chancellor, Río Piedras campus
- Dr. José R. Carlo, Chancellor, Medical Sciences campus
- Dr. Jorge Vélez Arrocho, Chancellor, Mayagüez campus
- Dr. Inés Sastre de Jesús, Professor of Biology, UPR-Mayagüez
- Dr. James Ackerman, Professor and Chairman of Biology, UPR-Río Piedras
- Dr. Eugenio Santiago, Director of the Herbarium, UPR Botanical Garden
- Arch. José Javier Toro, Toro Ferrer Architectos, CSP
- Dr. Margarita Fernández, Coordinator Accreditation, UPR Botanical Garden
- Prof. Ida de Jesús, Director, Office of Development and Infrastructure
- Mr. Marcos Caraballo, Herbarium Manager, UPR Botanical Garden

Background

According to the web site http://www.upr.edu/jardin/JardiBot.htm, the UPR Botanical Garden has the following **mission**:

> "El Jardín Botánico tiene la misión de ser un centro científico, educativo y cultural que al mismo tiempo sirve como área recreativa. Sus colecciones botánicas, lagos, cascadas y paradores quedan armoniosamente enlazados por veredas, caminos y senderos, cuyo recorrido permite al visitante conocer y apreciar mejor el valor de la flora nativa y tropical."

Its **history** is summarized on the same site as follows:

> El Jardín Botánico fue propuesto originalmente en 1959 y certificado por el Consejo de Educación Superior el 12 de septiembre de 1969. Fue inaugurado el 10 de marzo de 1971, por iniciativa de Don Arturo Roque y apoyado por el Presidente de la Universidad de Puerto Rico, Don Jaime Benítez. Durante los años 1971 al 1989 el Jardín estuvo parcialmente abierto al público. Luego del paso del Huracán Hugo, el Jardín se vio obligado a permanecer cerrado para su debida reconstrucción. En 1991 se abrió nuevamente para disfrute de sus visitantes. El Jardín cuenta con 289 cuerdas de terreno.

The UPR Botanical Garden, which is the physical home to the administrative offices of the UPR, offices and laboratories of the UPR-Mayagüez Agricultural Extension Service, and the U.S. Forest Service's International Institute of Tropical Forestry (IITF), has been a relatively quiet presence within Puerto Rico and on the international botanical garden stage until the appointment of Antonio García Padilla as President of the UPR. Under President García Padilla, an ambitious, award-winning design was commissioned for remaking the nearly 300-acre campus into a world-class botanical garden. The President's vision is coincident with a larger economic, scientific, and cultural renaissance within Puerto Rico, and the UPR Botanical Garden is meant to play a unifying and catalytic role in this enterprise, as explained below.

Two documents provided to the Committee summarize and set the tone for the context of the development of the science and other components of the UPR Botanical Garden. The first of these is the *Final Framework Plan: El Jardín Botánico de la Universidad de Puerto Rico*, a 145-page document produced by Field Operations and Toro Ferrer Architectos in May 2006. The conclusion of the *Plan* is very useful and informative:

- "The Botanical Garden at the University of Puerto Rico provides a unique opportunity for the City of San Juan and the island more broadly. The Garden can become a new green heart and a much-needed form of public urban space in Puerto Rico. Further, its intersection with the Ecological Corridor makes possible numerous new connections to city-wide trails and recreational paths network, which in turn would make the garden a major large park in this environmentally conscious system.

- In the Framework Plan the Botanical Garden is envisaged as a new hybrid form of landscape, one that primary objectives are - inclusion, activation and growth. Inclusion of many interests and diverse pool of users; from neighborhood residents to international tourists, activation through newly initiated programs; from displays and exhibits to commerce, education and research, and growth of the Garden; as an important research and science institution, as a Caribbean Island native plants conservatory and archive, as demonstration ground, and economical growth as well - through grants, attractions and events.

- Implemented in this form we believe that the Garden will raise the quality of life of the residents of San Juan and help spur development in the vicinity. We strongly urge the University to take steps towards implementation of this plan and make the Garden an active participant in San Juan's future."

The other context-setting resource for the Committee is a 64-page document entitled *The Botanical Gardens at the University of Puerto Rico*. Among the highlights of this document are the following salient points:

- The Botanical Garden forms the heart of a new urban district within San Juan
- The San Juan Knowledge Corridor is the flagship initiative of a new economic agenda for Puerto Rico
- Four existing units of the San Juan Knowledge Corridor are the UPR Botanical Garden, UPR Río Piedras, Centro Médico/VA Hospital, and the Universidad Metropolitana
- A new, 83-acre Science City at Oso Blanco is envisioned at the center of the San Juan Knowledge Corridor with labs, hotels, and green living spaces

Within the context of the overall 10-year UPR Strategic Plan, the activities being reviewed by the Committee fall squarely within Goal 3: Competitive Research, Investigation, and Creative Work, the details of which are outlined in the document *Ten Challenges 2006-2016: An Agenda for Planning*.

Finally, a major effort is underway with the University of Puerto Rico to obtain accreditation for academic programs and museum collections across the board. In fact the policy of the UPR in this regard is as follows:

> *UPR Board of Trustees (Certification Num. 138 2003-2004)*
> Wherefore: The University of Puerto Rico encourages a culture of evaluation and assessment of its academic programs and professional services.
>
> Wherefore: Both international and national academic communities endorse the accreditation processes with which peers and colleagues review programs and academic services to enhance and strengthen the quality of its services.
>
> Therefore: It is the institutional policy of the University of Puerto Rico to

sustain the actual accreditation of its academic programs and to encourage and support the well deserved accreditation of programs and services liable of such standing.

That the President of the University of Puerto Rico, along with the Chancellors, design an agenda or plan, with a set calendar, to achieve the academic goal hereby stated and periodically inform this Board of Trustees on its progress.

Review and Assessment of Current Institutional Assets

Documents provided to the Committee included Powerpoint slide presentations by Dr. James Ackerman (UPR-Río Piedras), Dr. Eugenio Santiago (UPR Botanical Garden Herbarium), and Dr. Inés Sastre de Jesús (UPR-Mayagüez). These documents, which outline the current people, projects, and research resources at their respective units, are on file with the office of the Vice Presidency for Research and Technology at the UPR. The main conclusion from these documents is that the extensive research activities and resources of the Biology Department and Agricultural Extension Service at the UPR Mayagüez and the equally impressive assets of the Biology Department of the Río Piedras campus and of the Medical Sciences Center need to be factored into the mix of opportunities for synergistic projects to be undertaken by the UPR Botanical Garden in the future; specific examples will be discussed below.

The documents provided indicate there are currently 30 investigators and 48 projects of varying degrees of relevance to the UPR Botanical Garden's future science agenda at the Medical Sciences Center, the Agricultural Service, and the Biology Departments of the Mayagüez and Río Piedras campuses. Among the extant physical resources, per documents provided to the Committee, include seven research laboratories:

- Central Analytical Laboratory
- Tissue Culture Laboratory
- Soil and Water Chemistry Laboratory
- Laboratory of Soil Fertility
- Virology
- Laboratory of Soil Physics
- Laboratory of Biological Control

The UPR Botanical Garden currently houses two of the major botanical/agricultural, ecological **libraries** in Puerto Rico, essential tools to carry out research in botanical sciences. These libraries are 1) International Institute of Tropical Forestry library and 2) Department of Agriculture Library.

