"Plants for people, People for Plants"

7TH PLANTA EUROPA CONFERENCE

Conferenee Proceedings

Editor: Lucas A. Andrianos *Co-editors: Jan Willem Sneep and Konstantinos Zorbas*

Horizon Research Publishing, USA

Conference Proceedings

PLANTA EUROPA CONFERENCE

Kolympari, Crete, Greece
Orthodox Academy of Crete (OAC)
May 21-25, 2014

CHANIA 2014

OAC - Foundation under the auspices of His All Holiness, the Ecumenical Patriarch Bartholomew

INSTITUTE OF THEOLOGY AND ECOLOGY
ORTHODOX ACADEMY OF CRETE

Horizon Research Publishing, USA

Planta Europa is the network of independent persons and organisations, non-governmental and governmental, working together to conserve European wild plants and fungi.

Planta Europa vision is a world where plants are valued - now and for the future. The joint goal of all Planta Europa members is to halt the loss of wild-plant diversity in Europe. Today Planta Europa brings together more than 80 member organisations from 35 European countries. Among the members are non-governmental conservation organisations, governmental bodies, botanical gardens, universities, research institutes and other organisations and private persons.

The history of Planta Europa started in 1993 when Plantlife International (PIWC) made a proposal to Bern Convention Plant Expert Meeting for a conference to discuss pan-European collaboration for plant conservation.

From 1 January 2014 the Swedish Species Information Centre hosted the PE Secretariat. The financial aspects and bank account will still continue by the Planta Europa Foundation in the Netherlands. The Orthodox Academy of Crete hosted the 7th Planta Europa Conference in Kolympari, Chania, Crete (Greece) on 21-25 May, 2014.

More information on Planta Europa activities are at www.plantaeuropa.net.

The Orthodox Academy of Crete (OAC) is a non-profit Foundation for the common good. It functions in canonical relation with the Holy Metropolis of Kisamos and Selinon, with the spiritual support of the Church of Crete and under the aegis of the Ecumenical Patriarch.

The basic mission of the OAC is to promote dialogue and to be a bridge between Orthodoxy and the world. In this context of dialogue, the OAC facilitates, as a way of thinking and living, self-reflection, interpersonal reconciliation, and a responsible relation with the Divine Creation. Based on the platonic tradition of "symphilosophein" (philosophising together), and on the Orthodox Christian spirit of ecumenical openness, the Academy does not set boundaries, nor restrictions in that dialogue. As an offer from the Church to modern man, it always remains accessible to all creeds and welcomes every one without discrimination.

With the organisation of conferences and a variety of other activities, the OAC encourages mutual understanding and solidarity on an inter-Orthodox, interfaith, intercultural and interscientific basis, in order to contribute to the reconciliation of peoples, the consolidation of peace, and human progress. Although most of the conferences are organised by the OAC, it cooperates with other institutions and organisations that want to use the facilities and experience of the OAC, and who seek a tranquil atmosphere for creative work and fellowship.

The Institute of Theology and Ecology is a department of the OAC. It was inaugurated in 1991 to advance the interlinking between Theology and Ecology in the struggle for the protection of the Divine Creation. Following the donation of about 9,000 Cretan wild plant specimens to the OAC by the French Botanist Jacques Zaffran in 2003, a Museum of Cretan Flora was created as a part of the institute.

Supporting Institutions:

Planta Europa Foundation (www.plantaeuropa.net)
The Institute of Theology and Ecology of the Orthodox Academy of Crete (www.oac.gr)
Flowers of Crete (www.flowersofcrete.info)
Technical University of Crete (www.tuc.gr)
Institute of Molecular Biology and Biotechnology – Foundation for Research and Technology-Hellas (www.imbb. forth.gr)
The local televisions Neatv (www.neatv.gr)
The local newspaper Haniotika Nea (www.haniotika-nea.gr)
The local newspaper Chania Post (www.chaniapost.eu)
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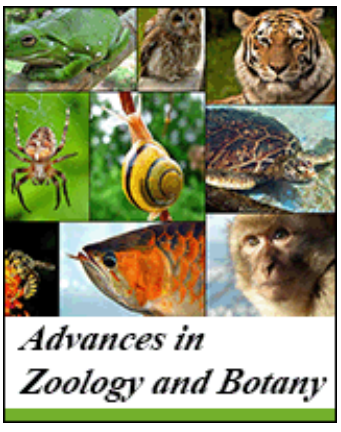

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Welcome Message

Jan-Willem Sneep

Chairman of Planta Europa
Director of the Planta Europa Foundation

Planta Europa Foundation, Laan van Meerdervoort 1030
2564 aw The Hague, the Netherlands
E-mail: jwsneep@live.nl

Distinguish Guests, Ladies and Gentlemen, Dear Friends. CALIMERA,

It is my privilege as Chairman of Planta Europa to welcome you all to this 7th Planta Europa Conference in Greece. (More than 80 participants from 25 countries)

This morning a special welcome to our distinguish guests:

- The President of Planta Europa, Dr. Anca Sârbu (Romania);
- The representative of the Orthodox Academy of Crete, his grace priest Dionisios;
- On behalf of the General Director of the Orthodox Academy of Crete, Mrs Catharine
- Zormpas;
- The Mayor of the Municipality of Platanias and Kolympari, Mr. Ioannis Malandraki;
- The Deputy Rector of the Technical University of Crete, prof. Giorgos Stavroulakis;
- The Chairman of the Standing Committee of the Bern Convention of the Council of Europe,
- Dr. Jan Plesnik (Czech Republic);
- The students of the High School of Kolympari.

You are on a special place now. You are in Greece, the father of our democracy. You can think and speak free. Greece with a long, rich history and a spectacular natural beauty is home to more than 6000 plant species of which 750 can only be found on Greek land.

Today you are on the largest island of Greece. The beautiful island Crete houses a huge variety of plants, flowers and trees. Over 2000 different kinds of plants grow on this island, of which about 160 are found nowhere else in the world. Especially in spring many of these plants grow. During the seasons, places on the island get a different face by the variety of vegetation.

A lot of different spices also grow on this island. They often distribute a strong sweet smell all years around to this Greek island and they have been used for culinary and medical purposes.
Crete is a real botanic paradise.

I can assure you, the coming days you will enjoy of the beauty of this island, you will enjoy of the beautiful Greek wild plants and you will really enjoy of the Greek gastronomy and the Greek hospitality..
As warming up we will start with a slide-show of some of the 12.500 wild vascular plants which occur in Europe. It will give us a good impression of the differences in colours, shapes, and life circumstances of the European wild plants. We can be really very proud on the rich European plant biodiversity.

Ladies and gentlemen, welcome again!

We are very grateful to the Greek partners for making it possible for us to come to the Orthodox Academy of Crete which host the 7th Planta Europa Conference and bring together the experts in the field of plant conservation from the different European countries and from countries outside Europe.

Many thanks to the members of the Organizing Committee for the preparation work of this conference, especially many

thanks to Dr. Lucas Andrianos for his excellent work and cooperation.
We are also very grateful for the financial support and the collaboration with:

- The Orthodox Academy of Crete;
- The Planta Europa Foundation;
- The ArtDatabanken – the Swedish Species Information Centre;
- The Botanical Park and Gardens of Crete;
- The Technical University of Crete;
- Greek olive companies Terra Creta and Biolea;
- NeaTV and Chania Post.

In 1995, almost 20 years ago, the first Planta Europa Conference took place in Hyères (France) and our network was initiated. From 1995 till now a lot of progress has been made, much national and international co-operation has been achieved and a lot of friendship has developed between people working on wild plant conservation in Europe.

Wild plants are essential to life. Plants are a vital part of the world's biological diversity and are an essential resource for human well-being. Plants cover the land surface of our earth like a fine skin, absorbing the energy of the sun to support the web of life on our planet. Besides the crop plants that provide our basic food and fibres, many thousands of wild plants have great economic and cultural importance and potential, providing food, medicine, fuel, clothing and shelter for vast numbers of people throughout the world and provide an important component of the habitats for the world's animal life.

Plants also play a key role in maintaining the planet's basic environmental balance and ecosystem stability, they clean our air and water. Plants are critical in the fight against climate change. But plants also give us pleasure, healing and artistic inspiration. The life support system of the planet can only be maintained by protecting plant biodiversity. Therefore a thorough understanding of the conservation of the European flora is needed.

European wild plants are amongst the most threatened in the world. This is due to agriculture and forestry, causing changes in the use of land, the effect of commercial and other economic activities, the introduction of non-native species of plants and the destruction of habitats. There are a lot of global and European political and legal frameworks, treaties, conventions to achieve the conservation of nature and wild plants, but unfortunately we see the implementation of all these duties seems to be very difficult and may go a long way. In Europe nature conservation, including wild plants will get less political attention due the recent economic, financial, social problems in the most of the European countries.

This means today we need to use a more proactive and innovative approach to save wild plants in Europe and in the world. Neither government authorities nor private organizations can successfully protect wild plants on their own. Only together we can save our wild plants. This reminds me on the following expression: if you want to go quickly, go alone; if you want to go far, go together. The development and the implementation of the European Strategy for Plant Conservation are good examples to work together in partnership.

In my opinion it should be a privilege and at the same time a challenge for all governments, politicians, regional and local authorities, scientists, NGO's, botanical gardens, citizens, representatives of organisations in the field of agriculture, forestry, fishery, tourism, recreation and health, to work together on a world in which wild plants are valued.

So, let us make an effort. Let us all work towards a greater understanding of wild plants.

A greater understanding of wild plants will lead to a greater understanding of our dependence on the earth's life support system. Therefore the slogan of this conference is "Plants for People, people for plants". We need the plants for our own survival, but at the same time it is our civilisation to take care on the wild plants. Plants for people, people for plants.

This Planta Europa Conference gives us the opportunity to exchange and share our knowledge, expertise, experiences and best practices related to many different valuable aspects of the European wild plants and fungi.

I wish you all a very fruitful conference and a very pleasant stay on Crete. Now, I officially declare the 7th Planta Europa Conference 2014 as open.

Thank you for your attention.
Dr. Jan Willem Sneep
Chairman of Planta Europa

Foreword

Konstantinos Zorbas

Director General of the OAC

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"You who painted the earth with flowers..."

I would like to welcome the continuation of the 7th Conference of Planta Europa, a leading European network for the plant diversity conservation, that brought together at the Orthodox Academy of Crete, in late springtime of 2014 (22−25 May), more than 135 plant scientists from twenty four different countries.

The theme of the 7th Planta Europa "Plants for People, People for Plants" gives the opportunity to botanists, mycologists, environmentalists, cell biologists and other plant scientists from all over the world to meet and emphasizes quite symbolically the importance of the implementation of the Global and European Strategies for Plant Conservation. But not only!

If we try to conceive the relation between the human being and nature, this can be visualized in the Orthodox Tradition during the lent time before Easter, called "Triodion" and especially the liturgical text from the Sunday called "Cheese-fare Sunday". This development, followed throughout creation, from the simple to the most complex and from the less perfect to the most, unveils a world, created with wisdom, plan and with an aim: "God saw every that he had made, and it was very good" (Gen. 1:31). 'Very Good' means perfects!

But the human being, "not respecting the command of the Master" to protect this perfect world, is being expulsed from Paradise. Adam by disobedience wept in his exile, sitting "outside of paradise"; he wept, remembering what he was, what he possessed, and Whom he lost. To this day, all mankind weeps and sighs over the first Adam, over the now elusive phantom of happiness.

Nature is in compassion in this pain and "has been groaning as in the pain of childbirth" (Rom. 8:22). Adam (that is the human being) is sitting opposite of Paradise. "Verily, Adam sat opposite paradise bewailing his nakedness and crying" and he asks from the nature: "O Paradise, perfect, all-holy and blessed, planted for Adam's sake and shut because of Eve, pray to God for the fallen…". And one other text: "O most-honored paradise, comeliness transcendent in splendor, the dwelling-place perfected by God, unending joy and enjoyment, the glory of the righteous, the joy of the Prophets, and the dwelling place of the saints, beseech the Creator of all, by the tune of the rustling of Thy leaves, to open for me the gates which I closed by sin, and that I be worthy to partake of the tree of life and joy, which I enjoyed in Thee of old" (Oikos of the same day).
In this perfect and absolutely educational perspective, Orthodoxy is committed to ecology, the respect of the nature; for this reason Church is "green" par excellence. And as our His Eminence the Ecumenical Patriarch Bartholomew Ier explains: "our faith and our worship strengthen our commitment for the protection of creation and promote the 'eucharistic use' of the world, the solidarity with creation. The Orthodox Christian attitude is the opposite of the instrumentalisation and exploitation of the world…" (Address By His All-Holiness Ecumenical Patriarch Bartholomew at the Conferral of an Honorary Doctorate in Sociology From the Izmir University of Economics, February 9, 2015).

With the blessing of the Church we, my staff and I, continue this effort. It is an effort which we consider holy, throughout the pedagogical programmes of the Orthodox Academy of Crete and the Institute of Theology and Ecology. Our responsibility through the ecological education is to underline social values, freedom and justice, mutual respect, solidarity with creation and with humanity.

We remain thankful for this encounter and express once again our gratitude to Planta Europa Network. We thank all participants for their cooperation, the board of Planta Europa, our staff and especially Dr Lucas Andrianos who represents the Institute and the OAC at the board of Planta Europa.

Thank you very much. God bless you all!

Dr Konstantinos Zorbas
General Director
of the Orthodox Academy of Crete

Editorial

Dr. Lucas Andrianos

Head of the Institute of Theology and Ecology– oac

Together to save the Plants of Europe and the whole Earth biodiversity

The seventh conference of Planta Europa took place at the Orthodox Academy of Crete in May 21-25 2015 and it was organized by the Institute of Theology and Ecology – Museum of Cretan Flora in Kolympari, Chania, Greece. The history of Planta Europa started in 1993 when Plantlife (UK) made a proposal to the Bern Convention Plant Expert Meeting (Council of Europe) for a conference to discuss pan-European collaboration for plant conservation. The followings are the milestones of the Planta Europa conference:

In 1995, the French Ministry of Environment hosts the 1st Planta Europa Conference in Hyères, France. This conference brought together plant conservation experts from throughout Europe for the first time ever. Hundreds of experts gather to discuss the directions and joint goals for plant conservation across Europe.

In 1998, the Swedish Species Information Centre hosts the 2nd Planta Europa Conference in Uppsala, Sweden.

In 2000, Planta Europa becomes the European programme of Plantlife International The Planta Europa constitution is finalised.

In 2001, the Czech Agency for Nature Conservation hosts the 3rd Planta Europa Conference in Pruhonice, Czech Republic. At this Conference, the Network mobilised its plant conservation expertise to develop a master plan with concrete targets to halt the loss of plant diversity in Europe by 2007. The outcome of this conference was the European Plant Conservation Strategy (EPCS). The 42 targets of the EPCS are specific, measurable, realistic, achievable and time bound.

In 2001: Adoption of Recommendation no 87 (2001) on the European Plant Conservation Strategy, by the Standing Committee (Parties/European countries) of the Convention of the Conservation of the European Wildlife and Natural Habitats (Bern Convention / Council of Europe), on 30 November 2001.

In 2002: The EPCS is endorsed by the Convention on Biological Diversity (CBD) as part of and a contribution to the Global Strategy for Plant Conservation (GSPC).

In 2004: Generalidat Valenciana and Botanic Garden of the University of Valencia host the 4th Planta Europa Conference in Valencia, Spain. A mid-term review of the EPCS was undertaken at the 4th Planta Europa Conference.

In 2007, The Association of Romanian Botanic Gardens, the local University Babes Bolyai and the Botanic Garden "Al Borza" hosted the 5th Planta Europa Conference in Cluj Napoca, Romania. The theme of the conference was "Working together for plants". Based on the outcome of this conference a renewed version of the European Strategy for Plant Conservation is developed.

In 2011: The Polish Academy of Sciences and the W.Szafer Institute of Botany host the 6th Planta Europa Conference in Krakow (Poland). The outcome of this conference is the "Declaration of Krakow".

In 2014: The institute of Theology and Ecology and the Museum of Cretan Flora at the Orthodox Academy of Crete hosted the 7th Planta Europa Conference in Kolympari, Chania, Crete (Greece) on 21-25 May, 2014.

Consequently the content of this book addresses once more the need for human response to the ecological threat to European plant diversity. It affirms human responsibility for halting plant biodiversity loss and the vast communities of Life. More than seventy (70) abstracts were submitted from 28 countries worldwide: Algeria, Belgium, Bulgaria, Canada, Czech, France, Germany, , Georgia, Greece, India, Iraq, Iran, Israel, Italy, Kazakhstan, Kenya, Latvia, Romania, Russia, Saudi Arabia, South Africa, Spain, Sweden, Switzerland, The Netherland, Turkey, United Kingdom and Ukraine. About the half of submitted papers was selected for presentation and publication in these proceedings.

The selected papers are classified in nine thematic sections, namely:

1. Politics and European strategy for the environment;
2. Plant products and commerce;
3. Environmental ethics and arts;
4. Reserve areas IPAS, in situ and ex-situ conservation and invasive species;
5. Agricultural ecosystems and biodiversity;
6. Protection and traditional knowledge;
7. Taxonomy and wild plant biology ;
8. Research , Conservation, Red list and botanical gardens;
9. Climate change and ecosystem services.

This book collects edited and revised versions of most of the papers presented at the seventh Planta Europa Conference on plant conservation (7PEC). There are many reasons why the motto for the meeting stresses the importance of the interdependence between people and plants. Human can be the cause of plant biodiversity loss or the solution for its sustainable use. The high number of submissions confirms the dynamism of Planta Europa in plant conservation and the noticeable attendance attests the suitability of the local facilities of the Institute of Theology and Ecology – Museum of Cretan flora- at the Orthodox Academy of Crete (OAC). The goal of the conference is to create a multi-disciplinary and international collaboration among botanists, politicians, educators, sociologists, artists and theologians working in the area of plant conservation and sustainability ethics.

I thank God and all supporting institutions for the successful organization of the seventh Planta Europa conferences. Special thanks are due to the Holy Covent of Chrysopigi, Terra Creta, Botanical garden of Crete, Biolea, the Municipality of Platanias and to all the conference participants for their valuable contributions and unforgettable company. Last but not the least, I address my gratitude to the Chair of Planta Europa Foundation, Dr, Jan Willem Sneep, and the president of "Flowers of Crete Association", Mrs Julia Jones, for their support in organizing the environmental exhibition and many side events that made the seventh Planta Europa conference a successful ecological awareness toward the protection of the Earth and its biodiversity.

Dr. Lucas Andrianos

Chair for 7th Planta Europa conference

Brief Repport

Mykyta Peregrym et Al.

Coordinator of the upcoming 8th Planta Europa conference in Kiev

The 7th Conference of Planta Europa, a leading European network of the plant diversity conservation, brought together in the late springtime (22−25 May, 2014) more than 135 plant scientists from 24 countries of Europe, Africa, Asia, and North America.

The tradition of this meeting was launched in Hyeres, France, in 1995 and became regular event with the periodicity of several years: Uppsala, Sweden (1998), Průhonice, Czech Republic (2001), Valencia, Spain (2004), Cluj-Napoca, Romania (2007), and Krakow, Poland (2011). This year the Planta Europa conference was hosted by the Orthodox Academy of Crete (OAC, http://www.oac.gr/), a nonprofit educational institution that organized about 2 000 social and scientific events since its foundation in 1968. The OAC is located at the suburbs of the scenic Mediterranean town of Kolympari (Chania prefecture, Crete, Greece). The slogan of the 7th Planta Europa meeting of botanists, mycologists, environmentalists, cell biologists and other plant scientists from all over the world was "Plants for People, People for Plants" that emphasizes quite symbolically the importance of the implementation of the Global and European Strategies for Plant Conservation. Ukrainian scientists properly represented their country during the conference with oral presentations and posters: Prof., Dr. Victor Melnyk (M.M. Gryshko National Botanical Garden, National Academy of Sciences (NAS) of Ukraine), "In situ and ex situ plant conservation in Ukraine"; Dr. Mykyta Peregrym (O.V. Fomin Botanical Garden at the Educational and Scientific Centre "Institute of Biology", Taras Shevchenko National University of Kyiv), "In situ and ex situ conservation of bulb and bulbotuberiferous plants in Ukraine"; Dr. Yuliya A. Krasylenko (Institute of Food Biotechnology and Genomics, NAS of Ukraine), "Arceuthobium oxycedri (DC.) M.Bieb. in Crimea: a brief history and future prospects" and "Educational and environment-oriented potential of the Fascination of Plants Day (FoPD) celebration in Ukraine" (with Prof., Dr. Yaroslav Blume and Andriy Mosyakin), and Marina Rudenko (Crimean Nature Reserve), "Conservation of Allium siculum subsp. dioscoridis in Ukraine". Also, a foreign member of the Ukrainian Botanical Society from Bulgaria, Prof., Dr. Alexander Tashev, participated in the meeting presenting the paper with Evgeniy Tsavkov "The dendroflora of the Pirin Mountain (Bulgaria) and its conservation importance". Ukrainian botanists also contributed abstracts to the conference proceedings: Dr. Olesya Bezsmertna (O.V. Fomin Botanical Garden at the Educational and Scientific Centre "Institute of Biology", Taras Schevchenko National University of Kyiv), "Polypodiophyta of native flora of Ukraine", Dr. Andriy Babytskiy (National University of Life and Environmental Sciences of Ukraine), "Incipience of study about the geocoenoconsortium structure of ecosystems", Dr. Svitlana Zhygalova (M.G. Kholodny Institute of Botany, NAS of Ukraine), "Conservation of natural habitats of critically endangered Iris pineticola Klokov (Iridaceae) in Ukraine", and Dr. Igor Olshanskiy (M.G. Kholodny Institute of Botany, NAS of Ukraine), "Two Juncaceae species disappeared from the Ukrainian Carpathians". Moreover, M. Peregrym and Y. Krasylenko participated in the Planta Europa photo and art completion and took the 2d and the 3d Prizes for the picture and art-herbarium, respectively.

Favorable conditions that facilitated the participation of the Ukrainian scientists have to be noted, namely the Planta Europa grants covering the accommodation, meals, and registration fee for the researchers that presented reports or posters. Opening ceremony started from the greetings of Planta Europa leaders: Chairman Dr. Jan-Willem Sneep (the Netherlands), President Prof., Dr. Anca Sârbu (Romania), and the OAC governance. The traditional Jean-Paul Halland Award for the special input into the plant conservation in Europe was conferred to J.-W. Sneep, and the Silver Leaf Award – to Prof., Dr. Claudia Perini (Italy), Ms. Elizabeth Radford (UK), and Prof., Dr. Kostas Iatrou (Greece). It should be noted that the Ukrainian botanist, Prof., Dr. Tetyana Andrienko, was awarded the Silver Leaf in 1998.

The Conference sections covered 14 thematic areas, such as the reconsideration of biodiversity protection and sustainable development concepts, Red Book lists of rare plants and protected areas, IPAs (Important Plant Areas) development, international political aspects of the environment protection, in situ and ex situ conservation, collaboration of experienced botanists with inspired amateurs as environmental volunteers, the European Environment Strategy, tourism and sustainable use, invasive species and commerce, agricultural ecosystems, taxonomy and wild plant biology, climate change and ecosystem services, and some others (for the complete listing of main topics, see Book of Abstracts at http://7peconference.wix.com/plantaeuropa).

During the conference, participants had the opportunity to test some plant-derived organic products produced in Crete, such as orange and lemon juice- supplemented olive oil, balsamic vinegar and herbal teas; to attend the presentation and botanical tour of Prof., Dr. Jacques Zaffran (a leading expert in the Cretan flora) and Dr. Lucas Andrianos in the Natural Flora Museum of the OAC, one of the major centers of Cretan plant diversity, exhibiting herbariums and floral illustrations by Ms. Julia Jones, to enjoy the field trip to the Botanical Garden of the Technical University of Crete (Akrotiri Peninsula) with the unique Mediterranean xerophytic shrub vegetation (tomillar, maquis and phrygana or garrigue), to the oldest Oil Museum in the village of Vouves, and to the Elafonisi, a key area of the NATURA 2000 network with an extremely rich and unique littoral psammophytic vegetation; to puzzle themselves in a workshop dedicated to in vitro orchid propagation by Philip Seaton (Royal Botanic Gardens, Kew, UK) and, finally, to visit such world-famous regional protected areas as Samaria and Agia Irini Gorges with well-preserved endemic and rare species of both the Crete and the Mediterranean Greece in general.

Among the capturing and informative oral and poster presentations highlighting the studies and conservation of plant diversity in European, North African and Asian countries, some have to be emphasized particularly. Thus, E. Radford reported on the "Updates of the implementation of PE strategy, European strategy and COP 10", analyzing the success and challenges in the implementation of the Global and European Strategies for Plant Conservation, and A. Sârbu shared the ideas about biodiversity education inside and outside botanical gardens. The development of educational and information technologies, including Android mobile phone applications, and their importance in the coordination of efforts of botanists and volunteers was discussed in most of the reports, both directly and indirectly.

At the closing session, the preliminary version of the "Crete Declaration" (available from the official Planta Europa website http://www.plantaeuropa.net/) was presented by Dr. Mora Aronsson (Sweden), who was elected a new Chair for the 8th Planta Europa Conference in 2017. We are pleased to inform that M. Peregrym, the active plant expert representing our country, was included in the Steering Committee in 2011 and was chosen to organize the next Planta Europa Conference in Kyiv at the O.V. Fomin Botanical Garden at the Educational and Scientific Centre “Institute of Biology”, Taras Schevchenko National University of Kyiv in spring 2017, in collaboration with the M.G. Kholodny Institute of Botany of the NAS of Ukraine, M.M. Gryshko National Botanical Garden of the NAS of Ukraine as well as the engaged individual Planta Europa members from the friendly profile organizations.

M.M. PEREGRYM, Yu.A. KRASYLENKO, V.I. MELNYK, A.N. TASHEV

Chapter 1 *Politics and Strategies for Plant Conservations*

How Well Are We Doing to Implement the Global and European Plant Conservation Strategies?

Elizabeth Radford[1,*], Suzanne Sharrock[2]

[1]Plantlife International, UK
[2]Global Programmes Botanical Gardens Conservation International

Abstract An online survey of the Plant Europa and European networks on Botanical Garden Conservation International found that the objectives and target of the CBD Global Strategy for Plant Conservation (and its regional counterpart in Europe are being implementation to varying levels. Good progress has and continues to be made on the targets within objective 1; plant diversity is well understood, documented and recognised. All three targets here scored amber and green, on a red amber green scale, where red is little or no progress, amber is reasonable progress and green is good progress. Those within objective 2; plant diversity is urgently and effectively conserved, varied considerable. Targets associated with *in situ* and *ex situ* species conservation, the conservation of ecological regions and important areas for plants and the combating of invasive species were all amber or green, but much work needed on conserving plant diversity of farmland, forests and genes (all red). Objective 3, that plant diversity is used in a sustainable and equitable manner; is helped by the presence of CITIES legislation that prevents trade in endangered species. However, not enough is being done to ensure harvesting of plants is sustainable (a red target). The plant conservation community has made very good progress with the final two objectives (4); Education and awareness about plant diversity, its role in sustainable livelihoods and importance to all life on Earth is promoted, and (5) the capacities and public engagement necessary to implement the Strategy have been developed. The dettil of implementation varies greatly between country and the species rich countries need to be prioritised for investment to address the regional imbalance.

1. Introduction

During the winter and spring of 2013/14 Plantlife International and Botanic Gardens Conservation International coordinated an online survey of their networks and associated plant conservation colleagues across Europe to establish the success in implementing the Planta Europa European Strategy for Plant Conservation (207 – 2014) and to measure progress in the implementation of Global Strategy for Plant Conservation (GSPC) for the Convention on Biological Diversity (2010- 2020 to contribute to the mid-term review of this Strategy.

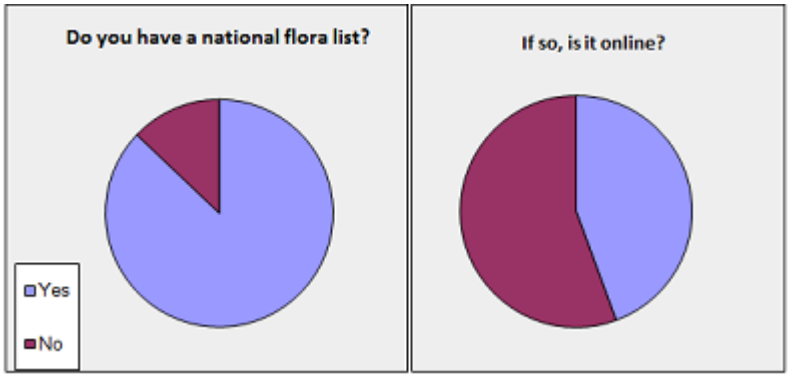
The aim was not to measure the implementation of each European target directly but to get a picture of the national contribution to the European and Global Strategy implementation. Representatives from the botanical and conservation sectors were contacted in every country whether or not a network member was present. However, survey was not comprehensive as it relied heavily on the Planta Europa network members and their contacts, and was a voluntary exercise. Fifty three quantative and qualitative questions were asked through an online survey (in English only) was open for 4 months. The full list of questions can be found in Annex 1.

2. Results & Conclusions

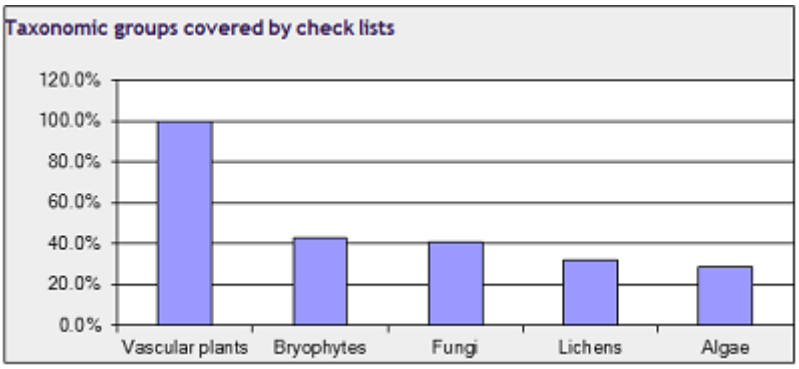
Over 80 partial and completed responses were received from 37 European countries including Armenia and Turkey. 36 out of 39 European countries (92%) were represented in the survey results. No data were made available from Bosnia Herzegovina, the Czech Republic and Hungary. Very limited data were made available from Spain, Portugal, Denmark, France and Ireland.

Results and conclusions are summarised under the areas relevant to the objectives of the CBD GSPC, with the colour indicating the status (red, amber, green) of this area of conservation work in Europe.

Objective 1: Checklists, Red lists and Methodologies



95% of countries have a national flora but only 48% of those are on line.



Not all flora as comprehensive across taxonomic groups however, all cover vascular plants, 20 include bryophytes, 10 cover some fungal groups, 15 cover lichen and only 13 algae. Twelve countries have published a flora since 2010.

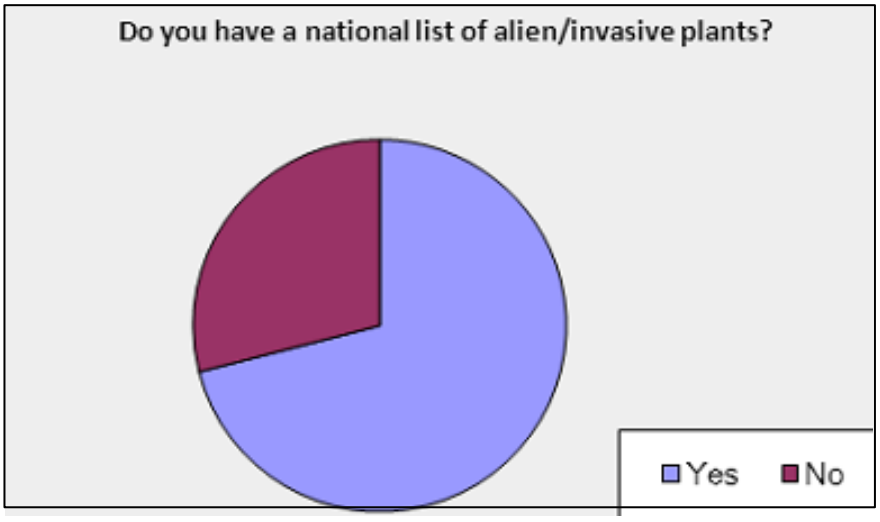
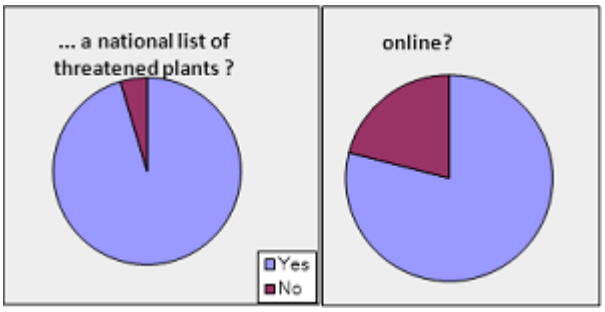
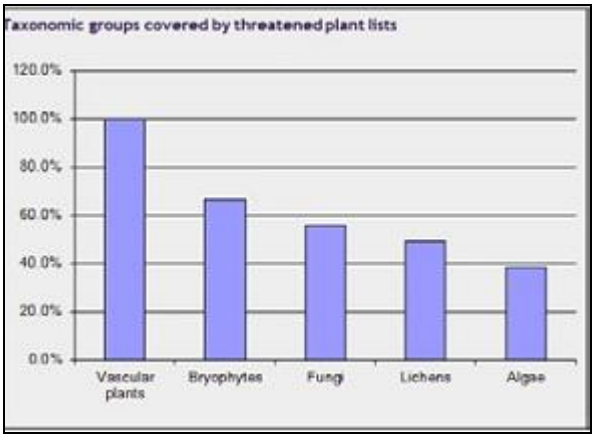


Figure 3.

67% of responding countries had information on alien invasives, but it is not always associated with the national flora. 54% contain some information on risk of spread but this is not comprehensive.



95% of responding countries have a threatened plant list, the exceptions are Macedonia FYR and Montenegro which do not have a threatened plant list. In 78% of countries these lists are on line and most countries have editions published between 2000 and 2009.



Again the taxonomic coverage of these lists varies, 100% of countries that have lists have them for vascular plants, 25 countries threatened bryophytes and 22 countries have assessment the conservation status of some but not all threatened fungal groups. 19 include lichens16 include algae, these are often charophytes (stoneworts)

In terms of improving methodologies there are many examples of improved and innovative conservation methods being used and developed for plant conservation in Europe:

- Manual pollinisation in natural populations of rare plants (Netherlands)
- Promotion of flagship species in protected areas (IUCN)
- Integrated ex situ/ in situ approach for aquatic, wetland and dryland species (Austria)
- Use of computer modelling for plant protection (Belarus)
- IPANet : use of " Natural Networks of volunteers" to undertake conservation actions and raise awareness on IPAs (Turkey, Macedonia, Bulgaria, Romania, UK, Netherlands)

Key future tasks for implementing objective 1 of the GSPC in Europe

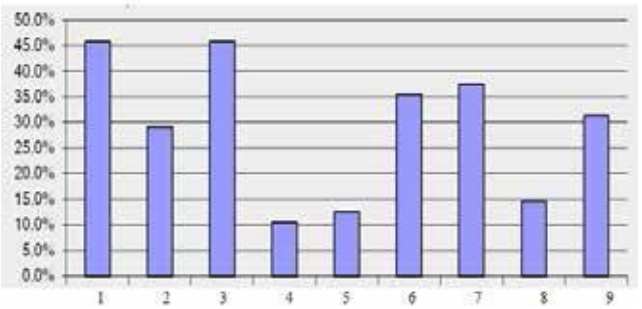
- Put the checklists and threatened species lists on line
- Develop a Red list for the flora of Montenegro, Macedonia FYR, and Bosnia Hercegovnia
- More focus on gathering information for bryophytes, lichens and fungi
- Seek opportunities for gathering knowledge about invasive alien species that affect plants through the potential new EU directive.
- Continue to showcase new methods through the GSPC web based tool kiton BGCI webpages.

Objective 2: Conserving sites and habitats Ecological regions & IPAs

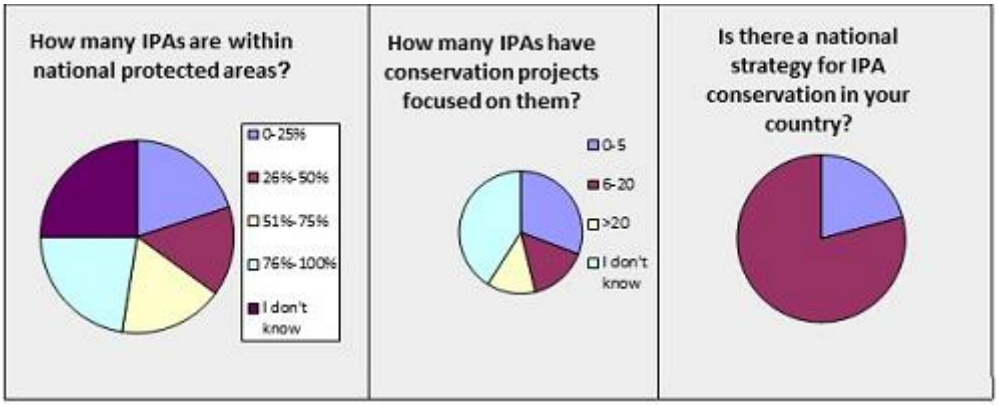
78% of European countries are involved in site based multi-country conservation projects examples include:

- Plant Microreserves
- IPANets - Natural Networks
- Wildflower Europe – celebrating rural landscapes
- ENSCONET seed conservation 2004-2009.
- Green Belt project – conservation along 'Iron curtain'
- GENMEDOC - network of centres to promote conservation of genetic resources of Mediterranean flora
- SEMCLIMED - effect of climatic change on Mediterranean flora diversity, conservation measures and increase public awareness global warming.

1901 IPAs have been identified in 19 countries in Europe. Albania has completed an IPA inventories recently, Switzerland has just begun a project, and there is an ongoing process to develop national list for areas of plant diversity in Ireland. All EU countries have identified Natura 2000 sites, but the Emerald Network has yet to be completed in Switzerland and Norway.



IPA data where available (in 45% of countries) is used for conservation efforts linked to (reference bar chart above) 1. Natura 2000, 2. the Emerald Network, 3. National Protected Areas, 4. High Nature Value farmland, 5. Ramsar sites, 6. The Pan European Ecological Network, 7. Invasives species, 8. Protected areas, or 9. It is not used.



Not a great deal is known about IPAs with conservation projects on them within the Planta Europa and BGCI networks. Moldova, Romania, Poland and UK have >20 known projects on IPAs. In 2010 an assessment was made that indicated 75% of IPAs across 14 European countries are protected at least on paper, this protection may not cover the botanical features of interest on these sites (Plantlife 2010).

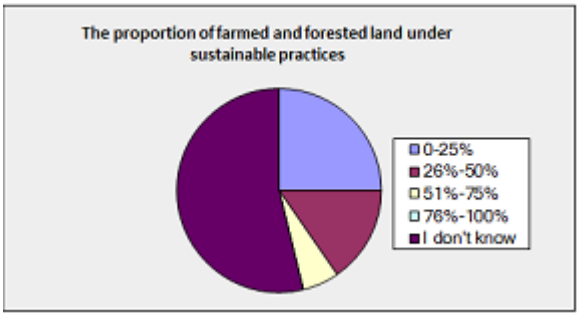
The following measures are being taken in countries to combat climate change and fragmentation:

- Better protection and management of sites, and raising awareness (26 countries)
- Swiss national red list of 20 threatened habitat types with action plans
- Program for Conservation of Forest Genetic Resources and Breeding of Trees in Poland for 2011-2023
- Roadside power line connectivity project in Sweden

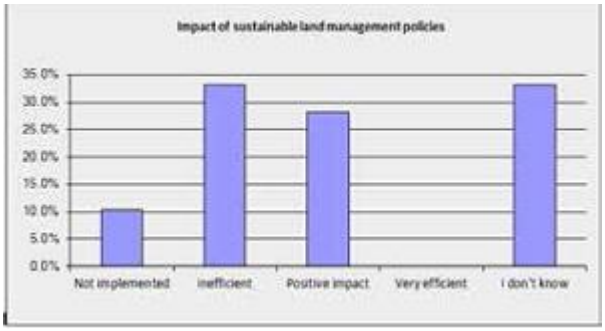
But there are also reports of no measures being taken:

- "Government measures are formal they usually don't work" Ukraine
- "Habitats are conserved only on paper" Macedonia FYR

Objective 2: Conserving sites and habitats Farmland & Forest



Only limited data were supplied by the networks on issues related to sustainably farmland and forestry, the perception is that small to medium amounts of land is farmed sustainably.

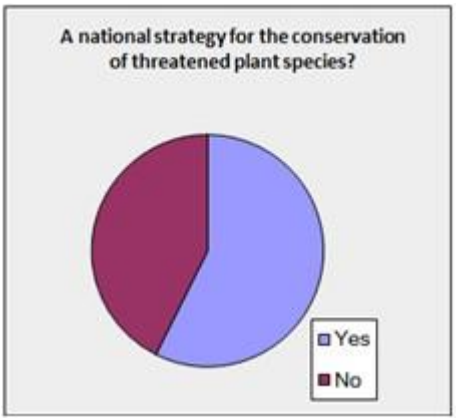


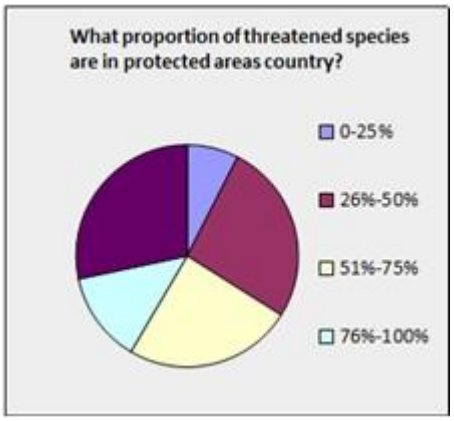
Data provided by the Networks are not comprehensive on this topic. Policies are in place in 10 of the responding countries however there were occasional conflicts in answers from different representatives from the same country.

Success examples of countries working towards sustainable management of production lands include

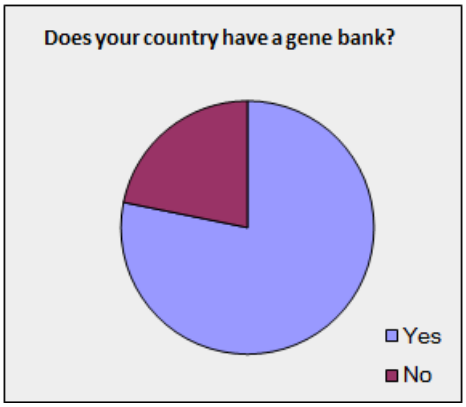
- Fundatia Adept working with farming communities in Transylvania, Romania
- Switzerland and Slovenia have good sustainable forestry practises

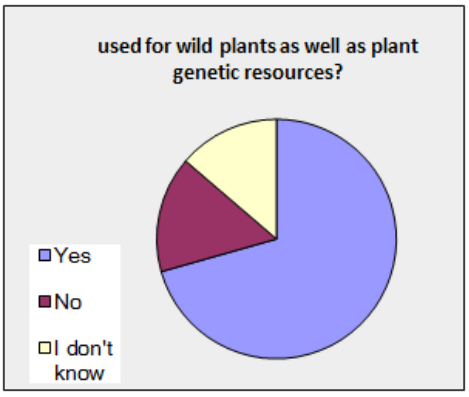
Objective 2 Conserving Species - In situ, ex situ, genetic diversity, invasives





54% of countries have a national conservation strategy for species and 13 countries, 35% report over 50% of their threatened species are in protected areas.





27 (73%) countries have a gene bank, many used for wild plants. 0-25% of nationally threatened species are believed to be in the gene bank (where data is available), and a slightly higher proportion of these species are in botanical gardens.

In situ genetic reserves for crop wild relatives:

- Greece, Netherlands, Slovakia, Switzerland, Poland, Armenia, have at least 1 in situ genetic reserve.
- Sweden includes Crop Wild Relatives within other reserves
- UK 1 existing protected area is recognised for Crop Wild Relatives

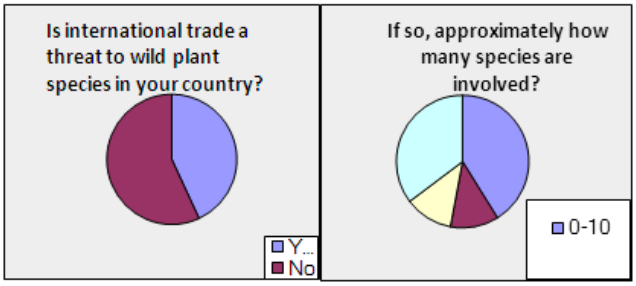
Projects to remove invasives from IPAs include:

- *Carbrotus edulis* (UK, Ireland, Spain)
- *Cotoneaster* spp.(UK) ,
- *Rhododendron ponticum* (UK)
- *Reynoutria japonica, Telekia speciosa, Bunias orientalis, Impatiens glandulifera, Heracleum mantegazzianum, Impatiens roylei* (Poland)
- *Heracleum sosnowskii*. (Latvia, Poland)
- *Acer negundo* (Romania)
- *Adenocaulon adhaerescens* (Russia)
- *Senecio inaequidens, Lupinus polyphyllus, Heracleum mantegazzianum, Rosa rugosa, Impatiens glandulifera, Picea sitchensis* (Norway)

Key future tasks for implementing objective 2 of the GSPC in Europe

- Need better real protection for sites and their plant features
- More connectivity between sites
- More plant conservation projects on IPAs/ Natura sites /Emerald sites/protected areas?
- The networks are largely not contributing to the conservation of production lands and have little knowledge of target implementation. Comprehensive assessment is therefore difficult
- Plant conservation networks would benefit from increased contacts with organisations who work in the conservation of production lands
- The networks need to provide information/evidence about plants to these organisations and the policy making process that affects production lands if it is available
- It is perceived that Europe is failing on the GSPC targets aimed at conserving production lands
- More comprehensive in situ protection for plant species, strategies for plant conservation including in protected areas
- Good work on ex situ conservation, but could look to apply more knowledge in situ
- More in situ action for crop wild relatives
- More strategic action on control of invasive species across Europe

Objective 3: SUSTAINABLE USE Trade, products, knowledge



Over 50% of countries perceived a threat to plant species from international trade and up to 10 species were perceived to be under threat in 32% of countries. This rose to over 50 species believed to be threatened by trade in Turkey, Spain and Greece.

12 countries are working with communities on medicinal and useful plant conservation. For example in the Samic community in Sweden and TRAFFIC works on improving the sustainability of plant products across Eastern Europe.

Key future tasks for implementing objective 3 of the GSPC in Europe:

- Little knowledge of the extent of the problem/threat to wild plants on a local scale?
- Bring in together small projects that are currently unconnected, and developing a central information source.
- Ensure 60% of plant products are from sustainable sources is a very broad target and has always proved difficult to assess
- Multi-country approach as adopted by TRAFFIC is proving successful

Objective 4: AWARENESS Campaigns, exhibitions, GSPC promotion

There are many innovative examples of raising awareness of plant conservation and the GSPC

- Multi-country approach as adopted by TRAFFIC is proving successful
- Year of Homeland Nature Protection(Poland) Fascination of Plants Day (Belgium)
- Protection of secular tree (Moldova)
- Roadside verge campaign, Coronation meadows, County flowers (UK)
- The Postcard project: postcards describing a red-listed species to majors (Norway)
- Plant fascination days, Scientist's Nights (Latvia)
- The Nordic Day of Wild Flowers
- Year of *Phyteuma nigrum* (Netherlands)

Many of us are still communicating in our networks in more traditional ways and are not yet using social media 84 % of network members communicate their work through conference talks and posters, 73% through workshops, 57% through website and blogs and 37% use social media.

Key future tasks for implementing objective 4 of the GSPC in Europe

- Our networks are good at awareness raising, but using links between plants and culture is proving to be a good way of re connecting communities with wild plants
- Moving (slowly?) towards social media
- We must ensure that activities have a legacy, that our audiences remember, understand, re-engage and act upon the message
- The fundamental importance of plants – is this really understood by decision makers?

Objective 5: AWARENESS Human resources-Partnerships - networks promotion

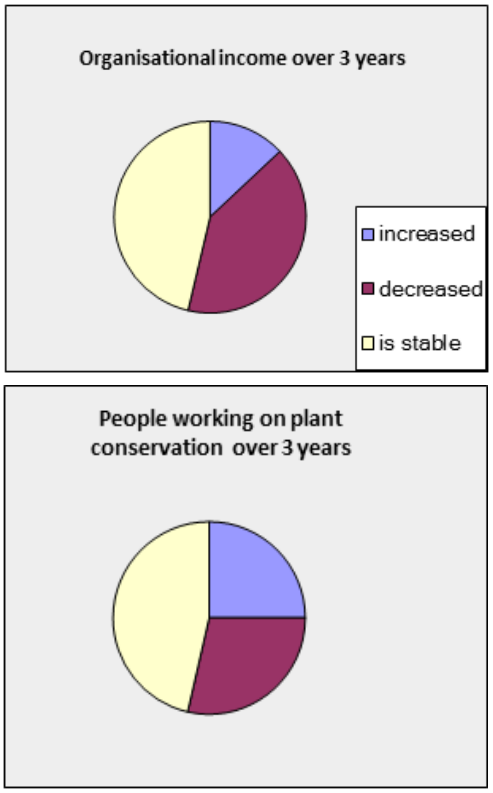


Figure 13.

Over the last three years income of 13% of the organisations in the networks have increased, 41% have decreased and 46% are stable. The human resource for plant conservation in 25% have increased, 28.5% decreased and 46.5% remained stable

More specifically

"Spanish budgets are 15-20% of 5-6 years ago"

"It's hard to get funding for plant conservation" - Norway

"Declining budgets and staff losses cause on ongoing difficulties" - Ireland

"We seem to raise more money for plant conservation in the Netherlands

"Last year I was the first botanist employed in my organisation which was established in 2006" – Croatia

"Bad" – Serbia

In terms of Partners and networking, 25 countries know who their national GSPC focal point is and 88% of organisations work with local partners. 41% of respondents work with greater with than 5 partners, there are also some umbrella networks for plant conservation, often associated with botanic gardens

Key future tasks for implementing objective 5 of the GSPC in Europe

- Better targeting of available resources
- New partnerships to address 'red ' targets?
- Partnerships that allow building skills and understanding

Conclusions

At mid-term of the GSPC and full term of the ESPC, not

all targets have been achieved. There is good progress in topics that are the core concern of our networks'. We are struggling to measure or implement those targets that are not our core interest or that require cross sector engagement. Those targets such as sustainably production of farmland and forestry have no natural botanical home in the organisations represented. Conservation activities beyond 'documenting' are taking place, though not to the same extent across all countries. Excellent innovative initiatives exist in all countries alongside a strong commitment to the GSPC across the plant conservation community in Europe. It appears unlikely that the GSPC targets will be achieved by 2020.

Measuring achievements at European level more difficult than national level and there are more gaps in implementation in Eastern European countries. A concerted cross European effort with more support and resources moving from west and central Europe to the East from within the network, governments and relevant agencies would help address some of these inconsistencies of implementation and bring all European countries to a similar implementation status for each target. Red 'production' targets related to farming, forest and wild plant products need multi-country approach which might best be led by international organisations. They are not traditional activities of our networks and require a cross sector approach for example with the rural development sector, leadership in this type of work is lacking in the plant community. We must continue to promote the message that plants are fundamental to a healthy European ecosystem. Plantlife and BGCI acknowledge the help of all the participants in the online survey, without whom this assessment would not have been possible.

Chapter 2 *Plant Products and Commerce*

Commercial Evaluation of Cretan Herbs

George Gkekas

Fooditerranean P.C., Greece

Abstract This paper was created by fooditerranean and presented at the 7th Planta Europa conference (7PEC), on May 2014. Fooditerranean is the first brand & business development company in Greece which addresses exclusively to small/medium/ agri-businesses. Crucial part of our job is to research, analyze the industry and identify the potential opportunities before we start creating a brand or an export strategy. This is exactly what we did in this paper regarding the Cretan herbs. The purpose of this presentation was to underline the commercial value of Cretan herbs, point out the drawbacks and outline a sustainable exploitation strategy. The research was carried out just a few weeks before the presentation, and it was based particularly on online sources, back up files of fooditerranean and empirical knowledge through professional projects. The structure of this paper consists of four main sections. We start with the current market presentations, following with the commercial characteristics of Cretan herbs, a SWOT analysis of the industry, and closing with recommendations giving some strategic guidelines for future development.

Keywords Herbs, Crete, Agricultural Exploitation, Business Development, Commerce, Food Industry, Marketing, Branding

1. Introduction

This paper was created by fooditerranean and presented at the 7th Planta Europa conference (7PEC), on May 2014. Fooditerranean is an international brand and export management company, the first in Greece which provides brand & business development services exclusively at small/medium agri-businesses. Crucial part of our job is to research and analyze the industry, identify the potentials before we start creating a brand or an export strategy. We create inspiring, differentiated and added value food products made to be established in targeted markets. The field of our activity lays mainly to the agri business development which includes brand creation and management, market research, business analysis, new export tools development, creation and implementation of targeted export strategies. On the other, hand we also have a remarkable activity in mentoring and education in order to create awareness for the strategic export concept. This is an export practice which we developed and apply to any export project we deal with. The strategic export concept has stand out as the best agri-business international development practice, among 27 other practices proposed by 7 European countries, during the European project AGROSTART. As a start-up, we succeeded in creating full brand identities for two companies in the food industry, consult many established companies in the sector and helped them to overcome drawbacks, and develop awareness campaigns about Greek food. Today we manage a group of S/M agri-business facilitating their penetration in new markets worldwide.

For this presentation the term Cretan herbs is referred not only to the indigenous ones, which are numerous, but also to the total herbal population of Crete. These herbs have been so far commercially underestimated. This presentation aims at creating awareness about the commercial value and emerge the great commercial opportunities of this botanic treasure of Crete. This analysis is also useful to the herbs of other regions in Greece.

2. Benefits

An appropriate commercial exploitation will bring benefits to both people and plants.

- A commercial exploitation will create awareness about the benefits of both human health and the unique attributes.
- New uses, new flavors, new products and new markets will emerge.
- Since commercial benefits will established, both

companies and government will set appropriate rules to ensure a sustainable production. An overexploitation or illegal cropping will decrease dramatically. (This has already started to happen).

- Companies will strive to boost sells by linking the products with the local tradition and culture. Greek cuisine, local tourism and other activities will also be promoted.
- Profitable and sustainable exploitation will create jobs, enhance income and create opportunities for the local society.

1.1. International Trade

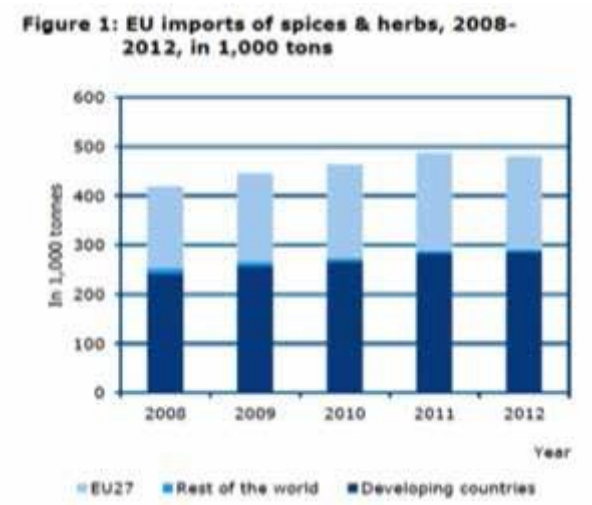


Figure 1. EU imports of herbs & spices

Herbs' trade seems to be a profitable commercial idea. But which is the market for these products out there? In this analysis we exclusively examine the hot drinks market (teas), where adequate amount of data are available. However, some of these herbs can have culinary use, or other uses (see below in this paper). Please notice that in a real case of a business development project, a much more extensive market research and analysis is required.

- EU27 in 2012 imported herbs and spices amounted to €1.7 million, while the exports of processed tea and coffee represent the 5% of the total exports (btw oils & fats represent only the 4% of the EU exports)
- A 67% of total EU imports are performed by the western Europe countries
- Most important suppliers come from developing countries due to appropriate climate and the low cost of production.
- Notice that the trade of these products only in EU, approached the 500.000 tons in 2012

2.3. Consumption

In huge markets like Russia, Turkey and China, immense consumption take place not just due to the number of the population but also due to the volume of the consumption. These countries are also among the biggest tea producers. These consumers will be happy to extent their tea experience, trying new flavors. So there are huge markets, familiar with the product, where penetration may be affordable.

On the other hand there are still some developing markets such as South America or India creating much potential for the herbal products.

Figure 2. The world's biggest tea drinking nations

3. Commercial Characteristics

Cretan herbs have many remarkable characteristics which can drive them to a commercial success. In this analysis we focus mostly on edible herbs. We illustrate the most important of these characteristics.

3.1. Diversity of Species

There are about 300 edible plants in Crete. This great variety gives many options to the producers to develop a long product line and meet accurately their potential customers' needs.

Family	Species	Mention frequency %
Apiaceae	Scandix pecten-veneris L.	69
Lamiaceae	Prasium majus L.	45
Asteraceae	Sonchus oleraceus L.	44
Papaveraceae	Papaver rhoeas L.	43
Apiaceae	Scaligera napiformis (Spreng.) Grande	40
Apiaceae	Torilis arvensis (Huds.) Link subsp. arvensis	40
Lamiaceae	Mentha longifolia (L.) Huds.	38
Lamiaceae	Mentha spicata L.	38
Lamiaceae	Mentha suaveolens Ehrh.	38
Asteraceae	Scolymus hispanicus L.	38

Figure 3. Ten mostly mentioned food wild plants

3.2. Diversity of usage

The variety of Cretan plants is followed by a great diversity of use. Every part of the plant can be used to develop a unique product which can meet specific needs. (In the brackets see the number of species related with the specific use)

- Leafy greens, stems and inflorescences, raw, boiled, cooked or sauté (122)
- Roots, rhizomes and bulb (10)
- Fresh herbs (15)
- Dried herbs for cooking (16)
- Dried herbs for beverages (24)
- Fruits, desserts-jams-pickles (18)

3.3. Processing

The options in processing are almost unlimited. Depending on the plant and the processing method we can produce edible or non-edible products. Again the options of product development are vast, and expanded to several industries, such as food, beverage, medicine, pharmaceutical, cleaning and cosmetics.

The methods of processing

For edible use: Sop / Brew / Juice / Solution / Pounder / Fresh

For non-edible use: Compress / Massage / Eyewash / Hand & foot wash / General wash

3.4. Nutritional Value

Healthy food is one of the most popular trends among consumers around the world. Cretan herbs offer an excellent variety of nutritional value, while some attributed could be characterized as rare. The list below, illustrates the different body system disorders as treated by the medicinal plants while again in the brackets is mentioned the number of the related plants. An important observation of the study is the strong relation that seems to exist between food and medicinal plants, as half of food plants were also considered important in traditional medicine.

Digestive system (44), Urinary system (43), Circulatory system (39), Respiratory system (38), Infection/infestations/injuries (36), Skin (34), Endocrinesystem (25), Mental/nervous system (15), Inflammation (8), Pain (8), Muscular-skeletar system (6), Poisoning (6),
Reproductive system (3).

3.5. Added Value

Due to this amazing diversity of the mentioned characteristics, Cretan herbs offer many opportunities of added value and differentiation, maximizing profits. This is an interesting example of ultra-added value for a Chinese tea.
Da Hong Pao

This tea dates back as early as the 18th century. We are actually talking about the premium version of this tea - because there are a variety of options - but this one is the most expensive. The Chinese government sold this tea in 1998 in an auction to the highest bidder, and received $900,000 for it. That comes out to around $1,250,000 per kilogram. This tea is more expensive than gold.

A branded malotira (not a premium brand) in a local supermarket comes up to €95.5/kg which is still a good deal.

The conclusion comes naturally. A well branded herb product offers attractive margins and seductive incomes.

3.6. Culture

The cultural aspect is particularly important when comes to food products. Connecting a food product with culture elements can be an effective marketing tool to differentiate the brand in a high competitive and demanding market.

On the other hand, it is important to be part of our culture. This is the best way not only to introduce the product to other cultures but also to suggest new uses or even new consumption habits.

Indeed. Herbs are strongly adopted by Greek culture. We can mention the most popular uses of herbs in Greece.

Medical treatment. Many herbs are used as natural medicine for stomach disorders, insomnia, cold treatment and much more.

Social life. A cup of herbal tea is a typical hot drink when socializing.

Mediterranean cuisine. Many herbs are important for some typical Mediterranean recipes.

Religion. Sometimes we use specific herbs even as ritual accessories. The connection with the religion indicates the

high degree of familiarity that Greeks have with these plants.

4. SWOT Analysis

Here we present, very briefly, a SWOT analysis on herb industry (a Greek perspective). We examine the Strengths, the Weaknesses, the Opportunities and the Threats. We will perform this analysis at the marketing point of view.

