Involving local communities in the conservation: education and utilization of botanical Resources

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Key Words: *Social Inclusion and Community Engagement, Teaching and Learning*

ABSTRACT
This paper will focus on the state of botanic gardens in Uganda as its main topic. It will include: a background of The Tooro Botanical Garden covering, its vision and mission; what The Tooro Botanical Garden has achieved; and what to advocate for future bicultural conservation in the context of botanical garden education and outreach programs.

Uganda has few public displays and education sites that can serve as botanic gardens. There is thus an urgent need to establish a botanic garden in every ecological zone of the country, which can then act as center for environmental education. The botanic garden will attempt to address the issue of education about sustainability, by teaching about the link between flora and fauna and local indigenous people.

Farmers and other rural inhabitants' posses' considerable indigenous knowledge, arising from their long utilization of natural resources, this knowledge is chiefly documented through ethnobotanical surveys. Ethnobotanical information is essential for assessing plant diversity, intra-specific variation and selection of superior strains, adaptation and the introduction of new wild plant species within traditional farming systems.

BACKGROUND
Tooro Botanical Gardens is a community based, non-profit organization founded in 2001. It is a center for excellence in growth and maintenance of a living plant collection from the Albertine Rift. Our vision for the garden is to ensure a natural, green, environment for conservation, education, research and recreation.

On a larger scale our mission is to establish further botanic gardens as centers of excellence in growing and displaying living collections from the Albertine Rift. These centers will specialize in conservation and scientific research for the purpose of education, horticulture and medicinal needs. Tooro Botanical Garden seeks to increase: the propagation of a diverse range of plants; undertake research; train communities; promote and create awareness of the preservation, conservation and sustainable use of plants within the Albertine Rift.

MAIN CONCEPT
Involving local communities in the conservation, education and the utilization of botanical resources

THE IMPORTANCE OF INDIGENOUS KNOWLEDGE
Farmers and forest dwelling people possess a great deal of indigenous knowledge arising from their utilization of NWPS (New Wild Plant Species) and agricultural crops. Local people are aware of variation as well as certain traits shown by, genetically superior individual trees or infra-specific taxa. This knowledge of tree to tree variation and consumption use is valuable in NWP research and development. This paper examines the contribution of genetic information and other contributions made by farmer's, from their indigenous knowledge, in the context of applied NWP research. The information and results were collected through extensive ethnobotanical and socio-economic surveys.

WHAT IS ETHNOBOTANICAL INFORMATION?

The information that local communities possess about their natural resources are concentrated on: how plants are used; how plant resources are distributed across the ecosystems they manage; the classification and identification of plants; animals present in their ecosystems (EYZaguirre,1995;).

Ethnobotanical information which emanates from ethnobotanical and socio-economic surveys as well as literature reviews, is often used to represent the indigenous knowledge of local people. The farmer's vision of biodiversity classification is also often crucial for NWFP research and development.

SURVEYS TO OBTAIN AN IDEA OF INDIGENOUS KNOWLEDGE

The procedures and methods adopted in conducting ethnobotanical and socio-economic surveys to generate information on indigenous knowledge (Shepherd and Okafor, 1991) consist of the following:

- Stratification of the area according to ecological zones- urban and rural settings.
- The selection of sample villages or communities.
- Village group meetings.
- Interviews about key information using structured questionnaire forms.
- A study of the natural resources of the area including the uses of forests wild and planted species.
- Identification of traditional classification systems based on ecological distribution, taxonomic differentiation in relation to local cultivar designations (e.g. Fruit types, phonological attributes, etc.) and social symbolic roles.
- Field observations of the traditional farming systems including home gardens/compound systems and fetish groves.
- Market surveys to document various products emanating from the local environment.
- Collection of herbarium specimens seeds, seedlings and wood samples to authenticate the various products identified during the various stages of the survey.
- Using ethno botanical information to target the collection and development of plant genetic resources of NWPs.

Eyzaguire (1995) states ethnobotanical information is essential for assessing diversity and adaptation of crops which in eco-geographical terms, "still remains to be learned about socio-eco-edaphic diversity of crops and to understand crop adaptation to micro-niches and micro environments"

When collecting genetic resources on cultivated and economically useful species, ethnobotanical information (including cultural differences, the socio-economic systems, the institutional environment, as well as land use locations) on the targeted area of collection is important as it can highlight significant variation within the species.

It will be necessary to ensure that ethnobotanical knowledge disseminated at botanic gardens is to put effective use by local communities.

APPLICATION OF ETHNOBOTANICAL KNOWLEDGE EARNED AT BOTANIC GARDENS

1. Construction of Ethno Botanical Nurseries

Local communities will be encouraged through education about sustainability, to construct village ethnobotanical nurseries, where useful species of indigenous plants can be cultivated.

The ethno botanical nurseries will provide opportunities for the younger generation in the community to learn the traditional knowledge of their elders, particularly that of herbal medicine.

They will also serve as demonstration plots where young people will be encouraged to plant indigenous species in afforestation, landscaping, soil conservation and urban park programs.

2. Setting up Herbal Clinics

A large proportion of the Ugandan population still uses herbal medicine in their health care .Ethnobotanical knowledge learned at botanic gardens will be used to document traditional medicinal practices that may be applied in herbal clinics. This will ensure that herbalists are involved more fully in the management of the area that supplies herbal medicines. The setting up of health clinics will further encourage agronomic and silvicultural practices in growing indigenous herbs and trees of medicinal values.

3. Establishment of Community Herbaria

Community herbariums can be effective tools in working with the younger generation in schools and villages, (Martin, 1995) students will be expected to apply basic herbarium techniques of pressing and drying plant specimens. This will encourage them to learn the knowledge of their elders, a traditional process that is rapidly dying in many communities.

4. Promotion of Arts And Crafts

Education for sustainability will enhance the sustainable and rationale use of plant resources in the production of baskets, textiles, wood carvings and many other handcrafts. The aim of which is to minimize the exploitation of plant resources.

5. Applications in Forestry

Ethnobotanical approaches to plant conservation learned at botanic gardens will be applied in agroforestry, reforestation, selective logging and the sustainable harvesting of non-timber forest products; suitable indigenous plant species will be used in agro forestry and in the ecological reconstruction of fragile lands.

CONCLUSION

As we look forward to, the sharing of information, advice and support of one another the critical challenge for Uganda is to develop the botanical gardens that will be needed to educate people in the sustainable use of plant resources. The botanic gardens will deal with the dynamics of both ecological and social approaches to education for sustainability. This will be used to measure the true value of plant resources, widen the use of indigenous species and establish sustainable harvest-levels, all of which will aid in the pursuit of protecting threatened ecosystems.

Emphasizing the understanding of ethnobotanical knowledge in botanic gardens will offer much needed options for future plant conservation and utilization. As educators in botanic gardens, we have an obligation to promote the dissemination of ethnobotanical knowledge for the sustainable use of plant resources and the protection of the environment. It is an objective that the proposed NMK botanic gardens will be working hard to achieve.

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Building Models to Build Up Unterstanding

Peter Lampert, Martin Rose, Michael Kiehn.
Botanischer Garten Wien (Botanical Garden, University of Vienna)

The workshop shows a practical approach to teach pollination biology both at botanical gardens and at schools, using self-made flower models. The models take up the results of recent empiric studies on learners' concepts about pollination (Lampert, 2012).

THE RELEVANCE OF POLLINATION BIOLOGY IN TEACHING

Pollination is essential to the production of fruit and seed and it therefore plays a major role in the lifecycle of higher plants. Furthermore, animal pollination (=zoophily) links the two fields zoology and botany, and the resulting coevolution between pollinators and flowers has led to the broad variety of shapes, colors and scents of flowers. Additionally, recent discussions about the worldwide declines of bee hives brought pollination and their protagonists in the focus of public attention. Therefore, the interaction between flowers and pollinators are a rewarding topic for teaching botany in botanical gardens or at school.

WHAT DO CHILDREN THINK ABOUT POLLINATION?

Children have got various different pre-concepts about pollination biology. Learning sessions should help students to make a change from nonscientific perceptions, which impede the understanding of biological topics, towards more scientific and "correct" concepts. To reach this so called "Conceptual change" (Duit and Treagust 2003), it is necessary to know about the concepts learners have. For this reason, the concepts of 10 year old children were examined in a qualitative study in which seven children talked about their concepts of pollination (Lampert 2012). A short summary about the results of this study will be given here, since the findings of the study had a strong influence on the design of the presented learning session.

A first insight into the students' perceptions concerns the role of pollination in the life cycle of plants. In the interviews the children showed that they have got great difficulties in differing pollination from seed dispersal. Several children reported that the pollen which is carried by the pollinators falls to the ground and a new plant will germinate out of this pollen. Although some children new, that there is a difference between pollen and seeds, they were not able to explain how the pollen "changes" to the seed which germinates. For these children, the pollen "ripens" to a seed. In addition, a notably difference regarding the two main agents of pollen dispersal, animals and wind, was observed. Most of the students mentioned, that pollen grains transferred by animals land on another plant, where the fruit or the seed develops. But when it comes to the agent wind, all of the interviewed children described a process which resembled seed dispersal. They gave examples (e. g. dandelion, *Taraxacum* sp., or various trees), where the "pollen" is taken away by the wind, falls on the soil and germinates.

Furthermore, the interviews showed that children at that age know the names of several flowers, but they are not able to tell differences in shapes of the flowers. Therefore, the children struggle with understanding plant diversity. In addition, most of the interview partners were not aware that there is a broad variety of visitors. The only visitor which has been mentioned by all of the students was the honeybee. As a consequence, the students also lack knowledge about differences between the visitor-groups, e.g. different mouth parts. Another important result is that children often have complex concepts about the interactions between flowers and visitors. The children have been asked, what they think why insects visit the plants and carry pollen. Some

students replied that the visitors try to collect food and that pollen is not transferred on purpose. According to this concept, which resembles the biological point of view, pollination is a side effect of the search for pollen or nectar. Surprisingly, all of the interviewed students revealed a second concept about the reasons for visiting flowers: This second concept sees carrying of pollen to another flower as a deliberate act of the pollinator. Some of these children see pollination as an act of help, where the pollinator deliberately helps the flower to reproduce. Other students claim that the interactions between animals and flowers are the result of a "smart nature" which knows about the needs of plants and pollinators. The children vary in the way they apply those two concepts on pollination. Some students tend to use the first concept more often; others showed throughout the interview, that they think that animals transport the pollen to the flowers intentionally. One of the students compared the transport of pollen even with a job: "For the animal pollination is like a job, as if a person is working as a gardener. […] The work of a wasp is pollinating flowers."

WHICH CONCLUSIONS CAN BE DRAWN FROM THESE INSIGHTS?

These results show that students lack experiences in the field of pollination biology. As a result, the life cycle of plants cannot be understood, because the processes of pollination and seed dispersal are not separated. Furthermore, the missing concept of diversity of plants and visitors makes it difficult for students to understand the diversity of a flowering field. The findings concerning the interactions between pollinators and flowers reveal that children have got more complex concepts about the backgrounds of pollination than expected. Those concepts interfere with the biological explanation that pollination is a side effect of collecting food.

A PRACTICAL APPROACH TO POLLINATION BIOLOGY USING FLOWER MODELS

The aim of the presented learning session (description on the following pages) is that children literally get in touch with flowers and pollination. The learning session starts with an introduction (or a repetition) of basic terms being used in the context of pollination. Another element is a guided tour through the botanical garden which emphasizes on pollination. Key element of this setting is a "nectar search game" including flower models. While interacting with the models, the children are in the role of different species of insects which try to collect nectar.

Nectar Search Game:

The children are divided into four different groups of insects, namely butterflies, bumblebees, honeybees and beetles. These groups differ in the structure of their mouth parts. (Most butterflies – long sucking proboscis; beetles – biting and chewing mouth parts; honeybees – relatively short sucking proboscis; bumblebees – intermediate length of the proboscis). These different mouthparts are symbolized by straws. Children who play "butterflies" receive the longest straws, the "bumblebees" intermediate straws and the "honeybees" get the shortest straws. The "beetles" do not receive any straws. After the children received their mouth parts, they get the task to search for nectar in the presented flower models. The three different types of flowers differ in the length of the corolla tubes (Figure 1.).

Figure 1. *Flower models with different length of the corolla tubes*

After the foraging of the “insects”, the children receive the task to stand next to the models they would prefer as an insect. Experience shows, that the “insects” prefer the flowers which match with their proboscis’ length. “Bees” prefer the models with the shortest corolla tube, because it is the only place where they can reach the nectar. “Bumblebees” and especially “butterflies” could also choose the flowers with the shorter tubes, but they usually avoid those models, because of the strong competition. The “Beetles” were not able to reach the nectar, so they experience that food is only accessible in certain types of flowers. These results of the game can be discussed in the group (Which insects were successful in gathering nectar? Which insects prefer which flowers? ...).

The attention of the students was intentionally driven to the nectar. While searching for food, “pollen” sticks on their faces (Figure 2.). This pollen is symbolized by curcuma powder, which has been intentionally put on the stamens before the session started. Most of the “insects” usually do not realize that they have been carrying “pollen”. With a mirror, they can convince themselves that the eager foraging led to an unintentional transport of pollen. The experiences can be discussed in the group and parallels to real flowers can be drawn.

Figure 2. *Student with “pollen” after interacting with a model*

Afterwards, the children can try out the remaining flower models of the sage flower (Figure 3) and the composite blossom (Figure 4). The composite blossom offers food (symbolized by sweets) to all insects. In the sage flower, the nectar (also symbolized by sweets) is hidden at the end of the corolla tube. To examine the sage flower, the students stop acting in their former roles. To reach the “nectar”, the whole insect (symbolized by the students hand – this aspect can be emphasized with a “bee glove”) needs to enter the flower. When the children try to reach the sweets, they trigger a mechanism (“turnpike”-mechanism) which places the pollen on the back of the “bee”. Advantages and disadvantages of generalists, where the nectar is available for a broad variety of insects (flower with short corolla tube; composite blossom) can be compared to specialists, where only specialized insects can reach the nectar (flower with long corolla tube; sage flower).

Figure 3. *Salvia model*

Figure 4. *Model of a composite flower*

MAIN POINTS DISCUSSED AT THE WORKSHOP

It has been pointed out that the flower models are an easy and cheap way to bring students closer to the topic of pollination. A learning session about pollination ecology involving flower models, as it is established in the Botanical Garden of the University of Vienna, could be applied in other botanical gardens as well.
An idea to take further advantages of the flower models is to build models about seeds and diaspores. A master thesis about this topic is currently in progress at the University of Vienna. The aim is to develop a learning session which shows the way from a flower to a seed. As it has been mentioned before, the processes of pollination and seed dispersal get often confused by the students. A learning session, which takes up the insights of students' concepts about those two processes, could be an important step towards a conceptual change.

Furthermore, the flower models can be modified in order to represent a broader variety of flowers. Color, shape, size of the organs of the flower can be adapted easily and the panelists are encouraged to develop the models further and gain experience in working with them. Another idea is to replicate more complex pollination mechanisms with flower models. The materials used to build the models can also be varied, depending on the demands (e.g. easy and cheap to build, but short life span vs. more expensive, more difficult to build, but higher durability).

A last option discussed during the session is the development of a role play about natural selection and evolution using flower models. As research showed, students struggle with explaining how the floral structures (e.g. long corolla tubes; nectar) and the proboscis of the visiting insects evolved. Therefore, one of the main aspects of Peter Lamperts' dissertation is the creation of a learning environment, which picks up the students' concepts pollination and their concepts about evolutionary processes. The aim is to create a session, where students experience the process of evolution in the role of "different generations of insects" which interact with "flowers".

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RESOURCE FROM WORKSHOP FEATURED BELOW

Building instructions for "simple" flower models

Materials

- Plastic cup or bowl (calyx)
- Coloured paper, lamination (petals)
- Small clamps (to join calyx and petals/stamina)
- Straws, batting (stamina)
- Straws (and/or pipe cleaners), table tennis ball, drawing-pin (pistil)

Tools: Scissors, laminator, ticket-punch, burner, short wire, hot glue gun.

Realization

Keep correct flower anatomy in mind.

Step 1: Copy the petal pattern onto coloured paper, cut the petals out and laminate them. Each petal needs a hole at the base to join it with the calyx.

Step 2: Melt 5 holes in the top of the calyx-cup for the petals. You can use a heated wire to melt the holes; this reduces sharp edges in the models. The holes should be big respectively small enough that the clams will fit but have no space to move. A bit lower you need to melt 5 holes for the stamina.

Step 3: Put the small clamps to the lower row of the holes and bend them on the inside of the calyx to the top. These are for the stamina to put on.

Step 4: Join the petals and calyx on the top row of holes with the small clamps. The petals are joined on the inside of the cup and folded at the calyx edge.

Step 5: 5 Straws are cut to the same length. Each straw (filament) gets a batting head (anther), joined with the hot glue gun.

To create the pistil, melt a hole, as big as a straw (style), in the table tennis ball (ovary) (see step 2). The straw can be fixated with the hot-melt gun. There are two possibilities for the stigma, depending on the flower. You can cut the straw to create stigma branches or you can glue a drawing pin to the top of the straw.

Another possibility to build the pistil is to make a small hole in the table tennis ball with a pin. Stick a pipe cleaner in this hole and cover it with a straw. With the pipe cleaner it is easy to form different shapes of the stigma.

Step 6: Glue the pistil to the bottom of the calyx and put the stamina on the clamps (see step 3)

The models were designed for a frequent outdoor use and great variability (change flower type/replace damaged parts)

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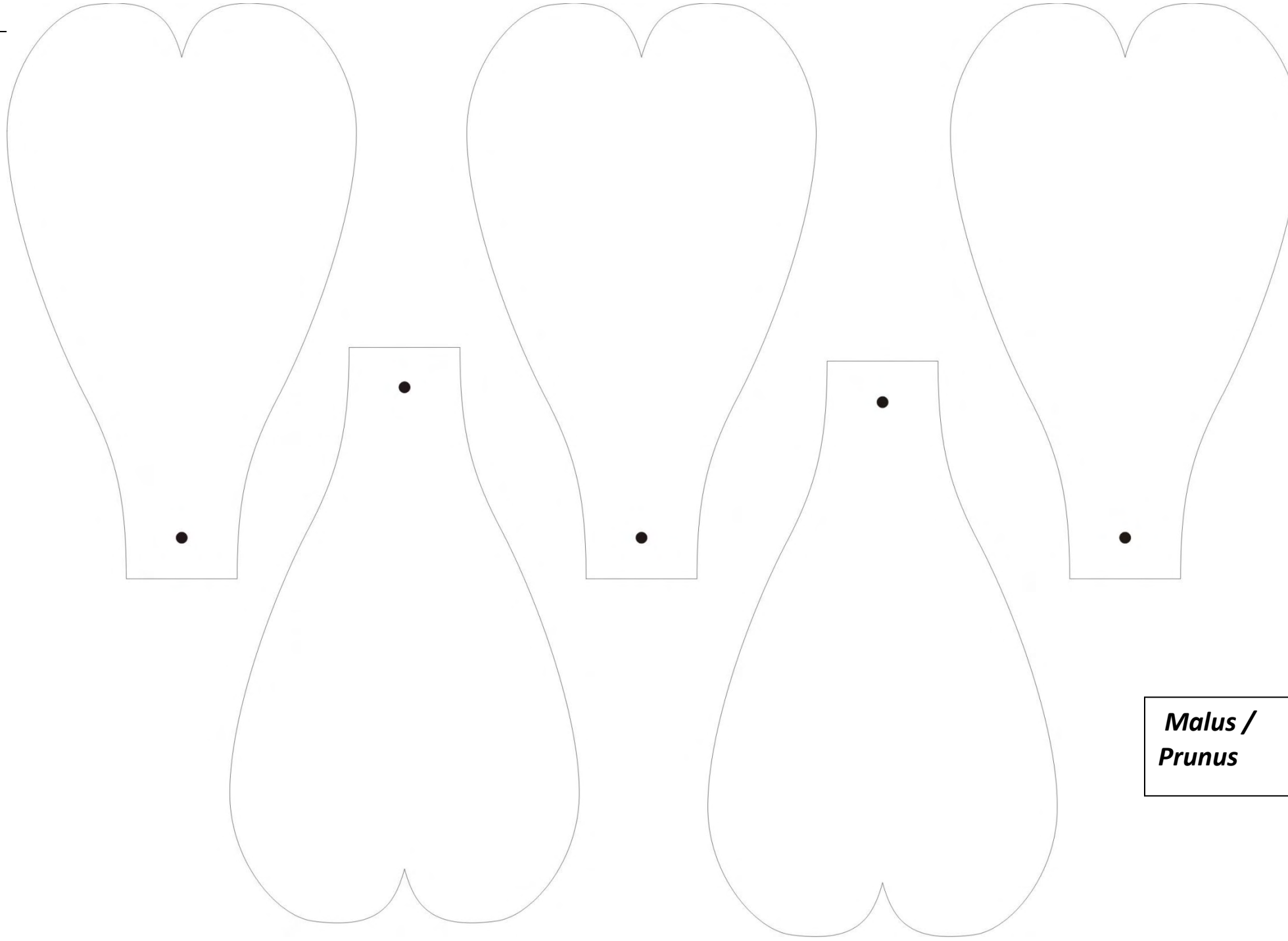
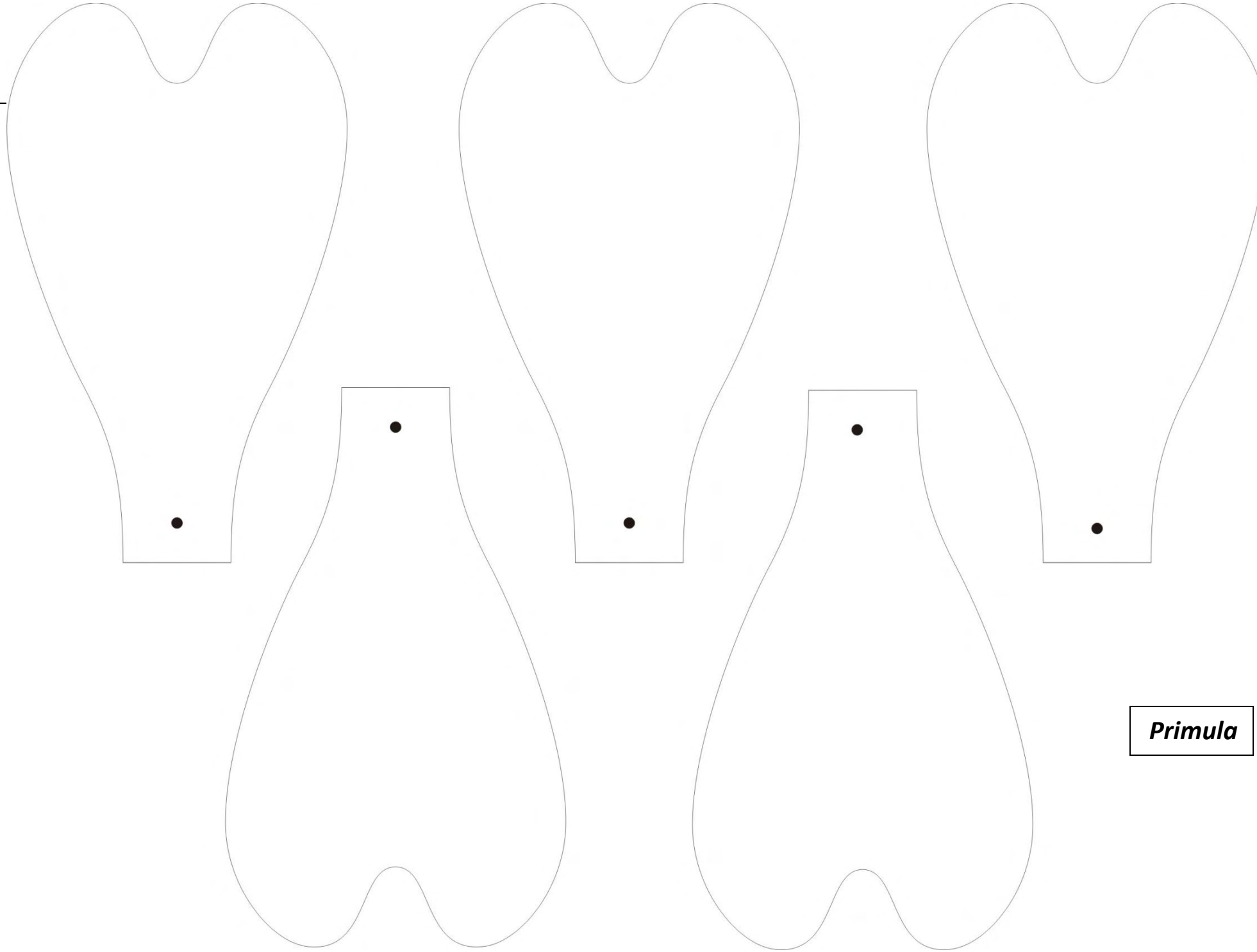
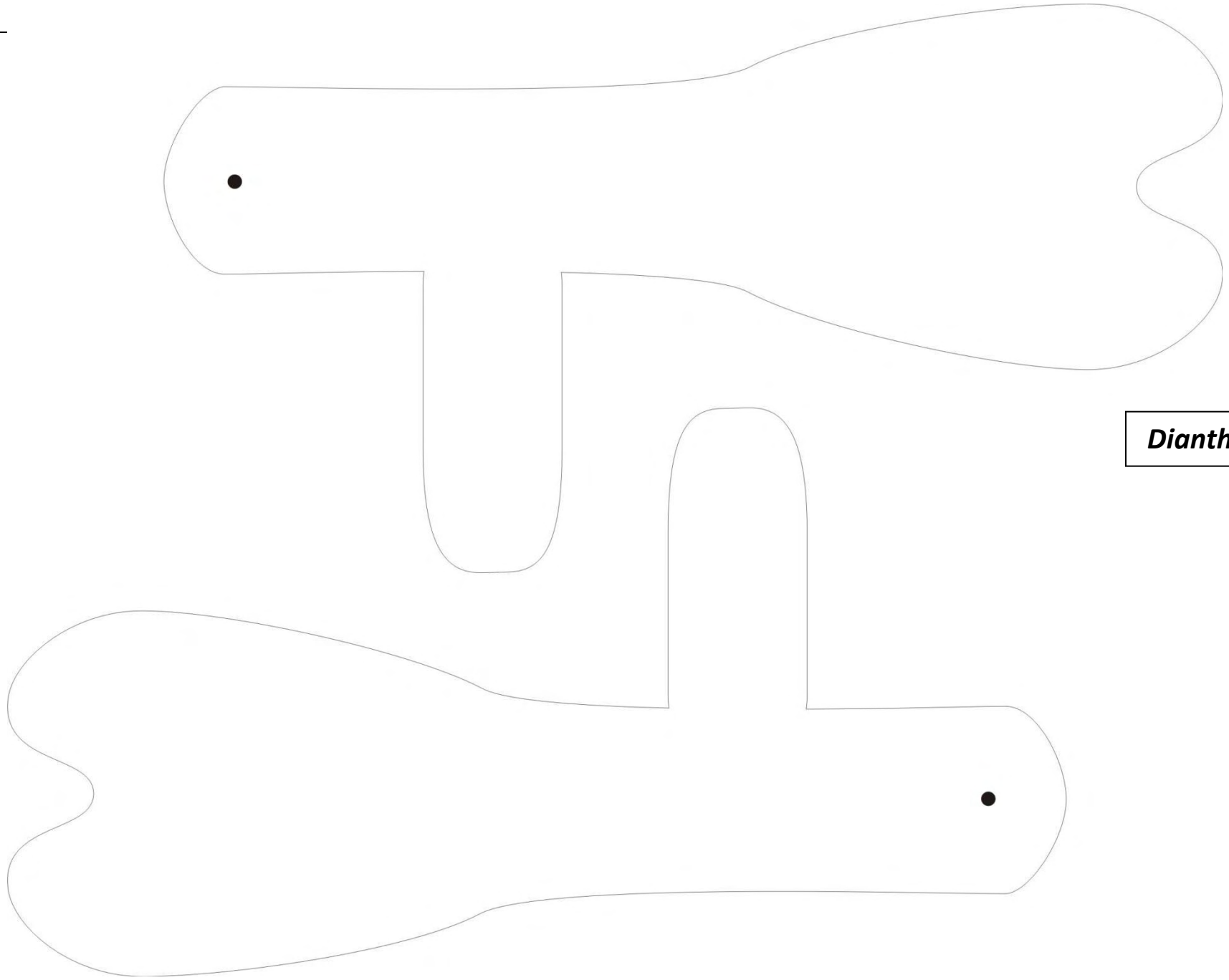


Malus / Prunus



Primula



Dianthus

Building instructions for the *Salvia* model

Step 1: Thread five washers (each 14 mm Ø) each on two wires and twist over the whole length. The washers act as counterbalance in the mechanism. Glue batting on the end of each wire for the model's fertile theca. Use small clamps to attach the sterile theca (laminated Paper) to the holes of the washers.
Step 2: Twist the wire with the washers around a round object (for example a pencil) to form a hinged bracket. Keep in mind that the arm's length on the side with the washer should be one third of the arm's length on the other side. The two sides should have a 90° angle.
Step 3: Both parts of the style are connected with small clamps. To achieve this you need to make a cut at the rear end.
Step 4: Both parts of the upper lip are connected with a small clamp. The three parts of the petal base must be bent together and fixed as well. Both parts (upper lip, petals) are connected with small clamps.
Step 5: The ovary is represented by a table tennis ball clued into the rear end of the model. The stylus is glued at the base of the flower as well and stabilized by two transparent supports glued into the model.
Step 6: The upper lip is folded inwards at the dotted line and connected to the lower lip by small clamps. You can stabilize the model by adding a base plate if needed.
Step 7: Finally the stamina are attached. A wooden stick is the axis to allow the movement of the stamina. It is put through the holes in the upper lip and the following parts are added in order:
Piece of straw-Stamen- Piece of Straw-Stamen- Piece of Straw
The pieces of straw keep the stamina in place. The wooden stick is fixated with the hot-melt gun.
In the sheets a black dot symbolizes a hole and a dotted line that you have to fold the sheet.