Currently, there are three scientific collections associated with the UPR Botanical Garden (a fourth museum collection on the grounds, that of the sculpture art, is not within the scope of this report). The first of the two main botanical assets of the UPR Botanical Garden is the **Herbarium**, a museum of plant specimens known internationally by the

acronym UPR. An Assessment Report (April 2001) of this collection, sponsored by the Institute for Museum and Library Services, stated that *"the collections are the most important in Puerto Rico and will gain importance as the program grows and the botanical garden builds its credibility as a scientific as well as a display collection."* The Executive Summary of that report (authored by Dr. Gerald Guala) is as follows:

> "The herbarium of the University of Puerto Rico Botanical Garden is comprised of approximately 36,000 specimens housed in a new and lovely building and now has a full time curator. The collections are the most important in Puerto Rico and will gain importance as the program grows and the botanical garden builds its credibility as a scientific as well as a display collection. Significant inputs are necessary in personnel and lesser inputs in equipment are needed. My five most important recommendations as follows: 1. Hire a collections manager and technician. 2. Purchase computer equipment described above. 3. Begin an integrated database system for the herbarium and living collections. 4. Begin repair of collections and cabinets. 5. Integrate and compile records and develop written policies."

Already, a collections manager has been hired (Marcos Caraballo), and a proposal to the National Science Foundation for databasing the specimen information has been submitted by Dr. Eugenio Santiago (Director of UPR Botanical Garden Herbarium) and Dr. James Ackerman (Director of the Herbarium of the Biology Department of the Río Piedras campus), so progress is being made towards meeting these earlier recommendations.

The international online listing in *Index Herbariorum* for this collection is as follows (http://sweetgum.nybg.org/ih/herbarium.php?irn=125733):

> **Puerto Rico Botanic Garden, University of Puerto Rico**
> Herbario
> Research Division
> Puerto Rico Botanic Garden, University of Puerto Rico
> P.O. Box 364984 San Juan, Puerto Rico 00936-4984 U.S.A.
> Phone: [1] 787/ 250-0000, ext. 6105, 6106, 6107. Fax: [1] 787/ 751-6808.
> E-mail: goetzea@yahoo.com
> Herbarium Code: UPR
> Correspondents: Eugenio Santiago-Valentín, Director
> Number of Specimens: 36,000
> Specialty: Puerto Rico; Virgin Islands; Caribbean.
> Important Collections: N. L. Britton; L. R. Holdridge; A. H. Liogier; R. O. Woodbury
> Incorporated Herbaria: Agronomic Experimental Station, Río Piedras; RPPR (3000 specimens)

The other main botanical collections asset is the living plants on the nearly 300 acres of land belonging to the UPR Botanical Garden. At present, these **living plant collections** are not accessioned and with the exception of a few labels on the plants themselves, not

identified nor much interpreted for visitors. The inventory, databasing, and imaging of the living collection should have high priority, and this information should be put online to increase public awareness of the UPR Botanical Garden and of its living resources.

The third scientific collection associated with the UPR Botanical Garden is the **Museum of Entomology and Tropical Biodiversity,** which maintains about 250,000 insect specimens, many of which are from the early 20th century. A Powerpoint slide show about this collection was prepared by the director of this collection, Dr. Rosa Franqui, and is on deposit with the Vice President for Research and Technology. It is important to find ways to integrate this significant biodiversity collections resource into the UPR Botanical Garden's research and educational program, and exhibitions around the theme of pollination biology of economically or ecologically important plant species offer an obvious first step.

Recommendations

I. Personnel and Recruitment

1. Recruit and hire key programmatic, managerial, and support staff

The absolute first priority is to recruit and hire a visionary and energetic Executive Director. A specific example of a director's position description for a university-based botanical garden (University of Tennessee) is given in Appendix I; this is an actual, current search, the posting taken from the American Public Gardens Association (APGA) web site. This particular example has a horticultural focus, but for the UPR it should ideally have a scientific focus. The ideal candidate would have tropical biodiversity, conservation, and economic botany (particularly bioprospecting) credentials, in addition to having a managerial background with a botanical garden or arboretum. Ideally such an individual would also be tenured in an appropriate UPR academic department, as this is the typical situation in university-based botanical gardens and arboreta (see examples in Appendix II).

While hiring an Executive Director is the first key step, he/she should be given the opportunity to make key hires in the managerial and programmatic areas of the Botanical Garden early on. Suggested organizational structures for the various components of the UPR-BG are given in the final section of this report. The titles are generic and could be adapted to the specific vision of the Executive Director. There are logical ways to combine some of the functions if funding is limited (e.g., in the Development arena, it would be possible to combine into one position someone who was concerned with individuals and special events, and to combine someone who was concerned with foundations and corporate giving into a single position). What is presented is an idealized depiction of functions. The key people, however, are leaders of the five main areas: Operations, Development and Special Events, Science, Horticulture and Living Collections, and Education.

II. Scientific Vision and Infrastructure

2. Develop joint projects with other UPR units and outside organizations

Below are ten themes or projects that would draw upon current UPR assets and those of existing partners outside of the UPR and that would be good fits for the UPR Botanical Garden in its expanding research portfolio locally and globally. As joint research projects are developed, special attention should be given to the integration of the living collections into the scientific mission of the institution; good examples of how this has been done elsewhere are at the National Tropical Botanical Garden in Kauai, Hawaii (http://www.ntbg.org/), and at the Fairchild Tropical Botanic Garden in Florida (http://www.fairchildgarden.org/). The UPR Botanical Garden could achieve a more international presence if it focused the development of its living collections to be those of the Caribbean flora and not just plants native to Puerto Rico, although certainly the latter should be a priority. Not all potential research projects lend themselves to involving living collections, but when appropriate it would be good take advantage of the abundant space for growing plants that the UPR Botanical Garden is fortunate to have on its campus.

- **Bioprospecting –** surveying and analyzing the plants, fungi, and microbes of Puerto Rico for pharmacologically active compounds. Such projects could be undertaken with contracts and grants from government (e.g., NIH) or companies (e.g., INBio model in partnership with Merck in Costa Rica). Projects could engage selected faculty of the UPR's Medical Sciences Center (particularly the Department of Pharmaceutical Sciences) in partnership with the UPR Botanical Garden, for which the Herbarium is essential for identifying and vouchering plant samples. There exists the potential for the UPR to realize royalties on drug discoveries if the business arrangements are properly structured. For more on INBio, and how this celebrated organization has integrated bioprospecting with garden display and education through its INBioparque in San José, see http://www.inbio.ac.cr/es/default.html.

- **Plant-based traditional medicines among Puerto Rican communities**- Documentation, comparative analysis, and public outreach concerning medicinal plant use in Puerto Rico and Puerto Rican communities in New York City. The NIH is funding a project parallel to this idea currently through The New York Botanical Garden. For a similar project in Puerto Rico, the UPR Botanical Garden could partner with the UPR's Medical Sciences Center, particularly the Graduate School of Public Health. Below is the abstract for the Dominican Republic project (Dr. Mike Balick, P.I.) to give an illustration of what might be developed on this theme for Puerto Rico:

  "The objective of this project is to investigate the utilization and efficacy of Dominican herbal medicine in New York City and the Dominican Republic. Studies have shown that parallel health care delivery systems