4.1. Strengths

- **Differentiation:** Most of these herbs have not been widely merchandized, or even branded, which means that they considered as new choice for tea consumers. They offer either different flavours or bring more nutritional value.
- **Diversity of species**, many of which have not been branded or even marketed so far. New products can be created, new consumers' needs can achieved, and new niche markets are possible to emerge.
- The Cretan herbs offer a great **variety of choices,** in terms of flavours, nutritional value and usage. That creates a very competitive food brand, and constitutes a great point of product differentiation.
- **Quality:** Quality derives from the unique microclimate, the cultivation practices and the particular attributes of these plants. However these are not enough to succeed in the international markets, unless they are marketed professionally.
- **Sources:** Cretans have direct access to the natural sources, as far as it concerns the special microclimate and the indigenous flora material.
- **Value:** The potentials to create high added value product for the consumers are high especially when branded professionally.

4.2. Weaknesses

- They are traded mainly in bulk or as basic brands. Only recently, a few branded herb products have been lunched. Even today only small percentage of the existed Cretan herbs has been exploited commercially.
- There is a lot of work to be done in the field of both production and marketing.

4.3. Opportunities

- Healthy, tasty, convenient and organic food, are the most popular **trends in the food industry** today. Cretan herbs can follow these trends very successfully.
- The use of herbs is **already spread and adopted** by many culinary cultures around the world. So it is easier for them to accept more alternative choices, without really changing their habits.

4.4. Threats & barriers

- **High investment** is required to enter in the business. Cultivation and labour cost are significant high.
- The **legal framework** is kind of vague. That costs time and money to anyone who starts up business.
- There is not an **organized system for seed supplies**. That may evoke dangers related to the quality, the trade, the originality and the legal exploitation of the seeds. The state failed to organize updated seed banks which could help enterprises to get certified indigenous seed at a competitive price.
- **Lack of official information** regarding the production, the exports along with prestigious market research, appear as a considerable barrier for a start-up company in the sector.

4. Suggested Strategies

- **Create remarkable brands**. Exporting in bulk means no added value products which hardly leads to a commercial sustainability and success. By creating remarkable brands we differentiate, we create awareness and we make a product more competitive in international markets.
- **Working in clusters or in groups** is the only way for the Greek agri-SMEs to be a considerable player abroad. The fragmented sector of agricultural production, forbids them to approach new markets at a profitable and competitive way. Teamwork enhances the negotiation power, allows the implementation of advanced export strategies and reduces the cost of penetration dramatically.
- Greek agri-businesses should focus **on professional production and marketing,** which is the only recommended way to commercialise wild herbs and achieve positive results to both plants and people.

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Chapter 3 *Environmental Ethics*

Environmental Ethics and the Role of Plants

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Abstract Environmental ethics originated in the 1970s in a context of the revival of applied philosophy and of new environmental concern. Its founders advocated rejection of anthropocentrism, which was later resuscitated; grounds are given for preferring a biocentric approach, using the example of reasons for classifying Cretan plants. Environmental ethics does not merely apply received principles to environmental cases, but is also contributing to the reconfiguration of mainstream ethics, its concepts and its scope.

Keywords Environmental Ethics, Anthropocentrism, Biocentrism, Ecocentrism, Stewardship, Ecofeminism, Moral Standing, Preservation, Future Generations

It is kind of you to invite me to address you on environmental ethics, an important branch of the subject of ethics, which is studied both by philosophers and theologians in many Universities across the world. Awareness of environmental ethics, is, I will suggest, one of the more crying needs of our time.

Environmental ethics originated among philosophers in the early 1970s, both in Australia, in Norway and in USA. Earlier writers, such as Aldo Leopold and Rachel Carson, had suggested that a new ethic was needed to address environmental issues; but they were not philosophers, and the climate among philosophers was hostile not only to environmental ethics, but to applying ethics to practical issues at all. However, this changed when a new awareness arose, fostered by the Vietnam War (in which defoliants such as Agent Orange were used) and by the indiscriminate use of pesticides such as DDT, highlighted by the same Rachel Carson. A new generation of philosophers came on the scene suggesting that there is a need for a new, environmental ethic embodying a less dominating attitude to the natural environment.

At much the same time, philosophers were re-discovering how in earlier generations philosophy had been applied to important social and political issues such as issues of war and peace, as when Hugo Grotius presented proposals for universal international laws independent of religion, and when Immanuel Kant put forward his plan for 'A Perpetual Peace'. In the decades following the Second World War, some philosophers returned to consideration of the ethics of war and of peace, while others, reflecting on the Nüremburg Trials, gave fresh consideration to medical ethics, emphasising the importance of the autonomy of patients and of subjects of experimentation. Thus the inauguration of environmental ethics could be seen as yet a further branch of applied ethics, alongside biomedical ethics and the ethics of war [Attfield (2012)]. This helps explain how it rapidly attracted attention and adherents, particularly in Australia and North America.

Probably the first of the founding generation of environmental philosophers was the Australian Richard Routley, who contrasted human-centred ethics with such widespread judgements as that it would be wrong for the last human being (a survivor perhaps of a nuclear catastrophe) randomly to cut down a thriving tree before he died, even though no one's interests would be affected. If this was wrong, the reason had to be independent of human interests, and if it would still be wrong if no animal interests were affected, then the reason had to lie somewhere outside the realm of sentient and conscious beings [Routley (1973)]. Others interpreted his remarks as advocating either biocentrism, for which all living creatures have moral significance and their flourishing has intrinsic value, and possibly ecocentrism, for which species and ecosystems have moral standing as well, even if they do not have a good of their own.

The differences between these two stances matter rather little. For even if species and ecosystems do not have intrinsic value, that is, value derived from nothing but themselves, they would still have considerable value of one kind or another if their species-members and living system-members have intrinsic value, as biocentrists hold. One of the earliest environmental philosophers, the

American Holmes Rolston, suggested that the value that ecosystems have be called 'systemic value', their value as systems, in the absence of which their living constituents could not even exist [Rolston, (1975, 1988)]. The issue, then, was not between biocentrism and ecocentrism, but between both of them and a humans-only or anthropocentric ethic. But drawing the line at human interests appeared arbitrary, granted that parallel interests can be found in at least some non-human animals.

The third of the founders of environmental ethics, the Norwegian Arne Naess, also wrote of the freedom of all life to flourish and blossom, but associated this with the much more controversial view that for the sake of the flourishing of other species, the number of human beings should be reduced [Naess, 1973)]. These teachings formed planks of the so-called Deep Ecology Movement. However, it was clearly possible to recognise the moral standing of non-human creatures without adhering to this Movement, as many philosophers including myself went on to do.

Another early participant in environmental ethics was the Australian John Passmore, who regarded Christianity as largely committed to an ethic of domination over nature, but still detected longstanding minority traditions such as that of stewardship, which could be contrasted with the domination approach [Passmore (1974)]. Passmore regarded the Old Testament as aligned to stewardship rather than domination, and found traces of the same approach in a few pagan ancient texts, and in the seventeenth-century Chief Justice of England and Wales, Sir Matthew Hale. It was an early contribution of mine to draw to attention that many of the Church Fathers of the Christian Church, both in East and West, were also adherents of the stewardship approach, and that the New Testament was readily capable of being interpreted in this way as well. Indeed with these debates, eco-theology was born. It should be added that Passmore's book *Man's Responsibility for Nature* remains one of the classics of environmental philosophy.

Subsequently environmental philosophy branched out into a number of fields. Val Plumwood, the one-time partner of Richard Routley, was one of the first contributors to eco-feminism, which stressed the links between the oppression of nature and that of women, and commended fostering relevant feelings, as opposed to focussing on male-oriented accounts of rationality [Plumwood (1991)]. The animal rights movement of theorists such as the utilitarian Peter Singer [Singer (1976)] and the animal rightist, Tom Regan [Regan (1983)], had clear links with environmentalism, although it usually refused to recognise moral standing on the part of non-sentient creatures. J. Baird Callicott attempted to derive an holistic version of environmental philosophy from the thought of Aldo Leopold, and at the same time distinguished his holistic stance form that of animal-welfarists [Callicott (1980)]. Also the Environmental Justice movement came into being to stress that pollution was often concentrated in areas inhabited by the poor, and in Third World countries to which powerful countries exported it. Later the concept of sustainability came to be applied to environmental resources, particularly after the international recognition accorded unanimously to sustainable development at the Rio Summit of 1992. Interpreting sustainability in the light of the foreseeable needs of future generations remains a central theme of current environmental ethics.

Yet further environmental philosophers and ethicists have returned to anthropocentrism, some of them claiming that reasoning about the goods and the needs of nonhuman species is redundant, since what is required to satisfy human needs is invariably the same as what the needs of nonhumans require. But this claim is implausible. Thus many nonhuman creatures may well eventually outlive humanity, as long as they are not extinguished first, and will need a supportive environment (air, terrain, foliage, seas, oceans and rivers) in which they can flourish in the posthuman period, whatever may be required by human interests across the previous period. There again, there seem to be creatures (undiscovered until recently) living two miles beneath the Antarctic ice-sheet; and it is implausible that preserving the environment of such creatures from disruption corresponds exactly to whatever is required to satisfy human interests either in general or in the Antarctic in particular. This being so, it seems best to take seriously the survival needs of nonhumans, rather than assume that these needs and those of human beings coincide.

Another ground for such approaches is that all judgements within environmental ethics are human judgements, and thus must ultimately reflect human interests. But this reasoning is unsound, for human beings often show themselves capable of making judgements and decisions that reflect concern for non-human creatures or their species or ecosystems or habitats, and while there is sometimes a background concern for the interests of (say) future human generations and their ability to appreciate and enjoy biodiversity, this almost certainly does not motivate each and every case of altruism towards non-humans. Indeed theories that restrict human motivation to human interests offer an unduly limited and limiting theory of human imagination and of human nature, and of what they are capable of.

Yet a further basis for anthropocentrism is the theory that the world we encounter is essentially a human world, understood through human concepts, which (it is added) invariably reflect human practices and purposes. This reasoning is too elusive to be easy to confront; but a parallel reply is possible here to the one just presented. Thus we may grant that classifying Cretan plants is part of a human project to understand the natural world, a project pursued partly for its own sake and also partly out of the human interest in finding medicines and nourishment. But it does not follow from this that all uses of the resulting classifications have the aim of enhancing either plant classification, or pharmacology, or human cuisine, or turn on the related values. Some uses of these classifications, for example, may be for the sake of the preservation of these plants themselves, and, while that too is a human project, it need not be entirely motivated to serve human interests, as opposed to a concern

to protect natural habitats for the sake of the living creatures that inhabit them. And if human concepts can assist such projects, that is no ground for either complaint or regret that they make possible such other-regarding activities.

Thus there is no necessity to adopt anthropocentrism, and we probably retain a broader perspective if we retain a broader view of human nature and horizons. Nevertheless, much valuable work in environmental ethics is being done by anthropocentric philosophers, some of whom adopt a pragmatist basis and make the main question about any given proposal that of 'Will it work?' For example, some forms of preservationism, which seek to exclude human beings (including peoples with traditions of living in certain forests) from large areas of those forests, are virtually implicit invitations to poaching, and thus counter-productive. By contrast, schemes and projects that reward local people for participation in preservation benefit both the people thus rewarded and the wildlife that the project seeks to preserve. Accordingly many purist applications of principle have worse effects than pragmatic adaptations, when these are devised with sufficient insight and ingenuity [Schmidtz (1997)]. All this can be accepted by biocentrists and ecocentrists, despite their continuing rejection of anthropocentrism.

These findings allow me to return to the role of environmental ethics, which at the start of this address was represented as one of several areas of applied ethics, either resuscitated or (in the case of environmental ethics) inaugurated in the 1970s. To some extent, its role really does involve the application of ethical principles to environmental issues, once these have been identified. Yet environmental ethics probably has a further role, which is not paralleled in other forms of applied ethics.

For reflection on environmental ethics brought to light (through the work of Kenneth Goodpaster) the issue of moral standing, which Goodpaster called 'moral considerability' [Goodpaster (1978)]. This is the issue of which items warrant consideration when decisions are being made. The conventional answer up to that time to the question 'Which things have moral standing?' was usually: current human beings. But reflection of the kind that Goodpaster introduced concluded that moral standing attached also to nonhuman creatures, whether sentient or not, and to future ones as well as present ones, including possibly ones which could be brought into being (that is, possible living creatures of the future). For all of these are liable to be affected by current human decisions, action and policies. Environmental issues are liable to affect life on earth for generations to come, and human agents are just as responsible for decisions likely to impact on future beings as ones where the main impact is on the present. There again, impacts on members of other species and on their habitats emerge as ethically significant, both for biocentric or ecocentric and for anthropocentric theories of ethics. Issues of human emissions of carbon dioxide and other greenhouse gases supply leading examples of all these matters [Attfield (2014)].

So environmental ethics is not just an application of agreed principles to environmental situations, it also has profound implications for the content of those principles, requiring a broadening of the scope of ethical concern. Similarly it has a related impact on what counts as an environmental problem, for problems are not restricted to obstacles to human interests of the current generation, but extend to the interests of members of other species, and to the foreseeable interests of members of coming generations. It applies, then, not just to issues of sustainability and of preservation, but to the entire gamut of human action, both individual and collective. So normative ethics as a whole stands in need of revision to take account of environmental ethics, which means that our entire culture stands in need of being reconsidered as well.

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When Plants Become Precious: Art, Culture, and Environmental Crises

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Abstract Drawing on the multidisciplinary literature of visual culture, ecological theory, ecofeminism, and environmental philosophy, I trace developments in environmental art to join in the ethico-aesthetic. This tradition calls for reflective thought on the value of subjective perception and distinctive lived experiences. It also calls for respect for sentiment, imagination, and creative expression. To a greater degree, regardless of how bleak things appear, the ethico-aesthetic paradigm calls for getting involved in practical activities that have a future. In relation to art, my inquiry follows a range of cultural activities that support ideas about reuniting humanity with the beauty of the natural world. Through practical engagements, environmental artistic practices also support conservation and the protection of endangered ecological systems. Informed by the art cannon of unity and beauty, my focus is to exemplify artistic practices that ascribe value to nature for the sake of nature. From this line of thought, my presentation conveys the theme of hope for a good outcome for Planet Earth.

Keywords Environmental Art, Practical Activities, and the Theme of Hope

1. Introduction

In light of the global environmental and ecological crises, this paper represents an enquiry into the concepts conservation and preservation that are directed toward raising public awareness about changing environments. Critical to my analysis is an interest in the connection between nature and human culture. As I explore the realm of subjective and cultural symbols, in relation to art and social life, my focus is directed by a background belief that all things are interconnected. My schedule has been divided between a studio artistic practice, an art teaching career, and work as an apiary inspector with the British Columbia Department of Agriculture. As an artist teacher and beekeeper, I have had an extraordinary opportunity to live close to Nature and in my work, to travel to small and isolated communities throughout British Columbia, Canada. Travel has brought me close to local and international cultural and artistic communities. I have had an opportunity to hear the voices of cross-cultural, land-based societies and their concerns about the impact of climate change; and I have listened to controversial issues of conservation. In my home province of British Columbia in the 1970s and well into the 1990s, there was little discussion about sustainable farming or forests–let alone land conservation or plant preservation. The economic conversation encircled "mega" projects: the damming of majestic rivers for hydro-electric power, massive energy extraction in mining, clear-cut logging in the forests; and in the sports and fishing industry, it was all about
"catch" rather than release.

While different theories examine environmental problems, from the "growth imperative" and the rise of global economics, the industrial civilization underscores the fact that people the world over rely upon the Earth's energy and upon the bounty of Nature for the essential ingredients of life. Meanwhile industrial progress, economic development, and the growing demand for minerals, timber, oil and gas contributes to the "rapid and catastrophic degradation of the planetary biosphere" [Suzuki. (1992)].

The eclectic political mix of the mid twentieth century sparked the peace movement, gave rise to the new women's movement, the environmental movement; and priority to ecological thinking, in support of the Ecofeminist perspective on the environment [Plumwood. (2006)]. Much of the literature of ecofeminist philosophy focuses on environmental ethics, environmental justice, and the possibility of creating an "earthcare ethic...premised on a dynamic human relationship with nature" [Merchant. (1995)]. In the art world, the challenge to the "hegemony of Modernism" overlapped with "feminism in the arts" to address the dialectical relationship between nature and culture [Chadwick. (1990)]. Thanks, in part, to the world wide environmental movement, the environmental art movement spread out to include documentary and filmic practices, and video installation. As well included is television programming such as the popular National Geographic and PBS series on Nature, the CBC production of The Nature Of Things with host Dr. David Suzuki and the

enormously successful BBC series, State Of The Planet with the influential and eminent Sir. David Attenborough.

The contemporary artists' interest in the environment has spurred on what has become recognized as an Ecoart movement. The Ecoart movement is local, regional and global. In addressing the relationship between cultural self-determination and sociocultural activities, Ecoart practices honour the harmonic beauty of the natural world. With an emphasis on social concerns, much of its witty, critical, political, ethical and aesthetically attuned works are directed toward reconnecting or restoring vital links between humanity and the natural world. The art works and the Ecoart productions, which I reference, may be viewed "on line" at numerous Internet art galleries, international art web-sites, and public art gallery web-sites.

The first part of this paper considers human activities that have changed the character of the living environment. I also draw insights from prehistoric and ancient civilizations that have used visual symbols which attest to the timelessness of art; not only as cultural ritual, but also art as a carrier of cultural and traditional knowledge. In creating an environmental narrative, philosophical theories of ecofeminism and ecological humanism provide a focus on principles of conservation and plant protection. From this, I address a profound shift—a sudden; if not a basic change—in sociocultural values turned toward ecological thinking that encourages good environmental practices. As I address ecosystem integrity, plant biodiversity, sustainable use of natural resources, I exemplify practical activities directed toward the protection of the natural environment. The second part looks at the ecological debate between the necessity to acknowledge the economic benefits of Nature's bountiful yield and the need to reduce the high price we level on Nature. The final section draws attention to artistic practices that use the language of the landscape as subject to ascribe value to Nature. By offering a dialogical critique on the use and abuse of the precious bounty of the land, waterways, oceans, and the biosphere, my presentation conveys the theme of hope directed toward a good outcome for Planet Earth.

2. Part I Conservation and Preservation

Travel has enriched my understanding of certain artistic accomplishments belonging to prehistoric and ancient cultures. In gaining knowledge of historical societies I have also raised my awareness about ethical practices in preservation and conservation that point not only to economic considerations, but also to cultural choice. For instance, while nineteenth century archaeological field work in the Maya-Toltec area, in the Yucatan peninsula, Mexico, uncovered prehistoric ruins; it was anthropological inquiry that introduced theory and speculation about its culture and its ancient civilization. Political decisions of the twentieth century are what led to the practical preservation of the cultural sites. Specifically, in 1972 the Mexican authorities placed all of the archaeological pre-Columbian monuments and historical artistic sites under the guardianship of the Mexican Federal Government. With an inviting economic upswing, resort areas such as Cancún, were developed. And in the 1980s, tourism officials turned their attention to socioeconomic policies that made previously inaccessible *zonas Arqueológica*, open to the touring public.

The Maya-Toltec site of Chichén Itzá is claimed by UNESCO as a World Heritage site. It is one of the most renowned and most visited archaeological complexes in all of Mexico. As a tourist I have had the opportunity to visit this vast cultural museum. Central to the complex stands an enormous step-pyramid that is aligned with the setting sun of the spring and autumn equinoxes. Four colossal stone sculptures depicting a feather-headed serpent mark each side. At the equinoxes the shadow image of a snake appears to slither along the northwest side of the pyramid. Close to the pyramid stands what is believed to be a proto-observatory. A rounded "astrological observation" building stands at top. It has openings aligned with the cardinal directions, and with the traverse path of Venus. From the Mayan interpreters, I learned that the Maya have lived in the area since time immemorial. Evidence of ongoing occupation exists from prehistory, and some of their ancient cultural traditions survive to be found in the living Yucatec Maya of this day.

Key to my inquiry is the fact that from ancient times the Maya developed a prosperous agricultural society built on the cultivation of corn, beans, peppers, and squash. Evidence of their cultural knowledge of the land, of the animals, of the growing seasons, and of seasonal change may be seen in visual narratives that are carved into the limestone walls and square stone pillars that mark or enclose the Chichén Itzá site.

Evidence also exists of a vast trade network, most likely accessed through a complex system of roadways that are yet to be thoroughly examined. Thanks to accepted world-wide trade practices in commodities and in seed and plant exchange, products such as the tomato, potato, beans, corn, peppers, and flowers arrive from the Americas to appear in markets throughout the world. In return, European plants appear everywhere too. In this sense, seed and plant exchange has not only altered peoples' lives but worldwide, it has altered the natural landscape. Wheat arrived in the Americas to enrich the economic landscape, but also to change ecological facts of the natural landscape and eventually, to almost edge out the native prairie grasses.

The European Knapweed, genus *Centaurea*, has not contributed economic value. All varieties of Knapweed exude a toxic substance through its root system, thus deterring the natural growth of wild plant and native grass species. It spreads freely and eradication with chemical sprays and the use of biological weed control has come at a high cost both to agriculture and to the health of the living habitat.

The Sainfoins, *Onobrychis viciifolia* are Eurasian herbs belonging to the legume family. Introduced into Canada in

the late 1900s as a forage crop the plants are deemed both beautiful and beneficial. Sainfoins naturalize easily and are drought resistant and frost hardy. The Sainfoins are good for domestic animals and for wild animals such as elk, deer, and moose. The pretty pink flower is attractive to the honey bee for its sweet nectar and in view of honey production; the Sainfoins are much valued by the beekeeper.

Baby's breath, genus *Gypsophila*, is another imported Eurasian plant species that naturalizes easily. As a garden escapee, it scatters its seed far and wide. In the southern Interior of British Columbia the plant invades the dry grasslands, and into the pine forests. Still, this "gypsum loving" garden plant is much coveted by the florist. The common weedy Dandelion, *Taraxacum officinale*, also imported from Europe, finds register among the noxious weeds of Canada. So thoroughly eradicated in certain parts of Europe and the UK, Dandelion seed now appears listed in specialty seed catalogues. As an early spring source of pollen and nectar, the Dandelion is a plant essential to the survival of the insect pollinators such as wild bees, and the honey bee population.

The European honey bee, *Apis mellifera*, arrived in British Columbia over one hundred and fifty years ago. From the initial two colonies, apiculture spread quickly throughout the province along with European settlement. And along with that, came vast quantities of imported European plant species. While introduced plants may be deemed precious as food crops and animal fodder, many of the imported wild plant species of Europe, are listed among the common invasive weeds of Canada [Mulligan. (1976)].

The highly invasive European Broom naturalizes extensively, and where it finds good growing conditions–along the rail beds and road right-of-ways of Europe, and in Canada and the United States–it takes over. The Canadian artist Emily Carr, well known for her love of Nature has this to say about Broom:

> Gilding, Jazzing, Blatantly gorgeous! Broom surges over the land commandeering every vacant lot. While tourists intoxicated by Broom's yellowness and smell rave, inhabitants turn from the red-hot-yellow-smell and the teasing pollen that makes them sneeze–shut their doors and windows to keep her out. Farmers curse her for devouring the land...Broom on the hill, Broom along the highways, fields of broom, Mountains of broom...In the dry season Broom is a serious fire hazard...She is not one of our native wild flowers. An early settler brought his pockets full and scattered the seed [Bridge. (2006)].

Such are the stories; migrants arriving in new and strange lands with "pockets full" of precious seeds. Seeds for cultural ritual, seeds carried on long journeys to be eaten as food, seeds brought from a beloved homeland and planted in the hope of creating a new and prosperous life in farming, seeds scattered to change a strange landscape into something familiar, and seeds planted from a desire to keep the memory and dream of home alive. By definition, however, many imported plants compete with native wild plant species, they are deemed neither useful to farmers nor good for the land. In addition, because imported plants have few predators, they often take over the landscape, "...as weeds we see them every day...weeds inhabit lawns, gardens, and waste places. In the country they line every roadside and grow vigorously in all fields....Weed control is a never-ending battle" [Mulligan. (1976)].

In Scotland I visited the Black Hills Estate, near Elgin, to view the gardens where there are more than 300 imported Rhododendron plants. Collected in the Himalayas in the 1920s the plants have naturalized to edge out native European wild plant species. Travelling on, through the Scottish Highlands, I stopped to photograph a number of tree farms. Viewed from the perspective of the UN Convention on Biological Diversity, the astonishing numbers of monoculture plantations of Ponderosa pine–an imported tree species native to British Columbia–go against the objectives of the Convention. From an environmental justice point of view, the application of toxic sprays, chemical fertilizers, pesticide sprays, and chemical herbicides typically used in monoculture tree farming is far and away from an ethical approach to "earthcare" [Merchant. (1995)]. Chemical application not only destroys plant biodiversity, but repeated applications eventually leaves the habitat unsuitable for plant growth. I was told by an informant that after several timber harvests, the economic yield of a monoculture tree farm typically falls off. A remedy to improve this is to clear-cut the remaining trees, and to leave the infertile ground fallow to rejuvenate naturally. At the tree farm which I visited, the long term plan directed toward restoration of the land and ecological balance includes the reintroduction of wild plants and trees species native to Scotland. In the interim, I noted, grasses, ferns, mosses, and a prolific bluebell had already filled the empty spaces. I later learned that the abundant blue flower was not the lovely "Bluebell of Scotland" but a highly invasive variety, imported from the Continent.

Vandana Shiva, a well know environmental activist, has recognized the privatization of land for monoculture farming practices and monoculture forestry management as the exploitation and the destruction of biodiversity in the name of "westernizing economic categories" [Shiva. (1990)]. Shiva elaborates on the damming of rivers, privatization of land for revenue generation, and the practice of monoculture:

> ...it goes far beyond a neutral concept of productivity...The expansion of cash crops undermined food production...the development process has deepened, instead or reversing, the process of underdevelopment....Development projects have destroyed women's productivity by removing land, water, and forests from their management and control, as well as by the ecological destruction of soil, water, and vegetation systems so that nature's productivity and renewability have been impaired [Ibid.].

Shiva identifies economic crop production as a bias against nature and against indigenous peoples. This bias, she claims, is not only a "violent" form of control that "denies the activity of nature and life" but it also has "generated a crisis of survival" for traditional communities. These facts are now well known; in the association between economic systems where the natural forests have to be "developed into monoculture plantations," and where the "river systems have to be controlled," biodiversity is lost, and so too the land. Thus, as Shiva points out, such systems displace indigenous people from traditional land uses. Following Shiva's analysis, it must be noted that expanding privatization of land for monoculture cash crop is deemed responsible for the destabilizing effects of both land and plant biodiversity: not to forget to mention ethical issues that arise in association with use and over use of chemical fertilization, herbicides and pesticides.

In India, I travelled to the "roof of the world" to view the Annapurna Massif in the Himalaya Range. Driving from Almora the picturesque hill country is laced from top to bottom and side to side with small terraced farmlands. The important characteristic of the small agricultural footprint corresponds with the tranquil idyllic beauty of the rural countryside. This to suggest traditional farming communities, and organic agriculture; but that is a romantic view, according to Shiva. Her research indicates that many traditional farming communities have been destroyed by large scale economic farms and industrial development. Following Carolyn Merchant, restoring the natural environment, depleted by industry, ought to be a common goal. Realization could come through "levels of cooperation" directed toward community balance and ecosystem integrity, supported by a "...global partnership to conserve, protect, restore the health of Earth's Ecosystem" [Merchant. (1995)]. In the area of ecological thinking, the call for the restoration of the balance between nature and culture, hearkens back to Rachel Carson's 1962 analysis:

> The earth's vegetation is part of a web of life in which there are intimate and essential relations between plants and the earth, between plants and other plants, between plants and animals. Sometimes we have no choice but to disturb these relationships, but we should do so thoughtfully, with full awareness that what we do may have consequences remote in time and place [Carson. (1962)].

While the "100 mile diet" supported by the small kitchen garden offers sustainable ways to carry on an ethical relationship with Nature, native wild plant species are edged out. Even a carefully tended garden plot will alter the ecological systems needed to maintain the ageless link between the cycles of nature's renewability.

The Canadian photographic artist Edward Burtynsky offers a "visual essay" on the "man-made" agricultural landscape; which includes startling images of terraced rice paddies in China that cover the plain from corner to corner and in his written text, comments on aspects of such landscapes:

> ....My photographs reflect the impact of humanity, not its absence. They are pictures of our footprint, and the diminishment of nature that results. They are distressed landscapes: images of land, and now of water, that we have altered, or diverted, or transformed, or used in this unprecedented period of population growth, agriculture expansion, and industrialization. 1

Through the use of special cameras and shooting from the advantage of a fixed-wing aircraft, Burtynsky presents astonishing aerial views of a "diminished landscape" where nature, transformed by the large footprint of humanity, suffers. 2 Burtynsky's photographic images of pivot irrigation farming in High Plains Texas, for instance, reveal monoculture on a grand scale; this is a landscape pock-marked by industrial agriculture.

In practice, each irrigation pivot is connected to a well-head that draws water, night and day, from the Ogallala Aquifer. According to Burtynsky's research, water levels have dropped by more than ten percent since the 1950s, and should the current rate of water use continue it will take more than 6,000 years to refill this precious natural resource.3 The greater part of the cash crop is alfalfa. It is cut, bagged, and shipped off to Japan to be used as fodder in the cattle industry. In the market, where meat is expensive, beef is a specialty food available only to a select few.

I wish now to focus on positive aspects of conservation and the protection of wild plant species that are directed toward the future. The Svalbard Global Seed Vault, located in the remote Norwegian Arctic, provides a means not only to protect "agricultural biodiversity" but also to preserve a wide variety of seeds.4 The Canadian Edelweiss Growers provide a valued service in the conservation and protection of the "famously rare" European Edelweiss: and, they promise to ship seeds anywhere in the world. 5 From the tradition of seed and plant collection instigated by scientific research, the University of Cambridge is in charge of plant specimens gathered by Charles Darwin and the rare herbarium sheets, prepared by John Henslow. Recently I took the opportunity to visit the Linnean Society in London, which holds the distinction of caring for more than fourteen thousand plant specimens. At the Royal Botanic Gardens at Kew, I visited the Shirley Sherwood Gallery of Botanical Art. The Kew archives list more than two hundred thousand works of botanical art. Taken together these concentrated efforts not only retrieve the past, but they also encourage practical ecological activities directed toward the future; for the conservation and protection of the precious vegetation of

1 On line at, "A decade of visual storytelling" www.thewalrus.ca/photo-essays (first accessed October 2013).
2 For images and essays go to www.edwardburtynsky.com (first accessed February 14, 2013).
3 Ibid.
4 Go to http://en.wikipedia.org/wiki/Svalbard_Global_Seed_vault to view the mission statement (first accessed March 15, 2014).
5 For images and more information go to www.edelweissgrowers.com (first accessed January 22 2014).

Planet Earth.

The American conservation group Ducks Unlimited began its land conservation and plant protection campaign in 1937. Their mission, to preserve the wetlands for waterfowl and wildlife habitat has spread to include international projects. This volunteer-based organization has ongoing conservation projects throughout North American, including Mexico, and in Venezuela, and Australia. According to the impressive fact sheet, of January 1, 2014, the organization has been "influential [in the] conservation of 118, 423,660 acres" in North America alone. Widely recognized for its youth education programs, the mission statement of Ducks Unlimited Canada is to protect and sustain the health of "precious resources" such as wetlands, and watersheds.6

Other long term land conservation projects include the efforts of the Nature Conservancy. This group works regionally, nationally, and globally to protect endangered wetlands, prairies, and mountain habitats. Since 1962 Nature Conservancy Canada has helped to "...save over a million hectares of ecologically significant land across Canada."7 In British Columbia, the Nature Conservancy Canada works in four regions: The Canadian Rockies, Central Interior, the West Coast, and the Southern Interior of the Okanagan and Similkameen valleys and the Thompson Nicola Valley region. Collaborating with private landowners, ranchers, and governments to protect the grasslands and open forests, Nature Conservancy Canada recently acquired a ranch property in close proximity to the Nicola Valley. This delicate bioregion, which will be held in conservation for the future supports vast numbers of wildlife, including the endangered Burrowing Owl.

3. Part II Environmental Polemics

There is a certain globalization of the concepts 'conservation' and 'preservation' that suggests cultural choice. Yet conservation and preservation of the precious "green mantel that gives life to the planet" has a contested, troubling, and conflict-ridden, history. Opponents of environmental protection claim that land conservation limits the potential of community growth. In the "jobs versus environment protection" argument, conservation comes at the expense of employment and tax revenue.8 Communities near and around the oil rich mining areas of the Canadian province of Alberta attest to economic growth and to the demand for housing. The rapid growth of the City of Calgary, for instance, shows unprecedented real estate development that has huge economic gain, but it comes with a high ecological cost. In just a few years, real estate development has spread to engulf hectares of fertile farmland. Ironically, community development is needed: homes for families, schools, hospitals, roads, services; while at the same time, such development destroys fertile farmland, and endangers the life cycles of prairie animals, fragile grasslands, and precious native plant species.

Shifting the focus to developments in industry–open pit mining, energy extraction, and timber harvesting–the economic argument claims that natural resource extraction is necessary for overall economic stability. The countering argument, against environmental devastation and ecological damage perpetrated by industry, supports economic developments in parks and recreation, and the creation of Ecotourism.

In British Columbia, environmental protest has proven an effective way of protecting vast ecological areas from unchecked development. In the 1990s, hectares upon hectare of old growth rain forests were slated for harvest. Often the site of confrontation between environmental activists and loggers, direct environmental action claim victory in Clayoquot Sound, on Vancouver Island and in other places too. 9 The environmental movement has also been instrumental in the protection of the Great Bear Rainforest. Located in the temperate zone of British Columbia, it covers an area of more than 400 km of lush 'old growth' coastal forest. 10 Another example is the protection of Gwaii Haanas, an island located at the southern tip of Haida Gwaii–the Queen Charlotte archipelago. While the logging companies argued for clear-cut logging and loggers their rights to jobs, the Haida First Nation argued indigenous rights to the land. 11 In addition, Haida elders provided traditional knowledge about the sacred cultural environment; and they presented unquestionable facts proving the continuous Haida occupation of the land. If not for the combined efforts of a determined group of environmentalists and First Nations peoples, hectares upon hectare of old growth coastal rain forests would have been lost to the devastating practice of clear-cut logging.

In the interior mountain ranges and the 'dry-belt' pine forests of British Columbia, the naturally tight growth pattern of the Lodgepole pine proves vulnerable to the enormous appetite of *Dendroctonus ponderosae*, the Mountain Pine Beetle. Native to northern British Columbia, the astonishing population explosion of the Mountain Pine Beetle is thought as the result of warmer winters due to

6 For Canadian program information go to www.ducks.ca/education and for information on international programs go to www.ducks.org.media/_global/_documents/StateFactSheets (both first accessed March 24, 2014).

7 For Canadian conservation information go to www.natureconservancy.ca (first accessed March 24, 2014).

8 For a longer discussion see "Environmental Protection Change, and Economic Development in the Rural Western United States" by Paul Lorah, University of St. Thomas, and Rob Southwick of Southwick Associates, Inc., at http://www.voiceforthewild.org (first accessed March 6, 2014).

9 For more information and images go to www.cathedralgrove.eu/text/03-Europeans-care-4.htm (first accessed December 2013).

10 For more information, go to www.savethegreatbear.org and click on More Images (first accessed October 2013).

11 In Canada, the term Aboriginal is the legal designation for indigenous Native Indian and Inuit people. From the mid1980s the term First Nations came into wide use. Although not a legal term it has been adopted by Canada's 614 "Indian Bands" and is now used politically to identify individual people and First Nations groups such as The Assembly of First Nations, and the National Center for First Nations Governance.

climate change. Following Dr. David Suzuki, "...in British Columbia alone it took less than 10 years for swarms of the Mountain Pine Beetle to eat their way through 18 million hectares old growth Lodgepole pine forests."12 The beetle has now made its way to Alberta and into the boreal forest. In British Columbia alone, dead or dying first growth pine forests have been clear-cut; this in part to stave off the invasion, and in part as a precaution against forest fires. As a result of these massive logging operations, the timber market has been flooded, lumber prices have dropped, jobs have been lost and despite replanting projects, entire logging communities have suffered in the economic downturn.

With new ideas in silviculture "big trees" are left standing in clear-cut sections. Dr. Suzanne Simard, forest ecologist at the University of British Columbia, provides research to show that a complex underground web of life connects big trees and plants, which clear-cut logging destroys. Her research reveals that, "...brilliant white and yellow fungal threads in the forest floor...transport carbon, water and nutrients upon which the health of the forest relies" [Simard. (2008)].13 When a big tree is cut down, plant biodiversity and the survival rate of the younger members of the forest, is substantially diminished. Simard elaborates:

> The big trees were subsidizing the young ones through the fungal networks. Without this helping hand most of the seedlings wouldn't make it....At the hub of a forest's mycorrhizal network stand the 'Mother Trees'. These are large, older trees that rise above the forest, a concept illustrated in the movie Avatar. These 'Mother Trees' are connected to all the other trees in the forest by this network of fungal threads, and may manage the resources of the whole plant community.14

Following Simard, as nature *is* like an interconnected community, environmental activists have been quick to adopt the theme of Native Knowledge, which holds that all life is interconnected. Drawing upon ancient cultural wisdom, followers of traditional Native Knowledge deem that the life-giving properties of the natural world ought to be protected not only for the sake of the environment, but also to insure the health and balance of future communities. Dr. David Suzuki explains:

> Seen in this light, Native knowledge and spiritual values are not simply 'natural resources'...for non-natives to mine, manipulate, or plunder. They are, and will always be, the precious life-sustaining property of First Peoples: sacred symbols encoding the hidden design of their respective universes; mirrors to their individual and collective identities; and ancient
>
> and irreplaceable maps suggesting possible paths to inner as well as ecological equilibrium with the wonder, ever-changing world [Knudson & Suzuki. (1993)].15

First Nations' environmental activists also point to industrial activities that are not only endangering the spiritual and precious web of life that envelops the Earth, but also to "big industry" practices that are disturbing the traditional life ways of indigenous communities throughout the world. Environmental justice and indigenous land rights have been addressed by the United Nations in the draft document of the Universal Declaration on the Rights of Indigenous Peoples [Suzuki et al. (1992)]. In Canada, Amnesty International addressed First Nations land issues—as indigenous land rights belong to the realm of human rights under the Canadian Constitution. 16 Most recently, issues of indigenous human rights and environmental ethics were addressed by Archbishop Desmond Tutu, at a conference in Canada holden at Fort McMurray, Alberta, in May 2014.17

4. Part III Visual Culture

In the art world, in connection with Plato's idea of "organic unity" Aristotle's doctrines are basic to critical inquiry into the relationship between nature and human cultural traditions [Hutton. (1982)]. For Aristotle, experience tells us that things are interconnected, especially so with ethical judgement and aesthetic enjoyment. In this sense, ancient philosophy provides the groundwork for the environmental arts to claim an interconnected affinity with nature. Starting with the romantic poets such as Wordsworth and Shelly, and landscape artists like Rosa Bonheur, Van Gogh, and Cézanne—all of whom drew inspiration from daily walks in nature—the environmental artist is often associated with the impulse to communicate with nature.

In the 1930s, the Canadian artist Emily Carr produced a prodigious body of work, based in part on the theme of communication with nature and in part on the theme of the living forest. Starting from her deep belief that all things are interconnected, Carr wrote about her knowledge of the forest and her belief that nature and life are interconnected, "...you can sit on the [forest] path and look down on the snarl of green. It is lovely. Suddenly, its life envelopes you, living, moving, surging with being, palpitating with overpowering terrific life, life, life" [Carr. (1966)]. In her nature writing Carr describes a personal contact with the earth through a 'felt' sensation of being *in* nature, "...the *liveness* in me just loves to feel the *liveness* in growing things, in grass and rain

12 See www.cbc.ca/natureofthings/m/episodes/beetles and click on images (first accessed April 2014).

13 For more information and images go to www.sifi.se/wp-content/uploads/2012/06/Suzanne-W.-Simard

14 The movie Avatar is a 2009 epic science fiction film directed by James Cameron. For images go to www.wikipedia.org/wiki/Avatar_(2009_film) (first accessed March 24, 2014).

15 For more information go to www.davidsuzuki.org (first accessed April 10 2014).

16 For information about human rights issues in Canada go to www.amnesty.ca and click on spring 2014 (first accessed May 2014), or see Amnesty Vol. 13, No.1.

17 Also see www.thestar.com/news/canada/2014/05/06 and click on related issues (first accessed, May 2014). To view a report by Bob Webber, on aboriginal treaties and climate change, go to www.thestar.com/news/canada/2014/05/06 (first accessed, May 2014).

and leaves and flowers and sun and feathers and fur and earth and sand and moss. The touch of those [is] wonderful" [Carr. (1966)]. Claiming the visual language of the landscape in her paintings, Carr projects her idea of nature and the living forest as, "...world life-energy" [Shadbolt. (1971)].

In March 2014 the curators at the Vancouver Art Gallery, Vancouver, British Columbia, brought a collection of Emily Carr's landscape paintings together with Edward Burtynsky's photographic narrative to create a "dialogue" about subjective approaches to nature.18 Among the most cherished of Carr's paintings are "sweeping forest canvasses" belonging to the *Deep Forest* series. In a work titled *Above The Gravel Pit*, Carr reveals an interest in the character of the "denatured" landscape where, in her words, "...nature has not had time to heal the scars and holes yet" [Carr. (1966)].As this painting depicts results of clear-cut logging practices that destroy the forest and the life of the forest floor, Carr's keen sense of observation also points to truths of economic systems that consider the forests primarily as plentiful sources of timber [Tippett. (1979)]. In *Scorned as Timber, Beloved Of The Sky*, Carr depicts one lone tree left standing tall against the devastated logged-over terrain. 19 Here, Carr's "interpretation of the spirit of the forest" is expressed as "symbolic of spiritual energies" [Shadbolt. (19710]. In relation to the interconnections of life's energy, this is a landscape depicted as horrific in scope and breath-taking in its splendour. As such, Carr's transformations of the landscape are well within, "...the formulation of an aesthetic of the sublime." Following Hans-Georg Gadamer, the "aesthetic consciousness" is all about the question of truth. In relation to art, this truth is, "...always linked to a crucial point of access to fundamental truths about the world" [Lawn. (2006)].

With a focus on the use and misuse of natural resources and the impact this has on nature and on the landscape, Burtynsky's photographic narrative brings the viewing public face to face with certain truths about unsustainable global developments.20 Burtynsky's reference to the impact of economic development on communities, on the land, and on natural resources raises questions associated with concepts of conservation and the protection of precious plants that support life on Planet Earth.

In his documentary film, *Water*, Burtynsky's images draw attention to the horrific force of water that is needed to clear silt from behind the Xiaolangdi Dam on the Yellow River, China. As his filmic transformations unfold, there are unsettling, awesome, and disturbingly beautiful images that hearken to the aesthetic of the sublime. In contrast, a still photograph of the *Three Gorges Dam* appears picturesque in the morning mist.21 In his essay, Burtynsky writes that by damming the majestic river 1.13 thirteen million people have been relocated, jobs lost, precious farmland flooded: and, invaluable cultural/historical sites, destroyed.22

In the fall of 2013 I was able to travel to the Greek Island of Crete. While there I had an opportunity to visit the ancient Minoan cultural site at Knossos–albeit a reconstruction by Arthur Evans. The autumn light of September lit up the walls, some of which carry decorative images. Later the same day, I visited the world famous Archaeological Museum in Iráklio (Heraklion), which holds a vast collection of Minoan art. Evidence of the Minoan interest in nature and proof that the Minoan culture valued the precious plants of Crete, is brought to the present in exacting botanical detail of flowering plants that are depicted on a multitude of jars, containers and in fresco fragments that belong originally on the walls of buildings at Knossos.23

The island of Crete is indeed rich in plant life. According to one travel book, there are over two thousand plant species, more than 180 native wild plants, a wealth of precious native bulbs, and the Mediterranean cypress, a tree species native to Crete that is listed as endangered. In their book *Orchids of Crete and their Conservation* Dr. Rosemary John and Julie Jones write of the very rare and endangered orchids of Crete. 24 Noting the loss of precious plants to the illegal trade in the export of rare endangered plants and bulbs, they also note the loss of plant habitat; this, due to the influx of mass tourism, the demand for holiday houses, and the rapid growth in housing development.

Within the environmental art movement, there are many approaches that connect the visual arts to political ideology and to broad social issues such as, social justice, the peace movement, and the planetary environmental crises. Working from the concept of a "personified" Earth, some ecofeminist artists draw inspiration from the Gaia hypothesis; this not only to claim that nature and spirituality are one, but also to express an embodied attachment to the enduring beauty of the living Earth. From the "pluralism of the 1970s" that gave rise to the Conceptual and Process Art movements, many artists chose to "dematerialise" the art objects by moving out of the studio altogether, and to work directly *in* the landscape [Chadwick. (1990)].

The British artist Richard Long, for instance, turned away from making art objects to concentrate on creating a sensuous connection with "integral parts of the landscape" by walking alone in the landscape. Claiming this activity as process art Long has stated, "...A walk expresses space and freedom and the knowledge of it can live in the imagination of anyone" [Lippard. (1983)]. Placing the emphasis on the physical experience of walking alone in Nature, Long's

18 Go to www.vanartgallery.bc.ca and follow the links to find Emily Carr (first accessed January 2014).
19 For more images go to www.vanartgallery.bc.ca and follow the links to Carr (first accessed April 2014).
20 For images go to www.vanartgallery.bc.ca and follow to links to Burtynsky (first accessed March 2014).
21 For images, go to www.edwardburtynsky.com (first accessed February 14, 2014).
22 Go to www.thewalrus.ca/photo-essays (first accessed October, 2013).
23 For images go to www.heraklion-crete.org/ (first accessed May 2014).
24 www.orchidconservationcoalition.org/pr/flowersofcrete and click on images (first accessed January 2014).

process works are relevant to contemporary environmental art practices. The Canadian artist Janet Cardiff's seminal "audio walk" in nature–created in 1998 at Wanäs Sweden–belongs to this tradition. In what is known as a collaborative authorship, Cardiff teamed up with fellow Canadian artist George Bures Miller, and to date they have produced more than a dozen imaginative video audio walks.25

Points I wish to connect tie these and other so-called 'postmodern' artistic practices within the international language of the landscape. Most notably, to the artistic conversation that is going on in the Ecoart movement. This global contemporary movement is cross-cultural, dialogic, interactive, technical, eclectic, optimistic, political, and witty. Many Ecoart images are accessible to the wider public as they may be viewed "on line" simply by going to a public art-site, or by entering a particular artist's name.

Swedish artist Erik Johanssen, for instance, relies upon the web as a form of 'gallery space' to exhibit his works. Billing himself as a contemporary "retouch" artist, Johanssen uses digital imaging that allows him to "toy" with the language of the landscape.26 Creating stark contrasts between cultural and traditional photographic views of the natural countryside Johanssen admits to using René Magritte inspired juxtapositions, which in a witty turn may be read in relation to use and abuse of the land and waterways.

The Canadian artist Rebecca Belmore's visual object/performance piece, *Speaking to their mothers*, has been used politically to get people to step up and speak for nature, and for environmental justice. In the name of protecting the precious plants of the earth, this installation has been used in an effort to wake people up to the dangers of unchecked energy extraction for economic gain.27 To "big industry" the living earth is simply "overburden" lying in the pathway of energy extraction. Although mining and oil companies working in Canada must promise to reclaim extraction sites, facts of the extraction process are such that any effort to rejuvenate the damaged earth is an almost impossible task. Evidence of long term environment devastation and industrial pollution can easily be found in the massive Athabasca oil sands project in northern Canada, at exhausted mine sites and quarries, and at mine tailings ponds, far and wide.28

Form and content are part of the theme of collective authorship in which artist herman de vries and his wife Susanne have created a visual statement based on the concepts of land conservation and preservation. In a work titled *di wiese/the meadow* they obtained a section of land, which they have left to lie fallow. They then claim the living environment and the rejuvenation process as art under the category of nature's art.29

In April, 2014 Rhonda Neufeld and Rodney Konopaki collaborated together on a site-specific installation for the Kamloops Art Gallery at Kamloops, British Columbia. Titled *Suggestions from Kamloops* the artistic work begins with a walk in nature. Holding a drawing paper between them as they walk, they record their subjective 'felt' experiences in nature. Back in the gallery, coloured pigments are rubbed into the paper to bring out the scratches, lines, and marks. These drawings are not compositions in the sense of the landscape as picturesque scenery. What they represent are embodied subjective experiences, presented as a visual text, wholly dependent upon a wide range of physical stimuli in relation to bodily experiences in nature. In addition, topographical lines were drawn on the gallery walls to depict points of reference that correspond with drawings fixed to the walls. Although Neufeld and Konopaki claim an autonomous art, the political language is there non-the-less. This is due, in part, to the placement of drawings that are meant to reveal specific surface regions in the physical landscape; and in part, due to facts of installation art.

Installation art is a well-known artistic strategy directed toward an investigation into the truthful nature of reality. Taken together with juxtaposition, which combines disparate elements to bring new meaning to immediate objects of perception, the viewer is encouraged to reason out the connection between the eclectic images and to bring new meaning to the viewing experience. In addition, given that the contemporary viewing public is well aware of the flow of language, and the politics of installation art, the political is brought to the viewing experience.

In my own installation work, titled *A Landscape of Unsettled Emotion and Changing Ecological Conditions*, I use ice and melt-water to achieve a visual transmutation of form. 30 In the viewing experience, the visual change of form, from a static state of ice to a dynamic state of the life-giving element of water, is highly symbolic of the great environmental changes brought to systems of nature by climate change. As such facets of experiential viewing releases emotional currents, an embodied state of disruption is suggested. As this belongs to the human psyche, the eclectic images translate 'felt' emotional shifts that belong to the realm of sensual reality. As the viewer reasons out the interconnected meaning, the greater implication of this work is meant to raise public awareness about the impact of climate change, and the attendant loss of critical aspects of the natural world.

In a recent documentary film *Tipping Point*, with reporter Bernice Notenboom, scientists identify twelve dangerous tipping points associated with climate change that have the potential to alter weather patterns around the world.31 Such

25 This collaborative work may be viewed at the Vancouver Art Gallery, June-September 2014. For more information and images, go to www.vanartgallery.bc.ca (first accessed May 2014).
26 www.erikjohanssonphoto.com/
27 For images, go to www.canadianart.ca (first accessed January 2012).
28 For alarming images of tailings pond breaches, go to 'Google' and enter tailings pond + images.
29 See www.hermandevries.org for images (first accessed June 15 2010).
30 To view this work, go to SaatchiGallery.com and follow the links (first accessed May 2014).
31 To view filmic segments go to www.knowledgenetwork.ca/programs (first accessed February 20, 2014).

change will, no doubt, alter planetary growing patterns that will in turn endanger the Earth's precious, "...green mantel of plants that give life to planet earth" [Carson. 1962)].

I close with reference to an enormous art installation titled *The Weather* created in 2003 by artist Olafur Eliasson for the Turbine Hall of the Tate Modern in London. What sets Eliasson's installation apart from entertainment is his treatment of the "dramatic illusion" effect [Hutton. (1982)]. Marcella Beccaria, a curator of the installation, explains, "...most visitors chose to ignore the obvious technical components needed to make up the installation–the back-lit lighting, the evaporating mist, the mirrors installed along the entire length of the ceiling–and chose instead, to stay with the staged illusion of the sun."32 According to a frequent visitor to the installation, the viewing public appeared to be responding to the artistic *imitation* of the sun as if they were experiencing an emotional primitive relationship with the ancient symbol of life.

5. Summary and Conclusions

Globalization of the concepts 'conservation' and preservation' suggest cultural values and choice; yet in practice, land and water conservation and the protection of earth's precious plants has a complex and troubling history. Thanks, however, to the efforts of dedicated environmentalists and groups working together with societies like the Planta Europa Foundation, national and international success stories may be told.

In the case of environmental and ecofeminist philosophy, new narratives in support of conservation and the protection of plant species are directed toward creating a partnership ethic as a guide for ecological thinking. While environmental activists and First Nations community leaders speak from a belief that all life is interconnected, research from Forest science and Earth system science can explain the interconnectedness of all aspects of Earth. Taken together with visual storytelling from the dust of time through the dawn of history and into the present day, the artistic conversation is not only integral to the age-old search for identification, but also integral to the relationship between the spiritual world and the material world. By placing the arts within the ecological vision of the interconnectedness of the Earth's system, the environmental art movement stresses the possibility of reconnecting humanity with the beauty of the natural world. As such, the ethico-aesthetic reality helps to encourage the wider public to get involved in practical activities that have a future: not only for the sake of humanity, but also in the hope of a good and peaceful outcome for Planet Earth.

32 For images, go to www.tate.co.uk (first accessed February 10, 2014).

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Chapter 4 Reserve Areas Ipas, in Situ and Ex-Situ Conservation, Invasive Species and Commerce

Ex Situ Conservation Programme in the Botanical Garden of Károly Eszterházy College, Hungary

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Abstract The conservation programme of 32 vascular plant species has been started in the Botanical garden three years ago cooperating with two national parks which are situated in Northern Hungary in the Northern mountain region. The seeds of the species were collected in the chosen habitats with the permission determined by the National Parks and the conservation specialists. Now we have different numbers of individuals from the following, mainly endemic and relict species: *Alchemilla monticola, Allium victorialis, Arabis alpina, Armeria maritima subsp. elongata, Aster oleifolius, Campanula latifolia, Cardamine glanduligera, Cirsium erisithales, Clinopodium thymifolia. Crepis pannonica, Dianthus plumarius subsp. praecox, Dracocephalum austriacum, Dracocephalum ruyschiana, Eriophorum vaginatum, Ferula sadleriana, Hesperis matronalis subsp. nivea, Hieracium bupleuroides subsp. glaberrimum, Lilium bulbiferum, Onosma tornense, Onosma visianii, Pleurospermum austriacum, Poa remota, Seseli peucedanoides, Sesleria heufleriana, Succisa pratensis, Stipa dasyphylla, Telekia speciosa. Tephroseris crispa, Thlaspi kovatsii, Trollius europaeus, Valeriana simplicifolia, Viola biflora*. We took some experiments to know how can we germinate and grow up to bloom this species successfully. We will collect in the next year: *Actea europaea, Adenophora liliifolia, Adonis vernalis, Crepis praemorsa, Gentianella ciliata, Lathyrus transsvlvanicus, Scrophularia vernalis, Tephroseris aurantiacus, Vaccinium vitis-idaea.*

Keywords Ex Situ Conservation, Germination Success, Soil Preference Bükk Mountains, Hungary, Regionality

1. Introduction

The attention to both taxonomic coverage and population biology will support the role of seed banks as conservation tools and botanical gardens can serve as living collections of seedlings grown from seeds which are not storable for a long period. But we do not know all of the features which determine the germination and growing success.

Generally known the natural plants have various reactions to environmental factors. In the temperate zone the majority of species after ripening the seeds or corps (by seed word, we think about seed and corp all along this article) get dormancy to avoid the inadequate period to germinate [Baskin & Baskin (1998), (2001); Angelovici et Al. (2010)]. The seeds of species need variously pre-treatment (for example pre-chill) and suitable environment (for example basic medium) to unlock the seed dormancy and germinate in large scale [Roberts (1981), Noronha et Al. (1997); Andersson & Milberg (1998)]. These impacts are often similar in their original habitats. Geminating and get the blooming period plants need suitable types of soil [Milberg (1997)], but we cannot always grow them in the soil of habitat. The suitable microclimate is usually more important for some relict species than the soil that is why should we make experiments for the suitable essential conditions or-ecologically-for the most limiting factor for different species and know all of phenological states of them. We set as an aim to achieve hundreds individuals of all species, than from the additional individual can we resettle in former habitat if its need.

We consider to collect the plant species just from our region, because the botanical gardens know and have to protect the regionally rare and very sensitive species and the way of keeping local plant species is easier (because of the same meso-climate), than in the other regions.

During field work and observations in the Northern Mountain Range in Hungary the locality of the collecting sites is determined or offered by the botanists of Bükk National Park and Aggtelek National Park Directorate.

2. Materials and Methods

We chose 41 endemic, glacial and interglacial relict species, the latter species reach here the edge of area. Some of species is requested from the national parks for ex situ conservation programme and resettle later originally habitat, because of decreased in this region (*Onosma visianii, Trollius europaeus*). On the basis our knowledge of country and national parks instructions we collected in the determined amount of seeds, than we cleaned and dried them in room temperature for some weeks. The amount of seeds and we measured the hundreds of weights and multiplied them ten [Török et Al. (2013)] and repeated it three times. If we had not enough seeds to repeat we counted and halved the seeds than we measured their weights and multiplied to 100 seeds. The thousand seeds weight was given in a number with four decimals.

The basic questions were:

- Do the seeds have dormancy by the examined species?
- How can we unlock the seed dormancy of this species?
- Do the species have soil preference by germinating and growing up?
- How many individuals can we grow up from seeds to bloom?

We looked for the appropriate pre-treatment (pre-chill, heat and naturally without pre-treatment) and environment (dark or light, distillate or more basic water) for germinating this species in a greenhouse. We used these treatments separately in filter papered Petri-dishes, which were kept in continuous wet. We did not test all species in all experiments. Pre-chill means dried condition 2-4 Celsius degree through 12-14 days in fridge. By heat experiments we poured boiled water between the seeds. In light experiment the seeds were in east orientation with 2 or 3 hours directs lights, like the all of experiments, except for the dark tests which was kept in a closed carton box. After half mounth incubation we measured twice weekly the germinated seeds in percent for germinated success. The results were taken into consideration if the differences were more than 20%.

We took an experiment, that how long exposure to cold (pre-chill) need for 4 species (*Gladiolus imbricatus, Hesperis matronalis subsp. nivea, Hieracium bupleuroides subsp. glaberrimum, Trollius europaeus*). We shared the seeds of species 4 groups and put them in the fridge (0-4 centigrade) for 3 weeks, 6 weeks, 9 weeks and in the case of the control we used 5 iterations. We put 50 seeds (5 x 10 seeds) per treatment at different species (total 200 seed used per species). The seeds have germinated negligible (up to 1 or 2 seeds), that is why we suppose this species need another or with another impact (for example temperature fluctuations) to begin germinate.

In germination and during the growing up in some species we planted the seedlings to variously soils (5 individuals per species) to examine the soil preference. We used basic (pH 6,90) and acid (pH 6,45) sand; basic (pH 7,87) hard ground; general soil from shops (pH 5,92). After 6 months we measured (with our own method) the 3 lowest leaves' width and length in centimeter. We multiplied them with the number of leaves or the numbers of nodes (stem leaved species) and averaged the values in five individuals per species, then account the logarithm. The results were taken into consideration, if the differences were more than 20%. This method helps us to compare the products in different soils.

We wrote the alive of rate in all of examined species with the number of seeds, and the number of growed up individuals in these days. In some species we have observations about replantation, vegetative propagation or in growing up in the Growing experience chapters. We did not use pesticides in our investigations.

The nomenclature for species follows The Plant List Version 1.1 (2013). To evaluate the distributions were used the Flora Europaea [Tutin et al. (1964-1993)] and the IUCN (2014) for the international red listed species. For the Hungarian state were used the Magyar Közlöny (2012) with following abbrevations: P protected, NP not protected, HP highly protected. The Új Magyar Füvészkönyv [Király et Al. (2010)] were used for the Hungarian distributions and habitats. The Red List [Király (2007)] for Hungarian red listed species were used with the following abbreviations: EX Extinct, EW Extinct in the wild, CR Critically endangered, EN Endangered, VU Vulnerable, NT Near threatened, DD Data deficient.

3. Results

Alchemilla monticola Opiz

- Distribution, international state: Eurasian species, distributed almost all of Europe from Portugal to Russia. Not red listed.
- Hungarian distributions: located in the North Hungarian Mountains and the west edge of Transdanubia, on mountain meadows, Nardus meadows, mire meadows.
- Collecting: Nagymező in Bükk Mountains on 11th of September 2011, about 10 seeds from one individuals, did not measure thousand-seed weight.
- Germination: did not use pre-treatment, but early in spring begin to germinate.
- Growth experience: germinated and growed up in hard ground soils and penumbra. We could grow up 3 plant to bloom.

Allium victorialis L.

- Distribution, international state: Alpic element, distributed from Spain to Russia. Not red listed.
- Hungarian distributions: founded in Bükk Mountains (North Hungarian Mountains) and Bakony Mountains (Transdanubian Mountains) in rocky and beech forests.
- Collecting: in Botanical Garden of Károly Eszterházy on 17th July 2012, 36 seeds, thats why

we could not measure thousand-seed weight.
- Germination: see below the table.
- Growth experience: we could grow up 11 plant per 36 seeds, but still they have not flourished.

Arabis alpina L.
- Distribution, international state: Alpic element, distributed much of Europe. Not red listed.
- Hungarian distributions: lives in Bükk Mountains on limestones rocky places and in Szigetköz (island in the North of Transdanubia), which was came by Danube.
- Collecting: Gerenna castle in Bükk Mountains on 26th July, 372 seeds.
- Germination: see below the table.
- Growth experience: not sample in different soils, like the shadows, but it tolerate direct sunlight. The flowering begin from 2 years old. We could grow up 14 plants per 350 seeds, but by the transplantation died a lot of individuals.