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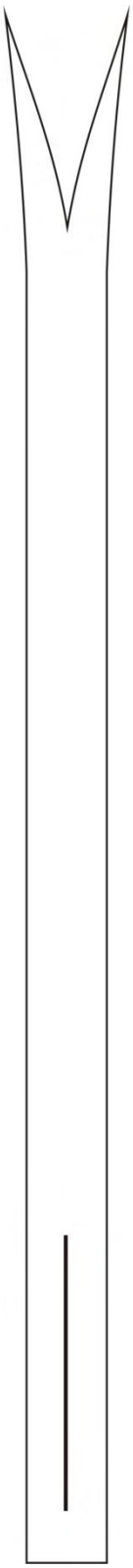
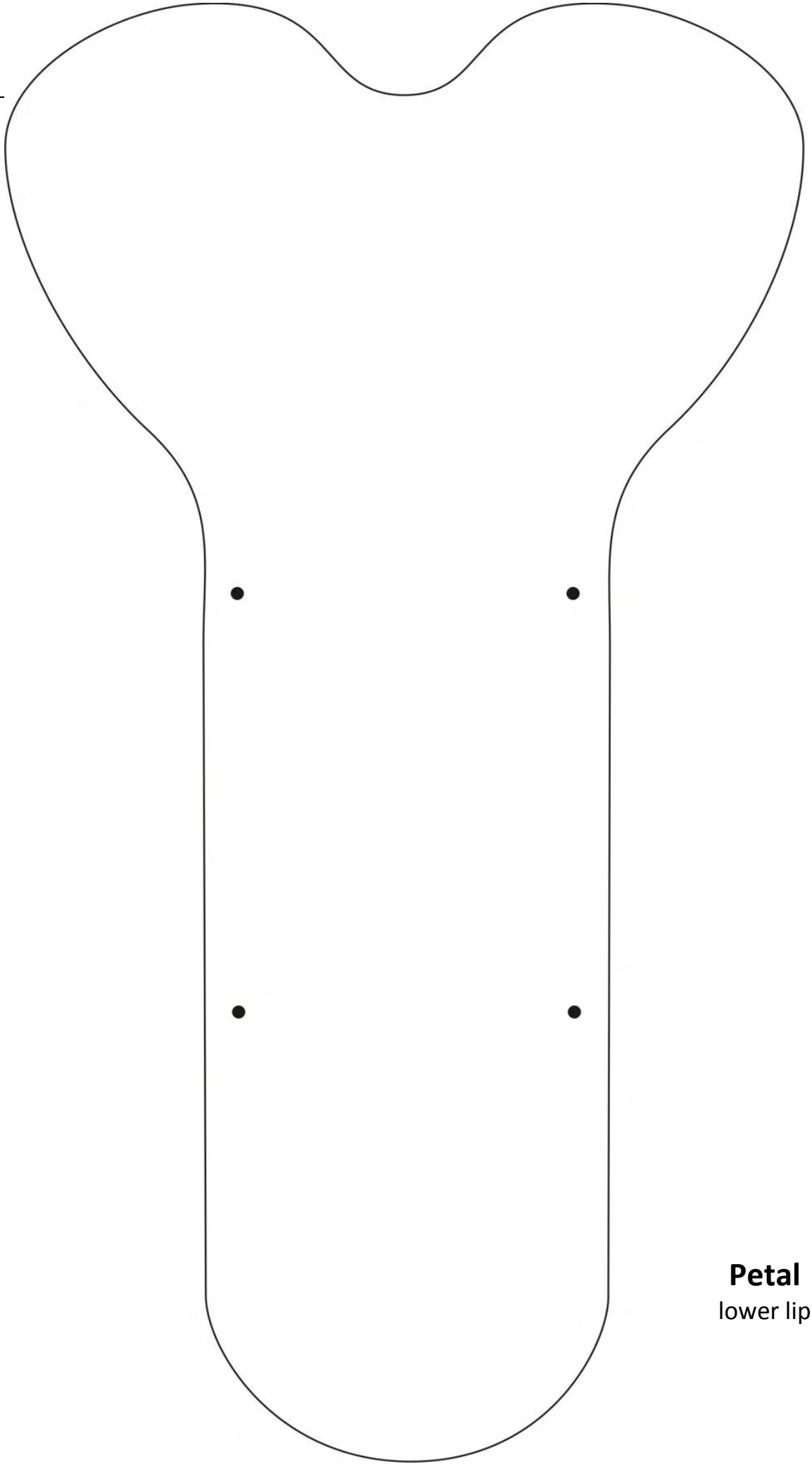


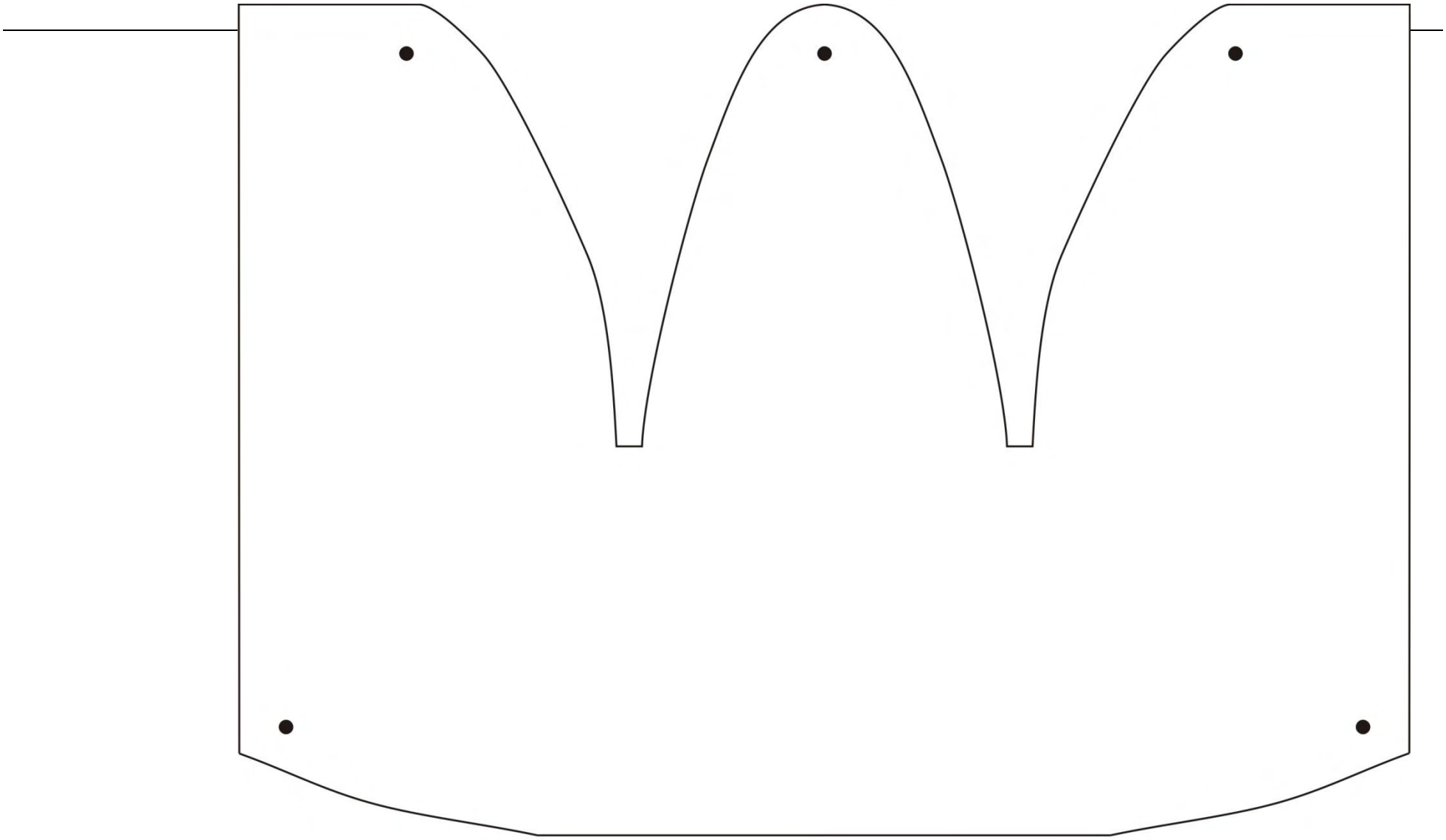
Anther
sterile theca

Style
front part

Style
rear part

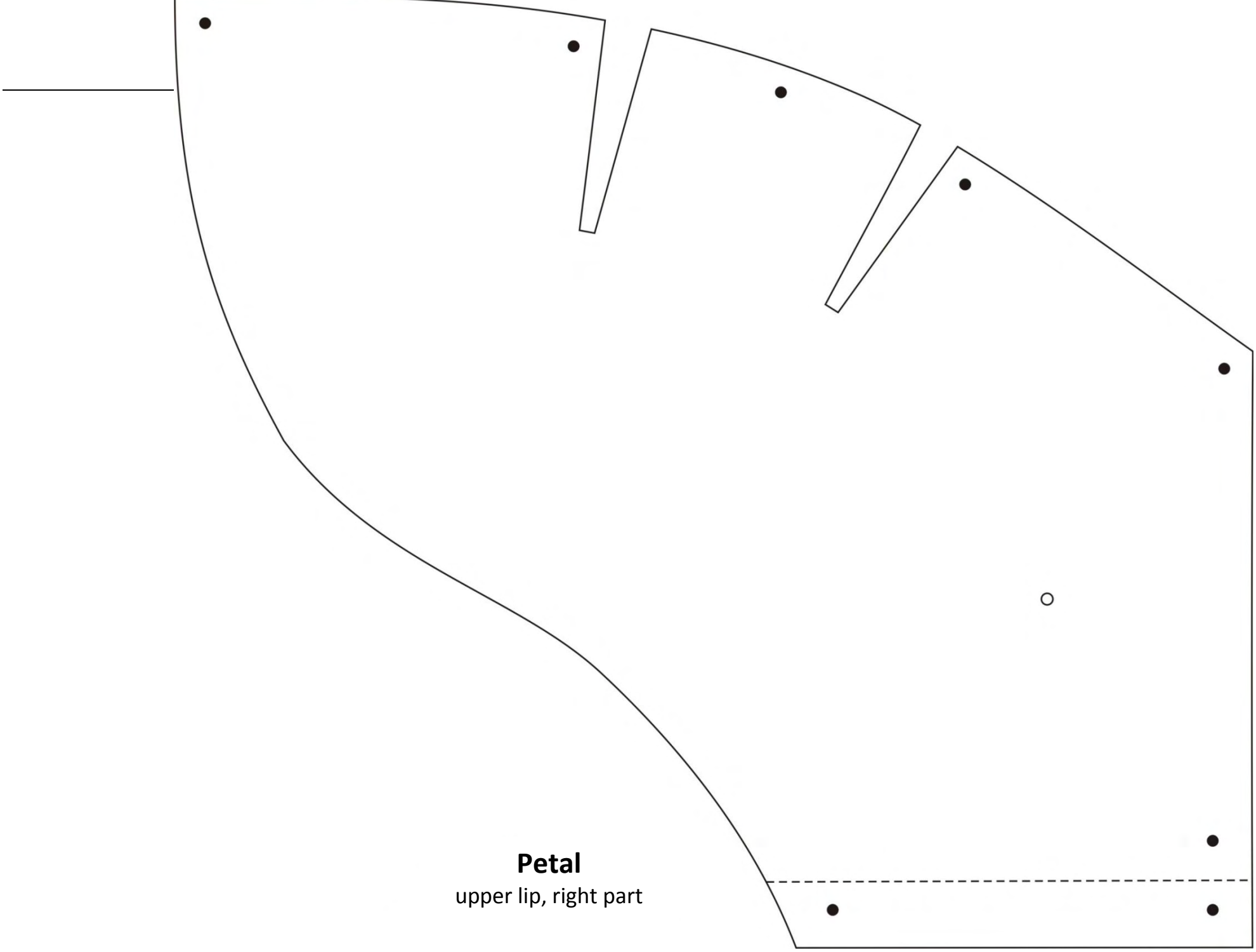


Petal
lower lip



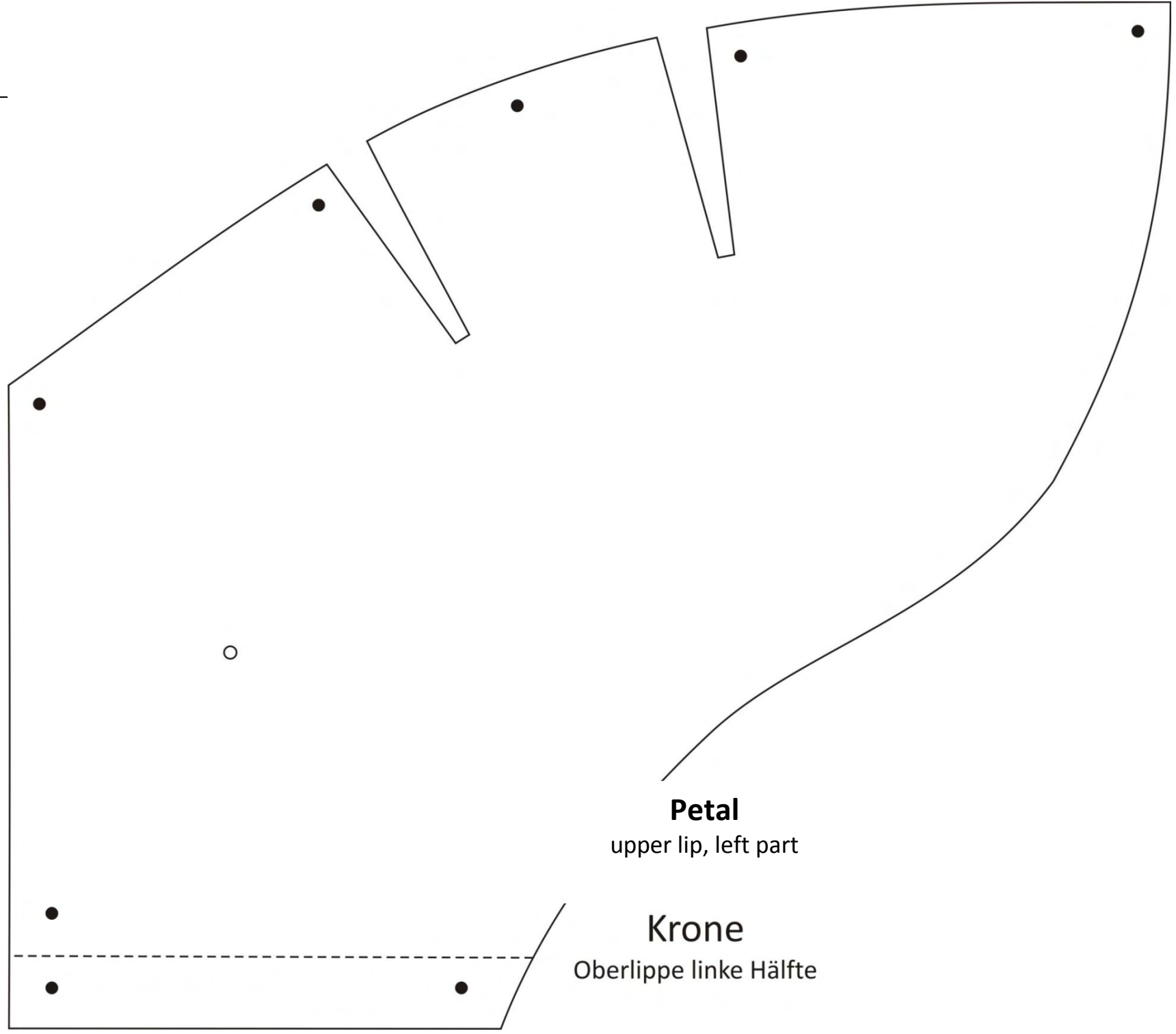
Petal

corolla tube



Petal

upper lip, right part

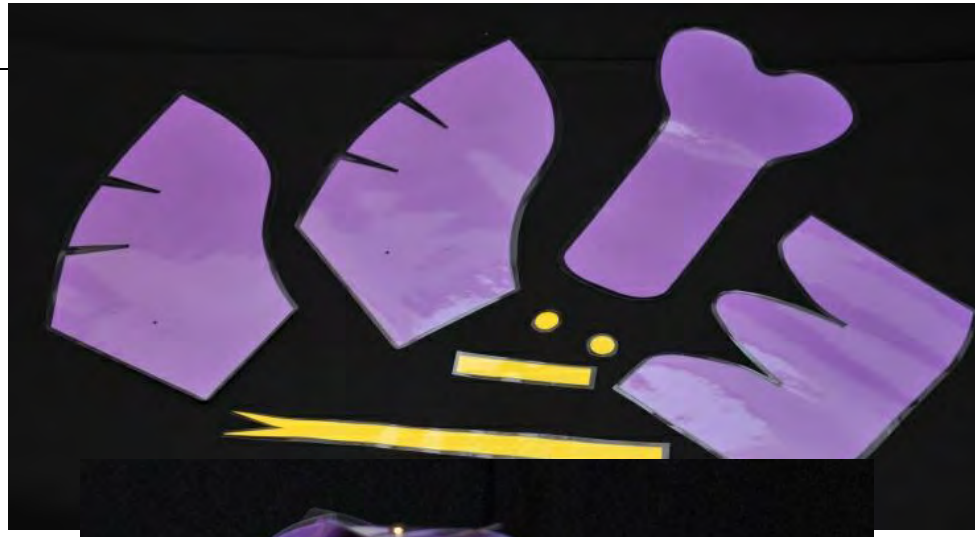


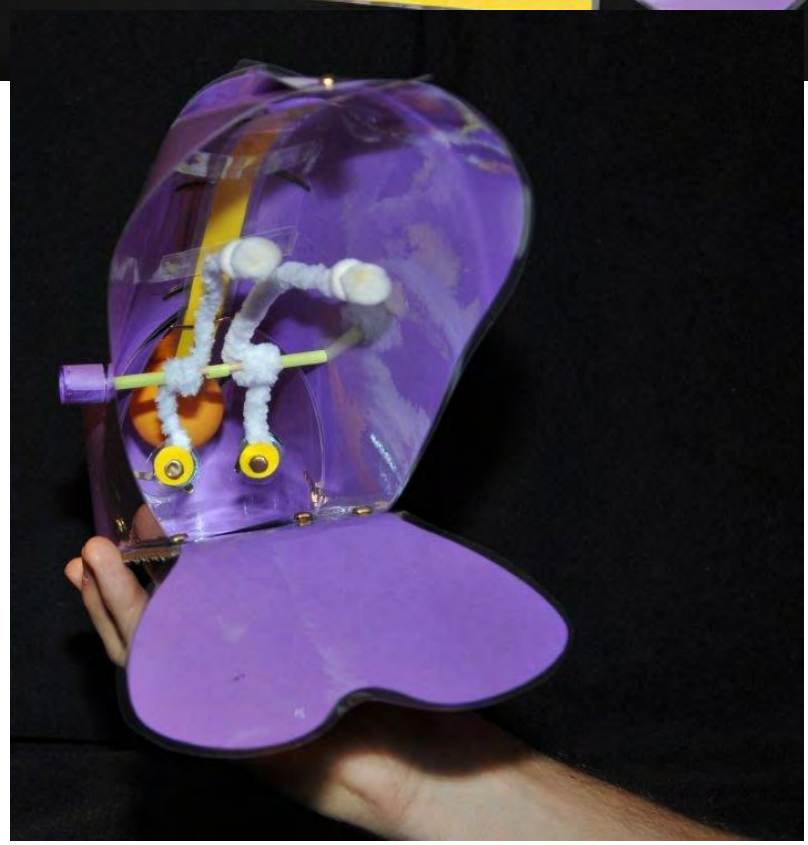
Petal

upper lip, left part

Krone

Oberlippe linke Hälfte





Act like an Insect

I am the following insect: …….

How did the flower attract me?

Colour: …….
Odour: …….
Sketch the structure of the flower:

What do I hope for at the flower?

How could pollination work here?
(*Keep the models in mind and observe the insects visiting the flower at the moment*)

Is the flower fitting to you as a pollinator? Why/Why not?

To which pollinator is the flower adapted?

Present your flower to the other insects and convince them of your choice.

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Floral Ecology

Chosen insect: …….

Flower characteristics?

Colour: …….
Odour: …….
Sketch the structure of the flower:

Why would the chosen insect visit this flower?

How could pollination work here?
(*Keep the models in mind and observe the insects visiting the flower at the moment*)

Is the flower fitting the chosen pollinator? Why / Why not?

To which pollinator is the flower adapted?

Present your flower to the others

Peter Lampert

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Observation record: Flower visiting insects

1) What is the proboscis length of the observed “insect”:

2) Check which flower is visited by the chosen ”insect”; sequence is important

Visited Flower			
1.	O short corolla tube	O medium corolla tube	O long corolla tube
2.	O short corolla tube	O medium corolla tube	O long corolla tube
3.	O short corolla tube	O medium corolla tube	O long corolla tube
4.	O short corolla tube	O medium corolla tube	O long corolla tube
5.	O short corolla tube	O medium corolla tube	O long corolla tube
6.	O short corolla tube	O medium corolla tube	O long corolla tube
7.	O short corolla tube	O medium corolla tube	O long corolla tube
8.	O short corolla tube	O medium corolla tube	O long corolla tube

Flower constancy

If a bee is able to find a sufficient amount of nectar in a flower it will visit flowers of the same plant species. This is called flower constancy.

1) Compare your observation record with the others. Can you find flower constancy in the observed “insects“?

2) Advantages of flower constancy
   - What is the advantage for the insect?
   - What is the advantage for the plant?
   - What is the basic requirement insects need to be flower constant?

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Worksheet: Garden Tour

Assignment: Find a plant per discussed flower (basket, lever mechanism, funnel shaped flower, disc shaped flower). Find out the following information for each plant:

	Plant 1	Plant 2	Plant 3	Plant 4
Name *(see label)*				
Flower type				
Colour				
Sketch				
Possible visiting insects?				
What does the flower offer these insects?				
How could pollination work?				

2015 BGCI International Congress on Education in Botanic Gardens *Peter Lampert*

Martin Rose
Michael Kiehn

Assignment: You, as an insect, are getting to know new flowers. Choose three different flowers and explore them. Think about which one of them fits the best to you. Present this flower to the others and explain why it is your favourite.

Chosen insect: …….

	Flower 1	Flower 2	Flower 3
Colour			
Odour			
Sketch			
What offers the flower?			
Which pollinator fits the flower?			
How could pollination work?			

Interpretive Plan Implementation – Advice & Guidance – Washington Park Arboretum
Part of the workshop: Interpretive Master Planning at Public Gardens: Three Case Studies from Finland, Australia and the United States

Chuck Lennox
Cascade Interpretive Consulting LLC, Seattle, Washington USA (Washington Park Arboretum)
Key Words: *Strategy and Future Vision for Greater Impact and Change, Research and Evaluation*

Washington Park Arboretum (WPA) is a beloved 93-hectare natural area first developed in 1934 within the city boundaries of Seattle Washington along Lake Washington in the Pacific Northwest of the United States. In 2004, an Interpretive and Wayfinding Plan was completed as one of the first proposed tasks in the implementation of a contentious Master Plan that took several years.

Managed in a unique arrangement by three institutions – University of Washington, City of Seattle Parks Department of Parks and Recreation and the Arboretum Foundation, WPA is a teaching and research site but also serves as urban habitat, a retreat from the pace of urban life and a recreation area (bicycling, running and walking). As the city rapidly develops with increased density, the arboretum is becoming one of the few large open spaces for wildlife and people. A major effort for the arboretum is balancing these public interests with the conservation and scientific needs of the collection and the educational needs of the university.

The WPA's major exhibits and gardens include the Japanese Garden, Azalea Way, Holly Collection, Pinetum and urban wetlands surrounded by an urban park with active recreation playfields such as soccer/football, and baseball. A bicycle and walking trail is in the planning stages. Shortly after the plan was completed, two major areas on campus (Union Bay Natural Area and Center for Urban Horticulture) were combined with the Washington Park Arboretum to form the UW Botanic Gardens.

The 2004 Interpretive & Wayfinding Plan was completed by the consulting team, including CIC, with a fifteen – twenty person planning team. It was the first project implemented following the implementation of the contentious master plan. With the unique governing status of the Arboretum and the intense public interest in the sites future, there was a strong incentive to "do it right".

With the theme of this session on interpretive planning, it gave me the opportunity to look back after 11 years to interview former and current staff members and participants in the planning process to gain their insight and perspective on the planning process and to offer advice for others facing an interpretive planning process.

INTERPRETIVE PLANNING ADVICE
The following advice was offered to planning teams for undergoing a planning process.

- Develop and Use Guiding Principles – Guiding principles were developed for different sections of the plan for future reference. Surprisingly these were mentioned as one of the most helpful elements in the plan. Future proposals for the grounds were filtered using these principles to ensure consistency and compatibility the existing features. These principles are also a method to use to review requests made from the public and another institution.

- Interpretation vs. Wayfinding – If a plan for interpretation and wayfinding needs to be done, split the process and do them as separate plans. Combining these tasks in this planning process was a challenge.

- Ensure an Internal Sponsor or Champion – Once the plan is adopted and approved, someone internal to the sponsoring institution needs to be its champion reminding employees of its existence and advocating for its use with related projects in the future. One employee at the management level still remains after the plan was completed in 2004. Without his sponsorship and advocacy on the plan's behalf it might have been forgotten on a shelf.

- Develop a Consistent Implementation Process – How will the plan be adopted and used? Who is responsible for its implementation? How do we get existing and future employees to use the plan? For the implementation of this plan, a standing monthly meeting (i.e. first Wednesday of every month) is scheduled with all of the management partners involved and new developments are discussed. The plan is reviewed for its consistency with new proposals

- Plan an Initial Implementation Project – To ensure support for the plan in the institution and with supporters, implement one project described in the plan soon (i.e. within six months) after its adoption. Ensure budget monies are reserved for the project. Physically demonstrating to staff and supporters what items are included in the plan will help build support for the plan and further implementation.

- Provide Common Access to the Plan – Staff and partners need to have consistent access to planning documents. The WPA gathered all historical documents into one page on their website, scanned pre-computer documents and organized them in one location for common use. http://depts.washington.edu/uwbg/about/master_plans.shtml This Master Plans and History web page is a first stop for new employees and volunteers to orient themselves and a common location for anyone wanting to find any plans or historical documents.

LOOKING BACK – FINAL WORDS OF ADVICE FOR PLANNING

Former and current staff interviewed for this presentation were asked to offer any final advice about the planning process that botanical gardens might undertake. The following words of advice were offered:

- Process is Most Important – The *process* of planning is more important than the plan itself. Bringing together staff, partners and the community can build stronger relationships, sort out differences in values and diffuse conflict if it's handled in a professional way. A fair and equitable process will build trust and confidence that the institution is in good hands and will prosper in the future.

- Take Your Time – Planning processes can be placed on a fast track for financial ("we have to spend the money now") or for external or internal political reasons. Being careful to ensure that time is well spent and all parties to the process feel engaged is will pay off in the long term.

- Before the Process Starts – Document and prioritize the issues you hope to solve as a result of this planning process. Perhaps the "shopping list" is too long or the items on the list need to be done separately. Are there enough resources – both budget and staff – to direct to the planning process?

- Be Cautious about Wholesale Changes – Focusing on specific issues that can be resolved in a planning process over a set period of time will help the planning process be more successful. Change takes time and cannot be mandated in a planning process.

- Practical vs. Inspirational – A plan needs to be practical to be implemented and used by staff. But a plan needs to inspire those involved in implementing it current day and in the future. Don't be

afraid of either!

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Figure 1: *This Entrance marker was the first project implemented in the WPA Interpretive and Wayfinding Plan and was a visual representation of the plan's purpose.*

WORKSHOP DISCUSSION

At the end of the three presentations, the following questions were proposed for small group discussions

4. A call or question - what next for interpretation in public gardens in light of global change.
5. A discussion around the need to work across silos within our organizations in order to provide rich interpretation.
6. A further discussion how to gain internal support for the planning process and some advice on how to make change happen

WHAT WERE THE OUTCOMES FROM THE WORKSHOP?

A number of interesting and significant questions for the future of Interpretation Master Planning in Botanic Gardens were posed by participants at the closing session of the workshop.

These were:

1. In the face of global change what are the next steps for Interpretation in a Botanic Gardens context. How are we as a community interpreting climate change – what's working in the space and what isn't? Have we established what is best practice climate change interpretation in a botanic garden and how are we measuring our impact? This is a really big question and one that we need to put on the international agenda in terms of answering.

2. We discussed the importance of collaborating early and often when developing Interpretation Master Plans. Botanic Gardens are communities that contain a number of different specialists from a number of different tribes: Botanists, ecologists, horticulturalists, landscape planners, marketing team to name just a few. As resources in Botanic Gardens are getting tighter many participants expressed the view that it is getting more difficult to work across traditional silos. Interpretation Planning can be one of those important bridge building exercises within organisations – regardless – the very best interpretation needs expertise from across a Botanic Garden in order to make it sing.

3. We discussed the importance of running curatorial processes within Botanic Gardens that support the implementation of Interpretation Master Plans after all the delivery of the Interpretation continues to have cross organisational inputs and implications.

The paradox of participation for botanic gardens

Dr Bernadette Lynch
University College London
Key Words: *Science Communication, Research and Evaluation*

Dr Bernadette Lynch presented the preliminary findings from her Five Year review of the BGCI programme, 'Communities in Nature: Growing the Social Role of Botanic Gardens'. Here is a summary of that presentation and the follow-up workshop:
From my time leading, researching and analysing the philosophy and practice of public engagement and participation in the museum sector, it is really no surprise to find that we in museums and botanic gardens share a great deal in our DNA but also in our reluctance to change. But it seems, ***change we must!***

Dr Robert Janes, eminent Canadian museum professional, recently wrote a book called *Museums in a Troubled World: Renewal, Irrelevance or Collapse.* He speaks of how museums have always essentially been about asking the question, **'What does it mean to be a human being?'** But he notes that the question is even more important now, when every living system is in decline and the rate of decline is accelerating. This question, he says, should be the central preoccupation of our lives. Of everyone's life.

This has huge implications for botanic gardens. If we take license here, we might re-word Jane's book for this context, and ask, 'Botanic Gardens in a Troubled World: Renewal, Irrelevance or Collapse?'

It means gardens taking up their local and global social responsibility at the heart of their mission. This is inextricably bound up with their environmental responsibility. It leaves *renewal* as the only possible strategy, a renewal of purpose that places the social role not on the periphery, but at the heart of botanic gardens. A purpose and direction that runs right throughout the organisation, excluding no one, no member of staff or their job description.

'COMMUNITIES IN NATURE' AND SOCIAL RESPONSIBILITY

Led by BGCI and supported by the Calouste Gulbenkian Foundation, the *Communities in Nature* programme sought to 'grow the social role' of botanic gardens, addressing the needs of communities and plant conservation in a mutually beneficial approach'(BGCI). The overall aim was to promote the social role of botanic gardens in and beyond the UK, encouraging gardens to examine their philosophy, values, goals and practices with the aim of realising their own potential to contribute towards positive social change and broad environmental awareness about climate change.

When the UK gardens directly funded as part of the *Communities in Nature* programme were asked how relevant their social role was, not one respondent said anything other than 'extremely relevant', in fact most said that they considered it 'urgent' that their garden actively embrace this role.

Why?

Three main reasons were given:

- Their own survival
- Their social and environmental responsibility
- The uniquely well-placed opportunity they offer

For many involved in the programme, *Communities in Nature* was a breakthrough – it provided test cases of social role programming of varying scope and degree. The programme served to illustrate how botanic gardens can grow a social role and be socially relevant institutions that engage with their communities

while addressing issues of social and environmental importance. How it is possible in practice to address social, economic, political, neighbourhood, individual, and group dimensions of exclusion whilst achieving public participation in plant conservation, whilst also ensuring that none of these are contradictory. *Communities in Nature* proved that such work is, with the right will and imagination, do-able. New audiences were created, (some very challenging for the gardens concerned), and new partnerships brokered.

Some of the gardens involved have gone on to prioritise the work, creating staff posts to support it and actively pursuing other sources of funding through strategic partnerships. This has shown that it can be done.

Nonetheless, according to colleagues across the sector, some roadblocks remain, mainly surrounding the issue of the social role not yet being embedded across the garden's staff, not yet embedded in the garden's mission. Lack of clear mission for the work and lack of leadership were cited as the central challenge. As one senior staff member of a large botanic garden recently remarked of his colleagues, for many gardens "there is still reluctance at senior level to see it as a priority." Yet from this study there appears to be much agreement across the sector, at all levels within the organisations, about the importance of growing gardens' social role, influenced by great examples of emerging social role practice around the world (that BGCI has been busy disseminating)(BGCI).

> "We need some lead gardens…to show everyone else it can be done… the long-term benefits of taking it further." (Paul Cook, ex-NESS Botanic Gardens, University of Liverpool)

EXPANDING THE CONVERSATION ABOUT '*COMMUNITIES IN NATURE*'

The Five Year Review decided to expand the conversation to include others outside the sector, to 'test the waters' and see what they think about the gardens' social role, and to see if they think there's there is potential to grow *Communities in Nature* through cross-sectoral working and expanded partnerships. Thus the gardens that had been directly involved in the *Communities in Nature* programme in the UK, met with a range of funding agencies as well as social and environmental activist organisations (including community conservation volunteers; urban agriculture groups and diversity in heritage groups),all interested in the subject of *Communities in Nature*.

The result was that there was great interest and excitement about creating partnerships and many practical ideas were shared. Yet, there was concern that there may still be a lack of commitment within the structures of gardens themselves as reflected in the absence of 'social role' in garden mission statements, preventing it from being further developed. One way suggested to help encourage others, is to… "create flagship gardens/ to support exchanges/networks/capacity building…getting botanic gardens understood outside of the botanic gardens niche – how you cross-fertilise with what's happening so dynamically in other parts of the environmental movement–…funders could help do this through being aligned." (Louisa Hooper, Calouste Gulbenkian Foundation).