involving herbal remedies and traditional healers exist within immigrant communities in urban settings, particularly among Hispanics. This has been documented among Dominicans who constitute the largest Hispanic immigrant group in New York City according to the 2000 US Census Report. Research into their ethnomedical traditions and practices can provide more culturally sensitive methods for handling diverse patient populations and contribute to improving the overall effectiveness of public health care in the US. In order to evaluate the botanical treatments used in Dominican traditional medicine, an integrative, multidisciplinary approach will be utilized that incorporates biology, chemistry, clinical medicine, ethnobotany, ethnomedicine, and public health. This project will be accomplished through the following steps: (1) conduct surveys among Dominicans in New York City and in the Dominican Republic to identify the most commonly used herbal remedies for selected health conditions; (2) analyze differences and similarities in the use of these remedies between Dominican populations in New York City and the Dominican Republic; (3) investigate the known pharmacology and chemistry of the most frequently used plants based on a review of the literature; (4) develop a list of botanical therapies deserving of further investigation for anti-inflammatory properties based on an evaluation of the status of biological and clinical knowledge about the plant, its importance to the Dominican pharmacopoeia, safety of its known or presumed constituents, efficacy, conservation status, and potential for sustainable production; and (5) test these botanicals using two in-vitro assays to measure anti-inflammatory activity, isolate/characterize anti-inflammatory components for purposes of standardization, and make recommendations for future clinical studies. The health conditions to be studied include the following: asthma, dermatological conditions, diabetes, diarrhea, musculoskeletal pain, reproductive/gender-specific disorders, and respiratory infections. These medical problems have been selected based on (a) their prevalence in the Dominican community, (b) the use of traditional remedies for their treatment, as well as, for some, (c) the role of inflammation in the condition's etiology. Inflammation is an important component of the pathophysiology of many health conditions. As such, an investigation into the clinically relevant, biological activities exhibited by traditionally used plants should reveal those that exhibit anti-inflammatory properties and may increase understanding of their efficacy in traditional use. The proposed project will be conducted by an international, multidisciplinary, and multicultural collaborative research team consisting of scientists, students, trainees, and assistants from four collaborating institutions in the United States and two in the Dominican Republic. The collaborative approach and results from this R21 project will enable preparation of an RO1 proposal."

- **Virtual Flora and DNA barcoding the plants and fungi of Puerto Rico -** creating a modern, online dynamic database of Puerto Rican plants and fungi,

with high-resolution digital images, e-keys to identification, maps, descriptions, links to the historical literature, etc. using the specimens of all three UPR herbaria (Botanical Garden, Río Piedras campus, Mayagüez campus) and in herbaria of collaborating institutions (e.g., Smithsonian, The New York Botanical Garden, etc.). DNA barcodes could be created for all species using DNA extracted from specimens in herbaria and (optimally) freshly collected plants from the field, at which time digital images of the living plants can be taken for the project. *This project theme can, and should be scaled-up to cover the entire Caribbean, and it should be broadened intellectually to encompass Caribbean-wide floristic or biogeographic studies, establishing the UPR Botanical Garden as a central node for these activities.*

- **Plant genomic approaches to human health and nutrition –** nutrition initiatives could be developed with UPR-Mayagüez (e.g., Dr. Dimuth Siritunga, plant molecular geneticist, specialist on tropical root crops, especially the genetic manipulation of cassava) and human health initiatives could be developed in conjunction with the Medical Sciences Center with appropriate faculty. For the sort of collaborative project between botanists and medical researchers that could be developed between the UPR Botanical Garden and the Medical Sciences Center, see the cycad genomics project (http://sciweb.nybg.org/science2/GenomicsLab.asp), for which Dr. Dennis Wm. Stevenson of the NYBG is the P.I., the relevant summary being:

  > "Another classical botanical question we are addressing with cycads is of important medicinal value. Several compounds isolated from cycads have been shown to be neurologically toxic, including a compound called BMAA, which mimics the neurotransmitter, glutamate. BMAA toxicity is believed to act by over stimulating glutamate receptor in human neurons. Using our EST based approach, we have identified genes that may be involved in BMAA biosynthesis. We have also identified a cycad EST similar to human glutamate receptors, which may play an important role in signaling mechanisms responsible for growth and development. By understanding the role of BMAA in cycads and its relationship to the native plant glutamate receptors, we may gain a clearer insight into glutamate receptor function or dysfunction in both plants and humans."

- **Ethnoflora of the Caribbean –** an online encyclopedia of the useful plants and fungi of the West Indies. The idea behind this theme is to create a dynamic online catalog of plants and fungi of the region that are used for food, fiber, fuel, medicines, etc. along the lines of the book done for the useful plants of a group of islands off the Horn of Africa, the *Ethnoflora of the Soqotra Archipelago*, a publication of the Royal Botanic Garden, Edinburgh: http://www.soqotra.info/rbge_book.html. This Web-based project would rely on extensive herbarium and library research, online database-mining, and selected field work in critical areas where traditional use of plants by rural peoples continues in the West Indies.

- **Flora Borinqueña and the urbanization of Puerto Rico** - increasing public awareness of Puerto Rico's native flora and its use in creating new green spaces in urban areas. The idea is to add a feature to the existing Flora Borinqueña web site (http://sciweb.nybg.org/science2/hcol/pr/florbor.asp), hosted by The New York Botanical Garden, that focuses on the noteworthy plants of Puerto Rico that once grew in areas of Puerto Rico that are now urbanized. Users will be able to explore the pre-urbanization flora by species or by area. Users can view these data in the Virtual Herbarium, or if they want to export them to Google Earth to overlay them with other data sets (e.g., rainfall, history, etc.), the dataset can be exported to Google Earth using a software utility. This initiative is already underway within the context of the UPR-NYBG partnership, with current UPR contributions coming from the Mayagüez campus; specimen data could be added from the Río Piedras and UPR Botanical Garden herbaria to make a more compete picture. Results could be viewed by online visitors to a redesigned and enhanced UPR Botanical Garden web site and in person by visitors to the Botanical Garden via computer kiosks or on hand-held PDA units.

- **Habitat Specificity of Puerto Rican tree species** - predicting species endangerment risk in response to climate change in the Caribbean Basin. This project idea is modeled on the 2007 M.S. thesis (Columbia University) by Hannah Stevens: *Habitat Specificity of Amazonian Tree Species*. Using herbarium specimen data from the URP's three herbaria, together with data from relevant collaborating herbaria outside of Puerto Rico, together with the Geographic Information Systems (GIS) capabilities of the UPR, a very interesting project could be developed for predicting Puerto Rican tree species endangerment risk in response to climate change. *Once the protocols are developed, the concept could be extended to throughout the Caribbean*. As an illustration of what this might entail, below is the abstract from Ms. Stevens' M.S. thesis:

  > "The Amazon Basin harbors the world's largest and most biologically diverse tropical rainforest. Yet still little is known about this important ecosystem and the species it harbors. Using herbarium collection data and a series of spatial analyses, this study attempts to answer the important question of how species are distributed, and to what degree they may be restricted to particular habitat types. A total of 315 tree species in 49 different families were analyzed using a dataset of 21,464 records obtained from herbarium specimens. Habitat types were delineated for the Basin using annual average precipitation, annual average evapotranspiration and soil type data. This is the first known spatially explicit Basin-wide habitat classification system based on a combination of these parameters. Species were plotted on the habitat matrix, and a measure of habitat specificity determined.

Results indicate that at least ten percent of the species analyzed can be considered restricted in their distribution, or habitat specific. Extrapolating this to the estimated 10,000 tree species found in the Basin, at least 1,000 of the Amazon's tree species are likely at significantly greater risk from factors such as climate change and habitat loss.

This study also points to the need for increased access and availability of digitized and georeferenced museum collection data. Areas such as French Guiana and Ecuador are well sampled, while nearly all of Brazil, which makes up the majority of the Amazon Basin, lacked sufficient data. This bias is primarily a result of uneven availability and access to digitized and geo-referenced specimens, rather than an artifact of collection effort. Further research would greatly benefit from increased data access. Despite inherent biases in herbarium collection data, this study provides an important look at how a suite of species may be affected by increasing threats such as habitat loss and global climate change, and has important implications for conservation planning and management.

- **Restoration ecology-** helping to resource degraded landscapes in Puerto Rico to green, natural areas. An obvious first pilot project would be the restoration of the Río Piedras, as it passes through the UPR Botanical Garden and is due to be modified in some fashion in connection with the upcoming redesign of the San Juan Knowledge Corridor and the Ecological Corridor. The UPR Río Piedras Biology Department, for example, has scientists on its faculty who could be invited to contribute to the redesign of the river's channel and floodplain to maximize the long-term sustainable management of native plants and animals there, making it an ecological showcase project for the UPR.