Armeria maritima subsp. elongata (Hoffm.) Bonnier
- Distribution, international state: Central-European-Baltic element, distributed from Switzerland to Russia and from Italy to Poland. Not red listed.
- Hungarian distributions: lives only in Bükk Mountains on silicate and slate rocky grasslands and slope steppes, all of Hungarian locality published by Vojtkó (2001).
- Collecting: Tárkányi peak in Bükk Mountain on 24th August 2014, 320 achenes.
- Germination: see below the table.
- Growth experience: need good permeable soils and penumbra placement, but it tolerate direct sunlight. The flowering begin from 2 or 3 years old. We could grow up 62 plant per 320 achenes.

Aster oleifolius (Lam.) Wagenitz (provisionally accepted name Galatella villosa (L.) Rchb.f.)
- Distribution, international state: Continental element, distributed from Czech Republic to Russia. Not red listed.
- Hungarian distributions: lives only in Tokaji Mountain (North Hungarian Mountains) on loess steps, which was abandoned vineyard.
- Collecting: Tokaji Mountain 31th October 2012, 11 seeds that is why we could not measure thousand-seed weight.
- Germinating: none of the achenes germinated, because of the 2012's summer was very droughty to the mature plant.

Campanula latifolia L.
- Distribution, international state: Eurasian element, in Europe distributed from Portugal to Russia. Not red listed.
- Hungarian distributions: located only in Bükk Mountains and Kőszegi Mountains (western part of Transdanubia) in gorge and beech forests and tall herb vegetation.
- Collecting: Hór valley in Bükk Mountains on 24th August 2013, about 350 seeds.
- Germination: did not use pre-treatment, but early in spring begin to germinate.
- Growth experience: need good permeable soils and penumbra or direct sunlight. The flowering begin from 2 or 3 years old.

Cirsium erisithales (Jacq.) Scop.
- Distribution, international state: Central-European element, distributed from Austria to Russia. Not red listed.
- Hungarian distributions: located in Bükk and Mátra Mountains (North Hungarian Mountains) and the western edge of Transdanubia in gorge, rocky and chestnut forests.
- Collecting: Hagymás-lápa in Bükk Mountains on 28th August 2012, about 120 achenes, did not measured thousand-seed weight.
- Germination: did not use pre-treatment, but early in spring begin to germinate.
- Soil preferences: see below the table.
- Growth experience: need good permeable soils and penumbra or direct sunlight. The seedlings and the developed plants are very sensitive to water-condition of soil, easily begin to rot. We could grow up 5 plant per 120 achenes. The flowering begin from 2 years old.

Clinopodium thymifolium (Scop.) Kuntze
- Distribution, international state: Illyrian element, distributed from Italy to Balkan. Not red listed.
- Hungarian distributions: located only in Bélkő (Bükk Mountains), all of Hungarian locality published by Vojtkó (2001). Lives in limestones rocky slopes.
- Collecting: Bélkő in Bükk Mountains on 29th September 2012, about 200 seeds.
- Germination: did not use pre-treatment, but early in spring begin to germinate.
- Growth experience: need good permeable soils and penumbra or direct sunlight. The flowering begins from 3 years old. We could grow up 8 plant per 100 seeds.

Crepis pannonica (Jacq.) K.Koch
- Distribution, international state: Pontus-Pannonean or notedly Caucasian-Pontic-South-Sarmathian-Pannonian element [Somlyay (2010)], distributed from Austria and Czech Republic to Russia. Not red listed.
- Hungarian distributions: located near some big cities (Tokaj, Salgótarján, Eger, Budapest, Esztergom,

Győr) and a village (Meszes) on steppes and shrub forests, all of Hungarian locality published by Somlyay (2010).
- Collecting: Nagy-Eged in Bükk Mountains on 24th August 2013, almost 300 achenes.
- Germination: did not use pre-treatment, 4-7 days after seedling begin to germinate.
- Soil preferences: see below the table.
- Growth experience: biennial [Simon (2000)], need good permeable soils and penumbra or direct sunlight. The seedlings are very sensitive to water-condition of soil, easily begin to rot. We could grow up 13 plant per 200 achenes.

Dianthus plumarius subsp. praecox (Willd. ex Spreng.) Domin
- Distribution, international state: Pannonean endemic element, distributed in Slovakia and Hungary. Not red listed.
- Hungarian distributions: located in Szalonna and Bükk Mountains in rocky slopes on limestone.
- Collecting: in Bélkő of Bükk Mountains on 10th July 2012, 10 seeds.
- Germination: did not use pre-treatment, but early in spring begin to germinate.
- Growth experience: need good permeable soils and direct sunlight. In this year we have 17 individuals. The flowering begins from 2 or 3 years old.

Dracocephalum austriacum L.
- Distribution, international state: Pontic element or notedly Caucasian-Pontic-Central-European element, distributed from France to Russia and the Caucasus [Virok et Puska. (2006)]. Not red listed.
- Hungarian distributions: it has been reported just in Tornai Mountains (North Hungarian Mountains), in the other locations have missed [Virók et Puska (2006)].
- Collecting: near from Jósvafő in Aggteleki-karszt on 12th July 2013, about 74 seeds.
- Germination: see below the table

Dracocephalum ruyschiana L.
- Distribution, international state: Eurasian element, in Europe distributed from France to Norway Russia. Not red listed.
- Hungarian distributions: just in Bükk Mountains in mountain meadows. All of Hungarian locality published by Vojtkó (2001)
- Collecting: Nagymező in Bükk Mountains on 27th July 2011, about 84 seeds.
- Germination: see below the table.
- Growth experience: need penumbra or direct sunlight and good permeable soils, but do not like if the soils dry out for some days. The flowering begins from 2 or 3 years old. We could grow up 19 plants per 84 seeds.

Eriophorum vaginatum L.
- Distribution, international state: Ciricumpolar element, in Europe distributed from Portugal to Russia. Not red listed.
- Hungarian distributions: located in Putnok hills and Mátra Mountains and north top of the Great Plain on sphagnum bogs and birch mires. .
- Collecting: near from Sirok in Mátra Mountains on 24th May 2011, about 460 seeds.
- Germination: see below the table.
- Soil preferences: see below the table.
- Growth experience: continuously need to keep wet the soil and like penumbra, but tolerate the direct sunlight. The flowering begins on 2 or 3 years old. We could grow up 31 plants per 460 seeds.

Ferula sadleriana Ledeb.
- Distribution, international state: Pannon endemic. In IUCN Red List is categorised as EN.
- Hungarian distributions: the species has dispersed area, all of Hungarian locality published by Csóka. (2004).
- Collecting: Bélkő in Bükk Mountains on 10th July 2012, about 150.
- Germination: After experiments we seeded them to pottered soil in open air conditions of the botanical garden. In spring 7 seeds began to germinate. We assumed that the seeds need temperature fluctuations or any other effects to germinate.
- Growth experience: the seedlings and the developed plants need big spot, because they grow a long tap-root. In the ELTE Botanical Garden of Budapest is flowering from 4-6 years old. We could grow up 7 plant per 150 achenes.

Gladiolus imbricatus L.
- Distribution, international state: Continental element, in Europe distributed from Czech Republic to Russia. Not red listed.
- Hungarian distributions: protected, located in the Transdanubian Mountains and the western edge of Transdanubia, North Hungarian Mountains and the north top of Great Plain.
- Collecting: István fountain in Zemplén Mountains (North Hungarian Mountains) on 13th August 2011, about 350 seeds.
- Germination: see below the table.
- Growth experience: need penumbra, but tolerate the direct sunlight and uniformly wet soil, that is why likes the hard ground soils. Based on our previous experiments the seedlings grow up slowly, likes the other bulbs, the flowering begin from 4-6 years old. We could grow up 42 plant per 350 seeds.

Hesperis matronalis subsp. nivea Kulcz.
- Distribution, international state: Pannon element,

endemic species of Bükk Mountains. Not red listed.
- Hungarian distributions: located only in Bükk Mountains in gorge forests. All of Hungarian locality published by Vojtkó (2001).
- Collecting: Tar rock in Bükk Mountains on 14th August 2012, about 400 seeds.
- Germination: After the experiments we seeded them to pottered soil in open air conditions of the botanical garden. In spring 68 seeds began to germinate. We assumed that the seeds need temperature fluctuations to germinate like the Ferula.
- Soil preferences: see below the table.
- Growth experience: need good permeable soils in shadow or penumbra, but tolerate the direct sunlight. We could grow up 68 plant per 400 seeds.

Hieracium bupleuroides subsp. glaberrimum (Spreng.) Fr.
- Distribution, international state: Alpic element, distributed from France to Poland and Hungary. Not red listed.
- Hungarian distributions: located just in Bükk Mountains in rocky slopes on limestones. All of Hungarian locality published by Vojtkó (2001).
- Collecting: Bélkő in Bükk Mountains on 10th July 2012, about 300 achenes..
- Germination and soil preferences: see below the table.
- Growth experience: like direct sunlight. We could grow up 59 plant per 200 achenes.

Laserpitium prutenicum L.
- Distribution, international state: Central European element distributed from Spain to Russia. Not red listed.
- Hungarian distributions: hardly known species, lives in Hungarian Mountains and some point of Great Plain in mountain meadows shrubs and calcifugous forests.
- Collecting: Nagymező in Bükk Mountains on 28th August 2012, about 300 achenes.
- Germination: did not use pre-treatment, but early in spring begin to germinate.
- Growth experience: need hard ground soils and penumbra. The rhizome is branched, but by the vegetative propagation is easily begin to rot.

Lilium bulbiferum L.
- Distribution, international state: Alpic element, distributed from Spain to Poland and Romania. Not red listed.
- Hungarian distributions: located in Szigetköz and Bükk Mountains in mountain meadows, forest edge habitats and hard wood galleries.
- Collecting: Nagymező in Bükk Mountains on 27th July 2013, 12 bulbils.
- Growth experience: need good permeable soils and penumbra or direct sunlight. The bulbils bloom from 4 or 5 years old.

Onosma tornensis Jáv.
- Distribution, international state: Pannonic element. Located only in Tornai hills in Slovakia and Hungary. In IUCN Red List is categorised as EN.
- Taxonomic state of the species has been discussed in several publications (Jávorka 1906, Kolarčik et al. 2010, Mártonfi et al. 2014)
- Hungarian distributions: lives rocky slopes on limestones and shrub forests.
- Collecting: Szent-János-rock in Tornai hills on 22th August 2012, 86 seeds.
- Germination: see below the table.
- Growth experience: need good permeable soils and penumbra or direct sunlight. We could grow up 3 plant per 200 achenes.

Onosma visianii Clem.
- Distribution, international state: Pannonean-Balcan element, distributed from Austria and Albania to Russia and Turkey. Not red listed.
- Hungarian distributions: located in North Hungarian Mountains and Transdanubian Mountains on limestones rocky slopes.
- Collecting: Bélkő in Bükk Mountains on 9th August 2013, 223 seeds.
- Germination: did not use pre-treatment, but early in spring begin to germinate.
- Growth experience: need good permeable soils and direct sunlight. We could grow up 22 plant per 100 seeds.

Pleurospermum austriacum (L.) Hoffm.
- Distribution, international state: Central-European-Alpine element, distributed from France to Sweden and Russia. Not red listed.
- Hungarian distributions: located in some point of North Hungarian Mountains in beech, gorge, rocky forests.
- Collecting: Nyárjú-mountain in Bükk Mountains on 23th September 2013, 5 twin dry fruit.
- Germination: did not use pre-treatment, but early in spring begin to germinate.
- Growth experience: need good permeable soils and shadow. By the transplantation need to pay attention, because the tap-root easily begin to rot. We could grow up 2 plants per 5 fruit.

Poa remota Forselles
- Distribution, international state: Boreal element, distributed from Austria and Czech Republic to Norway and Russia. Not red listed.
- Hungarian distributions: located in Mátra and Tornai

Mountains (North Hungarian Mountains) in Farxinus mires and forest fountain mires.
- Collecting: on Kőris-meadows in Mátra Mountains on 22th July 2013, about 350 seeds.
- Germination: see below the table.
- Growth experience: need continuously need to keep wet the soil and like the shadow. By the transplantation the seedlings are very sensitive, easily begin to rot. We could grow up 57 plants per 300 seeds.

Seseli peucedanoides (M.Bieb.) Koso-Pol.
- Distribution, international state: Submediterranean element, distributed from France to Russia. Not red listed.
- Hungarian distributions: located in North Hungarian Mountains on steppes and shrub forests.
- Collecting: nearb y Noszvaj (Bükk Mountains) on 16th August 2013, about 52 twin.
- Germination: did not use pre-treatment, but early in spring begin to germinate.
- Growth experience: need good permeable soils and penumbra. By the vegetative propagation need to pay attention, because rhizome begin easily to rot. We could grow up 5 plant per 50 twin fruit.

Sesleria heufleriana Schur
- Distribution, international state: endemic species in Carpathian-basin Carpathian elemet, distributed from Czech Republic to Russia.
- Hungarian distributions: located Bükk and Upponyi Mountains (North Hungarian Mountains).
- Collecting: Pyrker cliff in Bükk Mountains on 19th July 2011, 85 seeds.
- Germination: did not use pre-treatment, after seed begin to germinate.
- Soil preferences: see the table below.
- Growth experience: need good permeable soils in penumbra, but it tolerate the direct sunlight. We could grow up 21 plant per 85 seeds.

Succisa pratensis Moench
- Distribution, international state: endemic species in Carpathian-basin Carpathian elemet, distributed from Czech Republic to Russia.
- Hungarian distributions: located sporadically in Hungary in rich fens, Molinia meadows, dry deciduous oak woodlands and pine forests.
- Collecting: Nagymező in Bükk Mountains on 11th September 2011, 208 seeds.
- Germination and soil preferences: see the tables below.
- Growth experience: need uniformly wet soils in penumbra, but it tolerate the direct sunlight. We could grow up 21 plant per 85 seeds.

Tephroseris crispa (Jacq.) Rchb.
- Distribution, international state: Central-European-Alpic element, distributed from Austria and Czech Republic to Russia.
- Hungarian distributions: located in Bükk and Mátra Mountains in swamp woodlands and tall herb vegetations.
- Collecting: Létrás meadows in Bükk Mountains on 22th July 2013, 12 achenes.
- Germination: did not use pre-treatment, in autumn some of them begin to germinate.
- Growth experience: continuously need to keep wet the soil and like shadow or penumbra. The developed plants is sensitive to aphis. We could grow up 11 plants per 12 achenes.

Thlaspi kovatsii Heuff.
- Distribution, international state: distributed from Albania and Hungary to Moldavia. Not red listed. The Thlaspi kovatsii subsp. schudichii (Soó) Soó [Király et Al. (2010)] is an unresolved name, which is a Pannonean element.
- Hungarian distributions: just this subspecies lives in Hungary, located in two point of Zemplén Mountains in the edge of forests and on andesite rocky slopes.
- Collecting: Kőkapu in Zemplén Mountains on 30th May 2011, about 200 seeds.
- Germination: see the table below.
- Soil preferences: acid hardy ground, basic hardy ground
- Growth experience: need good permeable soils and penumbra, but tolerate the direct sunlight. The seedlings are very sensitive to water-condition of soil, easily dry out or begin to rot. We could grow up 38 plants per 200 seeds.

Trollius europaeus L.
- Distribution, international state: European element, distributed across Europe.
- Hungarian distributions: distinguished 3 subspecies. The rearest, Trollius europaeus L. subsp. tatrae (Borbás) Pócs et M. Balogh lives in this region wet grasslands and tall herb vegetation, all of Hungarian locality by Endes et Al. (2006).
- Collecting: nearby Szászfa of Rakaca basin (Cserehát hills) on 24th June 2014, about 150 seeds.
- Germination: did not use pre-treatment, but early in spring begin to germinate.
- Growth experience: continuously need to keep wet the soil, that is why likes he hard ground soils. Likes the penumbra, but tolerate the direct sunlight if the water condition of soil is uniformly wet. The seedlings are very sensitive to water-condition of soil, easily begin dry out.

Valeriana dioica subsp. simplicifolia (Rchb.) Nyman

- Distribution, international state: is distributed in the eastern part of Europe, from Austria to Russia.
- Hungarian distributions: located just in Cserehát hills and Bükk Mountains in swamp woodlands. In

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Hungary was discoverd and by Vojtkó (1999).

- Collecting: Csanyik-valley in Bükk Mountains on 9th August 2013, 12 seeds.
- Growth experience: continuously need to keep wet the soil,that is why likes the hard ground soils. We could grow up 5 plants per 12 seeds.

Table 1. 21 species conservation state (NP not protected, P protected, HP highly protected); Hungarian IUCN category; 1000 seed weights in grams (1000 S-W.) and those deviations (Dev.) in gram; number of measured 1000 seed weights per species (Num. 1000 S-W.); percent of germinations in acid (Ger.ac.) and basic soil (Ger.bas.); piece of seeds in the following pre-treatments (S.perTre.): no-pretreatment (No-pret.), pre-chill (Pre-ch.), heat (He.), distilled (Dis.w.) and basic water (Bas.w.) in light and in dark treatment (Da.).

Species	NP	IUCN RL	1000 S-W. (g)	Dev. (g)	Num. 1000 S-W.	Ger.ac. (%)	Ger.bas (%)	S.perTre. (piece)	No-pret. (%)	Pre-ch. (%)	He. (%)	Dis .w. (%)	Bas. (%)	Da. (%)
1. Alchemilla monticola Opiz	P	NT	-	-	-	-	-	-	-	-	-	-	-	-
2. Allium victorialis L.	P	EN	-	-	-	-	-	5	53	0	100	60	40	60
3. Arabis alpina L.	P	EN	0.1873	0,0001	3	-	-	20	25	15	30	15	55	5
4. Armeria maritima subsp. elongata	P	EN	1,9787	0,0026	3	-	-	20	53	20	45	70	55	35
5. Campanula latifolia L.	HP	CR	0,255	0,0018	3	-	-	-	-	-	-	-	-	-
6. Cirsium erisithales (Jacq.) Scop.	P	VU	-	-	-	7	3,3	-	-	-	-	-	-	-
7. Clinopodium thymifolium (Scop.) Kuntze	HP	CR	0,299	0,0011	3	-		-	-	-	-	-	-	-
8. Crepis pannonica (Jacq.) K.Koch	HP	EN	0.08875	0,003	2	20	57	20	-	-	-	-	-	-
9. Dracocephalum austriacum L.	HP	CR	-	-	-	-	-	30	1	1	-	-	-	-
10. Dracocephalum ruyschiana L.	HP	CR	2,37	0,02	3	-	-	10	23	20	0	-	20	30
11. Eriophorum vaginatum L.	P	CR	1,2788	-	-	-	-	100	34	42	-	-	-	-
12.Ferula sadleriana Ledeb.	HP	EN	3,9985	0,4627	2	-	-	10	0	0	0	0	0	0
13. Gladiolus imbricatus L.	P	EN	3,123	0,0182	3	-	-	50-100	3	23	-	-	4	2
14. Hesperis matronalis subsp. nivea Kulcz.	HP	NT	1,7313	0,0024	3	-	-	20	0	0	0	0	0	0
15. Hieracium bupleuroides subsp. glaberrimum (Spreng.) Fr.	P	CR	0,3883	0,0047	3	-	-	20	0	18	-	0	0	0
16. Laserpitium prutenicum L.	N	NT	0,0955	0,0028	3	-	-	-	-	-	-	-	-	-
17. Onosma tornensis Jáv.	HP	CR	0,16	0,0017	-	-	-	10	3	60	0	0	0	10
18. Onosma visianii Clem.	P	NT	17,7507	0,0068	2	-	-	-	-	-	-	-	-	-
19. Poa remota Forselles	P	EN	0,0238	0,0018	3	-	-	20	55	73	-	-	-	-
20. Sesleria heufleriana Schur	P	VU	-	-	-	23	40	-	-	-	-	-	-	-
21. Succisa pratensis Moench.	NP	-	0,8968	0,0026	2			10	40	50	40	30	50	
22. Thlaspi kovatschii Heuff.	P	EN	0,5575	0,0032	2	-	-	100	-	-	-	-	-	-
23. Trollius europaeus L.	P	DD	0,0831	0,0031	2	-	-	30-70	51	-	6	-	-	-

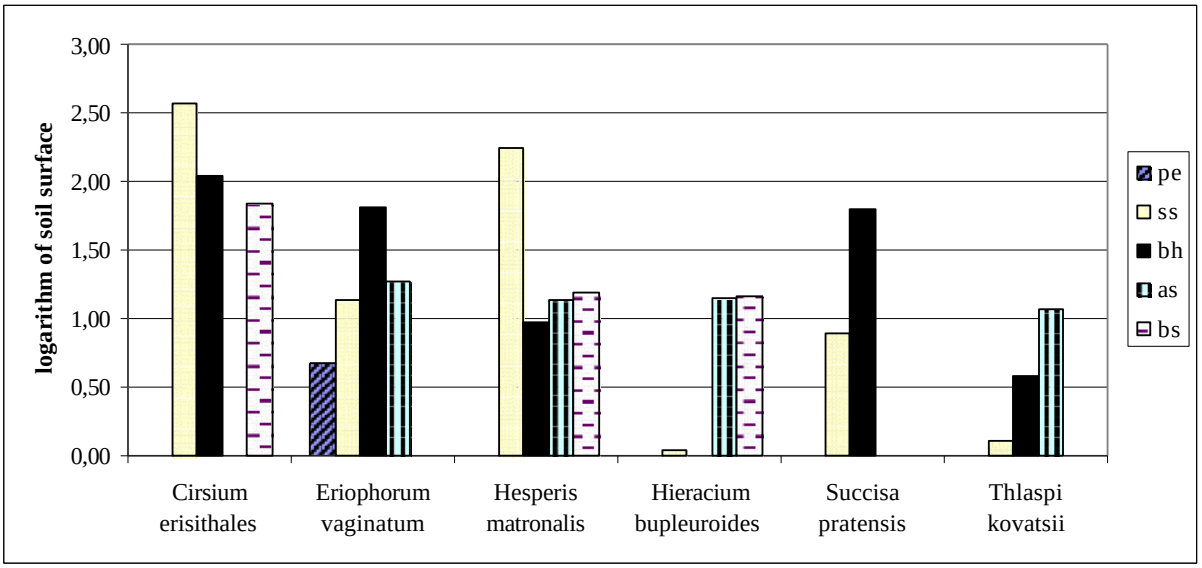

Figure 1. Examination of soil preference in growing up by six species. After serial numbers are the average and those deviation values in the brackets: **1.** ss 2,57 (2,79), bh 2,03 (1,87), bs 1,84 (2,21); **2.** pe 0,67 (0,76), ss 1,13 (0,64), bh 1,81 (1,22), as 1,27 (0,63); **3.** ss 2,24 (1,83),bh 0,98 (1,01), as 1,13 (0,63), bs 1,18 (1,09); **4.** ss 0,04 (0,04), as 1,15 (0,68), bs 1,16 (0,46); **5.** ss 0,89 (0,77), bh 1,80 (1,81); **6.** ss 0,11 (0,04), bh 0,54 (0,51), as 1,07 (1,27).

Viola biflora L.

- Distribution, international state: Circumpolar element, distributed from Austria and Czech Republic to Russia. Not red listed.
- Hungarian distributions: located just in Bükk Mountains gorge forests. All of Hungarian locality by Vojtkó (2001).
- Collecting: Leány-valley in Bükk Mountains on 9th August 2013, 3 seeds.
- Growth experience: need humid conditions inshadow or penumbra. The seedlings are very sensitive to water-condition of soil, easily begin to rot. We could grow up 2 plants per 3 seeds.

We got the permission of collection from inspectorate and we will investigate the following species: Actaea europaea, Adenophora liliifolia, Adonis vernalis, Astragalus dasyanthus, , Cardamine glanduligera, Crepis praemorsa, Gentianopsis ciliata, Lathyrus transsilvanicus, Paeonia tenuifolia, Peucedanum carvifolia, Pyrola rotundifolia, Scrophularia vernalis, Stipa dasyphylla, Telekia speciosa, Tephroseris aurantiacus, Vaccinium vitis-idaea

4. Conclusions

Ex situ conservation programmes need a fluent collaboration between National parks, Nature Conservation Authorities and Botanical Gardens, Seed Banks. The new results are published in order to exchange the knowledge about the growing experiments very quickly. The different pre-treatment experiments are useful for conservation biologist to use the most successful way in germination so the loss of collected seeds is low. The heat pre-treatment was successful at *Allium victorialis*, so we can try to germinate this species only with this treatment in the future. Distilled water and light were important factors in the case of *Armeria maritima ssp. elongata*. Pre-chill help to germinate at *Gladiolus imbricatus, Hieracium bupleuroides, Onosma tornensis*, The general soil from shops is appropriate to growing for *Cirsium erisithales* and *Hesperis matronalis*, but have to avoid for *Hieracium bupleuroides*, *Succisa pratensis* and *Thlaspi kovatsii*. The *Thlaspi kovatsii* like the acid soil, but the *Eriophorum vaginatum* which lives in acid shagnum marshes is growing the most successfull in basic hard ground. This experiment supported that the microclimate is more important for some plants than the soil property. The ex situ conservation programme can be followed by the reintroduction period when the number of individuals reaches the genetically variable level.

The individuals can be found in the botanical garden: http://botanicalgarden.ektf.hu

Aknowledgements

We would like to thank all of our colleagues who helped this program : József Sulyok and András Schmotzer, Bükk National Park Directorate, Viktor Virók and Tamás Zsólyomi from Aggtelek National Park Directorate and Nagy Sándorné, Gréta Szarka and István Mihalik, from the Department of Botany and Ecologyof Károly Eszterházy College , for their everyday effort in conservation activities.

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The "Colli Berici Natura 2000" Life + Project: Habitat Restoration and Species Restocking

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Abstract The "Colli Berici Natura 2000" LIFE+ Project promotes conservation actions in relation to habitats and species present at the SCI IT3220037 Berici Hills ("Colli Berici") site. This paper specifically concerns conservation actions relating to dry grasslands, consisting in scrub control (cutting and removal), re-colonisation and the planting of structural and rare species. The reconstruction of a wetland habitat, including the planting of vegetation, is also illustrated. Practical techniques, comprising seed collection and nursery breeding, are referred to.

Keywords LIFE Project, Restoration of Habitats, Restocking of Species, Dry Grasslands, Wetlands

1. Introduction

The "Colli Berici Natura 2000" LIFE+ Project (LIFE08 NAT / IT/000362) was promoted by the Provincial Authority of Vicenza together with other public bodies: the Consorzio di Bonifica Alta Pianura Veneta (Land Reclamation and Drainage Consortium for the Upper Plains of the Veneto Region), the Veneto Agricoltura agency, the Regional Forestry Service and local municipalities.

The general purpose of the project was the conservation of habitats and species present within the SCI IT3220037 Berici Hills site.

The Berici Hills are located in a highly urbanized region of North-East Italy. The range of hills is quite close to the cities of Vicenza and Padua. Approximately 16% - 18% of the plain within the Veneto Region presents built-up areas. These data clearly indicate the importance of defining the Berici Hills as an oasis for the preservation of wildlife habitats and animal and plant species.

During the rapid industrialization and urbanization of the countryside in the Veneto region, which began in the late 1960s and continued until the late 1990s, agricultural activities occurring in this range of hills progressively decreased. The agricultural and forestry landscape has thus rapidly changed and there has been an intense process of spontaneous reforestation.

However, the concentration of manufacturing activities on the surrounding plains, especially to the north of Vicenza and along the Padova-Vicenza road/rail link, has made it possible to preserve the natural characteristics of the Berici Hills.

Moreover, a gradual decrease of agricultural activities has reduced the presence of many semi-natural habitats maintained by traditional and non-intensive farming practices.

In the valleys and low-lying spaces between the hills there has been an increasingly widespread occurrence of intensive agricultural practices, with the development of the cultivation of maize and the loss of many of the wetlands tha formerly characterized the area.

In any case, there are various remaining evident natural characteristics which make the Berici Hills a high nature value area and an oasis of biodiversity in the midst of the surrounding densely populated plains.

Furthermore, the importance of the site is determined by the presence of priority habitats (6110*, 6210*, 9180*, 91H0*) and endemic species (*Saxifraga berica*), as well as other animal and plant species presenting high conservation value.

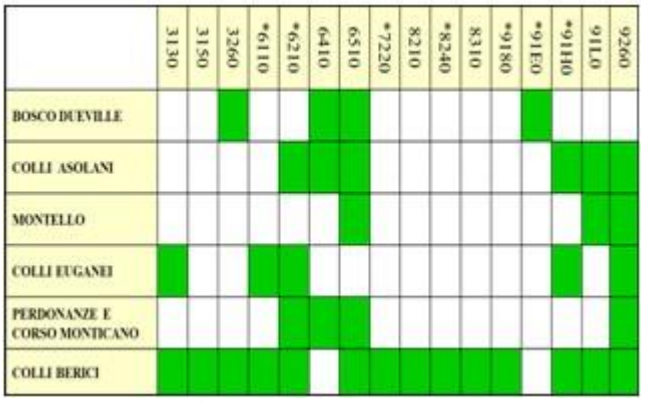

Figure 1. Presence of community-interest habitats in SCIs located in North-East Italy (continental region)

Actions undertaken include:

1) Action C1: The conservation of dry grassland threatened by the invasion of xero-thermic scrub achieved by cutting pioneer shrubs and planting rare herbaceous species (Pulsatilla montana, Pseudolysimachion pallens, Artemisia alba, Dianthus sylvestris, Lynum tenuifolium, Stipa eriocaulis, Scorzonera austriaca and seeding Bromus erectus).

2) Action C5: The creation of botanical micro-reserves; a micro-reserve is a small portion of territory presenting high value in terms of the wealth of endemic or rare plant species. A micro-reserve has a legal basis; it may be considered a permanent condition dedicated to the preservation and long-term monitoring of plant species.

3) Action C4: Conservation of priority habitat 9180* and protection against invasion of exotic species, such as Robinia pseudoacacia and Ailanthus altissima, with the cutting of plant phloem vessels and the replanting of autochthonous trees and shrubs.

4) Action C7: Restoration of pools to improve wetland habitats so as to promote the presence of amphibious and reptile species which are protected at Community level, such as Bombina variegata, Triturus carnifex, Rana latastei and Emys orbicularis, and locally threatened (Rana Dalmatina, Triturus vulgaris, Hyla intermedia). Along channels and wet areas, rare herbaceous species, such as Allium angulosum, Butomus umbellatus, Carex sp., Euphorbia palustris, Hydrocharis Morsus-ranae, Iris pseudacorus, Leucojum aestivum, Ludwigia palustris, Oenanthe fistulosa, Sagittaria sagittifolia, Schoenoplectus lacustris, Senecio paludosus and Trapa natans, have also been planted.

5) Action C8: Re-naturalization of surface water bodies. The purpose of this action is to identify best practices for an environmentally-sound management of surface water bodies, such as canals, ditches, drainage ditches and the wetlands of the valley areas of the Berici Hills, and thus with a view to not only regulate hydraulic systems but also to create favourable habitats for the introduction and preservation of plant and wildlife species.

6) Action C9: Nursery production of endangered species. This action relates to the production of rare or endangered species for which specific production protocols have been identified.

7) Action C10: Restoration of a former quarry site. This action involves pilot-intervention operations aimed at the naturalistic recovery of a hillside quarry.

2. Conservation of Dry Grasslands

The dry grasslands present in the Berici Hills (habitat code 6210) have secondary origin; their conservation therefore depends on the maintenance of those traditional, low-impact, agricultural activities (mowing, grazing) which, historically, produced, shaped and maintained these environments. To preserve the environment it is thus necessary to carry out the cutting and selective removal of shrubs to eliminate invasive plants in the xero-thermophilic fringes of woodland.

Areas of intervention were identified amongst surface areas of greater botanical interest affected by the phenomena of shrub colonization and where the cooperation of land owners was ensured. Loan-for-use contracts were signed with 17 owners for a total of 30 hectares, and interventions were in fact carried out over an area of approximately 26.6 hectares of dry meadows at sites having an average size of 1 hectare.

Recovery and conservation operations involving dry grasslands were carried out starting from the second year of the project. Following such actions, assessments were made on a case-by-case basis to determine whether it would be possible to recover turf by introducing plant species typical of dry meadows in areas with less or no grass coverage. For mowing and ground-clearance operations manual mechanical means were used, such as chain saws and brush-cutters. Interventions were carried out, respecting the natural ecotone condition identified at the sites in question, and avoiding the creation of margins that would be too regular and geometric. Other operations included the thinning and remodelling of patches of woodland bordering clearings used by many animal species for reproduction, nesting and the rearing of offspring.

For each area an estimate was made of the area covered by shrubs (first stage of colonization - borders), the surface area covered by tree-shrub vegetation (subsequent stage of colonization - mantle) and the surface area where grass coverage remains predominant.

The following interventions were carried out:

- thinning and re-modelling of wooded margins (selective thinning with removal of about 50% of tree coverage);
- selective removal of shrubs (removal of 90% of shrub coverage);
- mowing of grassland areas.

In various areas vigorous regrowth was recorded with respect to certain species, such as *Cotinus coggygria*. In order to contain this regrowth and curb the sucker production capacity of these species up to four successive interventions occurred over mowed surfaces.

Plant seedlings previously reproduced at a nursery, starting from seeds collected from natural populations, were also planted. Both rare species (*Pulsatilla montana, Himantoglossum adriaticum, Delphinium fissum*) and structural species (*Scorzonera austriaca, Artemisia alba, Dianthus sylvestris, Eryngium amethistinum, Stipa eriocaulis*) were planted in areas in which the turf was more degraded. In one case (Monte Molinetto) hay was brought from a donor site.

3. Improving Wetland Habitats

The purpose of the action was to establish best practices for an environmentally-sound management of surface water bodies, such as canals, ditches, drainage ditches and

wetlands in the valley areas of the Berici Hills; the action thus not only aimed to achieve a form of hydraulic control but also to create favourable habitats for the settlement and conservation of both flora and wildlife species.

Many of the water bodies are located along the internal valleys of the Berici Hills, however a part of the action was developed beyond the perimeter of the SCI on account of the fact that the area is public property; this latter condition allows for operation with a fair degree of autonomy, free from restrictions that may derive from private ownership. In addition, although it is outside the SCI, the area identified is essential for the reproduction of populations of amphibians, such as *Bombina variegata* and *Rana latastei* present within the SCI.

The intense development of agricultural practices has resulted in the loss of many habitats that were situated along the banks of watercourses and drainage ditches in the over-flooded valleys of the Berici Hills.

Until just a few years ago it was still possible to find fairly large populations of species now considered as rare, such as: *Ludwigia palustris*: a small plant typical of slow waters and muddy substrata, included in national and regional Red Lists and extremely rare in the territory of the Province of Vicenza. Reported as present in the northern valleys of the Berici Hills, according to recent studies conducted within the framework of the LIFE project it has nonetheless apparently disappeared from most sites.

Hottonia palustris: a radicant hydrophyte included in the national and regional Red Lists, very rare in the Province of Vicenza and present in the lentic waters of ditches. This species is sensitive to the eutrophication of waters and has been reported as present in the valleys of the Berici Hills; as in the case of the previous taxon it has disappeared from most sites.

Senecio paludosus: a hygrophilous helophyte that prefers swampy sites; it is included in the national and regional Red Lists and is rare in the Province of Vicenza. A rare plant occasionally found in the valley sites of the Berici Hills, this ragwort may eventually disappear entirely as a result of the cleaning and re-sectioning of ditches.

Sagittaria sagittifolia: a radicant hydrophyte included in the national and regional Red Lists, very rare in the Province of Vicenza and present in the lentic waters of ditches. This plant is also adversely impacted by the management of ditches and minor watercourses.

In recent years, these species have been found more and more rarely for reasons which are as yet not fully understood and which, apart from the simplification of crops and the use of herbicides, might also be related to the rapid spread of such species as *Myocastor coypus* and Louisiana crayfish.

The action involved the re-naturalization of a watercourse and the creation of a wetland area. Work began in the fourth quarter of 2011 and was completed in February 2013. The following works were carried out:

- reshaping of the watercourse over a total distance of 1,000 m;
- extraordinary maintenance of a further 800-m section upstream with respect to the same;
- creation of a wetland area covering 3,500 sq.m;
- seedlings grown in a regional public nursery were planted along the banks of the stream; the species are listed in table 2; three bales of wet-meadow hay obtained from a donor field located in the Beric area were also distributed; because of the heavy and persistent rain that fell in the autumn of 2012, the seeds contained in the hay presented poor germination;
- the adoption of maintenance procedures compatible with the development of riparian vegetation.

These interventions were recorded and included in the technical drafts for the preparation of a manual for the Management of Waterways envisaged within the framework of the LIFE project (for use by both public and private managers).

4. Improving Forest Habitats

The priority habitat 9180* (Tilio-Acerion forests of slopes, screes and ravines) is locally present along ravine environments. To preserve this habitat it is important to control invasive allochthonous species, such as *Robinia pseudoacacia*. This is a highly fragmented habitat, which, at the site, covers an overall surface area of about 28 ha. An intervention to contain the presence of Robinia was carried out using the girdling technique, affecting at least 50% of the coverage of Robinia and with the elimination of approximately 2,400 suckers/ha.

Subsequent operations were the cutting of Robinia shoots and invasive bushes and the introduction of forest species ecologically suited to the site.

5. Restoration of a Former Quarry Site

Quarrying activities were considered a threat to the state of conservation of the Berici Hills SCI and are currently confined to just a few extraction sites; quite a few abandoned quarries are present in the Berici Hills. Many of them are subterranean, while others are open-air sites. The activity is regulated by laws which provide for the recovery of the quarry site at the end of excavation operations.

The action undertaken with the LIFE project also aims to provide an example of a recovery of a natural environment that may be reproduced in similar situations. Re-vegetation techniques were used, such as the introduction of seed-rich hay from arid and humid donor meadows in the Berici Hills collected in May and distributed in the autumn (with quantities of approx. 400 g/sq.m).

Sowing occurred using the seeds of *Bromus erectus* and *Melica ciliata*, which were also gathered in the Berici Hills. The seeds were distributed with the hydro-seeding technique, without adding fertilizers or phytohormone

products to the mix. About 5 kg of mixed seeds of *Bromus erectus, Melica ciliata* and other supplementary species with a sowing density of about 5 g/sq.m were used.

The results were encouraging as far as the use of the seeds was concerned, while areas treated with hay-spreading did not attain satisfactory coverage; again, this was due to the heavy, persistent rains that fell in the autumn of 2012 compromising the germination capacity of the seeds contained in the hay.

Seedlings of species typical of habitat 3150 (*Hottonia palustris, Trapa natans, Spirodela polyrriza*) were introduced in the specifically-created artificial well.

6. Planting Techniques and the Production at a Nursery of Rare or Endangered Species

The action was carried out by the Centro Biodiversità Vegetale of the Veneto Agricoltura agency at Montecchio Precalcino (Vicenza), a department specializing in the nursery production of native species. When selecting species to be reproduced, the following objectives were considered:

- the strengthening of populations for susceptible species of priority interest in terms of conservation at the European, national and regional levels (table 1);
- the strengthening of the populations of susceptible species of priority interest in terms of conservation at the level of the SCI involved in the project;
- structural species, to be used in the creation of habitats;

For the choice of the species, reference was therefore made to the lists and guidelines set out in Table 1 and knowledge of the flora and vegetation within the territory on the part of technicians in charge of the intervention, with the support of the botanist responsible for the monitoring of procedures (Dr. Stefano Tasinazzo); the specific literature was also referred to.

The collection of the propagation material necessary for the production of plants occurred both within the Natura 2000 site and at other regional locations for the species that were found to be locally extinct in the Berici Hills at the time the action was carried out.

With the exception of the hydrophytes *Hydrocharis Morsus-ranae*, *Utricularia australis* and *Spyrodhela polyrhiza*, for which vegetative propagation was adopted, gamete reproduction (seeds) was employed for all of the plants used in the project. The nursery production of the species involved the adoption of appropriate techniques to interrupt the dormancy period for the seeds of some of the xerophilous species in habitat 6210*; on the other hand, for certain hygrophilous species it was necessary to adopt mechanical procedures to facilitate seed germination.

All of the material produced, amounting to 35,706 seedlings (Table 2), was planted at the project sites in suitable, recovered or reconstructed habitats.

In the case of the 6210* species, the planting of seedlings was associated with the reconstruction of the meadow structure by means of sowing and/or the distribution of hay with local seed collected from well-preserved, dry grasslands with a predominant presence *of Bromus erectus* sub-sp. *erectus*.

Legend to Table 1

- species of primary interest.
- species of potential interest.
- species of secondary interest.
- CR (Critically endangered; IUCN, 1994 and 2001): the highest category of threat, including species presenting an extremely high risk of extinction.
- DD (Data Deficient; IUCN, 1994 and 2001): this category does not indicate a particular threat but rather a lack of information concerning recently-discovered taxa that belong to critical groups etc.
- EN (Endangered; IUCN, 1994 and 2001): an intermediate category of threat, including species facing a very high risk of extinction.
- EX (Extinct; IUCN, 1994 and 2001): a category providing a theoretical point of reference, as opposed to those generally applied to living species and referring to taxa now extinct in their known or expected habitats.
- EW (Extinct in the Wild; IUCN, 1994 and 2001): a category used when a taxon is known to survive in cultivation (e.g. in domestic or botanical gardens).
- LR (Lower Risk; IUCN, 1994): a category of threat contemplated up to version 2.3 of the IUCN document (essentially corresponding to the current NT) referred to in the compilation of Red Lists for taxa at risk of extinction on a worldwide scale.
- NT (Near Threatened; IUCN, 2001): a taxon not currently threatened, but which is estimated as close to qualifying for a threatened category or may form part of such a category in the near future.
- r (only in relation to the Euganean Hills): "rare taxon present at just a few sites, although occasionally with quite a high number of specimens" (Masin & Tietto, 2005).
- RE (Regionally Extinct; IUCN, 2003): a taxon now extinct in the area considered, a category introduced with the document used for the compilation of the Red Lists of species at risk of extinction on a local scale (IUCN, 2003).
- rr (only in relation to the Euganean Hills): "a taxon present only at certain points or found at very few sites with a very small number of specimens" (Masin & Tietto, 2005).
- (SI): sub-endemic.
- VU (Vulnerable; IUCN, 1994 e 2001): a less serious category of threat, including taxa facing a high level of extinction.
- /: a species not recorded in the area under assessment.
- +: a species present in the study area and not falling into any of the categories provided for by the IUCN.
- *: a priority species or habitat according to the Habitats Directive.
- ?: uncertain data.

Table 1. Species which may be of 'priority conservation interest' produced within the framework of the "Berici Natura 2000" LIFE project by the Plant Biodiversity Centre of the 'Veneto Agricoltura' agency (cf. Tasinazzo S. 2006, not published and revised, Veneto Agricoltura agency; a project for the experimental production of endangered species)

SPECIES	Berne Conv. App. I	Habitats Dir. App. II	Habitats Dir. App. IV	RED LIST ITALY (1997)	RED LIST VENETO (1997)	RED LIST BELLUNO (2004)	RED LIST EUGANEAN HILLS (1996, S.I.D. and 2005)	RED LIST TRENTINO (2001)	RED LIST FRIULI-VENEZIA GIULIA (1997 and 2001)	END.	Habitat code	NOTES
Allium angulosum L.				VU	EN	/	EN	VU	+		6410	cultivated at the Botanical Gardens in Padua (Todaro *et al*., s.i.d.)
Delphinium fissum Waldst. & Kit *fissum*					VU	/	r	/	+		*6210	
Hottonia palustris L.				VU	EN	/	EN	EX	+		3150	cultivated at the Botanical Gardens in Padua (Todaro *et al*., s.i.d.)
Leucojum aestivum L. *aestivum*					VU	/	VU	/	+		*Phragmito-Magnocaricetea*; *91E0	cultivated at the Botanical Gardens in Padua (Todaro *et al*., s.i.d.); tests for germination ex-situ and reintroduction were carried out by the University of Pavia (Rinaldi & Rossi, 2005)
Oenanthe fistulosa L.						/	rr	/	VU		*Phragmito-Magnocaricetea*	
Pseudolysimachion spicatum (L.) Opiz *fischeri* Tràvn. [= *P. pallens* (Host) MA Fischer]					DD	/	/	VU	/		*6210	
Ranunculus lingua L.				VU	EN	RE	/	CR	VU		*Magnocaricion*	species believed to be no longer present in the Veneto (Scoppola & Spampinato, 2005)
Sagittaria sagittifolia L.				EN	VU	/	VU	/	VU		*Magnocaricion*	cultivated at the Botanical Gardens in Padua (Todaro *et al*., s.i.d.)
Saxifraga berica (Bég.) D.A. Webb	YES	YES	YES	EN	EN	/	/	/	/	YES	8210	
Senecio paludosus L.				EN	EN	CR	EN	EN	VU		*Magnocaricion*	cultivated at the Botanical Gardens in Padua (Todaro *et al*., s.i.d.)
Teucrium scordium L. *scordium*						CR	rr	VU	+		6410	
Trapa natans L.	YES			EN	VU	/	/	/	VU		3150	
Utricularia australis R. Br				EN	CR	CR	EN	VU	+		3150; 3160	

Table 2. Seedlings produced with action C9 of the LIFE "Colli Berici Natura 2000" project and corresponding destinations.

	ACTION C1	ACTION C4	ACTION C7	ACTION C8	ACTION C10	HAB 8210
Pulsatilla montana	1.107					
Pseudolysimachion spicatum ssp. fischeri	364					
Artemisia alba	8.841					
Dianthus sylvestris ssp. sylvestris	82					
Lynum tenuifolium	20					
Stipa eriocaulis	150					
Scorzonera austriaca	230					
Delphinium fissum ssp. fissum	10					
Philadelphus coronarius		1.100				
Acer pseudoplatanus		1.800				
Tilia platyphyllos		10				
Carpinus betulus		590				
Allium angulosum			700			
Butomus umbellatus			1			
Carex acuta			400			
Carex elata			370			
Hottonia palustris			30			
Hydrocharis morsus-ranae			70			
Leucojum aestivum			50			
Quercus robur			3			
Sagittaria sagittifolia			30			
Salix cinerea			7			
Senecio paludosus			60			
Teucrium scordium ssp. scordium			40			
Trapa natans			100			
Ulmus minor			3			
Viburnum opulus			20			
Allium angulosum				3.120		
Butomus umbellatus				2		
Carex acuta				4.760		
Carex acutiformis				480		
Carex elata				3.800		
Carex riparia				308		
Carex vesicaria				28		
Crataegus monogyna				60		
Eunoymus europaeus				30		
Euphorbia palustris				880		
Hydrocharis morsus-ranae				400		
Iris pseudacorus				531		
Leucojum aestivum				203		
Ludwigia palustris				1.800		
Oenanthe fistulosa				50		
Prunus spinosa				60		
Quercus robur				12		
Ranunculus lingua				259		
Rhamnus cathartica				90		
Sagittaria sagittifolia				312		
Schoenoplectus lacustris				44		
Senecio paludosus				1.288		
Teucrium scordium ssp. scordium				535		
Thelypteris palustris				6		
Trapa natans				200		
Carex pendula					110	
Saxifraga berica						150

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Identification of Important Plant Areas in Kazakhstan

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Abstract The paper presents the first results on identification of Important Plant Areas (IPAs) in Kazakhstan. 30 IPAs have been identified in the foothills of ranges of Junggar Alatau, Karatau, Shu-Ile and Ile Alatau Mountains (within the North Tien Shan piedmont botanical-geographic sub-province), and one in the Syr Darya river Delta. Three Basic Principles of IPA Identification have been used for site selection. Most IPAs have more than one qualifying feature. Vegetation of IPAs belongs to steppe, desert, shrub, floodplain forest, meadow, aquatic types. Steppe vegetation in the region is endangered habitat as a result of cultivation. Vegetation is formed by bunch grasses (Stipa hohenackerana, S. capillata, S. richterana) and Artemisia species. Savannoid vegetation as indigenous type of south Kazakhstan foothill and low-mountain landscapes is endangered habitat as a result of cultivation, grazing and haymaking. The most typical species of the habitat are Elytrigia trichophora, Botriochloa ischaemum, Aegylops cylindrica, Thaeniatherum crinitum, Poa bulbosa. Selected IPAs contains rare species of tulips listed in the Red Data Book of Kazakhstan (Tulipa kolpakowskiana, T. alberti, T. regelii, T. greigii, T. brachystemon, Incarvillea semiretschenskia, Iris kuschakewiczii) in rocky habitats; narrow endemic species such as Rhaphidophyton regelii, Schrenkia kultiassovii, Tulipa greigii, T. lehmanniana, Allium drobovii, A. oreoprasoides, Scutellaria kurssanovii in the belt of xerophilous subshrubs of the Karatau Mountains. The most of selected IPAs belong to regional / local level. Only one meets the criteria of International / National importance.

Keywords Wild Plants, IPAs, North Tien Shan Piedmont Botanical-geographic Sub-province, Syrdarya River Delta

1. Introduction

Kazakhstan has signed and ratified United Nations Conventions (Convention on Biological Diversity, 1994; United Nations Framework Convention on Climate Change, 1995; United Nations Convention to Combat Desertification, 1997; Ramsar Convention on Wetlands of International Importance, 2007). In 1995 the urgent need to identify Europe's most important plant sites was proposed at the first Planta Europa Conference in Hyeres, France. As a result, criteria for IPAs identification were developed. IPAs are natural or semi-natural sites exhibiting exceptional botanical richness and/or supporting an outstanding assemblage of rare, threatened and/or endemic plant species and/or vegetation of high botanical value. IPAs are intended to be areas of great botanical importance for threatened species, habitats and plant diversity in general, that can be identified, protected and monitored as sites [Anderson (2002)].

A purposeful identification of IPAs in Kazakhstan started in 2012 at the North Tien Shan botanical-geographic sub-province that comprises foothills of Junggar Alatau, Karatau, Shu-Ile and Ile Alatau Mountains. 30 IPAs were identified in those areas [Dimeyeva et al (2013); Sultanova et al. (2013); Kudabayeva et al. (2014)]. Another IPA was described in the Syr Darya River Delta [Dimeyeva et al. (2014). The methodology used in Europe was applied in Kazakhstan, a country that has different climatic conditions and botanical-geographic features.

According to Botanical-geographic regionalization the country of Kazakhstan is located in two botanical-geographic regions - Eurasian steppe and Sahara-Gobi desert (Rachkovskaya, 2006; National Atlas…, 2010). The steppe portions of Kazakhstan are associated with the Black Sea-Kazakhstan subregion of the Eurasian steppe region. It has three provinces: West-Siberian forest-steppe and Trans-Volga-Kazakhstan steppe in plains, and South Altai in the Mountains. Desert portions are associated with the Iran-Turan subregion of the Sahara-Gobi desert. North Turan, South Turan, and Junggar are provinces in plains; Junggar-North Tien Shan and Central Asian Mountains are highland provinces.

Kazakhstan's flora includes almost 6 ths. vascular plant species. Among them, 14 % of species are endemic; 406 species (7.1%) are listed in Red Data Book of Kazakhstan [(2014)]. Inventory of Regional Flora was made for 6 regions of Kazakhstan out of 14 (State Cadasters of vascular plants), for which have been developed regional Red Data Books. There are protected areas of different status in Kazakhstan: 10 Nature reserves of strict protection (zapovednik); 12 State National Parks; 4 Biosphere reserves; 10 - Ramsar wetlands; Nature reserves: republic importance – 5, regional importance – 1; 50 nature reserves of seasonal protection (zakaznik); Nature monuments: republic importance – 26, regional importance – 56; 5 Nature protection zones; 5 State

Botanical gardens; 3 Zoos. They occupy 8.5% of the total country's area, which makes up about 24 mln. hectares. Not all of the diversity of rare plant species is conserved *in situ*, as there exists no list of threatened habitats for protection. Therefore, the studies on IPAs identification might further lay the basis for establishment of new nature reserves at national and regional levels.

2. Methodology

The identification of the key sites was made according to Three Basic Principles of IPA Identification [Anderson (2002)]:

Criterion A - Threatened Species. The site holds significant populations of globally threatened species. By the A criterion, there are 4 categories: A(i) - Species must be listed as 'threatened' on IUCN global red list; A(ii) - Site contains European threatened species; A(iii) - Species must be listed as national endemic and 'threatened' on national red lists [Red Data Book of Kazakhstan (2014)] using IUCN categories (Ex, E, V); A(iv) - Site contains near endemic/limited range species with demonstrable threat not covered by A(i) or A(ii); A(v) – species that are endangered, vulnerable, and requiring protection at regional level [Artemov et al., (2005)] as well as so called 'worthy plants' [Green, Fitzpatric (2008)].

Criterion B - Richness/Diversity. The site has an exceptionally rich flora in relation to biogeographic zones of Kazakhstan. For each habitat is compiled a list of indicator species – endemics, near endemics that did not enter previous groups, as well as species typical and important for the area.

Criterion C - Threatened Habitats. The site is an outstanding example of a habitat type of global or Kazakhstani plant conservation and botanical importance. To apply this criterion each country needs to produce a national list of threatened habitats.

The criterion A should be considered principle for Kazakhstan, as the only regulative basis for plant protection in Kazakhstan are the Red Data Books (National or Regional level).

The classification of habitats is the basis for value estimation of IPAs by the criteria B and C. The both criteria are based on the same system. The EUNIS habitat system is used in Europe [Davies et al. (2004)], which represents the classification of European habitats. A habitat is described by its physical properties (topography, soil features, climate, water quality, etc.) and by plant or animal species that live there. The EUNIS habitat classification covers the whole European area. The scale selected for the EUNIS habitats corresponds to the plant classification in traditional phytosociology.

In CIS countries the EUNIS classification is not spread, and still there is no similar system at all. Habitat classifications were developed in Russia for the Altai-Sayan ecoregion [Artemov et al. (2005); Smelyansky, Pronkina (2009); Kupriyanov (2009)]. The authors adapted the European system for the West Siberia. Currently, materials are being collected for identification of habitat classification units in Kazakhstan. During field surveys threatened habitats are revealed, that are now under the process of interpretation of EU and Russian classification into Kazakhstan national classification system. Most IPAs have more than one qualifying feature. Description of IPA includes the map, the list of plants, identified rare species and communities, threats and risks and recommendations on protection and use.

Basing on the IPA correspondence to the three principles, different levels of value and conservation priorities are identified at the national and regional level. The IPA that match all the three criteria and represent the unique plant communities, plant species from IUCN global red data lists endangered and vulnerable plant species in Europe and Kazakhstan, are attributed to the national level. To the regional / local authority level IPA those territories are attributed that are able to match not only the three, but also two or even one criterion. For instance, among rare and disappearing species of the territories only those species can be found that are listed on the regional Red Data Book, or those that possess a high floristic richness typical of the habitat [Konstantinova et al (2007); Green, Fitzpatrick (2008)].

3. Results

Vegetation of identified IPAs belongs to steppe, desert, shrub, floodplain forest, meadow and aquatic types. Steppe vegetation in the study areas is almost completely cultivated. It is the most threatened habitat in Kazakhstan. Desert steppes in the belt of foothills within the North Tien Shan piedmont botanical-geographic sub-province are kind of reserves of natural steppe plant communities having a high floristic diversity with participation of rare species. Vegetation is formed by bunch grasses (*Stipa hohenackerana, S. capillata, S. richterana*) and Artemisia species. Botanical value of remaining sections of the steppe lies in richness of flora, representation of rare and endemic species (*Eremostachys gymnocalyx, Iris kolpakowskianum, Crocus alatavicus*, etc.) in the foothills of Junggar and Ile Alatau Mountains. Desert steppe vegetation of the Shu-Ile low Mountains contains sagebrush-fescue plant communities (*Festuca valesiaca*, *Artemisia sublessingiana, A. heptopotamica*) where grow plant species from Red Book of Kazakhstan (*Tulipa albertii, T. kolpakovskiana, Iris kuschkewiczii*) [Marynich, Nigmatova (2005)].

Next threatened habitat includes savannoid vegetation [Rubtsov (1955); Korovin (1962); Karmysheva (1982); Rachkovskaya et al. (2003)]. It is an indigenous type, characteristic of south Kazakhstan and Central Asian foothill and low-mountain landscapes. Its origin is connected with loess sediments and with the formation of a special (ephemeral) vegetation development rhythm, when a plant

vegetates in winter and spring seasons, thus avoiding summer drought. The most typical species are *Elytrigia trichophora, Botriochloa ischaemum, Aegylops cylindrica, Thaeniatherum crinitum, Poa bulbosa.* In the foothills of the Karatau Mountains this type is represented by tall grass savannoids (*Phlomis salicifoila, Verbascum songoricum*) with participation of steppe grass (*Festuca valesiaca*) and mountain xerophytes (*Pseudolinosyris grimmii, Rhaphidophyton regelii)*. The plant cover is composed by the four species that entered the Red Data Book - *Rhaphidophyton regelii, Schrenkia kultiassovii, Tulipa greigii, T. lehmanniana;* the four endemic species of the Karatau - *Allium drobovii, A. oreoprasoides, Artemisia karatavica, Scutellaria kurssanovii* [Kudabayeva et al. (2014)]. The degradation of the habitat is connected with cultivation, grazing and haymaking.

IPAs in sandy desert with sagebrush-psammophitic shrub (*Calligonum caput-medusae, Artemisia terrae-albae*) vegetation includes a rare stenotopic species *Eremurus anisopterus*. In argillaceous deserts, arborous *Haloxylon aphyllum* and sagebrush species (*Artemisia turanica, A. terrae-albae*) play role of dominating plants. Besides sagebrushes, the shrubby undergrowth is dominated by perennial saltwort species - *Salsola orientalis, S. arbusculiformis, Anabasis salsa*. The habitats are characterized by a high floristic richness, up to 40 species, which is not typical for desert communities used for grazing. One species from the Red Data Book is found (*Tulipa albertii*).

IPAs with shrubs are confined to steep inaccessible slopes. Among shrubs, dominating are *Spiraea hypericifolia, Cerassus tianschanica, Atraphaxis pyrifolia, Rosa spinosissima, Ephedra equisetina*. There were recorded rare species of tulips listed in the Red Data Book of Kazakhstan (*Tulipa kolpakowskiana, T. alberti, T. brachystemon*) in rocky habitats. Research in chalkstone ranges of the Shu-Ile low Mountains confirmed distribution of unique narrow endemic sub-shrub species *Incarvillea semiretschenskia.* This species forms communities with *Spiraea hypericifolia, Cerasus tianschanica, Atraphaxis pyrifolia* in shrub layer and *Stipa capillata, Festuca valesiaca, Sedum albertii, Allium petraeum, Iris kuschakewiczii,* etc. in herbal layer [Kokoreva et al. (2013)].

Least-disturbed wetlands were selected as IPAs with bushes, deciduous forest, and alluvial meadows of river valleys and shores of lakes. Rare species (*Malus sieversii, Pyrus regellii, Populus diversifolia, P. pruinosa*) in floodplains of the Junggar Alatau Rivers are in need of protection. The beds of temporary streams are also characterized by the presence of rare species and high plant diversity. Two IPAs were selected in this habitat. One is located in the foothills of north range of the Karatau Mountains in the temperate bed of the Bozsai River. Shrubs are spread in the dry floodplain (*Atraphaxis virgata* и *Meristotropis tryphylla*); on the levee belt shrubs (*Tamarix hispida, Lycium dasystemon),* semi-shrubs (*Krascheninnikovia ewersmaniana*), and lianas (*Clematis orientalis, Bryonia melanocarpa*). On above-floodplain terrace grows ephemeral-haloxylon-tamarix community (*Tamarix hispida, Haloxylon aphyllum, Poa bulbosa, Carex physodes, C. pachystilis)*. Other species of krascheninnikovia is found in shrubby layer (*Krascheninnikovia ceratoides*). The herbal covere includes: *Aeluropus littoralis, Heliotropium ellipticum, Atriplex tatarica, Salsola australis, Climacoptera lanata, Kochia iranica, Chenopodium album*, etc. Community composition represents not only rare (*Bryonia melanocarpa*), listed on the Red Data Book of Kazakhstan, but also economically valuable species - *Ferula foetida, Cistanche salsa*. Another IPA locates in the low Mountains of Ushkara (the Junggar Alatau) along the temporary stream of Nursai river. There are forb-shrubby community (*Halimodendron halodendron, Trachomitum lancifolium, Phragmites australis, Glycyrrhiza uralensis*). In the high floristic diversity, endemics *Limonium popovii, Euphorbia jaxartica* are noted.

The most of the selected IPAs pertain to the regional / local level, with one IPA matching the national criteria – "The Syrdarya river Delta". Two IPAs in the low Mountains of Kyzkash and Arganaty are valuable as whole sites with high diversity of flora and fauna [Sultanova et al. (2013)]. More than once it was mentioned that those areas should be rendered Nature Reserves of strict protection, still, the issue has not been solved. By way of example, we present here a more detailed description of the two IPAs that show different levels of diversity and representation of rare species.

4. National IPA Site "The Syrdarya River Delta"

Location: Kazakhstan, Kyzylorda region, the north-eastern coast of the Aral Sea (Small Aral).

Coordinates: the Syrdarya River Delta front - N 46° 07'22.0" E 60° 47'15.2", N 46° 09'55.5" E 60° 54'52.9"; area - 4000 ha; the Raimkol lake - N 46°03'48.3" E 61°46'44.8", N 46°04'00.7" E 61°43'08.5"; area - 1800 ha. Elevation – 41-62 m a.s.l.