ASKING INTERNATIONAL COLLEGUES

Through an online survey, the international community of BGCI members were also asked more specifically for their views on *Communities in Nature* as a strategy. Many expressed interest in the potential of *Communities in Nature* as a collective, international programme, with shared organisational learning outcomes, as a community of practice. Some of the gardens also reported on their own, outstanding programmes, reflecting a growing commitment to their social role across their organisations. These gardens are already leading the sector in their social role but asked that a stronger 'community of practice' be supported to share this work.

Most said that they would very much like to participate in any future, scaled-up, international version of the programme.
One colleague called gardens vitally important 'agents of change' (Kimberlie McCue,Desert Botanical Garden, Arizona). Another imagined a future for the social role of botanic gardens that might include a stronger element of consultation, collaboration and active agency on the part of the public, with a way of working locally that is: "community driven, [with] designed and built projects with less money but strong long term appropriate staffing support - [this] will be the most successful." (Phil Pettitt, Royal Botanic Gardens Sydney)
The overarching view from the responses by international garden colleagues was best summed up by the following: "We are convinced that the social role of botanic gardens should increase." (Yuri Naumtcev, Director, Botanical Garden of Tver State University, Russia)

The discussion with international colleagues continued at the St Louis Congress. (Dr Lynch hosted a follow-up workshop to her lecture, explicitly on the subject of planning for the future of the *Communities in Nature* programme).

Workshop participants came to the conclusion that the following three areas need to be addressed by BGCI and the sector as a whole:

1. **Building Communities**
   How much is gardens' social role actually contributing to *building strong communities*, rather than simply finding ways to bring more people into the gardens? Need better community knowledge and *community development training* for garden staff; to get out and understand community needs and issues, and find out where the community is already strong and find ways to make links, and further contribute.

2. **Hub Gardens**
   It was once again strongly suggested by participants that an international, *community of practice* should be led by BGCI, identifying those gardens who are leaders, who are already successfully delivering on their social role.

   Thus it was concluded that BGCI needs to identify and support (and help find funding for) *'hub' gardens*. These would involve identifying gardens already strong on delivering their social role. BGCI should work closely with the directors of these gardens to develop the network of hub gardens who can in turn lead a community of practice and act as mentors/trainers and support for other gardens within their geographical sphere of influence. This too would have implications for funders, who could fund this network.

3. **Good Practice Standards**
   The workshop agreed that it is important for public institutions to become widely known and respected less for their last project, but rather for their 'way of working' – the ethics of their practice. Participants recommended that BGCI help the botanic garden sector to identify *standards* and even perhaps a *branding process* (self-certification?) for gardens to aspire to in terms of social role, which would state the principles and 'ways of working' with communities to which the botanic gardens' sector might aspire / adhere.

   It was agreed that there is more work to be done on this, but it could be the subject of further discussion/research/ conferences and could serve as a way to reach out to funders/donors. It could include the gardens' marketing and development departments to make these standards known more publicly. It could also serve as an induction process for new garden staff. This too could be championed

by BGCI.

CONCLUSION: GAREDNS' PARADOX

> "Trying to reach society….what better place to do it than botanic gardens?"

This was recently noted by Paul Smith, the new Secretary General of BGCI. Yet, here we have the paradox to which I referred in the title of this paper.

The overall conclusion from the survey of UK and international garden colleagues was that despite the undoubted successes of the *Communities in Nature* programme, there are still some organisational issues to address within gardens. *Communities in Nature* certainly brought about significant changes in practice in a number of the gardens involved. This work is also assisted by the dynamic new social role springing up in gardens around the world. Yet, the social role is too often, still not seen as central to the gardens' mission. It raises the issues of change and , as many of the survey responses have suggested, the role of BGCI as *leader* – leading that change.

In conclusion, it seems botanic gardens are at a crossroads in terms of their mission, and hence their strategic priorities. But time and events are marching on and could be in danger of leaving some gardens behind. An Arizona Flagstaff Arboretum colleague, for example, described the disturbing reality of being on the front line of climate change with its loss of species and lifestyle, while acolleague from St Louis Zoo reminded us forcefully that botanic gardens have to get out of their comfort zones to address these challenges: "Have to talk about quality of life for everyone – and have to talk *to* people – go ask what they need!"

Under the leadership of BGCI, (for which, according to Paul Smith, the social role is a key tenet of its new strategic plan) botanic gardens are at a point in which they can build on *Communities in Nature*, inspired by strong, existing practice in gardens around the world. A concluding recommendation of the *Communities in Nature* Review was that BGCI identify gardens that can lead and mentor other gardens in developing their social role as 'agents of change'.

Fundamentally this is what *Communities in Nature* is about, as expressed by one colleague:

> "The delight is that programs [such as *Communities in Nature*], as implemented by and through botanical gardens, truly can and do make a difference in real peoples' lives. Gardens are more than just pretty places. Gardens are *agents of change*. **"**(Kimberlie McCue, Program Director, Conservation of Threatened Species and Habitats, Desert Botanical Garden, Phoenix, Arizona)

The *Communities in Nature: Five Year Review* will be made available by BGCI in the Autumn of 2015

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Sustainable Communities Field School: Innovative Environmental Education for Businesses

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University of British Columbia, Botanical Garden and Centre for Plant Research; Society Promoting Environmental Conservation; University of British Columbia, Institute for Resources, Environment and Sustainability & Department of Psychology
Key Words: *Teaching and Learning, Strategy and Future Vision for Greater Impact and Change*

INTRODUCTION

Mobilizing businesses to be active participants in developing sustainable communities requires collaborative, inclusive and innovative ways of engagement. 'The Sustainable Communities Field School' is a new three year educational program designed to engage employees of local businesses and community organizations in learning about sustainability. Based at the University Of British Columbia Botanical Garden (UBC-BG) in Vancouver, Canada, the program addresses a variety of topics including forest and biodiversity conservation, sustainable food systems, waste reduction and water management. Through innovative hands-on programming, the field school seeks to increase the number of companies actively engaged in greening their operations, with the aim that employees integrate sustainable best practices into their daily lives. As environmental educators and researchers we want to understand how to support citizens to create sustainable communities.

Community partnerships are integral to the program. Our curriculum is being developed in collaboration with two other Vancouver-based groups: the Society Promoting Environmental Conservation (SPEC) will help create and facilitate engaging programs; and the UBC Department of Psychology in conjunction with the Institute for Resources, Environment and Sustainability (IRES), will monitor and measure the outcomes of the education program. The design of the first year of the program will be flexible in order to meet the specific needs of individual organizations, to identify topics of interest, and to develop appropriate tools.

With both aesthetic and educational resources, UBC botanical garden offers a unique Pacific Northwest outdoor experience for people of all ages. Sitting on the bluffs above the Salish Sea (Georgia Strait), UBC botanical garden safeguards a spectacular collection of more than 50,000 plants representing over 7000 taxa in its 35 hectares (86 acres). Most of the programming for the field school will take place at UBC botanical garden; however, programs may occur at client workplaces or at other off-site locations that highlight some aspect of sustainability (e.g., a solar panel operation, local watersheds, etc.).

The psychology team will use a "community-based research" model, bringing in local stakeholders to assist with academic research. Led by Dr. Jiaying Zhao from UBC Psychology and IRES, the team will develop methods for testing and analyzing data collected from the participants in our programs. Among other things, surveys will be distributed to Field School participants before and after their visit to measure the effect the experience had on their attitudes and behavior. The team will do follow-up interviews with participants to gauge changes in behaviors over the longer-term. Given the lack of empirical evaluation of sustainability education in literature, we aim to provide rigorous scientific evidence of our Field School on promoting behavioral change towards sustainability.

Initial funding for the Field School extends until 2018. During that period we expect to pass 1000 individuals from 20 organizations through the school. Information derived from this work will be used to create a best

practices database available for any business or organization interested in improving sustainable practices for their staff and operations. The results of the research on educational delivery methods and their effects will be published in peer-reviewed journals. The hope is that the 'Sustainable Communities Field School' will provide an excellent social enterprise business model for other non-profits and botanic gardens looking to create similar sustainability ventures.

THE PROGRAM

In the pilot year, programming is focused on five areas: forests, food, waste, water and biodiversity. A typical 3-hour botanical garden tour starts in the David C. Lam Asian Garden, and from there, participants walk to the Food Garden to learn about growing vegetables, soil recycling and pollination. Stopping to observe honey bee hives, participants explore pollination and the value of bee colonies. Programs will vary from 1-6 hours in duration depending upon the type of tours selected.

The programming moves from the food garden to the Greenheart Canopy Walkway, a 308-metre aerial trail system perched in the canopy of the David C. Lam Asian Garden rainforest. Along the way, participants learn how First Nations people traditionally managed Garry Oak ecosystems to grow nuts, berries and root vegetables such as camas. They also learn about the roles of forests in biodiversity and water availability.

WHAT IS A FIELD SCHOOL?

Field schools are schools without walls. They are outdoor places where people learn about issues that relate in practical ways to their daily lives in a hands-on, interactive and fun environment. The idea of a "field school" is borrowed from the United Nations Food and Agriculture Association (UN-FAO 2015). First developed in South East Asia in the early 1990's, UN-FAO Farmer Field Schools have been shown to reduce pesticide use by convening and training farmers in integrated pest management techniques (Settle *et al* 2014). The programming varies across continents and communities, but is based on helping farmers become self-confident enough to take action to deal with challenges and obstacles that impact their farming livelihoods.

Locally, the concept of a field school was further developed by Dr. Tara Moreau, who, in 2010, as part of her postdoctoral research with the Pacific Institute for Climate Solutions, designed and launched the SPEC Urban Farmer Field School in Vancouver (SPEC 2015). Now in its 4th year, UFFS focuses on education around urban agriculture, food systems and climate change.

he Sustainable Communities Field School is the first attempt to extend this education model into the boardroom to engage companies and employees.

WHY BUSINESSES AND COMMUNITY ORGANIZATIONS?

Businesses and community organizations form the backbone of our communities. With entrepreneurial resources and human capital, it is businesses and organizations that will help drive the shift to a greener economy. In British Columbia, the City of Vancouver is at the forefront of sustainability, launching the Greenest City Action Plan in 2011. Under the plan's "Green Economy Targets," the City has set a goal to double the number of companies in the city actively engaged in greening their operations. The Field School team is exploring how to collaborate and assist local businesses to help reach this target.

There is a benefit to being at the forefront of this movement. Vancouver – like many major cities – is already going through a transition. Vancouver's green economy is growing twice as fast as traditional sectors (City of Vancouver 2015). Through our programming and workshops, the Field School will work to harness the

productive spirit of companies and organizations to continue propelling this shift – a shift that, we believe, fits well with the UN's Sustainable Development Goals, which aim to make cities more "inclusive, safe, resilient and sustainable" (UN-Sustainable Development 2015).

BGCI SESSION SUMMARY

The session called Innovative Public Garden Engagement Activities was well attended, with an audience of ca. 45 people. Dr. Moreau was the first presenter of the session and a diverse range of questions were asked related to the target audience of the Field School, sustainability topics covered in the curriculum, and the funding model used. There was a strong interest in the intersection between environmental and agricultural education. Several questions also inquired as to how botanic gardens can better measure and monitor how education is changing behaviours. In the months and years ahead, the Sustainable Communities Field School will continue seeking answers.

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The Cali Botanical Garden, a large open-air laboratory for the exploration of life

Isabel Elena Muñoz Galvis
Fundación Jardín Botánico de Cali – Colombia
Key Words: *Teaching and Learning, Strategy and Future Vision for Greater Impact and Change*

In the Botanical Garden of Cali we believe that environmental education should not be a matter of individual topics but rather of training programs. When teachers and students visit us they find a large, open-air laboratory that combines the features of native flora with the values and traditions that strengthen our national identity.

We try to encourage the appreciation of aesthetics and readings of nature. In this way, the educational program of 'Botanical Exploration' is the perfect excuse to invite children on an expedition that takes them on a journey through time. They are chosen by Celestino Mutis to come with us on a mission to explore, understand and search for the treasures of our tropical dry Forest. Our strategy of environmental interpretation is based on stories, myths and legends (View
Figure ***9***) where the magic allows us to understand how we live today thanks to what the forest offers.

Figure 9: *Elf Cali Botanical Garden*

Together with schools, we are helping the botanic garden gradually conquer the whole city, with strategies for urban agriculture and the planting of native flora to connect small relics of existing dry forest in the urban area, thus generating flows of connectivity with the local fauna, especially birds.

WHERE ARE WE?

The botanic garden of Cali, is located on the eastern side of the western mountains, in the middle basin of the river Cali, geographically, it is in between the urban and rural side of town. The botanic garden is a site of in situ conservation as it is located within a protected area of tropical dry forest.

In Colombia there is only about 8% of the original area of tropical dry forests, which is represented by tiny areas of fragmented landscape. BST del Valle del Cauca is an incredibly diverse habitat, yet few of the other remaining sites are in as good a condition, with the loss of species significant. For example, at least 80 % of the trees in our region are threatened regionally or nationally due to, deforestation, habitat degradation, over exploitation and loss of seed dispersers. According to the analysis of the state of ecosystems conducted by the Regional Autonomous Corporation of Valle del Cauca (CVC) the original area of Valle del Cauca was 351.132,79 hectares were as currently it stands at 3253.15 hectares. Natural coverage is 1.57 % and its representation in protected areas is 0.24%.

THE CHALLENGES

For the design of our proposed interpretation we identified the scope we wanted to achieve taking into account, the different audiences that frequent the garden, educational impact and the gardens responsibility in engaging the visitors with local biodiversity. The challenges we defined in making our interpretation were:

1. How to stimulate citizens to recognise and value the biological and cultural diversity in our area.
2. Be appealing to the public, whilst also communicating the dynamics of the forest.
3. Strengthen our identity with the native flora
4. Encourage the transformation of cultural practice and behaviours.
5. To be interesting and entertaining.

OUR PROPOSAL: EXPLORATION BOTANIC

The educational programme is a horticultural journey through time based upon Colombia's expeditions in Europe during the 18TH century.

The main component of the activity is a tour through the forest. However, we wanted to inspire more kids to take part in botany, so we also developed some complementary investigative activities. We understood that we would need to create a funny, relatable story, to make it easier to engage visitors in the science of the forest.

We this in mind we presented the tour as an expedition, with a letter being sent to the visiting school beforehand assigning them the 'mission' to come and discover the secrets of the forest. It was also decided to utilise expedition accounts from the past, within the tour and interpretations, as they are an inspiring localised resource that we found provoked much discussion.

Figure 10: *Past letter inviting the expedition*

We also thought it necessary to identify the main scientific skills we wanted encourage in our visitors and the types of activities we could use to do so (View
Table ***1***):

Table 1: *Conceptual references*

Scientific method	Features expeditions
• The Observation • Hypothesis • Experimentation or search for information • The organization of information • The conclusions or communication of the results.	• The appropriation of resources • Optimizing the use of the same • The increase of scientific knowledge • Lifting maps • The realization of inventories • Written descriptions as travel diaries etc.

SCIENCE BECOMING A GAME

After consulting all the relevant historical information on the time period the tour was to be based on, it was decided to make the experience a search for treasure in the forest. The basis of treasure, as well as being interesting, held a great potential for investigative activities.

Ideas covered within the tour would include:

1. Biodiversity is the key
2. Teamwork
3. Plant reproduction
4. Fertility without fertilizer

5. The water storage
6. Homework for each one.

One of our tools is a map (View
Figure ***11***) where the children can record the 'treasures' they have found, this is a useful resource as it provides a constant reference throughout the tour to help maintain engagement. At the end of the tour the children will also be given activities to take home with them as 'homework', with the hope of continuing engagement outside of the gardens walls.

Figure 11*: Map Botanical Exploration*

LET'S START EXPLORING!

When creating activities to complement the tour we kept in mind four key factors; observation, picking, drawing and classification (**Error! Reference source not found.**Figure 12). By including these four factors it ensured we were covering a range of, nature based topics, scientific skills and learning styles.

Figure 12*: Botanical exploration activities*

THE ACTIVITIES

The tour starts by indicating to 'explorers' to locate the starting point on the map. They are then assigned roles and the tools they need for the activity:

a. Researcher (magnifying glass).

b. Descriptor or browser support (sheet morphology of leaves and fruits).
c. Navigator (map)
d. Cartoonist, (camera)
e. The collector (lanyard and sticks).

Firstly the children have to sample an area of the forest floor by sectioning an area and collecting the leaves. They are then required to count and identify the leaves, producing a data sheet for the sectioned area. The data will then put into a collective data base where the children can see their contribution as a whole and identify the tree they surveyed. The aim is inspire community involvement as they are a part of the science in their area and establish more of an attachment to the local native flora. Through the botanic exploration project, the whole community helps to increase knowledge on local ecosystems, with everybody able to have a role. The project aims to provide an experience to inspire and connect people to nature, an experience that will hopefully last a lifetime.

Figure 13: *Children in botanical exploration*

Figure 14: *Children in botanical exploration*

Figure 15: *Children in botanical exploration*

OUR ACHIEVEMENTS ARE...

1. Makeover botanical research as fun experience.
2. Process knowledge linked to research, through play.

3. The flora of the city, closer and easier to understand.
4. Recognize the botanical garden as a laboratory for the exploration of biodiversity.
5. Recuperation of stories and knowledges associated with trees in the city.

Conservation and Sustainable Utilization of Plant Products by Communities in Western Kenya

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Key Words: *Social Inclusion and Community Engagement, Strategy and Future Vision for Greater Impact and Change*

ABSTRACT
Botanic gardens have played pivotal roles in nature conservation in the past without particular reference to the communities needs. It has become apparent that ethnobotany has been crucial in the community's survival. Plants are integral in human existence in most aspects of life. The reliance of people on plants products cannot be over emphasized. It is therefore difficult to ask the communities to conserve plants without alternative products provision. Sustainable utilization of plant products are integrated with the benefit sharing the communities receives from their participation. The university botanic garden, Maseno has incorporated local communities in the programmes that mitigate on the global warming, healthcare and environmental management leading to poverty reduction through *ex situ* plant conversation and sustainable use. The scientific research at the garden involves the community participation in the *ex situ* conservation, production of clean plant seeds and education on better methods of producing traditional food plants especially the indigenous plants with particular reference to local vegetables. The university botanic garden also encourages capacity building amongst the resource persons in the communities. The paper will report on the success results that have been accumulated over the past six years with regards to community collaborative efforts and the university students' participation in the projects.
Key words: conservation, community, benefit-sharing and healthcare

INTRODUCTION

The University Botanic Garden, Maseno (UBGM) is located right on the equator in Western Kenya, 20 Km from the large fresh water mass – Lake Victoria and 30 Km from Kakamega forest – the only surviving tropical rain forest left in Kenya. The region is inhabited by the Luo and Luhya communities whose life rotates more on agriculture and fisheries. The local communities have wealth of indigenous knowledge on the ethnobotany of the region and through their taboo system have succeeded in protecting some of the rare plant species. Biological conservation is a complex undertaking especially in the developing countries where large populace still relies on the forest products for their livelihoods. Majority of these people live below the poverty line of less than 1-US dollar per day, hence benefit sharing from conservation strategy should be encouraged.

COMMUNITY SEED COLLECTION

The scientists working at the garden have successfully developed a collaboration system with the communities where they bring into the garden seeds or seedlings of rare plant species of high value for *ex situ* conservation. The garden on the other hand is advocating the principles of conservation for efficient utilization by the community at their home gardens. The collections are conserved based on scientific thematic arrangement at the garden. The conservation ideas are shared with the primary school children and students from high school to tertiary education levels, colleges and universities. The children or students take the message and learnt principles to their families hence improving our conservation strategies among the communities for sustainability. Ethnobotanical interviews revealed the communities belief in the potential of the herbal remedies in disease control. Scientific identification of possible active compounds in the herbal extracts from highly harvested families is on-going.

Continued research on herbal medicine is necessary to remove the myths from practice and curative evidence and to interface herbal and conventional medicine.

The garden's area is 9 hectares, parts of it have been thematically planted with both indigenous and exotic

species, others used for field research experiment and building infrastructure for laboratories and greenhouses and illustrated in the figure 1. below.

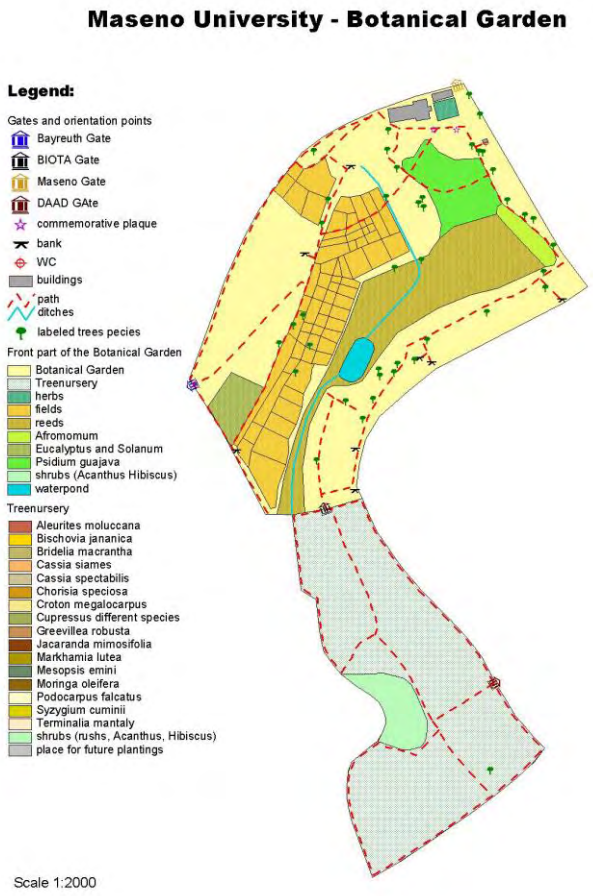

Figure 1. *Map and thematic arrangement at the University Botanic Garden, Maseno*.

THREATENED PLANTS AND CONSERVATION STRATEGIES

According to Mendonça *et al*., (2011), conservation is one of the key roles of botanic gardens as outlined by the GSPC. In recent decades, the phenomenon of expanding the powers of the botanic gardens has been occurring, especially, under agreements and international conventions that deal specifically with biodiversity conservation. The United Nations Convention on the Biological Diversity (CBD) based the editing of the International Conservation for Botanic Gardens document that discusses the various aspects of these institutions mission, emphasizing one of their roles to be conservation.

In the areas around the UBGM, just like in many other parts of the world, the survival of plants has been threatened. From the findings, medicinal plants are the most threatened at 43% followed by food plants at 32%, followed by plants that provide timber, fuel and shade at 19%. Ornamental plants account for the least number at 6%. This observation could be attributed to the fact that the local community around the garden still relies on herbal medicine for treatment of most diseases (Pers, Com.) and so these plants are over exploited. The community members also utilize the food plants so much and this over exploitaition makes these plants to be threatened. Ornamental plants are not so commonly valued and planted by the community members around the botanic garden. Their aesthetic values seem not to be appreciated and this explains why a small percentage is reported to be threatened. Overall 24 species were reported as threatened, but amongst these only a few species were reported as threatened by a reasonably high

number of community respondents.

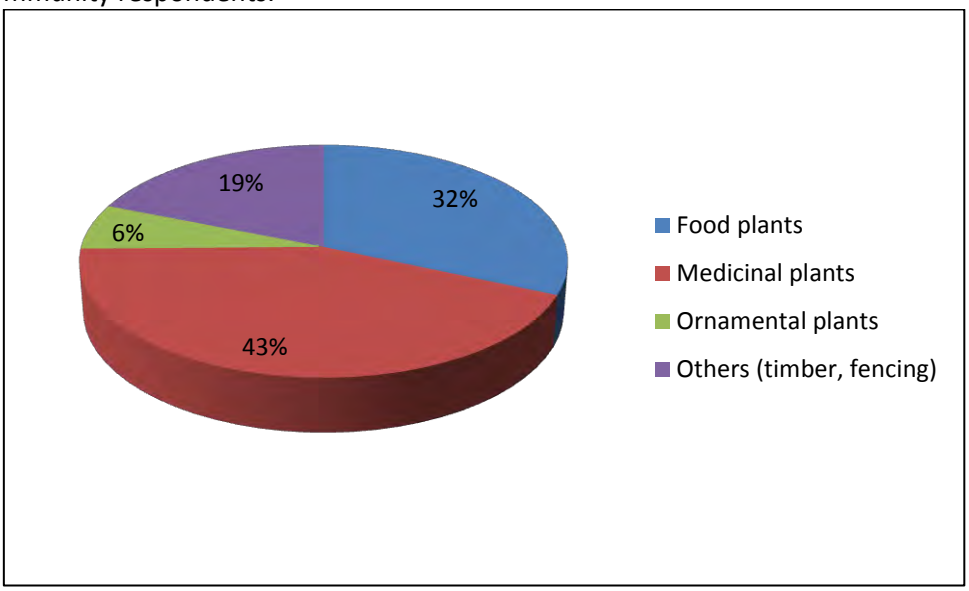

Figure 2. *Categories of threatened plant species around the UBGM*

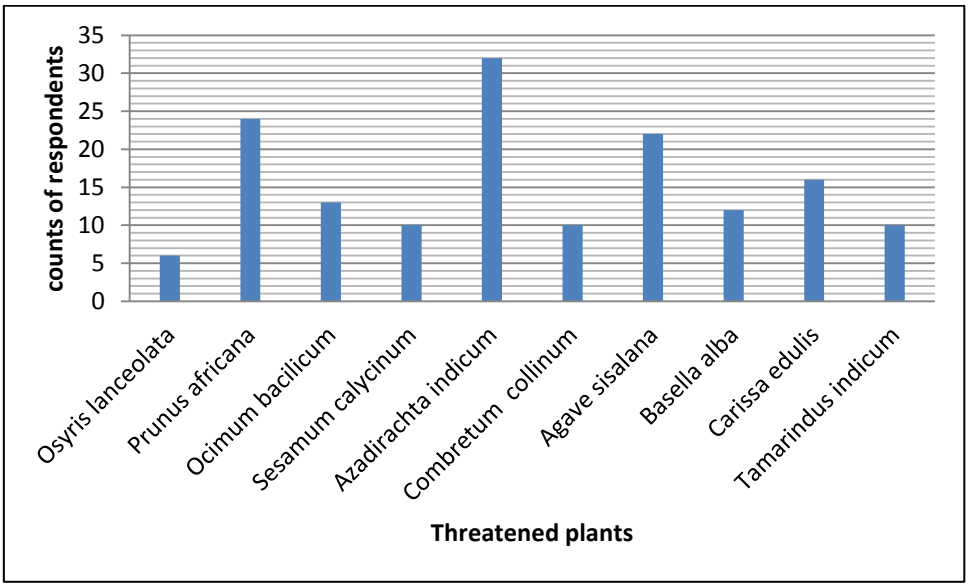

Figure 3. *The most threatened species (respondent perception) around the UBGM*

Other than the threatened plants mentioned above, respondents also pointed out that there were other plants that they wished could be conserved in the UBGM. Most respondents cited medicinal plants like *Senna didymobotrya*, *Maerua spp*, *Aloe vera* and *Zanthoxyllum spp.* Food plants such as *Cucurbita pepo, Passiflora edulis* and various species of leafy vegetables such as various varieties of *Brassica oleraceae, Spinacia oleracea* etc as well as ornamental plants, were also recommended to be grown in a green house within the UBGM.

The findings indicate that most plants are threatened due to over exploitation. This has been supported by Achigan-Dako *et al*., (2009) in their study of traditional vegetables of Benin. The plants are over exploited due to their medicinal significance, food provision, trade, firewood, charcoal burning and timber. The

findings indicate that over exploitation account for 35% of the reasons for the plants being threatened, followed by habitat loss due to clearance of land for infrastructure, agriculture and building (30%), then climate change (12%). 23% of the respondents attributed the threatening of plants to a combination of factors such as pollution and disease, over exploitation and climate change etc. No respondent attributed the threat to invasive species.

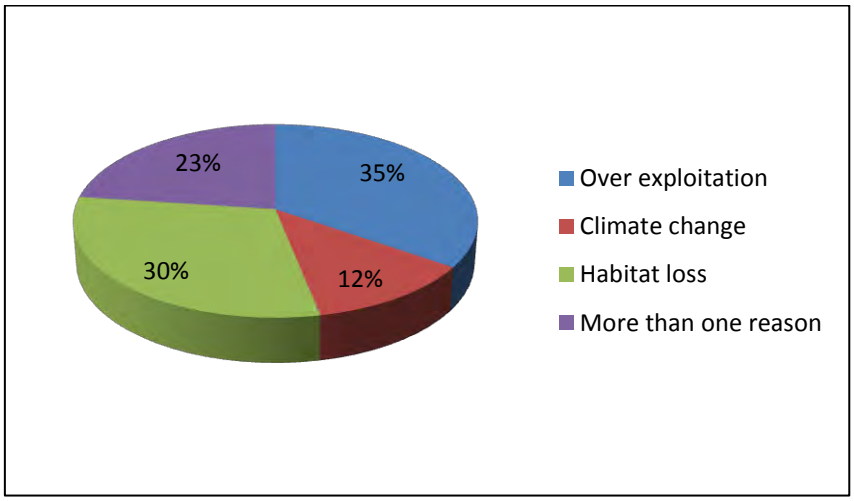

Figure 4. *Causes of plants being threatened around the UBGM*

Plants are important to humankind not only economically, environmentally and industrially but also spiritually, historically and aesthetically, for they sustain human life through direct and indirect gains by providing a wide range of products for survival and prosperity (Seth, 2004). Their conservation is therefore imperative. As exploitation pressure mounts, there is risk of biodiversity loss and hence the need of coming up with various conservation strategies which if implemented will save the threatened plants from extinction. The findings indicate several strategies of conservation of these threatened plants. 35% of respondents suggested raising of propagules (seeds) from these plants and storage of these seeds in a seed bank within the UBGM. This strategy is in line with the one being carried out at Til-Berc botanic gardens (BERC, 2003). These seeds can then be sold to the community members when need be. Nurseries for these plants should be raised and people, organizations and institutions encouraged to plant them. This strategy is in line with the one given by respondents in a near similar line of study in Benin (Achigan-Dako *et al*., 2009).

24% of the respondents suggested that education was the most appropriate strategy for conservation of these plants. The UBGM staff members should embark on educating the community members on the usefulness of these plants and the need to exploit them sustainably. The people should also be educated on how to harvest medicinal plants. Only trees over 30 years should be harvested for timber, and "cut one plant two strategy" should be adopted in order to save these plants from extinction.

The other strategy that was suggested by the respondents was government ban on use and trade of rare plants and their products. 21% of the respondents observed that this was to allow these plants to increase in population so that when the ban is lifted, the plant population could be sufficient to meet the needs of the users. Non-the-less, upon the government lifting the ban, it should still regulate the use of these plants. A good example was *Osyris lanceolata* which is treasured for its essential oils used in perfumery as well as its timber (Wildlife direct, 2009).

Despite majority of the respondents suggesting the above strategies, 8% of the respondents suggested other strategies such as domestication of wild plants, where there would be selection and replication of

cultivars with desired traits and genetic suitability for domestic conditions as this would ensure their regeneration and availability (Achigan-Dako *et al*., 2009). The other strategy suggested by 6% of the respondents was protecting the natural environment from activities such as quarrying, destruction of forest, land clearance etc. Through such protection of the environment, the plants will also be protected. Preservation of the plants in the UBGM was another strategy suggested by the 6% respondents. Preservation means put aside and in this case the respondents used it to imply that the threatened plants should be planted *ex situ* in the botanic garden where their conservation is guaranteed. There is, therefore an urgent need to adopt the replanting of these species not only in the botanic garden but also on the farms where they can readily be accessed by people. In addition, policies to support the replanting of these trees should be adopted and implemented (Maundu and Tengmas, 2005).