- **Puerto Rican Endangered Plants Initiative (PREPI) -** The overall goal of the PREPI (a project concept currently under development by The New York Botanical Garden, and the University of Puerto Rico Botanical Garden's Herbarium, is to rescue Puerto Rico's most endangered plant species (per IUCN criteria) first by getting them into cultivation, learning to propagate them, and then by ultimately reintroducing them into their native habitats. The PREPI work plan envisions seven major stages:
  - Find species' locality data from herbarium specimens and online databases
  - Conduct GIS analyses to predict where species could potentially occur
  - Conduct field studies to relocate species and to collect germplasm for cultivation
  - Grow species at UPR facilities and learn about propagation requirements
  - Launch a public awareness campaign on the importance of PREPI's goal
  - Reintroduce species to their natural habitats and appropriate restored landscapes
  - Conduct field studies to monitor re-introductions and to locate new populations of endangered species for incorporation into the PREPI scheme for rescue

This idea builds upon the several years' of successes that the UPR Botanical Garden's Herbarium Director, Dr. Eugenio Santiago and the Herbarium Manager, Marcos Caraballo, have had in locating endangered Puerto Rican plant species and cultivating them in the UPR Botanical Garden. Cultivation and study of propagation techniques will be possible through the UPR's campuses throughout the island, thus affording the full range of growing conditions necessary, with principal facilities for mesophytic species in Río Piedras and for more xerophytic species in Mayagüez. The UPR has personnel proficient in plant cultivation, and additional training can be provided through internships, for example at the NYBG, for selected UPR gardeners who are assigned to the PREPI. *The concept could be scaled-up and extended throughout the Caribbean once the protocols are developed, with the UPR Botanical Garden serving as the regional center for this activity.*

- **Puerto Rican Invasive Plants Initiative (PRIPI) –** 82 invasive plant and animal species have been documented by the National Biological Information Infrastructure (NBII) on its Invasive Species Information Node for Puerto Rico. The UPR Botanical Garden is very well positioned to take the lead on this issue within Puerto Rico, at least in terms of invasive plant and insect invasive species, by virtue of its Herbarium and Entomological Museum and its access to scholarly resources throughout the UPR system. Invasive species have millions of dollars of negative impact on the economy of Puerto Rico, and it would be a great service if the UPR Botanical Garden could develop projects around this theme to research and recommend action to control the most noxious and pernicious invasive species in Puerto Rico. *This project theme could be scaled-up to encompass all of the Greater Antilles or even the entire Caribbean region once the protocols are developed for within Puerto Rico, ideally in partnership with the Agricultural Extension Service at the UPR Mayagüez.*

3. **Create incentives for researchers to collaborate with UPR Botanical Garden** – The research projects proposed above, and others that could be envisioned, will only happen in a truly collaborative fashion if researchers have incentives to work with the UPR Botanical Garden. Busy professionals are typically fully engaged with the work they are already doing, so to make the collaborative science agenda of the UPR Botanical Garden succeed it will be necessary to offer incentives. These could include free and ample parking (not to be underestimated as an incentive!), housing for long-term visitors on the Botanical Garden grounds, visitor office space with modern amenities, a conference center, adjunct appointments with the UPR Botanical Garden, and equitable sharing in grant monies that are jointly raised, among other things. It will be an early challenge for the new Executive Director to work in this issue so as to catalyze authentic partnerships with other UPR units and with outside researchers internationally. One specific idea is the creation or expansion of native flora gardens as a teaching resource for courses in tropical botany, local flora, morphology, anatomy, and

economic botany. These recourses could attract botany professors from mainland U.S. universities to teach a course in tropical botany.

4. **Establish a *UPR Botanical Garden Science Center*** – creating a physical space that would be the symbolic and tangible location for the development of the UPR Botanical Garden's scientific agenda. It would be ideal if the 30,000 sq. foot Planta Piloto de Ron could be renovated with the location of the UPR Botanical Garden Science Center in mind. Already, there is a UPR plan to have environmental sciences programming in that building, incorporating programs of the Medical Sciences, Río Piedras, and Mayagüez campuses. It would be relatively minor matter to organize these elements around the theme of collaborative science research and education programs coordinated by the UPR Botanical Garden's Science Director (one of the key positions recommended for hiring by a new Executive Director). The UPR Herbarium should be relocated to this building, which is already conveniently nearby the building (former Food Technology) where the Entomology Museum is meant to be relocated. This opportunity should be taken to expand the current footprint of the herbarium in order to provide space for visitors (to foster further interaction) and for future research initiatives. The UPR Botanical Garden Science Center should have classroom space and meeting space for UPR events and international conferences, thus creating the UPR Botanical Garden as a destination for scientific discovery and discourse. The idea supports Goal 3 (Competitive Research, Investigation, and Creative Work) in the UPR's *Ten Challenges 2006-2016: An Agenda for Planning*.

III. Needs of an Integrated Public/Research/University Botanical Garden

5. **Re-brand the image and enhance publicity for the UPR Botanical Garden**
   The current UPR Botanical Garden mission statement needs to be updated and made more compelling to put it into sync with the vision and energy of the *Final Framework Plan*. See Appendix II for examples from other academic/research organizations with botanical gardens and arboreta; the ones for the University of Hawaii and INBio may be particularly relevant as they are situated in the tropics and they seem to share an institutional vision that resonates with the University of Puerto Rico's *Ten Challenges 2006-2016: An Agenda for Planning*. The link for the UPR Botanical Garden on the Association of Public Gardens and Arboreta web site is broken: http://www.publicgardens.org/Custom/GardenSearch.aspx (as are the links for various other gardens listed by the APGA). Priority projects could include the databasing and imaging of Herbarium collections and inventorying, mapping, databasing, imaging, and posting online of specimens in the living collection. Establishment of a newsletter and publication of popular guidebooks to plants would be another good way to get the message out about the UPR Botanical Garden. Plant Information Services could be offered on-site and on radio and television programs. Join the Center for Plant Conservation and

publicize the efforts to conserve and propagate rare and endangered Puerto Rican plant species (e.g., West Indianwalnut, *Juglans jamaicensis*).

Beyond the incentives to attract researchers to the UPR Botanical Garden, a strategy needs to be developed and implemented to attract the general public who are residents of Puerto Rico and visitors. This point relates to the important educational, cultural, and horticultural roles of the Botanical Garden and to the potential for income generation through a gift shop, café, parking fees, tram tours, entry to specialty gardens and exhibits, continuing education classes, etc. The new Executive Director needs to work with Puerto Rican tour operators to get the UPR Botanical Garden on their agendas and to make it a "must-see" destination for international visitors to the island. For example, INBioparque is a regular destination for ecotourists visiting Costa Rica because tour companies routinely package the INBioparque into their itineraries, and upon arrival visitors are educated about INBio's mission, learn about tropical plants and conservation, and buy their lunches at the café and souvenirs at the gift shop. The extensive Continuing Education Program of The New York Botanical Garden, for example, is an economic money-maker, and is a big attraction for the lay public to become engaged with the organization. Another idea is the creation of an exhibit center with rotating exhibitions on popular subjects such as ethnobotany, conservation, uniqueness of the Caribbean flora, history of botany, etc. The UPR Botanical Garden has the very great luxury of space and a great location – perhaps its greatest assets – so there are abundant opportunities for it to become THE place in Puerto Rico to buy plants and books about plants, to learn about plants, and to enjoy a green urban oasis.