Brief description of the Site

The Site includes wetlands of the Syr Darya advance delta that is forming after the construction of the Kokaral dam, as well as the deltic lake Raimkol with the surrounding territories. Geomorphologically, the Site is located within the alluvial-delta and the primary marine accumulative plains.

Habitats:

Table 1. EUNIS level 3 habitats plant communities in the Syrdarya Delta

EUNIS code	Plant communities
C.1.3	Communities of submersed plants (*Potamogeton crispus, P. perfoliatus, Myriophyllum spicatum*) and emergent plants (*Sparganium stoloniferum, Alisma plantago-aquatica, Butomus umbellatus, Salvinia natans*) in deltaic lakes
C1.5	Communities of marine submersed plants (*Zostera noltii, Zannichelia major, Potamogeton perfoliatus, P. crispus, P. pectinatum, Myriophyllum spicatum*)
C2.1	Communities of rooted-floating plants (*Nimphoides peltatum*), emergent plants (*Sparganium simplex, Cyperus fuscus, Butomus umbellatus*) and submersed plants (*Potamogeton pectinatum, P. perfoliatus, Myriophyllum spicatum, Ceratophyllum demersum*) in the river mouth
C3.1	Grass fens (*Phragmites australis, Typha angustifolia, Scirpus littoralis, S. lacustris, S. kasachstanicus)* in the delta front and low level lakes' terraces
C3.2	Communities of tall reed grass and cattail *(Phragmites australis, Typha angustifolia)* in the marine shoreline
C3.4	Affregations of *Eleocharis acicularis* and *Bolboschoenus planiculmis* in the drying shorelines of deltaic lakes
C3.5	Aggregations of *Xanthium strumarium, Chenopodium rubrum, Bolboschoenus maritimus, Cyperus fuscus* in the drying shorelines of deltaic lakes and low level of the Syrdarya floodplain
D6.1	Communities of annual saltworts *(Climacoptera aralensis, Petrosimonia triandra, Suaeda acuminata, Salicornia europaea)* in salt marshes and coastal solonchaks of primary marine plain
	Rare aggregations of annual saltworts *(Atriplex pratovii, Bassia hyssopifolia)* in coastal solonchaks of primary marine plain
E1.1	Communities of psammophytic grasses (*Leymus racemosus, Stipagrostis pennata*) in low hummocky sands
E1.6	Communities and aggregations of annual weeds (*Ceratocarpus arenarius, Salsola nitraria, Atriplex tatarica*) with participation of perennial species (*Euphorbia seguierana, Peganum harmala, Heliotropium arguzioides*) in degraded rangelands
E3.4	Reed (*Phragmites australis*), forb-grass (*Calamagrostis epigeios, Sphaeropyza salsula, Alhagi pseudalhagi, Glycyrrhiza glabra*) floodplain meadows
	Halophytic herb (*Aeluropus littoralis, Leymus multicaulis, Climacoptera obtusifolia, Suaeda acuminata*) with rare shrubs (*Tamarix hispida, Nitraria schoberi, Kalidium foliatum, Halostachys caspica*) meadows of above-floodplain and lakes' terraces
E6.1	Communities of halophytic herbs (*Aeluropus littoralis, Limonium otolepis, Frankenia hirsuta, Karelinia caspia, Limonium otolepis*) in coastal and meadow solonchaks of primary marine plain and lakes' terraces
E7.4	Mesophytic floodplain meadows (*Phragmites australis, Calamagrostis epigeios, Glycyrrhiza glabra*) *Lythrum salicaria, Calystegia sepium*) with oleaster *(Elaeagnus oxycarpa)*
F9.1	Communities of shrubs (*Halimodendron halodendron, Tamarix ramosissima, T. laxa, T. hispida, T. elongata, Lycium ruthenicum*) in above-floodplain and high level lakes' terraces
FD.1	Communities of sagebrush (*Artemisia terrae-albae*) with annual (*Eremopyrum orientale, E. triticeum, Koelpinia linearis, Alyssum turkestanicum*) and perennial (*Poa bulbosa, Allium schubertii*) ephemerals, and sedge (*Carex pachystilis)* in denudation plains
	Communities of wormwood and sagebrush (*Artemisia arenaria, A. terrae-albae)* with psammophytic grasses (*Leymus racemosus, Agropyron fragile*) and sedge (*Carex physodes*) in low hummocky sands
	Communities of psammophytic shrubs *(Calligonum aphyllum, Eremosparton aphyllum, Astragalus brachypus, Ammodendron bifolium, Atraphaxis spinosa, Convolvulus subsericeus*) in low hummocky sands
	Communities of halophytic shrubs (*Halostachys caspica, Nitraria schoberi, Tamarix hispida)* in primary marine plain
G1.1	Oleaster-willow (*Salix songarica, S. wilhelmsiana, Elaeagnus oxycarpa*) floodplain forest
G6.1	Communities of black saxaul (*Haloxylon aphyllum, Calligonum aphyllum, Stipagrostis pennata, Salsola nitraria*) in coastal sands

Criterion A

- A (i) Nymphoides peltatum (S.G.Gmel) O. Kuntze (Limnanthemum nymphoides (L.) Hoffmanns. & Link.
- A (ii) Salvinia natans (L.) All., Typha minima Funck.
- A (iii) Scirpus kasachstanicus Dobroch.
- A (iv) Atriplex pratovii Suchor.
- A (v) Artemisia scopiformis Ledeb., Atriplex pungens Trautv., Petrosimonia hirsutissima (Bunge) Iljin), Calligonum cispatum (Litv.) Mattei, Astragalus brachypus Schrenk, Haloxylon aphyllum (Minkw.) Iljin.

Criterion B

Two parts of IPA are distinct for their high floristic diversity. The species composition of plants has been studied rather sufficiently. In the river delta front and the adjacent territory, 112 species of vascular plants have been identified [Dimeyeva, Alimbetova (2012)]. The floristic composition of the Raimkol Lake and surrounding territories includes 113 species [Monitoring (2014)]. As indicator species of wetlands Scirpus lacustris was proposed for habitats C1.3, C2.1 and Salix songarica for G1.1 [Biodiversity (2012)]. Other indicator species typical of natural hydromorphic habitats are: Cyperus fuscus, Butomus umbellatus, Bolboschoenus maritimus, B. planiculmis, Eleocharis acicularis. In other habitats indicator species may be Turanian endemics [Turanian endemic plants (2010)], represented in the IPA by over 20 species, many of them being dominants of plant communities (Anabasis salsa, Artemisia terrae-albae, Halostachys belangeriana, Climacoptera aralensis, Agropyron fragile, Tamarix ramosissima, Calligonum aphyllum, Zygophyllum oxianum).

Criterion C

The habitats are listed on the Ramsar List in 2012 and are unique for the desert regions of Kazakhstan. They are especially important for birds of wetlands. Of special value are slightly disturbed habitats C1.3, C2.1, C3.1, E3.4, G1.1, G 6.1.

The condition of species and habitats is good. Habitat threats are fires, grazing, hay-making, felling of trees and shrubs, recreation, unstable water level. For conservation of the unique habitats and rare plants and animals in the Syr Darya River delta front was proposed establishment of a cluster site of the Barsa Kelmes Nature Reserve [Biodiversity (2012)]. The reserved status would ensure conservation of all the environmental properties of that area.

5. Local IPA Site – Arkharly Pass

Location: Kazakhstan, Almaty region, western foothills of the south range of Junggar Alatau Mountains.

Coordinates: N 44° 13' 45,0" E 077° 43' 13,7". Elevation - up to 1089 m a.s.l. Area – 25.7 ha.

Brief description of the Site

The Site represents low rocky Mountains with large fluctuations of relative altitudes, steep slopes, stony outcrops in rocks and debris, with deep valleys.

Habitats:

Table 2. EUNIS level 3 habitats plant communities in the foothills of the Arkharly pass

EUNIS code	Plant communities
E1.1	Forb communities (*Piptatherum songaricum, Poa bulbosa, Carex turkesnanica, Polygonum sp.*) in shallow gully
	Aggregations of *Festuca valesiaca, F. gigantea, Ferula dissecta* in screes
	Communities of *Sedum hybridum* in screes
FD.1	Shrub community (*Kraschenninnikovia ewersmanniana, Atraphaxis frutescens*) with *Leonurus turkestanicus* in shallow gully
	Bunch-grass-shrub communities (*Spiraea hypericifolia, Ephedra equisetina, Stipa lessingiana, Festuca valesiaca*) in gentle western slope
	Dense Dense shrub communities (*Spiraea hypericifolia, Cerassus tianschanica, Atraphaxis pyrifolia, Rosa spinosissima, Ephedra equisetina)* in steep northern slope

Criterion A

- A (iii) Tulipa brachystemon Regel, T. kolpokowskiana Regel.
- A (v) Cerasus tianschanica Pojark., Valeriana focariifolia Boiss., Kraschenninnikovia ewersmanniana (Stschegl. ex Losinsk.) Grubov.

Criterion B

Plant diversity includes about 50 species of vascular plants. Indicator species for the habitat E.1.1 - Piptatherum songaricum (Trin. & Rupr.) Roshev. ex Nikitina, Carex turkesnanica Regel; для FD.1 - Ephedra equisetina Bunge, Atraphaxis frutescens (L.) K. Koch, Atraphaxis pyrifolia Bunge, Spiraea hypericifolia L.

Criterion C

The habitat is occupied by slightly disturbed communities of low foothill vegetation not far from a highway with numerous vehicles near the Arkharly Pass. Habitat FD.1 is the most valuable for *Tulipa brachystemon* narrow endemic species *that* can be met with only in the Junggar Alatau. In that area, the species tends to grow on steep northern slopes covered by shrubby grooves.

Rare species form small groups, their condition is stable. Rare species are threatened by recreation loads and grazing. It is necessary to regulate and reduce the recreation loads, as well as to always monitor the condition of Red Data Book species of *Tulipa brachystemon, T. kolpokowskiana*.

6. Conclusions

The studies on IPAs identification have revealed the applicability of the criteria developed for Europe. The

EUNIS habitat classification and especially its version adapted for the West Siberia [Artemov et al. (2005); Smelyanskiy, Pronkina (2009); Kupriyanov (2009)] have facilitated the tasks of habitat identification in Kazakhstan. However, habitat irrelevances were noted due to the different climatic and botanical-geographic conditions. In particular, an addition was made to the Class G, group G6 - "Desert woodlands" was identified. The study of the first research experience in Kazakhstan has shown the global applicability of the methodology and feasibility of the outcomes utilization in environmental policy. The most unique IPAs will be proposed for consideration to the Committee of Forestry and Wildlife for establishment of protected areas as monuments of nature or nature reserves. This research is the first purposeful step on formation of Kazakhstan network of the IPAs and integrating it into International Network of IPAs.

Acknowledgements

The research was based on the materials received from the project supported by Ministry of Education and Science of the Republic of Kazakhstan titled “Important Plant Areas of Kazakhstan – a basis for monitoring of vegetation within the North Tien Shan piedmont botanical-geographic sub-province” (2012-2014) and OSCE Center in Astana/ IFAS project titled “Monitoring of Ramsar wetlands in the Syrdarya River delta” (2013).

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The Age Structure of the Coenopopulations of Rare Endemic Plant *Ikonnikovia Kaufmanniana* from Kazakhstan

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Abstract Results of studies of the age structure and density *Ikonnikovia kaufmanniana* coenopopulations are presented in this article. *Ikonnikovia kaufmanniana* (Regel) Lincz. (family *Limoniaceae* Ser.) is a rare, disappearing, endemic species with dwindling area and grows only in Kazakhstan and western China (in district Kuldja). Areal of the species is sharply reduced because of the rapid development of new territories and intensified grazing. Endemics such as *Ikonnikovia kaufmanniana* are the most vulnerable part of the regional floras. The loss of these species may lead to decreased stability of the ecosystem, whose integral part they are. Information about the current state of coenopopulations *Ikonnikovia kaufmanniana* is needed to clarify the prospects for their existence and development of strategy of its conservation. Age structure is one of the main characteristics of the plant coenopopulations. Three populations, nine coenopopulations of *Ikonnikovia kaufmanniana* were explored by us in 2013. We laid the accounting sites of 1 m² (by 10 accounting sites in each of coenopopulations) along transects every 10-20 meters depending on the terrain relief. We have counted all individuals of a certain age status at each area and have identified of *Ikonnikovia kaufmanniana* environmental density. Analysis age structure of coenopopulations *Ikonnikovia kaufmanniana* showed that all coenopopulations are normal, most of them are incomplete with members, and only two are completed with members. There are absent juvenile or subsenile or senile individuals in incomplete with members coenopopulations. Ecological density was very different and amounted from 5.5 to 29.2 individuals per m^2.

Keywords Population, Coenopopulation, Endemic, Age Structure, *Ikonnikovia Kaufmanniana*

1. Introduction

The Republic of Kazakhstan, is a contiguous transcontinental country in Central Asia. Kazakhstan is the ninth largest country in the world; its territory of 2,727,300 square kilometers. It has borders with Russia, China, Kyrgyzstan, Uzbekistan, and Turkmenistan. 44% of the territory of Kazakhstan is desert, 14% - semi-desert, 26% - steppe and 5.5% - forests. Flora of Kazakhstan has about 5700 species of plants [Flora of Kazakhstan (1956-1966)]. 306 species of plants are included in the first edition of the Red Data Book of Kazakhstan and protected by the Governmentм [Red Data Book the Kazakh SSR (1981)]. New information is being prepared for the second edition of the Red Data Book of Kazakhstan, which will include 404 species of plants in danger.

Endemic and rare plants are an integral component of the local flora and vegetation, and the disappearance of these species can lead to loss of biodiversity.

Some researchers have noted that the threat of the gene pool of rare endemic and endangered species at the present stage is in the anthropogenic transformation of the environment and habitat fragmentation and it's leading to a decrease in population and their isolation [Schnabel, Krutovskii (2004)]. Especially it applies to plants growing in extreme conditions of desert lowlands [Ivashchenko (2008)]. Lack of natural moisture, poor soil conditions, topography, salinity and overgrazing, all of it puts pressure on plants. One of these plants is Ikonnikovia kaufmanniana.

Ikonnikovia kaufmanniana is included in 1997 IUCN red list of threatened plants [IUCN Red List of Threatened Plants (1998)], also it is included in the list of rare and endangered species of animals and plants of the Republic of Kazakhstan [Resolution of the Government of the Republic of Kazakhstan (2006)].

In this regard, it is needed research of the current state populations of Ikonnikovia kaufmanniana. Demographic structure is one of the most significant characteristics of the population, which determines its ability to self-maintenance and sustainable development [Selyutina (2013)]. Goal of the work is identify and study Ikonnikovia kaufmanniana coenopopulations with taking into account such parameters as indicators of density and age structure.

2. Materials and Methods

Ikonnikovia kaufmanniana (Regel) Lincz. (Family Limoniaceae Ser.) is a rare, disappearing, endemic species with dwindling area (Fig. 1). Shrublets, herblike, 14-35(50) cm tall. Root thick, branches usually numerous, thick, covered with remnants of leaves. Numerous tough, leathery leaves are in dense rosettes at the ends of branches; violet-red flowers in very dense, large spikelets. Fl. June-August, fro. July-September. Lower slopes and base of Mountains. Xinjiang (Ili River basin) and Kazakhstan. This species grows In Kazakhstan, in the eastern spurs of the Trans-Ili Alatau Mountains (Turgen gorge, Mountains Syugaty, Boguty, Turaigyr) and by the foot of the ridge Uzynkara (Ketmentau) in Kazakhstan. Trans-Ili Alatau Mountains and Uzynkara Mountains are part of the Northern Tien Shan, Syugaty, Boguty and Turaigyr are north-eastern extension of Trans-Ili Alatau. Syugaty Mountains, and Boguty Turaigyr are deserted Mountains, there is no forest and soils are poorly developed the due to lack of moisture in them. A ridge Uzynkara surrounded on all sides by the desert landscape, by this terms it is a transition between the Northern and Southern Tien Shan. In the east Ikonnikovia kaufmanniana by single individuals and small groups permeates in district Kuldja (China). Areal of the species is sharply reduced because of the rapid development of new territories and intensified grazing [Red Data Book the Kazakh SSR (1981), Baitenov (1986)].

These researches were conducted in Almaty region in the Mountains Turaigyr and Syugaty. We investigated three Ikonnikovia kaufmanniana populations, in each of which has been allocated to three coenopopulations. Population 1 (coenopopulations 1,2,3) was located on the pass Alasy in the Mountains Turaigyr, coordinates N 43020.124', E 078056.337', altitude - 1394 m, population 2 (coenopopulation 4,5,6) - on the pass Kokpek in the Mountains Syugaty, coordinates N 43027.229', E 078038.984', altitude - 1163 m, population 3 (coenopopulation 7,8,9) - in the Mountains Syugaty before the pass Kokpek, coordinates: N 43031.472', E 078035.207', altitude - 1033 m (Fig. 2). To study the coenopopulations age structure longitudinal transects were laid in each of them. We have laid the 10 accounting sites by 1 square meter in each coenopopulation along transects every 10-20 meters depending on the terrain relief. We have counted all individuals of a certain age status at each site.

Figure 1. Ikonnikovia kaufmanniana (Regel) Lincz.

Methodological principles and approaches developed by T.A. Rabotnov [Rabotnov (1950)], A.A. Uranov [Uranov (1975)] and his School [Coenopopulations of plants (1976, 1988)] were used by us to study the age structure of populations. We have took into account all age states as juvenile (j), immature (im), virgin (v), a young reproductive (g_1), mature reproductive (g_2), old reproductive (g_3), subsenile (ss) and senile (s). As a unit of account we used individual. Environmental density we considered as the number of individuals per 1 m^2 of habitable space.

Figure 2. Map of the studied *Ikonnikovia kaufmanniana* populations

Table 1. Age states *Ikonnikovia kaufmanniana* in coenopopulations

No Population	No coenopopulation	Coenopopulation age structure, %								Density of individuals per 1 m^2
		j	im	v	g_1	g_2	g_3	ss	s	
1	1	0	6,2	10,9	35,9	18,7	17,3	4,7	6,3	6,4
	2	0	17,9	24,8	18,8	7,7	23,1	3,4	4,3	11,7
	3	0	17,5	39,5	28,1	6,6	5,2	0	3,1	22,8
2	4	0,6	8,5	30,1	45,2	4,6	6,5	0,6	3,9	15,3
	5	0,3	7,5	50	38	3,1	0,7	0,3	0	29,2
	6	0	11,2	34,7	32,7	7,1	12,2	0	2	9,8
3	7	0	1,7	23,7	42,4	16,9	13,6	0	1,7	5,9
	8	2,6	3,5	43,5	37,4	5,2	4,3	2,6	0,9	11,5
	9	0	5,5	14,5	49,1	5,4	20	0	5,5	5,5

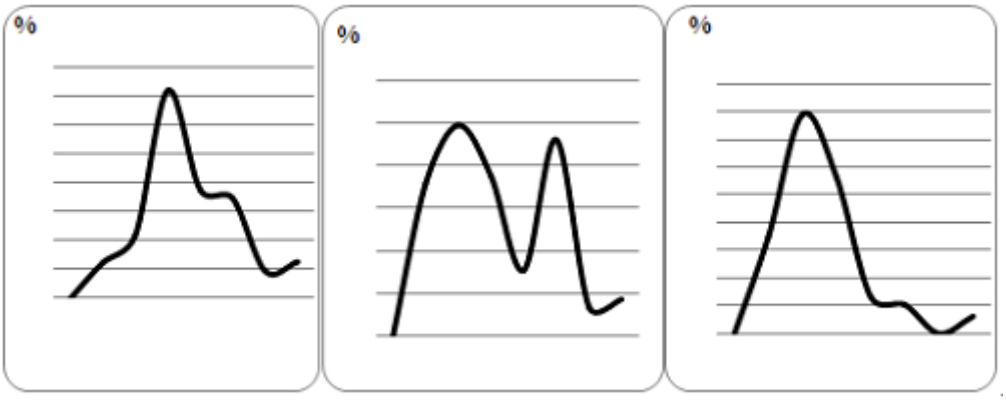
3. Results and Discussion

Population 1. Coenopopulations 1, 2 and 3 belong to a normal incomplete with members. There are not juvenile individuals, and also subsenile individuals are absent in 3d coenopopulation (Table 1).

Age spectrum of coenopopulation 1 and 3 are left-sided, have one maximum: in coenopopulations 1 - young reproductive individuals (35.9%), in coenopopulations 3- virginal individuals (39.5%). The age spectrum of the coenopopulation 2 has two maximum - virginal (24.8%) and old reproductive individuals (23, 1%) (Fig. 3). The highest density of individuals *Ikonnikovia kaufmanniana* been featured in coenopopulation 3 (Fig.6).

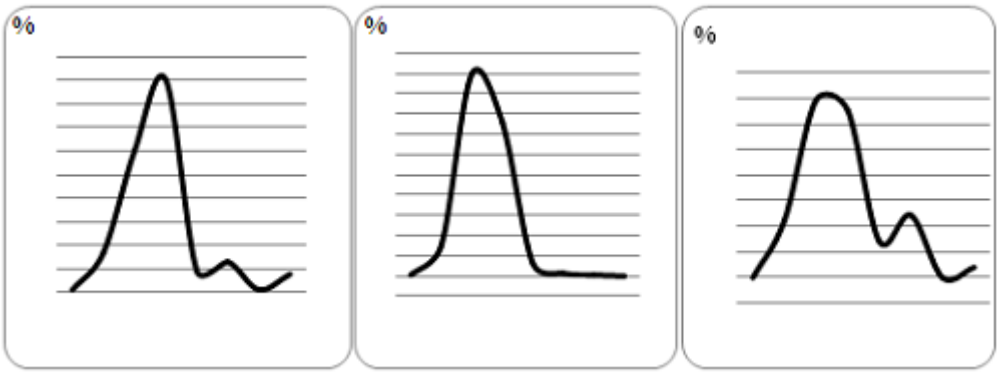
Population 2. Coenopopulations 4, 5 and 6 are normal, the coenopopulation 4 of them is complete with members and coenopopulation 5 and 6 are incomplete with members. Senile individuals are absent in coenopopulation 5, while juvenile and subcenile individuals - in coenopopulation 6. The age spectrums of the coenopopulations 4, 5, 6 are left-sided and have one maximum: in the coenopopulation 4 - young reproductive individuals (45.2%), in coenopopulations 5 and 6 - virginal individuals (50.0% and 34.7%). The highest density of individuals *Ikonnikovia kaufmanniana* been featured in coenopopulation 5 (Fig.6).

Population 3. Cenopopulations 7, 8 and 9 are normal, coenopopulation 8 is complete with members, while coenopopulations 7 and 9 are incomplete with members. Juvenile and subsenile individuals are absent in them (Table 1). The age spectrum of the coenopopulation7, 8, 9 are left-sided with single maximum: coenopopulations 7 and 9 - young reproductive individuals (42.4% and 49.1%), the coenopopulation 8 - virginal individuals (43.5%) (Fig. 5). The highest density of individuals *Ikonnikovia kaufmanniana* been featured in coenopopulation 8 (Fig.6).



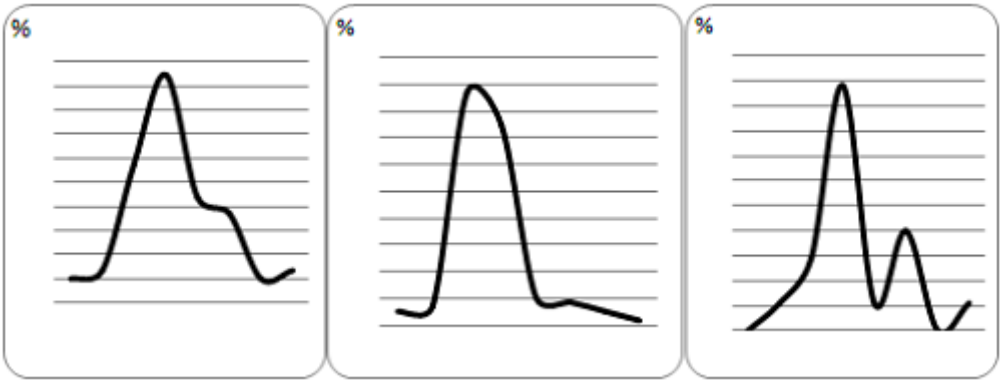
Coenopopulation 1 Coenopopulation 2 Coenopopulation 3

Figure 3. Ikonnikovia kaufmanniana age spectrums in population 1



Coenopopulation 4 Coenopopulation 5 Coenopopulation 6

Figure 4. Ikonnikovia kaufmanniana age spectrums in population 2



Coenopopulation 7 Coenopopulation 8 Coenopopulation 9

Figure 5. Ikonnikovia kaufmanniana age spectrums in population 3

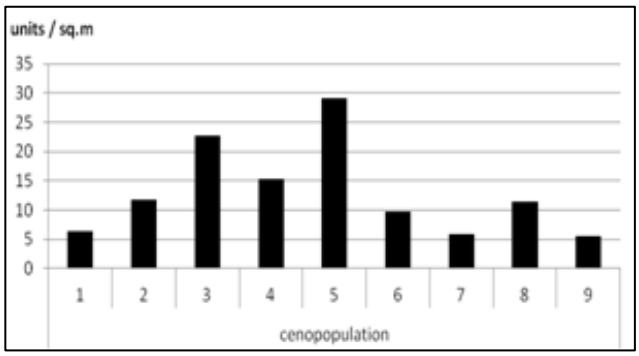


Figure 6. Density Ikonnikovia kaufmanniana in investigated coenopopulations

4. Conclusions

Therefore analysis age structure of coenopopulations *Ikonnikovia kaufmanniana* in three populations showed that all nine coenopopulations are normal, seven of them are incomplete with members, and two are complete with members. The lack juvenile, subsenile and senile individuals in most of the coenopopulations can be explained by that these individuals are usually the first those exposed to adverse conditions. Highest density was noted in coenopopulation 5, lowest density – in coenopopulation 9. The age spectrums of studied coenopopulations are left-sided with peaks on virginal or young reproductive individuals. These data suggest a relatively stable position *Ikonnikovia kaufmanniana* in the studied coepopulations.

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Assessment and Monitoring of Natural Populations of Medicinal Plant *Cistanche Salsa* (C.A. Mey.) G. Beck (Fam. *Orobanchaceae* Vent.) in Kazakhstan

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Abstract The surveys were undertaken for the purpose of inventory of commercial areas of *Cistanche* as well as to determine restoration potential of vegetation after commercial harvesting and to develop the recommendations on balanced use of natural populations of the Kazakhstan flora medicinal plant *Cistanche salsa* (C. A. Mey.) G. Beck of the family *Orobanchaceae* Vent. in the South Peri-Balkhash area (with in Balkhash district of Almaty region). The peculiarities of distribution of studied species in the South Peri-Balkhash area were determined and the floristic composition of vegetational communities with participation of *C. salsa* at the territory of Balkhash district of Almaty region was established. The studies aimed at monitoring of the reserves of *C. salsa* feed stock were carried out before and after harvesting at control index plots. There commendations on rational use of commercial plants of *C. salsa* in the South Peri-Balkhash area were developed. The extract from plant raw material collected from different cenopopulations was produced for further study and development on its basis domestic plant-based preparation for export and domestic use.

Keywords Kazakhstan, South Peri-Balkhash Area, *Cistanche salsa*, Monitoring, Rational Use

1. Introduction

Kazakhstan is located in the center of Eurasia (Figure1) and ranks fourth in the area at the Eurasian continent after Russia, China and India. The significant part of the country area is level land and only 10% falls within high Mountains (Altay, Dzhungarskiy Alatau, Tien Shan) which are located at the east and south-east of the country. The climate is continental and arid at the bigger part of the territory. The combination of various natural-climatic conditions, latitudinal zonality and altitudinal belts account for diversity of the country's flora [Esnazarova (2001)].

Figure 1. Republic of Kazakhstan

The Kazakhstan flora is rich in useful plants nearly 6000 species of higher vascular plants of which at least 1500 species are viewed as having medicinal properties [Grudzinskaya et Al. (2012)].

Among poorly studied and non-used species in the official medicine of Kazakhstan is *Cistanche salsa* (C. A. Mey.) G. Beck – multiyear herbaceous plant of family *Orobanchaceae* Vent. which is widely used in China, Korea, Japan and USA as physiologically active remedy [Isabayev (2010)].

In Kazakhstan this species of plant is produced only at the territories of Almaty and Zhambyl regions and then it is exported to Korea and China as in China to date the reserves of *Cistanche* were reduced, for that reason, the reserves of *Cistanche salsa* can be exhausted without due scientific approach and balanced use of natural vegetation [Sarsenbayev et Al. (2011)].

The present work was carried out with in the frame work of grant financing of scientific studies «Restoration potential of used vegetation of *Cistanche salsa* (C. A. Mey.) G. Beck) in the South Peri-Balkhash area» (2012-2014).

2. Objects of the Research

The object of the research is wild-growing populations of medicinal plants of Cistanche salsa (C. A. Mey.) G. Beck (fam. Orobanchaceae Vent.) in the South Peri-Balkhash area. Cistanche order Cistanche Hoffmgg. et Link of the family Orobanchaceae Vent. Includes early 20 species distributed in the Mediterranean, West and Central Asia countries. In «Kazakhstan Flora», the order Cistanche Hoffmgg. is represented by three species: C. ambigua (Bunge) G. Beck, C. flava (C. A. Mey.) Korsh. C. salsa (C. A. Mey.) G. Beck), by last data – five species among which apart from what were already mentioned above are C. mongolica G. Beck and C. fissa (C. A. Mey.) G. Beck. [Abdullina (1999), Baitenov (2001), Kazakhstan Flora (1965)].

Among the above-mentioned species the most widely-spread is Cistanche salsa – multiyear herbaceous plant of the height 10–40 cm, with thick tufted stem (Figure 2). The flower head has short cylindrical form of the height 5-25 cm and 5-8 cm wide and lush. The flowers are in spicate raceme, attached. The corolla is obtusely campanulate. Blossoms and fruits in April-May. The fruits represent as egg-shaped capsules opening with two shells [Kazakhstan Flora (1965)]. This species is growing on the solonetz and solonchaks, in desert steppes of almost all desert, small hummocky and piedmont Kazakhstan areas.

Figure 2. Cistanche salsa (C. A. Mey.) G. Beck (family Orobanchaceae Vent.) in the South Peri-Balkhash area

Cistanche practically has neither root system nor stems. The stolon (stem) is covered with chaffs. The plants vegetate on soil surface approximately two weeks. For this period the ripen seeds quickly break up and the plant dries out.

Cistanche mainly parasites on the roots of the plants *Haloxylon* Bunge order of the family C*henopodiaceae* Vent., order *Calligonum* L. of the family *Polygonaceae* Juss., order *Tamarix* L. of the family *Tamaricaceae* Link, thus attaching to the host's roots and sucking out its nutritional substances. The complex relationship system is formed between the parasitic plant and host plant which includes a number of adaptations from the side of the first plant and defense reactions from the second one.

In Kazakhstan *Cistanche salsa* is not used although it contains five times as many biological active compounds as ginseng. This plant is valued due to its high content of various polysaccharides, iridoids and other bioactive compounds in stolons which are widely used in developed countries as feedstock for production of many pharmacologically active compounds having pluripotential, tonic effect as well as increasing potency and having antioxidant activity.

The surveys aimed at inventory of commercial areas of *Cistanche salsa* and determination of restoration potential of vegetation after commercial harvesting were carried out for balanced use of *Cistanche* raw material base in the South Peri-Balkhash area (in Balkhash district of Almaty region) [Nasonova (1966)].

3. Methods of Study

The methods of study are general resource studying, geobotanical and phytochemical investigations [Methodology for determination of medicinal plants' reserves, (1986), Korchagin, (1964), Ponyatovskaya, (1964), State Pharmacopoeia of the Republic of Kazakhstan, (2008)].

4. Results of the Research

For monitoring of natural populations, control index points were determined for the first time ever and field surveys were carried out in the South Peri-Balkhash area before and after harvesting of *Cistanche salsa* raw material base at the territory of Balkhash district of Almaty region.

It was established that floristic composition of vegetational communities with participation of *C. salsa* includes at least 48 species of plants from 16 families with the highest representation such as *Chenopodiaceae* (14), *Asteraceae* (6), *Tamaricaceae* (4), *Poaceae* (3), *Limoniaceae* (3) and etc.

For the first time there were detected 15 species among accompanying of *Cistanche* (*Allium schubertii, Arnebia decumbens, Cardaria repens, Erodium oxyrhynchum, Microcephala subglobosa, Nepeta micrantha, Nonea caspica, Scorzonera sericeo-lanata, Scorzonera purpurea,*

Strigosella africana, Hyoscyamus pusillus, Hypecoum parviflorum, Lepidium perfoliatum, Trigonella arcuata, Ziziphora tenuior).

Such vegetational communities were detected and described as tamarix-saxaul, worm wood-teresken-saxaul, saxaul-worm wood communities with in *C. salsa* forms commercial areas. Vegetational communities are confined to takyr-solonetz and solonchak grey soil and at some places to clayey, sandy soils.

At the control key plots were identified the density of the reserve, phytomass, size of model specimens and yielding capacity of *Cistanche salsa* (Tables 1-3).

There serves of *Cistanche salsa* raw material base (Table 4) were calculated and a layout map on distribution of detected commercial areas of *Cistanche salsa* at the surveyed area of the Balkhash district of Almaty region was compiled. The most productive areas were recorded in the outskirts of Akzhar village (at the territory of Kurtinskiy SA) as well as at Ushzharma and Bereke villages (at the territory of Bakanass SA).

Table 1. Density of Cistanche salsa fresh feedstock at index plots before harvesting

Location of index plot and date of observation	Number of flowering specimens of *Cistanche*, spec. per 100 m^2	Density of feedstock reserve, spec./m^2	Yielding capacity of fresh feedstock, kg/ha
Bereke index plot (1) 30.04.2013	35	0.004	11.06±1.44
Kokzhide index plot(2) 1.05.2013	18	0.002	5.53±0.66
Akkol index plot (3) 1.05.2013	7	0.0007	1.94±0.25
Akzhar index plot (4) 1.05.2013	35	0.004	14.72±1.77
Akzhar index plot (4a) (Tekturmys) 1.05.2013	70	0.007	25.76±3.35
Ushzharma index plot (5). 1.05.2013	28 (to the right) 42 (to the left)	0.003 0.004	11.04±1.21 14.72±1.91

Table 2. Morphometric characteristics of wild-growing specimens of Cistanche salsa at Bereke and Akzhar index plots

Index plot	Bereke	Akzhar
Characteristics of model specimen		
Length of flower, cm	25.3±1.01	16.6±1.74
Length of stolon without flower, cm	23.7±1.45	24.8±3.23
Diameter of stolon, cm	4.35±0.40	4. 5±0.59
Weight of specimen, g	276.6±30.42	368.0±40.48

Table 3. Comparative characteristics of morphometric data of Cistanche salsa from different sampling locations

Sampling location	Length of flower, cm	Length of stolon without flower, cm	Diameter of stolon, cm	Weight of specimen, g
Almaty region, Balkhash district, Bereke index plot	25.3±1.01	23.7±1.45	4.35±0.40	276.6±30.42
Almaty region, Balkhash district, Akzhar index plot	16.6±1.74	24.8±3.23	4. 5±0.59	368.0±40.48
Zhambyl region, Sarysu district, outskirts of Zhailaukol village	28.3±1.13	81.7±4.09	5.7±0.51	1625.0±195.0

Table 4. Commercial reserves of Cistanche salsa at the territory of Balkhash district of Almaty region

Location of commercial areas (Nos. of blocks) as per the data of forestry administration	Area, ha (as per the data of forestry administration)	Average yielding capacity of fresh feedstock, kg/ha	Overall commercial reserve of fresh feedstock, t	Volume of possible annual crops of fresh feedstock, t
Bakanass forest administration Bakanass forestry (203, 204, 205, 213, 214, 215) Akkol forestry (298, 299)	34,835.0 4,558.0	10.9±1.27 1.94±0.25	280.4 6.6	56.1 1.3
Kurtinsk forest administration Akzhar forestry (1-35, 83)	6,333.6	20.24 ±2.23	99.9	20.0
Total	45,726.6	-	386.9	77.4

The monitoring of the state of *Cistanche salsa* commercial areas at index plots before and after harvesting showed that after the plants are taken out there remains the “traces” in the form of deepenings – holes which need to be filled up with soil in order to avoid drying out of roots of host plants. It was noted that the local producers leave the remainder of cut crowns of *Cistanche salsa* flowers with immature seeds near the holes with the intent that seeds when ripe would again fall into the soil and then attach to the host plant (Figure 3).

Figure 3. Natural populations of Cistanche salsa after harvesting of raw materials

With a view to ensuring preservation of natural populations of *Cistanche salsa*, then harvesting of feedstock at the used commercial areas should be carried out only after 4-5 years interval – "rest" as in order for the so-called tubers-tuberous formations to form new underground shootings at the points of contact with the roots of host plant would require at least 3-4 years.

An aqueous-alcoholic extract based on *Cistanche* was prepared for further study and development on its basis domestic plant-based preparation for export and domestic use. In future, the monitoring study of natural populations are planned to be carried out not only at the Balkhash district but also at the other habitats of this species such as Panfilov and Uigur districts of Almaty region.

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Chapter 5 *Agricultural Ecosystems and Biodiversity*

Fungi: A Megadiverse Kingdom – A Mysterious World

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Abstract Fungi are a critically important component in all niches of the ecosystem. They are a megadiverse group and present varied trophic roles and display a wide diversity of forms. As great as their biodiversity is large, so is their impact, both positive and negative, on humans.

Keywords Mycobiota, Orchids, Edible Mushrooms, Climate Change, Beneficial Fungi

1. Introduction

All fungi, members of the Mycota, are within a relatively recently created Kingdom compared with Kingdoms Planta and Animalia [see the five-kingdom system of Whittaker (1969)]. The Kingdom Fungi is highly diverse with an estimated 1.5 million species [Hawksworth (1991)] and attempts to assess the global fungal species richness are still underway [Bass & Richards (2011); Blackwell (2011)]. According to Mora et al. (2011) even though the number of known described species of approximately 611,000, that is low in comparison to other Kingdoms which makes them the second most diverse kingdom.

This megadiverse biologic kingdom is understudied with approximately 90% undiscovered fungal species with crucial life cycle hidden in the substratum and not visible or detectable most of the time. These organisms become suddenly visible, ranging from very small unicellular ones to large colourful fruiting bodies. Fungi play important roles as decomposers and symbionts as well as parasites and pathogens. Fungi provide enormously important services in their role as the recyclers in all ecosystems' niches.

Fungi appeared on Earth about 1,430 million years ago in the Proterozoic Era as demonstrated by fossils. Millions and millions of years ago, during the Cambrian period (542-488 Ma), fungi left the aquatic environment and colonized land, long before plants. Moreover, they helped plants, through mutual symbiosis, to colonize land [Lücking et Al. (2009)]. The use of fungi by humans dates back a long time. More than 5,000 years ago a prehistoric mountain traveller found frozen in the Alps, known as the Iceman Ötzi, took among his equipment pieces of two different fungal Polypores. One of these fungi is classical fire-starting tinder (*Fomes fomentarius*). The other fungus (*Piptoporus betulinus*) has medicinal and ritual significance with anti-microbial and anti-inflamatory properties [Peintner et Al. (1998)].

Mycology, the study of fungi, is a relative new science with relative few scientists considering the high fungal diversity. In the past fungi were often ignored, today papers citing fungi are increasing and these organisms are receiving more and more attention [Pautasso (2013)]. This is in large part due to the hard work of numerous mycologists that tried to bring this species rich but under-recognized group to a broader audience. In 1971 the International Mycological Congresses and Association (IMCs and IMA) were established with the aim to give a new platform for the re-launch of mycology and to encourage this science in all its branches [Hawksworth (2006)]. In 2010 the International Society for Fungal Conservation (ISFC) was founded to promote globally the presence of fungi and to draw attention to their conservation and biodiversity with agreements from the scientific world to governmental bodies (see http://www.fungal-conservation.org/). To further the conservation of fungi in Europe and to underline the activities done since, the European Council for the Conservation of Fungi (ECCF) was established in 1985. There now exists the conservation body of the European Mycological Association (EMA) and some related publications [Dahlberg & Croneborg (2006); Senn-Irlet et Al. (2007); Dahlberg et Al. (2010); Heilmann-Clausen et Al. (2014)].

David Minter wrote "It is difficult to over-emphasize how important fungi are"; in this context the aim of the present contribution is to provide examples of the fundamental role of fungi in maintaining life on our planet.

(http://www.fungal-conservation.org/blogs/orphans-of-rio.pdf)

2. Discussion

Orchids are often colourful and fragrant. The Orchid family is one of the largest of flowering plants, including more than 20,000 species and more than 100,000 hybrids and cultivars have been produced since their introduction in the 19th century. On the other hand the family has a high proportion of threatened taxa and are cited in lists of endangered species. Orchids produce a great number of almost microscopic seeds unable to accumulate enough nutrients for the embryo. Therefore, orchids must enter symbiotic relationships with fungi that provide these seeds with the nutrients required for germination. Well known in this symbiotic relationship are micromycetes of the *Rhizoctonia* group which help orchid embryos grow to the protocorm stage. Some orchids never become autotrophic and continue a relationship with fungi for longer or for their entire lifecycle. The existence of hyphal links between achlorophyllous plants and surrounding trees and the flow of carbon and nutrients from the tree through the mycorrhizal fungi to the mycoheterotroph has been demo1970-2007nstrated [Leake (1994)]. For instance the achlorophyllous *Limodorum abortivum* is associated with macromycetes like *Russulaceae* and *Tuberaceae*. Other studies also show that some terrestrial photosynthetic orchids associate with a range of fungi like *Tulasnellaceae*, combining mycoheterotrophy and photoassimilation [Girlanda et Al. (2006); Pecoraro et Al. (2013)].

Only a few mushrooms are chosen as delicacies even though many are considered edible. Among them *Tuber magnatum* is the most precious truffle which commands the highest prices on the market of any edible ectomycorrhizal mushroom. The white truffle grows in Italy and in limited areas of some other European countries and has attracted attention from numerous scientists. Nevertheless the successful cultivation of this biotroph is still not feasible. Their natural production shows a decline due to ecological changes and /or different factors such as hunters [Zambonelli et Al. (2012)]. Recent studies have provided new insights into its soil ecology and have identified appropriate cultural practices to maximize the production in natural truffières. In order to detect and quantify *T. magnatum* mycelium in the soil a specific real-time PCR assay using TaqMan chemistry was developed and the spatial distribution of *T. magnatum* extra-radical mycelium in productive soil and its growth over seasons was investigated [Iotti et Al. (2012); (2014)]. The ectomycorrhizal community in different natural truffle areas has been analyzed highlighting some common characteristics [Leonardi et Al. (2013)] and the effects of cultural practices have been studied concluding that tilling increases the quantity of white truffle mycelium [Salerni et Al. (2013)].

As an important component in all terrestrial niches presenting varied trophic roles fungi, like other organisms, demonstrate changes in their life cycle in response to climate change. There are few studies on this aspect but papers have revealed that in central Northern Europe during 1970-2007 there were changes in productivity and phenology of fungal fruiting bodies. Other work indicates that there have been increases in the duration of the fruiting season, increases of fungal activity. If there is no new balance between symbionts and saprotrophs this can result in an accumulation or loss of carbon [Kaserud et Al. (2012); Boddy et Al. (2014)]. One response to climate change has also been a change in geographic distribution. This has recently been discussed with regard to the occurrence and distribution of some *Tuber* species [Büntgen et Al. (2011); Splivallo et Al. (2012)]. A classic example caused by water stress and high temperatures is that of *Biscogniauxia mediterranea*. This wood-inhabiting pathogen is expanding from Morocco, where it was first recorded, to southern Europe and has been reported to infect chestnut, beech and ash, but prefers oak trees and among them the cork oak is particularly susceptible. These changes are typical of well-known landscapes characterized by Mediterranean maquis or shrublands [Picco et Al. (2011); Ragazzi & Moricca (2012)].

Today's agriculture also benefits greatly from the activities of numerous members of the Mycota. One of the most important families of agricultural fungicides are the strobilurins which were first isolated from the wood-rotting, mushroom-developing fungus *Strobilurus tenacellus*. In recognition of their origin, this group of fungicides was named the strobilurins [Barlett et Al, 2002].

The discovery of the strobilurin fungicides was inspired by a group of naturally occuring b-methoxyacrylates, strobilurin A, B and oudemansin A, however, these natural products were not suitable as agricultural fungicides. The elucidation of the structures and properties of these two natural products of *S. tenacellus* provided the starting point for the research of the major agrichemical companies like BASF, Bayer and ICI (now Syngenta). An example of the outstanding commercial success of this group of fungicides is azoxystrobin which provides control of fungi from all four classes of fungal plant pathogens, namely the Ascomycetes, Basidiomycetes, Deuteromycetes and Oomycetes (now a member of the Stramenopiles).

The strobilurin fungicides act by inhibiting mitochondrial respiration in fungi are an outstanding new class of fungicide. Strobilurins are now used on a wide range of crops throughout the world and are now considered to be one of the most valuable classes of single-site fungicides ever discovered by the agrichemical industry. Strobilurin fungicides have set new standards in disease management and improved yields and quality.

The use of biological control agents in the management of plant diseases of important crops has the potential to substantially reduce the use of chemical pesticides and thereby reduce adverse environmental effects they may produce. In the world of biological control of plant disease, fungi play an important role. Several fungi, not known to be

plant pathogenic, are known to parasitize important soil borne plant pathogenic fungi like *Pythium*, *Phytophthora*, *Rhizoctonia*, and *Sclerotinia* and phyllosphere pathogens like *Botrytis cinerea* and *Sphaerotheca fuliginea*. Among the most common mycoparasitic fungi are members of the genus *Trichoderma*, mainly *T. harzianum* [Harmen, G.E., 2000].

The fungus *T. harzianum* has been shown to parasitize the mycelia of *Rhizoctonia* and *Sclerotinia* and to inhibit the growth of many oomycetes such as *Pythium* and *Phytophthora* and other fungi such as *Fusarium* and *Heterobasidion* (*Fomes*). There is a great deal of evidence to indicate that the mechanism of control is a combination of mycoparasitism, antibiosis, competition for nutrients or space, tolerance to stress through enhanced root and plant development, induced resistance, solubilization and sequestration of inorganic nutrient, and inactivation of the pathogen's enzymes. The registration of biological control agents with regulatory agencies is relatively fast, inexpensive, and simple. This dogma is a subset of the concept that biocontrol agents of plant pathogens can become both profitable and useful.

3. Conclusions

Given the high level of diversity of the Kingdom Fungi, there is relative little written describing the importance of this group to the environment, to humans and to the planet Earth. In recent years there has been an increase in research and publication but much more research needs to be done on this extremely broad and important topic. This contribution is not a review on what is known but rather is intended to underline the importance of fungi and to increase the curiosity of others to learn more about them. Further, it is our goal bring these concepts to a larger audience, to a new and diverse group of people and to provide them references so they may learn more about the mysterious world of this megadiverse Kingdom.

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Arceuthobium Oxycedri (dc.) M. Bieb. in the Crimea: A Brief History and Future Prospects

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Abstract One of the damaging pests for *Cupressaceae* species in Mediterranean region is juniper dwarf mistletoe – *Arceuthobium oxycedri* (DC.) M. Bieb. − obligate parasite and epiphytic angiosperm. *A. oxycedri* manner of infecting host populations and its distribution patterns are poorly studied in South-Eastern Europe. Only a few papers were dedicated to *A. oxycedri* in the Crimean Peninsula, where fully isolated populations of its main host *J. deltoides* R.P. Adams reside. The current paper shortly overviews the results of juniper dwarf mistletoe studies in the Crimea from 1890, provides its distribution map, highlights the progress in *in vitro* approaches and presents the basics ideas of junipers forest preservation strategy from *A. oxycedri* infection.

Keywords *Cupressaceae*, *Juniperus Deltoides* R.P.Adams, Parasitic Plants, Juniper Dwarf Mistletoe, *Arceuthobium Oxycedri* (DC.) M. Bieb., The Crimea, Biodiversity Protection

1. Introduction

According to the Takhtajan delineation (1978), the flora of the Crimean peninsula is referred to Holarctic Kingdom, Circumboreal Central Europe Region and Crimea–Novorossiysk Province [(Takhtajan, 2009)]. Besides that, the reconsidered and broadened approach of Frey and Lösch (2010) put the Crimea into Pontic (its northern part) and Submediterranean (southern) regions [(Frey and Lösch, 2010)]. As the transition zone between Western and Central Mediterranean regions, the Crimean peninsula is characterized by high floristic diversity (2173 plant species in total) especially in its mountain part (7,000 sq.km) [Yena, 2012)]. It has to be emphasized that the peninsula hosts such relic forest and woodland communities as low juniper-oak woodlands, pine and deciduous forests [(Diduch, 1986)]. Juniper forests are referred to as "living forest fossils" because of their extremely slow growth and great lifespan (>3000 years) [(Sarangzai et al., 2010)]. Five juniper species are present in the Crimean dendroflora: Greek juniper (*Juniperus excelsa* M. Bieb.), Eastern pricky juniper (*J. deltoides* R.P. Adams), Fetid juniper (*J. foetidissima* Willd.) as well as common (*Juniperus communis* var. *communis* L. = *J. hemisphaerica* J. et C. Presl.) and Savine (*J. sabina* L.) junipers [(Yena, 2012)]. The typical element of low juniper-oak woodlands and schrublands (so called *shyblyak*) that usually comprises underwood of broad-leaved and coniferous forests, and sometimes forms light sparse forests communities is *J. deltoides* R.P. Adams. It is widespreaded from the Central Italy east to Iran and Israel according to the recent studies of Adams, who distinguished it from the cade, or the Western prickly juniper (*Juniperus oxycedrus* L.) [(Adams et al., 2004; 2005; 2014; Boratyński et al., 2014)]. *J. deltoides* is growing in natural areas of the Crimean Mountains from sea level up to 700-800 m a.s.l. of elevation excuding uplands (*yaylas*). Despite its high drought and chilling resistance, long life span and biological plasicity, *J. deltoides* suffers from natural soil erosion and drought due to the water level fall in limestones (*karst*), extreme temperatures of winters and summers, loss of the graduate transition between seasons, slow habitats degradation because of the sea transgression, overgrazing, fires and inappropriate agricultural practices. The abiotic challenges overlap with the biotic ones such as various rust fungi and insects (winter moss, juniper scale, aphides, etc.) [(Ruguzova, 2002)].

One of the major disease agents of Old World junipers and other *Cupressaceae* species is juniper dwarf mistletoe − *Arceuthobium oxycedri* (DC.) M. Bieb (= *Razoumofskya oxycedri* (DC.) FW Shultz ex Nyman) [(Hawksworth and Wiens, 1996; Hawksworth et al., 2002)]. Juniper dwarf mistletoe is dioecious evergreen heterotrophic plant from S*antalaceae* family exclusively parasitic on the representatives of C*upreccaceae* Grey. [(Hawksworth and Wiens, 1996)] (Fig.1).

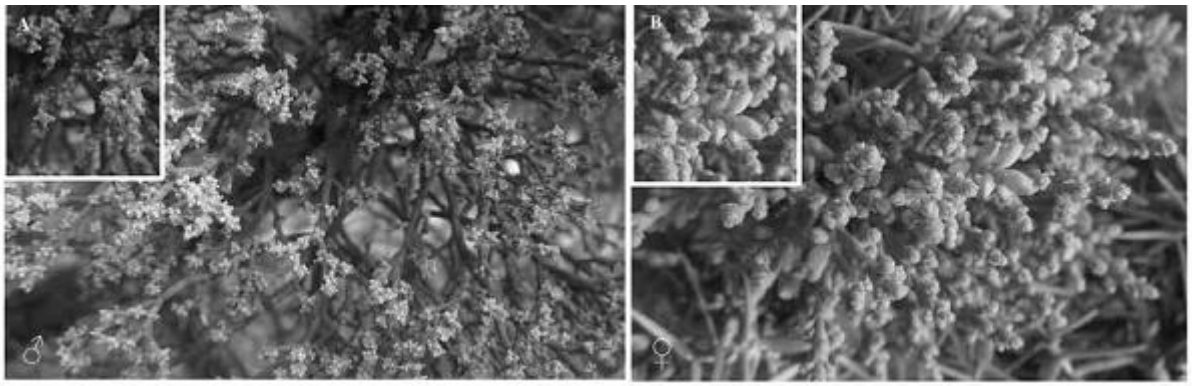

Figure 1. Aerial shoots of juniper dwarf mistletoe *A. oxycedri* found on *J. deltoides*: A – male (staminate) plants; B − female (pistillate) plants. Note the developing fruits that will ripe at the end of October (indicated by arrow). The insets show plants at higher magnification.

Dwarf mistletoes have a lot in common with the leafy mistletoes (*Loranthaceae, Santalaceae* and other families), since they depend on their hosts in terms of water and nutrients, but they are essentially leafless with the limited ability to authotrophy [(Bickford et al., 2005)]. *A. oxycedri* appears as nodulated simple or dichotomically branched perennial shoots with variable colour − from yellow-purple to olive-green. Theese shoots are anchored inside the host wood by the system of root-like haustoria (endophytic system). Even from a long distance, infected stands can be recognised by the presence of deformed, stunted, spike-topped, dead and dying trees. Infected trees, in turn, are marked by so called "witches brooms", a pendulous dense cluster of small twigs on a branch, and/or **s**wellings or other abnormalities on the branches and tree stems. The duration of juniper dwarf mistletoe life cycle is 6 to 8 years and includes *concieled phase* (1− 3 years: seed germination inside the host shoot, cortical strands development and further penetration from the bark to the cambium), *explicit phase* (3−5 years: development and growth of endophytic system) and *systemic infection phase* (aerial shoots production, maturation and seed development) [(Hawksworth et al., 2002)]. *Arceuthobium* spp. pollen is dispersed both by insects (such as flies, gnats, beetles, mothes, bees, etc.) and wind, while seeds are disseminated to the distance up to 23 m by the unique explosive discharge mechanism controlled hydrostatically, and stochastically spreaded by birds (sporadic ornithochory) and small mammals because of the sticky viscin cover [(Hawksworth and Wiens, 1996)]. Tiny thrips (*Thysanoptera* order) may favour the pollination of *A. oxycedri* in the Crimea by the transfer of its adhesive pollen to pistillate flowers [(Ruguzova, 2002)], however, further observations to reveal pollinators of *A. oxycedri* are required. To overcome the dominant view to *A. oxycedri* as target phytoquarantine object [(Mariuschkina and Mosyakin, 2006)] it has to be emphasized that dwarf mistletoes have ambiguous role in ecosystems and must not be treated exclusively as parasites, since some North America species provide food for the rare Johnson's Hairstreak Butter fly, host hyperparasitic fungi, give food and shelter to birds and mammals, impact processes ranging from fire disturbance to water use and carbon sequestration, and perhaps even serve as keystone species (see review of Barret et al. (2012)]. Therefore, one of the worthwhile fields of *A. oxycedri* research in the Crimea is the study of insects and birds confined topically and/or trophically to this parasite.

The story of *A. oxycedri* studies in the Crimean Peninsula, where fully isolated population of its main host *J. deltoides* R.P. Adams resides, is century-long [(Scrobyschevsky, 1890; Voronichin, 1908; Lasarev and Grygorov, 1980; Isikov, 1986; Isikov and Zacharenko, 1988; Ruguzova, 2002; Krasylenko, 2014)] highlighting mainly parasite findings, hosts variety, some aspects of flowering, pollination and fruit development, *in vitro* seed germination, character of morphological alterations and effects of sanitary cuttings of the affected junipers. However, many aspects of its ecology and biology still remain unelucidated. Moreover, the development of the multilevel biodiversity protection strategy of the Crimean juniper woodlands on the national and European level, inluding the pest management and shortage of sanitary cuttings, is strongly recommended, since the danger of rapid devastation and the replacement of native plant communities of the protected areas by the anthropogenic landscapes has been increasing inexorably. The political reorganisation and resubordination of nature-protected areas including those of UNESCO importance to new local organs also unfavour the preservation of relic forests biodiversity and require inretactive cooperation of plant scientists (mainly dendrologists and phytopathologists), environmentalists and political authorities.

2. Materials and Methods

2.1. Samples Collection and Preparation for Microscopic Studies

For *in vitro* studies and microscopy, *A. oxycedri* M. Bieb. brooms manifesting on *J. deltoides* R.P. Adams branches were collected in S.E. Crimea at Micro-Yalo (Balaclava, Sevastopol City Council) in October 2013 and in March 2014 at the Fraternal cemetary territory at the Nothern Side

of Sevastopol. Specimens were transported to the laboratory for the dissection and fixation approx. 18–24 h after collection. Fixating solution was a mixture of freshly prepared at room temperature 2% paraformaldehyde + 2% glutaraldehyde in a 0.1 M phosphate buffer (pH 6.8). *A. oxycedri* branches were exposed at 4 °C overnight, rinsed in the same buffer, cut by a razor blade and mount to gelatin-coated slides for the microscopic analysis without extra staining. Representative images were captured by a Canon Power Shot G6 digital camera (Canon, China) in the macro mode joined to Axioskop 40 light microscope (Carl Zeiss, Germany) equipped with Plan-Neofluar 10x/0.30, 20x/0.5 and 40x/1.30 Oil DIC objectives. Adobe Photoshop and Illustrator C S 3 were used for data processing. At least 10 sections were characterized in a minimum of three independent replicates.

For mapping, our own findings, paper reports and specimens from M.G. Kholodny Institute of Botany, NAS of Ukraine (KW) herbarium were used. *A. oxycedri* on *P. orientalis* branches collected at 8th and 14th of March 2014 were delivered to M.G. Kholodny Institute of Botany, NAS of Ukraine (KW) and Karadag Nature Reserve herbarium collections (PHEO).

2.2. Introduction of Juniper Dwarf Mistletoe into in Vitro Culture

A. oxycedri aerial shoots underwent vacuum sterilization in 70% ethanol for 10 min in a sealed Falcon flasks, and were additionally surface-treated with 33% hydrogen peroxide for 3 min and 6% sodium hypochlorite for 5 min, followed by 3-time rinsing in sterile deionized water for 5 min. Sterilized stems were cross-sectioned in tiny 2 mm-long bars with a razor blade and put into the modified regeneration White's medium (360 mg/l $MgSO_4.7H_2O$, 260 mg/l $Ca(NO_3)_2.4H_2O$, 200 mg/l Na_2SO_4, 165 mg/l NaH_2PO_4, 80 mg/l KNO_3, 65 mg/l KCl, 7 mg/l citric acid, 7 mg/l $Fe(NO_3)_3$, 20 g/l sucrose, 8 g/l agar, 2.3 mg/l $MnSO_4.H_2O$, 0.5 mg/l $ZnSO_4.H_2O$, 0.5 mg/l H_3BO_3, 0.025 mg/l $CuSO_4.5H_2O$, 0.025 mg/l $Na_2MoO_4.H_2O$, 0.05 mg/l $CoCl_2.6H_2O$, 7.5 mg/l glycine, 0.25 mg/l thiamine, 1.25 mg/l niacin, 0.025 mg/l calcium pantothenate, 0.025 mg/l pyridoxine, pH 5,8) supplemented with IAA 0.5 μM/Kin 5 μM (0.1/1 ratio) according to the protocols established earlier for western hemlock dwarf mistletoe, *A. tsugense* (Rosend.) G.N. Jones subsp. *tsugense* and lodgepole pine dwarf mistletoe *A.rceuthobium americanum* Nutt. ex Englm. [(Deeks et al., 2001; Martin et al., 2011)].

3. Results and Discussion

3.1. Distribution Range and Hosts of A. Oxycedri in the Crimea

A. oxycedri is confirmed from more than 30 countries, including northern Africa, Mediterranean Europe, the Balkan Peninsula, former Soviet Union Republics, the Near East, the Indian subcontinent and western China [(Ciesla et al., 2002)]. This species was found over a wide elevation range: from near sea level along the Mediterranean and Black Sea bassins to 500−3000 m in western China. Geographically, the manner of juniper dwarf mistletoe distribution in different regions is dispersed or restricted **[**(Gajšek et al., 2013)] that could be defined by host availiability, antropogenic pressure, climate and/or local microclimate features. The last suggestion requires additional data collection, comprehensive analysis and modeling, for instance, climate envelope modeling including logistic regression, general additive models, and neural networks [(Barret et al., 2012)]. It is known that low and even freezing night temperatures in late spring (that is typical for the Crimean climate) and early summer reduce *Arceuthobium* seed and pollen germination ability [(Barret et al., 2012)]. In general, *A. oxycedri* range appears to coincide with its hosts, but the junipers themselves occur in many regions as widely separated populations.

