

## A new botanical garden-led undergraduate course combining botany and high level conservation management thinking

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### Keywords

Botanical garden, Botany, Capacity-building, Course, Employer-employee, Management thinking, Nature conservation, Plant families, Undergraduate

### Abstract

We describe a newly-developed BSc course that aims to produce a new type of conservation expert. One of the main goals of the course is for students to obtain knowledge of plants and vegetation and their adaptations and needs. Another is to teach students at a high management level how to deal with major conservation issues, such as the ecological footprint, fragmentation and sustainable exploitations of forests. Course material is provided in the form of lectures and hands-on work sessions presented and led by experts in a certain field.

In this course the principles of botany are discussed in detail. Describing and identifying plants is practised, both in the practical rooms as well as in the botanical garden. The characteristics of 47 plant families, tropical as well as temperate, are highlighted and considered in the light of conservation issues. For this the botanical garden plays a crucial role, allowing students to recognise the true scale of biodiversity in a challenging yet engaging way. This will give students the essential skills to be used in discussions with decision makers on conservation issues.

At the end of the course companies as well as representatives from institutions and governmental bodies will be present at an employer-employee day. During this day students will become aware of what employers may expect from potential employees. Good plant knowledge often seems a crucial condition, alongside a high level of critical thinking.

Initial feedback confirmed that this course, with the aid of the botanical garden, has truly started a new way of capacity building in the field of plant conservation.

### Conservation and the botanist effect

*Over the last few decades, resources for descriptive taxonomy and biodiversity inventories have substantially declined, and they are also globally unequally distributed. This could result in an overall decline in the quality of biodiversity data as well as geographic biases, reducing the utility and reliability of inventories.*

*We suggest that greater investment in the training of botanists and in the provisioning of good facilities would substantially increase recording efficiency and data reliability, thereby improving conservation planning and implementation on the ground.*

Ahrends et al. (2011)

### Introduction

In order to build capacity in the field of plant conservation at management level, it is vitally important that today's biology students are made aware of the sheer beauty and astonishing variety and complexity of endangered ecosystems. Getting to appreciate an ecosystem's vegetation, and especially its individual plants, is a good starting point. Plants do not move and can therefore be easily collected and studied. A good place to study plants is in a botanical garden, where biodiversity is on display in a relatively small area. Moreover, the use of a botanical garden

for undergraduate and postgraduate courses may also serve as one of the validations for its existence.

Plants are the building blocks of every ecosystem. Plants are also very visible to decision makers and politicians visiting vulnerable ecosystems. These decision makers may be more easily convinced to take action on preservation issues, if their conservationist counterparts can demonstrate in-depth knowledge of the plants and the vegetation surrounding them.

Currently, courses on conservation at management or research level do not include any substantial botany training, be it pure plant knowledge or how plants interact with the environment. In this course the concepts of biodiversity and species decline will be correlated to an understanding of nature conservation, sustainability and human activities. This will be illustrated with examples from the plant kingdom, drawing on the expertise and plant diversity of the botanical garden. In addition, companies, as well as foundations and governmental organisations, will present themselves at an 'employer-employee day' and will explain what is expected from potential employees. Comprehensive plant knowledge is often one of the crucial skills required.

Feedback confirmed that this course has truly started a new way of capacity building in the field of plant conservation. A follow-up MSc-level course is under development as the next stage in a new series of courses to generate plant conservationists.

### **Intended learning outcomes**

At the end of this course students should:

- have gained a detailed understanding of plant diversity.
- be familiar with techniques to identify species.
- be able to correlate plant diversity to the overall condition of an ecosystem.
- be able to describe and interpret morphological trait patterns and relate them to taxonomy (species, genus and family level) and functional and ecological adaptation.
- be confident in using a herbarium.
- appreciate the importance of botanical knowledge in the field of conservation and sustainability research.
- be familiar with different scientific views and conservation models to quantify the loss of species and ecosystems, and be able to propose measures to counteract this.
- be able to explain habitat loss, overexploitation, fragmentation, climate change, their influence on wetlands, the influence of microbes, and the introduction of non-native species, and combine these issues with practical nature conservation policies at local, regional and global scales.
- be able to compare and contrast conservation of species and ecosystems with issues concerning sustainable use of natural resources and climate.

### **Outline of the course**

*Content (Table 1):*

- 2.5 days a week for 10 weeks
- Every week:

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- 1.5 day botany, partly in the botanical garden.
  - 1 day conservation issues, supervised by an expert in a particular field.
  - In all:
    - 4 x 0.5 and 7 x 1 day of botany (= 9 days)
    - 6 days of conservation issues
    - Throughout the course: a research project (groups of 5) on a conservation subject created and supervised by an expert who also serves as an e-mail coach, starting with a job application and resulting in a paper and a poster presented at a mini-symposium on the last day at WWF Netherlands Head Office
    - Week 7: an employer-employee day
    - Exam on the penultimate day of the course.