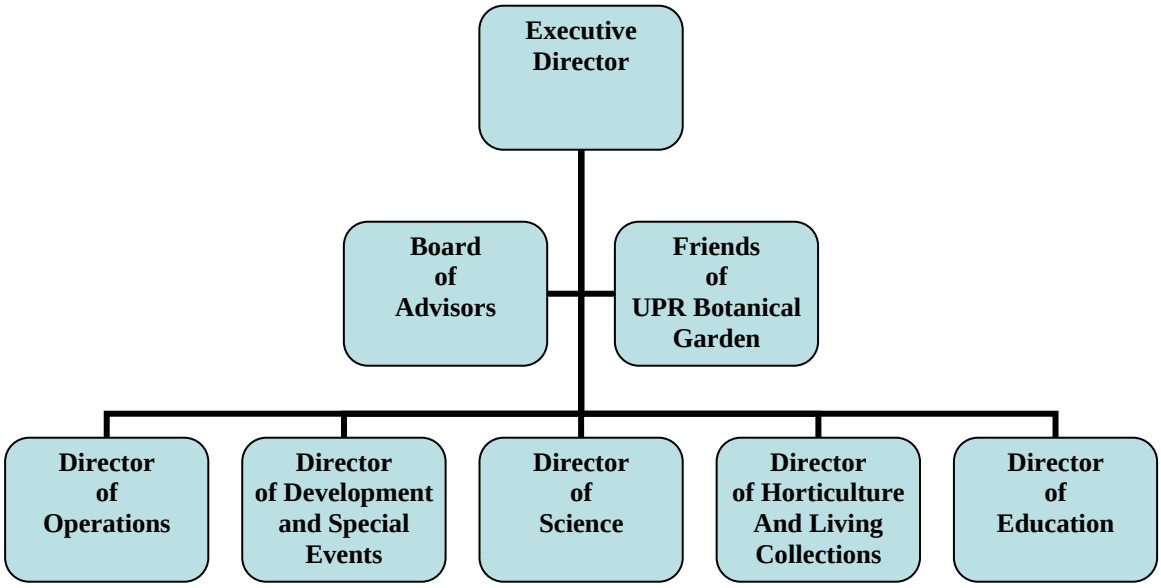
6. Diversify and increase funding base for the UPR Botanical Garden

The funding base for the UPR Botanical Garden needs to be diversified beyond its current major reliance on governmental funds and increased in order to reach the ambitious goals set forth in the *Final Framework Plan* and *Ten Challenges 2006-2016: An Agenda for Planning*. Volunteers are a key resource for the UPR Botanical Garden and the current group should be encouraged and supported and the size and scope of it grown. Establishment of a subset of this group to assist with fundraising efforts is an important goal. Examples of what several other university-based botanical gardens and arboreta have done to establish 501(c)3 organizations to assist with raising private funds are given in Appendix III.

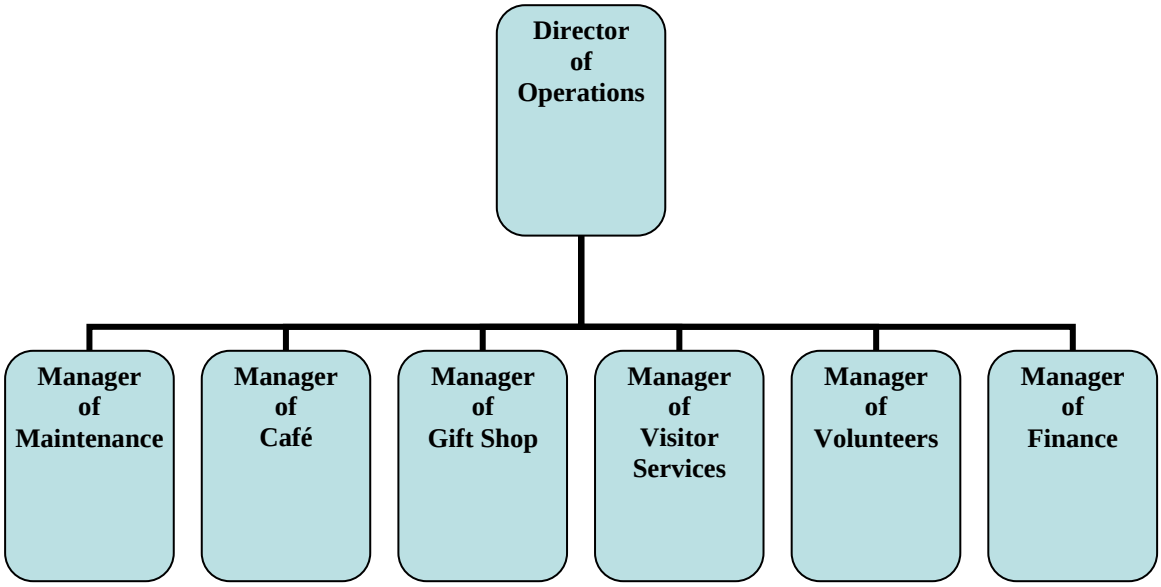
While a Friends group can help greatly with private individual gifts, major funding from special events, corporate contracts and philanthropy, foundation grants, and federal grants and contracts needs the management by an experienced Development team. This, of course, needs to be done in concert with the overall Master Plan of the UPR, but it is critical to have a cadre of Development professionals, working closely with a Friends group, to diversify the funding portfolio to ensure a sustainable future. Successfully accomplishing this goal would help fuel the execution of the architectural redevelopment plan for the UPR Botanical Garden designed by Field Operations and Toro Ferrer Architectos.

7. **Achieve AAM accreditation as soon as possible** – achieving one of the UPR Trustees' goals for accrediting programs and museums throughout the UPR system. The American Association of Museums (AAM) is the gold-standard for accreditation within the museum community, and the effort currently underway by Dr. Margarita Fernández and others should be supported by the new Executive Director (see Recommendation # 1) as one of his/her top priorities. Obtaining AAM accreditation will not only add prestige to the UPR Botanical Garden, but it will open the door to funding opportunities that this added prestige and international recognition will bring.

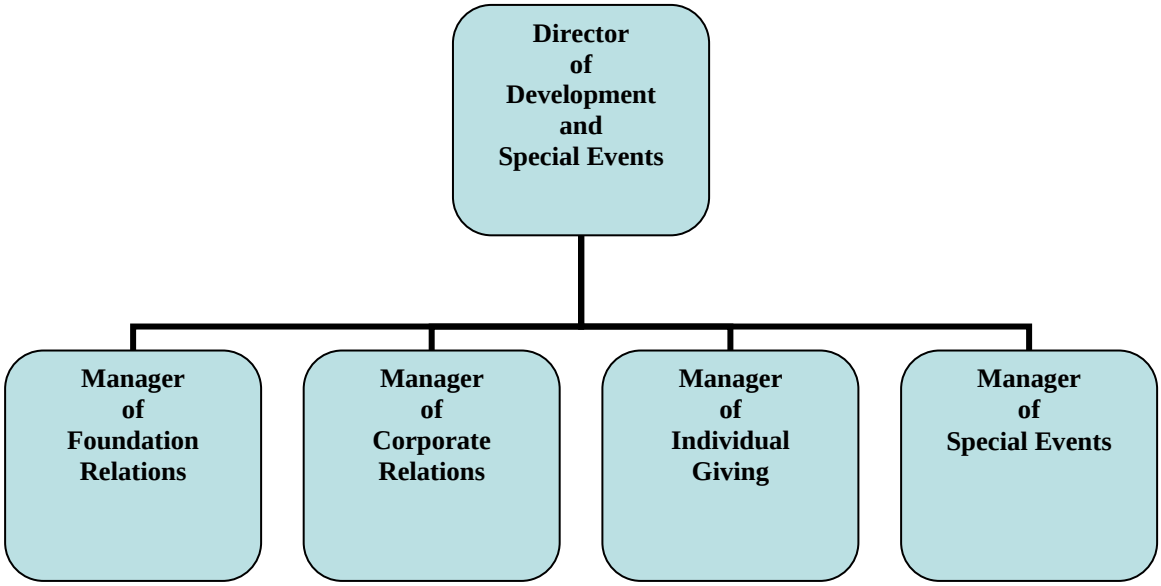
Possible <u>Overall</u> UPR Botanical Garden Organizational Structure