The remarkable feature of the Crimean *A. oxycedri* populations is the heterogeneity of its distribution [(Voronichin, 1908; Ruguzova, 2002)]. Thus, the main populations of juniper mistletoe confined to the Crimean Mountains partially overlap with *J. deltoides* distribution patterns (Fig.2,). The collection samples dedicated to *A. oxycedri* infection were found primarily at the Nikita Botanical Garden Arboretum (44°30`26.73``N, 34°13`57.38``E; ~ 70 m a.s.l.), "Foros" Park (44°23`19.78``N, 33°46`57.68``E; ~ 20 m a.s.l.), botancal reserve "Novyi Svet" (44°49`25.72``N, 34°54`34.67``E; ~ 60 m a.s.l.) [(Lasarev and Grygorov, 1980; Isikov and Zacharenko, 1988; Ruguzova, 2002)] and also at the Fraternal cemetary territory at the Nothern Side of Sevastopol (44°38`10.61``N, 33°33`30.17`E), where the hosts were used for the landscape design [(Krasylenko, 2014)]. Sole findings of the parasite on relic populations of *J. excelsa* at the Batlliman Natural Preserve have been also reported (Fig. 2,).

Not only juniper dwarf mistletoe distrubution pattern, but also its infection rate vary in a broad range: from its almost complete absence in isolated marginal juniper populations of the Main Ridge of the Crimean Mountains (for example, Agarmysh massif near town of Staryi Krym, Kirovskyi Distr., Karadagh Nature Reserve, Theodosian City Council) till 90 % of infection rate in some localities of the Crimean Southern Cost. In Crimea the most intense invasions were found at the Southern coast: Arboretum of Nikita Botanical Garden, "Cape Martyan" Nature Reserve [(Lasarev and Grygorov, 1980; Isikov and Zacharenko, 1988; Ruguzova, 2002)] (Fig.2).

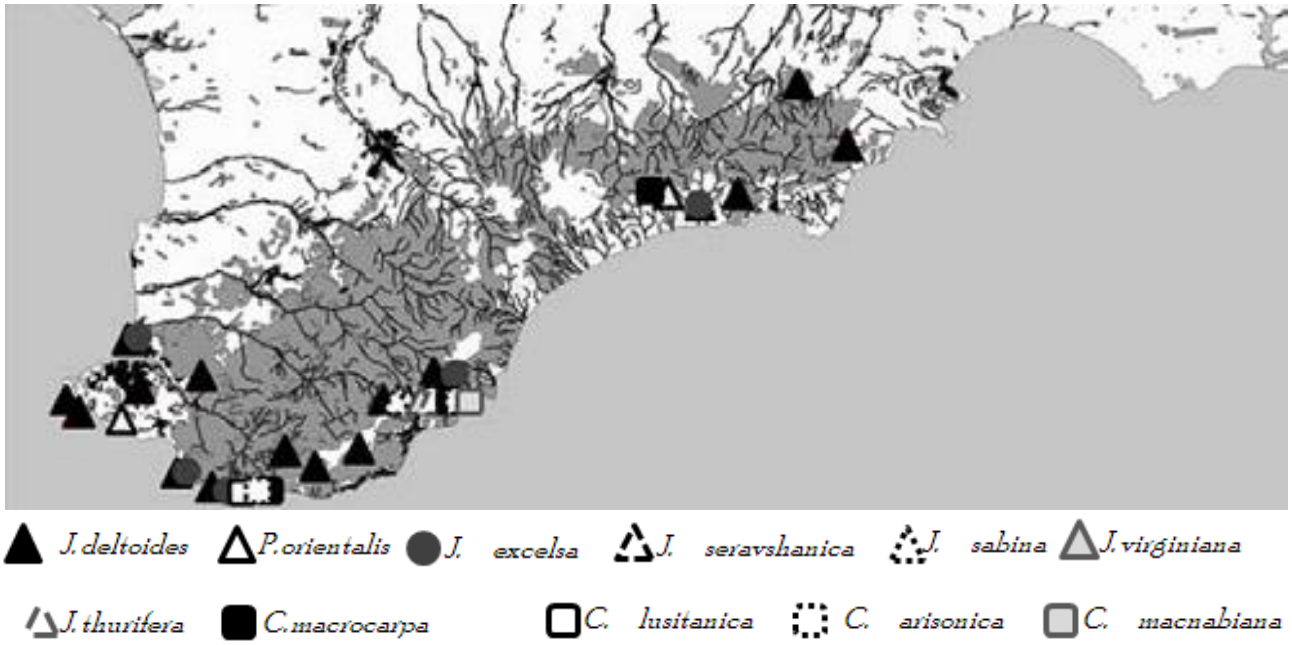

Figure 2. *A. oxycedri* distribution throughout the Crimean peninsula on different *Cupressaceae* hosts.

Furthermore, some novel highly-invaded native *J. deltoides* populations were revealed in 2012–2014 at the Southern Cost (settlement Limeny surroundings, NW from Symeiz, Yalta City Council (44°25`14.33``N, 33°59`14.61``E; about 200-400 m a. s. l.), Rodnoye village environs (Canyon of the River Chernaya, Sevastopol City Council (44°32`27.30``N, 33°41`54.60``E; 90-120 m a. s. l) as well as in adjacent coastal plots of the Main Ridge of the Crimea Mountains (locality Micro-Yalo, SE from town of Balaclava, 44°29`25.91``N, 33°36`59.61; 130 – 140 m a.s.l.). Therefore, the pattern of juniper dwarf mistletoe infection in the Crimea is sporadic both for all hosts and separate *J. deltoides* populations in particular, what corroborates the findings in Mediterranean region reviewed and mapped by Ciesla et al. [(2004)] and Gajšek et al. [(2013)]. The bright illustration of such patchy distribution is the arrangement of Eastern prickly junipers along Old Sevastopol-Yalta Pathway under the Baydaro-Castropolskaya Wall of the Ridge Ai-Petrinskaya Yaila between The Church of Christ's Resurrection and the junction with the New Sevastopol-Yalta Highway (44°24`17.70``N, 34°47`18.52``E): only some trees below 400 m a. s. l. were dotty affected, slightly or severely, while the others, even those directly contacting with the infected ones by their crones, have not hosted the parasite. Such kind of juniper dwarf mistletoe distribution might reflect a history of co-evolution and migration with its hosts. The ballistic dispersal of dwarf mistletoes guarantees only local spread; its rare long-distance dispersal by birds is puzzled.

In the nearest future, the Hawksworth 6-class dwarf mistletoe rating system [(Hawksworth, 1977)] with some modifications [(Gajšek et al. 2013)] will be used for the assessment of the dwarf mistletoe infection in stand, as it provides a quantitative reference scale for determining the relative population status of a dwarf mistletoe infestation in the Crimea. Moreover, the double-mapping of host-parasite distribution according the new data for the Mediterranean region is the task of high interest. Not so many papers have been dedicated to *A. oxycedri* distribution and its hosts infection rate in this area: general overview [(Ciesla et al., 2004)], findings from Slovenia [(Gajšek et al. 2013), Ziarat, Balochistan, and Pakistan [(Sarangzai et al., 2010)].

Aside from its primary host, Eastern pricky juniper (*J. deltoides* R.P. Adams), *A. oxycedri* in the Crimea also occasionally occurs on other native *Juniperus* species, Greek juniper (*J. excelsa* M. Bieb.) *inter alia* [(Isikov, 1986; Lazarev and Grygorov, 1989)] and on the exotic representatives of *Cupressaceae* family, cultivated in the peninsula mainly in parks and Arboretum of Nikita Botanical Garden (*J. seravshanica* Kom., *J. sabina* L., *J. virginiana* L., *J. thurifera* L., *Cupressus macrocarpa* Hartw, *C. macrocarpa* Hartw. "Lutea", *C. macrocarpa* Hartw. "Lambertiana", *C. lusitanica* Mill, *C. lusitanica* var "Benthamini" (Endl.) Carr, *C. arisonica* Greene ("Glauca" var glabra (Sudw). LT., *C. macnabiana* A. Murr., *C. funebris* Endl, etc.) that can be considered as secondary hosts [(Isikov and Zacharenko, 1988; Krasylenko, 2014)]. Among the 18 species and ornamental forms of *Cupressaceae*, invaded by juniper dwarf mistletoe in the Crimea, these authors also mention Chinese arborvitae, or Oriental thuja (*Platycladus orientalis* (L.) Franco) that is naturally ranged mainly beyond *A. oxycedri* distributive province: Nothern China including Inner Mongolia, Korean Peninsula, Russian Far East and some Central Asia republics [(Farjon, 2013)]. It has to be noted that all the findings of *A. oxycedri* on *P. orientalis* are confined strictly to the Crimea, what makes these data unique. We have found the massive invasion of *P. orientalis* at the Fraternal Cemetary Park at the Nothern Side of Sevastopol (44°38`10.61``N, 33°33`30.17`E; 30-60 m a.s.l.) (Krasylenko, 2014) and local invasion of 5 trees planted on the wayside of New Sevastopol-Yalta Highway at Foros surroundings,(44°24`02.60``N, 33°48`09.52`E; 180 m

a.s.l.) (Yalta City Council) touching by their crones with *J. deltoides* severely infected by *A. oxycedri*. In the same time, *P. orienetalis* trees planted denslely with other conifers (*Cedrus*, *Cupressus*), have not hosted *A. oxycedri.*

Taking into account the fact that *A. oxycedri* in the Crimea mainly prefers two different hosts, both the representatives of native and exotic floras, the genetic heterogenity of the parasite might be asummed. Thus, the comparative amplified fragment length polymorphism (AFLP) analysis revealed two distinct genetic races of lodgepole pine dwarf mistletoe *A. americanum* infecting *Pinus contorta* var. *latifolia* and jack pine *P. banksiana* in different locations in Canada. However, no apparent morphological, embryological or phenological differences among mistletoe from different sourses and hosts were established, what disputes its taxonomical subdivision into distinct genetic races [(Stewart and Ross, 2006)].

3.2. Some Aspects of A. Oxycedri Parasitizing

A. oxycedri exhausts its hosts by pirating carbohydrates and water, reduces growth intensity, seed production ability and lifespan of infected host trees, disturbs host physiology (hormonal imbalance because of the enhanced cytokinin synthesis), provides entrance points for the decay fungi, increases host susceptibility to draught, insects, canker fungi, rodent damage, and, therefore, affects plant morphology [(Hawksworth and Wiens, 1996)]. Juniper dwarf mistletoe infection can be easily revealed macroscopically due to the typical morphological changes (Fig.3).

Though, recent data indicate that symbiotic/mutualistic/pathogenic interactions can contribute to the increased plant resistance or tolerance to abiotic constraints, since common signalling molecules are synthesized by both partners in many symbiotic and pathogenic (viral, bacterial, or fungal infection) relationships and can input into well-tuned host response to the environmental challenges. In particular, the reactive oxygen and nitrogen species (ROS and RNS, respectively) content regulated by (non)-enzymatic antioxidant systems, are supposed to be a key regulators of plant-pathogen interactions [(Rouhier and Jacquot, 2008)], and of parasitic plants-host interplay might not be an exclusion.

On tissue level, dwarf mistletoes develop the endophytic system within the host wood (Fig. 4, A) that anchors the aerial part by basal cups (Fig. 4, B) and extract nutrients from the host by spreading cortical strands and sinkers up to the primary xylem (Fig. 4, A).

In 1-3 years, aerial shoots arise from endophytic system (Fig. 4, E, F). Cortical strands are fine strands of mistletoe endophytic tissue penetrating the host phloem that give rise to aerial shoots and rays of intra-xylemal sinkers. Evident distortion of annual rings and cambial tissues have been observed in the rough cuts of the mistletoe-infected *J. deltoides* peripheral branches (Fig. 4, C, D).

It has to be noted that *A. oxycedri* morhology, anatomy and embryological development have not been studied completely as compared at least to New World dwarf mistletoes (*A. globosum*, *A. americanum*, *A. douglasii*, *A. tsugense*, etc.), since only some aspects including pistillate flowers formation, double fertilization, embryo subtension by 3 endosperm cells, transverse zygotic division, subsequent formation of 2-, 4- and 8-cellular embryos were described earlier [(Scrobyshevski, 1890; Sadik et al., 1986 a,b; Ruguzova, 2002)]. Moreover, the morphological studies aimed to reveal the isophasic parasitism strategy of *A. oxycedri* proposed for dwarf mistletoes species in general by Kuijt [(1960)] and confirmed for common North American dwarf mistletoes (*A. americanum*, *A. pusillum* and *A. douglasii*) as well as for Himalayan endemic *A. minutissimum* [(Lye, 2006)] are of high interest for the Crimean species.

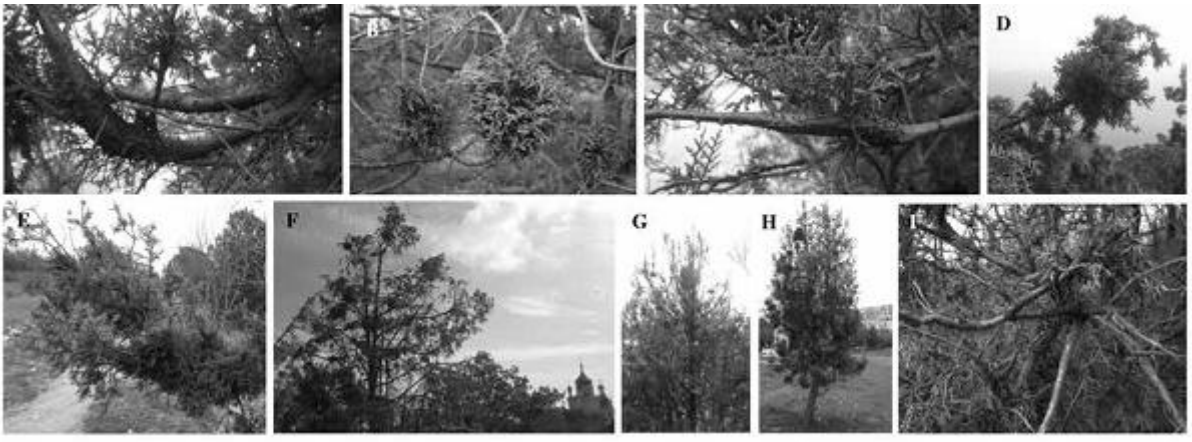

Figure 3. The variety of morphological alterations of *J. deltoides* and *P. orientalis* branches caused by *A. oxycedri* infection: A − fuziform branch swelling; B − lyra-like branch incurvations and terminal thinning of the host branches; C − multiple basal cups formation and host's bark desquamation; D – G − host's crone lighting; H − stunted "bonsai"-like growth; I − general tree regression. Photos were taken by the author.

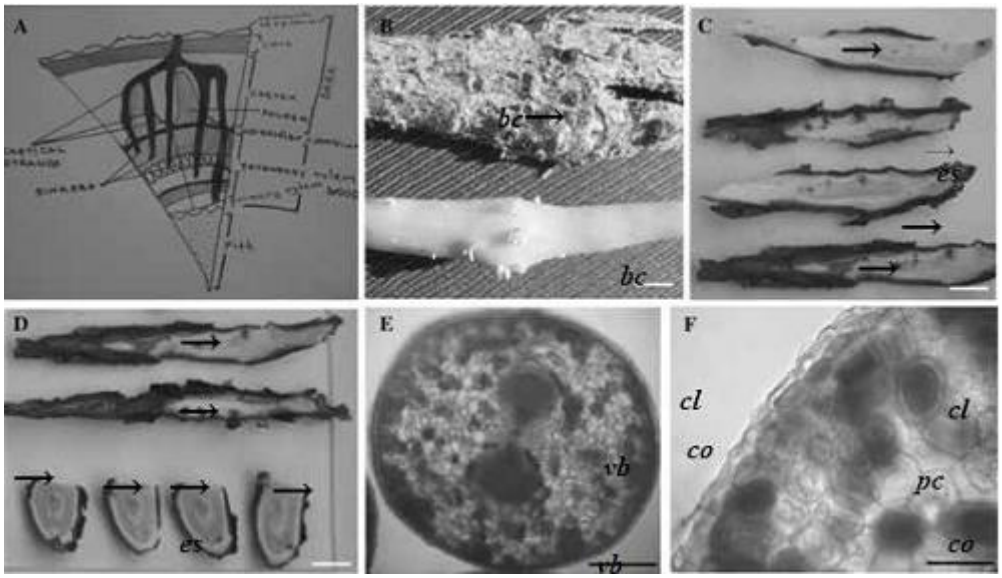

Figure 4. The development of *A. oxycedri* endophytic system and aerial shoots: A – general scheme of *Arceuthobium* spp. infection (adapted from [Hawksworth and Wiens, 1996]); B – *J. deltoides* bark desquamation uncovering basal cups (*bc*). Bar = 2 cm; C, D – rough longitudinal and transverse sections of the mistletoe-infected *J. deltoides* branches: endophytic system *(es)*. Bar = 1 cm; E – transverse section through *A. oxycedri* stem at third internode located distally from the mature leaves: cuticular layer *(cl)*, cortex (*co*), vascular bundles (*vb*). Bar = 500 μm; F – upper stem tissues: cuticular layer *(cl)*, cortex *(co)*, pigment cell *(pc)*. Bar = 200 μm.

In turn, the research of the molecular mechanisms of host-dwarf mistletoes interactions (cell signalling events involving ROS/NO, jasmonate and salicyllic acid, infection-responsive gene expression profiles, cytoskeleton remodelling durung cortical strands formation, etc.) are at the very beginning. One of the promising trends is the study of both host and parasite microtubules/actin microfilaments rearrangement during the establishment of the endophytic system. It is known that cytoskeleton is important for the formation of an apoplastic barrier to arrest pathogen ingress and to facilitate signalling of the presence of symbionts or pathogens on the plant surface [(Schmidt and Panstruga, (2007)]. It is likely that over the next decade the plant cytoskeleton role in signal transduction during the plant response to pathogens and symbionts will be further elucidated [(Takemoto and Hardham, 2004)].

3.3. Introduction of A. Oxycedri into in Vitro Aseptic Culture

Since the control of dwarf mistletoe infections has been hindered by poor knowledge of the parasite biology, its introduction to *in vitro* culture [(Deeks et al., 2002; Martin et al., 2012)] and observation under environmentally controlled conditions will facilitate the elucidation of the signalling cascades regulating host-pathogen interactions and the cell mechanisms of host colonization, e.g. haustoria formation with the involvement of cytoskeleton components. It was confirmed that cut juniper branches infested with mistletoe maintain remain viabile only for a few days at room temperature and approximately a month in a fridge [(Martin et al., 2012)] and its transportation on the host branch submerged into the tap or distilled water for more than 6 h causes the osmolysis making the histological studies complicated. The possibility to cultivate *A. oxycedri* in aseptic tissue culture will favor to a better understanding of its physiology and the anatomy of the inaccessible haustoria, easily obrain DNA/RNA samples and stain actin filaments and microtubules with immunolabeling. To facilitate laboratory studies of this obligate parasite, a modified White's medium developed for the lodgepole pine dwarf mistletoe *A. americanum*, with some modifications was used for the introduction of *A. oxycedri* into *in vitro* culture to initiate callus formation from stem explants [(Deeks et al., 2001; Martin et al., 2011)].

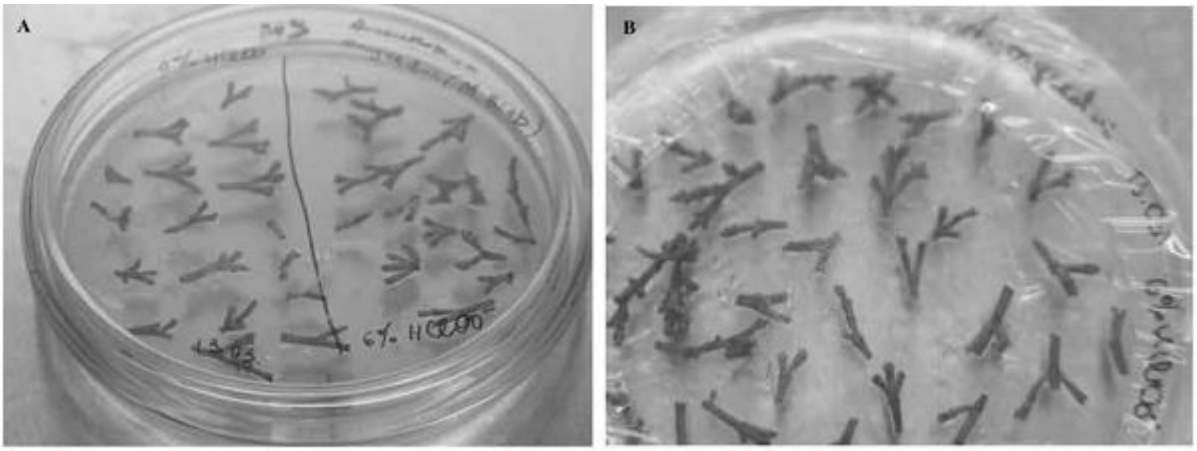

Figure 5. *A.oxycedri* aseptic tissue culture: A – stem explants immediately after the placement on the agarized White medium; B − wound callus development on the cut ends of aerial shoots in 3 weeks after the introduction.

The optimal 0.1 IAA/Kn ratio recommended for *A. americanum* (IAA 0.5 μM/Kin 5 μM) [(Martin et al., 2011)] was not as effective for *A. oxycedri* regeneration as for *A. americanum*, because only superficial wound callus appeared on the cut ends of aerial shoots in 3 weeks after the introduction (Fig.3, B). Therefore, longer time of cultivation, test of different phytohormones ratio, variation in the content of basic vitamins and micronutrients in the medium are required. In turn, the mature seeds displayed 5-month delay in germination and 42% viability on the artificial medium [(Ruguzova, 2002)].

3.4. Basics of Juniper Dwarf Mistletoe Management Strategies in the Crimea

The need to develop preventive and suppressive approaches that have to be ecologically relevant, economically efficient, socially acceptable and adapted to native Crimean juniper forests and planted stands of the representatives from *Cupressaceae* family, is evident. General management actions regarding *A. oxycedri* distribution in the Crimea should combine silvicultural, biological, chemical and "do-nothing" approaches [(Hawksworth et al., 2002; Shamoun and DeWald, 2002; Dorji, 2007)] considering the local specificity of landscapes and the instability of the Crimean environment protection system.

Silvicultural control for slow-growing and restrictedly-spreading juniper dwarf mistletoes, easily detected and strongly confined to definite hosts are efficient and relatively easy in the implementation, since the main actions are pruning, targeted sanitation cutting of the infected host branches bearing aerial *A. oxycedri* shoots and/or shoots theirselves to reduce the population and impact of dwarf mistletoes as well as future inoculums. Moreover, thinning, clear cutting/burning for highly infested trees as the extreme measurement with further replacement with mistletoe-free regeneration, and planting of non-host species in the infected stands (such "buffer zones" are valid only for artificial plant communites) can be used as well. City and suburban areas landscape designers have to follow the recommendations incorporated in local forest management plans about the use *Cupressaceae* or *Pinaceae* species unsusceptible to *A. oxycedri* or, at least, not to plant initially sensitive hosts (such as *P. orientalis*) in the nearest proximity to the infected ones. Forest managers and dendrologists have to realize that the reasons for the complete cutting have to be scientifically proven and sufficiently substantiated. The sad example of the unreasoned cutting is the eradication of *Cupressus sempervirens* L. at the Southern Cost by the directive of I.V. Stalin, who mentioned their "cemetery-like coloration", though officially it was explained that "these trees attract mosquitoes from genus *Anopheles* and favour to malaria progression in the peninsula" [(Zgurovskaya, 1984)].

The other promising trend in *A. oxycedri* study is the search of its potential *biological control* agents among its endophytic fungi, its inter- and intracellular colonialists, and mycoherbicides producers as it was done for European mistletoe *Viscum album* L. [(Varga et al., 2012)]. Moreover, the whole assemblage of fungal species in Eastern pricky juniper consortium and the taxonomic structuring of *A. oxycedri* mycobiota in the Mediterranean and Sub-Mediterranean regions is an issue of high interest. Natural enemies as biocontrol agents does not have to eradicate all the dwarf mistletoe from the entire stand, only to diminish endophytic system and aerial shoots growth. For instance, such aerial shoot fungi as *Colletotrichum gloeosporioides, Cylindrocarpon (Septogloeum) gillii,* and *Caliciopsis (Wallrothiella)* and canker fungi (*Neonectria neomacrospora)* parasitize on pistillate flowers, shoots, and fruits of certain spring flowering species of mistletoes and are associated with dwarf mistletoe cortex and endophytic system [(Hawksworth and Wiens, 1996)]. Insect attacking *A. oxycedri* in Bhutan that potentially can be also employed as biocontrol agents is snout moth *Dioryctria taiella* Amsel.

[(Dorji, 2007)]. It was suggested for the Crimean juniper dwarf mistletoe that its life cycle might be disrupted at the pollination stage by the putative control of thrips [(Ruguzova, 2002)].

Chemical control. Sanitation cuttings of *J. deltoides* infected by juniper dwarf mistletoe is the only, but not optimal method of pest management recommended in Ukrainian phytoquarantine literature [(Maruishkina and Mosyakin, 2006)]; in particular, considering the increased activity of erosion processes in typical *J. deltoides* habitats. Florel® is the only chemical approved by the Environmental Protection Agency for use in controlling dwarf mistletoes that doesn't kill the parasite, but prevents seed production for 1−3 years [(Shamoun and DeWald, 2002)]. Its active ingredient is ethephon, an ethylene-releasing growth regulator that causes mistletoe shoot abscission, however, unable to damage dwarf mistletoe endophytic system, only postponing the parasite resprouting. High-valued trees in recreation, residential, or commercial sites may benefit from applications of ethephon to control dwarf mistletoe spread and intensification. In recent study, the use of three herbicides (Basagran, Roundup and Gramoxone) on *A.oxycedri* brooms at junipers forests in areas located at the East Gorgan state region, North of Iran is presented [(Kavosi et al., 2012)]. Only Basagran in concentration of 0,1 g revealed no toxic effects on the host plant and was relatively effective due to its influence on endophytic system and prevention of *A.oxycedri* sprouting next year after the chemical control [(Kavosi et al., 2012)]. The large-scale screening of herbicides and other pest-controlling chemicals would be very helpful in the Crimea.

"*Do-nothing*", or "no management" approach might be considered in the protected wildlife areas, national parks, wildlife sanctuaries and biological corridors, where old mistletoe-infested trees provide habitats and/or for a variety of insects, fungi and birds [(Dorji, 2007)].

Hence, the development of novel conservative methods of biological control and phytoquarantine approaches instead of sanitation cuttings and common herbicides (Roundup, Basagran and Gramoxone) treatment [(Kavosi et al. 2012)] joined with the selective "do-nothing approach" for the preservation of *J. deltoidess* populations in Crimea is required. The local forest-protecting authorities have to monitor actively the existing infested stands in known localities and prevent further infestation. Forest staffs and phytopathologists have to gain new knowledge and training of juniper dwarf mistletoe world management practice, in order to develop recommendations and to increase the awareness of general public.

4. Conclusions

Therefore, in the the current paper the distribution, host specificity, phenology, pathomorphology and some other characteristics of Old World juniper dwarf mistletoe *A. oxycedri* (DC.) M. Bieb from the Crimea have been briefly reviewed, and these aspects were compared with those of the well-studied New World *Arceuthobium* spp. The importance of juniper dwarf mistletoes for native woodland communities in the Crimea is emphasised, since this species is represented not solely as the phytopathological agent, but also as the important component topically and trophically embedded into ecological system. Further studies are to be specifically addressed to the following issues: mapping of *J. deltoides* and *A. oxycedri* co-distribution in the Crimea, study of the pollinating insects, feeding birds, factors that regulate the duration of *A. oxycedri* life cycle, field trials of some herbicides, search of fungi and insects as the potential agents for *A. oxycedri* biological control as well as the novel electronic and confocal microscopy studies of parasite phenology (double fertilization, fruit development, seed germination, etc.), and cell mechanisms of host colonisation (plant-plant interactions) involving cytoskeleton of both host and parasite.

Acknowledgements

The author expresses her gratitude to O.V. Kukushkin (Karadag Nature Reserve, Theodosia, Crimea) for the help in field research in the Crimea and critical comments of the manuscript as well as to Prof. A.V. Yena (Crimean Agrotechnological University, Simferopol, Crimea), Dr. A.I. Ruguzova and Dr. V.P. Isikov (Nikita Botanical Garden, Yalta, Crimea) for valuable remarks and suggestions. Prof. C. Ross Friedman and Dr. L. Martin (Thompson Rivers University, Canada) expressed the immediate interest to the presented work from its very beginning and helped significantly with the establishment of *A. oxycedri* tissue *in vitro* culture. The author is also grateful to Prof. S.L. Mosyakin (M.G. Cholodny Institute of Botany, Kyiv, Ukraine) for sharing some books and passing *A.oxycedri* sample on *P.orientalis* branch to KW herbarium.

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Education for Biodiversity Inside and Outside Botanical Gardens

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Abstract This paper aims to share the experience of the Botanical Garden "*D. Brandza*" from Bucharest as regards active environmental education through on- and off-site targeted projects. Two key aspects underpinned this work: i) the need for children in urban areas to learn about traditionally cultivated plants that they normally only see in supermarkets, and ii) the need for adults and children from rural areas to learn more about the valuable spontaneous plants growing in protected areas in the proximity of their places of residence. Both aspects were addressed through specific activities carried out in nature, helping those involved acquire a better environmental awareness and new skills. In this respect, between 2011 and 2013 the Bucharest Botanical Garden implemented two environmental pilot projects, with the participation of about 1500 people. The projects helped promote knowledge on plant diversity, volunteering, communication and citizens' direct civic participation in the protection and conservation of plants.

Keywords Plant Diversity, Citizens, Communication, Partnership, Volunteering

1. Introduction

The necessity of ecological education is recognised as a high priority issue for our sustainable future and is stressed in all major international documents addressed to biodiversity conservation(*The Convention of Biological Diversity*, *The Global Strategy for Plant Conservation*, *Agenda 21*, *The European Plant Conservation Strategy*, *CITES*) [Akeroyd et. Al. (1994)]. Education and awareness about plant diversity and the need for its conservation are of fundamental importance in order to foster and promote environmentally responsible citizenship all over the world.

Many questions arise regarding how to best approach this matter: "*Where to do it?*", "*How to do it?*", "*To whom to be addressed?*", "*Which are the best subjects?*", "*Who can do it?*" s.o. There are many players in this field, and botanical gardens continue to play a fundamental role in the provision of environmental education for the children and citizens in general [Willison & Greene (1994)].

Botanical gardens are increasingly seeking to address the contemporary society's need for better environmental education in a variety of creative ways. A successfully trend is to open the botanical gardens to peoples, in many different ways. Building on their knowledge, plant collections and dedicated staff, botanical gardens can provide education for biodiversity not only within their premises, but also outside their gates, thus enabling people who do not live in the proximity of a botanical garden to discover and appreciate the natural treasure of biodiversity.

Starting from this assertion, our contribution will provide as example, the experience of the Botanical Garden "*D. Brandza*" from Bucharest, which developed during the last years, both type of ecological education activities: i) inside the garden (*The Garden of the Granny* project), dedicated to city children and ii) outside (*Natural Networks of Places and People* project), carried on for children and other citizens leaving near protected areas from Romania. In both case, the information received in schools is insufficient and the practical activities related to these subjects are limited.

2. About the Projects

Natural Networks of Places and People project

The environmental education activities carried out outside the premises of the Botanical Garden started in 2012, within the framework of the project *Natural Networks of Places and People*.

This is an European project, part of the Europe for Citizens programme, which was implemented simultaneously in Romania, Bulgaria and Macedonia, during 2012. The project was coordinated by the non-governmental organization Plantlife International and implemented in Romania by the Association of Botanical Gardens in Romania, with the direct support of the Bucharest Botanical Garden [Plantlife (2013)].

The project aimed to stimulate volunteering and engagement of citizens with national and European

environmental policy, through their participation in activities of learning, protection and conservation of plants and habitats with conservative value from Romanian protected areas, located near the communities in which they live. A Romanian working team was created, including botanists from the Bucharest Botanical Garden and citizen volunteers from the local communities included in the project.

Three important Natura 2000 sites from Romania, key hot spots for wild plants, which belong to the European Network of Important Plant Areas [Sârbu et. Al. (2007), Sârbu et. Al. (2009)] and three localities from the proximity of these sites were selected and included in the project: Natura 2000 site Fântâniţa-Murfatlar and the city of Murfatlar, Natura 2000 site Stânca Tohani (Fig. 1) and Gura Vadului commune, Natura 2000 site Bucegi (Fig. 2) and the city of Sinaia.

A number of 308 citizens between 14 and 73 years old were involved in the project activities (Fig. 3). About 50% of them were schoolchildren and young people.

Various types of activities were organised for the citizens of the three local communities: conferences, botanical trips in the protected sites, training of volunteers for the monitoring of important plants from the protected sites, seminars and debates. Particular attention was paid to volunteer children, interested to learn more about the protected plants from their neighbour-hood protected area and about how to recognise them (Fig. 4). A number of 62 schoolchildren were involved in training activities and become able to participate in botanical survey and future monitoring actions addressed to protected plants.

In this respect, four protected plants [Oltean et. Al. (1994)] were selected for each Natura 2000 site involved in the project: *Alyssum caliacrae*, *Echium russicum* (Fig. 5), *Paronychia cephalotes*, *Scutellaria orientalis* (Fig. 6) for the site: Stânca Tohani, *Ajuga salicifolia*, *Linum pallasianum* subsp. *borzaeanum*, *Ononis pussila*, *Paeonia tenuifolia* for the site: Fântâniţa-Murfatlar, *Gentiana lutea*, *Gymnadenia conopsea*, *Scorzonera rosea*, *Trollius europaeus* for the site: Bucegi. Field files with their key indicators [Ciocârlan (2009)] necessary for their recognition were developed and used by the schoolchildren during the practical botanical works (Fig. 7).

In order to enrich the children's knowledge of the value and importance of protected areas and plants in their vicinity, a booklet "*Together for plants*", including botanical information and pictures of the key plants from the three selected Natura 2000 sites, was produced in 2012 and made available for all the citizens involved in the project [Sârbu et. Al. (2013)]. This was a very well received action to spread knowledge about plants and to raise public awareness about the importance of plant conservation.

Figure 1. Natura 2000 site Stânca Tohani, Romania (Photo. Anca Sârbu)

Figure 2. Natura 2000 site Bucegi, Romania (Photo. Anca Sârbu)

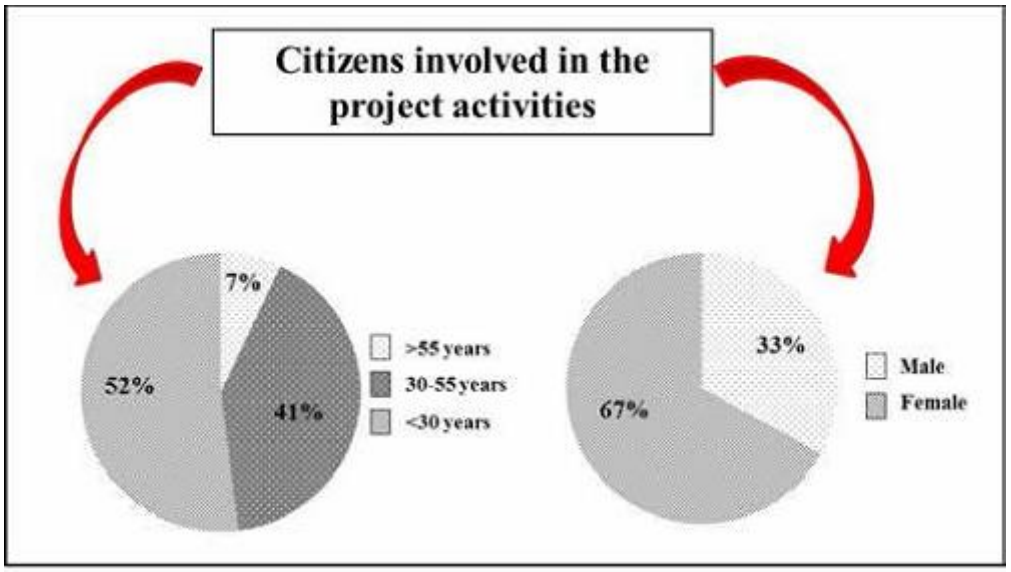

Figure 3. Distribution of the citizens involved in the *Natural Networks of Places and People* project, by age and gender.

Figure 4. A schoolgirl investigating a plant during the guided botanical work in Natura 2000 site Stânca Tohani, Romania (Photo. Anca Sârbu)

Figure 5. *Echium russicum*, Natura 2000 site: Stânca Tohani, Romania (Photo. Anca Sârbu)

Figure 6. *Scutellaria orientalis*,Natura 2000 site: Stânca Tohani, Romania (Photo. Anca Sârbu)

Figure 7. Schoolchildren during a botanical survey conducted at the Natura 2000 site Stânca Tohani, Romania (Photo. Anca Monica Paraschiv)

Granny's Garden project

Granny's Garden is a joint project, implemented by the Botanical Garden "*D. Brandza*" from Bucharest in partnership with the not-for-profit organisation 'Team Work Association'. The project was launched in 2011 and aimed to create a small traditional Romanian domestic garden within the Botanical Garden, for the benefit of children, students, and parents alike.

Why "Granny's Garden"?

The Granny's Garden as a traditional Romanian garden, is a space where visitors can discover directly and in context the different kinds and varieties of plants usually cultivated in rural gardens. Children from the city often miss the opportunity to spend any time in the countryside, in the middle of nature, and they only get to know fruit and vegetables from the market or the supermarket shelves. An another hand, for those adults longing for the freshness and beauty of a countryside garden, the Granny's Garden offers an oasis of traditional plants right in the middle of the urban jungle. Thus the garden is a space for learning and discovery, as well as a space for enjoyment, and a reminder of the value and beauty of traditional, rural gardens.

The garden is also a reflection of the close relationship between man and nature in a rural setting, where the garden plays a vital and well established role and is organised accordingly. From medicinal plants and herbs, to fruit and vegetables, and the flowers scattered in between rows, all plants in the garden have a specific role. The Granny's Garden project has helped reveal to children the importance of the domestic vegetable garden and the need to preserve phyto-diversity by cultivating traditional varieties.

What did the project entail?

The project involved the creation – for information and eco-educational purposes – of a traditional Romanian domestic garden over an area of 1.100 m^2 within the premises of the Bucharest Botanical Garden.

Over 1000 seedlings of vegetables, herbs, medicinal plants, ornamental plants, fruit trees and shrubs were planted on separate layers of small alleys. The space is dedicated to eco-educational activities, and enables children and parents to experience a healthy lifestyle.

What's next?

Granny's Garden is a self-regenerating space. The fruits of each year provide the seeds and plants for the following year. All the maintenance work is carried out by the specialist staff of the Botanical Garden and by volunteers from the Team Work Association. Numerous activities for children are organised regularly in the Granny's Garden: learning about the plants cultivated in the garden (Fig. 8, Fig. 9), seedling work, volunteering for care and maintenance, picking up fruit and vegetables, tasting of the fruit and vegetables from the garden, using the fruit and vegetables for various creative activities (Fig. 10).

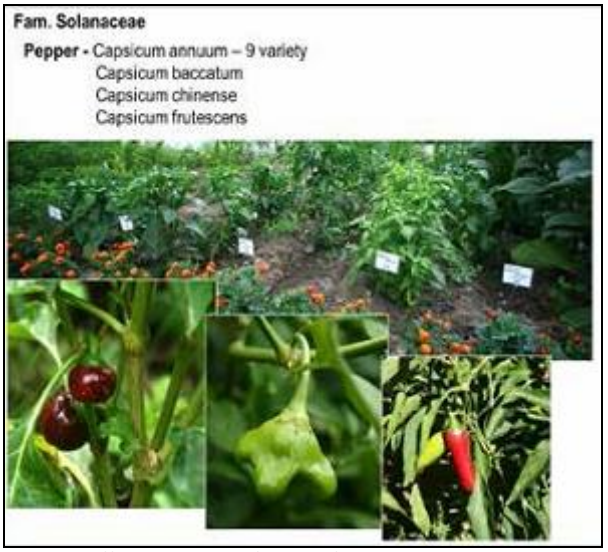

Figure 8. Different varieties of pepper from the *Granny's Garden* (Photo. Petronela Comănescu)

Figure 9. Children inside the *Granny's Garden* (Photo. Petronela Comănescu)

Figure 10. Products of children's creativity using fruit and vegetables from the *Granny's Garden* (Photo. Petronela Comănescu)

Although the project is primarily targeted at children, the students of the Faculty of Biology also benefit from the project, as they get to directly explore the cultivated representatives of some important families studied during their Botany course (Fabaceae, Solanaceae, Brassicaceae), and they can also understand more easily the importance of preserving traditional varieties and see the limits of applied genetic diversity.

Over the last three years, over 1200 children, parents and grandparents have learnt about plant diversity in the traditional domestic garden under the guidance of the specialist staff, and enjoyed all that the well-kept Granny's Garden has to offer.

3. Conclusions

- The two environmental education projects developed inside and outside the Botanical Garden "*D. Brandza*" from Bucharest, were well received by the 1500 citizens of different ages involved in the activities, and were especially enjoyed by school children, teachers and young people.
- These projects offered knowledge, raised awareness and directly engaged various categories of people in practical and diverse activities, offered the opportunity to interact directly with nature and helped promote volunteering.
- For the organisers, the projects emphasised how important is to communicate to and engage the public in assessment and protection of biodiversity, and how much, more people need to know about the natural world they live in.
- The communication with citizens has helped increase their interest in the protection and conservation of the environment, and raised awareness of the necessity to safeguard plants, an indispensable element of our sustainable future.

Acknowledgements

We thank to *Europe for Citizens programme* and to *Foundation for Partnership and MOL Romania* for funding the education for environment projects, implemented by Botanical Garden "*D. Brandza*" from Bucharest.

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Plant Conservation in Ukraine

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Abstract Ukraine is characterized by high diversity of wild flora. Flora of Ukraine is one of the richest in Europe and includes 4523 species of vascular plants. Ukraine occupies 5.7% of area of Europe and it houses 37% of European vascular plants. 9% of species of vascular plants of Ukraine are endemics. There are 611 species of vascular plants in the Red Data Book of Ukraine (Diduch, 2009). The nature reserves funds of Ukraine included around 7790 objects, occupying around 5,7 % territory of Ukraine. Now Ukraine has a good perspective for improving the net of protected areas. All 31 botanical gardens in Ukraine are involved in *ex situ* conservation of plants. The collection of rare and endangered species in the National Botanical Garden harbors 136 species included in Red Data Book. Modeling of the populations of rare and endangered species in artificial forest and steppe communities is an original method of *ex situ* plant conservation.

Kewwords Plant Conservation, Flora, Population, Rare and Endangered Species, Ukraine

1. Introduciton

Ukraine is a part of main European centre of plant diversity in the areas around the Mediterranean and the Black Seas.

Ukraine is characterized by high diversity of wild flora. This richness in plant life owes to a wide variety of ecosystems, including coniferous pine and spruce forests, deciduous oak, beech and hornbeam forests, steppe grasslands, subalpine and alpine communities of the Carpathian Mountains and submediterranean communities of the Crimean Mountains. Flora of Ukraine is one of the richest in Europe and includes 4523 species of vascular plants from 997 genera and 189 families. Ukraine covering 5.7% of area of Europe, houses 37% of European vascular plants (Melnyk, 2000).

Ukrainian natural plant cover has been greatly altered by man's activity. Less that 32% of country has natural or seminatural vegetation. Only 14.3% of Ukrainian territory is covered by forests. The number of threatened native plant species has increased and, at the same time, many newcomers adventives species increased in number. Ukraine is a country with long tradition of nature conservation. The actual goal for modern Ukraine is integration in situ and ex situ conservation.

2. Plant Cover

According geobotanical division (Barbarich, 1977) the territory of Ukarine belong to European deciduous forest region, European forest-steppe region, European-Asiatic steppe region, Mediterranian forest region. Lawland part of Ukraine are occupied 85% country territory. There are three geographical zone on the low-land part of Ukraine.

The zone of mixed forest occupy 19% in northern part of Ukraine in Polisian lawland. Thank to the prevalent of sandy sediments in Polisia the pine and oak-pine forest dominante in landscapes of Northern part of Ukraine. The oak and hornbeam fornbeam forest are occupied more productive gley soil in southern part of Polisia. The alder forests cove fload-plaine. Insular spruce forests are dispose in specific ecoton between forest and boggy ecosystems. Insular spruce forests and durmast oak-forest are rare communities of Polesie. Uncial forest community of this region is pine forest with Rhododendron luteum Sweet.

Southern from Polisia is lesosteppe (forest-steppe) zone characterized by rich soil. In the more humid area gray forest soil is supported for deciduous forests. The fertile chernozem soils are favorable for meadow steppe. Much of the forests and nearly all the steppe transformed into cultivated lands. Oak and hornbeam forests in plato and pine forest in the terraces of the rivers represent forest vegetation of forest steppe zone of Ukraine. The insular beech forests in the eastern limit of area of Fagus sylvatica in Europe are rare forest communities of the lowland of Ukraine.

South of the forest-steppe is the steppe zone, broad grassland zone covering about 40% of the territory of Ukraine. Perennial xerophyte sod grasses of such genera as Stipa, Festuca, Poa, Koeleria, Agropyron and Cares humilis prevail in the steppe of Ukraine. Desert steppe with dominantion of Artemisia grasses is presented on the saline soil in the south of the Black and Azov Seas. Nowadays only in protected areas and unsuitable for agriculture places remain fragments of steppe vegetation.

The vegetation of two Mountains of Ukraine is very

different. Carpathian Mountains characterized by rich diversity of wild flora. This richness in plant life owes a wide variety of ecosystems. Ukrainian Carpathians is characterized by five vegetation belts. The upper limit of submontane belt, being a transition belt between the lowland and the Mountains, varies from 200-600 m a.s.l. This area covered by forest community, mainly oak (Quercetum) in dry, acid habitats and oak-hornbeam forest habitats. Natural woodlands have been replaced by meadow (Arrehenatheretum elatioris) dominates.

The lower mountain belt reaches 400 – 1400 m a.s.l. beechwoods (Dentario glandulosa-Fagetum) prevail and fir forests (Galio-Abietum) are also present. In poor habitats acidophilous fir-spruce forests (Abieti-Piceetum) is considerable. In the flooded valley bottoms along the river, the grey alder bod association (Caltho-Alnetum) occurs.

The upper montane belt rang from 450-1450 m a.s.l. The spruce forests of the order Vaccinio-Piceetalia dominate in this belt.

The subalpine belt with Pinus mugo, Duchekia viridis, Juniperus sibirica, Rhododendron kotschyi shrubs ranges from 1300-1550 m a.s.l. in Gorgany Mts and Chornogora massif.

The alpine belt ranges from 1800-1850 m a.s.l. in Chornogora massif. It is dominanted by high-mountain grassland with Festuca supine, Carex sempervirens, Juncus trifidus.

Mach smaller Crimean Mountains along the Black See in the Crimean peninsula, an extraordinary rich in floristic sense have three vegetation belt different in southern and northern slopes. The southern macroslopes of Crimean Mountains characterized of the three vegetation belts:

1 The lower submediterranean belt (up 400 v) of hemixerophitic Quercus pubescens forests, which in Juniperus exelsa and Pistacia mutica;

2 The middle forest belt (400-800 m) of mesexerophytes and xeromsophytes woods with Pinus pallasiana and temperate with prevailing of Quercus petraea;

3 The upper forest belt (800-1300m) of Fagus sylvatica and Pinus kochiana.

The northem macroslope supports a different group of plant communities:

1 The lower forest belt (up to 400 m) is covered by Quercus pubescens and steppe with domination of Stipa and Festuca species;

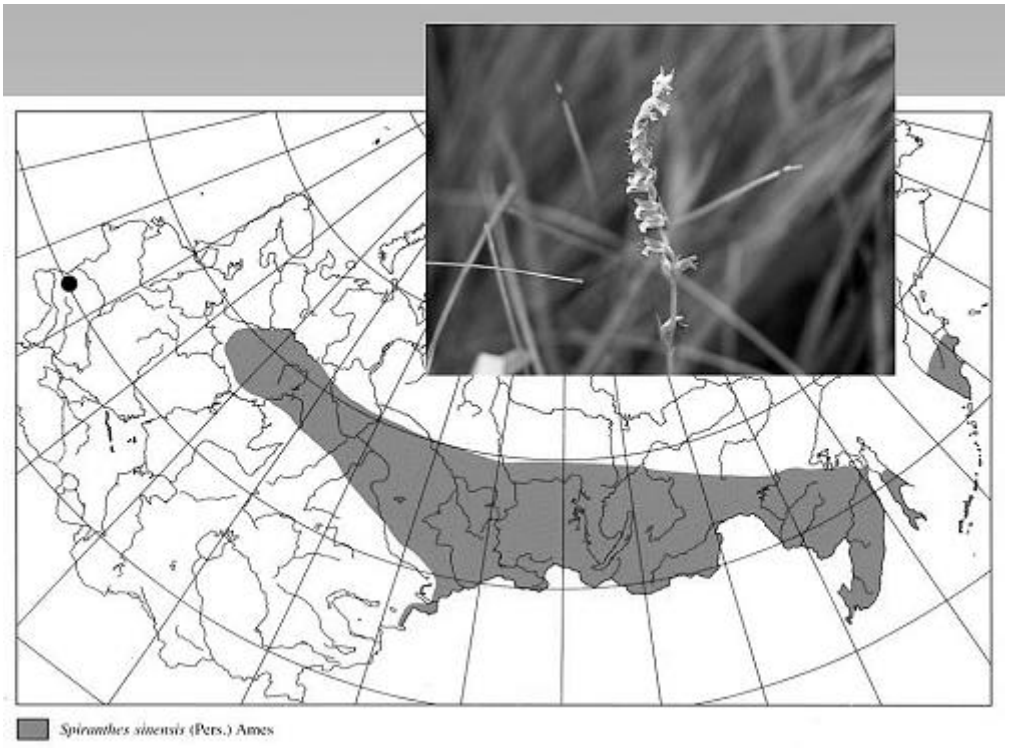
2 The middle forest belt (400-800 m) with temperate broad-leaf forest (Quercus petraea, Carpinus betulus, C. orientallis, Fraxinus exelcior);

3 The upper forest belt (800-1300 m) with prevailing of beech Festuca sylavtica.

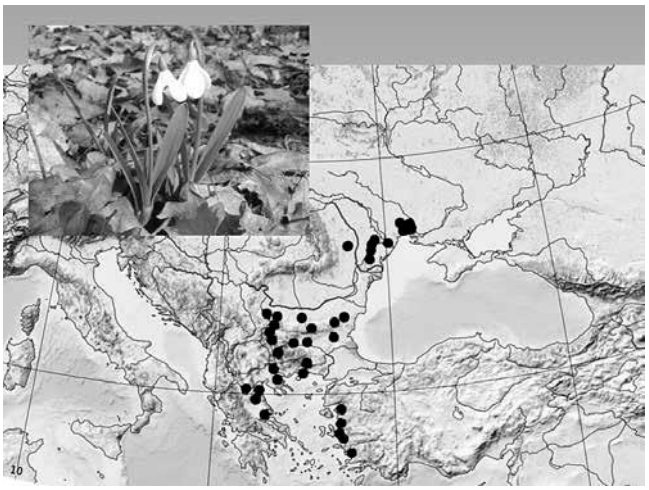
The Quaternary glaciations determined the current flora of Ukraine. The uplands of Ukraine were refuges for some species during glaciation. Many relict species (*Daphne sophia* Kalen, *Daphne cneorum* L., *Euonymus nana* Bieb, *Staphylea pinnata* L., *Sorbus torminalis* (L.) Crantz, *Rhododendron luteum* Sweet, *Gymnospermium odessanum* (D. C.) Takht.) remain to our days in these refuges. The old Tertiary flora of Ukraine was destroyed during glacial time. Some species have survived in Ukraine possibly from the older Pleistocene and they represent glacial relicts. *Aconitum lasiocarpum* (Rchb. Gayer), *Aconitum moldavicum* Hacq, *Alnus incana* (L.) Willd., *Betula humilis* Schrank., *Crocus heuffelianus* Herb., *Linnaea borealis* L., *Salix lapponum* L., *Salix myrtilloides* L., *Woodsia ilwensis* R. Br. are among them (Melnyk 2005).

Nine per cent of species of vascular plants of Ukraine are endemics. The richest centers of plant diversity of Ukraine are mountain regions: Crimean Mountains, occupying only 1.2% territory of Ukraine, occurs 2400 species of vascular plants, and Carpathian Mountains occupying 15% territory of Ukraine, with 2050 species. Both mountain regions are characterized by high endemism. There are 240 endemic species in the flora of Crimean Mountains, and 133 endemic species in the flora of Ukrainian Carpathians (Melnyk. 2000). The are many narrow endemics, known from single localities, for example, *Lepidium turczaninowii* Lipsky endemic of Crimean Mountains. It is known only from one locality in the vicinity of Feodosia town in extreme east of Crimean Mountains by the shore of Black See. This local population accounts to 5000 individuals only.

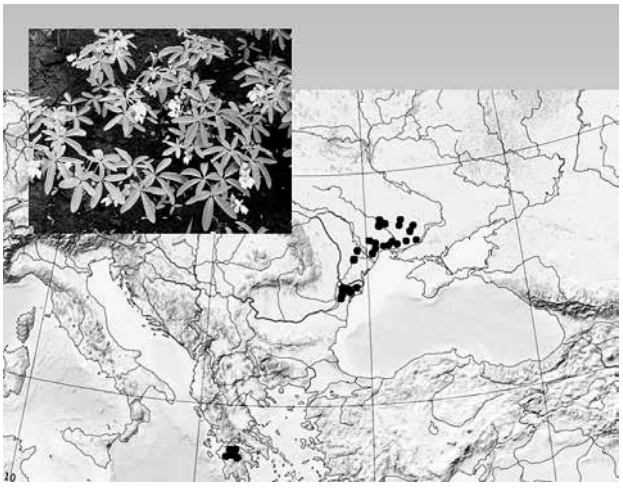
Some endemic species of Ukraine and adjacent territories are tertiary relicts. Unical shrub species *Daphne Sophia* Kalen., known from 20 localities from Middle-Russian Upland (Ukraine, Russia); *Syringa josikala* J. Jacq. ex Rchb., known from 32 localities from Eastern and Southern Carpathians (Ukraine, Romania) are amond its. There are some rare species of Ukraine, not endemics, absent in others region of Europe represent *Spiranthes sinensis* (Persl.)Ames, known from one locality from Lviv region in Ukraine. has large distribution in Asiatic part of area (Melnik, 1995, 2005) (Fig 1)



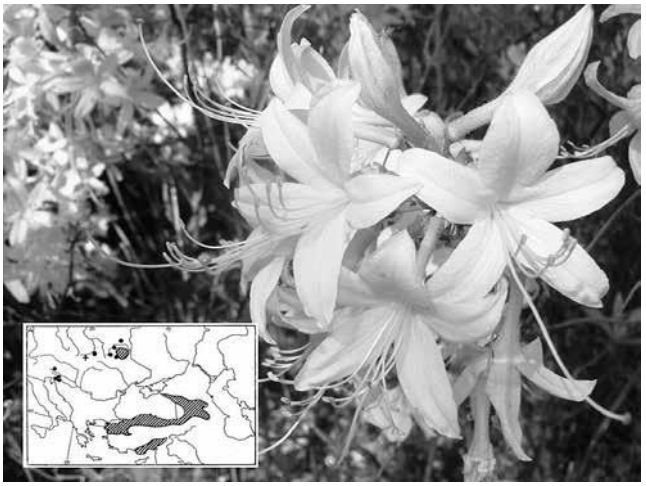
Ames: rare species of European flora, known only from one locality from Ukraine and has large distribution in Asiatic part of area.
Figure 1. *Spiranthes sinensis* (Pers.) Ames



A. - Galanthus elwesii Hook.f.;



B. - Gymnospermium altaicum (Pall.) Spach;



C. - Rhododendron luteum Sweet

Figure 2. Rare European Species common for Ukrainian and Greek floras.

The rare European species *Galanthus elwesii* Hook. f., *Galanthus nivalis* L., *Gymnospermium altaicum* (Pabl.) (Spuch) (*Gymnospermium odessanum*) (DC.) Fakht,) *Rhododendron luteum* Sweet. are common for Ukrainian and Greek floras. (Fig 2)

826 species of plant and mushrooms are included in Red Data Book of Ukraine (Didukh, 2009). 611 species of vascular plants, 46 species of mosses, 60 species of algae, 52 species of lichens and 51 species of mushrooms are among them.

3. In Situ Plant Conservation

The history of plant conservation in Ukraine goes back to 1886, when first Ukrainian natural reserve was founded for protection of the virgin beech forest in Podolian Upland. Famous steppe reserve Ascania-Nova was founded in 1889. On the Natural Reserve fund of Ukraine consists of around 77400 objects oc cupying around 5, 7 % of the territory of Ukraine and include 17 zapovednics, 4 biosphere reserves, 23 national natural parks. 305 zakazniks of state levee and 2997 monuments of nature of regional level. Small protected territory occupy 80 % by quantity from all protected areas.

Zapovednics (strict nature reserves) from one of the most extensive and well tended systems of nature reserves. Nature reserves were strictly protected against any anthropogenic influence. Work and research were purely scientific and educational.

National parks were created to preserve valuable natural, historic and cultural sites, provide tourism opportunities and recreation. Similar to zapovedniki scientific research and ecological education have a high priority.

The most of the small protected areas are used as a good reserves to protected rare and threatened species of plants. 77 rare species including in Red Data Book of Ukraine are only protected in small areas. There are *Selaginella helvetica* (L.) Spring., *S. selagonoides* (L.) Beauv. ex Mart. et Shrank., *Woodsia ilwensis* (L.) R. Br., *Aconitum besserianum*Andrz., *Aquilegia transilvanica* Shur, *Delphinium elatum* L, *Gymnospermium odessanum* (DC)Tacht., *Androsace kozo-poljanski* Ovcz, *Cyclamen coum* Mill. s. l., *Daphne sophia* Kalen., *D. taurica* Kotov, *Spiraea polonica* Blocki, *Doronicum hungaricum* Rchb. f., *Leontopodium alpinum* Gass., *Ligularia sibirica* Cass., *Colchicum fominii* Bordz., *Eremerus spectabilis* M. Bieb s.l., *Galanthus elwesii* Hook. f., *Leucojum aestivum* L., *L. vernum* L., *Iris pineticola* Klokov.

Protected areas occupy 5,7 % territory of Ukraine. It is a very low index for country with high index of plant diversity. As a result, only 2/3 of plant species from Red Data Book of Ukraine (2009) are under protection *in situ*.

Crimean Mountains along the Black Sea in the Crimean peninsula, an extraordinarily rich in floristic sense, has on of the best net of protected territories in Europe, including four reserves (Karadage, Krimskij, Mis Martyan, Jaltinskij and 179 small protected areas. For regret, now Crimean peninsula under Russian occupation is a grey spot in geographical maps. In such circumstance plant protected territories in peninsula are required protection and monitoring from international organization, such us Planta Europa.

Now Ukraine has good perspective to improve the net of protect areas by mean of organization reserves and national parks in hunting territories of former president V.Yanukovich.

4. Ex Situ Plant Conservation

Yet in 1956 famous Ukrainian botanist S. S. Kharkevich (Kotov & Kharkevich 1956) proposed to organize ex situ plant protection in botanical gardens of Ukraine. In 1970 this initiative was put into effect and first in Ukraine plot of rare and endangered plants was opened in National Botanical Garden of Ukrainian Academy of Sciences in Kyiv. Now each of 31 Ukrainian botanical gardens has collection of rare and endangered species.

According to Target 8 of the Global Strategy for Plant Conservation adopted by the Convention on Biological Diversity in 2002, 60% of threatened plant species should be accessible in ex situ collections, preferably in country of origin (Sharrock & Jones 2005). About 81% of species from Red Data Book of Ukraine (2009, Didukh) are represented in collections of rare and endangered plants in Ukrainian botanical gardens.

The largest centre of ex situ plant protection in Ukraine is National Botanical Garden of Ukrainian Academy of Sciences in Kyiv. Into its collections of rare and endangered plants 136 species from Red Data Book of Ukraine (2009) are included. Special aim of creation of this collection was to represent the plants with high risk of extinction in natural habitats. So far, as a great value have the narrow endemics of Ukraine, species known from single localities in Ukraine and

from margins of areas, they are represented in our living collection, e.g. Euphorbia wolhynica Besser ex Racib., Lonicera caerulea L., Iris germanica L., Aconitum lasiocarpum (Rchb.) Gayer, Galanthus plicatus M. Bieb., Galanthus elwesii Hook., Fritillaria montana Hoppe A–C, E–.

In National Botanical Garden in Kyiv rare and endangered species are represented not only in plot 'Rare and endangered species of Ukraine', but also in phytogeographical plots 'Forest of lowland part of Ukraine', 'Steppe of Ukraine', 'Ukrainian Carpathians', and 'Crimean Mountains' occupying 52 ha. These plots are little copies of Ukrainian landscape ecosystems, where is represented all diversity of forest and steppe vegetation of Ukraine. The 60-years old cultivated forest and steppe phytocoenoses are very similar to natural Ukrainian forest and steppe communities. Collection of living plants in phytogeographical plots consists of 1178 species of Ukrainian flora, and include many rare and endangered species.

Important aspect of ex situ plant protection is modeling of the population of rare and endangered species. Unique 60 years cultivated forest and steppe phytocoenoses in the National Botanical Garden are suitable habitats for many rare and endangered species of Ukrainian flora. Rare forest species of Ukrainian flora – Galanthus nivalis L., Galanthus elwesii, Galanthus plicatus, Erythronium dens-canis L. (Fig. 2D), Euonymus nana, Leucojum vernum L. (Fig. 2H), Lunaria rediviva L., Tulipa quercetorum Klokov et Zoz. and rare steppe species Adonis vernalis L., Paeonia tenuifolia L. formed, during many years, stable introductive populations with homeostatic age structure. The populations are very similar in age structure to populations of these species in natural habitats (Melnyk 2000).