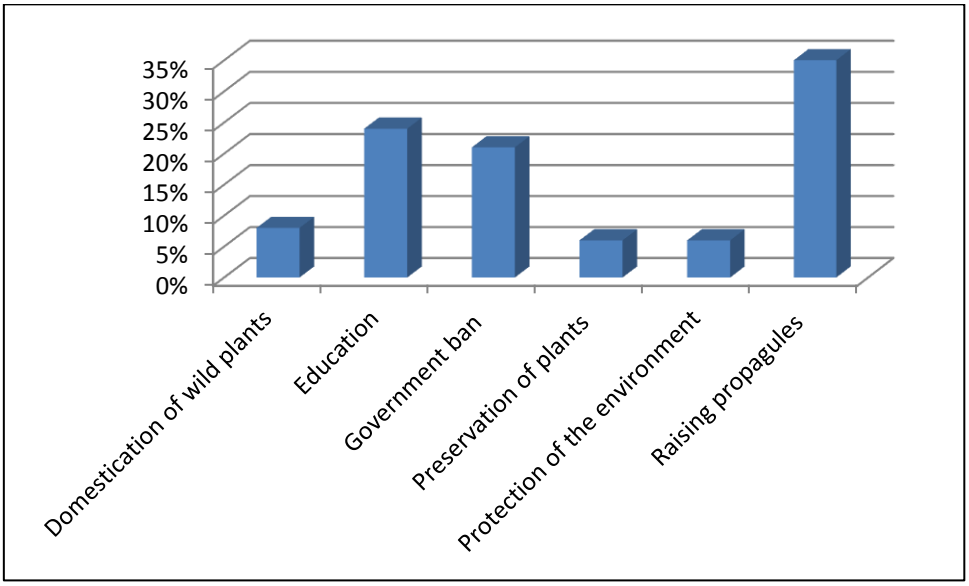

Figure 5. *Conservation strategies of threatened plants*

BENEFITS AND POLICY

The primary objective of our activities is to reverse the lose of plant species through communities engagement and policing for we believe they are better placed to protect their environment. We are also advocating benefits sharing from forest products and recognition of the use of herbal medicine for healthcare without considering the practice as repugnant. The introduction of *ex situ* conservation of plants of high value in the garden has changed the landscape and created aesthetic environment for recreation by students and local community. We believe that through this collaborative approach the garden will be able to achieve its role in the global strategies for plant conservation and the post millennium development goals.

The overall mission of the garden is to support study, Education and research activities at the university and contribute to the overall improvement of the university-community collaboration. Nurture the spirit of conservation and strive to improve the life and culture through conservation and utilization power, link the plants life with society and expand the circle of nature through conservation. The development of Botanic Garden at Maseno University has created a centerpiece contribution in East Africa on research infrastructure development and enhancement of higher education. The biodiversity of the tropics is diminishing at a faster rate but we believe in conservation and that together we will succeed in our research and development endeavors and contribute to the sustainable beauty of our institutions and the World for the future generation.

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Getting beyond the roadblocks in plant science education

Amy Padolf and Phillip Turvil
Fairchild Tropical Botanic Garden and Royal Botanic Gardens, Kew
Key Words: *Teaching and Learning, Strategy and Future Vision for Greater Impact and Change*

FORMAT AND STRUCTURE
This workshop was conducted in lecture format and was held in a large auditorium space. Because of the venue, audience participation was limited to a question and answer session with the two speakers at the end.

As botanic gardens, we are uniquely positioned to promote the formal study of plant science and address environmental issues; yet we can never assume that our students, teachers and community members have the basic theoretical and practical knowledge or materials to understand them.

ROADBLOCKS
Within the last five years, it has become quite apparent throughout the world that we face significant educational and environmental roadblocks that affect both formal and informal science education. These roadblocks have begun with a shortage of opportunities for students to participate in authentic scientific research combined with diminished access to natural areas and a lack of laboratory resources within our schools. These factors have caused students to be less prepared for college-level science courses and thus careers in STEM (Science, technology, Engineering and Mathematics) fields. It is a perfect storm with cyclical implications. Fairchild and Kew are armed with world-renowned science education programs, a tradition of solid local and international conservation research and support from the community. Botanic gardens now have an opportunity to greatly enhance science education and identify and encourage talented young scientists.

Roadblocks we face include:

- A distinctive lack of pathways to enable students to connect an interest in plant science with a career
- Very limited school curriculum and a lack of laboratory resources
- Few opportunities for students and communities to participate in authentic research
- Diminishing access to natural areas
- Minimal post-secondary botany programs
- Garden funders rarely include support for this type of programming

WHY NOW?
In societies with more and more technology, individuals must be able to make informed decisions about scientific issues that affect their personal lives, the well being of their communities, and national issues such as health care and energy policy. Research has shown, however, that in the United States, the general level of understanding of basic scientific concepts and of the nature of scientific inquiry may be insufficient for the average citizen to be able to make informed decisions.

Economically, a strong STEM workforce is becoming increasingly important for the USA's economy, infrastructure, and environment. The world's education agenda is focused on an urgent need for a population that is more STEM-literate and prepared for scientific careers. However, one of our major challenges is finding tools to encourage diverse populations to pursue STEM careers, particularly in fields related to the environment.

In order to identify possible solutions, botanic gardens can ask themselves the following questions:

- What makes us unique
- Where is our expertise
- What do we have and how to we leverage it?
- What do we know?

Every public garden will answer those slightly differently.

Fairchild Tropical Botanic Garden has taken a unique approach to integrating our science and education, while meeting the growing needs of our community. We have found by combining the history and strength of Fairchild's research, the wide-reaching success of our education programming, the magnitude of our partnerships and the power and passion of our community, that we can change how informal educators look at educating the next generation to encourage careers in STEM fields.

In doing so, Fairchild created *Biotech* at Richmond Height, Miami's new conservation biology high school that hosts Fairchild's botany magnet program. This a one-of-a kind botany intensive high school magnet program was designed to be a significant path for those kids who already have an interest in botanical science, or to encourage it. This year marks the inaugural class of nearly 140 freshmen from across our county. The school is equipped with a state-of-the-art micro-propagation laboratory so that students can contribute to the nationally recognized conservation initiatives such as the Million Orchid Project (www.fairchildgarden.org/ the-million-orchid-project); we have also build in research opportunities within our collection.

Our partner the Royal Botanic Gardens, Kew, developed the 'Grow Wild' programme (www.growwilduk.com) to inspire communities, friends, neighbours and individuals across the UK to come together to transform local spaces by sowing, growing and enjoying native plants. The programme engages people aged 12 – 25 with 'outside the garden gate' activities They are on-track to meet targets set by the Big Lottery Fund (www.biglotteryfund.org.uk) to enable 200,000 young people to sow seeds and 100,000 to take other action, together with reaching 4 million others through media.

Roadblocks faced by Kew:

1. **Perception** – reframing scientific messages to attract young people by changing their perception of plants, including aligning horticultural activities with commercial brands recognised by the target audience. For example, Kew commissioned a top-ten chart music band to grow wild flowers at a music gig in London. A range of such attractions – with clear messaging – has earned a great deal of participation and media exposure.
2. **Access to audiences** - to access young people, Kew developed partnerships with organisations that had a direct relationship with our target audience. This offered a credible way to share messages. For example, messages about free seed kits were shared through a youth group in Northern Ireland with access to over 1,000 young people. Across the UK, this approach has extended to over 150 partner organisations.
3. **Programme management** – to reliably reach target audiences, Kew invested in systems able to manage several concurrent programme activities by a multi-disciplinary team. For example, clear processes and clear quality standards. This extended to significant work to integrate the activities of Grow Wild into other teams at Kew; notably in finance, legal, procurement and science areas.

The ongoing challenges are researching the programme impacts by examining programme outputs and behavioural change of participants and, as significantly, presenting the programme impacts to internal and external stakeholders.

There are a number of resources and techniques that Kew has now developed for Grow Wild. These resources can be discussed with industry partners. Please get in touch.

Agents of Change: Reconnecting People to Nature through Biophilic Design and Art

Richard Piacentini, Emily Kalnicky and Sonja Bochart
Phipps Conservatory and Botanical Gardens (Piacentini/Kalnicky), Biophilic by Design, Inc. (Bochart)
Key Words: *Strategy and Future Vision for Greater Impact and Change, Social Inclusion and Community Engagement*

If everyone on earth tried to live the lifestyle enjoyed in the U.S.A., then it would take seven planets-worth of resources. Human exponential population growth and unsustainable use of natural resources is resulting in major environmental problems such as climate change, habitat destruction and loss of biodiversity. Botanical gardens have responded to this by engaging in activities such as *in-situ* and *ex-situ* conservation efforts, establishing seed banks, plant collection and educational programming. But are we, as botanical garden professionals, treating the symptoms and not the cause?

The cause is directly related to our lifestyles and our disconnection to nature. People, especially those living in the USA, consume far more resources than it is possible to sustain us and we are so mechanized and wired that even our children are disconnected. Sadly, many of them only experience nature through electronic devices. According to data from a 2010 study (Rideout, Foehr and Roberts, 2010), children spend more than seven hours each day in front of electronic media. Furthermore, most people in modern society spend less time outdoors and more time indoors. Researchers examining nature recreation since 1987 report an 18–25 percent decrease in nature recreation over a 21-year period (Pergams and Zaradic, 2008). Additionally, when asked how people perceive something as natural or unnatural, most people, when thinking of words as "natural" identify only things that lack human interference (Vining, Merrick and Price, 2009).

Botanical gardens have the potential to change behaviors and improve human and environmental health by leading by example and emphasizing the important relationship between people and plants. It is this lost connection to nature that has led to widespread environmental apathy and unsustainable lifestyles. We need to reconnect people to nature through our gardens. We need to find new ways to make those connections possible.

Understanding how connection to nature develops is important, because researchers have found that the more a person feels connected to nature, the more likely they are to act in a way that is considered environmentally responsible (Mayer and Frantz, 2004). Environmentally responsible behaviors include, for example: recycling, taking public transportation, buying local produce, turning off the lights when you leave the room, using energy-efficient appliances, and using renewable energy resources. Part of the reason why people who feel strongly connected to nature may be more likely to act in in environmentally responsible ways may be due to a sense of "we-ness" they feel with nature. In interpersonal relationships, this sense of "we-ness" means people are more likely to exhibit protective behavior including empathy and willingness to help (Frantz and Mayer, 2014).

If connection with nature is an important component for resultant behavior to be more environmentally responsible, how can we reconnect people to nature? One very important way we can do this is through the way we construct our buildings. Many of the buildings we create today completely isolate us from nature. We spend over 90 percent of our time in buildings, and if we are lucky enough to have a window, we usually cannot open it. So how can we reconnect people to nature when they are increasingly spending time indoors? This is where biophilic design comes in. Biophilia, a term that was popularized by E.O. Wilson, recognizes our innate desire to be connected to other life forms (Wilson, 1984). Biophilic design, therefore, can help transform our built environments to make it easier to connect to nature. Traditional biophilic design focusses on environmental features, natural shapes and forms, natural patterns and

processes, light and space, place-based relationships and evolved human-nature relationships. Emerging patterns, many developed as a result of the design from the Phipps Conservatory case study, later discussed, are mindfulness, sensory rich, interactive opportunities, rethinking possible, intrinsic connection, cycles and seasons, and a place-based focus group process.

In recent years there has been growing interest and research focused on biophilia. If there is an evolutionary basis for a connection with nature, why then, are there differences in the level of connection people feel? Factors affecting how connected an individual feels with nature may vary based on whether the connection is seen as implicit or explicit. An explicit attitude is something that can be controlled or readily available for recall, whereas an implicit attitude is seen more as an automatic process or subconscious, since it is not readily available for recall or manipulation. Individuals may amend their explicit beliefs depending upon the audience or context. However, an individual is not able to amend their implicit beliefs since these occur on the subconscious level. This is similar to the concept of implicit memory (Goldstein, 2014).

Research supporting the impact of biophilic design and connection with nature to health outcomes shows: a positive impact on happiness (Zelenski and Nisbet, 2014), decreased stress (Brown, Barton and Gladwell, 2013), increased speed to recovery from illness (Ulrich, 1984), reduced symptoms of ADHD (Kuo and Taylor, 2004), and improved cognitive performance (Mehta, Zhu and Cheema, 2012).

The impact of outdoor nature on health is also promising. In a review of 17 articles measuring 20 different physiological responses to nature, positive impacts were found on brain activity, cardiovascular health, endocrine health and immune function (Haluza, Schönbauer and Cervinka, 2014). Additional support for interior biophilic design includes research participants reporting a reduction in state anger and stress with exposure to nature paintings in a simulated office setting (Kweon, et. al., 2008); as well as a report on the first three months of a two-year longitudinal study highlighting benefits of incorporating plants and other biophilic elements into a retrofitted office site (Gray and Birell, 2014). For those interested in learning more about the history of biophilia and traditional biophilic design, the following books are recommended: Wilson, 1984 and Kellert, Heerwagen, Heerwagen and Mador, 2011.

CASE STUDY – PHIPPS CONSERVATORY AND BOTANICAL GARDENS

At Phipps, we took an old brownfield site and built the Center for Sustainable Landscapes (CSL), one of the greenest buildings in the world and the first building to simultaneously achieve the Living Building Challenge, LEED Platinum, 4 Stars SITES, and Platinum WELL Building certifications. The building makes extensive use of the landscape to achieve this performance and the building provides extensive opportunities for staff and visitors to engage the landscape, starting with the green roof and at each of its three levels.

However, it wasn't long after we moved into the building that we realized something was missing. It was so quiet and eerie inside that it was unnerving. We engaged a sound artist to incorporate nature sounds into the atrium that would be linked to our building control system and weather station. We then embarked on developing a comprehensive biophilic art program with consultants Sonja Bochart and Nicole Capozzi.

The resulting program, The BETA (Biophilia Enhanced through Art) Project, is a multi-sensory, place-based, comprehensive, inspirational art program that included more than twenty local and international artists and fifty art pieces. The project was developed and informed through mindfulness-based creative focus groups with an emphasis on biophilic design patterns. The outcome is intended to improve health, happiness and wellbeing, and promote connections to nature and living systems. Biophilic patterns for the project included natural materials and non-toxic finishes, local and regional art, interactive opportunities, rethinking possible, beauty, intrinsic connections, animal forms and motifs, cycles and seasons, subtlety, sacred geometry, mindfulness and sensory rich designs.

Results from preliminary studies of our staff from a survey conducted in 2013, three months after first occupying the CSL, and in a repeat of the survey in 2015, suggest that people are changing the way they think about their relationship with the environment (65.4 percent affirmative in 2013; 72.7 percent affirmative in 2015). When asked if the CSL project has changed the way they live in relationship with the environment, in 2013, 54.9 percent said yes and in 2015, 66.7 percent stated yes. Staff included additional comments about these changes, one of which is included below:

> "I was always very careful to recycle and turn off the lights, but did it out of habit. Now I am aware of what I am doing and that even as one person I can make a difference in the environment. " (April 2015)

Focused specifically on the Biophilia Enhanced Through Art (BETA) project at Phipps, we collected preliminary data from a member survey of individuals who have participated in tours of the artwork. We found that overall, participants felt their explicit connection with nature increased after the tour and members felt peaceful and engaged one or more of their senses in the experience.

For individuals interested in measuring connection with nature at their organization, we recommend two different tools. For explicit connection with nature, Schultz's (2002) Inclusion with Nature Scale is validated and accessible for a wide range of ages. To measure implicit connection with nature the FlexiTwins game is applicable for a wide range of ages and is freely available as a downloadable app or desktop game (Schultz et al., 2004). We recommend the use of pre- and post-surveys, employing a mixed-methods approach. Incorporating biofeedback to these studies helps to quantify, on a physiological level, the health impacts people are experiencing.

Botanical Gardens have a long history in connecting people to nature. These connections can help address the root cause of many environmental problems. Botanical Gardens can take this opportunity to the next level by incorporating biophilic design principles into their buildings and enhancing it with biophilic inspired art.

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Nature of Play: 10 years of the Ian Potter Foundation Children's Garden

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Key words: *Teaching and Learning, Strategy and Future Vision for Greater Impact and Change*

THE IAN POTTER FOUNDATION CHILDREN'S GARDEN

Background

The Royal Botanic Gardens Victoria is dedicated to the conservation, display and enjoyment of plants and extends over two locations, Melbourne and Cranbourne, and incorporates the National Herbarium of Victoria and the Australian Research Centre for Urban Ecology, which is based at The University of Melbourne.

Opening in 2004, based at Melbourne Gardens, the Ian Potter Foundation Children's Garden (Children's Garden) was the first of its kind in Australia. An iconic play space for Melburnians, its unique, child-focussed design has inspired numerous other nature-based play spaces around Australia, and it has also become internationally recognised as a leading example of a children's garden that nurtures children's interaction with nature.

Sally Jenkinson tells us that childhood play is central to an individual's healthy development and that play is the 'serious work of childhood' (Jenkinson, 2001). Botanic gardens have a key role in encouraging creative play through connection to nature. The Children's Garden provides such a perfect opportunity.
The vision of the Children's Garden is simple, as engraved on the opening gate to the Garden (Figure 1): it is a place where children can delight in nature and discover a passion for plants. The Children's Garden delivers on this vision, encouraging unstructured play, through both design and education programs.

Figure 1 : *The vision of the Children's Garden*

In 2014, the Children's Garden celebrated its 10th birthday. Celebrating this 10-year milestone, it is timely to reflect on how the Children's Garden has met the vision, how it has been used, what lessons learned can be shared and future aspirations.

DESIGN

The Children's Garden is a 5000m^2 space of great design, encouraging children to connect with nature. The garden contains wetlands, a bamboo forest, a kitchen garden and a "rill" – a small stream that meanders through the Garden, where children can paddle. Visitors to the Garden are encouraged to stroke, plant, harvest, prune, observe, roll on, dig, climb, play with, float, crawl through, sit among and generally become familiar with everything in the Garden. Children learn through their senses and imagination, and the intent was to intrigue children by plants, using them to inspire imaginative play and art.

Recent funds donated by the Ian Potter Foundation, to celebrate the 10-year anniversary, have enabled us to expand the Gathering Lawn, which includes a small passive water feature nestled under a Banana Forest with extra seating and shade trees for school groups. The funding has provided a new interactive art installation and enhancements to water management as well as existing facilities. Figure 2 shows the design of the Children's Garden.

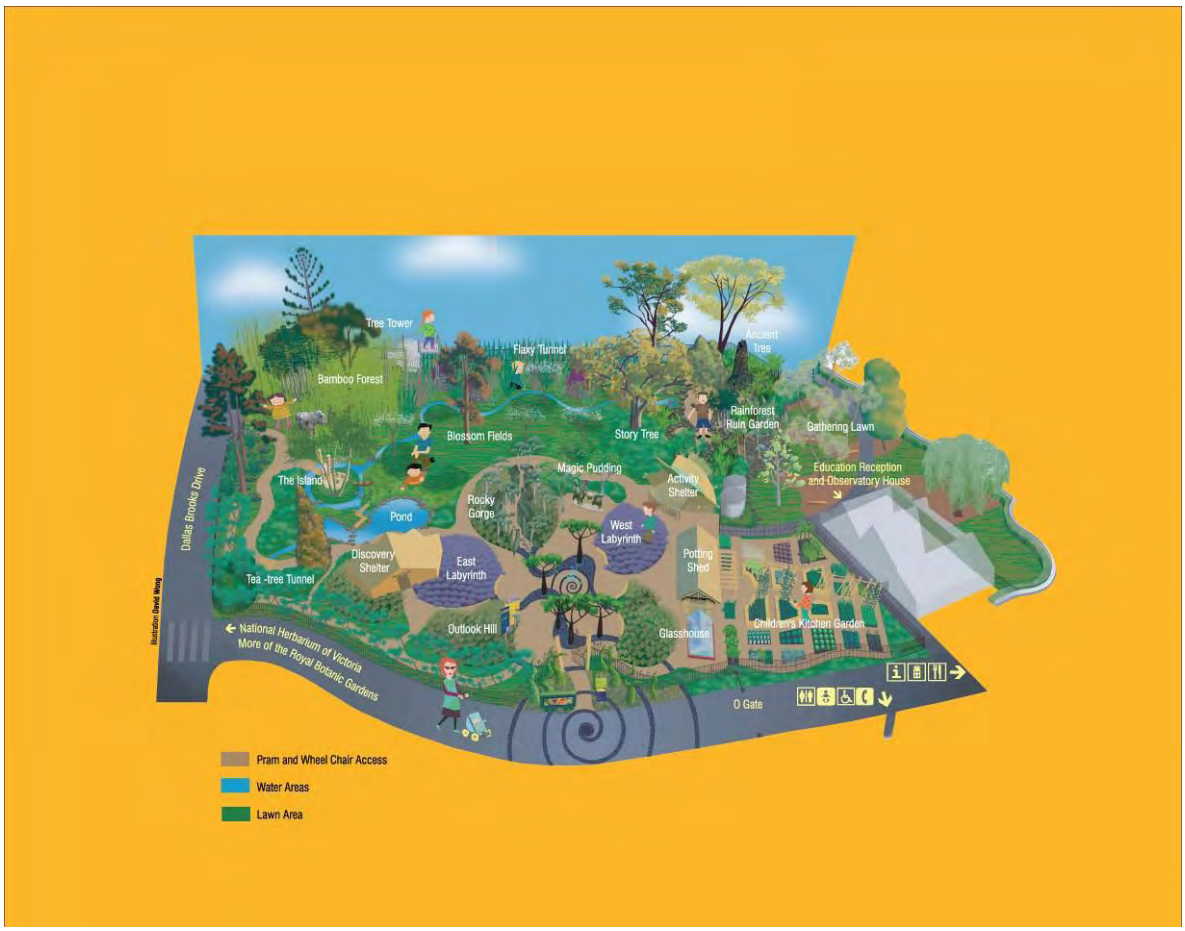


Figure 2: *Map of the Ian Potter Foundation Children's Garden*

COMMUNITY ENGAGEMENT

Public Programs employees believe in connecting children to nature through immersive experiences, taking a child-centred play-based approach. This approach has been taken in program design. *'A child needs to touch the earth and be touched by it'* - Chris Joy, Education Co-ordinator, Royal Botanic Gardens Victoria.

Figures 3 and 4 show how the Children's Garden has grown since opening.

Figure 3: *Opening of the Ian Potter Foundation Children's Garden in 2004*

Figure 4: *The Children's Garden in 2014*

The following gives a snapshot of the visitation and engagement in programs based at the Children's Garden during 2004-2014:

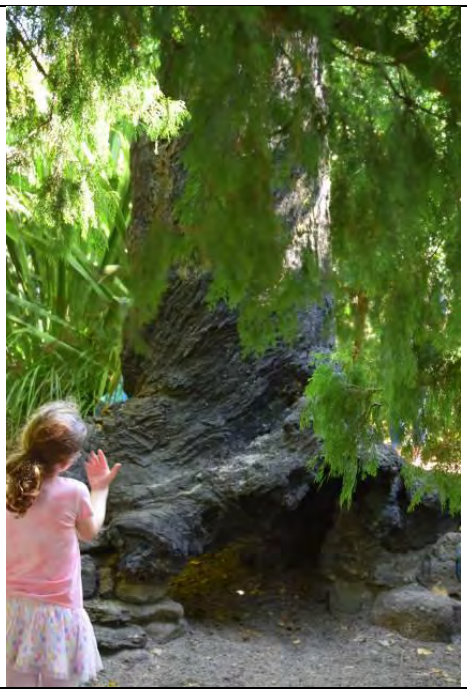
- 3.2 million visitors
- 150,000 students participated in education programs
- 10,000 children participated in visitor programs
- 10,000 teachers participated in professional development.

The Children's Garden has been a gathering place for many years for seminars and workshops for the discourse on Nature Play. Working in partnership with the Kids in Nature Network, holding the inaugural Nature Play Week in 2014, the Royal Botanic Gardens Victoria is breaking ground in the field of Nature Play.

Figures 5 to 10 show some of the many ways children engage in play in the Children's Garden.

Figure 5*: Children enjoying the Spiral Fountain. Water play continues to be a popular activity for children. A lavender mound can be seen at the back of the picture.*

	**Figure 6:** *A child enjoying a boat race down the rill. The boat has been made with natural materials found in the Children's Garden.*
	**Figure 7:** *A child exploring the Bamboo Forest.*
	**Figure 8:** *An educational objective is to partner with schools with a disadvantaged demographic, to provide their students and teachers with a learning opportunity that they would not usually have access to. This picture shows students enjoying the Gardens and our horticultural expertise, with the aim of giving them the tools and inspiration to grow and foster their own garden in their school.*

	**Figure 9:** *Volunteer-led visitor program activities are regularly held in the Children's Garden*
	**Figure 10:** *Children engage with the natural elements of the Children's Garden. For example the Grandmother Tree (River Redgum Eucalyptus camaldulensis) has been used in many different ways. 100s of games have been played here, including Santa coming down the chimney, a bear cave, or a fireplace created with red leaves like fire. This is an example of unstructured, open play.*

LESSONS LEARNED

There have been many lessons learned over the last ten years:

- No 'play equipment'. When the Children's Garden first opened, there were complaints that there was no play equipment. This was a conscious decision, as the Garden was designed to encourage children to interact with the natural world. New things take a while for people to understand, and now no such complaints are received. To illustrate this, a father was once observed watching his toddler move rocks. The toddler was moving them backwards and forwards. 'Who needs toys when you have rocks?' the father said.
- Children need loose plant material, as they understand you shouldn't rip bits off living plants. There is a constant need for plant material, challenging horticultural expectations of tidiness.
- The mud digging pit has been very successful. It is dirt, not sand, so by adding water you get mud. Simple yet effective and many activities are based from here.

- The Children's Garden is so popular that we now have to encourage families to visit the rest of the Garden. Our programming often encourages this.
- All-abilities access was considered when designing the Garden. Not the entire Garden is accessible, approximately 80% of it is. It was decided to take a balanced approach, as designing it to be 100% accessible would cut down on opportunities for others. For example ducking under and climbing on rocks would not have been possible.
- Parents need to be comfortable to allow their children to play. It has been helpful to have coffee and toilet facilities nearby, so then parents will give their children their own time in the Garden.

- Some of the design elements have not worked as expected. For example, the turf mounds were designed for kids to roll down; however their most popular use is as picnic space!

- Water is one of the most popular elements of the Garden. Children love the rill! It is just deep enough to put their feet in, and floating miniature boats and leaves in the rill is very popular.

- Safety. Many safety issues have been taken into consideration, and adapted along the way:

    - Encouraging SunSmart[1] whilst playing in water – this is to address a dual issue of sun protection and dealing sensitively with complaints of nudity. Messages are communicated via signage and face-to-face explanation
    - Water features need to be managed like a public pool, not a water feature. This is to ensure the water is safe for play
    - Adventure vs risk. There is a challenge of providing children with the opportunity to learn decision-making skills when facing risks, whilst ensuring we have a safe environment. A key focus has been safety around the pond near the Discovery Shelter. There is mesh in the pond in deep areas, and a low fence is currently being installed around the pond to increase safety
    - Providing soft surfaces in areas where children may fall.

- Maintaining horticultural integrity. This is a very resource-intensive garden requiring approximately double the time and plant resources as compared to other areas of Melbourne Gardens. There is sophisticated planting in the Garden, botanical integrity in the planting. Plants maintain the landscape and the feel, and there have been many trials to identify plants that have been successful. For example seven different bamboos had been trialled over the years for the Bamboo Forest. With such high traffic, getting the soil structure correct has been key, along with resting the Garden. The Children's Garden is closed for rest during winter for eight-weeks of the year.

SUMMARY

There is no doubt that the Children's Garden delivers on its vision, and we will keep doing this by:

- continuing to work on reducing barriers to visitation
- continuing to partner with like-minded organisations, such as Kids in Nature Network, to promote the importance of nature play
- developing new programs for different audiences
- continuing to seek funding for outreach programs.

[1] *'Sunsmart' is the Victoria State's campaign to minimise rates of skin cancer in Victoria by promoting a suitable level of people's exposure to sunlight, in order to achieve a balance between the harm of ultraviolet radiation exposure and the benefits of vitamin D production [Ed. note].*

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Phenomenological Approaches in Learning with Plants

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Key Words: *Technologies for Engagement and Learning, Teaching and Learning*

LIFE WITH LIVING BEINGS

Human life is embedded in a context of mutualistic interrelations with other living beings, and has always been so. As E.O. Wilson (1996) puts it "*For more than 99 per cent of human history, people have lived in hunter-gatherer bands intimately involved with other organisms. During this period of deep history, and still farther back, into paleohominid times, they depended on exact learned knowledge of crucial aspects of natural history*". It is therefore not surprising that humans show the "*innate tendency to focus on life and lifelike processes*" that Wilson (1984) referred to as "biophilia".

"*As language and culture expanded, humans also used living organisms of diverse kinds as a principal source of metaphor and myth. In short, the brain evolved in a biocentric world, not a machine regulated one*" (Wilson, 1996). In our times however the conscious perception of the complex world and its living beings, and thus our thinking is shaped by the scientific predisposition of modern western scientific thought that is established from early on in formal and informal education.

Human life in our time takes a new turn, towards not only a "science shaped" thinking, but to a science-and technology based experience of the world. The embeddedness in living environments and the continuous encounters with living beings are waning and giving way to an ever more intense involvement with human technology.

WHAT SCIENCE CAN AND CANNOT DO

It is innate to science to be reductionist; in fact, it is indispensable for science to be reductionist, in order to be able to formulate testable hypotheses and thus to make the scientific method and all the insights that result from it possible. Via its particular perspectives and reductionist methods science creates an unambiguous "simplified" research object that is characterized by nothing but its material qualities and its physical properties. In this tradition modern biology basically reduces phenomena of life and living beings to the characteristics of non-living or no-more-living *things*. This turn to the non-living is an expression of a fundamentally Cartesian view of a world consisting of objects that act and react upon each other, with no room for anything that cannot be explained or extrapolated on this basis. Modern natural sciences thus have narrowed and shortened our view and our understanding of "the living" due to focusing mostly onto mechanic and physiological aspects. Modern biology asks the fundamental question: "what is life?" quite as if it was something tangible or at least attached to tangible entities. It is not.

LIFE AND US

Ernst Mayr (2004) emphasizes that, "*…many of the basic problems of Biology simply cannot be solved by a Philosophy as that of Descartes, in which the organism is simply considered a machine*".

"Life" abounds with phenomena that are difficult or impossible for science to explore satisfactorily. Living systems, ranging from a single cell, to ecosystems, or the entirety of "Gaia" is organized in a highly complex manner, with multiple mutual interactions between living and non-living elements. These mutual interactions bring forward phenomena of emergent, fulgurant (Bertalanffy 1968, Lorenz 1978) or oversummative character that cannot be explained from the individual properties and functions of their parts alone, i.e. in a fundamentally Cartesian manner. These are an expression of the characteristic principle of organization of living beings and phenomena: "*The whole is more than the sum of its parts*".

'Living beings' are therefore unpredictable in their behavior. It shows behaviors and properties that cannot be computerized, such as the specific subject-object relation that is only given to living beings, the "ambiguity" of living beings.

There is something else biology as a Cartesian science cannot capture. Modern biology is concerned with "the living", as referring to something that is outwardly observable, and that is shared by all humans, animals, plants and microorganisms, i.e. with the phenomena that would be called in Aristotelian terms as *zoë* (ζωή). It shies away from that aspect of life that Aristotle may have called *bios* (βίος), the inner life and liveliness.

"Life" has more to offer to learning and cognitively and personally developing human beings than what the scientific method can capture straightforwardly. Rather than being exclusively a source of 'data' living beings and our contact and interaction with them make us ourselves "more alive".

THE WORLD WE LIVE IN

In the science of biology, which may be considered a modern epigone of natural history and our ancient intellectual involvement with living nature, this reductionism however has consequences on human life well beyond the scientific domain.

Notably, not only science, but in fact the entire 'anthroposphere' or 'technosphere' created based on science and technology is innately reductionist, as in offering a reduced experience of the living world. Our living environments in the western – and increasingly also eastern – economies are becoming more and more aseptic, predictable, reproducible and everywhere the same in a way that Ritzer (1993) subsumed in the concept of "McDonaldization". The words of Max Frisch (1994) in his 1959 novel *Homo Faber* of Technology as *"the knack of so arranging the world that we don't have to experience it*", have turned out to have been prophetic, and are more appropriate than ever in our digital age.