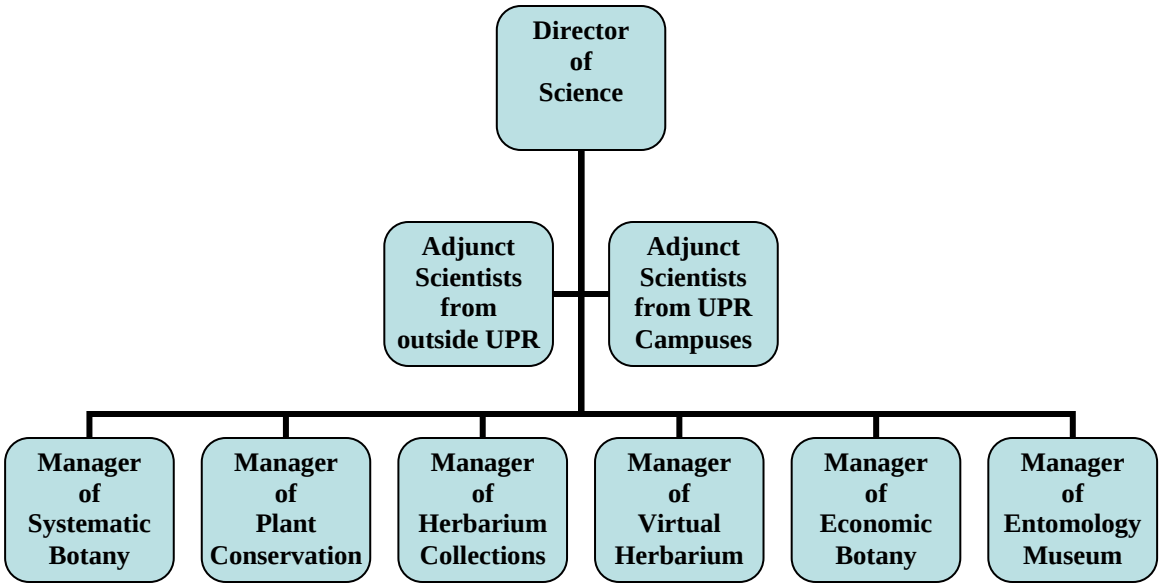
Possible Organizational Structure of <u>Operations Department</u>



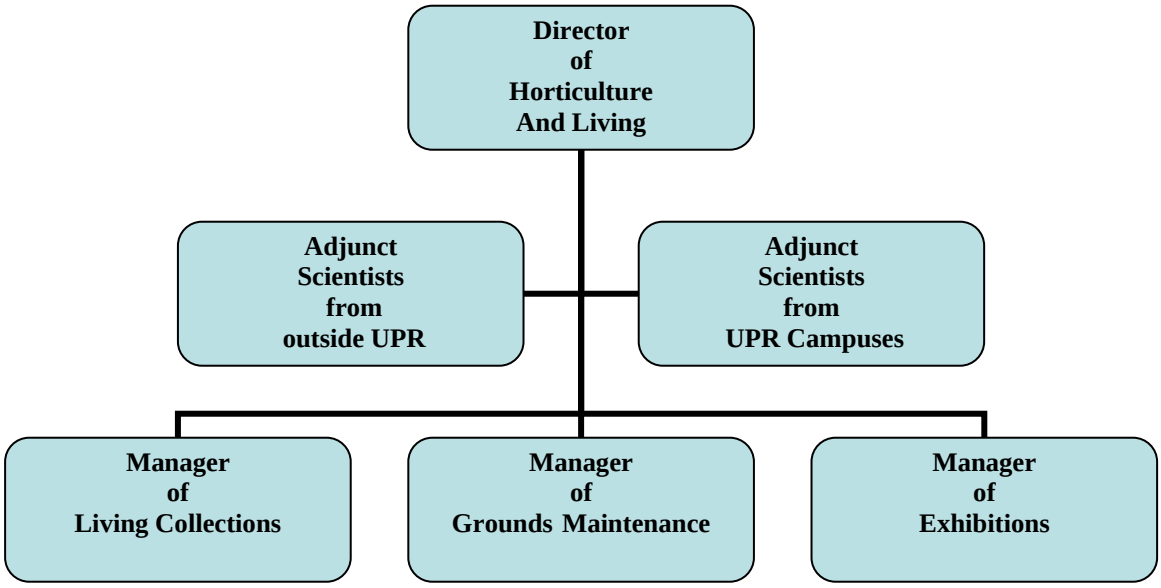
Possible Organizational Structure of <u>Development and Special Events Department</u>



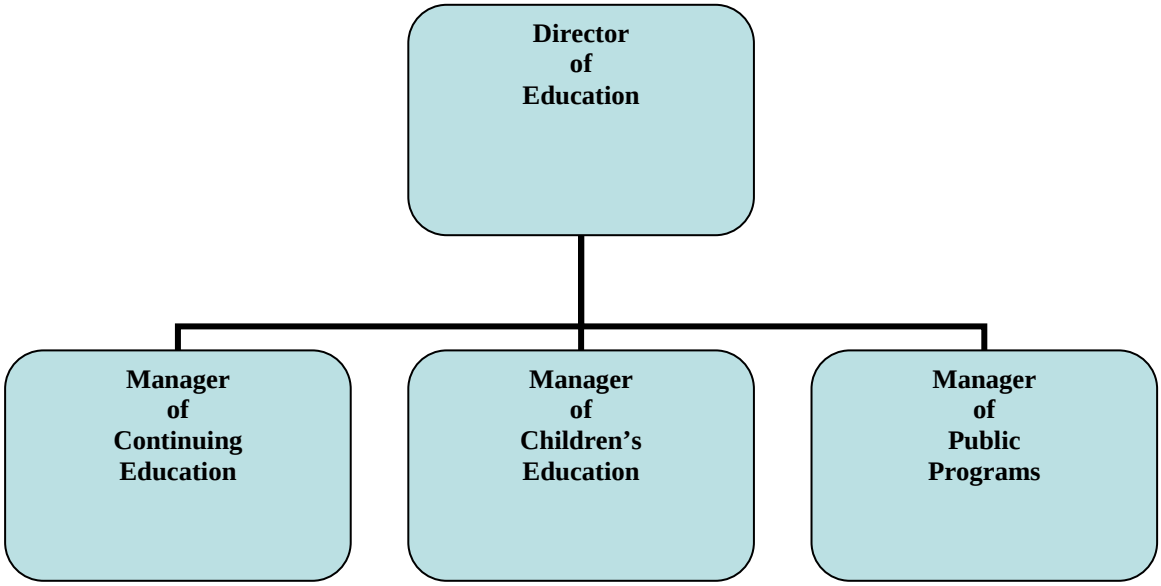
Possible Organizational Structure of <u>Science Department</u>



Possible Organizational Structure for
Horticulture and Living Collections Department



Possible Organizational Structure for Education Department



Appendix I
Current Example of Director Posting for a University-Based Botanical Garden

Director of the University of Tennessee Gardens (Posted: September 12, 2007)

The Director of the UT Gardens is responsible for overall development and public relations for the UT Gardens and will work closely with the UT Gardens Horticultural Director, the Plant Sciences Department Head, and the Friends of the Gardens (a fundraising and advocacy group that provides partial support) for the betterment of the Gardens and the Public Horticulture program in general. The Director will be the point of contact, coordination and liaison between Friends of the Gardens and university units associated with the Gardens. These duties will include coordination of Friends of the Gardens' volunteers and their activities in the gardens. The Director will also work closely with the Deans of Research, Extension, and the College of Agricultural Science and Natural Resources; the UTIA Development staff; and the Director of the East Tennessee Research and Education Center. A major responsibility will be the development of a Gardens master plan, including strategies for development and plans for expansion. The Director's duties will include budget management, fundraising, marketing, networking with nursery and green industries in the local community and state, as well as elected officials and others interested in the Gardens. The successful candidate will be expected to seek and obtain support for the Gardens from individuals, foundations, corporations and other agencies as appropriate. The Director will report to the Vice President of the University of Tennessee Institute of Agriculture and receive input from the Vice President's Advisory Committee for the UT Gardens.