Unique achievements of the National Botanical Garden are a good evidence of perspectives of plant populations modeling in cultivated forest and steppe for protection of floristic diversity ex situ. Special attention is given to plant reintroduction. Dianthus hypanicus Andrz. and Silene hypanica Klokov. were reintroduced from botanical garden to former natural habitats in the slopes of Southern Bug river in Mykolaivska region. Now populations of recovered species occupy large place in National Park Bugsky Gard in south of Ukraine.

5. Ukrainian Plant Species in European Red Lists

Plant protection in Ukraine is a part of Pan–European biodiversity conservation. Evidantly, rare species of European importance are priority species for protection in Ukraine and every European country. So far as, the role of European Red Lists are very difficult goal and richness of European flora and different conception conserning extend of biological species. In this connection rare endemic species of Ukraine flora are absent in "European Red List of Globally Threatened Animals and Plants" (1991). Some endemic plant species of Ukraine and adjacent territories (such us *Achillea glabercima* Klok., *Colchicum fominii* Bordz., *Daphne sophia* Kalen., *Dianthus hypanicus* Andrz., *Diplotaxis cretacea* Kotov., *Genista tatragona* Bess., *Lapidium turczaninowii* Lipski, *Pulsatilla grandes* Wenter., *Syringa josikala* J. Jacq. ex Rchb.) are present in "European Red List of Vascular Plants" (2001). For regret this list has many mistanes and blunders. Including to European Red List many weed plants with large ranges and agressive bechavior, such as, *Armoratia rusticana* Gaertn, Mey. et Kit, *Festuca oviana* L., *Melilottus albus* Medik., *Melilottus officinalis* (L) Pall., *Ranunculus flammula* L., *Ranunculus reneps* L., *Raphanus raphanistrum* L., *Urtica dioica* L., (Fig 3) many common hydrophilous plants, such as *Alisma plantago – aquatica* L., *Lemna minor* L., *Lythrum salicaria* L., *Phragmites austrialis* (Gav.) Trin. ex Stend., *Typha angustifolia* L., and ignoring many rare speciesdestroyed the idea of plant conservation in all. In such circumstances improvement of "European Red List" is very actual problem for plant conservation in Pan – European level.

Figure 3. Same "rare" weed species from European Red List (2011)

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Fascination of Plants Day (FOPD) in Ukraine

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Abstract Fascination of Plants Day (FoPD) has been launched in 2012 under the umbrella of EPSO (European Plant Science Organization) and supported by the majority of European, North- and South American, Asian, Australasian and African countries. Ukraine adopted this society-oriented idea and hosted various public events related to basic plant science, agricultural research, nature conservation, biodiversity, education and arts. Many Ukrainian government and public organizations supported and organized FoPD events in 2012 and 2013 as well as the Universities in regional centers, botanical gardens, nature protection areas, colleges, primary schools, artists and media. The scope of local events was broad: open lectures and workshops in plant research centers, international conferences, educational cycles of presentations, topiary art, physiology of flowering and many others), open day in botanical gardens, interactive games for primary school children, literature contest "Verbum de Plantis" and other events. Attendees of the FoPD events from all age groups had the opportunity to visit ecological routs in protected areas, recognize common and rare species with the botanists sharing the principles of field guides use and become informed about the main achievements of plant research in Ukraine.

Keywords Fascination of Plant Day, Plant Biology, Biotechnology, Plant Biodiversity, Botany, Education, Wild Plants

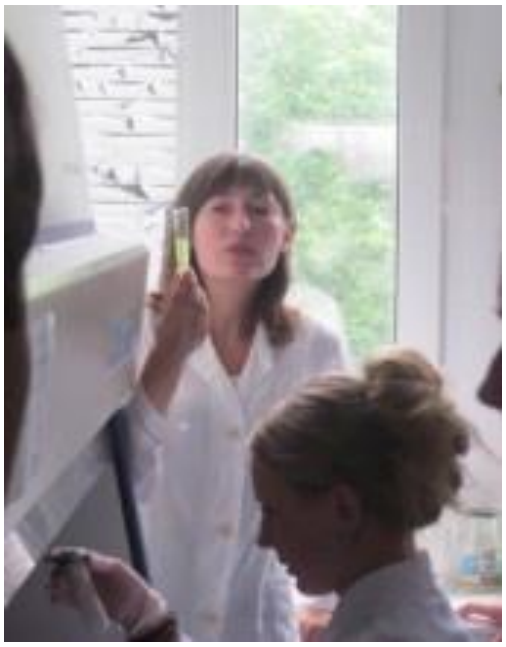
1. Introduction

Many nature-honoring festivals have usually been celebrated in Ukraine for years such as traditional religious (Green May Days, Holy Trinity, Ivana Kupayla, Herbalist's Day, etc.) and newly-appeared professional holidays (Earth Day, Flora Day, Biodiversity Protection Week, etc.). In turn, Fascination of Plants Day (FoPD) cannot become an exclusion: Ukraine has immediately adopted it in May 2012 by efforts of Ukrainian EPSO cluster headed by the Institute of Food Biotechnology and Genomics (IFBG) of Natl. Academy of Sciences of Ukraine (Director − Prof. Dr. Yaroslav B. Blume). This cluster was established earlier under initiative of Prof. Ya. Blume on the basis of four leading institutions from Natl. Academy of Sciences (IFBG, M.G. Khlolodny Institute of Botany, Institute of Plant Physiology and Genetics, M.M. Gryshko National Botanical Garden) and Taras Shevchenko Kyiv National University (Educational and Scientific Centre "Institute of Biology"). Respectively, Prof. Ya. Blume took the responsibility as the National Coordinator of FoPD events in our country and invited Dr. Yulia Krasylenko to become the main Supporting Scientist under the rule of EPSO.

Finally, both FoPD 2012 and 2013 in Ukraine joined more than 20 research, educational and nature protecting institutions from Kyiv, Kharkiv, Lviv, Ostroh, and other cities.

2. Institute of Food Biotechnology and Genomics NAS of Ukraine

Young attendees of the IFBG Open Day events had the opportunity to get involved into the workshop of plant protoplasts isolation (Dr. I. Tanasienko and PhD student O. Burlaka) and discuss hot aspects of plant biotechnology and genetic engineering such as existing ways and new technologies for gene transfer, successful introduction of "green inventions", benefits of the genetically modified plants comparing to chemically-treated ones, potential of transgenic plants for biofuel production, etc. Dr. S. Isayenkov presented a lecture about the progress of biotechnology in the enhancement of plants' resistance to the environmental stresses such as high salinity and drought, and Dr. D. Lytvyn – about the authophagy in plant cells, highlighting the cellular mechanisms of *felo-de-se* in plants. In "20 nm inside the plant cell" workshop (Dr. Y. Krasylenko) all the students prepared their own temporary slides from fresh leaves and petals, tobacco suspension culture BY-2 and tiny tomato seedlings grown in aseptic conditions and explored their samples using fluorescent microscopy. The advantages and research potential of laser scanning confocal microscope was also at the focus during the workshop. At the end of the event participants had a lot of fun dissolving the plant-related quiz performed by PhD students I. Goryunova and S. Plokhovska.



3. M.G. Kholodny Institute of Botany NAS of Ukraine

Prof. Dr. Elizabeth Kordium, Corresponding Member of Natl. Academy of Sciences of Ukraine, prominent Ukrainian scientist in the field of plant cell and developmental biology, organiser of many space experiments including those guided by NASA, gathered many people presenting an open lecture dedicated to plants behaviour under microgravity. Young botanists organized an ecological tour called “Spring Forest Biodiversity” in protected areas 20 km south of Kyiv in the beautiful locality of Koncha-Zaspa. The initial idea was to lead the excursion at “Lisnyky” forest preserve situated on the right bank of Dnieper River uplandsandy terraces andswamps of Vita River (confluent of Dnieper). However, since ecological paths of "Lesniki" preserve ("Holosiyivsky" national park) along the winding riverbed of Vita River were occupied by the hungry mosquitoes at the time of FoPD, the route has been switched to “Zaplavny” preserve in the vicinity of "Lesniki". “Zaplavny” is situated in the area of floodplain of Dnieper River and has a great biological and habitat diversity including meadows and oakeries rich in some rare species of plants and animals. During the first part of the excursion participants were told about the natural history of the area, including the geological processes of the past, forming of the modern biota and aboutrecent history of nature conservation activities in Koncha-Zaspa. After that there came the main part of excursion with a lot of information on local wild plants along with their ecosystem role, medicinal, alimentary and other useful properties. The time we organized this excursion was very rewarding in terms of the variety of plants in blossom. The members of the excursion were very inspiredobserving such beautiful and highly ornamental flowering plants as yellow flag (*Iris pseudacorus*), Siberian iris (*Iris sibirica*), woodbetony (Betonicaofficinalis), salvia species (Salviaverticillata), floweringrush(Butomusumbellatus), globeflower (Trolliuseuropaeus), cranesbill (Geranium sanguineum, Geranium palustre), heartsease and dog-violet (Viola sp.) etc.as well as some blossoming tree and shrub species such as willow (Salix sp.), bird cherry (Padus sp.), hawthorn (Crataegus) and many others. Participants were challenged by trees and herbs recognition observing their stems and leaves as well as typical spring plants including Red Book species (A. Mosyakin). Keen zoologist and naturalist V. Kotsuba commented the ecological status of the investigated area. Plants with medicinal properties (for outer application) and those containing dying substances were also infocus during our walk. Ancient Greek, Ukrainian and Celtic legends about plants and animals were at the background of the excursion. On the encampments everybody could taste herbal tea, learn the principles of plant herbarization (time and way of collection, drying techniques, paper mounting and labeling approaches), see some samples of art-herbariums (Y. Krasylenko) and soft toys made of chamomile-dyed cotton fabric (O. Morgun).

Photo: Dmitriy and Anna Usovy, Anna Veretennyk

ESC Institute of Biology, Taras Shevchenko National University of Kyiv, Department of Plant Physiology and Ecology

Second International celebration of Plant Day was carried out at the Department of Plant Physiology and Ecology, "Institute of Biology" of Taras Shevchenko National University of Kyiv supported by the national organization "Women in Science" and UNDP – GEF. The event launched this year brought together future plant biologists – winners of biological contests, lyceum students and pupils from different Kyiv schools as well as other members of Minor Academy of Sciences and first year biology students.

Workshop on plant anatomy began with the history of plant anatomy teaching at University, outstanding scientists and anatomists of plants – O.V. Brayon and M.F. Bilanovskiy. Everybody was able to take a look on the specimens aged more than 100 years, get acquainted with the structure of microtome and fixing slides. On modern LCD-microscope students were familiarized with the difference in the structure of mono- and dicot plants and tried to master the basics of method microslide cuts. The pigments extraction methods and their chromatographic separation as well as determination of parameters of chlorophyll fluorescence induction in leaves of kalanchoe before and after the thermal stress were demonstrated at the master class on physiology of green leaf. In studies of plant nitrate contents over 20 of the most common vegetables, fruits and herbs were analyzed. Young researchers personally discovered indices and found out that most of nitrate contain vegetables grown in greenhouses - different varieties of lettuce, early cabbage, carrots and radishes. Participants also learned how to calculate the amount of nitrate consumed, as well as became familiar with the basic rules and ways to reduce nitrate levels in plant foods for a healthy and balanced diet.

Quiz, which was held at the event, consisted of two parts: crossword and opportunity to display ones erudition in the knowledge of ornamental plants. The most active and intelligent participants were awarded prizes. Active part in organization of the Second International Plants Day in took part lecturers, researchers form the Laboratory of Physiological Basis of Plant Productivity and postgraduate students (Dr. Prof. N.Taran, Dr. M.Volkogon, Dr. L.Batsmanova, Dr. V.Storozhenko, Dr. O.Kosyk, O.Smirnov, O.Kalinichenko, Dr. V.Belava et al.).

4. Plant Quotes Collection “Verbum de Plantis”

Lina Kostenko, Rabindranat Tagor, Federiko Garcia Lorka, Alexander Dumas, Thomas Mann, Boris Grebenshikov, Paul McCarthey, Iosif Brodsky, Osip Mandelstam, Vladimir Vysotsky, Yasunari Kawabata…Plants-fascinated, we are not alone! Facebook link: https://www.facebook.com/groups/138898152957203/

5. Kharkiv Karazine National University, Department of Plant Physiology and Biochemistry

Within the excursion "Fascination of Flowering: Rododendron Collection and Peonies" to Kharkiv University botanic garden visitors learned the main challenges in modern physiology of flowering (classical hypothesis of flowering, exogenous and endogenous factors of blossom induction, nature and characteristics of floral stimulus (“florigen”, molecular aspects of floral morphogenesis and its phytohormonal regulation). The most inquiring students were invited to attend the cycle of lectures “Systemic regulation of the onthogenesis” at the Department of Plant Physiology and Biochemistry tutored by Dr. O.Avksentyeva. Students had the opportunity to watch 15 min-long episodes from BBC movie «Hidden Plant Life” between their lessons at the University. The highest popularity gained the episodes about plant migrations, survival of the fittest inense of allelopathy and different types of symbiosis.

Presentation “Purpose of studying plants?” as well of poster presentation about their importance prepared by students hooked the attraction of various people visiting the Faculty during that time.

FoPD initiative was also supported by Students Scientific Society and Kharkiv regional department of the Ukrainian Society of Plant Physiologists. The main local organizers of the Fascination of Plants Day even in Charkiv - Dr. Prof. V.Zhmurko, Dr. V.Tymoshenko, Y.Popova, and N.Kupina – hope to start the “celebration tradition” for students, researchers and lecturers of the Biological Faculty.

6. Ivan Franko National University of Lviv, Biological faculty State Natural History Museum NAS Ukraine

The Second International Conference on Plant Morphology "Modern Phytomorphology" joined 258 participants from Ukraine, Poland, Russia, Belorussia, Georgia, Moldova, Azerbaijan, Kazakhstan, Latvia, Slovakia, Romania, Germany, Netherlands, Turkey, India and Albania. The scientific results were represented in 140 publications which were published in two volumes of "Modern Phytomorphology" journal and are available for downloading on the www. phytomorphology.org. From this number, 53 papers are published in English, 45 – in Ukrainian and 42 – in Russian. 48 papers are published in 3rd volume and 92 – in the 4th volume of "Modern Phytomorphology".

The personal participation in the conference took about 100 scientists from Ukraine and other countries. They represented 3 keynote and 33 sectional reports as well as 25 posters. The reports were divided into 4 sections: "Principles of Plant Anatomy and Morphology", "Reproductive Plant Morphology", "Applied Plant Morphology" and "Plant Morpho-Physiology" held on 15 and 16 May. During the conference the hot questions of contemporary morphology of plants and fungi, the problems of processing of the morphological data and its integration with new molecular data along with the application of the morphological analysis to plant and fungi taxonomy were raised. Conference participants underlined that the morphology is an indispensable source of information about pharmaceutical, anti-radiation, ecological, adaptive and decorative values of the plants.

"The special care in the current year had the investigations on applied morphology of higher plants and protection of the introduced plants. The other mainstream was the morphology of the higher plants reproductive organs" – reports the capital organizer of the Conference A. Novikoff, the junior scientist of the Department of Biosystem and Evolution of the State Natural History Museum, NAS of Ukraine.

7. National Nature Park "Homilshanski lisy", ecotourist club "Slidopyty" and ecological organization "Social harmony"

National Nature Park "Homilshansky forests" in Kharkiv region met the participants with the picturesque palette of landscapes: White lake, old birch grove, secular oaks extra-protected by law, Koropovsky excavation, Pavillion of Love with the breathtaking view on Seversky Donets valley, wavy paths and closely clamped foliaceous forest. Research fellow M. Yarotska along with her colleagues and friends organized field quiz with the search of real treasures in the roots, hollow stubs with beaver nibbles, among the patchy flowers with the help of a map, compass and intuition.

8. "Dermansko-Ostrozhsky" National Park

Located in the intersection of three geographical regions – Volhynian uplands, Male Polissia (e.g. Minor Polissia) and Podolian uplands this Park has many unique forest phytocenoses. During the excursion enthusiastic visitors learned some plants typical for this area with O. Golovko. One of the Park special places, the Buschan marsh, has very rich flora that is considered to be one of the largest calcareous fens in Eastern Europe.

9. Floral Motives by Artist Olga Morgun

Plants inspire not only scientists to submerge to their "green profounds", but also artists. Sceneries with sun-drenched fields, tender prairie smokes on watercolors, floristic compositions, Gaudi Casa's, cyanotypes, eucalyptus ecoprints of India Flint, embroidery and Irish lace…Bionics as a joint of nature, science, art and technology…Today we feel the strong need of returning to the "nature cradle", to the roots of our Tree of Life. Using indigo and bundling techniques a young Ukrainian artist Olga Morgun "plants"

Her trees on cotton and linen: http://o1a.livejournal.com/69453.html

10. Comprehensive School of Ozera Village Borodyansky Region

This educational cycle of interactive games, navigated by primary school teacher I. Ilyenko and research fellow G. Bayer, was dedicated to plant biodiversity and allowed curious kids to gain basic knowledge about plants, discover their biological forms, habitats, medicinal and edible characteristics. Such games as ”Mysterious foresters”, ”Marvelous reformers”, ”Green pharmacy”, “Meadow disco” as well as quizzes and painting activities draw to understand the basic “environmentally-friendly” rules of interaction with the environment.

FoPD events in Ukraine were sponsored by the OPTEK company – the Ukrainian representative of Carl Zeiss (Germany), Junker & Partner (Germany), Dr. Heinrich Schneider Messtechnik (Germany), MAHR (Germany), ACCRETECH TSK (Japan), ADCOLE (USA) that provided additional microscopes and financed gifts for the most active participants and photocontest winners.

11. Photo Competition "Plants in Focus"

Best photos of the Ukrainian students, scientists and general public related to all aspects of plants life were organized in online exhibition http://www.facebook.com/groups/228192540621798/:

12. Conclusions and Future Prospects

It could be concluded that Fascination of Plants Day (FoPD) in 2012-2013 was successful and fruitful event in Ukraine. It has united the efforts of many nature-oriented enthusiasts and professionals from different regions of Ukraine representing various institutions, universities, botanical gardens NGOs and other organizations as well as informal creative groups. The activities of FoPD showed the great interest of people to plant science, nature conservation and ecological awareness. Moreover, Fascination of Plants Day has established the unique creative environment for people of science, humanities-minded people and artists working together and discovering the wonderful world of plants form different viewpoints. "FoPD traditions of celebration" give the opportunity to educate "green-minded" people from the early childhood, who will be able to build new well-informed and partnership-oriented society, especially on our way in EU integration.

Furthermore, this all-Ukrainian event is aimed to attract attention of the society to the important issues of plant life as well as nature conservation, since our country has biodiversity-rich national parks, landmarks, biosphere reserves and other protected areas with Red-listed plants and unique landscapes.

We are planning to continue this good tradition of FoPD in Ukraine through the involvement of new creative and talented people, who adore plants from different points of view: scientists, farmers, teachers, artists, florists, landscape designers, representatives of biotechnology companies, and other active members of our society through better coordination of the whole interactive process in 2015. The detailed information and illustrated reports of FoPD-2012 and 2013 in Ukraine could be found at the official EPSO site: http://www.plantday12.eu/ukraine.htm. Welcome to FoPD celebration in Ukraine

Chapter 6 *Protection and Traditional Knowledge*

Botanical Diversity and the Need to Explore the Wild Relatives of Cultivated Plants of Kazakhstan Flora

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Abstract On the basis of the analysis of the biological diversity of flora Kazakhstan the need of studying the wild relatives of cultivated plants was substantiated in this article. The taxonomic analysis of phyto-diversity of the Republic of Kazakhstan was presented. The most valuable plants, relatives of the cultivated plants, were revealed; their significance for the region was explained. The need of the targeted measures for identifying the habitats of plants for their conservation and use was revealed. The research directions were substantiated. The most appropriate locations for the *in situ* conservation – the especially protected natural territories where the habotats of many species of the relatives of cultivated plants is concentrated, were presented.

Keywords Kazakhstan, Botanical Diversity, Wild Relatives of Cultivated Plants, Flora

1. Introduction

Kazakhstan is a transcontinental state situated on the border of Europe and Asia. In the direction from west to east, the country stretches as far as 3 000 km, from north to south – 1650 km. Area of Kazakhstan is more than 2700 square km. Natural and climatic conditions of Kazakhstan are significantly determined by its deep continental location. From north to south: forest-steppe; steppe; desert.

Mountain ridges Altai, Saur, Tarbagatai, Zhungar Alatau, Northern and Western Tien Shan. The highest point of Kazakhstan is the Khan Tengri Mountain (6.995 m), at the frontier with China and Kyrgyzstan. Such a vast territory of Kazakhstan is characterized with a great variety of landscapes.

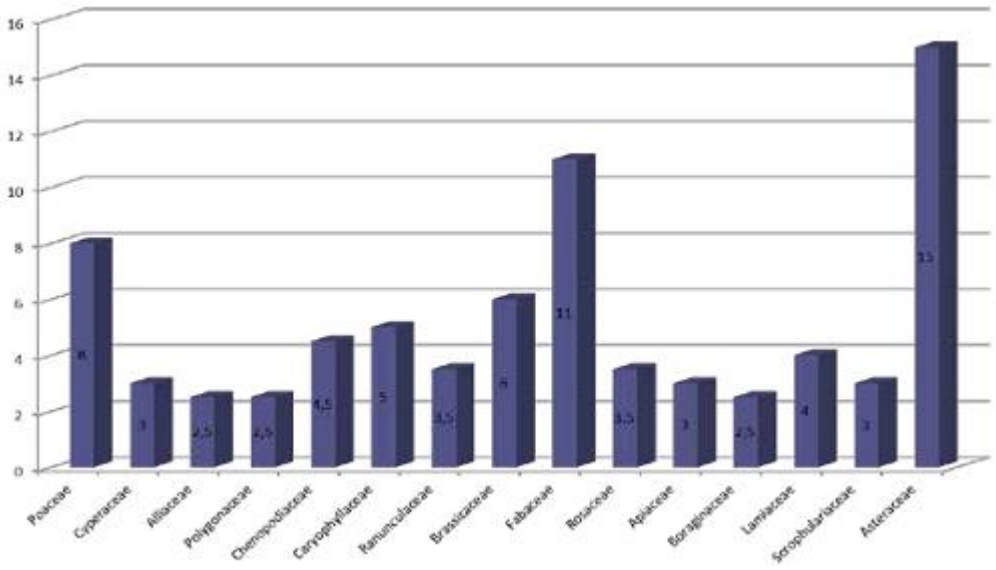

Figure 1. Distribution of species of flora Kazakhstan by the families

More than 13000 plant species grow in the territory of Kazakhstan, including: 5754 species of vascular plants; 5000 species of fungi; more than 2000 species of algae; about 500 species of mosses.

Flora of Kazakhstan is presented by 161 families [Baitenov (2001)], 1118 genera and more than 6000 species of vascular plants. Most of species are belong to such families as *Asteraceae* Dumort. – about 15%, then *Fabaceae*, *Poaceae*, *Brassicaceae*, *Caryophyllaceae*, and *Chenopodiaceae* (Figure 1).

2. Objects of the Research

Objects of the research are the wild relatives of cultivated plants growing on the territory of Kazakhstan. Particular attention is given to endemic species-relatives. Among Embryophyta 14% of the total number of species are endemic species that indicates the originality of Kazakhstan flora. Such endemic species of wild relatives of cultivated plants as Armeniaca vulgaris, Malus sieversii, Amygdalus ledebouriana, Pistacia vera, Berberis iliensis, most of them came into the Red Book of Kazakhstan [(1981)].

South and South-east of Kazakhstan are characterized by the highest percentage of endemic species – over 41% of the total species of the republic. The mountain ridges of Syrdarya Karatau Tau and Western Tien Shan are particular interest. They combine taxa varied by age and genesis.

3. Methods of Study

The methods of collecting the herbarium material [Skvortsov ()], its identification [Flora of Kazakhstan ()] were used. To determine the species habitats the GPS method was used (Global Positioning System).

4. Results of the Research

Richness and diversity of species composition, within Central Asia centre, causes a considerable diversity of wild relatives of cultivated plants.

Specificity of species composition of Kazakhstan flora within Central Asia centre became the basis for its definition by N.I. Vavilov as one of 8 historical-geographical centres of development of cultivated flora. Determining value of genetic centre was reasoned by wild cereal growth including Aegilops species (A. cylindrica, A. triuncialis and A. juvenalis). Besides, in characteristic of genetic centre 42 species of cultivated plants and their wild relatives are adduced. Among indigenous cultivated plants are: Lens, Cicer, Cannabis and lots of fruit plants (Vitis, Pyrus, Malus, Cerasus, Armeniaca etc.).

However, current paces of human development and use of natural ecosystems (expansion of tillable lands, collection of rare and endemic plant species, uncontrolled collection of plants, overgrazing, industrial development, local and global climate change) result to transformation of natural vegetation, threat of botanical diversity loss and first of all loss of relatives of cultivated plants. It is necessary to note that demand in them becomes global.

To save the most valuable representatives of wild relatives of cultivated plants ranking according to their priority is necessary. Defining criteria of conservation are:

Criterion of relationship and economic importance that is determined by:

- Participation in selection process;
- Economic value;
- Systematic proximity to the cultivated species.

Criterion of rarity and vulnerability that joins:

- Endangered species;
- Vulnerable species;
- Rare species.

Species diversity of the Tulipa genus, the most widely represented in the foothill areas. In general, tare 32 wild-growing representatives of the genus. Although Holland is called the country of tulips, species and genetic diversity of these plants are concentrated in Kazakhstan.

The valuable "savages" grow in Kazakhstan such as Malus sieversii, Juglans regia, Hippophae rhamnoides, wild species of Ribes, Rubus, Crataegus, Rosa and Portulaca, Asparagus, Lactuca, etc.;-120 species of Allium genus, including grandparent species representing a wealth of genetic material both at the national and the global level.

A great variety of wild relatives of cultivated plants became the basis for their detailed study in the territory of Kazakhstan. Lately scientists from USA, Holland and Russia showed great interest in the wild relatives growing in Kazakhstan.

Among the wild relatives of cultivated plants in Kazakhstan the main attention focused on study of Armeniaca and Malus sieversii, which is apple cultural ancestor [Dzhangaliyev (1977), Dzhangaliyev, Salova (2007)]. Malus sieversii has high intraspecific diversity, which is crucial for getting new and high resistant cultivars. 12 varieties of apple were described for the territory of Kazakhstan.

28 cultivar-clones of *Malus sieversii* and 16 cultivar-clones of Armeniaca vulgaris were sorted out from natural populations of Kazakhstan. 43 patents were obtained. Kazakhstan genetic resources of *Pistacia vera*, *Amygdalus communis* and *Vitis vinifera* are promising for further study. The most northern areas of these species are located in Kazakhstan. It causes the presence of genetic basis of winter hardiness and cold resistance in their natural populations.

In Kazakhstan, where grain production is one of the main areas of agriculture, identifying the current state of wild relatives of cereal crops is a priority. Currently in the steppe part of Kazakhstan the growth borders of 32 species of particularly valuable cereals are determined [Sitpayeva (2004), Sitpayeva et Al (2004), Sitpayeva (2006)].

Species of the *Aegilops* genus are promising for further study as wild relatives of cultivated cereals. Within the

framework of International cooperation CIMMYT (Mexico) 115 wild plant populations from different phytogeographical regions of Kazakhstan were investigated and 308 seed samples of wild relatives of cereals were collected. Data of Kazakhstan biodiversity integrated by FAO into annual report on plant genetic resources and genetic erosion monitoring.

Problem of collecting, conservation and sustainable use of plant genetic resources and their wild relatives is extremely important at the present stage of development of the world community, as it is directly related to national and global food security.

Meanwhile, there is still no National genebank in Kazakhstan. Taking into account the importance of Kazakhstan biodiversity conservation the program "Botanical diversity of wild relatives of cultivated plants of Kazakhstan as a source of enrichment and gene pool conservation of agro-biodiversity for the implementation of the Food Program" was developed.

The summarized goal of this program is to create a genebank of wild relatives in 5 Republican State botanical gardens located in different phytogeographical areas of Kazakhstan (Figure2).

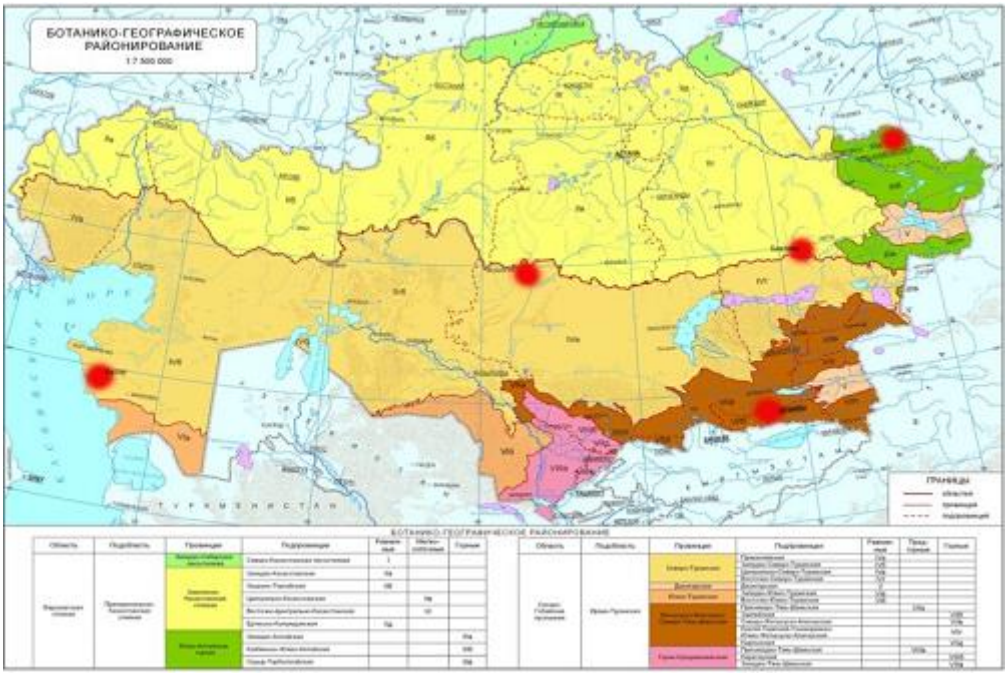

Figure 2. Distribution of botanical gardens on the territory of Kazakhstan

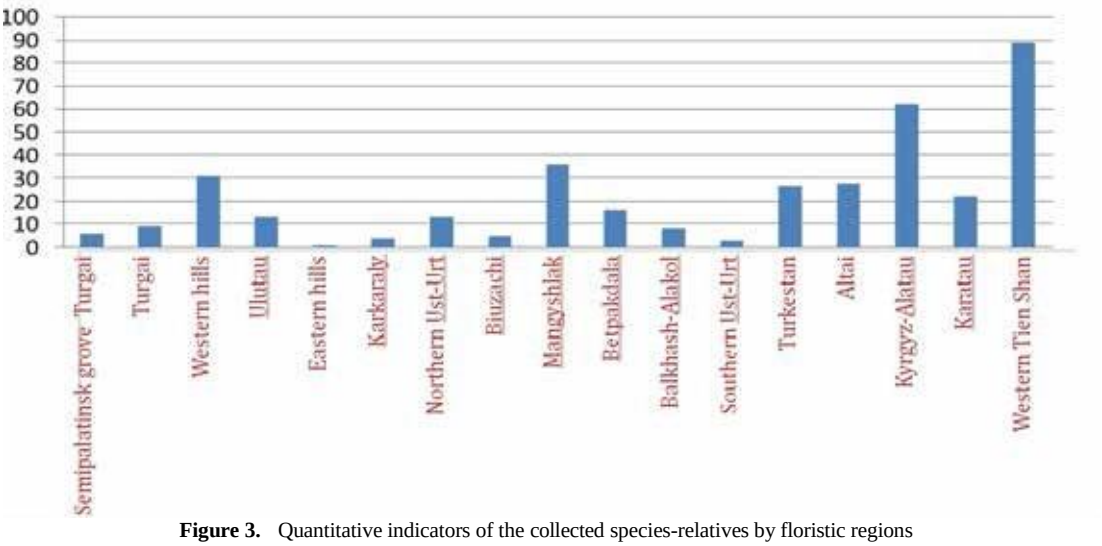

Figure 3. Quantitative indicators of the collected species-relatives by floristic regions

Research areas of wild relatives of cultivated plants:

- Identification of species diversity of wild relatives of cultivated plants;
- Evaluation of phytocoenotic role of wild relatives of cultivated plants;
- Identification of resource potential;
- Detection of pathogens of fungal diseases and evaluation of the extent of damage of wild relatives of cultivated plants;
- Breeding and genetic assessment of wild fruit plants;
- Seed bank arrangement.

In 2013 to collect data on wild relatives of cultivated plants (WRCP) 36 expedition trips were realized. 9 administrative areas and 36 administrative regions of Kazakhstan were investigated. Botanical field studies were conducted within 17 of 29 floristic areas.

Number of collected species of WRCP varies depending on species richness of each floristic region of Kazakhstan. The greatest number of species is represented in Western Tien Shan and Kyrgyz Ala-Tau characterized by high flora diversity (Figure 3).

The most preferred variant for optimal conservation of genetic resources of wild relatives is *in-situ* preservation, maintaining and recovery of viable populations of species in their natural surroundings.

The main objects where conservation of components of biological diversity is planned are especially protected natural territories in Kazakhstan, such as:

- 10 Nature reserves of strict protection (zapovednik)
- 12 State National Parks
- 5 Nature reserves
- 50 nature reserves of seasonal protection (zakaznik).

The results of 2013 showed that the greatest number of species of wild relatives stored in reserves (Aksu-Dzhabagly, 105 species and Karatau, 72 species) and natural parks of South Kazakhstan (Sairam-Ugamsky, 78 species) (Figure 4).

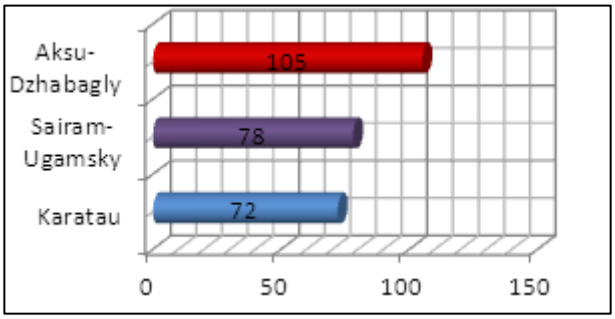

Figure 4. Range of species-relatives in the reserves and natural parks

Many species of WRCP have legal protection status and included into national and regional Red Books: *Allium microdictyon* Prokh, *Allium microdictyon* Prokh. , *Allium pskemense* B. Fedtsch, *Allium longicuspis* Regel, *Allium galanthum* Kar. et Kir., *Pistacia vera* L., *Allochrusa gypsophiloides* (Regel) Schischk, *Armeniaca vulgaris* Lam., *Malus sieversii* (Ledeb.) M. Roem., *Sorbus persica* Hedl, *Vitis vinifera* L., *Artemisia cina* Berg, *Pyrus regelii* Rehd. *Amygdalus petunnikovii* Litv. *Cerasus erythrocarpa* Nevski. *Ex-situ* conservation supposes ability of mobilization and further conservation of plant facilities and restore of populations of selected species in the case of their loss. International and domestic experience of seed banks' arrangement was studied for creating WRCP gene bank in Kazakhstan. For information about seed storage, temperature control, humidity, preparation and processing procedures of seed storage the staff of our Institute visited a number of organizations, such as:

- Bank of living seeds France (Paris, Lyon);
- Bank of genetic resources of the Aegean Agricultural Research Institute (Turkey, Izmir);
- Pannonian Seed Bank (Hungary);
- Russia Scientific Research Institute of Plant Growing (Russia, St. Petersburg)
- Kazakh Scientific Research Institute of Agriculture and Plant Growing (Kazakhstan, Almalybak).

In the Institute of Botany and Phytointroduction since 2013 Seed bank of wild relatives of cultivated plants was organized. Its total area is 150 m^2. All the necessary equipment for conservation of short-term (active) and long-term (basic) collections was purchased. Rooms for seed drying, germination and banking were arranged.

538 samples of wild congeners of cultivated plants from 17 floristic regions of Kazakhstan having food, medicine and forage value were prepared for banking in 2013.

Wild relatives of South Kazakhstan are presented by the largest number of samples (337 samples, 185 species), that is a reflection of the wealth of species diversity in the region.

Topical issue for the desert areas of south-east of Kazakhstan is identifying wild relatives of cultivated plants of woody plants represented by 11 taxa. It is necessary to note that species *Elaeagnus oxycarpa* Schlecht, *Hippophae rhamnoides* L., *Berberis iliensis* M. Pop., *Berberis sphaerocarpa* Kar. et Kir., *B. sphaerocarpa X B. iliensis*, *Lonicera iliensis* Pojark., *Nitraria sibirica* Pall., *Nitraria schoberi* L. are autochthonous.

Information model of species passport of wild relatives of cultivated plants was developed for generalization of collected material. This model includes:

- Systematic affiliation.
- Life form.
- Key diagnostic features.
- Morphology description.
- Terms of flowering and fruiting.
- Ecology.
- General distribution.
- Distribution in Kazakhstan.
- Place of actual registration.
- Characteristics of seed.

Thus, a database that will be created during the program implementation will be a component of Strategy of preservation of world's plant genetic resources and will be the basis for development of the monitoring plan.

Created seed banks and developed recommendations for

conservation and sustainable use of botanical diversity of wild relatives of cultivated plants in Kazakhstan will: - promote development of exchange and use of genetic resources both domestically and internationally; - strengthen the positive scientific and technological image of the country; - and improve the competitiveness of Kazakhstan economy.

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The Dendroflora of the Pirin Mountain (Bulgaria) and its Conservation Importance

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Abstract The paper presents systematic and biological characteristic of dendroflora in Pirin Mountains (Southwestern Bulgaria). The systematic structure of Pirin dendroflora is interpreted in comparison to the flora of Pirin and in Bulgaria. Biological spectrum and biological types of the Pirin dendroflora is presented. The geoelement are analyzed according to the classification of Stefanoff and to the classification of Walter adapted to the Bulgarian conditions. The distribution of tree species was studied regarding their distribution in vertical belts. The conservation importance of the dendroflora for Bulgaria and Europe was discussed according to national and international documents. The full list prepared includes included 216 species of 87 genera and 41 families, with indication about their distribution –in Northern and Southern Pirin, respectively.

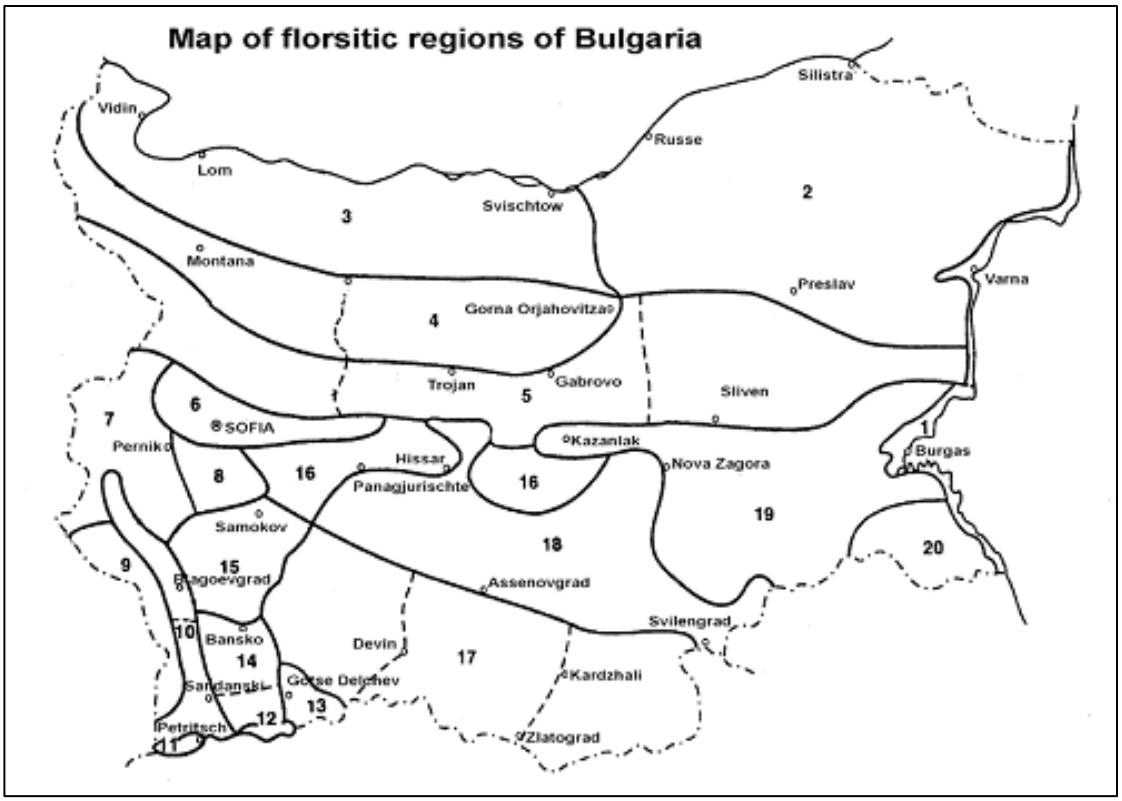
Keywords Dendroflora, Systematic Structure, Conservation Value, Pirin Mountain, Bulgaria

1. Introduction

Pirin is a part of Rila and Rhodopes massif on the Balkan Peninsula, and is situated in the southwestern part of Bulgaria, between the deep valleys of Struma and Mesta (Fig. 1.). The main orographic roof of Pirin is oriented northwest – sout-southeast and is closer to the northeastern periphery of the mountain. Northern part of the mountain is separated from Rila Mountains (15) by the saddle called Predela (1140 m a.s.l.), the southern border is Paril saddle (1170 m a.s.l.) separating it from Slavyanka Mountains (12). The mountain length is about 80 km, and width – up to 40 km, with an area of 2585 km2, more than 30% of which being above 1600 m a.s.l. Pirin is the second highest mountain in Bulgaria (after Rila) and third on the Balkan Peninsula (after Olympus in Greece). Morphographiccally, the territory of Pirin is subdivided into three unequal parts: Northern Pirin – 74% of the total area, Central Pirin – 6,7%, and Southern Pirin – 19,3% of the total area. There are three peaks higher than 2900 m. The mountain has typical configuration with acute peaks in the north, becoming more rounded and less steep to the south.

The climate of Northern Pirin is influenced by the high altitude and its affiliation to the Continental-Mediterranean climatic zone [Bondev, (1997)]. Figures 2 and 3 represents climatograms for the region of the city of Bansko, situated at the foothills north of the mountain, and Vihren hut, situated below the Vihren peak, in the northern part of the mountain, at 1950 m a.s.l. According to the information of climatic station of Vihren hut, (Fig. 3), the mean annual temperature in the region is 3,5°C, maximum one is 12,2°C (August) and the minimum one is -4,7°C (January). Often penetration of wet Mediterranean air masses during the winter causes abundant rainfalls. The mean annual rainfall is about 1500 mm with maximum during the autumn-winter season and minimum during the summer. Pirin is the mountain with highest snowfall in Bulgaria – 472 cm, measured in the region of Vihren hut (1950 m a.s.l.). The July isotherm 10° for the northern slopes of Pirin passes at about 2300 m a.s.l., which determines the alpine tree line in the region [Panayotov, (2006)]. The relatively low annual temperature amplitude is determined by the high air humidity and abundance of streams, rivers and lakes (176 lakes), as well as the strong solar radiation. The deep river glacial valleys and circuses provide conditions for isolation of populations of plant species, which leads to speciation processes. The plant cover of the mountain is subdivided in five altitudinal belts (above the belts of xerothermic oak forests typical for the valleys of Struma (10) and Mesta (13) [Nikolov et Jordanova, (2013)].

The diversity and distribution of geolements and plant communities is determined by the large altitudinal range and by the two types of bedrock – marbles, mainly in the northern part, karst on the northeastern slopes and granites and crystalline schists in the central part, where there are two marble peaks – Orelek and Sveshtnik.



1. The Black Sea coast (North-South), 2. North-Eastern Bulgaria; 3.The Danubian Plain; 4. The Predbalkan (West - East); 5. Stara planina Mt. (The Balkan – West, Central, East); 6. Sofia region; 7. Znepole region; 8. Vitosha region; 9. West Frontier Mt.; 10. The Struma Valley (North-South); 11. The Belasitza Mt.; 12. The Slavianka Mt.; 13. The Mesta Valley; 14. The Pirin (North-South); 15. The Rila Mt.; 16. Sredna Gora Mt. (West-East); 17. The Rhodopes (West, Central, East); 18. Thracian Plane; 19. The Tundja Hilly Plain; 20. The Strandzha.

Figure 1. Floristic regions in Bulgaria (according Bondev, 1966)

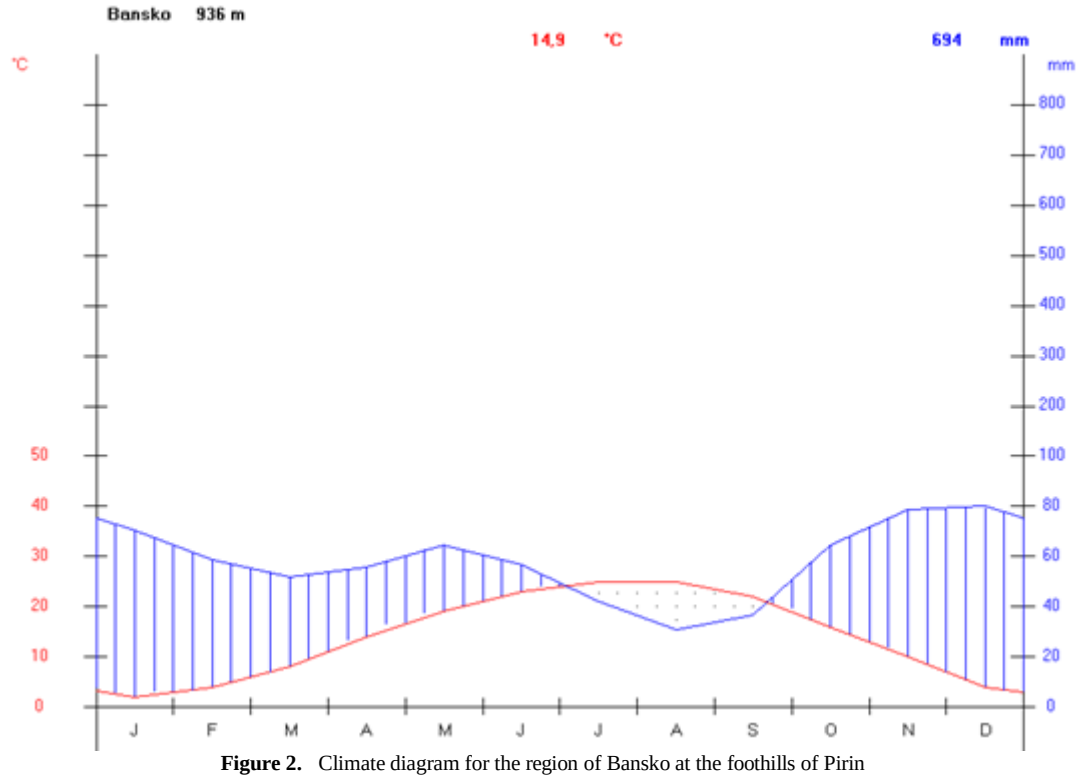


Figure 2. Climate diagram for the region of Bansko at the foothills of Pirin

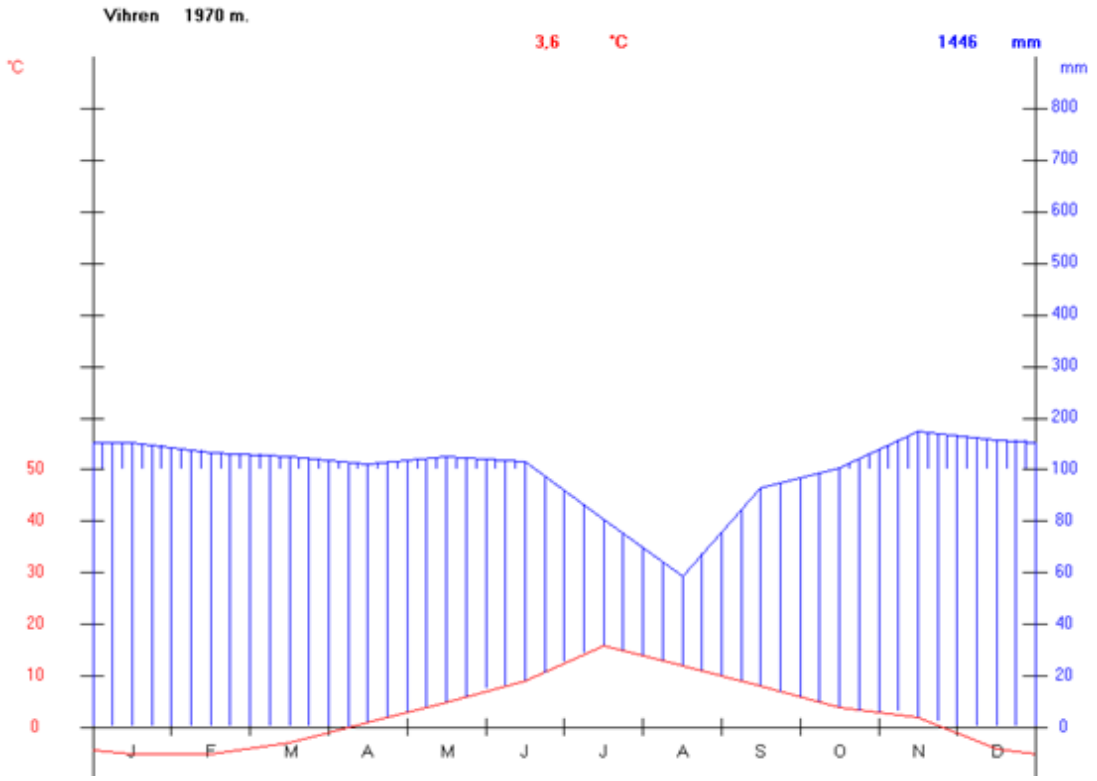


Figure 3. Climate diagram for the region of Vihren hut below the Vihren peak

A large protected territory was declared in Pirin in 1962 – "Vihren" peoples' park, which was renamed to "Pirin" in 1975 and in 1998 was re-categorized as Pirin National Park. Its territory had been continuously enlarged and is currently 40332,4 ha, which is 15,6% of the total mountain area. Also, there are four nature reserves on the territory of Pirin – Bayuvi Doupki-Dzhindzhiritza (1934 – for conservation of natural relic forests of Pinus peuce and P. heldreichii), Tisata (1949 – for conservation of Juniperus excelsa), Orelek (1985 – for conservation of primary beech and P. peuce forests) and Yulen (1994 – for conservation of forest, subalpine and alpine ecosystems). The forests cover about 40 % of the Park territory and the broadleaved occupy only 3%. The most widespread species is Pinus mugo – 5962 ha, followed by Punus peuce – 5415, 8 ha, Picea abies – 2379,2 ha, Fagus sylvatica – 1098 ha and Pinus heldreichii – 893,4 ha

Special studies focused on the Pirin dendroflora are not known. All the information had been gathered and presented within the framework of studies on the Pirin flora, or Bulgarian dendroflora. One of the first floristic and forestry studies was the expedition in 1897 initiated by the Bulgarian Prince Ferdinand I, with the participation of the forest inspector Konstantin Baykushev and the Austrian gardener Johann Kellerer. The plant list accompanying the report of Baykushev contain many interesting species, some of them new to science, for example, Saxifraga ferdinadi-koburgii [Stanev, (2012); Tsavkov, (2013)]. During the expedition the forest inspector K. Baykushev found a very old individual of Pinus heldreichii in Banderitza valley, which is considered today as the oldest coniferous tree in Bulgaria, with a height 22 m., perimeter 7, 8 m (more than 2 m in diameter) and an age more than 1300 years.

The papers reporting floristic studies in Pirin are numerous, but no summarizing information about the arboreal species was published. Kožuharov et Al. (1988) describing the phanerophytic genepool of Bulgarian flora report for Pirin 160 arboreal species. In the "Flora of Pirin" of Kitanov et Kitanov (1990) we were able to find 169 species of 83 genera and 41 families.

The main information sources for the present paper were Conspectus of the Bulgarian vascular flora [Assyov et Petrova Eds. (2012)] and the developed by the authors' database for the Bulgarian dendroflora [Tashev et Tsavkov (2008)]. The information was updated using publications containing new information [Kitanov et Kitanov (1990); Tashev et Al. (2013); Zhelev et Aneva in press]. The presence of Juniperus exelsa, Ficus carica and Platanus orientalis in the mountain, as indicated by Kitanov et Kitanov (1990) was not accepted. We consider that these species could be classified to the floristic region of Struma valley, characterized by lower altitudes and warmer climate with well-expressed Mediterranean influence.

The information in table shows that Pirin flora contains 52 % of species, 67.7% of genera and 76.1% of the families of Bulgarian flora [Assyov et Petrova Eds. (2012)].

To date the dendroflora of Pirin was not subjected to complete and detailed study. The objective of the present study was to characterize the indigenous and introduced dendroflora in the Pirin massif and to present information about the species of conservation importance.

Table 1. Distribution of the species of Bulgarian and Pirin flora and dendroflora by divisions and classes (Magnoliophyta only).

Divisio	Flora		Dendroflora	
	Bulgaria	Pirin Mt.	Bulgaria	Pirin Mt.
Equisetophyta	8	6	0	0
Lycopodiophyta	8	5	0	0
Polypodiophyta	43	30	0	0
Pinophyta	19	13	19	13
Classis Liliopsida	804	413	6	2
Classis Magnoliopsida	3220	1667	407	201
Magnoliophyta Total	4024	2080	413	203
Total	4102	2134	432	216

Based on the database on the Bulgarian dendroflora developed by us [Tashev et Tsavkov (2008)] we found that the arboreal plants of the Pirin are 216 species of 87 genera and 41 families. This accounts for 5.3% of the species, 9.5% of the general and 27.1% of the families of Bulgarian flora and 50 % of the species, 58.8% of the genera and 70% of the families of the Bulgarian dendroflora. The divisio Pinophyta is represented only by 13 species, and Magnoliophyta – by 203 species, of which 2 species belong to classis Liliopsida, while the remaining 201 species belong to classis Magnoliopsida. The first ten most numerous families regarding the arboreal plants include 152 species, or 71.4% of the all dendroflora of the Pirin. These are *Rosaceae* – 56 species (25.9% 33), *Fabaceae* – 27 species (12.5 %), *Salicaceae* – 14 species (6.5 %), *Fagaceae* – 12 species (5.6%), *Pinaceae*, *Caprifoliaceae* and *Lamiaceae* – 8 species each (3.7%) etc. Sixteen families are represented by only one species. The most represented genera are *Rubus* – 18 species (8.3%), *Rosa* – 15 species (6.9%), *Quercus*, *Chamaecytisus* and *Salix* – 10 species each (4.6%), *Sorbus* and *Genista* – 7 species each (3.2%) etc. Fourty six genera are represented by one species only.

According to their biological type (life form) the arboreal plants in Pirin can be classified into 9 groups, five of them transitional. The groups are as follows: trees – 52 species (24.1%), trees or shrubs – 8 species (3.7%), shrubs or trees – 22 species (10.2%), shrubs – 106 species (49.1%), vines – 4 species (1.9%), semi-shrubs – 9 species (4.2%), perennial plants to semi-shrubs – 8 species (3.7%), semi-shrubs to perennial plants and – 5 species (2.3%) and shrubs to semi-shrubs – 2 species (0.9%). According to the classification of Raunkiaer (1934) 172 species (79.6%) are phanerophytes (Ph), 23 species (10.6%) are chamaephytes (Ch) and the transitional categories chamaephytes to phanerophytes (Ch-Ph) are 5 species (2.3%), hemicryptophytes to chamaephytes (H-Ch) are 7 species (3.2%) and chamaephytes to hemicryptophytes (Ch-H) are represented by 5 species (2.3%).

The phytogeographic origin of the 216 species of Pirin dendroflora was determined by means of the Walter classification adapted to the Bulgarian conditions [Assyov et Al. (2012)]. According to this classification, the most numerous are the geo-elements with Mediterranean component of origin – 104 species (48.1%). Among them predominate sub-Mediterranean (*subMed*) – 45 species (20.8%), followed by the Euro-Mediterranean (*Eur-Med*) – 17 species (7.9%), Mediterranean ones (*Med*) – 15 species (6.9%) and Pontio-Mediterranean (*Pont-Med*) – 13 species (6.0%) etc. Second position keeps the group with the European component of origin – 72 species (33.3%). Among them predominate pure European ones (*Eur*) – 22 species (10.2%) followed by the Euro-Asiatic (*Eur-As*) – 18 species (8.3%) etc. Third position keep the elements with Pontian component of origin – 22 species (10.2%). Boreal and subBoreal elements are 21 species (9.8%). The species of Balkan origin are 22 (10.2%) – 9 of them are Balkan endemics (*Bal*) and 2 of them are Bulgarian endemics (*Bul*). The adventive geo-elements (*Adv*) are only 7 species (3.2%). According to the classification of phytogeographic elements of B. Stefanoff (1943), the arboreal plants in Pirin can be classified as follows: 110 species (50.9%) are thermophytes, mesotherms and microtherms of the Mountainous Centre, 40 species (18.5%) are mesotherms and microtherms of Sylvic-Boreal Centre. The thermophytes of the Mediterranean, Northern Continental and Southern Continental Centres are 27, 20 and 6 species, respectively, and the species belonging to other phytogeographic centres are only 7. In the classification according species mobility, the stationary plants completely predominate – 184 species (85.2%). These species are adapted to the more conserved habitats, followed by the mobile and secondary penetrated species – 17 (7.9%) and 14 (6.5%) arboreal plants, respectively. These results indicate the predomination of the autochthonous floristic elements and point out the relatively conserved from anthropogenic pressure dendroflora of Pirin.

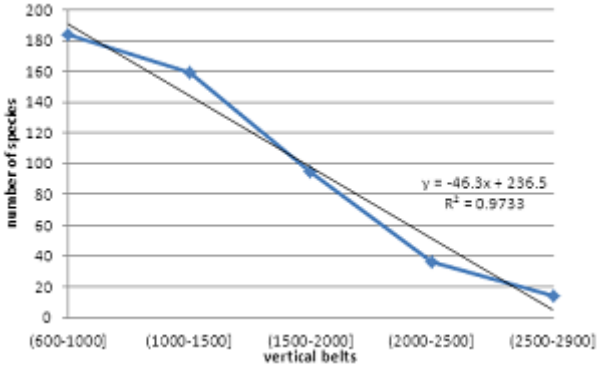


Figure 4. Distribution of number of arboreal species by vertical belts

A substantial part of the Pirin's dendroflora is attributed to the species important from conservation point of view for Bulgaria and for Europe. Total 11 species (5.1 %) are included in the Red Data Book of P. R. Bulgaria [Velchev, Ed. (1984)], of them 8 species (3.7%) with a category "rare", and 3 species (1.4%) – with a category "threatened by

33 The percentages are calculated regarding the number of species of Bulgarian dendroflora.

extinction". In the Red Data Book of R. Bulgaria [Peev, Ed. (2011)] are included 7 species – *Castanea sativa, Convolvulus holosericeus, Daphne cneorum, Empetrum hermafroditum, Rhamnus alpinus and Thymus perinicus*" with category "endangered and *Taxus baccata* with category "criticaly endangered. Nine species (4.2%) are protected according to the Biodiversity Act of Bulgaria (2002), and after the amendment of the same Act (2007), 8 species became protected – *Chamaecytisus ratisbonensis, Convolvulus holosericeus, Crataegus orientalis, Empetrum hermafroditum, Iberis saxatilis, Rhamnus alpinus, Taxus baccata* L. and *Thymus perinicus*. The highest conservation value of the species of Pirin dendroflora has *Taxus baccata* – a species that had been protected in all legislation documents from 1961 to 2007. *Saturea pilosa* is included in the "List of rare, threatened and endemic plants in Europe" (1983) with a category "rare". *Pinus peuce* and *Thymus perinicus* are included in the "1997 IUCN Red List of Threatened Plants" (1998) with a category "rare", too.The dendroflora of Pirin is richest in the ratio of tertiary relic species – 56, or 25.9% of all arboreal species and 4 species are glacial relic – *Empetrum hermafroditum, Dryas octopetala, Salix herbacea* and *S. reticulata.* The medicinal plants in dendroflora of Pirin are 124 and meliferous plants are 159.

The information presented above outlines the unique relic character of the dendroflora of Pirin Mountains. It is of high conservation value for the flora of Europe, too.