Even in education such trends can be found ubiquitously. Learning processes are treated and discussed frequently in a suspiciously mechanistic fashion. The "module descriptions" that are demanded in the wake of the European "Bologna Process" of tertiary education reform mirror an attitude as if learning was just "downloading" data – predictable, reproducible and quantifiable.

In 2014 in Europe's largest Education Trade Fair among many hundreds of exhibits only two could be seen that actually presented any tool or product that involved a living organism, while at the same time thousands of electronic tools, and a flood of hardware and educational software were shown. Even biology presented itself here mostly as a "computer science".
Also in non-formal education living beings are on the wane, as impressively illustrated in Richard Louv's 2005 work "Last child in the woods".

PHENOMENOLOGY AS A COMPLEMENTARY ALTERNATIVE

As life in a living environment makes ourselves "more alive", by implication life in a machine-dominated and even machine-made world makes us "more machine-like" too, and in effect leads to an alienation from living beings. This manifests itself in a behavior towards other living beings – including humans – as if they were merely machines too. Approaches to escape from this particular version of a "technology trap" can be offered by a holistic view and a broad, comprehensive understanding of life and living beings that is fundamentally alien to a scientific worldview.
In contrast to the scientific method, methods of phenomenology are focused precisely on those areas of "the living" that are, as addressed above systematically blanked out by modern natural sciences.

- The double nature in a sense of zoë (*ζωή*) and bios (*βίος*)
- Oversummativity
- Specific Subject-object relations

- Ambiguity of “the living”

It is important to note that the views of phenomenology and natural sciences, though contrary in some aspects, are at the same time complementary. For the understanding of “Life” and living beings both views are fundamental and describe from their respective angles only different aspects of “the living” as a total phenomenon.

EDUCATION FOR LIVING AND UNDERSTANDING

It emerges as a challenging task for life science education to re-establish our connection to living beings and “Life” in general in formal and informal processes of learning. Life science education therefore needs to begin questioning the megatrends of digitalization and computer modelling as the main approach to learning about living beings. It needs to develop approaches to re-focus education on the living world in its entirety, and to bring back *living beings* as natural and ever-present elements into learning by employing phenomenological methods and blended learning in life-science teaching and education.

Bringing back living beings in educational context, notably may happen in any class and any subject, quite in parallel to the way living phenomena used to be omnipresent in human life and evolution from our earliest origins on. As Tanner (1971) called for environmental topics to be included and integrated across the entire curriculum, we should today aim at making living beings and living phenomena a part of teaching and instructional processes wherever and whenever possible.

This does not have to – and should not - be limited to formal education. Successful strategies to bring back life into learning need to include bringing back living plants to children's rooms, fostering plant based learning and testing new forms of teaching using the live plants.

In particular in the life sciences we see a particular need for the development of new modules of teaching and learning that are explicitly focused on living organisms in their entirety, and that involve direct interaction with living beings. In our workshop “*Phenomenological Approaches in Learning with Plants*” at the BGCI's 9th International Congress on Education in Botanic Gardens we discussed approaches that have been developed in our group, including combinations of live-plant based tools that aim at overcoming the ever-widening gap between virtual-life and real-life exposure in learning. The tools developed in this work for implementation of phenomenologically oriented teaching and learning in a botanical garden context includes:

- BRYO - a single plant instructional example a tool in teaching and fostering interest in plants that has been developed and tested with 14.000 children in the last two years (Obermaier 2013).
- The bottle garden - a semi closed system suitable for both, primary and secondary school- an element of direct interaction with and taking care of living beings.
- the ecosphere - a closed system, based on similar principles and suitable for secondary schools

As the best illustrative examples in biology are often highly unusual organisms, botanical gardens with their collections offer ideal environments and facilities for phenomenologically oriented teaching and learning.

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APPENDIX- PHOTOGRAPHS FROM CONFERENCE

Figure 1. *Even to expert botanists, as here in our workshop “Phenomenological Approaches in Learning with Plants” at the BGCI's 9th International Congress on Education in Botanic Gardens, plants like Bryophyllum are still a source of wonder.*

Figure 2. *We used the illustrative example of an hourglass (left) – in which "motion" was visible, even though it was not "alive", and a hermit crab (bottom right, hiding in a snail shell), motionless, but living. During the workshop it decided, unpredictable as it suits a living being, to walk across the table.*

Figure 3. *Blended learning. A live plant and a non-living optical and electronic tool as a complementary combination allow an encounter with a living being.*

Bucolic tales for children

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Key Words: *Teaching and Learning, Social Inclusion and Community Engagement*

INTRODUCTION

The Cadereyta Regional Botanic Garden (CRBG) is a small garden located in the State of Querétaro in central Mexico. One of its goals is to teach people about the ecological and economic importance of plant resources of our State. The CRBG is located in the arid zone of Queretaro and Hidalgo, at the southern end of the Chihuahuan Desert. This is a tough environment that shelters an important number of desert endemics. Many of them are represented in the botanical collection of the CRBG (Sánchez and Sanaphre, 2009).

The CRBG receives 20,000 visitors annually. All of them are subject to a programme of environmental education (EEP). This programme uses the scenario provided by the Botanical Garden. Visitors are served according to a basic protocol, centered on guided tours. The main goal of the EEP is to develop a consciousness in the individuals about the environment and its problems. These individuals should take care of the environmental problems and should have appropriate tools to solve them, individually and collectively (Sánchez, 2015a).

THE LEARNING THEORY

Learning theory is constructivist, and is based on principles such as: (1) People learn better participating in their own learning processes, (2) People learn better through direct experiences, (3) People learn better using their senses, (4) A new learning experience is based on a previous one, (5) Each person has particular and unique ways of processing information and experiences, (6) What you discover by yourself generates special encouragement and satisfaction, (7) Clear expectations should be given at the beginning of the learning process (Sánchez and Galindo, 2009; Sánchez et al., 2012).

This programme works with several hundred (3000-4000 per year approximately) of boys and girls from the elementary schools in the municipality of Cadereyta de Montes. The programme seeks to influence them towards a better understanding of our environment, and our role in it. For many of them, especially the younger, more complex concepts can be translated and taught through the use of stories, which we call ‘bucolic’.

BUCOLIC TALES FOR CHILDREN

Bucolic tales are an outstanding educational tool to convey concepts and core values for the development of an environmental ethic that all young humans need to rationalize. The chronological rhetoric of narrations is the basic practice that human beings have to communicate stories. At the botanic garden, the minds of the children attending this unique experience can receive a precise imprint of the central principles and processes of Nature through this kind of story. The stories are adapted narratives that incorporate a bucolic style, in the broadest sense, to describe and assess Nature, ethically and aesthetically. They explain that human beings need Nature, but Nature does not necessarily need us; and that we must engage in dialogue with it.
The benefits of using literary narratives in terms of the environmental education programme may include, among others:

- They allow us to simplify concepts and convey ecological values through metaphors and allegories.
- They generate images that can strengthen the value of Nature in the mind of the youngsters.

- They introduce children to logical thinking and to understanding causes and effects in the operation of Nature.

- They show the value of personal action and foster the development of ideas and concepts about Nature that will underlay future actions.
- They clarify complex concepts, allowing the listeners to reach bio-ethical conclusions.
- They enable the listeners to learn basic ecological interactions, even on an unconscious level.
- They enable the listeners to learn about the aesthetics of Nature.
- They are a child-friendly way of describing landscapes, and comparing urban and rural environments and explaining their mutual dependence.

We repeat that education through simple concepts presented as narratives in the form of stories may have a significant effect on future adult human beings as regards their conduct towards, and respect for, Nature. We would like to mention two examples: The first is a short story called 'Botanizing'. It is the story of a poodle dog and his human friend who visit a botanical garden to learn the scientific names of plants. The human child introduces the most interesting plants and recites to the little poodle a short poem (haiku) for each of them (Sánchez, 2010). This is one of them:

Cardiospermum halicacabum:
"Paper lantern, flashlight:
Illuminate this infinite journey".

Cardiospermum halicacabum is a Sapindaceae species abundant in our botanical garden whose vernacular name is 'paper lantern' ('farolito').

A second example is a long story called 'Shennongjia's Magic Comb' (*Keteleeria davidiana* (Pinaceae) is the species from which the Shennongjia's magic comb is made of). It has as its central theme the importance of the mystic assets that the trees give us to preserve the order of the world in which we live. Due to the extinction of a special type of tree which produces a fragrant wood that allows the preservation of this order in her land, Daniela, the protagonist girl, embarks on a journey to obtain a magic comb that will allow her to recover this order. This so-called order is the idea of the conservation of plant species. She learns during the trip that human values such as effort, sacrifice, patience, temperance, and joy are essential to formulate ideas for the protection of the flora. The setting of the story describes a route between Mexico and the sacred mountains of Shennongjia in China. This device allows the story to describe many landscapes along the journey and some of their most representative plants and animals. The story ends with the conclusion that is the handling of Nature with clear ideas which will allow its conservation and ensure ecological stability.

A fragment of this story talks about the importance of the benefits of Nature: "Just as they leave the thick Metasequoia forest, they could observe the purple mountain, the highest peak of the region, the site, where it is said, many years ago, God Shennon, sacrificed himself to solve the problems of men. His immolation produced medicinal, healing plants and supplies that human beings have used, for centuries, to live happily. That peak was Shennongjia" (Sánchez, 2015b) (Figure 1). Many names of species of trees and plants in Mexico and China are mentioned throughout the narrative, with the desire that the audience becomes familiar with them.

Figure 1: *Illustration from 'Shennongjia's Magic Comb'*

Some of these stories have been included in digital material widely distributed in schools and others will be read in educational trials that will be added to the routine practices of the EEP of the CRBG.

CONCLUSION

We propose that basic ecological concepts important to understanding Nature in our land are translated into bucolic tales and broadcasted among children population of Mexico. This can be achieved through the newly created network for science popularization of our State (Querétaro) and simultaneously with the help of environmental education centers that exist in the more than 40 botanical gardens of Mexico.

We believe that this can promote a culture of greater environmental literacy, as a means to achieve sustainability and environmental governance. To educate about Nature, naturalize education.

ACKNOWLEDGEMENTS

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The role of the Mexican Association of Botanical Gardens in the Conservation of Mexican threatened flora.

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Key Words: *Teaching and Learning, Social Inclusion and Community Engagement*

Mexico is a country with an exceptional biological diversity, expressed in a wide variety of ecosystems. It is one of the most diverse countries worldwide from a biological standpoint. Its geographic location and complex geological history, among other key factors, has led to a varied arrangement of conditions that have enabled the coexistence of biological elements of multiple origins. According to CONABIO (2008), nearly 30,000 species of vascular plant have been identified in Mexico, meaning the country has one of the largest collections of vascular plants. It is estimated that 40-60% of the plants recorded are endemic to Mexico.

However, Mexico also faces important challenges regarding the amount of knowledge it has about its plant diversity as well as how to conserve it. There is yet to be a complete picture of Mexico's national flora with data on species and their numbers still not known. Current field collections and data of flora species remains uneven along the nation and the number of taxonomists and specialists is not enough to cope with the task of listing and describing new species.

Mexican plant diversity faces other types of challenges as well. As a result of its demographic growth, Mexico has transformed and disrupted its original ecosystems to a significant extent, and the remaining natural vegetation shows evident signs of deterioration. Changes in land use have important effects on biodiversity such as the loss of and modification of ecosystems and the fragmentation of remaining natural vegetation. Invasive species affect native plant species as well. Another activity that threatens plant diversity is illegal wildlife exploitation through collection, transportation and trade of wildlife specimens. Last but not least, global climate changes are among the most important stress factors that compromise the persistence of ecosystems and species in Mexico and worldwide (SEMARNAT, 2008).

Mexico has conservation policies, laws, lists and international agreements to cope with the tasks and challenges of biodiversity. Among the most important legal instruments, we can mention the following:

- Laws on the subject of knowledge, conservation and management of plants: Federal Plant Health Law (1994), General Law of Ecological Equilibrium and Environmental Protection (1998), General Wildlife Law (2000), Federal Law of Plant Variety (2007).
- The National Standard NOM-059-SEMARNAT-2010 lists the plant and animal species and subspecies which are categorized as threatened. According to this standard, plants currently represent the taxonomic group with the largest number of threatened species (both angiosperms and gymnosperms). Among them, families with the largest number of threatened species are Cactaceae (244 species), Orchidacae (188 species), Palmae (64) and Agavaceae species (39 species).
- The Priority List of Species and Populations was released in 2014. It is a compendium of threatened, umbrella, flag and charismatic species to optimize efforts and maximize conservation outcomes. Species in this list are of strategic importance for the conservation of other species and habitats, or for the maintenance of the ecosystem structure and functions; they can also be endemic or threatened, or have a very clear social, cultural or economic interest.
- The system of Protected Natural Areas (ANP in Spanish) has been the main *in situ* conservation strategy in response to the destruction of natural ecosystems since the past century These are either terrestrial or aquatic areas representative of a number of ecosystems, where the original environment has not been significantly altered as a result of human activity and which provide several types of environmental services, even hosting relevant natural resources.

- The system of Management Units for Wildlife Conservation (UMA in Spanish) was created in 1997, aiming to contribute to the promotion of biodiversity conservation while addressing the production and socioeconomic development needs in the rural sector. Its main objective is the conservation of natural habitats and environmental services. UMAs are pieces of land that can be either private, communal or ejidal.
- The National System for Conservation of Genetic Resources coordinates actions between research institutes and producers, to ensure conservation and sustainable management of selected crops and wild species.

Mexico has also signed several international treaties and agreements:

- Convention on International Trade in Endangered Species of Wild Fauna and Flora (1973).
- Ramsar Convention on Wetlands (1975)
- The Convention on Biological Diversity (1992)
- The Global Strategy for Plant Conservation (2002)
- The Cartagena Protocol on Biosafety (2010)
- The Aichi Nagoya COP10 (2010)

The commitments made with these signatures have lead the nation to build and divulgate its own national instruments of conservation, for instance, the Mexican Strategy for Plant Conservation (EMCV, in Spanish) (CONABIO, 2012).

EMCV is based in six main objectives: (1) Generation and transmission of knowledge; (2) *Ex situ* and *in situ* conservation, (3) Ecological restoration, (4) Prevention and control of threats, (5) Sustainable use and (6) Environmental education. The actions stated in the strategy are designed to understand, preserve, encourage sustainable use, educate and build capacities to preserve plant diversity. Mexican Botanical Gardens are considered among the main actors to develop specific tasks in order to achieve goals and objectives of the EMCV.

Within this panorama, the Mexican Association of Botanical Gardens (AMJB, in Spanish) is a key organization for the reinforcement of plant conservation tasks. The AMJB consists of 63 members in 25 states and its main objectives are: (1) To integrate all Mexican Botanical Gardens, promoting collaboration among them; (2) To promote the creation of new Botanical Gardens across the nation, so they can serve as information reservoirs; (3) To promote the study of, *in situ* and *ex situ* conservation and the sustainable use of Mexican plant diversity, linking to traditional knowledge; (4) To create divulgation and environmental education programs, and (5) To partner with other national and international similar associations.

Objective number three is being developed by the members of the AMJB: They preserve in *ex situ* 4,826 native species. Of these, 441 are mentioned as threatened in the NOM-059-SEMARNAT-2010. 354 species are listed in the IUCN Red List, and 990 in the CITES Appendices. Mexican botanic gardens are also developing propagation protocols and reproducing 900 plant species. Of these, 187 species are currently facing threats to their survival (Caballero, 2012).

Moreover, plants in living collections are an essential component for the environmental education activities at botanical gardens. The approach to environmental education has evolved over time, and has transformed itself from being, to most unattainable, to an outdoor classroom, not just only for botanists or researchers, but for the entire society. Collections and propagated plants are an important tool in all Mexican botanic gardens for the development of divulgation and education programs which will raise public awareness about the importance of plant diversity and its conservation. This is the way in which AMJB members are developing its objective number four.

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Health care project- Enhancing suitable food production and food security

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Key words: *Social Inclusion and Community Engagement, Teaching and Learning*

INTRODUCTION

University of Maribor Botanic Garden with partners presents the results and integration of the recent project 'Health Care NE' in education programs for elementary school groups. The project focuses on raising the awareness, knowledge, attitudes, and acceptance of agrobiodiversity and extends the classical guided tours of the garden towards sustainable food production and food consumption.

In transnational cooperation we developed four modules covering: ecological food production (organic farming); sustainable food consumption; the importance of biodiversity and recognizing sustainable food - labeling. Through the project a demonstration garden in Slovenia and a demonstration farm in Austria became further integrated in an already existing system of education. Workshops provided material for activities based on experimental and multi-sensory learning (visual, auditive, olfactoric, gustatory, tactile), which included a variety of evaluated games based on a theoretical background.

This project is special because of its transnational and interdisciplinary cooperation in developing modules for teaching biodiversity.

PARTNERS IN THE PROJECT

- Leading partner: Bio Ernte Steiermark from Austria is a network, connecting food production with marketing, politics, economy and media. It is represents a team of consultants, specialists in different fields.
- University of Maribor, Slovenia: Faculty for Agriculture and Life Sciences, department for organic farming with the University of Maribor botanic garden
- Institute for control and certification Slovenia, one out of three certification organs in Slovenia
- Central institute for meteorology and geodynamics, Austria

THE PROJECT

In the Health Care Project, which was based on transnational cooperation, we focused on raising awareness and acceptance of agrobiodiversity. In order to promote agrobiodiversity education programs and new demonstration gardens were created.

Module 1: Good for environment – good for me

The module demonstrates organic farming as an ideal way of food production. It also includes general environmental issues by stressing the importance of climate protection, saving water and soil. A wider look at other farming issues is also covered with a detailed look at the relevance of the choice of animal breeds for farmers; GM free food production; and the importance of food safety by eco–control systems.

Figure 1. *One of the projects demonstartion sites.*

Module 2: Our food – our future
The module introduces: lacto–vegetable, organic grown foods; the choice of regional and seasonal produce; environmentaly friendly packaging; fairtrade, and presents the importance of eating with pleasure.

Figure 2. *Food farmed by the project and used in module 2 classes.*

Module 3: Organic production protects the environment
The module explains: what the benefits are of organic growing versus conventional; comparing biodiversity; carbon and water footprints, and soil fertilty.

Figure 3. *Children taking part in one of the planting activites of the project*

Module 4: Labelling – I Know What I Eat
The module explains the importance of labelling organically grown products and introduces the symbols for organically grown products in Slovenia, Europe and some other countries worldwide.

GAMES
With every module various games and practical tasks for childern were created. Some of them have become more popular than others with schools. Children are encouraged to work in pairs or small groups and what they learn, they share with other children in the bigger group. Popular tasks are: analizing their lunch, where it comes from; comparing traditional and ecological farming; preparing a meal using fresh produce from the vegetable garden and working with seeds as well as planting and simple gardening tasks.

RESULTS
During the project, four educational modules were developed: ecological food production (organic farming); sustainable food consumption; the importance of biodiversity and recognising sustainable food (labelling). Demonstration gardens were planted to teach the modules. Two excursions were organized: austrian partners visited Slovenia and Slovenian partners visited Austria. In both cases students were present and at the same time evaluation was carried out.

Workshops for school childern (6th and 9th grade) were organized and more evaluation was carried out. A collabrative website was created in both countries languages, with all information on the project including teaching resources.

At the Faculty for Agriculture and Life Sciences International Biosimposium, the project finalised and all papers from all partners were presented to teachers and interested public members. A short educational film was made and it was presented at the Biosimposium. The film describes all the key elements the project was based on, which make the circle of organic farming and food production: SOIL – PLANTS – ANIMALS – PEOPLE.
Papers are also availble in paper edition of lecture collection.

DISSCUSION
The modules provide materials for workshops based on experimental and multi-sensory learning (visual, auditory, olfactory, gustatory, tactile), and also include a variety of evaluated games to be used for the

teaching and learning of biodiversity with children. New demonstration objects were created and integrated in a bigger system to ensure future maintenance: in Austria a demonstration farm is integrated in an already existing agricultural school and in Slovenia, a demonstration garden is integrated in Maribor University Botanic garden. It offers an interesting and valuable addition to the existing plant collections and gives many opportunities for new practical demonstrations to the public.

For biodiversity promotion it is important, that it is based on transnational and interdisciplinary cooperation. The Health Care Project was partly funded by European Union in European territorial cooperation.

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Science and education at the Vilnius University Botanical Garden

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Vilnius University Botanical Garden, Lithuania
Key Words: *Science Communication, Teaching and Learning*

Vilnius University Botanical Garden (VU BG) started its activity in 1781. The VU BG was founded by the French professor J. E. Gilibert, as a part of the Department of Nature History of Vilnius University. It was the first scientific institution of nature science in Lithuania. The most flourishing time of the Botanic Garden was the first half of the nineteenth century, when thousands of plants from over the world flourished in the Garden and it became known as a famous centre of botany knowledge in Lithuania and the surrounding countries. Sadly, this successful period of the Garden's existence was interrupted by big geopolitical changes in Eastern Europe. A new period of rebirth for the Garden started only in the twentieth century. The VU BG is now situated in two places: in the central part of Vilnius city – Vingis Park – since 1919, on the outskirts of Vilnius city – and Kairenai – since 1974. VU BG has a big area (199 ha) with a beautiful landscape that includes archaeological and architectural monuments, and indigenous and introduced flora (more than 10000 taxa). It is possible to develop educational programs because of a number of factors: the large number of native Lithuanian flora exhibited (the different ecological conditions in the Garden allow 30 % of native Lithuanian flora species to grow), our plant collections, the Garden's facilities and our traditional and non-traditional horticultural exhibits. Nowadays the main reasons why people in thousands every year visit our BG are the plant collections, our educational, cultural activities and the attractiveness of our scientific work.

For many years VU BG has been active as a scientific and an educational institution. Scientific activity is focused in the Department of Scientific Programs, with main research areas: introduction and investigation of ornamental and horticulture plants; the collection, assessment and conservation of plant genetic resources; plant molecular taxonomy; genetic polymorphism, genetic instability of plants; biotechnology of cultivation and reproduction; micro propagation *in vitro;* phytopathology, and mycorrhizal fungi diversity. The scientists collaborate very closely with colleagues from other departments of VU to carry out scientific programmes as well as educating the general public. Research into the indigenous flora growing within all territory of the BG was carried out in close collaboration with botanists of the Faculty of Natural Sciences. 483 species of different plants from 82 plant families were described.

In 2004 an educational trail for native flora was established as result of this work. This trail is very popular among visitors now. In 2008 an information system and special education stands were created to tell visitors about each of the habitats featured in the Garden – dry slope, pond, overgrown pond, wetland forest, broadleaf forest and pine forest habitats (Figure 1). Most of the plants have labels that give their taxonomic and Lithuanian names and some of their characteristics. Everyone can find poisonous, medicinal, fragrant and plants used for dyeing. In 2004 a display of plants used in soil improvement was established, in collaboration with specialists of public agency for soil remediation technologies. This display includes 58 species of indigenous flora representatives, 11 vegetable species, barley mutants, sunflowers and maize (Ryliskis and Zilinskaite, 2014).

VU BG's experimental fields, some specialized core collections and laboratory are open only for students of high schools, scientists and other professionals. But the results of our researches are always presented to stakeholders and task groups, especially if results of researches are intended to have a practical application. For example, the results of the investigation of mycorrhizal influence on the growing of new forest plantations were presented to 200 Lithuanian forest owners, and the results of the investigation of diseases

of the genus *Tulipa* L. were presented to 200 farmers.

The general public can visit this department a few times per year during particular events: the International Biodiversity Day (since 2002), Researcher's Night (since 2009), Spaceship Earth (since 2007) and Berries of

Figure 1: *Education route – the natural habitats of Lithuanian flora at the VU BG*

Autumn (since 2007). At those events, visitors get answers to many questions through behind-the-scenes guided tours, hands-on experiments or workshops. We want to make botanical education as attractive as possible to our different audiences, for the general public, for children, for seniors, for non-professionals, without it being too serious or boring The first example is where young people produced their own micro-plants in the laboratory (Figure 2). They are so proud after one hour of such serious work and they now have a better understanding of the life of every plant. The second example was to produce an extraction of DNA from fresh young leaves and to see the process of its generation (Figure 3). It is so exciting for teenagers, even if they are totally bored with everything in adult life. Plants producing fruits could be more interesting, attractive and tasty for everyone. Maybe, except some of them, like the fresh fruits of Japanese quince (*Chaenomeles japonica*).

Figure 2: *Propagation in vitro (Researcher's Night festival)*

Figure 3: *DNA extraction from fresh young leaves (Researcher's Night festival*

During last few years public interest in the educational possibilities of the VU BG has grown very significantly. Today the VU BG has collaborated with other organizations, including governmental organizations for non-formal education of adults, schoolchildren, public body enterprises and private businesses. This collaboration has resulted in the organizing of a lot of educational events: public lectures, workshops, training courses, guided tours, academic events (as Researcher Night, Spaceship Earth), exhibitions, fairs etc. The target audiences for these events included the youngest groups (the 2014 competition "My green window", which engaged more than 600 kindergarten groups and 136 school classes) and schoolteachers (the "Green spaces for education and training process: the dissemination of

good practice" conferences held in 2013 and 2014 at the VU BG).

The aim was to share with schoolteachers the best national and international experience. The VU BG staff are very active in disseminating results of their work: popular publications, TV and radio interviews, consultations, web sites, on line databases for researches and visitors: the ECPGR *Ribes* and *Rubus* Database http://projektai.vu.lt/ribes-rubus/ (managed by the IPGRI and ECPGR request); the VU BG plant's database ("Index Plantarum" of Vinius University Botanical Garden) http://botsodas.lt/indexplantarum (Lithuanian and English-language versions available); and the Database of Latin-Lithuanian names of woody plants http://www.botanikos-sodas.vu.lt/lt/nuorodos/vardynai (Zilinskaite and Skridaila, 2014). All these facilities are useful not only to educate large number of target audiences but also help us to develop our public relationships.

Finally, looking to the future, we are preparing some new projects for the development of the multifunctional infrastructure of the Garden, with the aim of bringing together the research and educational work of the Garden.

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Engaging your community: who's missing from your garden?

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Brooklyn Botanic Garden
Key Words: *Social Inclusion and Community Engagement, Strategy and Future Vision for Greater Impact and Change*

SESSION STRUCTURE
Delegates from botanical gardens all over the world convened for a 'World Café' session that lived up to its name. The topic under discussion was how to draw visitors and program participants that reflect the full diversity of the surrounding community into a botanical garden . The World Café session was held on the last night of the Congress, Thursday, April 30, from 8:40-9:40 p.m. at the Missouri History Museum. Delegates had already attended twelve hours of Congress sessions and activities by the time the Café began, but the long day did not deter 55 participants from engaging in meaningful conversations on a topic of great interest to them.

A World Café format relies on stimulating questions, small group conversations, and networking to elicit the collective wisdom and creativity of participants in order to address a challenge put before them. To this end, a large room at the Museum was set up with many small tables for four. Lights were dimmed, and tables were covered with large sheets of white paper and colorful markers. The café ambience was made complete with cut flowers and chocolate snacks. As delegates entered the room, they were asked to make full groups of four rather than spreading out at incomplete tables or enlarging groups with additional chairs.

Three key questions were explored, one at a time, in three successive rounds of conversation. Each key question defined an overarching topic, and numerous related questions were supplied to stimulate deeper discussion and invite exploration in a number of different directions, depending on individual interest. Participants were encouraged to write, draw, or otherwise diagram their discussion on the table-tops to capture the flow of conversation and share ideas with newcomers as they moved from one table to the next. Initial table groupings were maintained throughout question one and midway into discussion of the second question. At this point, two people from each table moved to another group, while two people stayed behind and welcomed their newcomers. Question two discussions continued and question three was completed in the new table groupings.

At the end of the café, all participants recorded one or more take-away ideas on large post-it notes, displayed on the outer walls of the room. A brief Town Hall session permitted whole-group sharing via a handheld microphone. The session concluded with a Gallery Walk around the outer walls to read the big ideas that had been captured on post-it notes. The three sets of questions given to participants are described below, along with representative table-top comments and summary remarks culled from the Gallery Walk.

ASSESSMENT OF VISITOR DEMOGRAPHICS
The first guiding question and related discussion prompts asked participants to describe the composition of their community and compare it to a profile of their garden's visitors:

How well do your garden's visitors and program participants reflect the surrounding community?

- What demographic factors can be used to describe a community? (Age, gender, race or ethnicity, income, education etc) Do you know the statistical composition of your community, or of particular segments of it? Where can you get accurate data to check your assumptions?

- Have you gathered demographic information on your garden's visitors or program participants? What methods did you use? Is some information harder to collect than other types of data? What did you learn about your visitors? Which sectors of your community are not proportionately engaging with your garden? What target populations would you most like to reach?

- Which community descriptors are most central to an individual's sense of identity? A community may also be described by affinity or interests (sports fans, musicians, gardeners etc.). Which are most relevant to you in planning education programs? Have you used common interests to draw a wider spectrum of your community?

In most conversations, specific cohorts of visitors/program participants were described (such as "teens" or "seniors") that botanic garden staff were aware of as frequent visitors. It seemed that most gardens had a sense of who is coming but also a sense of who is not coming, based on their awareness of the demographics of their gardens' communities. Comments collected from table-top notes and summary statements at the end of the café strongly supported the notion that gardens need to collect and analyze visitor data and information about their community to assess which segments of the community they are or are not engaging.

Comments

- *Find out: Who actually comes and why? Who doesn't come and why? … and, Should we care or do something about it?*

- *Look for new audiences ... Visitor studies are key! ... Find ways to bring more families to botanic gardens.*

- *School is a time to engage all groups from the society, but how can we maintain their contact with the Garden when they become adults/parents/seniors?*

- *Know who is <u>not</u> coming in order to most effectively build strategies to engage them – need for <u>data</u>, not assumptions.*

- *We can't serve <u>everyone</u>! Look to our mission and communities to prioritize.*

IDENTIFYING PARTICIPATION BARRIERS

The second set of questions given to participants encouraged them to focus on one or more target audiences that are underrepresented at their gardens, and to explore the various types of barriers that may deter visits.

What barriers may exist that limit garden visits or program participation by a specific target audience?

- What issues would you expect to be barriers for this audience? (Financial, work schedules, lack of interest, perceptions, ...) Have you had a personal experience where you visited a garden or museum and did not feel included or welcome?

- How can you check your assumptions about a target audience? What challenges do you have in gathering this information? Have you had success with community surveys or focus groups? Are there community advocates that can help you make a connection?

A number of café participants listed barriers which diminish garden attendance by specific audience groups. Barriers that were most often identified were:

- Perception: do community members perceive that whoever is in the botanic garden is not 'them'? Do they ask 'is it for me'? This seemed like a key concern during this phase of the café conversation stream and a concern central to the café theme.
- Access: this was interpreted in various ways, including practical ones such as whether the garden is accessible via available and affordable transportation
- 'Don't feel welcome'; this phrase appeared several times
- Cost of entry to botanic garden; price
- Cost of travel to the botanic garden
- Lack of awareness
- Lack of interest
- Work schedules.

COMMENTS
Summary comments also captured some higher-order questions about identifying participation barriers including the following:

- *Realize that other venues may trump gardens: libraries, hospital/health, sports.*
- *Check assumptions through focus groups, social media.*
- *Determining community needs… who defines that and how?*
- *Do they not know we exist? OR Do they know and don't care?*

OVERCOMING BARRIERS TO ENGAGING NEW AUDIENCES
The final round of questions prompted creative thinking about how to overcome participation barriers for a particular garden or program, as well as deeper thinking about how garden education relates to the overall mission of the garden.

How can you overcome participation barriers to engage your target audience?

- What would it take for the garden to meet their needs? If the barrier is physical or logistical, what resources might be available to overcome it? (Scholarships, transportation, creative scheduling, ...) What is driving your motivation to reach this audience? Who has the authority to make the decisions necessary to change? How can you influence the outcome?
- When barriers are social or cultural, what needs to change within the garden to reach your audience? Can your target audience relate to your staff or volunteers? Are you providing a venue for members of a particular community to interact and bond with each other? Is there an opportunity to draw diverse populations together to share a common experience?
- Can you meet your program goals and the needs of your audience at the same time? What are you trying to accomplish with a particular program? Why does it matter? If you think about your mission at a higher level – the ultimate goals behind your programmatic goals – does it create freedom to develop a different kind of program than you had in mind? What happens if you set aside your expectations about the program structure and brainstorm

new ways to reach your ultimate goals?