Qualifications include: a bachelors degree or graduate degree (preferred) in Horticulture, Landscape Architecture, Public Relations, or Business Administration; a passion for, and understanding of, the workings of public gardens and public horticulture; strong interpersonal skills; administrative and leadership experience; evidence of success in having worked effectively with administrators, professionals, students, a diverse staff, and volunteers; and a strong track record of experience leading successful fundraising programs and interacting with constituents and donors. Salary and benefits are competitive and commensurate with training and experience.

Active review of applications will begin November 1, 2007, and the search will continue until the position is filled. Applications should include a letter describing qualifications and career goals, a curriculum vita, academic transcripts, and names and contact details of three references. Send application materials to Director of UT Gardens Search Committee, Office of the Vice President for Agriculture, University of Tennessee, 2621 Morgan Circle, 101 Morgan Hall, Knoxville, TN 37996-4505. Please see plantsciences.utk.edu, utgardens.tennessee.edu and agriculture.tennessee.edu/ for more information about the Plant Sciences Department, the Gardens and the UT Institute of Agriculture.

The University of Tennessee is an EEO/AA/Title VI/Title IX/Section 504/ADA/ADEA institution in the provision of its education and employment programs and services. All qualified applicants will receive equal consideration for employment without regard to race, color, national origin, religion, sex, pregnancy, marital status, sexual orientation, age, physical or mental disability, or covered veteran status.

Appendix II
Mission and Vision Statements of Selected Botanical Gardens, Arboreta & Environmental Organizations with an Academic/Scientific Research Focus

Arnold Arboretum, Harvard University
http://www.arboretum.harvard.edu/
The Arnold Arboretum of Harvard University discovers and disseminates knowledge of the plant kingdom to foster greater understanding, appreciation, and stewardship of the Earth's botanical diversity and its essential value to humankind. This is accomplished through three areas of activity:

Research
The Arnold Arboretum promotes research by its scientific staff and other scientists to increase our knowledge of the biology and evolutionary history of plants.

Horticulture
The Arboretum is committed to attaining a leadership role in the management and presentation of botanical collections and landscapes.

Education
Education programs are based on the unique resources of the Arnold Arboretum. They utilize the living collections and the cultural landscape, as well as the information resources and expertise of the staff to educate in the life sciences, plant biology, horticulture, and related disciplines.

In addition to these primary activities that fulfill our mission, the Arboretum maintains library, archival, herbarium and web resources to provide information, materials and support for Arboretum scientists and visiting researchers, as well as students and the interested public. These resources hold significant value as historical and/or biological records, and are managed and conserved utilizing the best available preservation practices. Information technology is critical both to the management of these resources and to the services that facilitate and promote their active use.

Connecticut College Arboretum
http://arboretum.conncoll.edu/
The Arboretum serves a multitude of functions for the College and the greater New London community. For the college academic program, especially Botany, Biology, and Environmental Studies, it is a living laboratory just a few steps from the classroom and dormitory. Generations of faculty and students have used the forests, meadows and wetlands for teaching and research. For the entire student body, the Arboretum provides a welcome connection with the natural world, a place to get away from the stress of classroom and dorm. Parts are available for running, and all trails are suitable for hiking or casual strolling. The Arboretum is open everyday, dawn to dusk, and serves as park

for the surrounding communities. Dog walkers, parents with young children, and office workers out for a quiet lunch break are all frequent users.

Cornell Plantations
http://www.plantations.cornell.edu/
Vision Statement
In order to attract and inspire visitors, and provide them with the opportunity to learn about plants, the natural sciences, and preservation of natural resources, Plantations staff, volunteers and advisory groups, working as a team, will develop, manage, and interpret the arboretum, botanical garden and natural areas, and will develop and maintain facilities and infrastructure in support of these goals.

Mission Statement
The purposes of Cornell Plantations are:

- To hold, manage, protect and enhance the living botanical collections and the natural areas and gorges of Cornell for the benefit and use of the university community and the public.
- To be a vital center for the plant and natural sciences on campus, presenting and interpreting these sciences through its botanical collections, natural areas, display gardens, and educational programs, and providing resources and opportunities for research, education, and cultural growth for the Cornell community.
- To represent Cornell among major botanical gardens and arboreta, and to serve as a resource for the people of New York State in fulfillment of Cornell's land grant college mandate.

The Fell Arboretum at Illinois State
http://www.ilstu.edu/depts/arboretum/
The Fell Arboretum is committed to curating diverse species of trees and other plants integrated with art and architecture on the campus of Illinois State University. The principal goal is to sustain a living laboratory as both an educational resource and aesthetic experience.

Instituto Nacional de Biodiversidad (INBio) and INBioparque – Costa Rica
http://www.inbio.ac.cr/es/default.html
Misión: Promover una mayor conciencia sobre el valor de la biodiversidad, para lograr su conservación y mejorar la calidad de vida del ser humano.

Visión**:** Somos una organización científica y tecnológica de reconocida excelencia y liderazgo, que genera información y promueve iniciativas de conservación y uso sostenible de la biodiversidad que se incorporan al quehacer de la sociedad.

INBioparque
http://www.inbio.ac.cr/inbioparque/es/index.html
Misión: Promover el valor de la biodiversidad y la importancia de su conservación, mediante la recreación y educación de los visitantes.

Visión: Somos una empresa innovadora y excelente en la comunicación del valor de la biodiversidad y su conservación, con un equipo humano comprometido con la educación, recreación y calidad del servicio.

Lyon Arboretum and Botanical Garden (University of Hawaii)
http://wwwdev.hawaii.edu/lyonarboretum/
The Lyon Arboretum and Botanical Garden is the only University botanical garden located in a tropical rainforest in the United States. It is also the only easily accessible tropical rainforest on the island of O'ahu. It currently consists of almost 200 acres at the top of the Manoa watershed with a set of small cottages and greenhouses used for research and community education about plants and the natural environments of Hawai'i. As a branch of the University of Hawai'i, it serves as a center for educational activities on plants, arts, culture, geography, and a range of other sciences. Currently, scholars from Anthropology, Biology, Botany, Culinary Arts, Engineering, Geography, Hawaiian Studies, Horticulture, and Zoology use the Arboretum in parts of their research or teaching. Approximately 34,000 visitors each year participate in classes, research projects, other community activities, or simply wandered the grounds enjoying the beautiful plant displays. Several community organizations use the Arboretum as their base of operations, including Hui Hana, Garden Club of Honolulu, and the Arboretum Association. Through these organizations and others that periodically use the facilities, the University is able to regularly interact with a broad cross-section of the local community.

The Harold L. Lyon Arboretum coordinates, facilitates, and executes research, instruction, and service activities that utilize its collections and resources. Its major emphases are tropical plants, native Hawaiian plants, conservation biology, and Hawaiian ethnobotany. The Arboretum is responsible for:

- Developing a major resource center for tropical plants with Hawaii/Pacific Basin/Asian focus, by enhancing its living plant collection, and establishing an appropriate reference library and herbarium. Making its collections and information available to a broad clientele including students, researchers, industry, and the general public, by performing and disseminating the results of research, by appropriate outreach and educational activities, and through plant and seed exchange programs.

- Serving as an outdoor laboratory for school and university students and classes.

- Importing, identifying, improving through breeding, and introduction to the public, plants useful for horticulture, research, education, or industry.

- Preserving and propagating germplasm of endangered plant species, especially those native to Hawaii. Special attention is given to the use of micropropagation and tissue culture technology in conservation of Hawaiian plants.