Annex 1. Systematic list of the Species of Pirin Dendroflora

Pinophyta: Cupressaceae: *Juniperus communis* L. (N, S[34]), *J. deltoides* R. P. Adams (N, S), *J. pygmaea* C. Koch (S), *J. sibirica* Burgsd. (N, S); **Pinaceae:** *Abies alba* Miller (N, S), *A. borisi-regis* Mattf. (N, S), *Picea abies* (L.) Karst. (N, S), *Pinus heldreichii* Christ (N, S), *P. mugo* Turra (N, S), *P. nigra* Arnold (N, S), *P. peuce* Griseb. (N, S), *P. sylvestris* L. (N, S); **Taxaceae:** *Taxus baccata* L. (N, S).

Magnoliophyta: Aceraceae: *Acer campestre* L. (N, S), *A. hyrcanum* Fisch. et C. A. Mey. (N, S), *A negundo* L. (N, S), *A. platanoides* L. (N), *A. pseudoplatanus* L. (N, S), *A. tataricum* L. (N, S); **Anacardiaceae**: *Cotinus coggygria* Scop. (N, S), *Pistacia terebinthus* L. (N, S), *Rhus coriaria* L. (N, S); Apocynaceae: *Vinca major* L. (N, S); **Araliaceae**: *Hedera helix* L. (N, S); Berberidaceae: *Berberis vulgaris* L. (N, S); **Betulaceae**: *Alnus glutinosa* (L.) Gaertn. (N, S), *Betula pendula* Roth (S), *Carpinus betulus* L. (N, S), *C. orientalis* Mill. (N, S), *Corylus avellana* L. (N, S), *C. colurna* L. (N, S), *Ostrya carpinifolia* Scop. (N, S); **Brassicaceae**: *Aurinia saxatilis* (L.) Desv. (N, S), *Iberis saxatilis* L. (N, S), *I. sempervirens* L. N, S; *Matthiola fruticulosa* (L.) Maire (N, S); **Caprifoliaceae**: *Lonicera caerulea* L. (S), *L. etrusca* Santi (N, S), *L. nigra* L. (N, S), *L. xylosteum* L. (N, S), *Sambucus nigra* L. (S), *S. racemosa* L. (N, S), *Viburnum lantana* L. (N, S), *Viburnum opulus* L. (N, S); **Celastraceae**: *Euonymus europaeus* L. (N, S), *Eu. latifolius* (L.) Mill. (N, S), *E. verrucosus* Scop. (N); **Cistaceae:** *Fumana arabica* (L.) Spach (N, S), *F. procumbens* (Dunal) Gren. et Godr. (N, S), *Helianthemum nummularium* (L.) Mill. (N, S), *Rhodax alpestris* (Jacq.) Fuss (S), *Rhodax canus* (L.) Fuss (N, S); **Convolvulaceae**: *Convolvulus holosericeus* M.Bieb (N, S); **Cornaceae**: *Cornus mas* L. (N, S), *C. sanguinea* L. (N, S); **Empetraceae**: *Empetrum hermaphroditum* L. (N, S), **Ericaceae**: *Arctostaphylos uva-ursi* (L.) Spreng. (N, S), *Bruckenthalia spiculifolia* Reichenb. (N, S), *Vaccinium myrtillus* L. (N, S), *V. uliginosum* L. (N, S), *V. vitis-idaea* L. (N, S); **Fabaceae:** *Amorpha fruticosa* L. (N, S), *Astragalus angustifolius* Lam. (N, S), *A. gladiatus* Boiss. (N, S), *Chamaecytisus absinthioides* (Janka) Kuzmanov (N, S), *Ch. albus* (Jacquet) Rothm. (N, S), *Ch. ciliatus* (Wahlenb.) Rothm. (S), *Ch. glaber* (L.f.) Rothm. (N, S), *Ch. hirsutus* (L.) Link (N, S), *Ch. jankae* (Velen.) Rothm. (N, S), *Ch. lejocarpus* (A. Kern.) Rothm. (N), *Ch. ratisbonensis* (Schaeff.) Rothm. (N, S), *Ch. rochelii* (Wierzb.) Rothm. (N, S), *Ch. supinus* (L.) Link (N, S), *Chamaespartium sagittale* (L.) Gibbs (S), *Colutea arborescens* L. (N, S), *Coronilla emerus* L. (S), *Corothamnus agnipilus* (Vel.) Klask. (N, S), *Corothamnus rectipilosus* (Adam.) Skalicka (N, S), *Genista carinalis* Griseb. (N, S), *Genista depressa* M. B. (N, S), *Genista januensis* Viv. (N, S), *Genista ovata* Waldst. et Kit. (N, S), *Genista rumelica* Vel. (N, S), *Genista subcapitata* Panč. (N, S), *Genista tinctoria* L. (N, S), *Robinia pseudoacacia* L. (N, S), *Spartium junceum* L. (N, S); **Fagaceae:** *Castanea sativa* Mill. (N, S), *Fagus sylvatica* L. (N), *Qu. brachyphylla* Kotschy (N, S), *Qu. cerris* L. (S), *Qu. dalechampii* T. Ten. (N, S), *Qu. erucifolia* Steven (N, S), *Qu. frainetto* Ten. (N, S), *Qu. longipes* Steven (S), *Qu. pedunculiflora* C. Koch (N, S), *Qu. polycarpa* Schur (N, S), *Qu. pubescens* Willd. (N, S), *Qu. virgiliana* (Ten.) Ten. (N, S); **Globulariaceae:** *Globularia cordifolia* L. (N, S); **Hypericaceae:** *Hypericum olympicum* L. (N, S); **Juglandaceae:** *Juglans regia* L. (N, S); **Lamiaceae:** *Satureja cuneifolia* Ten. (N, S), *Satureja pilosa* Velen. (N, S), *Teucrium chamaedrys* L. (N, S), *T. montanum* L. (N, S), *T. polium* L. (N, S), *Thymus perinicus* (Velen.) Jalas (N, S), *T. pulegioides* L. (N, S), *T. thracicus* Velen. (N, S); **Loranthaceae:** *Arceutobium oxycedri* (DC.) Bieb. (N, S), *Loranthus europaeus* Jacq. (N, S), *Viscum album* L. (N, S): **Oleaceae** *Fraxinus ornus* L. (N, S), *Jasminum fruticans* L. (N, S), *Ligustrum vulgare* L. (N, S), *Phillyrea latifolia* L. (N, S); **Pyrolaceae:** *Orthilia secunda* (L.) House (N, S); **Ranunculaceae:** *Clematis flammula* L. (N, S), *C. recta* L. (N, S), *C. vitalba* L. (N, S); **Rhamnaceae** *Frangula alnus* Mill. (N, S), *F. rupestris* (Scop.) Schur (N, S), *Paliurus spina-christi* Mill. (N, S), *Rhamnus alpinus* L. (N, S), *Rh. catharticus* L. (N, S), *Rh. saxatilis* Jacq. (N, S); **Rosaceae** *Amelanchier ovalis* Medicus (N, S), *C. integerrimus* Medicus (S), *C. nebrodensis* (Guss.) C. Koch (N, S), *Crataegus monogyna* Jacq. (N, S), *C. orientalis* Pall. ex Bieb.

34 – N in brackets means that the species occurs in Northern Pirin floristic subregion, and S – the species occurs in Southern Pirin floristic subregion.

(N, S), *Dryas octopetala* L. (N, S), *Malus dasyphylla* Borkh. (S), *M. praecox* (Pall.) Borkh. (N, S), *M. sylvestris* Mill. (N, S), *Prunus avium* L. (N, S), *P. cerasifera* Ehrh. (N, S), *P. cerasus* L. (N, S), *P. spinosa* L. (N, S), *Pyrus amygdaliformis* Vill. (N, S), *P. nivalis* Jacq. (N, S), *P. pyraster* Burgsd. (N, S), *Rosa agrestis* Savi (N, S), *R. caesia* Sm. (S), *R. canina* L. (N, S), *R. corymbifera* Borkh. (N, S), *R. dumalis* Bechst. (N, S), *R. gallica* L. (N, S), *R. glauca* Pourret (N, S), *R. heckeliana* Tratt. (N, S), *R. micrantha* Borrer ex Sm. (N, S), *R. myriacantha* DC. ex Lam. et DC. (N, S), *R. pendulina* L. (N, S), *R. pulverulenta* M. Bieb. (N, S), *R. tomentosa* Sm. (N, S), *R. turcica* Rouy (N, S), *R. vosagiaca* Desportes (N, S), *Rubus anoplocladus* Sudre (N, S), *R. caesius* L. (N, S), *R. canescens* DC. (N, S), *R. crassus* J. Holuby (N, S), *R. discolor* Weihe et Nees (N, S), *R. euryanthemus* W. Watson (N, S), *R. glandulosus* Bellardi (N, S), *R. guentheri* Weihe et Nees (N, S), *R. hirtus* Waldst. et Kit. (N, S), *R. idaeus* L. (N, S), *R. lloydianus* Genev. (N, S), *R. minutidentatus* Sudre (N, S), *R. miostilus* Boulay (N, S), *R. sanguineus* Friv. (N, S), *R. saxatilis* L. (N, S), *R. scaber* Weihe et Nees (N, S), *R. serpens* Weihe ex Lej. et Court. (N, S), *R. thyrsanthus* Focke (N, S), *Sorbus aria* (L.) Crantz (N, S), *S. aucuparia* L. (N, S), *S. chamaemespilus* (L.) Crantz (N, S), *S. domestica* L. (N, S), *S. graeca* (Spach) Kotschy (N, S), *S. torminalis* (L.) Crantz (N, S), *S. umbellata* (Desf.) Fritsch (N, S); **Rutaceae:** *Dictamnus albus* L. (S); **Salicaceae:** *Populus alba* L. (N, S), *P. canescens* (Ait.) Sm. (N, S), *P. nigra* L. (N, S), *P. tremula* L. (N, S), *Salix alba* L. (N, S), *S. caprea* L. (N, S), *S. cinerea* L. (N, S), *S. fragilis* L. (N, S), *S. herbacea* L. (S), *S. purpurea* L. (N, S), *S. reticulata* L. (N, S), *S. silesiaca* Willd. (N, S), *S. triandra* L. (N, S), *S. waldsteiniana* Willd. (N); **Santalaceae:** *Comandra elegans* (Rochel ex Reichenb.) Reichenb. f. (N, S); **Saxifragaceae** *Ribes alpinum* L. (N, S), *R. petraeum* Wulfen (N, S); **Scrophulariaceae:** *Veronica kellererii* Degen et Urum. (N, S); **Simaroubaceae:** *Ailanthus altissima* (Mill.) Swingle (N, S); **Solanaceae:** *Solanum dulcamara* L. (N, S); **Staphyleaceae:** *Staphylea pinnata* L. (N, S); **Thymeleaceae** *Daphne cneorum* L. (N, S), *D. mezereum* L. (N, S), *D. oleoides* Schreb. (N, S); **Tiliaceae:** *Tilia cordata* Mill. (N, S), *T. plathyphyllos* Scop. (N, S), *T. tomentosa* Moench (N, S); **Ulmaceae:** *Ulmus glabra* Huds. (N), *U. minor* Miller (N, S); **Liliopsida**:**Liliaceae:** *Ruscus aculeatus* L. (N, S), *R. hypoglossum* L. (N, S)

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Chapter 7 *Taxonomy and Wild Plant Biology*

Contribution to the Study of Marine Plankton in Bejaia Gulf

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Abstract Plankton is very important not only for aquatic life, but also for the whole planet. Made of living organic producer matter, phytoplankton is also a major source of oxygen. It is the basis of complex food webs that provide most of the biological functioning of the seas and oceans which lead to particular fish. These provide livelihoods for millions of people. This work is done in the Gulf of Bejaia (north-east Algeria). It is a contribution to the study of biodiversity of marine plankton in the region. Observations allowed us to identify 62 taxa of phytoplankton belonging to 19 families and 8 classes and divided into: 03 Cyanophyceae, 02 Euglenophyceae, 16 Dinophyceae, 01 Dictyochophyceae, 26 Diatomophyceae, 03 Ulothricophyceae, 10 Chlorophyceae and 01 Rhodophyceae. Among these families, Diatomophyceae (26.31%), Dinophyceae (21.05%) and Chlorophyceae (21.05%) remain the richest in species. They are dominated by the genera Chaetoceros, navicula; Ceratium and Scenedesmus. Concerning the zooplankton, we identified 17 genera belonging to four different branches. The majority of genera are represented in the phylum Arthropoda, which accounts 10 genres. They are dominated by Copepods, Euphausids and Decapods. The remaining types are divided into 04 Protozoa, 02 Tunicates and a unique gender of Annelids. The results which are sill fragmentary, show a big diversity that should not be overlooked. They are a starting point for studies on marine plankton in the Gulf of Bejaia which is so far rarely addressed. Furthermore, an analysis of the chemical composition of water should be avoided to understand more about the effect of environmental factors on the population dynamics and see their influence on the distribution of plankton in the Gulf of Bejaia.

Keywords Plankton, Gulf of Bejaia (Algeria); Biodiversity

1. Introduction

Plankton is the whole living pelagic characterized by their passivity toward the movement of water mass [Peres (1976)]. It has a vegetable fraction, the phytoplankton which is the origin of the organic products and the animal fraction, the zooplankton take a key place, because it is at the interface between the autotrophic and the big heterotrophic [Banse (1995)].

Algerian coast has been the subject of many studies in the field of planktonology, as an example those achieved in Algiers Bay, which led to an assessment series of seawater fertility and plankton diversity [Aourach et khelifi (1997) et Dadi (2002)]. In Bejaia Gulf, any study has been done and plankton remains unexplored. The purpose of the present work is to contribute to the knowledge of the diversity of marine flora and micro fauna of Bejaia Gulf.

2. Materials and Methods

Many samples were collected in Bejaia gulf (east coast of Algeria) (Fig. 1), between April and June 2010. Six sampling points were selected following two radial (Fig. 2).

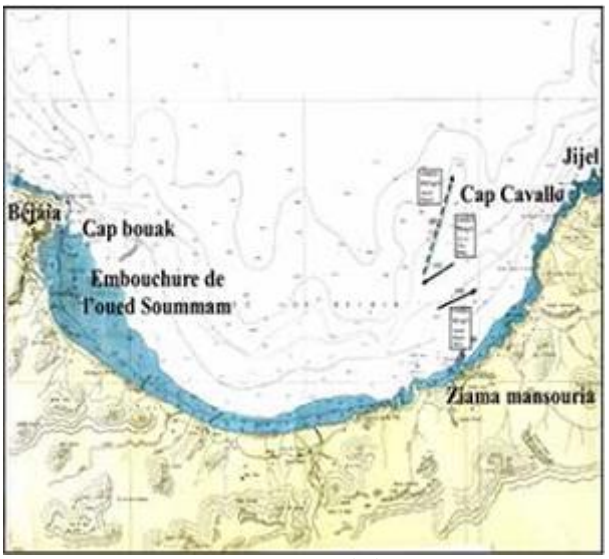


Figure 1. Location Gulf of Bejaia

Figure 2: Location of sampling points

For the crop, we use plankton net of 25 µm of empty meshes which has a collector at its lower end. At the same time, we measured the pH, the dissolved oxygen, the air temperatures and water salinity using multi-parameters. GPS was also used to establish the position and the location of sampling points

The collected samples are placed in bottles and they are transported in icebox to the Hydrobiology laboratory of the University of Bejaia.

Some of samples are observed directly in the fresh state. Another is fixed in formalin 35% and kept away from light for further follow-up observations.

The crop observations were made by light microscopy. A digital photographic camera was also used for the representation of different taxa. On average of twenty preparations per sample was examined with several photographs which permit us to identify the different forms.

3. Results

a) Physical and chemical characteristics of crops points

-***Temperature***: The water medium-temperatures measured during the harvest ranged from 19.78 to 23.98 ° C. This increase is related to the air temperature evolution which influences directly the superficial mass water temperatures.

-***Salinity***: The measured salinities have little fluctuation. The average is of 31.2 ‰ except for Oued Soummam's mouth which recorded a salinity of 15 ‰ (brackish water).

-***Dissolved oxygen***: The average of measured content is 4.97 mg / l. The sampling point 3 which is characterized by turbid water and mud smell recorded the lowest content which could be explained by neighboring activities discharges (03.5mg / l).

-***Potential hydrogen***: The pH of the water is approximately the same, with an average of 7.59.

b) Composition of plankton communities

Despite the short duration of crops, the water samples taken in Bejaia Gulf proved to be very interesting. They identified 83 different taxa, including 62 phytoplankton taxa and 21 zooplankton taxa (Fig.3).

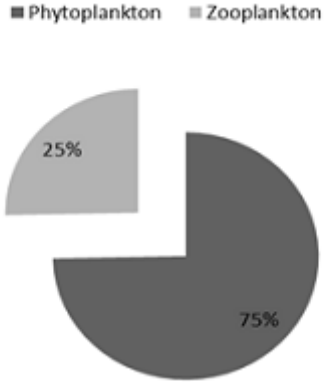


Figure 3. Taxonomic composition of plankton communities

c) Phytoplankton communities (Plate 1)

62 different taxa were identified in the prospected area in Bejaia Gulf (May-June 2010); 08 on a level with species by 13% of the whole. It concern: Prorocentrum micans, Ceratium fusus, Cyclotella meneghiniana, Bacteriosira fragilis, Fragilaria crotenensis, Enteromorpha flexuosa, Scenedesmus quadricauda, Ceramium floridanum.

These 62 taxa are divided into the following 08 classes: 03 Cyanophycaea 02 Euglenophyceae 16 Dinophyceae, 01 Dictyochophyceae, 26 Diatomophyceae, 03 Ulothricophyceae, 10 Euchlorophyceae, 01 Rhodophyceae. Figure 4 summarizes the distribution of different branches.

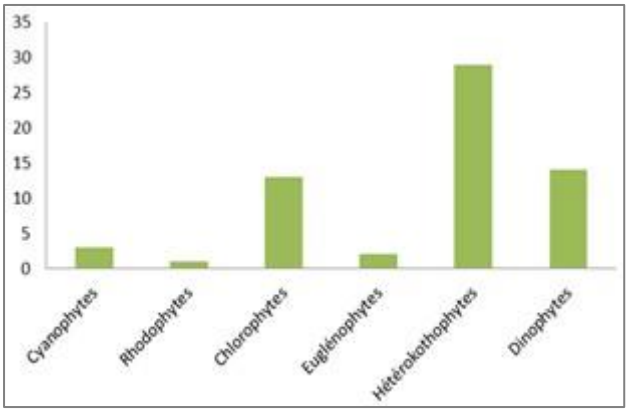


Figure 4. Distribution of phytoplankton taxa per Branch;

We notice that Diatomophyceae are the richest taxonomic group, representing 41.93% of the whole of algae listed. It is dominated by two genders *Navicula* and *Chaetoceros* which have 6 different forms each. The Dinophyceae is in the second position (25.80%) and *Ceratium* gender with 7 different forms is the best represented. It has been observed more than thirty times in sea water and 02 times in a brackish environment (Oued Summam's mouth). *Prorocentrum micans* was found under three distinct varieties but uncommon (Tab. 1).

This richness can be explained by the presence of

Favourable conditions for the development of Diatomophyceae and Dinophyceae in spring. According to Lefevre (2008), these groups prefer the calm waters, warm and sunny for long time which corresponds to the conditions of our sample period.

A quantitative approach of all individuals showed that Diatomophyceae with the *Fragilaria* and *Navicula* genders develop in waters with low salinity (point 1). On the other hand the Dinophyceae with *Ceratium* gender which is found offshore in 4, 5, and 6 sampling points prefer the oceanic waters.

The Dictyochophyceae or Silicoflagellates are less rich in species. They are exclusively planktonic and marine (Sournia 1986). Currently, their global scarcity (Ehrhardt and Seguin, 1978) could explain their reduced number in our samples.

By comparison of different points, we notice a difference between phytoplankton communities of brackish water (point1) and marine waters (points 2, 3, 4, 5, 6). Thus, the species recorded in Oued Soummam's mouth are among of Diatomophyceae (*Amphiprora, Cyclotella, Fragilaria, Navicula), Euglenophyceae and Euchlorophyceae(Scenedesmus, chlorella, crucigenia, planktospheria*).

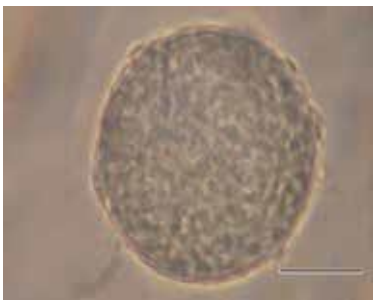
The Dinophyceae, Ulothricophyceae (*Cladophora, Enteromorpha*) and Dictyochophyceae (*Dictyocha*) are better represented in the marine environment.

Table 1. Distribution by branches, genders and classes of microalgae inventoried in Bejaia Gulf (2010)

Embranchements	Taxons	%	Classes	Genres	%
Cyanophyta	3	4.84	Cyanophyceae	2	3.77
Rhodophyta	1	1.62	Rhodophyceae	1	1.88
Chlorophyta	13	20.97	Chlorophyceae	6	11.32
			Ulothricophycea	3	5 .66
			Zygophycceae	4	7.54
Euglenophyta	2	3.23	Euglénophycceae	1	1 .88
Heterokontophyta	29	46.77	Chrysophycceae	1	1.88
			Diatomophycceae	28	52.83
Dinophyta	14	22.58	Dinophycceae	7	13.20
Total	62	99.97		53	99.96

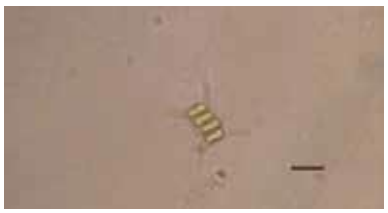
Protoperidinium conicum (Gran) Balech

Navicula

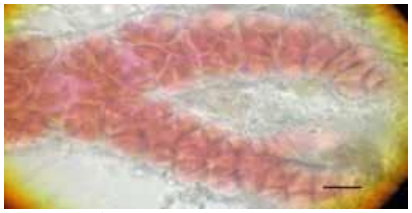


Dictyocha

Enteromorpha flexuosa



Scenedesmus



Ceramium floridanum

The scale is equivalent to 10 µm

Plate 1. Some species of phytoplankton from the Gulf of Bejaia

d) Zooplankton communities (Plate 2)

Among zooplankton, 21 taxa were identified. They are divided into 16 different genders and they are from four branches. It concern 13 Arthropods, 06 Protozoa, 01 Tunicates and 01 gender among Annelids. Figure 4 shows the distribution of these branches.

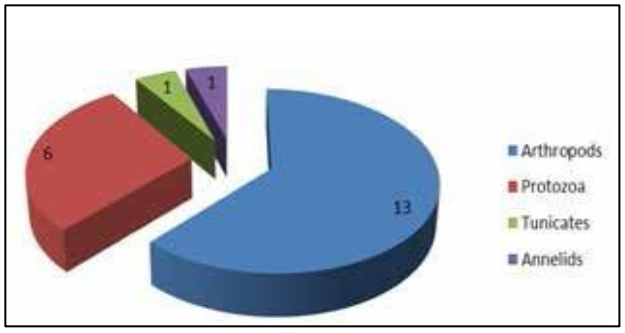


Figure 4. Distribution of zooplanctonic taxa per branch

By analyzing this inventory, the first for this area (Bejaia Gulf) some remarks emerge:

- The most of the observed genders belongs to the arthropods branch in which we have identified copepods (*Calanus, Acartia, Temora, Geatanus*), Krill (*Furcilia*) and decapod with many larval forms (*Zoe Alppheus* and *Carangon*).
- Annelids are present by Erantes Order as *Trochopore* larvae.
- The distribution variation of taxa in the study area can be explained by salinity and the distance from the estuarine zone. It is the case of *Temora, Oihtona* and Euphausiids harvested in point 6.
- According to Furnestin (1960) several copepods live near the coast such as *Calanus* and *Paracalanus* and a very varied population of crustaceans as decapod larvae which explains their presence in this inventory.
- *Paracalanus, Acartia* and *Vorticella* genders seem to flee the high salinities and find themselves frequently in the estuarine area.
- The sampling point 3 is poor of species because the waters are slightly transparent and have decomposition odor. The only gender identified at this level is *Geatanus* which is characterized by these nocturnal migrations [Bougis (1974)]. We think that this station by the opacity of its water is a cause to find this gender during the day in plankton net.

Acartia

Alpheus glober Oliv

Paracalanus

Globigerina

Gaetanus ninor Furcilia

The scale is equivalent to 0,1mm

Plate 2. Ssome species of Zooplankton from the Gulf of Bejaia

4. Conclusions

Our observations, though fragmentary at the moment, have enabled a first inventory of plankton in marine waters in a part of Bejaia Gulf.

For phytoplankton, 08 species were identified among sixty taxa. We noticed the adaptability of Diatomophyceae in salt and less salty water and the importance of Dinophyceae especially *Ceratium*

For zooplankton, the abundance of Arthropods (Crustaceans) is very clear and salinity is a major factor in the distribution of species.

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In Situ Conservation of Allium Siculum Subsp. Dioscoridis K.Richt

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Abstract We have investigated the ontogeny, natural population structure and status of rare Crimean plant Sicilian honey garlic *Allium siculum ssp. dioscoridis* K.Richt for the first time. The life cycle of this plant as well as the degree of threat to its populations are highlighted.

Keywords Allium Siculum SSP. Dioscoridis, Nectaroscordum, Population, IUCN, ERL

Allium siculum (Ucria) Lindl. subsp. *dioscoridis* (Sm.) K. Richt. (*Amaryllidaceae* J.St.-Hil.*)* [The Euro+Med PlantBase (2013)] has many synonyms: *Allium dioscoridis* Sm., 1809, Sibthorp & Smith, Fl. Graec. Prodr. 1: 222. – *Nectaroscordum dioscoridis* (Sm.) Stankov & Taliev, 1949, Syst. Classif. Vasc. Pl. Eur. Russ.: 910. – *Allium bulgaricum* (Janka) Prodán, 1923, Fl. Român. 1: 187. – *Allium meliophilum* Juz., 1950, Bot. Mater. Gerb. Bot. Inst. Komarova Akad. Nauk SSSR,: 12: 3. – *Nectaroscordum bulgaricum* Janka, 1873, Oesterr. Bot. Z., 23: 242. – *Nectaroscordum siculum* subsp. *bulgaricum* (Janka) Stearn, 1978, Ann. Mus. Goulandris 4: 104.

Some authors refer this species to the genus *Nectaroscordum* [Kudryashova (2003)], however, the genetic studies [Dubouzet, (1998), Baranyi (1999)] have not confirmed its independence. At the moment Sicilian honey garlic (Fig. 1) belongs to the genus *Allium* subgenus *Nectaroscordum* (Lindl.) Aschers. et Graebn. familia *Amaryllidaceae* [The Euro + Med PlantBase (2013)].

It is considered to be a relict species with the disjunctive habitat on its northeastern border of the Crimean – Balkan – Asia Minor area. We have studied mountainous terrain of the Crimean forest of the Crimean Nature Reserve, the largest preserved protected area of the peninsula, located at the central part of the Crimean Mountains, near a foot of Babugan, on yayla and partly on a southern downhill of the Main Range.

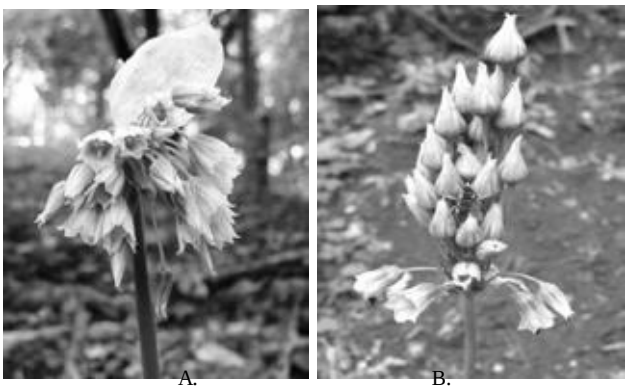

Figure 1. A. siculum ssp. dioscoridis at the beginning - A (the third decade of May) and at the end of flowering - B (first decade of June).

A. siculum populations were registered on the north macroslope in mixed forests with Fraxinus excelsior L. ssp. excelsior, Acer hyrcanum Fischer et C.A.Meyer ssp. stevenii (Pojark.) E.Murray and Cornus mas L. reaching 500-700 m a.s.l. of elevation.

The population comprised 2000 individuals with 500−1000 plants in each part with the average density of 19.1 plants per m2. Moreover, we studied the age structure of the population (Fig. 2) and revealed that the individuals in the virginal (v) stage were dominant. However, the population is not complete, since the senile (s) stage is absent. As for the ontogenetic details of the Sicilian honey garlic, we found that it is a monocarpic plant. Ecological strategy of A. siculum is a stress-tolerance. It is pollinated by such insects as Apis mellifera L., Paravespula germanica F., P. vulgaris L., Bombus terrestris L., B. hortorum L., Vespa crabro L., etc. Performance-pollination is about 60%. Natural causes of downsizing are confinement to ash forests, defect wild ungulates (red deer and wild boar), breach of habitats by human activity.

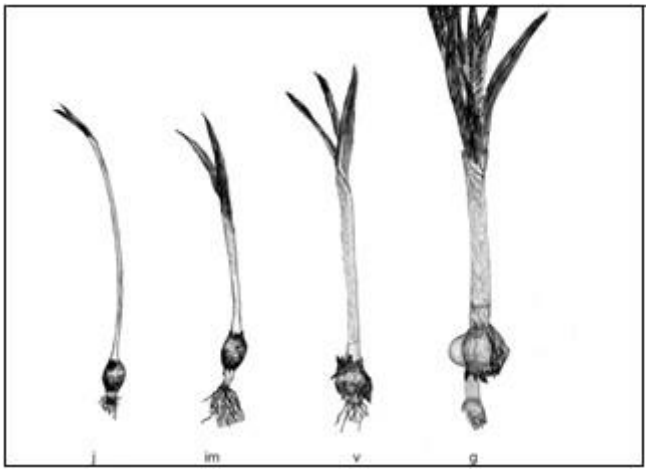

Figure 2. Age states of A. siculum ssp. dioscoridis (j – juvenile, im – immature, v – virginal, g – generative).

A. siculum listed in the Red Book of Ukraine [RBU (2009)] and the Red Book of the Republic of Moldova [RBM (2002)] under the category of the endangered species, though it is not protected at the European level and is absent in the European Red List of Vascular Plants (ERL) [Bilz (2011)]. We propose to include A. siculum ssp. dioscoridis to the list of the protected species basing on the following IUCN criteria [IUCN (2012)]. First, the area of its Crimean habitats is less than 5,000 km2 (Criterion B1). Second, the populations of Sicilian honey garlic are highly fragmented existing in more than five locations (B1a). We observed a reduction in area, extent and quality of habitat of this species (B1biii). Finally, the extreme fluctuations in the number of mature individuals are observed (B1civ). Therefore, the results of the evaluation criteria for IUCN RL [IUCN (2012)] are EN B1ab(iii)c(iv).

As a conclusion, we recommend to include the rare Crimean plant Sicilian honey garlic Allium siculum ssp. dioscoridis K.Richt to the IUCN Red list under the category "endangered species".

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Chapter 8 *Research, Conservation, Red List And Botanical Gardens*

Aspects of Orchid Conservation: Seed and Pollen Storage and Their Value in Re-introduction Projects

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Abstract Dry seeds of many orchid species, when stored at low temperatures, are capable of maintaining high levels of viability for many years. Orchid seed banking has the potential to become a valuable part of emerging integrated conservation strategies. Orchid Seed Science and Sustainable Use (OSSSU), with its ambition of building on the 300+ species already in storage in 26 countries around the world to store seeds representing a minimum of one thousand species in the next five years, and to expand the network to include more institutes and countries, provides an example of what can be achieved by a small, dedicated group willing to share their technical expertise and to develop a deeper understanding of the underlying science. Recent work indicates that it may be possible to store orchid pollen of some species for a minimum of six years under similar conditions to those used for orchid seeds, thereby facilitating pollen exchange between collections. OSSSU partners in a number of countries have demonstrated that raising plants from stored seeds can be used successfully in reintroduction projects.

Keywords Orchid, Seed Storage, Pollen Storage, Reintroduction, Research

1. Introduction

With around 153 taxa (including some sub-species), Europe has an orchid flora roughly equivalent in numbers to North America excluding the sub-tropical state of Florida. Europe incorporates the Mediterranean Basin hotspot, an area that has been impacted by humans for millenia. According to Myers and Cowling (1999) "the Mediterranean Basin is one of the hottest of hotspots; indeed in many ways it is hyper-hot, scoring very high in the fundamental criteria we use to define hotspots. It is exceptionally rich in diversity, especially plants, and second in the world in plant endemism. It is also highly threatened, and in fact has the lowest percentage of natural vegetation remaining in pristine condition of any hotspot".

According to the most recent IUCN Red List for Europe (www.iucnredlist.org/initiatives/europe) at first sight the current status of the continent's orchid species, however, may appear to present little cause for immediate concern. More than half the species are categorised as being of least concern. On the other hand, 62% of species are listed as decreasing, with the population status of a further 34% listed as being unknown. Many species remain subject to inappropriate land management and habitat change or the collection of tubers for salep, or of whole plants for horticulture. Thus 50 species (approximately one third of the total number of species) are listed as being either near-threatened or threatened. Of these 30 species (approximately one fifth of the total number of species) according to the Red List categories are either Vulnerable, Endangered or Critically Endangered. The future impact of climate change and a warmer world on orchid populations is a matter of great concern [Seaton et Al. (2010]. Climate change predictions include warmer winters in Northern Europe and hotter and drier summers in the Mediterranean region, with an increase in the number of heat and drought events [Giorgo and Lionello (2008)]. Responding to an increase in average temperate of 2^0C due to a combination of the heat island effect of the city of Boston, USA and global warming, plants in Concord flower on average ten days earlier than they did 160 years ago [Miller-Rushing and Primack (2008)], including the native Pink Lady's Slipper Orchid, *Cypripedium acaule* [Primack (2014)]. A long-term population study has shown that *Ophrys sphegodes* in the south of England now flowers, on average, two weeks earlier than it did 32 years ago [Hutchings (2010)]. Orchids, with their reliance on specific symbiotic fungi at different stages in their life-cycles, specialized habitats and pollinators are particularly sensitive to environmental change and can be a key indicator of the overall health of the environment. They have been referred to

as being potential "canaries in the coalmine" (www.serc.si.edu/labs/plant_ecology/naocc.aspx). Climate change combined with increasing habitat fragmentation means that for many species natural migration of populations to suitable habitats may not be an option and a case may be made for future human-assisted translocations of populations to new habitats [Stone (2010)]. In addition, small populations are often vulnerable to accidental loss. For example, 22 orchid species restricted to the mountain rainforest in the Montebello region of Mexico were lost when their habitat was completely destroyed by fire in an area where fire was used in the management of agricultural and cattle grazing [Soto Arenas et Al. (2007)].

2. Orchid Seed Science and Sustainable Use (OSSSU)

Seed banking has the potential to act as an insurance policy against possible future extinctions, preserving the maximum amount of genetic diversity in a minimum of space and at relatively little cost [Seaton and Pritchard (2003)]. Indeed the extreme small size of individual seeds means that seed representing the whole of the European orchid flora could theoretically be stored in a small domestic freezer. A small number of such seed banks would provide a valuable resource for both horticulture and research, and maintain the possibilty of future reintroductions. The value of such collections to the scientific community could be considerably enhanced if the percentage germination of full seeds was counted immediately post harvest and before the seeds were dried and stored at low temperature.

Orchid Seed Stores for Sustainable Use (OSSSU), a three year Darwin Initiative project funded by defra (http://darwin.defra.gov.uk/) the UK Department for Environment and Rural Affairs, was launched in the autumn of 2007 with workshops in Chengdu, China and at Jardín Botánico de Quito, Ecuador. A summary workshop was held in September 2010 at Jardín Botánico Lankester in Costa Rica bringing together representatives of each of the original participating institutes together with representatives of new recruits to the project. Initially focusing on fifteen countries in Asia (China, India, Indonesia, Philippines, Singapore, Thailand, Vietnam) and Latin America (Bolivia, Brazil, Chile, Colombia, Costa Rica, Cuba, Ecuador, Guatemala), the network has continued to expand to include at the time of writing additional countries in Asia (Laos, Nepal, India, Taiwan) and Latin America (Cayman Islands, Dominican Republic, Mexico, Panama, St Eustatius), the USA and a number of European partners (Estonia, Italy, Spain (Mallorca), Russia). Subsequent workshops have been held in Shenzhen in April, 2012, China to stimulate the setting up of an in-country network and Jardín Botánico Orquideario Soroa (October, 2012), Cuba for partners in Latin America.

The project was founded with the aim of setting up a global network of orchid seed banks using common protocols for drying and storing the seeds, and carrying out germination tests to measure both initial seed germination and subsequent changes in germination with time. The data gathered from this work would be made available to participants via the OSSSU web site (www.osssu.org). For each of the original 15 countries a target was set of storing seed of 20 species in a freezer at -20^0C per country over the three year period. The target was modest because of the work involved in carrying out regular germination tests on two different germination media. It was agreed that germination tests should be carried out on Knudson C [Knudson (1946)], which would provide, for the first time, data enabling comparison of germination of a wide range of species from a wide range of countries and a wide range of habitats. At the same time seed was sown on what was deemed to be the 'best' medium available (i.e. the medium that was expected to result in the highest percentage germination for that particular species) to provide a comparison with results obtained with Knudson C. The original target of 300 species stored was exceeded by a considerable margin by the end of the three year period and the number of seed lots stored continues to increase as the network expands to include more countries and institutes.

Key to the success of the project was obtaining good quality seed at the outset. This can be defined as being seed that has reached full maturity and is free from contamination by bacterial and fungal spores together with a high level of full seeds and initial percentage germination. The importance of collecting mature seed cannot be over-emphasised. Although it is possible, or even routine, to sow immature seeds of many species, commercially to obtain seedlings for sale more quickly or to overcome problems of dormancy of mature seeds (e.g. many *Cypripedium* species), immature seeds will not tolerate drying and therefore it is not possible to store them in seed banks. Although wild-collected seed was stored where cultivated material was not available (e.g. Chile), for practical reasons (collecting seed in the wild can be expensive and time-consuming) the majority of seed collections were made with hand-pollinations in living collections. Charles Darwin (1899) was fascinated by the often bizarre pollination mechanisms of orchids that in many cases are by no means obvious to the casual observer. Thus teaching horticulturalists and students about the intricacies of orchid flower structure forms an integral part of orchid seed banking activities. Cross-pollination should be the norm, thereby capturing the maximum amount of genetic variation within a species. It also avoids the problems of self-incompatibility that have been shown to occur in a number of orchid genera (e.g. *Oncidium* and *Restrepia*) [Millner et Al. (2012)].

Correct identification of the species is vital. To allow future conservationists to confirm an identification it is desirable that herbarium vouchers are taken where practical (i.e. material should only be removed if it is not going to have a detrimental impact on the orchid population being sampled). The genus *Ophrys* has, for example, been the subject of much debate as to what constitutes a true species

[Pedersen and Faurholdt (2007)] and well-documented reference material may be invaluable in future. In any case, the plant should be photographed when in flower, showing close-up details of the flowers, the whole plant and, where seed is collected in its natural habitat, the habitat and any further relevant details (exact location, co-flowering species, aspect etc.).

In the initial stages of the project two people from each participating institute were trained, thereby minimising the risk to the project of loss of expertise through unpredictable staff turnover. It was expected that the skills would then be passed on to other members of that institute through cascade training and many of the participating institutes have their own training programmes. For example, a number of five-day workshops have taken place in Ecuador at Jardín Botánico Quito where students have been instructed in seed storage techniques beginning with pollination and through to measuring percentage germination. Indeed regular and effective communication and continuous training are essential to the continued success of the project.

Many orchids are relatively easy to grow from seed using equipment that can be found in the average kitchen [Seaton and Pritchard (2008)]. A description of the recommended techniques is available in Growing Orchids from Seed [Seaton and Ramsay (2005)], and its subsequent publication in Spanish through the auspices of OSSSU [Seaton and Ramsay (2009)] has made the techniques described available to orchid biologists in Spain and Latin America. It is due to be published in Chinese in 2014 through Kunming Institute of Botany (Chinese Academy of Science). The vast majority of epiphytic orchids can be germinated successfully in the laboratory asymbiotically, and although this is also true for many European terrestrial orchids [Ramsay and Dixon (2003)], many species germinate more rapidly and produce more robust plants when germinated using an appropriate symbiotic fungus [Seaton et Al. (2011)]. Thus it is often desirable, and sometimes essential, to isolate suitable symbiotic fungi [Rasmussen (1995)]. Isolation techniques, including seed baiting, are widely employed and fungal isolates can be stored at low temperatures [Ramsay and Dixon (2003)].

3. OSSSU: Future Activities

A decision was recently made to change the name (but not the initials) of the project to Orchid Seed Science and Sustainable Use to better reflect its future aims in focusing on science. The work taking place at the Universidade do Oeste Paulista (UNOESTE), Brazil, provides an example of what can be achieved. Teaching is a core function of the project at UNOESTE. Students are taught about the floral biology and pollination techniques for both large flowering Cattleya and the small flowered Pleurothallis. Seed biology, seed storage and germination protocols are studied. As stated above, it is highly desirable to have a high value for initial viability. This can be measured using germination tests on sterile media, but there is increasing interest in using vital stains such as fluoroscein diacetate or tri-phenyl tetrazolium chloride. Such stains, where they are closely correlated with germination tests, have the potential to make assessments of viabilty quicker and easier to carry out. Thus Hosomi et Al. (2011, 2012) have used the tetrazolium stain to determine seed viability, capturing images using a digital camera to enable a permanent record of observations to be made.

To date limited work has been carried out on orchid pollen storage, however evidence gathered at Kew's Millennium Seed Bank has shown that pollen has similar longevity kinetics to seed and may be stored for several years and successfully used to sire new seeds, if dried to a suitable moisture content and stored at -20°C. Although -196°C may also be suitable [Pritchard and Prendergast (1989]. This raises the possibility of collaborations between institutes holding living collections either in the same country or between countries where exchange of pollen would ensure the maintenance of genetic diversity within populations, and support out of season pollination of exotic species.

4. Reintroductions and Community Involvement

A number of successful orchid re-introduction projects both have been and are being undertaken throughout the world with both epiphytic and terrestrial species. Such projects take commitment and time. Some are focused on botanical gardens and some on university departments. Others are carried out by groups of enthusiastic amateurs. Successful reintroductions of epiphytes include that of *Cyrtopodium punctatum* in the Fakahatchee Strand in Florida by staff from Atlanta Botanical Gardens and the Florida State Parks Department [Ferreira et Al. (2012)]. A total of 16 species have been reintroduced by scientists at the National Botanical Gardens in Singapore over the past ten years, most notably what is reputed to be the world's largest orchid, *Grammatophyllum speciosum* [Yam Tim Wing (2013)]. *Cattleya quadricolor* is being propagated for reintroduction in Cali, Colombia by members of la Sociedad Vallecaucana de Orquideología [Seaton and Orejuela (2009)]. The flagship for successful reintroduction of a terrestrials orchid in the UK has been *Cypripedim calceolus* which, due to wild collection had been reduced to a single plant in its native habitat [Ramsay and Dixon (2003)]. Other examples of reintroduction projects with terrestrial species include *Cypripedium kentuckiense* and *Platanthera chapmannii* in Georgia USA (Richards pers. comm.) (http://www.atlantabotanicalgarden.org/conservation/tissue-culture-lab); *Platanthera leucochila* by orchid biotechnologists at Illinois College, USA (http://www.ic.edu/orchidrecoveryprogram); *Diurus fragrantissima* in Eastern Austalia [Seaton (2009)]; *Cypripedium macranthos* in China [Seaton (2010)] and one of North America's rarest orchids, *Peristylus holochila*, in

Hawaii [Zettler and Perlman (2012)]. In Italy *Limodorum trabutianum* is the subject of a successful conservation project that clearly demonstrates the value of combining *in situ* and *ex situ* techniques [Magrini et Al. (2011)].

Most of the above projects are dependent on small numbers of committed individuals working for little or no financial reward. Such volunteers frequently bring with them a different set of skills to those scientists who are co-ordinating the projects. Without such community involvement many of the projects would fail. The comments of two scientists running such community projects in Eastern Australia and Tasmania are apt. Reiter writes from Victoria, Australia that in the last two years she has introduced twelve species with colleagues and community groups [Reiter et Al. (2012)] and she is looking at another 17 to 20 that they have growing to be put back in the ground over the next two years. She writes, "To be honest if we didn't have the community groups and cross agency support to help in all aspects the program we would have folded years ago". Likewise Nigel Swartz [pers. comm.] in Tasmania says, "My volunteers are wonderful, with many coming with a complete skill set in sterile technique with long backgrounds in science and research - they were just so desperate to work with orchid fungi!"

To be effective, future successful conservation activities should expand to develop educational programmes and involve the participation of a wider range of stake-holders, bringing with them a broad range of experience and expertise, and willing to work on various aspects of orchid conservation in what is becoming known as 'Citizen Science'. In the UK this is beginning through the National Collections (organised by the charity Plant Heritage) of different orchid genera held by dedicated amateur growers who are following the OSSSU protocols [Seaton (2011)]. Successful germination of orchid seeds (often on Petri dishes) inevitably leads to protocorms that can be transferred to larger culture vessels, and perhaps different culture media, for 'growing on' until they are sufficiently large to be tranplanted into a suitable medium or compost. Such plants can and are being used by OSSSU partners to enhance living collections thereby reducing collection pressures on wild populations and for possible reintroductions. Terrestrial orchids can be planted in raised beds (Richards, pers. comm.) or, where appropriate, artificial bogs or marshes [Londo (1992)] where they can be grown until they are large enough to be transferred to reintroduction sites.

5. Education

IUCN recommendations include raising public awareness. If we are to convince the general public of the importance of conservation we need to engage with as wide an audience as possible, thus OSSSU partners continue to be involved in public outreach through giving talks at local societies and presentations at conferences. Growing orchids from seed provides an ideal entry into conservation activities both for adults and children. OSSSU partners in Cuba and the Dominican Republic have active outreach programmes for schoolchildren. King Charles 1st School in Kidderminster and Writhlington School in Radstock in the UK have dedicated and well-resourced orchid laboratories providing an opportunity to introduce and focus the enthusiasm of a younger generation on the importance of orchid conservation. Where examination syllabuses in biology are focusing increasingly on molecular biology and the teaching of plant biology is increasingly marginalised, they provide an opportunity for students to learn about the importance of plants and their conservation and participate in practical conservation activities.

6. European Orchids and OSSSU

The advantages of belonging to the OSSSU network include an opportunity to exchange information and advice. OSSSU currently has three partner countries within Europe (Estonia, Italy and Mallorca) working on their regional orchid floras and there are opportunities to involve additional institutes and countries in the network. The very successful orchid reintroduction programme in Victoria, Australia [Reiter et Al. (2012)] illustrates clearly what can be achieved and there is currently a movement to establish a North American Orchid Conservation Center (NAOCC). One wonders if it would not be possible to establish a similar network within OSSSU for European countries. An initial target for such a network could be to have representative seed of all native orchids from the hotspot under long-term seed bank conditions by 2020, a target similar to that set for the orchids of southwest Australia biodiversity hotspot (with 408 native terrestrial orchid species [Swartz and Dixon (2009)].

It seems apt to conclude with the aphorism 'there is no time like the present'. In other words we should begin storing seed, their fungi and pollen without delay. IUCN recommendations for those species at immediate risk of extirpation include *ex situ* conservation strategies: seed collection (and storage) and artificial propagation by vegetative division of clonal material. Living collections could and should be established in botanical gardens and other appropriate locations both as a reservoir of genetic material and as a teaching tool. Bringing species into cultivation has the potential to reduce pressure on wild populations through making the (often illegal) collection of plants from their natural habitats unnecessary. Germination techniques have been successfully developed for a wide range of species and, as a result, they have become relatively straightforward to propagate from seed and by division.

Some species, however, are currently intractible (e.g. *Cephalanthera longifolia*), and there is a need for more research into dormancy mechanisms of terrestrial orchid species. Orchid seed banking would also benefit from research designed to improve long term germplasm storage, including storage at -80^0C and -196^0C (liquid nitrogen). There is a need for genetically diverse fungal collections to be made and maintained, and seed encapusulated with its

fungal partner could be stored where appropriate. All of the above would involve a wide range of stake-holders and be linked with an extensive programme of education and public awareness.

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Important Plant Areas of Armenia Project: The Progress Report

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Abstract Armenia is notable for its rich flora and diversity of habitat types. Because of growing destructive influence of human factor and climate change impact conservation of plant diversity of the republic becomes more and more actual. Selection of the Important Plant Areas (IPA) is one of the important steps to promote protection of the areas of botanical importance. The IPA of Armenia project has been supported by the Rufford Small Grants Foundation and let to identify the candidate IPAs. We are on the completion stage of our work now and plan to prepare the final IPA list to join the European IPA online database.

Keywords Wild Plants, Plant Diversity, IPAs, Flora of Armenia

1. Introduction

Republic of Armenia is located in the south of the Transcaucasia and occupies north-eastern part of vast Armenian Highland. This is a typical mountainous country with sensible altitude variations between 400 and 4000m above sea level. The highest peak is Mountain Aragatz (4095m above sea level). The climatic conditions are very diverse all over the country's territory: almost all climate types of the region except humid subtropics may be found here - vast areas with dry continental climate, temperate areas, cold mountainous areas and even dry subtropics in the most south and north of the republic, so the habitats diversity of Armenia is remarkable and has a mosaic character. The flora is very rich: about 3600 vascular plant species are found here, 123 of which are endemics. The flora of Armenia includes almost a half of the species of the Caucasian flora [Red Book of Armenia, (2010)] while the country's territory forms only 6% of the Caucasus.

Conservation of plants and habitats diversity is one of the most actual goals in the republic. 452 species (about 13% of the whole flora) are in the Red Data Book [2010], 86% of which (389 species) are critically endangered and endangered. The Important Plant Areas (IPA) identification in Armenia was started in 2003 in response to the growing loss of the republic's biodiversity and urgent need for its monitoring and conservation.

2. The IPA of Armenia Project

The implementation of the IPA of Armenia project became possible thanks to the Rufford Small Grants Foundation's support: Rufford small grant (2003-2004), booster (2006-2007), continuation (2011-2013) and completion (2014 – 2016) grants. The first pilot project let us to identify the IPA candidate sites matching all the three criteria for IPA selection; the booster grant gave an opportunity to focus more on the botanical richness sites (Criterion B). The IPA, responding to the criterion C were identified during our work on the continuation grant, one of the outputs of which is the two-level classification of the habitats of Armenia. This classification scheme, showing the diversity of Armenia's habitats is prepared for the first time. It is based on the classification of vegetation and is a result of detailed literature studies and many years of fieldwork.

The rare and threatened habitat types of Armenia have been identified and the similar habitat types in the EUNIS classification have been found. The list represents 16 habitat types: sand deserts with *Calligonum polygonoides*, saline deserts, semideserts with *Salsola dendroides*, tragacanth heaths with *Gypsophila aretioides*, pomegranate-pistaceo open forests, open pear forests, grass steppes with wild wheats, grass-forbs steppes with *Asphodeline taurica*, hazelnut forests, aspen forests, riverine plane forests, mixed yew forests, pine forests, rhododendron subalpine heaths, eutrophic meadow lakes and saline marshes. Accordingly, 16 IPA of national, regional and global conservation concern, representing the rare and threatened habitat types of Armenia were identified. Most of them are important also for holding the populations of endemic, rare and threatened species as for their floristic richness. All of the selected habitat types are limited in their distribution in Armenia estimated to be less than 5sq km. Some are represented with only 1 or 2 sites and show decline in distribution. 14 of 16 selected habitat types are listed in the Resolution 4 of the Bern Convention. When assessing the potential IPAs we take into account also

the genetic diversity of plants as, for example, the pear open forest is a habitat for at least 10 pear species, represented with many forms, which makes this site a carrier of unique gene pool.

Illustrated publications on the habitats classification scheme (in Armenian, Russian and English) [Asatryan et. Al., (2013, 1)] and on the IPAs, representing the rare and threatened habitat types of Armenia (in Armenian and English) [Asatryan et. Al., (2013, 2)] were produced. For each of the IPAs an up-to-date information on the location, area, description, botanical significance, endemic and the Red list plant species, current conservation status and present condition as well as recommendations on management and conservation of the selected sites are given.

Determination of the floristic richness sites was one of the hardest tasks especially for such a country as Armenia – mountainous, full of mosaic habitats. So when identifying the areas of botanical richness we consider two types of sites: sites, representing an exceptionally rich flora for particular level 2 habitat type similar to the approach given in the IPA selection manual [Anderson, (2002)] or represents a mosaic of different habitat types. As, for example, we have at least 2 IPAs – Arailer and Arteni Mountains, which are notable for their floristic richness, but these are ecosystems, where some habitat types are represented with comparable proportions the way, that is difficult to find the main habitat type. So these are considered mosaic areas: Arailer (2577m) - about 650 species, which forms around 20% of the total flora of Armenia and Arteni (2044m) - 439 species, 17% of the flora.

3. Education and Awareness Raising

Education and awareness raising activities form an important part of the IPA of Armenia project and include trainings for the protected areas' staff and local conservationists, meetings with decision makers, publication and distribution of project related papers, online reports, brochures, booklets and posters. Presentations on general and more specific topics related to plant and habitat diversity of Armenia and its conservation are given to the training participants, they also took herbarium techniques course and have been involved in the fieldwork to gain practical skills on place. The project provided also technical support to the hosting protected areas staff in a form of herbarium presses, herbarium paper, labels etc. Three seminars are planned for the 2015 in some towns of Armenia, located by the protected areas and will be organized in collaboration with Young Biologists Association of Armenia.

4. Future Plans

There are 32 sites in the list of the candidate IPAs. We work on preparation of the IPA final list provided with the full set of the data to join the European IPAs online database. We will compare the IPAs with Important Bird Areas of Armenia (the IBA project is implemented by the Armenian Society for the Protection of Birds (ASPB)) in order to find overlaps between them. The IPA of Armenia project activities and results contribute to the implementation of the Target 5 of the Global Strategy for Plant Conservation (GSPC) and support the integration of Armenia into European conservation programs and initiatives.

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Rare and Endangered Plants of Smolensk Lakeland National Park

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Abstract Smolensk Lakeland national park is situated in the west of Russia, in Smolensk region. It's a biosphere reserve, where nature conservation combines with a wide range of human activities. The wild flora consists of 953 species, 10 of which are enlisted in Russian Federation Red Data Book and 63 in Smolensk Region Red Data Book. Since 2006 we have been monitoring some rare, threatened and endangered plant populations to assess growth condition, extinction trends, as well as determine population threats. Rare plants populations are often under anthropogenic pressure, mainly intense recreational activities. We studied populations of 25 plant species and found that 2 species are increasing (*Cypripedium calceolus* L., *Dactylorhiza baltica* (Klinge) Orlova), 20 species have stable populations, and 3 species are decreasing (*Swertia perennis* L., *Epipactis helleborine* (L.) Crantz, *Epipactis palustris* (Mill.) Crantz) and need conservation actions. Presumably the main population threats are ground water level and grassland colonization by shrubs and trees. Our findings can be used for new editions of Red Data Books, educational and conservational purposes.

Keywords protected areas, national parks, rare plants, endangered plants, Red Data Books

1. Introduction

Smolensk Lakeland national park is situated in the western part of Russia between N 55°21′ – N 55°46′ and E 31°29′ – E 32°18′, in temperate broadleaf and mixed forest zone. The park is a biosphere reserve, where nature conservation combines with wide range of human activities. The total area of the park is 146237 ha, woodlands occupy 74% of it, wetlands 25%, and anthropogenic meadows 1%.

The wild flora of vascular plants consists of 953 species, 10 of which are enlisted in the Russian Federation Red Data Book [Ministry of Natural Resources and Environment (2008)] and 63 in the Smolensk Region Red Data Book [Smolensk Region Department of Wildlife… (2012)]. Previous researchers [Vakhrameeva et al. (2003)] enlisted 55 plant species as endangered, vulnerable, and rare (not threatened) at the national park. We studied 23 species from this list, one species that is data deficient (*Iris sibirica* L.), and one species that is decorative and can be decreasing under anthropogenic pressure (*Gladiolus imbricatus* L.). The aim of our study was to estimate population status and population trend through long-term monitoring.

2. Methods

We monitored populations of 25 plant species from 2006 till 2014. The studied species grouped by families are:

Athyriaceae
Cystopteris fragilis (L.) Bernh.

Ophioglossaceae
Botrychium lunaria (L.) Swartz
Botrychium multifidum (S. G. Gmel.) Rupr.

Liliaceae
Allium ursinum L.

Iridaceae
Gladiolus imbricatus L.
Iris sibirica L.

Orchidaceae
Coeloglossun viride (L.) Hartm.
Cypripedium calceolus L.
Dactylorhiza baltica (Klinge) Orlova
Dactylorhiza fuchsii (Druce) Soo
Dactylorhiza incarnata (L.) Soo
Dactylorhiza maculata (L.) Soo
Epipactis helleborine (L.) Crantz
Epipactis palustris (Mill.) Crantz
Goodyera repens (L.) R. Br.
Listera ovata (L.) R. Br.
Malaxis monophyllos (L.) Swartz.
Platanthera bifolia (L.) Rich
Platanthera chlorantha (Cust.) Reichenb.

Ranunculaceae
Anemone sylvestris L.

Brassicaceae
Lunaria rediviva L.

Crassulaceae
Jovibarba globifera (L.) J. Parnell

Gentianaceae
Swertia perennis L.

Scrophulariaceae
Digitalis grandiflora Mill.

We mapped populations' locations with GPS receiver. For each population we assessed growth conditions with geobotanical description of plant community. Geobotanical description contains floristic composition and relative foliage projective cover for each species on a standard growth plot of 100 square meters. We placed growth plots on sites with maximum density of examined plant.

Population size and population ontogenetic structure were counted up. Population ontogenetic structure consists of following ontogenetic stages: j – juvenile, im – immature, v – mature vegetative, g – generative, s – senile (often senile plants are absent in populations). If a population was small we counted all plants on the growth plot and if a population was fairly big we counted plants on 20 sample plots of 0,25 square meters each.

Number of flowers and number of fruits were counted up on samples of 20 generative plants.

3. Results and Discussion

Two species are increasing their population size: *Cypripedium calceolus* L., *Dactylorhiza baltica* (Klinge) Orlova.

Cypripedium calceolus is enlisted in the Russian Federation Red Data Book as rare [Ministry of Natural Resources and Environment… (2008)] and in the Smolensk Region Red Data Book as vulnerable [Smolensk Region Department of Wildlife… (2012)]. *C. calceolus* has wide ecological range, can grow under the forest canopy and in open areas. It occurs on moist soils rich in humus, prefers soils with much calcium content, from neutral to alkaline. *C. calceolus* grows in sparse pine, fir, broad-leaved, small-leaved and mixed forests. Usually it occurs as individual plant or small groups [Vakhrameeva et al. (2008)].

In the national park *C. calceolus* has two small populations. One population is situated in birch and spruce forest (*Betula alba* L., *Picea abies* (L.) Karst.) at the northern lakeside. Total foliage projective cover for herbaceous plants was 80%. Predominant herbaceous plants in the forest were *Oxalis acetosella* L. (40% foliage projective cover), *Impatiens parviflora* DC., *Rubus saxatilis* L., *Galeobdolon luteum* Huds., *Gymnocarpium dryopteris* (L.) Newman. In 2008 we found 9 vegetative and 9 generative shoots. In 2014 we found 9 vegetative shoots and 4 generative shoots, and we consider one plant of few shoots as dormant.

Second population is in spruce forest with birch (*Picea abies* (L.) Karst., *Betula alba* L.) at the northern lakeside of another lake. Total foliage projective cover for herbaceous plants was 40%. Predominant herbaceous plants in the forest were *Oxalis acetosella* L., *Rubus saxatilis* L., *Vaccinium myrtillus* L., *Vaccinium vitis-idaea* L. In 2008 we found 2 vegetative and 3 generative shoots. In 2014 we found 4 vegetative shoots and 3 generative shoots. Number of shoots is slightly increasing.

Dactylorhiza baltica is enlisted in the Russian Federation Red Data Book as rare [Ministry of Natural Resources and Environment… (2008)] and in the Smolensk Region Red Data Book as endangered [Smolensk Region Department of Wildlife… (2012)]. *D. baltica* grows usually in conditions of full light, on humid to swampy and slightly acidic to slightly alkaline soils. It occurs mainly on wet meadows [Vakhrameeva et al. (2008)]. *D. baltica* has numerous populations medium to large size all over the national park, basically it grows on wet meadows and often can be found in anthropogenic ecosystems, like roadsides.

Typical population of *D. baltica* is situated on wet meadow with slight disturbance from cattle. Total foliage projective cover for herbaceous plants was 80%. Predominant herbaceous plants were *Filipendula ulmaria* (L.) Maxim., *Geum rivale* L., *Equisetum palustre* L. Total area of the population is 200 square meters. In 2013 average population density was 9,4 plants per square meter and population ontogenetic structure was 17% juvenile plants, 21,3 % immature, 21,3 % mature vegetative, and 40,4% generative. Average number of flowers was 24,2 per generative plant and average number of fruits was 10,6 per generative plant. In the Smolensk Lakeland national park *D. baltica* needs no conservation actions.