COMMENTS

Not surprisingly, the majority of participants' comments collected at the end of the session related to this area of discussion. Again, the comments ranged from specific ideas to engage new audiences, to broader topics of how priorities are set and where education fits into a garden's array of interactions with their community. Were our gardens founded with the intent to serve their communities? Do our gardens address 'community' in our mission statements? Is it essential to ensure access for its own sake, because it's better for our gardens, or because of the local and global environmental issues our planet faces?

- *Botanical gardens must be connected to the community and the people. They must see it as their own and make it grow.*
- *The materials we produce and programming we offer are put together by people who largely resemble our attendees. If we want to reach new communities, we must involve them in development of programming and materials rather than presuming that we know what they want/need.*

- *Develop Strategic Plan & Mission first before outreach.*

- *High-ticket prices are a barrier to low-income families; providing a family rate or having discounted ticket days might reach out to those that are usually unable to visit. Even getting them through the gate once might leave a lasting impression on their view of the importance of botanic gardens.*

- *Bring music, arts, and culture into the garden even if your mission is to promote plants. Don't be afraid to do this since it can help support your goals and bring new audiences to you.*
- *Link plant conservation and local issues/concerns.*
- *Need to get out of our gardens and talk to our communities about that THEY WANT – co-production of programs.*
- *Establish a young adult group to act as advisory for public support and fundraising –just to get that age group involved.*

- *To overcome barriers, you must know your audience really well. Get to know your audience personally before trying to teach them... Recognize the strengths of our visitors. Earn the trust of the community.*
- *Break down preconceptions of botanic gardens being only for the elite. Find role models/spokespersons to show kids and underserved groups that botanic gardens are cool; they're worth visiting and learning about.*
- *Look outside your comfort zone and welcome innovation and change.*
- *Invite a leader of the community you'd like to attract to be on your board.*
- *Botanic gardens need a new business model: historically elite and perhaps arrogant; unaware of the community and how they might support and serve local audiences.*

- *There's a gap between programs and member audiences… programs are designed for diversity, visitor base is not... Need understanding/commitment from senior management. It's not always about money or the bottom line.*

CONCLUSIONS

Reading through the thoughts shared during this cycle of the Café, it appears that most participants believed their gardens are not engaging the full spectrum of their community, they want to change that,

and in general they believe the approach to doing so requires a combination of community outreach and communication, learning about the interests of the community, and finding synergy with existing garden resources or developing new resources in response to community interests. Making changes or additions to garden staff and governing bodies to achieve deeper community engagement was often mentioned. Our collective comments, ideas, and reflections speak to a desire to see the diversity of our communities reflected in the range of our visitors and program participants.

How to involve the public with innovative activities

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Shanghai Chenshan Botanical Garden
Key Words: *Teaching and Learning, Strategy and Future Vision for Greater Impact and Change*

Shanghai is a large international city, one of the most important in the world with more than 25 million inhabitants. The development of Shanghai is absolutely fascinating and the GDP is ever increasing! It is easy to contemplate the importance of a botanical garden in such a huge city! Although we can say Shanghai is a green city (with many parks, a lot of urban trees, plantation along highway, etc), like any highly urbanized area real contact with nature is lacking.

In 2005, the Shanghai Municipal Government, the Chinese Academy of Science (CAS) and the State Forestry Service together decided to establish a major new botanical garden in Shanghai's fast-growing western suburbs. This landmark project was associated with the Shanghai Expo so the garden had to be ready for May 2010. The three stakeholders expected the new garden to meet a variety of needs, Chenshan would need to: represent the vegetation of Eastern China; put emphasis on endangered plants; carry out research in conservation and sustainable products; build comprehensive education programs and provide an attractive, modern landscape for visitors. Since its opening in Spring 2010, more than 3 million visitors have crossed the gate of which, 15 % were children!

The garden is quite large with 207 hectares, 26 theme gardens and a plant collection presented to the public of around 10,000 taxa from which 3,000 species represent Eastern China flora. The garden is surrounded by a green-belt but this green-belt is not only the "internal-external" boundary of Chenshan but also a unique landscape space which leads to the mountain-water landscape in the center of the garden. The green-belt is also a display area, showing plants from Europe, Africa, North-America and Australia. Its mission is clear and simple: "*To conserve the plants of Eastern China, discover sustainable ways of using them, and share our knowledge and enthusiasm with the public*".

What could be the role of a botanical garden in a city, or moreover, in a country with such huge economic development? Where everyone wants to improve their quality of life by mass consumption! Where everyone wants to own their own car!

The answer is not easy because, in the western world, we have followed the same practices since the middle of the last century! But at the same time, the Chinese Government is really concerned about the big environmental problems in China: air, soil and water! For example, China is today the biggest electric wind mill energy producer in the world. Things are changing fast in China! Botanic gardens can play a unique, influential role in change by simply bringing people to the garden; allowing them to have contact with plants and "nature". Gardens can also provide visitors stress relief and relaxation whilst allowing them to find refuge from crowds, hard work and technology.

At Chenshan, as it mentioned in our "2015-2020 Strategic Plan", our target group is kids and teenagers, but indirectly, through our activities with kids, parents are most of the time present, and participate in the programme. The programmes are always interactive. For example, during our International Orchid Show, kids were involved in hands on activities such as, drawing, paper collage, etc. They often perform in front of the public and visitors! They are proud of their achievements and so are the parents!

On the National Day holiday, a very crowded day, the programmes are related to what the children eat, for example, they look at onion cells under a microscope, of which they are fascinated by! Sometimes, it's

more educational, sometimes it is more fun!

For teenagers, we organised once a year an "Education Forum" with our researchers. They give lectures and teenagers ask questions. The forum focuses on the uses of plants; medicinal, food, energy and very little on horticulture; as teenagers want to know more about what kind of plants are good for their health. Teenagers are in a key stage of their lives where they are open to accepting new things, so it is certainly the best time for them to expereincescience education. We believe botanical gardens are an important outside school base and need to explore and implement education strategy for teenagers, to cultivate their emotion attachment to nature and to improve their environmental awareness . (He, 2013)

For younger ages the children's garden is point of education activities. The area is currently receiving important improvements with the addition of new equipment and attractions. Recently, in collaboration with Shanghai Zoo, we introduced some animals like lamas, wild pigs and peacocks which have been big success! Certainly one of the best attractions in the garden at the moment! Last year we opened a "Tree House" on a small island within the garden, to focus upon educating about the importance of trees.. (Picture 1).

In the digital age, consideration needs to be paid to how to share knowledge effectively. Therefore, over the last few years, we put a lot of effort in to implementing new technology such as QR code, applications for mobile phones, microblog, etc. The 33rd Report on Internet development published but the China Internet Network Information Center, showed that as of January 2014, the number of internet users in China has reached 610 million meaning more than 45% of the population (Zhang, 1014). However, the education team made the statement recently that, for the moment, all those technologies such as "Apps" and QR Code are not as useful as we thought few years ago. For that reason we have decided to slow down the development of new applications. Like most botanic gardens, we do education on site and for us, it is most probably the best way to transmit information in a garden. Human contact is certainly better than any electronic devices! Contact with plants, gardens, nature, is the most effective way to appreciate, respect, and protect the planet!

Recently, Wassenberg *et al*. (2015) published a paper on what are the benefits of visiting a Botanical Garden and why visitor comes to a botanic garden by using the means-end theory, which is commonly used in marketing and retail to link the attributes, consequences and values of a product. This study revealed that visitors felt that the "botanic garden" ,"plants" and "activities" were the most meaningful attributes, which led to: "new experiences and learning"; "stress relief and relaxation"; "transference" and "improved quality of life".

In that sense, Chenshan Botanical Garden, located in one of the most densely populated cities in the world tries to reach a good balance between education and a wide range of leisure activities, not nessecarily linked with specific horticulture interests !

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Picture 1 : The “Tree house” : A very well integrated installation appreciated by kids.

BiodiverseCity St. Louis: Cultivating Community Partnerships
(Panel discussion – Friday, May 1, 2015)

Sheila Voss
Missouri Botanical Garden
Key Words: *Technologies For Engagement And Learning, Social Inclusion And Community Engagement*

How does a community come to value biodiversity? Really value it in ways that manifest in their personal behaviors and routines, consumer choices, lifestyle habits, values, and world views. How does this happen, who is involved, under what conditions, and over what period of time? How does this happen in heavily populated and developed urban areas where biodiversity isn't even on the radar, where peoples' lives and livelihoods are primarily spent indoors or commuting in vehicles, literally and figuratively separated from the nearby nature that makes their livelihoods possible. Why would a community struggling with civil strife, racial tensions, income inequality, social justice, chronic health issues, public school systems challenges, and declining populations cite biodiversity conservation as something to rally its citizens around (Sobel, 2004)? This panel, comprised of leaders and decision-makers from Missouri Botanical Garden, Missouri Department of Conservation, and the City of St. Louis, addressed these questions and more in the session *BiodiverseCity St. Louis: Cultivating Community Partnerships*.

The panel session began with context and background provided by Deborah Frank, Vice President of Sustainability for the Garden. Launched by the Garden in 2012, BiodiverseCity St. Louis is a network of organizations and individuals from across the greater St. Louis bi-state area, encompassing the City of St. Louis and 16 counties, home to nearly 3 million people. While the Garden had been active for decades in local St. Louis conservation and environmental stewardship efforts (ex: Deer Creek Watershed Alliance), there was a desire to achieve greater impact on a greater scale. Influenced by his formative years spent botanizing the flora of inner city Dublin and co-developing a Biodiversity Action Plan for the once-blighted Ballymun area, Dr. Peter Wyse Jackson, soon after joining the Garden as President, convened a community summit in 2012. At this summit, he invited a diversity of stakeholders from throughout the region to come together with focused intent to think critically about the state of biodiversity in the St. Louis region, to share their current work and priorities, to discuss the most pressing threats and challenges to local biodiversity, and most importantly, to come together around a shared vision of a more biodiverse St. Louis, a healthier, more vibrant, and resilient St. Louis.

Following the summit, the Garden embraced its role as forum and central hub for this network of stakeholders, which has grown to include more than 100 organizations, including non-profits, universities, corporations, municipalities, faith groups, community/neighborhood organizations, and other citizens. A multi-disciplinary team from the Garden took the lead in bringing BiodiverseCity St. Louis to life, with development of a central website, monthly E-newsletters, *Wild Ideas Worth Sharing* speaker series, community workshops and summits, and educational outreach. Learning from similar initiatives in the U.S. (ex: Chicago Wilderness, Kansas City Wildlands) and around the world, as well as emerging voices in the field who are documenting the benefits of urban biodiversity (Beatley, 2011), BiodiverseCity St. Louis is still evolving and growing as a community-wide network, responding to needs and priorities of its network members, playing lead roles in specific action project campaigns (ex: Milkweeds for Monarchs, Bush Honeysuckle Eradication), and collaborating on local and regional grants focused on local biodiversity conservation. While some minor grant funding has been procured to support BiodiverseCity St. Louis efforts thus far (less than $50,000US), the most significant and foundational contribution has been the Garden's continued commitment of staff time and focus.

Dr. George Yatskievych, Missouri Botanical Garden Botanist and Curator of the Flora of Missouri, then took

the panel attendees back in time for a detailed, and botanically infused natural history lesson centered on what Missouri was just a short while ago, pre-European settlement – mostly tall-grass prairie and woodlands. Echoing the sentiment of many in the ecological restoration field, George emphasized that BiodiverseCity St. Louis isn't about restoring what was, but rather, what could be if given the chance. He concluded with a focus on the threat that invasive exotic species pose to native Missouri flora and ecosystems, and the complexities involved with controlling them. Among the key take-aways of George's message to panel attendees was there remains more to figure out and investigate as it relates to dynamics of local natural communities and the distinct and special elements within. The science is never done!

Following Deborah's and George's presentations was Catherine Werner, Sustainability Director for the City of St. Louis, working out of the Mayor's Office. (Note: Ms. Werner also co-delivered a keynote during the BGCI Congress, in collaboration with Dr. Rebeca Quinonez-Pinon, together addressing the imperiled monarch migration and the conservation connections between St. Louis and Mexico.) As a city leader with years of experience in community conservation efforts, Catherine has focused the City's resources around sustainability and nature-rich neighborhoods (Figure 1.). In recent years, she led the charge for the development of the Mayor's Action Plan for Sustainability, including key metrics for accessible, quality green spaces, city park enhancements, vacant lot transformations and revitalizations, and a healthy urban forest. She launched the City's Urban Vitality & Ecology initiative, which aims to build community capacity for citizen stewardship in the urban core, via integrated efforts and collaborations among neighborhood leaders and residents as well as City departments, including Parks & Forestry, Health, Police, etc. As part of this effort, a specific community in North St. Louis, the Baden neighborhood, was selected as a pilot project, based on criteria such as access to green space, health and wellness of its residents, walkability, access to healthy food, inventory of vacant lots and condemned properties, flooding and stormwater events, crime, economic trends, and other factors. A Baden Pilot Project team, comprised of community-based individuals and partner representatives from the City, the Garden, Missouri Department of Conservation, and others, meets regularly to report on progress, share community news and events, and identify possible neighborhood projects and enhancements that will enable greater biodiversity, beauty, civic pride, and stewardship.

Figure 1. CityGarden**:** *In recent years, downtown St. Louis has transformed its central downtown corridor leading up to the iconic Gateway Arch with CityGarden, a multi-block urban garden designed to infuse downtown life with nature-rich nodes and portals.*

Following Catherine was Tracy Boaz, Missouri Department of Conservation's St. Louis Regional Supervisor for Private Land Services. Tracy focused on why her state agency has a stake in connecting urban residents to forest, fish, and wildlife resources. Citing statistics and research on urban population and lifestyle trends (Kellert, 2013), Tracy emphasized that city dwellers need first-hand experiences with these resources if they are to come to value and protect them long-term. As a tax-supported state agency, Missouri Department

of Conservation has an obligation to the state's citizens to ensure natural resources can be sustained for future generations (Figure 2.). Given where the vast majority of citizens live, work, and play, MDC efforts must focus on resources in the urban and suburban areas of the state. In St. Louis, MDC is a key partner of BiodiverseCity St. Louis as well as the City's Urban Vitality & Ecology Initiative, taking an active role in the Baden Pilot Project via invasive species removal efforts, vacant land negotiations, and city park enhancements.

Figure 2. boy with caterpillar: *While exotic creatures in zoos and aquaria amaze and delight, it's clear that everyday life forms living among our sidewalk cracks and stairwells can elicit similar if not even greater wonder and awe, if we take the time to appreciate them. Photo credit: Missouri Department of Conservation.*

Following the panelists' comments, the attendees posed a spectrum of questions and challenges to the presenters. Central was the issue of financial support, budgets, and grants. Many in attendance were curious about and intrigued with the Garden's initiation of BiodiverseCity St. Louis, which was not spurred by a large-scale grant or contract. This was contrasted with other like-efforts shared at the Congress (ex: Kew's Grow Wild campaign, lottery-funded) which had different beginnings, as well as different programmatic, geographic, and demographic scopes. The Garden panelists and moderator (also a Garden staffer) responded by emphasizing the basic importance of senior leadership and big-picture vision; solid and diverse community relationships, partnerships, and trust; and a sustained commitment to re-direct existing resources (staff time) to an institutional priority. On the same topic of budgets, a session attendee asked the extent to which the budgets of the City of St. Louis reflected the Mayor's commitment to sustainability and urban vitality. This was a spirited discussion among attendees and panelists that crystallized the challenges of prioritizing urban biodiversity conservation amid other competing and headline-grabbing pressures and needs. Other attendees peppered the panelists with somewhat simpler questions, like the tactics involved with influencing and challenging the aesthetics of city dwellers who prefer neat, manicured landscapes of monocultures to wild-looking, lanky prairie patches and wildflower meadows. More spirited discussion ensued, as well as references to well-regarded lay-public books on this topic (Tallamy, 2007).

The session concluded with Gil Penalosa (BGCI keynote speaker, 5/1/2015, from 8-80 Cities), joining the panelists on stage to interact with them and the session attendees, making connections between walkable cities and biodiverse cities. Among the closing comments from panelists and attendees focused on the key theme of the panel – the importance of community partnerships and the need to leverage those

partnerships to build capacity at the community-level for active citizen stewardship of local places and spaces (Figure 3.).

Figure 3. soil-encrusted hands. *When neighbors have the opportunity to turn over dirt with each other, to enable more life to survive and thrive in their own neighborhoods, a bond is made that brings communities together.*

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Panel Bio-cultural Conservation in the context of Botanic Garden Education: Words for Country

Sharon Willoughby
Royal Botanic Gardens Victoria (Cranbourne Gardens)
Key Words: *Social Inclusion and Community Engagement, Teaching and Learning*

ON 'COUNTRY'

The Royal Botanic Gardens Victoria manages two gardens based in the city of Melbourne in the south eastern State of Victoria, Australia – the historic Melbourne Gardens, established in 1846 in the inner city and Cranbourne Gardens, on the suburban fringe of Melbourne, established in 1970.

In 2012 the Royal Botanic Gardens Victoria opened a new visitor experience – the Australian Garden at Cranbourne Gardens. The Australian Garden is an inspiring and immersive contemporary display of the Australian flora, landscapes, art and architecture. Set in a 15-hectare site, the Australian Garden's design follows a conceptual journey of water from the arid inland landscapes of central Australia, along dry river beds and down mighty rivers to the coastal fringes of the continent. Within this striking landscape, display gardens explore the beauty and diversity of Australian plants and the evolving connections between people, plants and place. The Australian Garden is also a place where visitors can discover inspiration and information about how to use Australian plants in their own home gardens. In all Cranbourne Gardens is 363 hectares in area – two thirds of which is remnant vegetation and an important ark of biodiversity on the urban edge.

For our local community the Cranbourne Gardens are an important wild recreation space where visitors can spend time in the natural world. For our Indigenous community the Cranbourne Gardens are also an important place to be "in or on Country". 'Country' is a complex term used by Indigenous Australians to refer to the land: on which they were born, to which they belong and their place of Dreaming. This usage of the word Country is much broader than the word 'country' in Standard English.

Cranbourne Gardens sits on the traditional Country of the Boon Wurrung peoples. In writing this paper I would like to acknowledge the traditional custodians of this land upon which I live and work. I would like to pay my respects to their Elders past and present and acknowledge the support and generosity of Boon Wurrung Elder Aunty Fay Stewart Muir who has guided this project through development and delivery. I would also like to acknowledge Sarah Bingle from the *Library has Legs* program at the Casey and Cardinia Library, who has been our other partner in this bicultural project.

THE BALEE KOOLIN BUBUP BUSH PLAYGROUP PROJECT

Working in partnership with local Indigenous service agencies, local government departments and Indigenous Elders has been the key to learning how to co-facilitate programs with our local Indigenous community. One of the best outcomes we have had so far from this approach is the development of a bush playgroup for children aged 0 to 4years and their families – the Balee Koolin Bubup Bush Playgroup. The Bush Playgroup follows the 68,000 year-old tradition of teaching children in the great outdoors using traditional Indigenous pedagogies. The playgroup is co-facilitated by botanic gardens staff, community members and local Elders. This project brings together the goals of the Botanic Gardens to increase plant and environmental literacy in our community. The Indigenous community's goal is to help the next generation to learn Boon Wurrung words for Country and important cultural stories, as part of our local library and local government's goal of increasing early childhood literacy in our region.

As well as an important example of socially inclusive practice, this project is a good example of the role that botanic gardens can play in supporting the conservation of traditional knowledge and culture along with plant information (biocultural knowledge)(BGCI, 2012). This is especially important to grasp in working with our Indigenous community for whom plant knowledge, the plants themselves and traditional language are all inseparable concepts.

WHAT DID WE LEARN ABOUT WORKING IN PARTNERSHIP?

Sarah and Aunty Fay taught us the benefits in working in broader partnerships with our local Indigenous community. These partnerships bring together: local services, and support agencies, our Indigenous community (especially Elders) and the Botanic Gardens. This approach essentially creates a bigger support base ('scaffolding') for all the partners involved.

We have also learnt the value of holding meetings on Country out in the bush. We take vacuum flasks filled with tea, biscuits, and also a willingness to spend time chatting. Creating a meaningful partnerships has become more about creating relationships based on mutual respect and trust than our next most urgent outcome – this takes time and lots of cups of tea. This takes courage and the willingness to go with the flow of discussion (all ideas at the antithesis of much of modern western work practices).

An important guiding document for this work was produced by the *Secretariat of National Aboriginal and Islander Child Care* (SNAICC): *Opening doors through Partnerships*, which outlines culturally appropriate approaches to partnerships. The following eight points have been our guiding lights:

- Commitment to developing **long-term sustainable relationships** based on **trust**.
- **Respect** for Aboriginal and Torres Strait Islander cultural knowledge and history, lived experience and connection to community and Country.
- Commitment to **self-determination** for Aboriginal and Torres Strait Islander peoples.
- The aim of **improving long-term outcomes** for Aboriginal and Torres Strait Islander children, families and communities.
- **Sharing responsibility and accountability** for shared objectives and activities.
- Valuing **process elements as integral** to supporting and enabling partnership.
- A commitment to **redressing structures, relationships and outcomes** that are unequal and/or discriminatory.
- Openness to **working differently** with Aboriginal and Torres Strait Islander peoples, recognising that the mainstream approaches are frequently not the most appropriate or effective(SNAICC, 2012).

LANGUAGE

The common goal of all the project partners was to improve literacy at the early childhood level in our local Indigenous Community. Elders wanted to focus on the conservation of language – especially words for Country, plants and animals as a gateway to traditional knowledge. This foundation in cultural stories is seen as the bedrock of indigenous cultural identity and the key to closing the gap between Indigenous and Non-Indigenous people in terms of life expectancy, health and educational outcomes(COAG, 2008).

In the late 18th century, there were between 350 and 750 distinct Indigenous languages or dialects spoken across the Australian continent. At the start of the 21st century fewer than 150 Indigenous languages remain in daily use and all except roughly 20 are highly endangered. Of those that survive only 10% are being learned by children and those languages are usually located in the most isolated areas of outback Australia (Bibble, 2011). Indigenous languages and the traditional knowledge they encode are increasingly endangered.

Our local government authority, the City of Casey, looking at educational indicators in our region, wanted to improve early childhood literacy as a gateway to kindergarten and the primary school. As an organisation the botanic gardens wanted to increase the plant and environmental literacy of our community; as we discussed in a number of session across the Congress– we are looking to cure *plant blindness*. As it became clearer that what we really all shared in the partnership was an interest in biocultural conservation through literacy – funding to create a joint project became available from the Victorian Department of Education administered by the City of Casey.

BUSH PLAYGROUP COMMUNITY STEERING GROUP

We decided to establish a playgroup for children 0 to 4 and their families that would focus on building literacy in words for country. Our first step was to establish a Community Steering group with representatives from across the partnership. At our first meeting, out in the bush, the pedagogy and curriculum for the playgroup were discussed and developed by the elders present.

Aunty Fay decided that the name of the playgroup would be Balee Koolin Bubup Bush Playgroup, using Boon Wurrung words for the Cherry Ballart Tree (*Exocarpos cupressiformis*) that the playgroup meets under – Balee. Koolin is the word for Indigenous Victorians and Bubup means child.

The funding that we received from local government allowed us to recruit a local Indigenous Early childhood facilitator Jaffa Richardson. Jaffa runs a weekly 2-hour bush playgroup session under our Cherry Ballart Tree. Children and families hear stories, play games and create artwork. At special quarterly sessions elders come to run workshops with families. The first workshop of each year has been a formal welcome to Country, passing all the children 'through the smoke' in a ritual blessing. Many of the programs focus on stories and song in traditional language.

HOW DO WE WORKING DIFFERENTLY TOGETHER?

We are still learning how to work with our community in this space. The important lessons we have learnt so far are:

- Cultural protocols take time to learn. Our community has been very gentle with our many miss-steps. This work takes courage on both sides of the cultural divide.

- Broader multi-partner partnerships provide better scaffolding for Indigenous children.

- Relationship building takes human rather than organisational time.

- Improved educational outcomes for Indigenous students rely on strong Indigenous identity and access to cultural knowledge.

- Cultural traditions and plants are inseparable in Indigenous tradition. So to is the self and Country. To conserve one we must conserve the other. This becomes increasingly important in times of global change.

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STORYTELLING IN THE AUSTRALIAN GARDEN: THE THREE MOST USEFUL THINGS WE DISCOVERED?
Part of the workshop: Interpretive Master Planning at Public Gardens: Three Case Studies from Finland, Australia and the United States

Sharon Willoughby
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Key Words: *Strategy and Future Vision for Greater Impact and Change, Research and Evaluation*

STORYTELLING IN THE AUSTRALIAN GARDEN: THE THREE MOST USEFUL THINGS WE DISCOVERED?

THE AUSTRALIAN GARDEN CASE STUDY

The Royal Botanic Gardens Victoria manages two gardens based in the city of Melbourne in the south eastern State of Victoria, Australia – the historic Melbourne Gardens, established in 1846, in the inner city and Cranbourne Gardens, on the suburban fringe of Melbourne, established in 1970.

In 2012, the Royal Botanic Gardens Victoria opened a new visitor experience the *Australian Garden* at Cranbourne Gardens. The Australian Garden is an inspiring and immersive contemporary display of the Australian flora, landscapes, art and architecture. Set in 15 hectares, the Australian Garden design follows a conceptual journey of water from the arid inland landscapes of central Australia, along dry river beds and down mighty rivers to the coastal fringes of the continent. Within this striking landscape, display gardens explore the beauty and diversity of Australian plants and the evolving connections between people, plants and place. The Australian Garden is also a place where visitors can discover inspiration and information about how to use Australian plants in their own home gardens.

In comparison to Kaisaniemi Botanic Garden, in Helsinki Finland, which is a project that is just underway and the Washington Park Arboretum in the USA who's interpretive plan is now 11 years old, the Australian Garden project has only been fully open to the public for three years.

What Did We Learn?

1. Seeing the imagined garden

One of the challenges in trying to start Interpretive Master Planning when a garden only exists on paper and in plan form is understanding what the garden will be like and imaging the garden spaces through the eyes of visitors. The Public Programs team used a number of techniques to help us understand the opportunities for storytelling within the new garden.

We used an adaption of "Sensory Mapping" a technique developed by the Sensory Trust UK where we spent time in a multidisciplinary team (horticulturalist, landscape planner, land management team members) describing the garden to each other concentrating on the kind of sensory engagement each space would offer. For example, the sound of falling water, plants close to the path that will release their scent when brushed, must see photo opportunities and areas with great textures to explore. This activity helped us to develop a 3-dimensional understanding of the 2 dimensional plans.

Once we decided the four key themes within the garden would be, we spent time with big plans laid out on a table and lots of coloured pens. We planned the virtual visit of a number of different visitor groups – families, school groups, tour groups, etc. and worked out where best within the garden to discuss each theme (colouring in each area of the garden with its theme matched colour: green for plant science, pink for home gardening etc.). We looked for both a good spread of interpretation across the garden but also places for pause and reflection.

2. Creating a Sign Family

One of the most significant issues we had experienced over the years with developing interpretive signage was the amount of extra money we would need to spend bouncing signage text backwards and forwards with graphic designers – when text would not all fit onto a sign. We decided that once the visual identity (brand / look and feel / colour palate and style guide) was established for the Australian Garden we would develop a family of signs for use in the garden and create a sign manual that would layout how many words would fit onto a typical sign template. The advantage of this approach has been twofold – first, staff developing an interpretive sign know how many words they have to work with from the outset and, secondly, the signage manual containing all the specifications for building signs means that once a sign is written it is easy to communicate with manufacturers and have the sign made quickly and easily.

3. Evaluation: Is this approach having an impact?

How do we know that the themes that we have chosen, the interpretive methods that we are using (signs, tours, program, QR codes etc.) are having an impact on the way that visitors to the Australian Garden use Australian native plants? There is some anecdotal evidence that the Australian Garden is having an influence on the gardens grown (we see photos of front gardens where people have copied and recreated their favorite element of the Australian Garden) by people who have visited the Australian Garden but how to unpack and quantify that influence?

In order to do this work we have worked in partnership with Dave Kendal and Alison Farrar at the Australian Research Centre for Urban Ecology a division of the Royal Botanic Gardens Victoria based at Melbourne University. A project was established that used standard social science methods to look at markers such as: gardening attitudes, values and connectedness to nature to unravel the pathways of influence around the Australian Garden.

For more details on this study see the BGCI Journal *Roots*: Willoughby, Sharon, Dave Kendal, and Alison Farrar (2013) "Do Our Gardens Influence Our Visitors?". *Roots*, Volume 10, Number 2, October, Page 22.

The key point here is to begin with the end in mind. Work out through the master planning process how you will evaluate your Interpretive Master Plan – how will you know that you have been a success?

Figure 16.-- *The Australian Garden at the Royal Botanic Gardens Cranbourne, 2012. Photograph: John Gollings. Landscape Design: Taylor, Cullity and Lethlean with Paul Thompson*.

WORKSHOP DISCUSSION

At the end of the three presentations, the following questions were proposed for small group discussions

1. A call or question - what next for interpretation in public gardens in light of global change.
2. A discussion around the need to work across silos within our organizations in order to provide rich interpretation.
3. A further discussion how to gain internal support for the planning process and some advice on how to make change happen

What were the outcomes from the workshop?

A number of interesting and significant questions for the future of Interpretation Master Planning in Botanic Gardens were posed by participants at the closing session of the workshop.

These were:
1. In the face of global change what are the next steps for Interpretation in a Botanic Gardens context. How are we as a community interpreting climate change – what's working in the space and what isn't? Have we established what is best practice climate change interpretation in a botanic garden and how are we measuring our impact? This is a really big question and one that we need to put on the international agenda in terms of answering.

2. We discussed the importance of collaborating early and often when developing Interpretation Master Plans. Botanic Gardens are communities that contain a number of different specialists from a number of different tribes: Botanists, ecologists, horticulturalists, landscape planners, marketing team to name just a few. As resources in Botanic Gardens are getting tighter many participants expressed the view that it is getting more difficult to work across traditional silos. Interpretation Planning can be one of those important bridge building exercises within organisations – regardless – the very best interpretation needs expertise from across a Botanic Garden in order to make it sing.

3. We discussed the importance of running curatorial processes within Botanic Gardens that support the implementation of Interpretation Master Plans after all the delivery of the Interpretation continues to have cross organisational inputs and implications.

Natural Connections: Visitor-Centric & Participatory Engagement
Enhancing the Future of Visitor Experiences: Creating a 21st Century Learning Environment

Jennifer L. Wolff, CIG
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Key Words: *Teaching and Learning, Strategy and Future Vision for Greater Impact And Change*

ABSTRACT
As public gardens, we serve our visitors and the greater communities we are part of as trainers, facilitators of conversations, educators, technical experts, credibility lenders, community hosts, and catalysts for change. At the Missouri Botanical Garden, we've defined the following core educational priorities:

1. Get people of all ages, abilities and backgrounds outside – exploring and caring.
2. Greatly strengthening and deepening environmental and ecological literacy.
3. Building the will, capacity, and skills to live more sustainably.
4. Protecting plants and our natural world, both locally and globally.

This serves to share recent initiatives and experiments with visitor-centric, participatory, and personalized learning at the Missouri Botanical Garden. The intent is to spark conversation and inspire botanic garden educators to think and discuss the following:

1. How and in what ways are their botanical gardens becoming active learning partners with their visitors?
2. What methods are being used to facilitate experiences based on visitor motivations and interests?
3. In what ways are we inviting visitors to learn more about plants in personally relevant ways?
4. What are we doing to learn more about our visitors, what they are learning, and how they are impacted based on their experiences with us?