#### *Examples of research projects:*

- Wood certification and tropical forests
- Fragmentation and nature conservation
- Reintroduction of the otter in the netherlands
- The ecological footprint
- Carbon dioxide sinks in tropical forests
- Other functions besides carbon dioxide in redd (united nations, 2008)
- Bromeliaceae, their taxonomy and conservation
- Genetic diversity and nature conservation
- Red lists and nature conservation: plants
- Eco-cities, sustainable cities
- Sustainability, religion and culture
- Sustainability and the landscape: regulating
- Botanical gardens and *ex-situ* conservation: tropical or temperate.

#### *Conservation Issue Days*

- REDD
- Living Planet Report (WWF, 2012) and ecological footprint
- Sustainable (tropical) forest management
- Corridors and fragmentation

- The role of herbaria and taxonomy in conservation projects
- The role of microbes in the conservation of ecosystems
- Every Conservation Issue Day starts with two lectures, followed by a workshop, each resulting in a short essay or a presentation or a fact sheet made by the students (in groups of 5) based on given literature

#### *Botany (1), 4 x 0.5 day*

- Lecture: introduction to 'botanical language'
- Workshop: making a complete description of a living plant
- Lecture: introduction to nomenclature, botanical keys and floras
- Workshop: identifying living plants using the Dutch Flora
- Lecture: introduction to collecting and taxonomy of Bromeliaceae by a world expert
- Workshop: answering taxonomical questions about this group using herbarium material
- Lecture: The Foundation Trésor
- Workshop: tour of the Utrecht Botanical Garden greenhouses
- All workshops in a laboratory (binoculars available).

#### *Botany (2), 7 x 1 day*

- Lectures (2): introduction to pollination syndromes
- Workshop: a practical exercise in a laboratory: studying flowers in relation to the pollinator
- Lectures (2): introduction to dispersal mechanisms
- Workshop: a practical exercise in a laboratory: studying fruits in relation to the dispersal mechanisms
- 5 days: Lectures (2): introduction to 46 plant families
- Workshop: a practical exercise in a laboratory: studying family features and making diagnostic descriptions, 10 families each day
- Workshop: aided by a map (Fig 1) and blue labels with only a family name (standard labels are green) in the garden (Fig. 2) a 'plant hunting' session in the botanical garden focussing on the diversity within each family
- All material supplied by the Botanical Garden.

#### *Assessment*

- Marks for the application letter, poster session and research project paper (30%)
- Marks for essays, presentations and factsheets of the workshops (10%)

- Exam marks, exam consisting of half botany, half conservation issues, including making a description and a flower diagram of a living plant (50%)
- Attendance and marks for practical sessions (10%).

### **Typical outline of a plant family lecture**

- An example of a well-known species within the family.
- A detailed botanical drawing and an explanation of the flower features.
- Flower diagrams showing the diversity within the family.
- A distribution map.
- An overview table including almost all, mostly morphological, characteristics of the family (details of which are formative and not assessed); for instance, numbers of genera and species, habit, position of leaves/stipulae, inflorescence, flower formula, gender, fruit etc.
- Pictures of flowers and fruits and their characteristics.
- An overview table including ecological features (details of which are part of the assessment); for instance, pollination, dispersal, uses, habitat and CITES information.
- Pictures of examples of the use of species within the family.
- Pictures of endangered and CITES species.
- Pictures of 'species with a story' (e.g. invasive, poisonous, historical, spectacular, symbiotic or generally unusual plants)
- Pictures showing several species within the family that are part of the botanical garden collection.
- Pictures from a personal photograph collection, for tropical plants mostly taken during field trips in the Trésor Nature Reserve in French Guyana (a nature conservation project of Utrecht University), together with stories with personal experiences, highlighting fascinating aspects of the family.
- An overview slide detailing the diversity and variability observed within the family.

For a list of the families studied see Table 2.

|         | Monday | Tuesday | Wednesday | Thursday | Friday |
|---------|--------|---------|-----------|----------|--------|
| Week 1  |        |         |           |          |        |
|         |        |         |           |          |        |
| Week 2  |        |         |           |          |        |
|         |        |         |           |          |        |
| Week 3  |        |         |           |          |        |
|         |        |         |           |          |        |
| Week 4  |        |         |           |          |        |
|         |        |         |           |          |        |
| Week 5  |        |         |           |          |        |
|         |        |         |           |          |        |
| Week 6  |        |         |           |          |        |
|         |        |         |           |          |        |
| Week 7  |        |         |           |          |        |
|         |        |         |           |          |        |
| Week 8  |        |         |           |          |        |
|         |        |         |           |          |        |
| Week 9  |        |         |           |          |        |
|         |        |         |           |          |        |
| Week 10 |        |         |           |          |        |
|         |        |         |           |          |        |