- Developing a research and training program in restoration of Hawaiian ecosystems. Serving as a University field station for terrestrial biology and stream biology.

J.C. Raulston Arboretum (NC State University)
http://www.ncsu.edu/jcraulstonarboretum/index.php
The JC Raulston Arboretum at NC State University promotes responsible, inspirational design and management of cultivated landscapes through plant development and evaluation, as well as academic and public education. Strategic Goals:

- Provide creative research and educational programs for students, the green industry, and the public in an effort to improve the American landscape.
- Function as a living laboratory which resides in and complements the curricula of NC State University.
- Collect and evaluate plants for their potential ornamental value and landscape use.
- Develop improved ornamental plants through controlled breeding, evaluation, and selection.
- Provide visitors with an inspirational and educational experience, and an opportunity to connect to the natural world.

Linnaeus Arboretum (Gustavus Adolphus College)
http://gustavus.edu/arboretum/
"The mission of the Gustavus Adolphus College Linnaeus Arboretum is to facilitate environmental education and enhance the application of environmental ethics for all areas of study. The Arboretum provides the College and community a living sanctuary of plants for education, environmental stewardship, reflection and recreation."

The Lynn R. Lowrey Arboretum (Rice University)
http://www.arboretum.rice.edu/welcome.cfm
The mission of the Arboretum is:

- To create a teaching and research collection of woody plants that will serve students, faculty, and staff by enhancing the campus as a place for study, learning about plants, appreciation of the natural world, relaxation, and enjoyment.

- To promote environmental literacy by enhancing the campus as a living laboratory of attractive, diverse plantings that engage and inform campus residents and visitors.

Matthaei Botanical Gardens and Nichols Arboretum (University of Michigan)
http://www.lsa.umich.edu/mbg/default.asp

Mission: Promoting environmental enjoyment, stewardship and sustainability through education, research, and interaction with the natural world.

The purpose: provide a hands-on University and community laboratory for conserving, restoring, and celebrating the environment

The business: develop citizens and leaders dedicated to appreciating, understanding and restoring our environment; promote environmental education, research and public outreach

The values: inspire and enrich people's lives through contact with plants and nature; recognize the restorative value of nature and beautiful gardens; engage scientists and artists in research, teaching, and outreach activities; apply ecological principles in our horticulture and land stewardship; advance sustainable practices and the conservation of biodiversity, particularly that of the Great Lakes Region.

Mount Holyoke College Botanic Garden
http://www.mtholyoke.edu/offices/botan/
The primary mission of the Mount Holyoke College Botanic Garden is to maintain a diverse, well-documented and accurately labeled living plant collection that supports and enhances teaching and research for the faculty and students of Mount Holyoke College. The plant collection should be displayed in a well-designed, visually pleasing manner that promotes knowledge and interest in plants. The Mount Holyoke College Botanic Garden should also promote conservation of the world's natural resources and a better understanding and appreciation of the relationship between humanity and the rest of the natural world.

North Carolina Botanical Garden
http://www.ncbg.unc.edu/
The North Carolina Botanical Garden is part of The University of North Carolina at Chapel Hill. We further the University's mission of teaching, research, and public service through our own mission: "To inspire understanding, appreciation, and conservation of plants in gardens and natural areas and to advance a sustainable relationship between people and nature."

The Edith J. Carrier Arboretum (George Madison University)
http://www.jmu.edu/arboretum/
Mission Statement: The establishment of an Arboretum on the James Madison University campus is based on the philosophical viewpoint that an appreciation of nature is part of intellectual development. In an increasingly urbanized society, natural environmental areas must be provided where different segments of the public have places to meet together to discuss their common interests. Since an environment is common to all forms of life, and the quality of that environment is contingent upon the interactions of people, it follows that a natural Arboretum, emphasizing native plant species of the mid-Appalachian region would be a desirable and productive facility. Development of some

limited gardens with cultivated varieties would be an asset and serve horticulturists. The Edith J. Carrier Arboretum serves as an excellent example of how public open space can make a significant contribution to the quality of life in a suburban environment.

An arboretum is a place where trees, shrubs, and herbaceous plants are cultivated for scientific and educational purposes. This arboretum provides an ideal combination of botanical gardens and natural forest, each complementing the other and serving the purpose of research, teaching and demonstration. The complex serves as an outdoor biology laboratory as well as an environmental center for this region.

The Morris Arboretum of the University of Pennsylvania
http://www.business-services.upenn.edu/arboretum/
The Morris Arboretum of the University of Pennsylvania is a historic public garden and educational institution. It promotes an understanding of the relationship between plants, people and place through programs that integrate science, art and the humanities. The Arboretum conducts four major activities: education, research, outreach, and horticultural display. As the official Arboretum of the Commonwealth of Pennsylvania, the Morris Arboretum of the University of Pennsylvania provides research and outreach services to state agencies, community institutions and to citizens of Pennsylvania and beyond.

Vision for the Future: The Morris Arboretum of the University of Pennsylvania is a historic public garden and an education institution. It is an important resource for extending an appreciation of the world's ecology, and an understanding of the importance of plants to people, in a biological, cultural, historical and aesthetic context.

The University of California Botanical Garden at Berkeley
http://botanicalgarden.berkeley.edu/
Mission Statement: "To develop and maintain a diverse living collection of plants to support teaching and worldwide research in plant biology, further the conservation of plant diversity, and promote public understanding and appreciation of plants and the natural environment."

University of South Florida Botanical Gardens
http://www.cas.usf.edu/garden/
The mission of the Botanical Gardens at University of South Florida is to foster appreciation, understanding, and stewardship of our natural and cultural botanical heritage through living plant collections, displays, education, and research.

University of Washington Botanic Gardens
http://depts.washington.edu/urbhort/
University of Washington Botanic Gardens will concern itself with "sustaining managed to natural ecosystems and the human spirit through plant research, display and

education." Conservation and research programs currently include the Rare Plant Care and Conservation Program -- a member of the national Center for Plant Conservation -- and restoration ecology where scientists are learning how to rehabilitate degraded ecosystems. The University of Washington Botanic Gardens is a unit of the UW College of Forest Resources. The new framework complements and enhances the college's strategic themes centering around the concept of natural resources and environmental sustainability

Appendix III
Examples of University-based Botanical Garden Friends Groups

Friends of the University of Tennessee Gardens
http://www.friendsoftheutgardens.org/
Established in 1992, the Friends is a 700-member nonprofit 501(c)(3) whose mission is to advocate, promote and raise funds for the Gardens from citizens on the university campus, in the community, and across the state.

Friends of Linnaeus Arboretum (Gustavus Adolphus College)
http://gustavus.edu/arboretum/fla.cfm
Friends of Linnaeus Arboretum (FLA) is a friends-of-the-college organization dedicated to promoting and supporting the arboretum. Membership gifts help to support the planting of trees and flower gardens, and also provides for educational programming and events that take place in the Linnaeus Arboretum. Twinflower, a publication of the FLA, is published several times each year with news, phenology notes, information about interpretive displays and programs, reports on FLA activities, and home gardening tips.

Friends of Fullerton Arboretum (California State University)
http://www.arboretum.fullerton.edu/help/vol.asp
The Friends of the Fullerton Arboretum is a nonprofit corporation organized in 1972 for the sole purpose of promoting the Fullerton Arboretum. The Friends provide support by raising funds, hosting events, running the plant sales and gift shop, and coordinating the work of the many volunteers. Join the many dedicated volunteers who offer their time and talent to enrich the garden experience. Volunteers are needed to propagate plants, guide nature tours, docent in Heritage House, or work on the grounds or in the office. The members of the Friends of the Fullerton Arboretum Board of Trustees are volunteers and oversee volunteer groups. Volunteers join the Friends membership and receive training, mailings, and invitations to members-only activities.