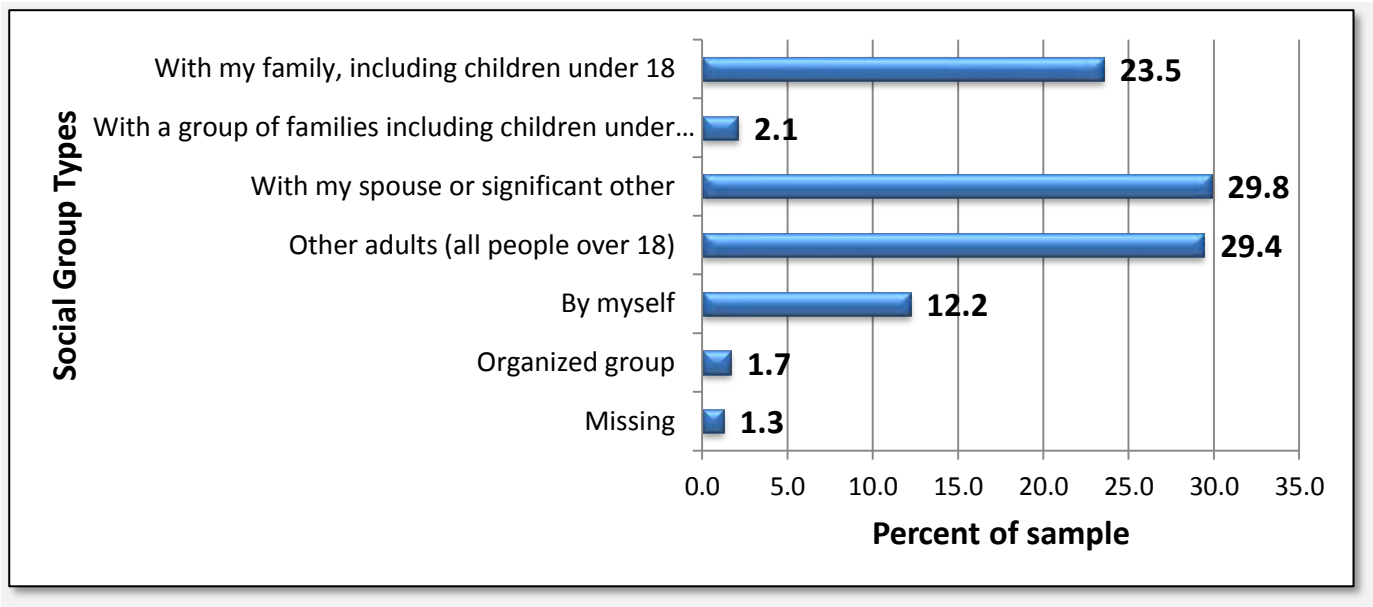
INTRODUCTION
For many botanical gardens around the world, the importance and urgency of our missions has exponentially increased over the past decade. Today, top institutions like the Missouri Botanical Garden, are called upon to ***be global leaders in developing a sustainable world, emphasizing conservation, restoration, and the responsible use of resources***. Collectively, botanical gardens have an ***opportunity, and an obligation, to better engage, involve, and empower our millions of visitors***, in promoting conservation and sustainability, at home and around the world.

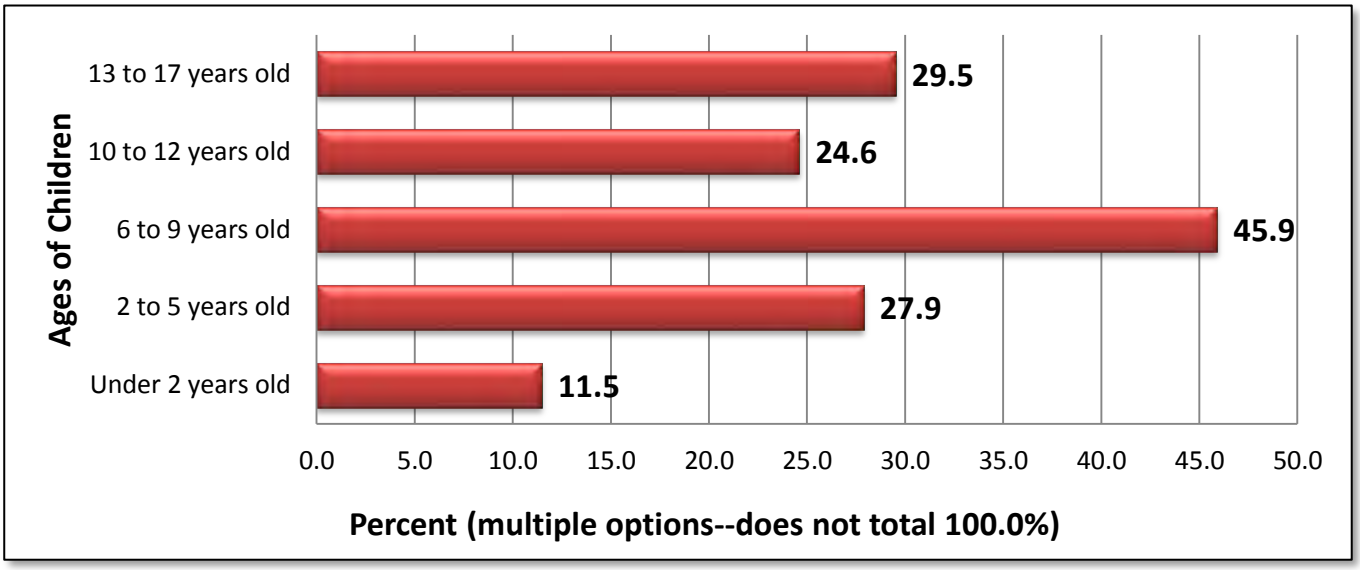
To help meet this challenge, Missouri Botanical Garden launched *Natural Connections,* a comprehensive package of visitor-centric, participatory engagement tactics and tools. In developing and implementing this initiative, Missouri Botanical Garden's Interpretation team continues to draw upon the growing body of knowledge and practice in the fields of informal science education and "free-choice" learning, which recognizes that people bring their own identities, knowledge, agendas, interests, and motivations to informal learning environments. As well, the tools and technologies to engage visitors have multiplied, allowing greater reach and impact through interactive media of all kinds. In designing experiences to serve today's visitors, we work to accommodate a range of learning styles, abilities, backgrounds, preferences, and ages. Successful initiatives, methods, and programs engage visitors in dialogue and interchange, inspiring and providing opportunities for them to react, editorialize, question, ponder, create, contribute, and share. Thus, Missouri Botanical Garden is striving to be and ***active learning partner with our visitors, facilitating their experiences based on their motivations and interests, inviting them to learn about plants in personally relevant ways, and enabling us to learn more about our visitors***.

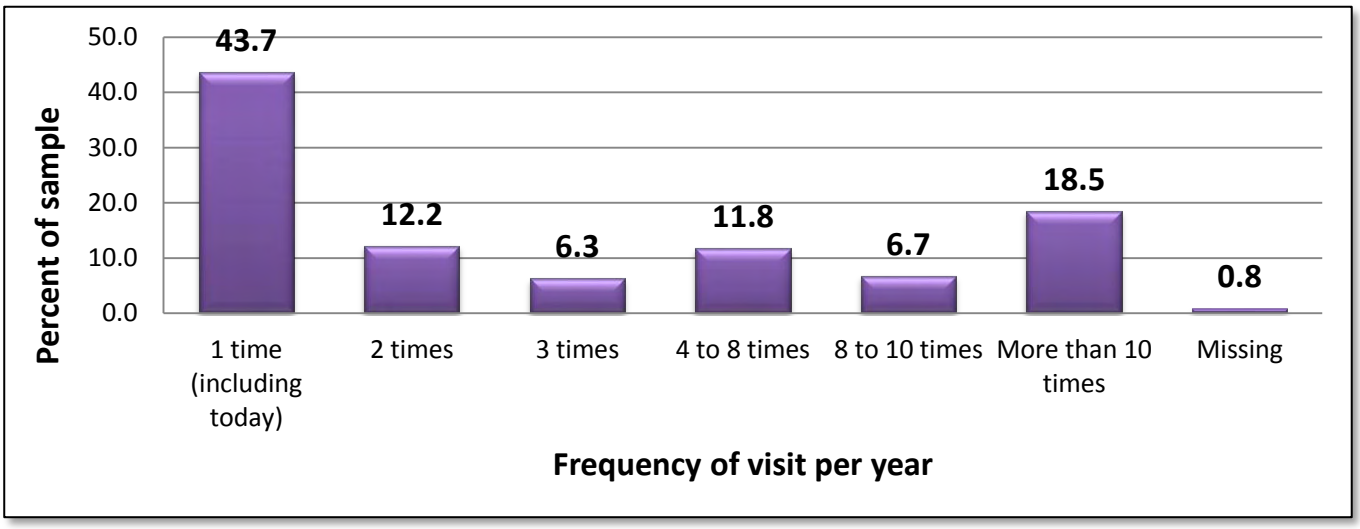
CHALLENGES

One challenge to implementing visitor-centric engagement was the need for much more extensive information about our visitors than Missouri Botanical Garden has traditionally collected. First, we had to ask ourselves who are our visitors, who are we connecting with and in what ways are we connecting with them?

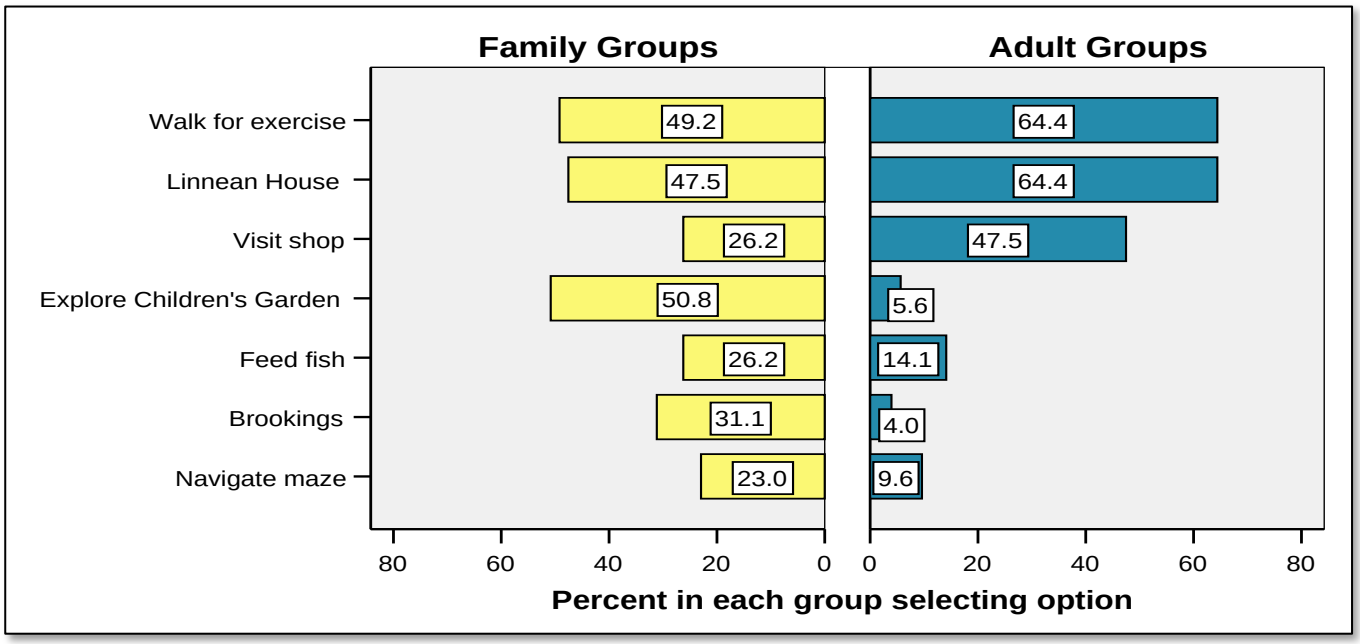
Over the past several years, Missouri Botanical Garden has conducted several visitor and member surveys, focus groups, and studies to gather data to inform our efforts. In 2011, we contracted with a professional evaluation partner, Carey Tisdal of Tisdal Consulting, who conducted a front-end evaluation to provide (1) information about current Missouri Botanical Garden visitors to support decisions about the design of interpretive strategies and tactics as part of the *Natural Connections* initiative; and (2) a baseline for formative and summative evaluation efforts. Data were collected on site between June 7, 2011 and July 24, 2011 and two methods were used: an exit survey of adults over 18 and in-depth interviews of 15 social groups selected on the basis of social group type, visit frequency, and residence. Among the 238 exit survey respondents, about 45% were over 55 years old and about 30.0% visited as part of a family group. Nearly 23% were from outside the St. Louis metropolitan area. The evaluator found significant differences in how respondents visited the Garden based on three group variables: visit frequency, social group type, and residence.

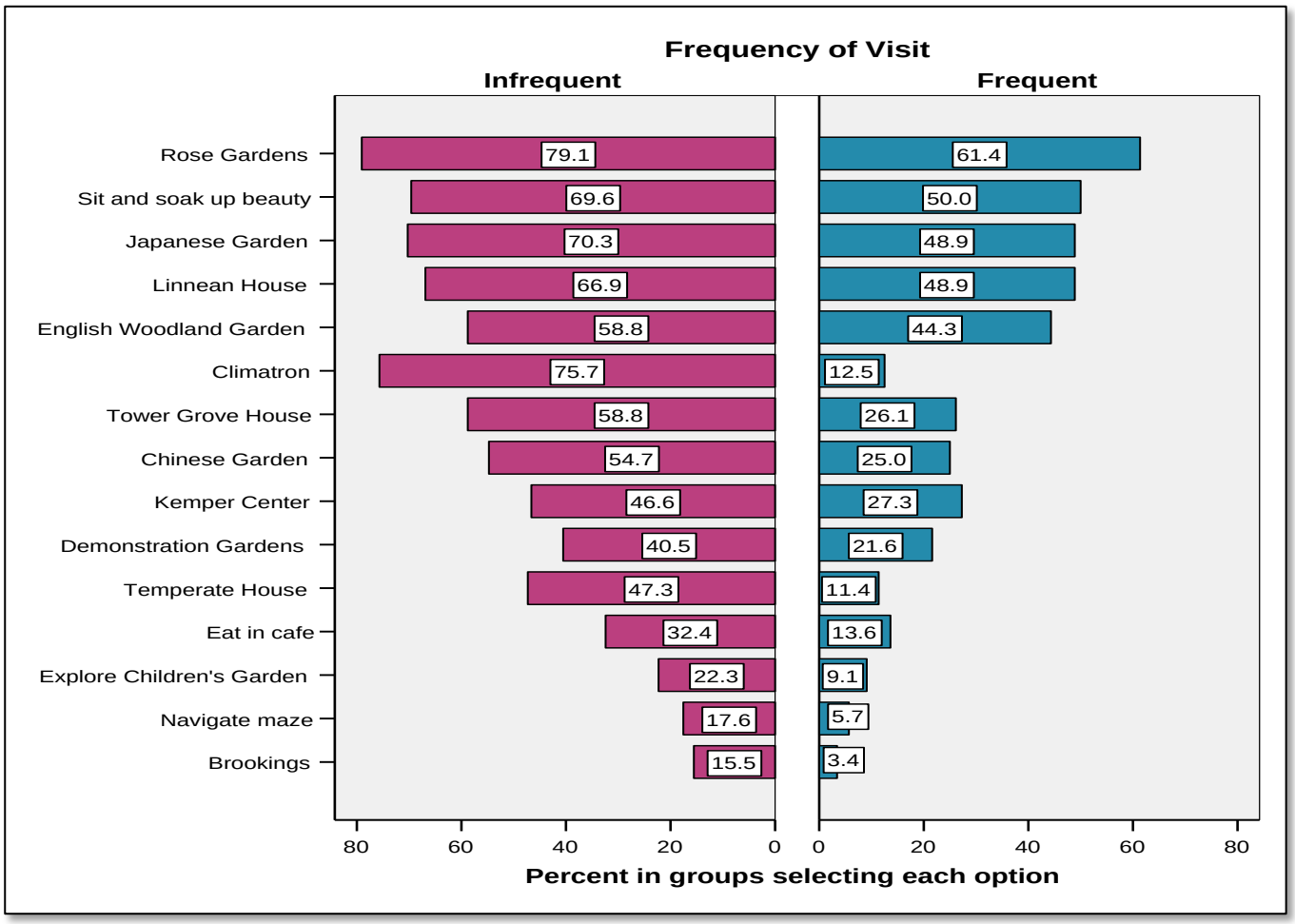






Groups were compared on three major visitation variables: length-of-stay, extent-of-use, and satisfaction.





Based on study findings, Missouri Botanical Garden learned that (1) infrequent visitors stay longer and use the Garden more thoroughly, (2) family groups are more likely to use areas with interactives, and (3) we need to look at what we're offering to engage adults more actively. As a result, we developed an initial

visitor segmentation that we use in *Natural Connections* projects:

Adult visitors (in groups of other adults or alone):

- **Leisure Seekers**: frequent visitors who may stay a shorter time and use fewer areas each visit.
- **Occasional Visitors**: first-time and infrequent visitors who probably will stay longer and want to see and do more during their visit.
- **Avid Gardeners/Plant Lovers**: primarily adult visitors who are focused on horticulture.

Family visitors (those visiting with children aged 12 and under):

- **Local Families with Children**: who may already be familiar with the Garden and come to visit a few favorite areas, such as the Children's Garden or Brookings Interpretive Center.
- **Out-of-town Families with Children**: who may want to see as much as possible, including those areas of the Garden that are particularly appropriate for children.

The study also found that, while all visitors were overwhelmingly satisfied and complimentary of the Garden from the point of view of a place of beauty in which to spend time with family and friends, ***there were far fewer who cited greater awareness of plants and human reliance on plants for survival, the importance of personal choices and actions for plant conservation, or MBG's role in promoting sustainability and conservation worldwide***.

GOALS & OUTCOMES

The overall goal of *Natural Connections* is to explicitly welcome, equip, and engage our visitors to pursue their interests and explore the Garden so that they may achieve four critical outcomes:

- Personally relevant, meaningful, satisfying, and memorable visitor experiences.
- Greater awareness of plants and human reliance on plants for survival.
- Increased knowledge of choices and actions to promote conservation and sustainability.
- Stronger affinity and support for the Garden and its global mission.

For visitors to have a personally relevant, meaningful, engaging, and an educationally-rich Garden experience, interpretive methods, tactics, and tools are specifically designed where they:

1. Learn something new and provocative that they didn't know before about plants and the environment.
2. Connect with the Garden's mission-rich work either locally or globally.
3. Inspired or are empowered to grow their knowledge, change an attitude, modify a behavior, increase their skills, or put what they've learned into practice.

NATURAL CONNECTIONS INITIATIVES

Ridgway Visitor Center Experience – Visitor Engagement Station & MyGuide to the Garden

As with any visitor center, they are hubs of visitors arriving, admission transacting, directional questions, shopping, dining, restrooms, and what's the must see thing today. Recognizing that the Garden welcomes hundreds of thousands of visitors each year, from all walks of life, and from all around the world, we stopped to assess what our visitor center experience was. We asked - what is the center providing and what's missing? Given the design of our facility, we recognized one key issue, there was a disconnect for visitors from the transaction point on the lower level to the actual doors leading into the Garden. Once visitors were on the upper level, many had questions about what to see, where to go, and what opportunities were awaiting them in the Garden.

In 2010, the Garden piloted a **Visitor Engagement Station** in the Visitor Center utilizing an existing mobile lab station equipped with visitor guide maps, event cards, course catalogs, and display garden brochures.

Conclusions from the pilot experience proved visitors were receptive and desired more interaction with Garden representatives. Following that pilot, the Station remained a mobile station in the Visitor Center where visitors were interacted with daily, weekly, and monthly. The responses were overwhelmingly appreciative for the presence of and interaction with Garden personnel prior to going into the Garden or upon exiting. The Station provided visitors with a forum to ask questions, provide feedback, engage in learning more or learning something new about plants, and to seek recommendations for what to see and do.

In 2012, the Garden's *MyGuide* project was launched. This project involved the development, implementation, and assessment of a new series of multi-media, visitor-centric guides designed to help connect visitors to the Garden's diverse plant collections, venues, exhibits, and messages in more personally relevant and participatory ways. Across all formats, *MyGuide to the Garden* shares common elements, including a compelling welcome message, customized maps, "Dig Deeper" stories and content, and prompts to share and connect. Print versions were made available at the Station. With increased visibility and interactions, the pilot Station was no longer sufficient and funding was secured for the fabrication of a new and improved station equipped with digital interactive kiosks.

The Garden's *MyGuide* project is specifically intended to enable more personalized learning among visitors. Informed and inspired by Museum 2.0 approaches of participatory, customized engagement versus passive, one-size-fits-all information consumption, this project is part of the Garden's *Natural Connections* initiative and embraces the visitor as the center of it all – where all real learning and meaning-making takes place. The project objectives aim to:

- Provide customized informational, educational, and interactive content based on visitors' interests, motivations, and goals;
- Serve as a gateway to further exploration of Garden resources;
- Prompt deeper thinking about plants and the role they play in our lives; and
- Encourage visitors to react, contribute, and connect with the Garden and others who share their interests.

While *Natural Connections* and the *MyGuide* project are multi-phased, long-term initiatives for the Garden, Phase I of the *MyGuide* project within the grant funding focused on two major components: 1.) Data gathering and analysis to further define and characterize the Garden's audiences (segmentation); and 2.) Piloting two initial *MyGuide* experiences, including development, delivery, and evaluation of print, online, and mobile formats.

Overall, findings from the June/July 2013 Print Field-Test provide a valuable snapshot of the potential transformative impact this new series of guides could have on the traditional Garden visitor experience, and support the conclusion that accomplishing all of the original *MyGuide* objectives required a full suite of systematic, explicit, redundant, and consistent messages and opportunities for visitor engagement: the printed guides, the high-profile visitor engagement station, the concierge-like experience of customizing one's own visit, and the web- and mobile formats to ensure visitors can experience *MyGuide* via their medium of choice. As the project moved from behind-the- scenes development to actual visitor-facing

elements including printed guides and a fabrication of an improved visitor engagement station, the *MyGuide* project was presented as "*MyGuide to the Garden: Inspiration to Help You Grow."* Today, the Station is staffed daily with a core group of over 130 volunteers, is equipped with digital interactive *MyGuide* kiosks, print *MyGuide* tours, and an array of Garden opportunities, event information, and resources to learn more. The effectiveness of the *MyGuide* project, specifically the extent to which they result in the desired visitor outcomes, will continue to be measured and assessed as the project continues to evolve and grow.

Display Gardens and Annual Flower Shows

A key element of improving the visitor experience and engagement is better signage – to help people find their way, identify what they see, and explain its significance. Guided by a new signage plan based on best practices of universal design, the Garden developed, designed, had custom fabricated, and has implemented new interpretive, site identification and way finding signage. Interpretive signage is written with visitor interests and aligns within six strategically defined content tracts; History & Heritage, Plants & People, Botany & Biodiversity, Gardening & Horticulture, Art & Culture, and Sustainability & Conservation. Within each suite of signage that is implemented, digital prompts (mobile tagging, QR codes) are integrated along with non-digital prompts (questions, ideas, activity suggestions) which are designed to encourage active visitor interaction with the Garden, our collections, messages, mission, and each other.

Pot-a-Plant Activities

For visitors who visit botanical gardens, many anticipate having the opportunity to get their hands dirty, so to speak, and want the hands-on experience with plants. In 2013, as part of the year of *Foodology*, we piloted an opportunity for visitors to do just that. While the Garden has offered countless opportunities like this for adult, youth, family, and students as part of programming, this opportunity had been tested on a limited basis in years past, but not as part of a summer-long series.

As part of the "Savor Your Summer" series, the Garden hosted "Herb and Heirloom Tuesdays", every Tuesday, from 10 a.m. – Noon, May 28-August 25. In collaboration with the St. Louis Herb Society, Garden staff co-hosted a special presentation in the Garden's famed Victorian District focused on "Cultural Culinary Herbs" from across the globe. From ground plantings of Greek, Italian, Mexican and Spanish herbs to container gardens featuring French, Lebanese, Thai, Chinese and Indian herbs, visitors were given the opportunity to experience the diverse herbs that flavor our world. Each Tuesday, the first 200 participants potted an herb plant of their own to take home, along with a different recipe card each week. The response from visitors was overwhelmingly positive. One impact story came from a parent who shared that she and her son had participated in all 14 pot-a-plant sessions. They carved out a small space along the side of their house to start their herb garden. As their herbs grew, they harvested and cooked with them creating a great intergenerational experience for them around a new found interest in plants.

Children's Garden

The Missouri Botanical Garden's Doris I. Schnuck Children's Garden: A Missouri Adventure reflects the Garden's leadership role in connecting children with plants and nature and is the centerpiece of the Garden's efforts to attract and serve young families. Its purpose and vision aim to engage children and their families in an adventure-filled journey through the diverse ecosystems and settlements of 19th century Missouri, while fostering curiosity and an understanding of plants in the world around them.

Children's Garden educational programming provides age-appropriate experiences that create personal connections between plants and people. Research has shown the benefits of age-appropriate, gardening-based learning experiences and that a child's outdoor experiences can be enhanced by mentoring. The Garden has learned from recent member surveys and evaluations that visitors want opportunities for "little ones to plant and water and learn about gardening anytime they're in the Children's Garden."

The Garden has been responding to these findings through the Edible Garden which features a series of raised beds planted with a wide range of vegetables and herbs to encourage children to discover, closely observe, smell, touch and, at times, nibble on the plants. The space also hosts 500 square feet of gardening plots designed with wooden mulch between each bed so children can step in amongst the plantings to help weed, water, harvest and plant alongside staff and volunteers.

Equipping the Children's Garden with this hands-on family-friendly garden has provided a unique opportunity to connect plants and food in visitors' minds. Why is this important? Children today have very little exposure to where food truly comes from. You might ask a 6-year old where a tomato comes from and get the response, "a grocery store." Unfortunately this can also be true for adults. Farmers, the producers of crops consumed by the entire U.S. population, currently make up less than 2% of this country's work force. The general population has limited involvement or knowledge in growing, harvesting and gathering. Hats off to the technology that makes this luxury possible; but we need to remember our roots. In our Edible Garden, activities are geared toward fun and engaging ways for families to "grow your own" themed edible gardens where they live, work and play today.

Tower Grove House

When Henry Shaw's historic Tower Grove House opened to the public in 1953, it became an instant must-see for Garden visitors. While staff and volunteer interpreters are on hand to enrich the tour, the inside of the house is not always open or available to everyone.

Starting with its seasonal opening in late March 2014, Tower Grove House began offering a new digital tour experience for visitors who were not able to enter the home, as it is not accessible. Tablets loaded with the virtual tour are available on-site during normal operating hours (Wednesday through Sunday from 10 a.m. to 4 p.m.), or visitors can download the virtual tour as a PDF and view it from their personal tablets any time, which can be especially helpful for large groups who otherwise might miss this attraction when it is closed.

This new experience is part of the Garden's efforts to provide a more inclusive experience for all of our visitors. The tour contains photos and captions showcasing everything from the parlor and dining room to the basement and Shaw's bedroom. Visitors can also learn more about Shaw, the house's many uses through the years, its architect George I. Barnett, and more. The on-site tablet is available upon request at Tower Grove House. Visitors can plan their visit, learn more, and download the PDF at www.mobot.org/tghouse.

Brookings Interpretive Center

The Brookings Interpretive Center is the Garden's indoor, year-round, family-friendly destination for themed exhibits encouraging hands-on discovery, exploration, and learning. Originally constructed during the renovation of the Climatron in 1990 to house educational displays related to tropical rainforests, by the mid-2000's the Center's existing displays were significantly outdated and were removed to provide space for functions related to signature exhibitions. Since 2008, the Center has hosted seven innovative, interactive staffed exhibits: *Exploring Trees Inside and Out*, *EarthWays Living the Green Life*, *DinoQuest: A Tropical Trek Through Time*, *TREEmendous*, *Plants and People: China, Foodology: Digging in to the Roots of Our Food,* and *Nature In Your Neighborhood*. The public response has been incredibly strong, with exhibit visitation averages 100,000-120,000 each year.

While the Center clearly demonstrated great potential as an interactive learning venue, it also presented significant challenges due to outdated infrastructure and facilities. In 2015, the Garden plans to renovation and expand the space to create a dynamic, welcoming, family-friendly, digitally-equipped, year-round space that can be configured for multiple purposes. Slated to open in spring 2016, visitors will be invited to explore together as they experience changing themes, participate in a variety of hands-on activities, and have a chance to join the conversation and create their own content. Driven by the concepts of universal design, the new space will accommodate visitors of all ages and abilities. Both "high touch" and "high tech" features will cater to a range of interests and learning styles. Expansion and reconfiguration of the space, along with refurbishment of the infrastructure, and installation of upgraded technology and features are required to fulfill the Brookings Center's pivotal role as a multi-generational 21st Century learning environment suited for changing exhibits, classes, and events.

Through the years, the Interpretation Team has listened to visitor feedback. The anecdotes and comment cards have been an underlying guiding principle throughout the planning process because the space really is for them. The new zones within the space will give the Garden the opportunity to explore a wide variety of educational experiences that focus on plants, the places they grow, how we rely on them, and the importance on protecting them. We want to keep visitors excited about exploring the world of plants. Given the interest and excitement visitors have expressed with previous exhibits, we want to keep that inspiration going in our new space. Visitors are encouraged to share ideas and watch the progress of the new space at www.mobot.org/brookings.

IMPACTS & BENEFITS

- Greater diversity of experiences; increased length of stay
- Customizable, repeatable experiences
- Active, unique learning experiences
- Increased diversity of visitors
- …and more members too!

CONSLUSIONS & RECOMMENDATIONS

At the conclusion of the panel session, participants asked questions, commented on the panelists work and overwhelmingly agreed that:

1. As informal educators, we need a forum to collaboratively share ideas, pose questions, contribute best practices, and solicit feedback from one another.
2. Within the field of interpretation, we need to foster a dialog among peers and colleagues around what's working, what's not, and how are we measuring our impact and success. How do we know what visitors are learning from our engagement opportunities? Can we determine the long-term impacts of those experiences? If so, how?

Recognizing we all see the need and are committed to the above, the group wasn't sure on next steps. Thoughts were shared on existing forums through LinkedIn, APGA, and BGCI, however, it none seemed to fit quite the type of open-dialog forum that we were seeking. A few participants did recommend that we reach out to APGA and BGCI on how best to approach this need and determine how a united forum could be created.

The Arabian Desert's botanical bounty:
poems to celebrate Qatar's Quranic Botanic Garden

Diana Woodcock
Virginia Commonwealth University in Qatar
Key Words: *Teaching and Learning, Science Communication*

Having lived for eleven years now in an oil-rich land at the edge of the Arabian Desert, I have become increasingly concerned about local and global conservation issues. Qatar is facing an environmental disaster due to its radical economic expansion as it supplies oil and gas to the world and prepares to host the 2022 World Cup. Because of this, and in preparation for the opening of Qatar's UNESCO-sponsored Quranic Botanic Garden, I have been conducting research for a collection of poems featuring the ecology and flora of this tiny desert country surrounded on three sides by the Arabian Sea.

Hema, an Arabic concept construed as the nomadic sense of respect and protection of the environment, has been ignored while Qatar is being overdeveloped. The discovery of oil has transformed one of the world's poorest countries into one of the richest. Once dominated by nomadic and semi-nomadic people dependent on fishing, pearling, camel breeding and dhow construction, its people now rely on an expatriate workforce made up of the poorest members of India, Pakistan, the Philippines and other impoverished nations to construct new roads and housing compounds, sports stadiums and universities, hotels and hospitals, shopping centers and a brand new airport .

I have been exploring Qatar's desert since 2004, mainly to observe and record its flora. As a a PhD candidate at Lancaster University, I have focused on two questions for my research: Why have devout Muslims drifted away from the Quran's environmental ethic? And what can poetry and botanical gardens achieve that a scientific treatise or textbook cannot? The interdisciplinary facets of my research – botany, cultural and Islamic studies – inform the poems included here. They are from my work in progress, The *Desert's Botanical Bounty: Poems from the Heart of the Arabian Desert,* which promotes a greater appreciation of and commitment to protecting not only the unique biosphere of the Arabian Peninsula, but other equally endangered ecosystems around the world.