Twenty species have stable populations. For example, *Platanthera bifolia* (L.) Rich. has many populations small to medium size all over the park. In each population number of plants increases and decreases, but despite population waves the trend is stable. Typically mature vegetative plants predominate.

Three species are decreasing: *Swertia perennis* L., *Epipactis helleborine* (L.) Crantz, *Epipactis palustris* (Mill.) Crantz.

Swertia perennis is enlisted in the Russian Federation Red Data Book as endangered [Ministry of Natural Resources and Environment… (2008)] and in the Smolensk Region Red Data Book as endangered [Smolensk Region Department of Wildlife… (2012)]. In the national park *S. perennis* grew in wet thinned birch and alder forest (*Betula alba* L., *Alnus glutinosa* (L.) Gaertn.) at the southern lakeside. Total foliage projective cover for herbaceous plants was 50%. Predominant herbaceous plants in the forest were *Carex nigra* (L.) Reichard, *Thelypteris palustris* Shott, *Geum rivale* L., *Phragmites australis* (Cav.) Trin. ex Steud., *Menyanthes trifoliata* L., *Swertia perennis* L., *Filipendula ulmaria* (L.) Maxim., *Angelica sylvestris* L., *Viola epipsila* Ledeb., *Lysimachia vulgaris* L. Green moss projective cover was 30%. In 2006 the only *Swertia* population covered 200 square meters, average density was 20,3 plants per square

meter. Population ontogenetic structure was 34% juvenile plants, 29% immature, 30.1% mature vegetative, and 6.8% generative. In 2011 we observed 21.1% juvenile, 26.3% immature, 45.6% mature vegetative, and 7% generative plants, average density was 11,4 plants per square meter. In 2013 we didn't find any *Swertia* plants on this place. Presumably number of plants decreased because summer droughts of 2010 and 2011 affected water-level of nearby lake and ground water level. This population needs further searching.

Epipactis helleborine (L.) Crantz is enlisted in the Smolensk Region Red Data Book as data deficient [Smolensk Region Department of Wildlife… (2012)]. *E. helleborine* grows in a wide ecological range, it is shade-tolerant, grows more often in partially shadowed, although may occur in open sites. It grows usually on the fresh or wet soils, prefers soils rich in humus. *E. helleborine* occurs in broad-leaved forests (beech, oak and hornbeam), small leaved (birch, more rarely aspen) and mixed forests and can well adapt to secondary habitats [Vakhrameeva et al. (2008)]. In the national park *E. helleborine* was registered in 4 sites [Vakhrameeva et al. (2003)], we studied one of them. The population is situated in birch and alder forest (*Betula alba* L., *Alnus glutinosa* (L.) Gaertn.) at the eastern lakeside. Total foliage projective cover for herbaceous plants was 50%. Predominant herbaceous plants in the forest were *Carex nigra* (L.) Reichard, *Menyanthes trifoliata* L., *Lysimachia vulgaris* L., *Thelypteris palustris* Shott. Green moss projective cover was 75%.

In 2007 we found 43 plants and population ontogenetic structure was 5% juvenile plants, 10% immature, 57,5% mature vegetative, and 27,5% generative. In 2012 we didn't find any *Epipactis* plants on this place and there was no other dramatic changes in ecosystem. Maybe some plants can be dormant.

Epipactis palustris (Mill.) Crantz is enlisted in the Smolensk Region Red Data Book as rare [Smolensk Region Department of Wildlife… (2012)]. *E. palustris* grows in a relatively narrow ecological range, it is a light-requiring plant, seldom growing in partial shade. It occurs mainly on wet soils resisting periodical flooding, but avoids dry soils, and it is indifferent to soil richness. *E. palustris* often forms large populations in slight anthropogenic influence [Vakhrameeva et al. (2008)]. In the national park *E. palustris* was registered in 5 sites [Vakhrameeva et al. (2003)], we studied one of the populations. *E. palustris* grew on an opening between willows. It was a wet meadow. Total foliage projective cover for herbaceous plants was 85%. Predominant herbaceous plants in the forest were *Potentilla erecta* (L.) Rausch., *Succisa pratensis* Moench, *Alchemilla vulgaris* L., *Deschampsia caespitosa* (L.) P. Beauv., *Filipendula ulmaria* (L.) Maxim., *Solidago virgaurea* L., *Carex flava* L. Green moss projective cover was 20%.

In 2008 we found 163plants growing in aggregations with average density of 41 plants per square meter. Population ontogenetic structure was 8% juvenile plants, 33% immature, 50% mature vegetative, and 10% generative. In 2011 we observed only 3 immature, 5 mature vegetative, and 1 generative plants. In 2014 we didn't find any *Epipactis* plants on this place. Shrubs and trees colonized the site. *Epipactis palustris* needs wet soil so recent droughts could affect species extinction and growth of shrubs and trees.

All decreasing species grew on wet sites. Recent droughts in 2010 and 2011 could affect ground water level and species survival. Presumably the main population threats are changes of ground water level and site colonization by shrubs and trees.

4. Conclusions

We studied twenty five plant species, of which: 2 species are increasing (*Cypripedium calceolus* L., *Dactylorhiza baltica* (Klinge) Orlova), 20 species have stable populations, and 3 species are decreasing (*Swertia perennis* L., *Epipactis helleborine* (L.) Crantz, *Epipactis palustris* (L.) Crantz) and need conservation actions. All decreasing species grew on wet sites. The main population threats are not clear, presumably they are changes of ground water level and grassland colonization by shrubs and trees.

Acknowledgments

Sincere thanks to: administration of Smolensk Lakeland national park for supporting the research, administration of All-Russian Research Institute for Nature Protection "VNII Prirody" for supporting conference presentations, and Dr. Maria G. Vakhrameeva for consulting.

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Chapter 9 *Climate Change and Ecosystem Services*

Climate Change and Nature Conservation in Europe

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Abstract Up to the end of this century, warmer conditions and significant variations in precipitation regime are predicted for many areas dedicated to nature conservation across Europe. Significant consequences are expected for Natura 2000 sites and for their elements of biological diversity. In this frame, the present contribution aims to highlight the observed climate change pressures, impacts, threats and to underline future prognosis, addressed to some habitats of community interest defined by annex I of the Habitat Directive. Aim also to promote the need of adaptation management, to actual and future climate change challenges, as an essential process for the long-term sustainability of the protected areas of Europe.

Keywords Climate Challenges, Protected Habitats, Protected Species, Adaptive Capacity

1. Climate Change – A Challenge for All of us

The climate of the Earth is a dynamic system which was always been changing, according to the natural changes from the atmosphere, hydrosphere, cryosphere and to the links between. But, during the last 250 years, many human activities were identified as the most significant causes of actual and future changes of the global climate [IPCC (2007)].

Unfortunately, climate change becomes a great global threat in our time, a worldwide problem for all of us and an additional challenge for biodiversity and sustainable development [EEA (2012)]. It is happened day by day, affecting more and more our daily life and impacting the elements of biological diversity (flora, fauna and environmental systems), the socio-economic sectors (agriculture, forestry, fishery, energy, transport, tourism) and the human health (air pollution, weather extreme events, diseases).

There are many links connecting climate change and biological diversity of the Earth and different dimensions of climate change impacts were already reported for different biological elements, starting from individual species up to the entire environmental systems [Campbell et. Al. (2009)]. Significant consequences are predicted and expected with respect to the stability of the biosphere's elements and to the benefits and services which natural world will be provided to the humane society in the future. Many consequences address to protected areas and to plant diversity, which are expected to experience a diversity of impacts during this century [Araújo (2011)].

Protected plants with special ecological preferences (low temperature, snow, edaphic humidity) may be lost in the future, affecting in this way the conservative value of many Natura 2000 sites.

2. Climate Change Pressures

What can we expect from climate change in Europe during this century?

The real dimensions of climate change are difficult to be predicted for such a long period of time, but three key climate change pressures can be underline:

- Increase of global average temperature, predicted to rise by 1.1°C to 6.4°C up to the end of 2100 [IPCC (2007)];
- Changes in precipitation regime, expressed in terms of precipitation increase, decrease and seasonal distribution variability;
- Changes in the frequency and amplitude of the extreme weather events, as heavy rains, storms, torrents, floods, drought, late frosts s.o.

In this respect, for the Northern Europe mild and humid winters are predicted and for the Southern Europe, warm and dry summers are expected. The intensity and distribution of

the extreme events across Europe is predicted to show a general increasing trend, with a large variability according the regions of the continent [EEA (2012), EEA (2013)].

The climate change effects as mild winters, reduced snowfall, warm spring and summers, dry and torrid summers, low precipitation will affect also the cryosphere's elements, inducing the snow mass decrease, glaciers melting, decrease in mountain permafrost areas, decrease of the Sea ice s.o.

It is also important to underline that a wide range of impacts of climate change has already observed on environmental systems of Europe, where significant changes are expected with respect to species (e.g. plants, fungi and animals), whole ecosystems and their different categories of services.

Rapid changes in climatic conditions as temperature and precipitation, determine changes in species distribution, express for example, in altitudinal shift [Kullman (2007)], phenological modifications, threat of reproduction and growth processes [Lapenis et. Al. (2005)], high risk of extinction and loss of rare endemic species, which are very specialise and well adapted to restricted life conditions [Sârbu et. Al. (2013)]. Unfortunately, the amplitude and the rapidity of the climatic changes on Earth are expected to be high and to exceed in many cases, the adaptive capacity of species, reducing their chance to migrate and to colonise new areas [EEA (2013)].

Major changes to ecosystems as a result of climate change are also projected to occur during this century, in Europe. They address to different aspects, as the changes in distribution by upwards shift in mountain areas [Metzger et. Al. (2008)], changes in composition, structure, and functions [Del Grosso et. Al. (2008)], with a special regard to the presence of invasive species [Hellmann et. Al. (2008)], capable to affect the structure and the stability of the ecosystems, in condition of climate change.

3. Climate Change Impacts on Natura 2000 Habitats

Starting from the evidence that climate change is a major threat, with significant impacts on many aspects of biological diversity [Campbell et. Al. (2009)], a special attention was addressed to protected habitats from the Sites of Community Interest which belong to Natura 2000 Network, the most important tool for conservation areas in Europe.

In this context, a detailed analyse, was carry out (2010-2013) in the frame of the European project "*Adaptive Management of Climate-Induce Changes of Habitat Diversity in Protected Areas* (HABIT-CHANGE)", for 89 Natura 2000 habitat types, from ten Natura 2000 sites, located in Central and Eastern Europe.

The selected Natura 2000 habitats belongs to different Natura 2000 sites (wetlands, forests, grasslands, alpine and costal ecosystems) and are included in 14 categories according to the Natura 2000 system of classification [DG EUR 27 2007]:

Classes of habitats: Costal and halophytic habitats, Temperate heath and scrub, Raised bogs and mires and fens, Rocky habitats and caves;

Subclasses of habitats: Sea dunes of the Atlantic, North Sea and Baltic coast (+ Black Sea), Inland dunes old and decalcified, Standing water, Running water, Natural grasslands, Semi-natural dry grasslands and scrubland facies, Semi-natural tall-herb humid meadow, Mesophyll grasslands, Forests of Temperate Europe, Temperate coniferous forests.

Based on the climate change effects reported, seven impact classes related to the selected Natura 2000 habitat groups were identified. They address to: **seasonality** (changes of mean and maximum temperature, precipitation, frost and snow days), **hydrology** (decrease of precipitation during vegetation period, variation of the precipitation intensity), **soil** (change of soil structure, nutrients and chemistry), **sea level rise** (local coastal flooding), **extreme events** (heavy rains, floods, drought, wildfire, storms), **CO_2 concentration** (increasing concentration), **cumulative effects** (the invasion of aliens, land use changes s.o.).

An overview of the already observed impacts and threats of climate change, addressed to six categories of well represented habitats in Europe was included as example in the Table 1. For each of them the prognosis for the 21 century has also been estimated [EEA (2012)].

Table 1. Major impacts of climate change and projected changes by 2100, addressed to six groups of Natura 2000 habitats

Habitat group	Climate change impacts	Categories of threats
Costal and halophytic habitats (Fig. 1)	Sea – level rise Storm surges	Erosion of coastlines Change of soil structure Loss of halophyte vegetation of drift line
PROGNOSIS for the 21 century. At this moment habitats of this group are 14% affected by climate change but, the projection of global mean sea-level rise, range between 20 cm and about 2 m [EEA (2012)].		
Standing water (Fig. 2) *Running water*	Hydrological changes (water regime and water level)	Alteration of the floodplain of running waters Modification of the rivers bed Drying out of the rivers
	Increase of water temperature	Decrease in duration of lakes and rivers ice Decrease the water quality Affect the bank ecotone conditions Negative effect on benthic invertebrates, plankton species and aquatic macrophytes Development of aquatic thermophylic invasive plants
PROGNOSIS for the 21 century. Can be expected that global worming will intensify the impacts and changes in the seasonality of river flow across Europe.		
Raised bogs and mires and fens (Fig. 3)	Changes of ground water level Changes in precipitation pattern Temperature increase Drought	Erosion and soil leaching Mineralisation of peat Accumulation of organic material Wildfires Increasing tree cover, spread of reed and of alien plants Decrease of the bryophytes and specialised plants
PROGNOSIS for the 21 century. 50% of the habitats of this type are affected by climate change in Europe and the prognosis is that the process will increase.		
Temperate coniferous forests (Fig. 4)	Temperature increase Changes in precipitation Decrease of ground water level Rising atmospheric CO_2 Heavy rains, storms and torrents	Affect growing conditions of the tree Increase of pests and diseases Loss of the tree depending on water supply and low temperature (*Picea abies*) Damage by extreme events Affect the species composition, the forest biodiversity and productivity
PROGNOSIS for the 21 century. At this moment 22% of the habitats of this type are affected by climate change [EEA (2012)]. According the actual prediction regarding the evolution of the climate change pressures, the value of the forest in Europe is projected to decrease with about 28%.		
Temperate heath and scrub from alpine climate (*Bushes with Pinus mugo and Rhododendron myrtifolium*, Romania) (Fig. 5)	Temperate increase Changes in precipitation Reduction of frost and snow days Torrents and storms	Erosion, ruptures Habitat fragmentation Potential loss a plants strongly depending on humidity, low temperature and snow presence
PROGNOSIS for the 21 century. Degradation and potential loss of this type of habitat, dominated by mesohygrophyte and psichro-termophyte plants.		

Figure 1. Annual vegetation on drift -lines, Black Sea, Romania

Figure 2. Standing Water, Danube Delta lake, Romania

Figure 3. Raised bog Mohos, Romania

Figure 4. Temperate coniferous forests, Natura 2000 site Bucegi, Romania

Figure 5. Bushes with *Pinus mugo* and *Rhododendron myrtifolium*, Natura 2000 site Bucegi, Romania

Natura 2000 habitats are simultaneously subject to various categories of climate change impacts and it is difficult to estimate which of these habitats will be more profoundly affected in the future. However, bogs, mires and fens are considered to be the most sensitive habitat types to the actual and predicted climate change impacts, but also forests, costal habitats and alpine habitats are vulnerable.

Other additional stressors as human habitat fragmentation, eutrophication and degradation, land use-change and inadapted human management practices, with significant impact on the integrity and the quality of these relevant areas for biological diversity conservation in Europe, needs to be also considered.

The long-term value of Natura 2000 sites will be affected by actual climatic and anthropic impacts, main drivers for changes in the phenology and distribution of plants and animals. In this respect, many plant species with restrictive environmental conditions and low ability to adept may face extinction.

The loss of protected species will reduce the conservative value of Natura 2000 habitats. The particularly large extinction risk of plants was reported from the mountain habitats across Europe and especially from high elevation. Alpine habitats characterised by the presence of many endemic species, sensitive against raising temperature and the high moisture amplitude variation require special attention.

The recent study (2010-2013) addressed to Bucegi Natura 2000 site, Romania highlighted that mountain flora with conservative value is very sensitive to climate change effects. In this respect, from 215 vascular plants from the site, nominated for conservation in national (Romanian Red List) and international documents (IUCN Red List, CITES, Habitat Directive), 85% are sensitive at least to one of the climatic parameters (temperature, humidity) and 50% (hemichryptophytes and chamaephytes) are sensitive to both parameters. These last categories include 60 endemic plants for Carpathian Mountains (Fig. 6, Fig. 7, Fig. 8). The assessment of plants sensitivity to different potential climate pressures, offer significant information about the vulnerability of species itself and can suggest potential trends for the plant communities from Natura 2000 sites.

Figure 6. *Dianthus glacialis* subsp. *gelidus*, Natura 2000 site Bucegi, Romania

Figure 7. *Achillea schurii*, Natura 2000 site Bucegi, Romania

Figure 8. *Campanula transsilvanica*, Natura 2000 site Bucegi, Romania

4. Management under Climate Change – Reference Points

Adaptations of protected areas management to new and dynamic climatic frame, takes shape as a continuous, flexible process, including a large range of partners as scientists, conservation managers, decision-makers, stakeholders, citizens s.o. The aim is to reduce the vulnerability of these important areas for biodiversity conservation, to develop their capacity to tolerate as much as possible the disturbance and to obtain a favourable conservation status under new climatic conditions.

A successful approach for climate change adapted management in protected areas, address to significant actions as:

- To assess the impacts of climate change at the site level and to collect data regarding the sensitivity of the biological elements;
- To review the current management plans taking into consideration the actual and predicted climate change impacts on the site;
- To evaluate the limits on acceptable changes;
- To develop suitable adaptive management plans, strategies and practical actions, according the site-specific needs;
- To monitor results and periodically evaluate management effectiveness;
- To reduce the over-use of the natural resources;
- To decrease the non-climatic pressures, resulting from land-use, fertilisation, eutrophication, tourism s.o;
- To involve the stakeholders and the local communities in the implementation of the adaptive management measures;
- To share knowledge and practical experience;
- To better transfer the scientific knowledge into conservation measures and practices.

5. Conclusions

Climate change is an important threat for long-term conservation of Natura 2000 habitat diversity. Different dimensions of climate change impacts were reported for the elements of biodiversity in Natura 2000 sites, with severe effects on individual species and habitats.

Climate change will increase in magnitude up to the end of this century, affecting more and more the integrity and quality of different type of habitats and many species will lose their suitable conditions of life. We are expected to be confronted in the near future, with a significant reduction of Natura 2000 sites value, caused by the loss of many valuable protected species and habitats.

The way to buffer as much as possible the climate change effects on protected areas and to support the resilience of the ecological systems is based on the continuously adjust of the conservation measures to changing conditions.

In this respect, the expected decrease of ecosystem services, due to habitats degradation and species loss, can be also a strong motivation for the adjustment of our mentality about the overexploitation of natural resources and our involvement in nature conservation.

Acknowledgements

The information obtained in the frame of the project "*Adaptive management of climate-induced changes of habitat diversity in protected areas* – HABIT-CHANGE – (2CE168P3)" were used for the development of this contribution. We thank the European transnational funding programme INTERREG IV B Central Europe for co-funding this project.

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Holistic Strategies for Deforestation, Poverty and Climate Change Mitigation: Balancing Human Greed and Natural Resource Sustainability

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Abstract One third of the world forest has been destroyed and the same scaring scenario is perpetrated for the increase of carbon dioxide emission. Despite technological and financial miracles in the twenty first century, the gap between the poor and the rich is increasing in a steady step. "Hungry" people cannot think and "poor" communities would not protect their forest area except if the globalized monetary system would secure their basic needs. Changing strategies for a more sustainable community is therefore most urgent than ever. Deforestation, poverty and climate change are deeply interlinked. Every single issue has to be solved with a holistic approach to the root causes of all problems. There is a global feeling that structural greed is the main cause of the current crisis so we need to develop tools for assessing greed and measure our progress towards sustainable development. In this paper, we present methodologies for developing socio-political recommendations to foster sustainable community. Scientific models have been developed to measure progress toward sustainable development (SAFE model) and assess structural greed index on individual and national level (GLIMS model). Following the call of the "Green" Ecumenical Patriarchate Bartholomew, the Institute of Theology and Ecology of the Orthodox Academy of Crete (OAC), has repeatedly stressed the need to tackle the ethical roots of global crisis. Religion and science have to join their efforts and interfaith initiatives such as the Working Group on Climate Change (WGCC) of the World Council of Churches (WCC) should play greater role in climate change awareness. The OAC contributes to this goal by promoting dialogues on environmental ethics, poverty reduction, and climate change awareness worldwide. It runs academic workshops on greed and a Museum of Cretan flora for educational purposes.

Keywords Greed, Sustainable Development, Eco-justice, Deforestation, Climate Change

1. Introduction

Since the publication of the Brundtland Report in 1987 the concept of sustainability has gained increasing attention among policy-makers and individuals. There is clear evidence that development is currently unsustainable. Deforestation, ozone depletion, global warming, depletion of aquifers, species extinction, collapse of fisheries, soil erosion, and air pollution are among the obvious signs of ecological distress. For the last few decades our society is also showing similar signs due to poverty, illiteracy, AIDS, social and political unrest, and violence.

Global deforestation sharply accelerated around 1852. It has been estimated that about half of the Earth's mature tropical forests—between 7.5 million and 8 million km2 (2.9 million to 3 million sq mi) of the original 15 million to 16 million km2 (5.8 million to 6.2 million sq mi) that until 1947 covered the planet have now been destroyed. Some scientists have predicted that unless significant measures (such as seeking out and protecting old growth forests that have not been disturbed) are taken on a worldwide basis, by 2030 there will only be 10% remaining, with another 10% in a degraded condition. This reality is alarming on local as well as on global level.

Recently, fuzzy logic has been proposed as a systematic tool for the assessment of progress toward sustainable development. A model called SAFE (Sustainability Assessment by Fuzzy Evaluation), which uses basic indicators of environmental integrity, economic efficiency, and social welfare as inputs and employs fuzzy logic reasoning was developed to provide sustainability measurements on the local, regional, or national levels. Recently a similar project entitled GLIMS (Greed Lines and Indexes Measurement System) was also developed by the Greed Line Study group of the World Council of Churches (WCC) in order to study the limits and levels of greed in contemporary societies.

This chapter provides an approach to sustainable decision-making using sensitivity analysis of the GLIMS

model for measuring greed. Sensitivity analysis can reveal the most important factors contributing to a sustainable lifestyle within the limits to greed. The chapter has five sections. Section 1 gives an introduction to the concept of sustainable policies and climate change factors. Section 2 gives an overview of the SAFE model and its importance in linking deforestation, poverty and climate change for sustainable decision making. Section 3 presents the concept of the GLIMS model and its possibility to measure greed for purposes of sustainability and climate mitigation. Section 4 discusses the potentiality of evaluating strategies for a sustainable lifestyle with GLIMS computation results on individual levels. This section answers critical questions such as "How greedy is our lifestyle?" and "How do it affect climate change?" Before the conclusion, a report on the activities of the Institute of Theology and Ecology at the Orthodox Academy of Crete in tackling ecological problems and, especially, climate change will be described in Section 5.

2. The SAFE model: Linking Deforestation, Poverty and Climate Change

a. Description of Sustainable development concept: the SAFE model

Sustainable development, as defined by the Brundtland Report, is the "development that meets the needs of the present without compromising the ability of future generations to meet their own needs". Sustainable development is difficult to define but many researchers recognize that it is a function of two major components, ecological and human.

According to the SAFE methodology, the overall sustainability – Climate Change Risk- of the system whose development we are asked to appraise has two major dimensions: ecological sustainability (ECOS/Deforestation) and human sustainability (HUMS/Poverty). These will be referred to as the primary components of the overall sustainability (OSUS/ Climate Change). The ecological dimension of sustainability comprises four secondary components: water quality (WATER), land integrity (LAND), air quality (AIR), and biodiversity (BIOD). The variables describing the human dimension of sustainability are political aspects (POLIC), economic welfare (WEALTH), health (HEALTH), and education (KNOW).

Figure 1 illustrates all the dependencies of sustainability components.

To evaluate the secondary components we adopt the Pressure-State-Response approach, which was originally proposed to assess the environmental component of sustainability.

The indicators used in the SAFE model are given in Table 1. Statistical data for the basic indicators can be obtained from many sources, such as United Nations organizations, World Bank, World Resources Institute, international federations, governmental and non-governmental organizations, etc..

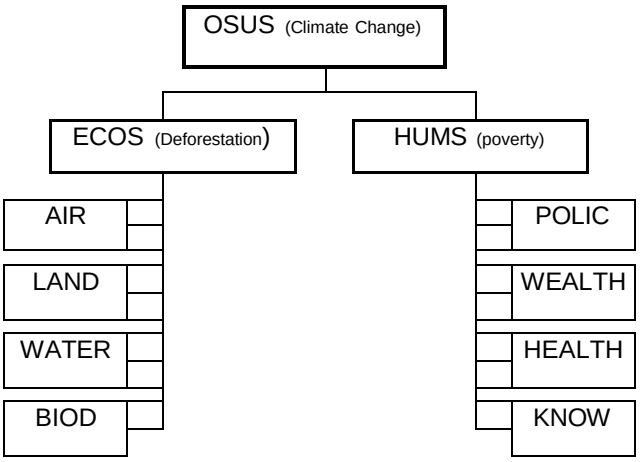

Figure 1. Dependencies of sustainability components.

b. Sustainable decision-making using the SAFE model – Sensitivity analysis

Sensitivity analysis plays a fundamental role in decision making because it determines the effects of a change in a decision parameter on the system performance. Additionally, since most decisions regarding sustainable development involve groups of experts, politicians and individuals, often with uncertain criteria and conflicting interests, sensitivity analysis could be used to investigate the dependencies of sustainability components on particular policies and decisions.

To be able to design policies for sustainable development, one should have a tool for measuring sustainability and a tool for simulating sustainability scenarios. Without these tools, it is useless to formulate any policy for sustainable development, because not only is there no alternative way to assess the results of the policy, but also it is impossible to tell whether the society is on a sustainable path or not.

The SAFE model provides these prerequisite tools for the formulation of sustainable policies by assessing sustainability for different scenarios of development. A scenario is defined by a suite of sustainability indicators, which largely reflect the results of policies and actions taken in a particular period. When these values are changed and the resulting changes on sustainability observed we could identify the most important indicators promoting or impeding progress toward sustainable development. The next step is to recommend future policies and actions that would increase or decrease the values of the indicators identified as promoting or impeding, respectively among others, the results from the sensitivity analysis of the SAFE model show that deforestation and poverty are crucial factors influencing overall sustainability and shaping climate change.

Table1. Basic indicators* used in the SAFE model

Secondary Component	PRESSURE	STATUS	RESPONSE
LAND	(1)) Commercial energy use (2) Solid and liquid waste generation (3) Nuclear energy production (4) Population density	(5) Net energy imports (6) Domesticated land (7) Forest and woodland area	(8) Population growth rate (9) Primary (clean) energy production (10) Nationally protected area (11) Urban households with garbage collection
WATER	(12) Water pollution (13) Urban per capita water use (14) Freshwater withdrawals	(15) Annual internal renewable water resources	(16) Percent of urban wastewater treated
BIOD	(17-19) Threatened plant, fish and mammals species. (20) Threatened frontiers forest	(21 – 23) Total number of plant, fish and mammals species. (24) Current forest	(25) Protected area (26) Annual deforestation - reforestation
AIR	(27) CO_2 emissions (28, 29) Total CH_4 and N_2O emissions	(30 – 34) Atmospheric concentrations of greenhouse and ozone-depleting gases	(35) Fossil fuel use (36) Primary electricity production (37) Public transportation
POLIC	(38) Military spending (39) General government consumption (40) Murders (41) Human rights (42) Environmental laws and enforcement	(43) Regime (democratic-nondemocratic) (44) Institutional Investor Credit Rating (45) ICRG risk rating (46) Central government finance	(47) Official development assistance (48) Government total expenditure for social services
WEALTH	(49) GDP implicit deflator (50) Imports (51) Private consumption	(52) Total external debt (53) GINI index (54) GNP (55) Resource balance	(56) GDP growth (57) Exports (58) Poor households
HEALTH	(59, 60) Cases of infectious diseases: measles and tuberculosis (61) Infant mortality rate (62) Maternal mortality rate	(63) Life expectancy (64-66) Percent of one-year-old infants immunized against measles, polio and DPT (67, 68) Number of people treated per doctor and per nurse	(69) Public health expenditure (70) Daily per capita calorie supply (71) Access to sanitation
KNOW	(72) Number of patent applications filled by non-residents (73) Lack of libraries/schools	(74, 75) Expected years of schooling, male and female (76, 77) Gross school enrollment ratio: primary and secondary	(78) Public expenditure on education (79) Number of patent applications filled by residents (80) Personal computer (81) Internet hosts (82) Number of scientists and engineers

*Sources and explanations for indicators in World Bank, World Resources Institute, and the International Helsinki Federation for Human Rights (IHR)

Deforestation is a contributor to global warming, and is often cited as one of the major causes of the enhanced greenhouse effect. Tropical deforestation is responsible for approximately 20% of world greenhouse gas emissions. According to the Intergovernmental Panel on Climate Change deforestation, mainly in tropical areas, could account for up to one-third of total anthropogenic carbon dioxide emissions. Reducing emissions from deforestation and forest degradation (REDD) is a mechanism that has been under negotiation by the United Nations Framework Convention on Climate Change (UNFCCC) since 2005, with the twin objectives of mitigating climate change through reducing emissions of greenhouse gases and removing greenhouse gases through enhanced forest management in developing countries.

3. Overview of the Greed Lines and Indexes Measurement (GLIMS) Model

a. Combining Religion and science to tackle greed

Greed is the greatest of all plagues against justice, peace and sustainability. The society of 21th century relies on unrestricted structural greed and promotes it through unlimited growth, overconsumption and individualistic competitive behavior. We need an empirical tool to measure, monitor and control the various aspects of human greed on global, national, corporal as well as on individual level. Jesus Christ reminds us to "take care to guard against all greed, for though one may be rich, one's life does not consist of possessions" (Luke 12:15, The New American Bible Revised Edition). Religion and science should give answers to critical questions such as "what is greed?" and "how can we measure and control it?"

The conceptual description of structural greed is driven from the findings of the World Council of Churches (WCC) greed line group study on poverty, wealth and ecology. Fuzzy logic evaluation is used to assess greed;

b. The concept of greed and its measurement: GLIMS model

Greed could be defined as the *desire to have more than one's legitimate share of material goods and power*. In contrast to poverty which deals with needs that can be objectively defined and even quantified, greed is about desires which are "*difficult to contain*" and involve an "*emotional energy that seeks to transgress or disregard limitations*" and which are consequently difficult to circumscribe and measure.

If greed is "having too much" money, resources and power (in contrast to describing poverty as" having too little"), when does one "have too much"?. It was proposed that the point or level when individuals or societies "have too much" is approached or describes a situation (status), first of all, when other individuals and societies have too little resources to live by and, second of all, and when the accumulation of wealth and power undermines the common good or threatens (desire/trends) the global commons.

While the "poverty line" is drawn at the point of personal consumption allowing for the satisfaction of basic needs, the *greed line could be drawn at "the highest point of personal consumption which can be obtained without negatively affecting the welfare of society and that of future generations***.**" "Greed lines" are the levels of resource consumption, money accumulation or power seizure over which societal or individual behaviors may harm human well-being and creation integrity. These negative effects of behaviors beyond greed lines could be expressed in term of relative poverty or socio-economic injustice or sentimental offenses and environmental destructions.

The GLIMS model uses fuzzy logic reasoning and inputs from statistical indicators of natural resources consumptions, financial realities, economic performances, social, ethical and political facts. The outputs are concrete measures of three primary indexes of ecological, economic and socio-political greed (ENV-GI, MON-GI, POW-GI) and one overall multidimensional structural greed index (MSGI). The results are greed index scores that are expressed in a scale of zero to one hundred. The global greed index score equal to 100 corresponds to the maximum level of greed for the subject of analysis.

In contrary to poverty line, GLIMS model allows the formulation of discrete limits to all aspects of greed and it gives an overall multidimensional structural greed index (MSGI).

The knowledge ruling the computation of greed indexes is represented by fuzzy rules whose general form is: "***IF*** (PREMISE) ***THEN*** (CONCLUSION)".

For example, such a rule could be as follows

- "***IF*** (POVERTY is *high*) AND (ECOLOGICAL FOOTPRINT/Deforestation is *high*) ***THEN*** (OVERALL SUSTAINABILITY/Climate change risk is *high*)"; or
- "***IF*** (POVERTY is *medium*) AND (ECOLOGICAL FOOTPRINT/Deforestation is *medium*) ***THEN*** (OVERALL SUSTAINABILITY/Climate change risk is *medium*)"; or
- "***IF*** (POVERTY is *low*) AND (ECOLOGICAL FOOTPRINT/Deforestation is *low* ***THEN*** (OVERALL SUSTAINABILITY/Climate change risk is "*low*"; etc.

The rules are expressions of the role of interdependencies among various dimensions of greed. They are combinations of IF-THEN rules operating on rule bases derived from expert knowledge on the system integrity. By their nature, such functions are highly non-linear. The term "integrity" is defined as the degree to which each greed variable fulfills criteria of greed lines. Criteria of greed lines are recommended critical target that each greed indicator should pass to become in a greedy status. These rules are the results of multidisciplinary analysis about greed and its polymorphous effects.

Table 2 summarizes the list of greed indicators and their limits to greed used in the GLIMS model.

Table 2. Explanations for the greed indicators on individual level.

Greed indicators	Personal /institutional data values					
	Legitimate target	Greed line interval		Greed line unit	Indicator definition and link to greed	Data sources
1-PERSONAL ECOLOGICAL FOOTPRINT	Lower better Red light when ratio is > 1 Earth.	0.9	1	1= one planet Earth	Amount of biologically productive land and sea area necessary to supply natural resources and to assimilate associated waste for a given lifestyle.	Personal ecological footprint can be calculated at http://www.footprintnetwork.org
2-FINANCIAL ASSETS	Moderation Red light when ratio is > 100%.	80	100	Percentage of revenue	Amount of money that an individual has in the financial market.	Survey
3-FINANCIAL INTEREST RATE	Moderation (5% is the world average interest rate) Red light when ratio is > 5%	0	5	Percentage	Depending on the desire for making more money in a short time, a higher interest rate is considered to be result of greedier behavior	Survey
4-ANNUAL INCOME	Moderation Red light when ratio is > 40000 US .$ /capita/year	30000	40000	Money in US .$ based on purchasing power parity (PPP)/ capita)	Higher personal revenue compared to the average population is a sign of greed	Survey
5-HOUSEHOLDS DEBT	Moderation Red light when ratio is > 100%	80	100	Percentage of revenue (installment vs. income ratio).	Because of imbalanced behavior (production vs. consumption), the limit over which a person or an institution is considered as greedy can be set to 100%	Survey
6-LIVING STANDARD COSTS	Moderation Red light when ratio is >0,8	0,6	0,8	In a scale of zero to 1	Access to adequate living standard is a fundamental need for human right but luxury living is offensive and becomes a form of greed when in excess compared to the average standard.	Survey
7-SOCIAL CLASS STATUS	Moderation Red light when ratio is >0,8	0,6	0,8	In a scale of zero to 1	High level of social class distinction is a form of greed with respect to dignity and inequality when compared to the average standard.	Survey
8-EDUCATIONAL EXPENSES	Moderation Red light when ratio is >0,8	0,6	0,8	In a scale of zero to 1	Education a fundamental need for human right but it becomes a form of greed when educational expenses are in excess compared to the average standard.	Survey
9-HEALTH CARE EXPENDITURE	Moderation Red light when ratio is >0,8	0,6	0,8	In a scale of zero to 1	Adequate health is a fundamental need for the fulfillment of human right but it becomes a form of greed when health expenditure is in excess compared to the average standard.	Survey
10-PERSONAL MORALITY	Higher better Red light when ratio is <0	0	5	In a scale of -10 to +10	Morality index intends to provide a time-base measure of the moral behavior of individual. The red light is 0, under which the bad behavior is threatening human life and peace.	www.moralityindex.com/
11-RESPECT FOR PERSONAL FREEDOM	Higher better Red light when ratio is <5	5	6	In a scale of 1 to 7	One should not tolerate any violation of freedom as it is an obvious sign of greed. Higher values reflect high level of liberty and low values imply violation of human right in a greedy society. Values range between min=1 and max=7.	Survey

The methodology of the measurement of greed indexes, as well as the concept for the selection of greed indicators are depicted in the following figure 2.

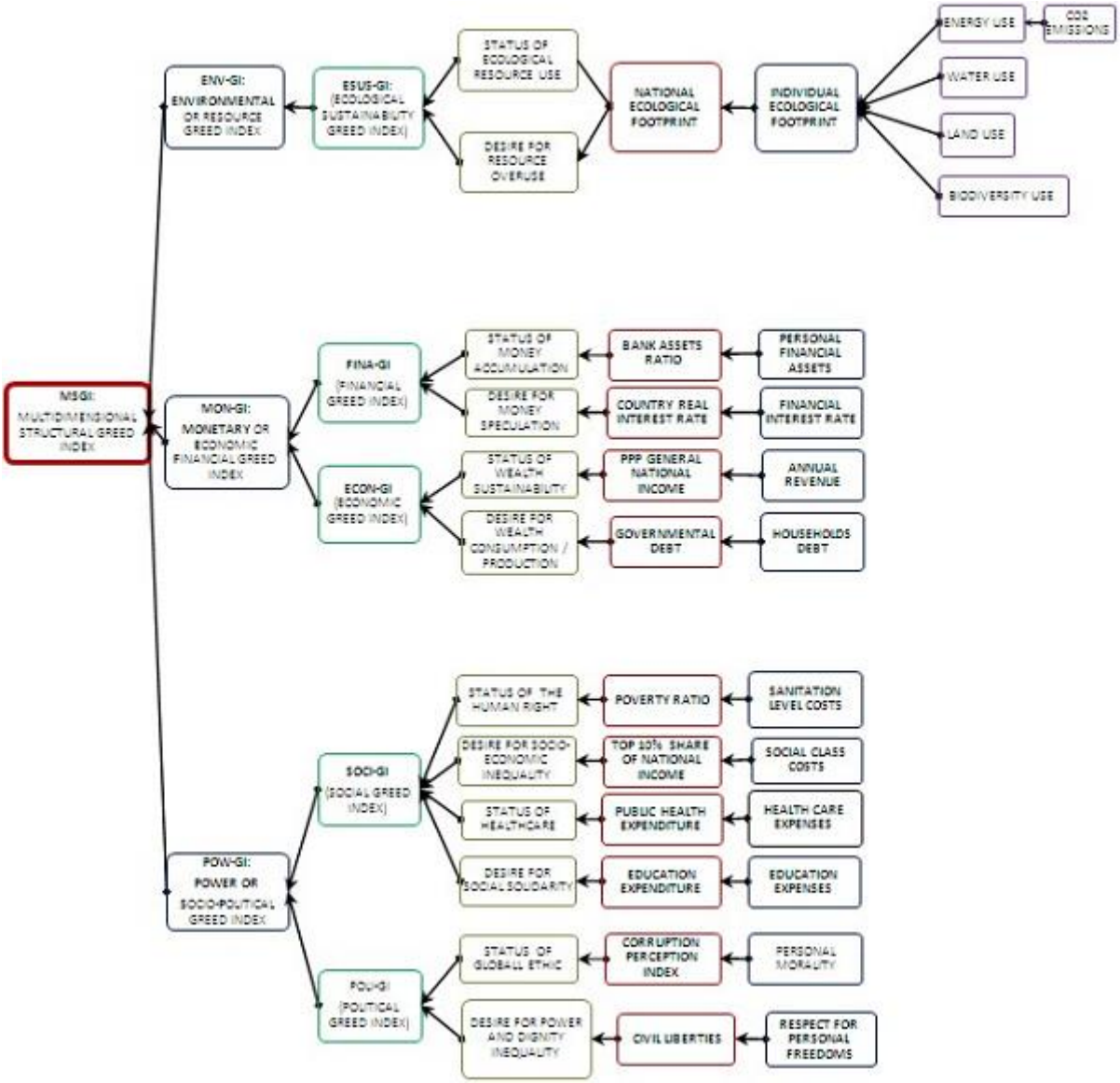

Figure 2. Methodology of the greed indexes measurement and selection of indicators

4. Evaluating Strategies for a Sustainable Life Style on Individual Levels with GLIMS Model

Evaluating strategies for a sustainable life style on individual levels is a pilot project of the WCC and the Institute of Theology and Ecology of the OAC in order to promote sustainability and to avert climate change. To evaluate individual greed indexes, we applied the GLIMS model to selected economies and few individuals.

One individual is considered greedy with respect to a specific "dimension" of structural greed when its greed index is greater than 50. The greed line for MSGI measurements is then [50-60] and the red light is 40 (enough level). Data for the whole set of greed indicators for countries are retrieved from statistical researches while data for individuals are obtained via surveys that are based on questionnaires such as follows (Box 1: Personal Greed Index Sample Questionnaires).

Here we report the results on individual assessments which show that the environmental, economic and social greed levels of each person would need corrections because they have all over passed the red light level of "enough" (MSGI equal to 40).

The results are compiled in the following table (Table 3):

Box 1. Personal Greed Index Questionnaires

1. How big is my ecological footprint (http://www.footprintnetwork.org/en/index.php/GFN/page/calculators/)?
2. Do I have stock shares or savings capital in the bank? If yes, how much?
3. If I have financial investments, how much is my financial interest rate?
4. How much is my annual income? And how high/low it is compared to the average?
5. How much credit card debt do I have? How much is my monthly installment vs. your monthly income?
6. How much do I spend on luxury goods in a year? How many cars do I have? How big is my house?
7. Would I consider myself to be part of the upper, middle or lower income class? Do I aspire to a higher social class? If so, which class?
8. How much do I spend for my health care (except for diseases and disabilities)?
9. What level of education do I have (in years of schooling)? How much do I spend on my education per year with respect to the average neighbors?
10. How much tolerance do I have for corruption and for human rights violations?
11. How much do I value money and power over friendships, sharing, harmony, and wisdom?

Table 3. Values of greed indexes measurements for selected individuals (2012 survey)

INDIVIDUAL GREED INDEXES	Person 1 N (Male)	Person 2 L (Male)	Person 3 A (Female)	Person 4 G (Female)	Person 5 S (Young)
ESUS-GI	40.26	41.28	55.29	50.41	44.28
ENV-GI	**40.37 (E)**	**41.53 (E)**	**54.90 (G)**	**50.36 (G)**	**44.77 (E)**
FINA-GI	20.37	22.80	56.91	20.37	20.37
ECON-GI	46.20	50.41	41.69	36.93	26.05
MON-GI	**38.31 (F)**	**40.53 (E)**	**49.79 (E)**	**35.48 (F)**	**32.19 (F)**
SOCI-GI	43.17	53.74	55.82	44.31	43..40
POLI-GI	37.29	32.08	59.21	37.28	28.63
POW-GI	**44.33 (E)**	**45.43 (E)**	**51.88 (G)**	**44.69 (E)**	**41.04 (E)**
Overall MSGI score	**45.50 (E)**	**46.23 (E)**	**50.37 (G)**	**46.73 (E)**	**44.94 (E)**

Linguistic values for greed indexes: L = Low; F = Fair; E = Enough; G = Greedy; VG = Very Greedy; EG = Excessively greedy

5. Other Activities of the Institute of Theology and Ecology at the OAC in Tackling Ecological Problems and Climate Change Worldwide

a. Sustainable Alternatives for Poverty Reduction and Ecological Justice" (SAPREJ)

In April 2014, the World Council of Churches and the Orthodox Academy of Crete organized the second international conference on "Sustainable Alternatives for Poverty Reduction and Ecological Justice" (SAPREJ) in Antananarivo Madagascar. The first SAPREJ conference was held in Greece in 2012 at the Orthodox Academy of Crete in Kolympari, Crete. Greece is most affected by the global crisis and Madagascar is among the poorest countries in the world. Poverty has increased and deepened substantially over the last two and a half decades, with real per capita income having decreased by 40 percent between 1971 and 1991. The poverty assessment for Madagascar estimates that 70 percent of the population can be defined as being poor and 59 percent as being extremely poor. Poverty is also deeper in rural areas than in urban areas with an unemployment rate of about 80 %. Madagascar has lost 80% of its eastern rainforests since then.

Responding to the call for pilgrimage of justice and peace at the last 10th Assembly of the World Council of Churches in Busan South Korea, the OAC conference was meant to bring a message of hope and solidarity to the needy and marginalized communities in Africa. About twenty five proposals from a dozen of countries (Canada, Germany, Greece, Fiji, Qatar, USA, Nigeria, Uganda, Zambia, Algeria, The Netherlands, and Madagascar) were presented.

Madagascar and the global south (developing countries) in general expressed their call for justice and mutual collaboration with the global north (developed countries). They ask for the support of the World Council of Churches, NGOs and all churches in solving the problem of climate change through eco-justice and poverty reduction programs.

b. Ecological Theology and Environmental Ethics (ECOTHEE) and Museum

In 2008, the Institute of Theology and Ecology at the OAC started to organize international conferences, seminars and workshops focused on ecological theology and environmental ethics (ECOTHEE) and biodiversity

conservation (Museum of Cretan Flora). Each ECOTHEE conference takes place every two years at the Orthodox Academy of Crete where priests, scientists, politicians and the general public come to reflect together on finding solutions to ecological problems. ECOTHEE book series, resulting from the outcome of each conference, were published and distributed worldwide.

The museum of the OAC exhibits about 9000 specimen of Cretan wild plants and it offers various educational programs demonstrating the interrelation between plant conservation and climate change mitigation. Thousands of tourists, scientists, students, church members and the general public visit the museum every year. Two other important international conferences on plant biodiversity were also organized by the OAC in 2010, for the conservation and sustainable use of wild plant diversity (CSUWPD) to celebrate the year of biodiversity, and in 2014, for the conservation of wild plants in Europe to mark the 7th Planta Europa conference in Crete. During these conferences, the issue of climate change is always at the center of discussions. Since 2011, the Institute of Theology and Ecology at the OAC has been organizing workshops and seminars on the limits to greed (greed line) and sustainable lifestyle management. Lectures on structural greed have been given worldwide to spread the call for a change in lifestyle with respect to the limits to greed/growth.

6. Conclusions

Church leaders, policy makers and every single believer would need a practical tool to clarify the effects of greed and establish policies or strategies for a sustainable life style. With the help of science and religion, we developed tools for monitoring greed and sustainable development. The SAFE (Sustainability Assessment by Fuzzy Evaluation) allows decision makers to assess their progress towards sustainable policies while the recent model, called GLIMS (Greed Lines and Indexes Measurements System), is meant to provide a comprehensive description and measurement of structural greed. GLIMS model offers an explicit way to assess greed and help shaping sustainable policies to tackle climate change at its roots (poverty, ecological footprint, deforestation, ethical recessions, education and inefficiency in production and distribution systems). The model allows also the monitoring and simulation of greedy behaviors in national, corporal and individual level. Therefore it is helpful for anti-greed policy-making and ethical reflections.

It is crucial to understand that poverty; deforestation and climate change are interlinked and governed by structural greed. To overcome greed, recommendations differ from economy to economy and corrections vary from individual to individual. More developed countries need to focus on the effect of their environmental greed whereas less developed countries should strive to correct their political system. The monitoring of sustainability and greed index are indispensable for decision-making and policy design at individual, communal or national levels if we want to attack the problem of climate justice, peace and sustainability more efficiently.

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PLANTA EUROPA CRETE DECLARATION 2014

PLANTA EUROPA

CRETE DECLARATION 2014

The participants of the 7th Planta Europa Conference on the Conservation of European wild plants and fungi held in Kolympari, Chania, Crete (Greece), 21-25 May 2014 with the theme "Plants for People, People for Plants":

Know that the functioning of Planet Earth, and our survival, depends upon plants; that wild plants are essential to life and human well-being;

Acknowledge that wild plants (algae, bryophytes and vascular plants) and fungi play a key role in providing ecosystem services; maintaining the planet's environmental balance and ecosystem stability e.g. cleaning air and water;

Aware that the conservation of natural habitats is a vital component of the protection and conservation of wild flora;

Note that the European plants are amongst the most threatened wild species in the world;

Note the tremendous species diversity of fungi, their crucial place within many biological interactions, and their underpinning of several ecosystem services;

Recall the importance of the European Strategy for Plant Conservation 2008-2014 (ESPC), developed by the Planta Europa network in collaboration with the Council of Europe in Romania in 2007; as a regional contribution to the Global Strategy for Plant Conservation (GSPC) 2011-2020 of the Convention of Biological Diversity, endorsed by CBD-COP 10 in Nagoya;

Emphasize the close relationship of the GSPC targets to the Aichi targets of the CBD strategic plan and thus the important role of the GSPC and the ESPC in contributing to the delivery of CBD Strategic plan (2010);

Recall the need to continue the implementation of the recommendations of the Krakow Declaration 2011, adopted by the participants of the 6th Planta Europa Conference in Krakow;

Acknowledge the ongoing progress with the implementation of both the European and Global Strategies for Plant Conservation detailed in review carried out by Plantlife and BGCI in 2014; especially the progress with documenting the extent of and threats to plant diversity, development of innovative methodologies for plant conservation, and high quality education and awareness raising activities;

Welcome the participation of representatives of conservation organisations in Algeria, Armenia, Canada, Kazakhstan and Pakistan in the Planta Europa conference;

Acknowledge the efforts Armenia and Kazakhstan to implement the GSPC through new Important Plant Areas initiatives;

Welcome the following decision that contribute to European and global plant conservation

Decision XI/26 on Global Strategy for Plant Conservation, adopted at the 11th meeting of the Conference of the Parties to the Convention on Biological Diversity (CoP11), Hyderabad (India), October 2012;

The EU 2020 Biodiversity Strategy, adopted by the European Commission in May 2011, and the Conclusion on the implementation of the EU 2020 Biodiversity Strategy, adopted by the European Parliament in April 2012;

Recommendation no 159 (2013) of the Standing Committee of the Bern Convention (Council of Europe), adopted on 30 November 2012, on the effective implementation of guidance for parties on biodiversity and climate change;

Recommendation no 168 (2013) of the Standing Committee of the Bern Convention (Council of Europe), adopted on 6 December 2013, on the European Charter of Fungi – gathering and biodiversity;

Recommendation no 167 (2013) of the Standing Committee of the Bern Convention (Council of Europe), adopted on 6 December 2013, on the European Guidelines on Protected Areas and Invasive Alien Species.

The conference:

1. **Reaffirms** Planta Europa's commitment to the implementation of the GSPC and which remains an invaluable global framework for plant conservation;
2. **Decides to extend** the current ESPC 2008-2014 at least until the next Planta Europa conference;
3. **Redoubles our efforts** to deliver and promote the GSPC at national level alongside the EPSC;
4. **Requests** national, regional and international authorities, conservation organisations, private companies and citizens in the field of nature, agriculture, fisheries, forestry, tourism, health, planning, trade in plant products, spatial planning, and environmental issues to:

- collaborate with all relevant actors involved in plant conservation activities in implementing relevant (inter)national agreements on plant conservation and in helping disseminate good practices;
- promote education and awareness on the need to protect the wild plants and fungi in Europe, and to conserve their habitats;
- provide, as appropriate, the Planta Europa Network with information about the progress towards the implementation of the targets of the European Strategy for Plant Conservation;

5. **Encourages** its members and partners to develop additional multi-country cross sector partnerships, in those areas of the European and global plant strategies where implementation needs improvement – particular activities that improve the conservation status of plant and fungi species and important sites and the sustainable use production lands;
6. **Encourages** members and partners to explore the possibilities of engaging citizens in scientific and conservation activities that safeguard wild plants and their habitats *(e.g. protest against chemical waste in the Sea of Crete and climate change awareness).*

The conference participants express their gratitude to the "green" Patriarch, His All Holiness the Ecumenical Patriarchate Bartholomew of Constantinople, the Spiritual Mentor of the Orthodox Academy of Crete, for His inspiration in the care of the biodiversity and to the Institute of Theology and Ecology of the Orthodox Academy of Crete for hosting the 7thPlanta Europa Conference.

Done in Kolympari, Crete (Greece), 24th May 2014

Photo Memories 7PEC 2014

Photo memories from the 7th Planta Europa conference

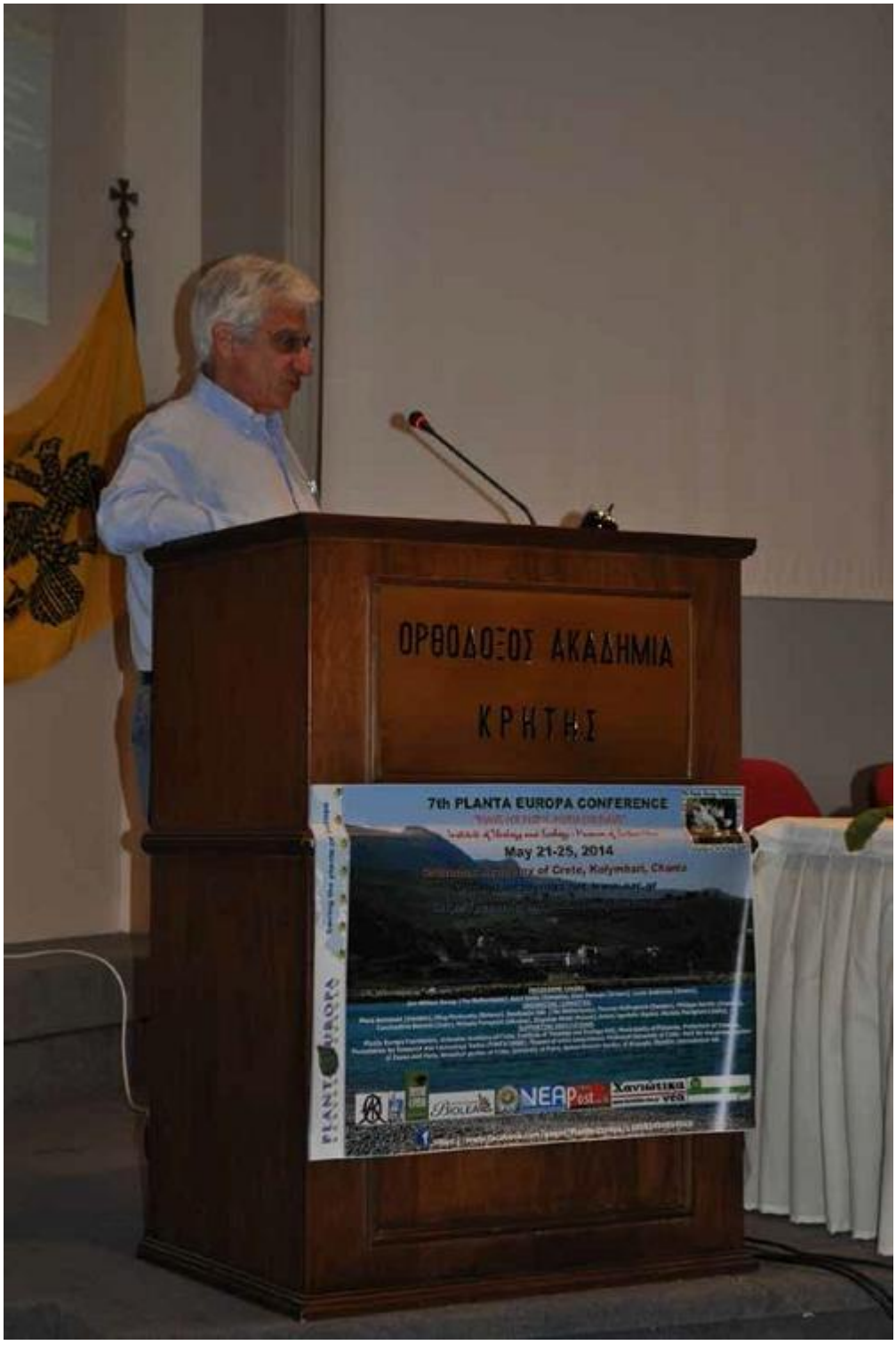

website af
ough many others: Flicker, Linkedin,
oursquare, Google+, Resear
7th PLANTA EUROPA CONFERENCE
May 21-25, 2014


ORTHODOX ACADEMY OF CRETE


Other international frameworks:
Council of Europe, IUCN,
EU/NATURA 2000
Jan Pisnik
Nature Conservation Agency of
the Czech Republic


There are many approaches (theories)...
Anthropocentrism
Biocentrism
Shallow vs. Deep Ecology
Ecofeminism


WELCOME
7th PLANTA
EUROPA
CONFERENCE


ΟΡΘΟΔΟΞΟΣ ΑΚΑΔΗΜΙΑ
ΚΡΗΤΗΣ
7th PLANTA EUROPA CONFERENCE
May 21-25, 2014


Goodbye cool world?

The Editors of ECOTHEE 2013

Dr. Lucas Andrianos (Andriantiatsaholiniaina) was born in Madagascar in 1969. In 1993, he graduated from the University of Antananarivo with a degree in Agronomy and earned his Master's Degree in Hydrology from Brussels' University of Libre in 1995. In 2001, he received his Doctoral Degree from the Technical University of Crete, specializing in Environmental Sciences and Sustainable Development. Lucas lived in Canada for a year as a postdoctoral fellow at Simon Fraser University in Vancouver British Columbia. Since 2006, he has worked at the Foundation for Research and Technology (FORTH) and at the Orthodox Academy of Crete (OAC) in Kolympari as the Scientific Officer and Head of the Institute of Theology and Ecology.

At the OAC, Lucas organizes seminars and conferences. In addition, he travels and lectures on ecological theology, fuzzy methodology, hydrology, economic anthropology, sustainable development, environmental ethics, and structural greed. Lucas is the founder and chief editor of a series of environmental books: *Ecological Theology and Environmental Ethics; Conservation and Sustainable Use of Wild Plant Diversity;* and *Sustainable Alternatives for Poverty Reduction and Ecological Justice.* Lucas is an active member of various academic and environmental organizations in North America, Asia, Africa and Europe. He is currently a member of the Planta Europa Steering Committee, and collaborates with the World Council of Churches as a sustainability consultant for the Greed Line Study and the Diakonia — *Poverty, Wealth and Ecology*.

Dr Jan-Willem Sneep was born in The Netherlands in 1948. He studied biolgy, ethology and botany at the University of Utrecht. Since 1980 Jan-Willem has worked as a member of the Ministry of Agriculture pertaining to Nature and Food Quality, for the Ministry of Economic Affairs in the Hague.

In the 1990s Jan-Willem developed a number of species policies in the Netherlands. He has been the Dutch representative at many international Conventions and Agreements: the Bern Convention (Council of Europe), the Convention on Biological Diversity (CBD), the Convention on the Conservation of Migratory Species (CMS/Bonn Convention), the African-Eurasian Water-Bird Agreement (AEWA), the Agreement on the Conservation of Populations of European Bats (EUROBATS), and the Agreement on the Conservation of Small Cetaceans of the Baltic and North Seas (ASCOBANS). Jan-Willem received the (first) Golden Butterfly Award in 1994. Until July 2005, he was the Head of the International Division of the Department for Nature of the Ministry of Agriculture, Nature and Food Quality. He developed the International Policy Programme for Biodiversity of the Netherlands in the years 2002- 2006, and he organized several international conferences. From 2003- 2007, he was Chair of the Committee of Experts for the development of the Pan-European Ecological Network (PEEN) of the Council of Europe. From 2004- 2014 he was Chair of the Planta Europa Steering Committee. Presently, he is the Director of the Planta Europa Foundation. In honour of his plant conservation work he received the 2014 Golden Planta Europa, Jean Paul Galand, Award.

Dr. Konstantinos B. Zorbas was born in 1959 in Larissa. In 1981, he received the Degree of Political Science in Strasbourg, and in 1987 he received the Degree of Sociology from the Catholic Institute of Paris and the degree of Theology from the Institute "Saint Serge" in Paris. Konstantinos began his postgraduate studies in Sociology of Christianity and in Pastoral Sociology and worked as a researcher in the Centre National de la Recherche Scientifique (CNRS) and the Catholic Institute in Paris. In 1996, he enrolled in postgraduate studies at the Theological Faculty of Thessaloniki, in Ethics and Sociology.

From 1988-1999 Konstantinos was a staff member of the Orthodox Academy of Crete (OAC) and from 1998 he served in Secondary Ecclesiastical Education and as a visiting Professor while furthering postgraduate studies in the Department of Biology at the University of Athens. From 2004 -2009 he served the Church of Greece as Director of the "Observatory of Social Issues" and from 2009-2014 he served as the Permanent Representation of Greece to the European Union. In 2014 Konstantinos became the OAC General Director.

Konstantinos has published sociological and theological studies in Greek and foreign magazines and has participated in many scientific international congresses. He has contributed to proposals and interventions put forth by various Commissions of the Conference of European Churches (CEC), and the World Council of Churches (WCC). He has participated in many ecumenical missions and is a member of the Ecumenical Association of the Academies and Laity Centers (Oikosnet Europe).

This book, and the Conference itself, will not solve or fully cover the important issue of plant conservation in Europe. The collaboration between participants has opened new opportunities for analysis and criticism of the existing plant conservation strategies. The papers provide a useful perspective to evaluate the diversity of the approaches towards sustainable use of wild plants and plant conservation issues. The Planta Europa Crete Declaration for 2014 summarises the outcome of the 7th Planta Europa conference and is presented at the end of this book. Much is still needed to improve the understanding of Plant conservation problems and awareness.

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ISBN 978-1-943484-00-3
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