- = Botany
- = Conservation issues
- = Self study and working on research
- = Special day (employer-employee day and mini-symposium on the last day).
- = Exam

Table 1 Outline of the course schedule

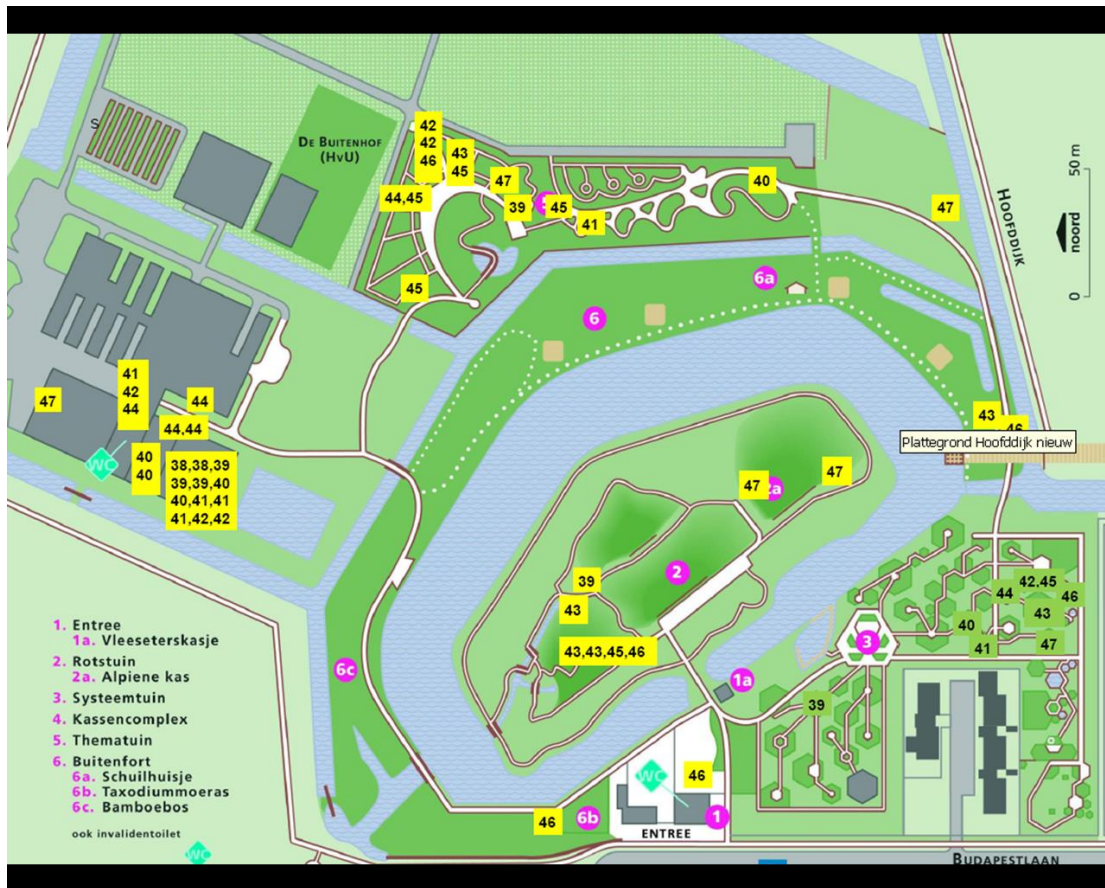


Figure 1 Map of the garden with family number positions



Figure 2 Blue labels in the Garden

| Families:     |              |                |                  |                |
|---------------|--------------|----------------|------------------|----------------|
| Day 1         | Day 2        | Day 3          | Day 4            | Day 5          |
| Cyatheaceae   | Lauraceae    | Poaceae        | Melastomataceae  | Lecythidaceae  |
| Polypodiaceae | Annonaceae   | Cyperaceae     | Myrtaceae        | Primulaceae    |
| Cycadaceae    | Magnoliaceae | Bromeliaceae   | Rutaceae         | Apocynaceae    |
| Zamiaceae     | Piperaceae   | Ranunculaceae  | Sapindaceae      | Rubiaceae      |
| Cupressaceae  | Araceae      | Crassulaceae   | Dipterocarpaceae | Lamiaceae      |
| Pinaceae      | Asparagaceae | Euphorbiaceae  | Malvaceae        | Plantaginaceae |
|               | Iridaceae    | Passifloraceae | Brassicaceae     | Solanaceae     |
|               | Orchidaceae  | Fabaceae       | Caryophyllaceae  | Boraginaceae   |
|               | Arecaceae    | Rosaceae       | Cactaceae        | Apiaceae       |
|               | Costaceae    | Moraceae       | Ericaceae        | Asteraceae     |
|               |              | Betulaceae     |                  |                |

Table 2 List of families **studied**

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*Web-site:*

<http://www.mobot.org/mobot/research/apweb/welcome.html>