Botanical gardens are recognized now for their increasing social importance in connecting people to their communities and in educating them to issues of sustainable development and biodiversity conservation. Qatar's proposed UNESCO-sponsored Quranic Botanic Garden undoubtedly will play a key role in transforming the country's capital, Doha, and helping residents revalue the ecosystem they inhabit.

The goal of my research and book project is identical to that of Qatar's Quranic Botanic Garden project: to make a major contribution to environmental conservation, scientific research, and education revolving around Qatar's indigenous plants and the ones mentioned more than once in the Quran. I am hopeful that my book will accomplish two things: inspire a greater appreciation of and commitment to protecting the unique environment of the Arabian Peninsula; and promote Gulf Arabs' well-being.

Following are a few of the poems from this work in progress.

ABU NAKHLA WETLAND

In the gaunt desert, walk
among the mundane with an attitude
of waiting, not searching,

for the most precious gifts.
Watch Desert lark lift and float
over the wastewater park.

Note how the three vegetation zones –
littoral, submerged, wetland –
enrich varied plant communities:

Zygophyllum qatarense (terrestrial species
around boundaries); Phragmites australis
(most abundant of littoral vegetation);

Typha domingensis (cat's tail).
Wait on the verge beside the most
common species, completely submerged,

Tamarix ramossissima.
What would the world be
without wastewater wetlands?

Long live the familiar opportunists:
Rumex dentatus, Sporobolus
arabicus, Juncus rigidus.

And migrants stopping over:
avocets, Golden orioles, hoopoes.
Wait in the gap, one desert pavement crack,

one space of gaunt desert calling you out
as the moon's April shadow lingers
longer at dawn. Meander among

Meio- and Macrofauna: copepods
and isopods; rotifers and gastrotrichs;
oligochaetes and Tadpole shrimps;

the flies – mays, caddis and dragons.
Wait among mundane endemic mammals –
Gerbillus nanus, Jaculus jaculus, camels.

And nesting endemic birds – Reef heron,
the Greater – most far flung – flamingo,

Water rail, Little grebes – each one

a radiant hallelujah over this emaciated desert.
Wait, watching and walking around
the happenstance of fresh water till

heart bleeds for the most precious
endangered gifts. What else can this
makeshift wetland be called but love?

With wild joy, dance on the cracked pavement.
Then sit silent and still as you've done
on windowsills of monastery cells,

on coastal cliffs that offered asylum.
When the hardness becomes intolerable,
inflate your raft and float on the wetland

light as a mayfly, silent as a day moth
sipping nectar from one yellow-green flower
of Zygophyllum qatarense.

Revel in the joy of hovering over such
wild sweetness. Then go home.
Let the wastewater wetland –

all its usual precious beings –
insinuate themselves
into your daydreams.

DESERT ECOLOGY LESSON 3: LANDFORMS—WADIS AND RUNNELS

Dry season. Wadis and runnels stark.
Beside them, one desert lark linking
sky and earth, quenching its thirst

at the thorny salt wort, singing
in the language of longing,
igniting the listener's desire.

The lark, in full light, takes flight,
and you the wandering pilgrim –
watching, rootless and wingless –

wax envious. In the hilly terrain,
southwestern region, massive ridges
and elevations with low-lying long runnels

create wadis Galal, Dhiab, Al-Jah
with their bristlegrass* forming
phytogenic mounds in the main channels,

their shrubs of Acacia ehrenbergiana
and Lycium shawii, their fine sediments
cracking after drying, or rolling –

in the main channels – into thin clay crusts
like Pepperidge Farm's Pirouette rolled wafers.
Long runnels: some dissecting desert pavement

on limestone Miocene ridgetops;
some lying at low levels between elevated
hamada ridges; others draining the plateau

(every pilgrim should know) –
their downstreams meandering westward.
Then, short narrow runnels dissecting

the ridges' gentle slopes, and runnels cutting
backwards confined to the Miocene ridges,
result of erosion and disintegration –

fine rock detritus on which grow Acacia
ehrenbergiana and Pennisetum divisum,
and on the wind-deposited sand, Panicum turgidum.

These wadis and runnels like the Spirit's
messengers offer hope, encourage
patience and faith – word become runnel

through which life-giving water eventually
will flow across this span of arid land that you,
dear pilgrim, feel you've known forever.

Peace be to dry, expectant wadis
and runnels winding through desolate
yet perhaps the ultimate blessed space.

DESERT ECOLOGY LESSON 4: SABKHAS
That night, after a day spent
on the coastal margins, I dreamt
I was a sabkha gently emerging

from the sea, displaying my fine silt
and calcareous sands like a proud weaver
of silk carpets and kalims.

I showcased my mangroves –
Avicennia marina – and my halo-
phytic plant communities:

Glaucous Glasswort, Sea
Rush, Mangrove Grass.
Mobile dunes encroached on me,

confining my vegetation to the lower level
between the cusps of coalesced dunes.
I glistened in the harsh sun,

gypsum crystals adorning me.
My silt and sands spread out
between sea and cracked earth

of packed desert pavement.
I proved a moist treasure trove
for Slender-billed gulls,

whimbrels, sandpipers and crabs.
But whose waste was seeping
into my heart? Oblivious,

a Little Stint before day was spent
came to peck about my mudflats,
moving among plastic bags

and other trash,
taking just enough
to sustain it.

DESERT ECOLOGY LESSON 18: WARNING – DANGER
You'll be tempted at first to stay out
of the desert, warned of its dangers,
put off by its sparseness. But the secret
lies in walking the middle path between

its vacuity and reality, seeking on deep
sandy accumulations merkba – that tufted
perennial grass (good fodder
for the grazers), Hammada elegans –

stout unarmed shrub Bedouins
once used to scrub clean their clothes,
Cyperus conglomeratus on the sides of barchan
dunes, Rhanterium epapposum grazed

by camels, even ephemeral growth of Zygophylum
simplex in the man-made hollow on the grey-
brown plateau. The secret: to know where and
when to go: after heavy storms when every rodat

is flooded with run-off water.
Go to where there is continuous spillage,
discharge of sewage, where Phragmites
australis grows densely, covering a vast terrain.

Later you can brave oil fields and abandoned
farms, muster courage to sit in the empty space
between spring and winter, wait for the rains
to fill up wadis, flood the plains, transform

bare ground till it is chastened once more.
Go bravely and sniff around for a bit of heaven.
Praise all the brave ones who've defied the harsh
conditions, the parched desert pavement.

Don't fear the desert's interior; it's not the enemy.
Beware the polluted city on its edge, grown
like a callous, a cancer; beware the men –
each one with his phallus shrinking from poisons

he's unleashing into air and sea. Pity
the workers in sand-caked buildings that scrape
the sky. Pity yourself unless you escape
to seek out and praise the heart of the desert.

DESERT ECOLOGY LESSON 19: THE DICOTS

Everything that seems empty is full of the angels of God. ~ St. Hilary

Best time and place to perceive
the radiance of mind's true nature:
hour preceding dawn in the desert

before day takes precedence,
bringing everything to light.
All seeming at first deserted.

But look closer: the annual herb
devils thorn thriving, its flowers
ripening under the surface;

the delicate thread-stem carpetweed
donning its green flowers.
In every depression along margins

of cultivated land, in shady moist places,
on dry salines, Her most advanced floral
plants stretching your boundaries to the max.

Fullness of the presumably empty desert
surrounding you, holy presences abounding,
you'll never want to leave, having reached

deep inside where the center holds.
Hour before dawn, words having lost
all meaning, you'll float across the Empty

Quarter like a Mute swan, oblivious to time,
trailing your toes through drifted sand,
heaven under your feet, each formation –

shamal-sculpted – rising
like a jubilant proclamation.
You'll hear an angel applauding

each flower ripening
as your mind's true radiance shines
bright as the Harvest Moon.

DESERT ECOLOGY LESSON 34: RHAMNACEAE AND TILIACEAE
When all the world's bad news
has brought you down,
rise up, go out to the rodat –

depressions of loamy compact soil –
where desert trees, shrubs, woody
climbers flourish; rejoice with them

in sunlight and air. Then
as the day goes, so let each care.
Seek out Wild jujube,

that thorny shrub with almond-
green florets and orange berries,
Sidr its Quran-given name.

Find Arabian jute, that prostrate
perennial with tortuous branches
forming mats on compacted soil.

Look up from the flora –
stark horizon – neither lofty pines
nor majestic maples.

Just open desert. But at your feet,
a feast: herb, shrub, small tree.
Care for them as a form of prayer.

Applaud their fecundity.
Consider buffalo thorns and lindens
as friends, then watch what happens.

Lacking worldly power in this
eleventh hour – they're among the few
who can teach and console us now.

DESERT ECOLOGY LESSON 37: DESERT SQUASH AND RED THUMBS
No wonder at all it was *the desert,*
not the temple, that gave us the prophets.*

If you would sit alone beside desert figwort –
tiny, purple, orchid-like,
employ no other masters than
heliotropes and Fagonia indica,

let vetivergrass be your holy scripture,
become for a day the foliage, leaf,
stem, and root of purslane-leaved aizoon,
sprout as exuberantly out of the hard-packed

drifted sand – you would earn your keep
as the desert creatures' high priest.
If you'd settle for a while at your still point,
gaze intently enough to notice the ripple

in the dewdrop collected on one leaf
of Fagonia ovalifolia, notice how it regards you
in its own way, become convinced it hears

what you say as you praise its perfection;

if you would stay still long enough beside it,
you would become the child you once were
and have been seeking all these long years –
sense of wonder and expectancy of miracles

overruling every obstructive fact
and pressing preoccupation. You'd ride
the wind – play it with as much finesse
as dunes play the shamal – your spirit soaring

with desert lark, dashing here and there
with the grounded francolin. And though
you've longed to be caught up
into swirling galaxies, you'd beg,

Please leave me to succumb
to desert squash and red thumbs.

*Wendell Berry

Acknowledgements

"Abu Nakhla Wetland" -- Avocet, Fall 2012; *Desert Ecology: Lessons and Visions* (chapbook), 2014
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"Desert Ecology Lesson 37: Desert Squash and Red Thumbs -- *Crab Creek Review,* 2015 (Vol. 1)

FURTHER RESOURCES FROM CONGRESS WORKSHOP

Following are a few of the poems from my work in progress. These were shared during the workshop I led at BGCI's 9th International Congress on Education in Botanical Gardens.

FOR ALI SHARIF, WILDFLOWER EXPERT

A yellow dwarf radiates photons
onto Earth, and impeccably

tailored flowers unfold their petals
like the oppressed unfurling flags

in protest against hunger
and poverty, but mostly against

desperation.
Magnanimous wildflowers,

theirs the most unsordid act
of the day. Don't interrupt.

Let them have their say,
after which you may well decide

silence is the only
appropriate reply.

QURANIC BOTANIC GARDEN
Inauguration Day, September 2008

A sidra sapling is planted at the proposed site.
Around it will grow three hundred species
of local flora, the Quran's ninety, the Hadith's
fifty—mustard, saffron, pumpkin, henna,
pomegranate to name a few. A garden

designed in a traditional fashion—
four quarters, water canals, a central fountain—
spread over twenty-four hectares knowledge
from the Holy Book's one hundred and fifty
verses depicting divine flora.

What a sight to see—such diverse heads
in concert: botanists and phytochemists,
engineers and architects, Muslim scholars

all agreeing on grapes, figs, date palms,
pomegranates just at the eleventh hour of

habitat loss, oil spills, inadequate livestock
management. Plan well, dear experts: wadis,
baadiya, rodats, oases, sunken flower-beds,
gulistans, bustans, plants from the coast,
the hills and gravel plains, sandy terrain,

aquatic habitats (Inland Sea and wadis).
Don't forget the salt-tolerant halophytes.
Grace this modern metropolis with a space
for reverie, for desert mind to hear a unified
botanical voice rising out of primordial sand.

Don't dawdle. Be quick and firm
before one more specia is lost.
Lead us into plant presence—not one of us as
clever as the cactus with its spikes and prickles,
the acacia with its knack for attracting fine

waterborne sediments—wisely folding its petals
by midday. Place before us a date palm
just as its fruit is ripening, beckoning
to the passage migrants. Don't delay.
Build for us today a Quranic Botanic Garden.

Let the sidra sapling grow up strong and straight—
a sacred Lote tree—to lead us into holy presence.
But simultaneously, let us protect the wild—
the camel thorn for starters, for those
sure-footed ships of the desert to graze.

ISLAM AND ECOLOGY

> *The seven heavens and the earth and all therein declare His glory:*
> *there is not a thing but celebrates His praise . . .* -- Qur'an 17:44

The problem begins
with separation of science
from the sacred, religion
from the secular; with denial
nature comes from a higher,
holier realm. Once the gist
of vicegerency is misconstrued,

nature's screwed.

Only one way will save it—
relive its sacredness,
bear witness to these truths:
nature depicts like an icon
the Creator—reflects Paradise,
memories kept in the soul's depths;
divine grace, baraka, flows
through arteries of the natural

and cosmic world order.
At every chance we must—
above all at dawn and dusk—
make the fields and forests,
desert flats and mountain peaks,
sky and sea our libraries;
inquire of the crows
what all they know;

follow the shooting star
to places near and far;
pace the shoreline sandpiper-
like, seeking sustenance;
turn our faces sunflower-like
to the blaze every single hour
of our fleeting earthly sojourn
in perfect unity and praise.

YET IN AUGUST
Torn between the trellised and untrellised,
I praise plants from the Holy Qur'an,

cultivated fruit trees – date palm,
pomegranate, olive,
fig, ginger, grape,
Christ's thorn (sidra tree);

plants from the Hadith and Sunna –
Camel's hay, citron,
orfot and True senna.
Praise plants that bring me face to face
with creation, resurrection.
Yes, praise beet and kust.

Praise annuals – the cultivated:

onion, leek, and garlic;
mustard and sesame;
safflower and wheat;
rice and barley; lentil and
Black cumin.

Praise creepers and climbers:
melons; pumpkins; gourds.

Praise wild perennial herbs:
'heart of the desert' ones like Bitter gourd;
aquatic ones – wild ginger, cust root,
sweet flag, Narrow-leaved cattail, saffron.

Praise cultivated perennial herbs:
aloe, sweet basil. Praise desert shrubs:
Toothbrush tree and Salt tree;
cultivated shrubs Henna and Katam.

Praise wild desert trees: acacia,
Umbrella thorn, tamarisk.
Praise tropical/subtropical trees:
camphor, kamala, banana.

August gardens overflowing,
shamal winds blowing
over the arid desert landscape.
Mirages like mirrors.

Heat rising like incense
from the desert's heart.
Dormant seeds waiting for winter rains.

Beyond the tended garden,
not a hint of green.
Austere grace of a barren waste.
One Crested lark cries out against stark reality.

But oh the sound one dormant seed can make
splitting open hard-packed ground,
exposing parched earth's intimacies.

Yet in August, redemptive winter rains
seeming most improbable.

ACACIA

Eating ice cream and candy,
I give thanks for the acacia –
for its Gum arabic.

In the desert, I come
into the shade of one and praise
its slanted, flat top.

Admire its wisdom: small leaves
for conserving water; thorns and
prickles keeping grazers at bay;

the heartwood's deposits of metabolic
wastes serving as preservatives –
making it unpalatable

to abrasive insects, resistant
to invasive fungi. Sole wood
used to construct the tabernacle

and all its features. Chosen
by Noah for the ark, by boat builders
in ancient Egypt and modern Sudan.

It shall be the reward for Heaven's people.*
Broken are we, out of sync with the universe
while the acacia's not strayed

one millimeter from the sacred way.
Listen how the Persian nightingale
still sings plaintively dawn and dusk

from its crown. A haunt from the beginning
till now for Little owl Athene noctua,
Crested lark, Southern Grey shrike,

White wagtail alike.
The acacia's austere stamina resonates
with the hermit's solitude and silence.

Some say acacia's no match
for Scotch fir. Still, I much prefer
it in its solitary stand against grains of sand.

For a moment, in its presence,

poisonous fumes hovering on the horizon
(oil flares) fade to an illusion.

*Quran 56:27-33)

CITRULLUS COLOCYNTHIS

All day clouds hung over the desert. Wind blew as if to brew a great storm of hard long rain. But once again, nothing came of them. Beside a wadi, I waited—endured hunger and heat, slept among bitter apples: collocynth thriving on sandy loam, its perennial root sending forth scabrid vine-like stems. Solitary yellow flowers bloomed in the leaves' axils. Lemon-sized gourd-like fruit was filling up with soft white poisonous pulp in which flat ovate seeds would eventually please birds of passage who'd come to disperse them. Unable to resist, I tore one from the ground to transplant in my garden. But its delicate microscopical leaf structure caused it to wither within an hour. Clouds still hanging low, wind continuing to blow, I recalled how its fruit flourished profusely between Palestine's mountains and the Mediterranean's eastern shore, Gaza to Mt. Carmel—soil and climate all-sufficient for its growth. I took note: Leave things where they grow. Wild gourd of the Old Testament*—earth gall, exceeding bitterness—and yet, its nutty-flavored seeds taken from their poisonous enclosure, innocuous. In hard soil, widespread. Desert Bedouins grind and make a bread. Precious food source of one Central Saharan tribe—Tibboo Resade—seeds tramped on to remove the last traces of bitter pulp, cleaned by winnowing, mixed with ashes from camels' dung, placed on a smooth stone and rubbed with another to crush the testa, kernels sifted, boiled in water, dried in the sun, then mixed with desiccated powdered dates until finally palatable, nutritive. This is how we live: tearing through the toxic enclosure to what can sustain us.

*II Kings 4:38-40

DESERT ECOLOGY 38: UMBEL FAMILY
Here's the secret to thriving
in this desert: taking part in the life
of lady's-lace – glabrous herb

sprouting in cultivated land. Listen
intently till you hear the lower leaves of each
bishop's-weed withering at anthesis.

Though you be heavy, notice
how each fruiting umbel opens
as if in flight. And though darkness

appears to reign, how each one—

long-peduncled—reflects one ray
of mysterious, glorious light.

DESERT ECOLOGY 47: PLANTAINS (PLANTAGINACEAE)

The sparingly-hairy herb ispaghula
flourishing on fine deposits
in depressions. The densely

silky-hairy herb wedaina in sandy
southern habitats. Buck's-horn plantain—
pinnatifid with acute lobes

forming basal rosettes on hard
compact alluvial soil.
The lancelike ribwort, leaves tapering

to a petiole. So may my soul
rise up out of harsh aridity
into the silence unclaimed

by the world, starburst
of earth's truth, quantum
leap into the space between

depression and sky, safe
from malathion, far from
manicured lawns. May it catch

fire from the bee that is just now
honing in on one corolla,
heaven under its feet.

DESERT ECOLOGY 48: DAISY/SUNFLOWER FAMILY (COMPOSITAE)

The Compositae live as if
my desert garden is heaven,
possessing powers and magic,
knowing how to sustain themselves
through drought, will remain when

I have ceased rambling about.
I sit still as a Buddha,
observe how the flowers crowd
into heads on a common receptacle.
I make just one of them

my companion, meander with it
along the middle path between
world's reality and vacuity, note
its brief flowering—rays and discs—
day by day the sun harsher, note

how the filaments are free, the anthers
united, how some leaves are armed
with thistles, others are not: aster-like
Aaronsohnia, sagebrush, yellow sea daisy,
white thistle with its leathery leaves,

field marigold, perennial
thistle, knapweed
(cobwebby herb), mum,
with its naked receptacle, chicory
with milky sap, the erect eclipta.

Transplanted from their natural dominion:
depressions with fine-textured
sediments, gravelly soil, alfalfa
fields, borders of irrigation canals.
Their cross to bear: lash of sand,

scarcity of rain. No fountain,
no watermill. Persistent shamal.
And yet, what jubilance—nearly
sequestered from industrial
pollution. What dignity—every

spring blossoming stunningly,
what fragile joy distracting from
the yellow-tinged horizon.
Dazzling, humbling, silencing me
as each one hints of forever.

DESERT ECOLOGY 57: SEDGES (CYPERACEAE)
When I grow weary traveling this Milky Way
all alone, panic setting in, I go out
to maritime sand or inland gravelly soil,
meander scarab beetle-like among sedges,
praising how they dress themselves in compound
inflorescences, how they perfume ever so subtly
but sweetly the desert air while masking fumes
from the distant oil flare:

Cyperus effusus among ruins of a forgotten
fishing/pearling village; smooth flatsedge
lavishing its graces on marshy places;
tuberous bulrush filling in margins where
water spills—runners of its creeping
rhizomes dilated in woody tubers.

Perennial herbs assuaging my rage
touched off by the latest tragedy—
earthquake on the remote Tibetan plateau,
children trapped in collapsed schools
while purple nutsedge sends its long
slender stolens bearing black tubers and
leaf rosettes along the moist ground.

Sacredness of every day. Graceful,
lilting sisters softening this harsh desert
no human hands built, these sedges
the only mosques in sight, their prostrate
rhizomes kissing the ground, their flowers
in dense heads or glumes the only gold
domes to dominate this airy space.

Back in the city, in the cold sterility of
MegaMart, my eyes smart as I consider
whether I could live on the trigonous nut
of Cyperus conglomerates—spare myself
this weekly trip. Among sedges,
dance and throw away my original plan?
How could I ever again live separated
from sedges and the song of the desert lark,
urging each creeping rhizome on?

DESERT ECOLOGY 46: BROOMRAPE
(inspired by *Anima Christi)*

Heaven is under our feet as well as over our heads. ~ Henry David Thoreau

Cistanche tubulosa,
sanctify me.

Your fleshy stem covered with
oblong-lanceolate scales,

save me.

Your ovoid fruit,
fill me with love.

Your thick, dense spike,
strengthen me.

Your calyx with acute
scarious-margined lobes,
empower me.

Robust, perennial root parasite,
hear me:

Within your littoral salt marshes,
hide me.

May I never be separated from you.

Protect me by your yellow, blue, purple
flowers from evil's power.

Call me, dear Desert hyacinth,
at my death's hour.

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"Acacia" -- *Desert Ecology: Lessons and Visions* (chapbook), 2014.

"Citrullus Colocynthis" -- *Ellipsis . . . Literature & Art,* 2010 (Vol. 46); *Tamed by the Desert* (chapbook, Finishing Line Press), 2013.

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"Desert Ecology 46: Orobanchaceae (Broomrape)" -- *Conservation and Sustainable Use of Wild Plant Diversity,* Orthodox Academy of Crete Publications, 2011*; Desert Ecology: Lessons and Visions* (chapbook, Finishing Line Press), 2014.

"Desert Ecology 47—Plantaginaceae" -- *Avocet*, Fall 2010; *Tamed by the Desert* (chapbook, Finishing Line Press), 2013.

"Desert Ecology 57: Cyperaceae"--*Off the Coast*, Winter, 2012; *Tamed by the Desert* (chapbook, Finishing Line Press), 2013.

"For Ali Sharif, Wildflower Expert" -- *Conservation and Sustainable Use of Wild Plant Diversity,* Orthodox Academy of Crete Publications, 2011*; Desert Ecology: Lessons and Visions* (chapbook, Finishing Line Press), 2014.

Push and pull factors determine adolescents' participation in nature observation

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NATURE CONNECTEDNESS

People are believed to have an instinctive love for nature and living things, as suggested by the biophilia hypothesis (Wilson, 1984) but this kind of affective (emotionally driven) attitude toward nature requires contact with nature to be formed (Davis et al., 2006). Indeed, affective attitudes toward nature may play a much greater role than cognitive, rational thinking, when influencing people's conservation attitudes towards biodiversity (Martin-Lopez et al., 2007). For example, people are inclined to protect the animals that they have a preference towards or love (Martin-Lopez et al., 2007). Nature connectedness, as affective, experiential connection to nature (Mayer and Frantz, 2004) can be cultivated by first-hand experience of nature. A substantial body of research has found that outdoor environmental education activities provide these first-hand experiences and can foster children's connectedness to nature (Collado et al., 2013). However, few studies have assessed whether connectedness to nature determines adolescents' willingness to engage with the natural environment. It is important for us to understand the drivers of participation in nature-based activities because it is urgent to reconnect people with nature to avoid the 'extinction of experience' (Miller, 2005).

PUSH AND PULL THEORY

Push and pull theory has been widely used to understand why people choose certain travel locations (Tsephe and Obono, 2013) (Figure 1). The theory relates two factors specifically to a single action such as 'participation in an activity'. 'Push' factors are internal psychological forces, for instance, social interaction, escaping from daily routine, sense of adventure, and gaining knowledge, affect people's visit to national parks. 'Pull' factors are external environmental features that attract people to specific travel destinations, such as sunshine, historic monuments, convenience of facilities, and easy access (Kim et al., 2003). The push-pull framework for travel behaviour seems to be involved in factors that lead to choice of a destination. Similarly, going outside for wildlife viewing may be considered as a special mobilizable way of ecotourism, instead of using a fixed viewing platform (Higham et al., 2008). Therefore, in this study, we apply push-pull framework to further explore factors that discourage adolescents from participating in nature observation.

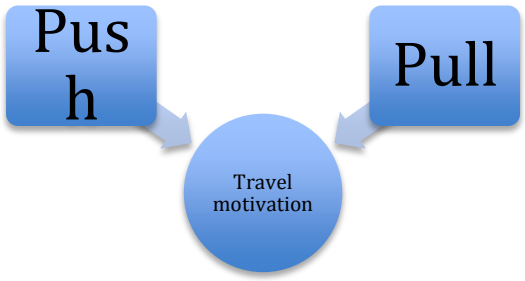

Figure 1. The Push and Pull Theory for travel motivation.

METHOD

This study was conducted in the Xishuangbanna region of southwest China. The region has a high level of

biodiversity but relative lack of opportunities for environmental education for local students. We systematically sampled 10 middle schools in three counties from a total 43 middle schools in Xishuangbanna region, using the sample function in R software (4 middle schools in Jinghong City, 3 in Menghai county and the other 3 in Mengla county). In the schools sampled, grade 8 classes were randomly selected to take part in this study. We target adolescents, as this age group would be able to use an observation toolkit and record observed results by themselves. It is also a critical period for o developing their cognition of nature when experiencing the wild (Kellert, 2002). All human-related and informed consent protocols were approved by the schools investigated and approval to approach schools was granted by the schools' principals.

QUESTIONNAIRE SURVEY

We designed a questionnaire that addressed the following topics: 1) adolescents' nature connectedness, 2) their enjoyment of plants and animals, 3) demographic information. We used a paper-pencil test to collect data during class hours.

Adolescents' nature connectedness

Although a connectedness to nature scale is reliable and valid widely used, it is relatively abstract for Chinese students to evaluate the extent to which people experientially views themselves as egalitarian member of the broader natural community, have a sense of kinship with nature, and view their welfare as related to the welfare of the natural world (Ernst and Theimer, 2011). To measure adolescent's nature connectedness we adopted the enjoyment of nature scale from Milfont and Duckitt (2010). Nature connectedness is defined as the belief that enjoying time in nature is pleasant and preferred to spending time in urban areas, as compared to the belief that enjoying time in nature is dull, boring and not enjoyable.

Adolescent's enjoyment of plants and animals

Following the studies of Cheng and Monroe (2012) about children's affective attitudes towards nature, we developed our own scale by subdividing their scale into enjoyment of plants and enjoyment of animals. Enjoyment of plants was defined as people enjoying spending time planting and seeing plants in the wild. While the enjoyment of animals, in this study, referred to people enjoying time viewing birds and insects.

Demographic information

This section collected information about schoolchildren's age, gender, pet ownership, camera and binocular ownership, whether their school was in a rural location, whether one of their parents is a biological teacher and their proximity to forest (how long does it takes from their home to the nearest wood by walking?).

Nature Observation Clubs

To address the increasing gap between students and nature, we established an environmental education program referred to as 'Nature Observation Club'. The Nature Observation Club was aimed at encouraging adolescents to engage with learning about local natural environments, and prompting their emotional affinity with nature. To reduce experimental bias, only one environmental educator from Xishuangbanna Tropical Botanical Garden introduced the programme and carried out the questionnaire surveys. This was to retain consistency in the messages communicated to the audience.

A short lecture introducing the Nature Observation Club

To introduce the Nature Observation Clubs in the 10 schools, a 30-minute lecture was given to pupils. The lecture consisted of four sections: watching birds, plant and animal photography, making insect specimens, and observation of three kinds of plant seeds and their germination.

Participation in the nature observation club

After finishing the introduction of the Nature Observation Club, adolescents then voluntarily applied for participation in the Club if they were interested in this program.

If anyone wanted to participate in the Club, they would fill an information sheet for their name, and QQ account (a chat tool similar to Facebook). Between7-10 participants were teamed up. A nature observation toolkit was distributed to each team. This toolkit included binoculars, camera, magnifying glass and insect specimen's production tools packaged into a schoolbag (Figure 2). Participants used this toolkit to conduct observation and exploration of nature during their free time. A total of 340 adolescents participated in the *Nature Observation Club* and 35 sets of toolkit were distributed to the participants.

Figure 2. The toolkits of the nature observation schoolbags.

Follow-up interviews

Follow-up interviews were carried our two months after nature observational clubs had finished due to its potential for understanding genuine reasons (Drury et al., 2011). We interviewed 107 participants and 97 non-participants for the reasons why they participated in the clubs or not. We used QQ to collect this information, which is suitable for engaging with adolescents'. Adolescents' answers were recorded in a text document.

RESULTS

Nature connectedness affects schoolchildren's participation

Based on AICc (Corrected Akaike's Information Criteria), the most supported model retained age, nature connectedness, and previous nature experience as explanatory factors. All 16-candidate models indicated that none of the socio-demographic factors contribute to the explanation participation in the nature observation clubs (all p-value > 0.05) except for age (Table 1). It suggested that younger adolescents showed more willingness to participate in nature observation than the older ones. Our results indicate that nature connectedness significantly influences adolescents' willingness to participate in the nature observation clubs (Table 1). More previous nature experiences were a positive factor predicting schoolchildren's willingness to participate in the clubs. Nature connectedness was the strongest predictor of participation in the nature observation clubs as it had higher estimates values than other factors. However, the proportion of variance explained by sole nature connectedness was relative low, just 12%.

Table 1. Summary of the most highly supported models developed to assess the impact of age, nature connectedness, and previous nature experiences on participation in nature observation clubs.

Model	Age	Nature connectedness	Previous nature experiences	ΔAICc	Estimate R^2
Slope (*b*)	-0.24*	0.62***	0.30**	0.00	0.17
Std. Error	0.10	0.17	0.12		
X_1^2	5.22	12.73	6.73		

Note: Binary response variable is whether schoolchildren participate in the nature observation club. * p < 0.05, ** p<0.01, *** p<0.001. ΔAICc: Corrected Akaike's Information Criteria.

Compelling factors leading to adolescents could not participate in the Nature Observation Clubs

We interviewed 107 participants and 97 non-participants. Factors with high frequency that 'push' adolescents away from participation in nature clubs include: indifference in plants and animals, herd-mentality and lack of self-confidence. Lack of time and heavy schoolwork were external 'pull' factors and hinder most adolescents in their participation in the nature observation clubs (Figure 3). 28% non-participants (N=27) reported that they had no free time to participate in the nature observation clubs. Some of them declared that they liked nature and were interested in plants and animals. For example, one student said: "I like walking outdoor to observe animals' life and listen to sound of nature, but I have no time to observe plants and animals." Another student said: "I have no free time during vacation for participating as I take a piano course in Kunming and have to make missed lessons."

24% (N=23) non-participants directly said that they were not interested in plants and animals. 14% (N=14) indicated that they missed out the participation in the clubs due to being sick, having urgent things to do at home, and other activities to do.

As for the participants, most of them (56%, N= 60) stated that they were interested and fond of plants and animals. Other 'push' forces included learning about biology, curiosity and for fun (Figure 3). No 'pull' factors, such as attraction of observation tools, easy access to forests, were found during the interviews.

Figure 3. Compelling "pull" and "push" factors leading to adolescents whether participate in the natural observation clubs.

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