



## **Darwin Initiative for the Survival of Species**

### **Final Report**

### **Darwin Project in Coastal Vegetation Survey and Conservation for Lebanon**

**Project Reference No. 8/196**



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## 1. Darwin Project Information

Project title	The Darwin Project in Coastal Vegetation Survey and Conservation for Lebanon
Country	Lebanon
Contractor	Royal Botanic Gardens Kew
Project Reference No.	8/196
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Starting/Finishing dates	June 1999/ July 2002

## 2. Project Background/Rationale

Located at the crossroads between Europe, Asia and Africa, the Mediterranean Basin comprises a wealth of habitats and rich biodiversity and has been recognised as one of the world's 25 hotspots for conservation priorities (Myers *et al*, 2000). Lebanon is an integral region of the Mediterranean Basin in terms of biological wealth and the whole country lies within the Levantine Uplands Centre of Plant Diversity (WWF and IUCN, 1994) with a reported 12% of its flora being endemic. However, Lebanon's environment is under many anthropogenic pressures threatening its floristic richness and extensive biodiversity, including habitat loss and fragmentation, unsustainable use of resources, urban development and pollution. The coastal zone of Lebanon has endured the greatest threats induced by human pressures. Some 67% of the population live within the coastal zone at a very high population density. Population growth is estimated to be increasing by 1.65% annually. Rapid industrialisation has taken place along the coast, thereby exacerbating the problem and further threatening coastal ecosystems. In addition to this industrial and residential development along the coast the tourism sector has focussed primarily on the coast, placing immense stress on coastal habitats. Thus the coast is considered to contain the most threatened habitats in the country.

The current environmental condition of the Lebanese coast demands urgent and immediate biodiversity studies as well as an evaluation of the overall ecological status of coastal habitats. Studies of this nature will facilitate the implementation of practical strategies for conservation as well as management of coastal ecosystems to prevent further degradation and loss of biodiversity and will aid Lebanon in meeting its obligations under the CBD.

The need for this project was identified through discussions with staff from RBG Kew and AUB in Lebanon during April 1997 and August 1998. Discussions were also held with protected area managers and the team responsible for the Lebanese National Biodiversity Strategy and Action Plan (Ministry of Environment, 1998). These meetings identified the need to support national conservation objectives through the development

of plant and habitat conservation skills in Lebanon. The need for these activities was identified as a priority by both AUB and the newly formed Ministry of Environment.

Lebanon is a signatory to the Convention on Biological Diversity (signed 1992, ratified 1994). The conservation infrastructure of the country has suffered through years of civil war and is poorly developed in terms of protected area establishment and biological inventory. The project was conceived in such a way as to directly support the objectives of the CBD and the recently completed National Environmental Action Plan for Lebanon, in particular through capacity building for botanical inventory (Article 7). Results from survey work on culturally and economically important plant species may enable recommendation for their sustainable use (Article 10) to be made, and wider application to protected area management (Article 8) and threatened species management (Article 9). With few professionally trained taxonomists in Lebanon, the project was devised to provide training in plant identification, field botany techniques, inventory and herbarium practice (Article 12) and threatened species management (Article 9). With no recent flora for the country and no Red List for vascular plants, the project was designed to establish skills for a complete floristic review of the country and to produce a conservation assessment of the coastal flora, thought to be the most threatened zone in Lebanon. Results from this project would provide lots of materials for the promotion of public awareness and development issues (Article 13).

### **3. Project Summary**

The overall purpose of the 'Darwin Project in Coastal Vegetation Survey and Conservation for Lebanon' was to improve national capacity for the management of plant diversity, threatened species management and protected area planning and management. The key objectives were:

- 1) To undertake a survey of coastal vegetation areas, the most threatened habitat in Lebanon using:
  - GIS survey assessing geology, land use and incorporating vegetation survey data
  - Selection of five sites for ground truthing
  - Survey of Lebanese and UK herbaria for plant records
- 2) To undertake an inventory of coastal species of these five sites, identifying threatened plant species and habitats, including an initial assessment of culturally and economically important plant species
- 3) The identification of important areas/ sites for plant conservation
- 4) To provide training in botanical inventory, plant identification, and herbarium management
- 5) To provide training in recovery planning for three selected species and the initiation of planting projects with coastal resorts
- 6) To establish plant biodiversity as a teaching and research component within Lebanese universities

- 7) To establish professional and scientific links between UK and Lebanese scientists, particularly with regard to plant diversity assessment and management in preparation for the Euro+Med project and potential botanic garden development.

These original objectives continued to be the clear focus throughout the project. The operational plan underwent some slight modifications during the project, mainly in terms of timings for certain activities, but also in the relative importance of some objectives. There was a change in project leader early on in the project due to staff changes at RBG Kew and the project length was extended and a new end date agreed. All of these modifications were communicated to the Darwin Initiative either via the six-monthly and annual reports, or directly by letter and approval gained for the changes.

All elements of the project were closely tied to the objectives of the CBD and to helping enable better implementation by the Lebanese Government. A project of this nature has implications for many of the key articles of the CBD, but its major impact was in the delivery of Article 7, Identification and Monitoring, and Article 12, Research and Training (see Appendix I). A body of information about biodiversity along the thermomediterranean coastal zone of Lebanon has been established and systems for monitoring this developed (Article 7). Research capacity has been built principally at the American University of Beirut for undertaking biodiversity studies and making recommendations about their conservation and sustainable use (Article 12). This body of information and capacity is now being applied to implement other keys aspects of the CBD; most notably General Measures for Conservation and Sustainable Use (Article 6), *In situ* and *Ex situ* Conservation (Articles 8 and 9), Sustainable Use of Components of Biodiversity (Article 10), Incentive Measures (Article 11) and Public Education and Awareness (Article 13).

This project has enjoyed a large measure of success and made important contributions to our understanding of the biodiversity of the coastal habitats of Lebanon and of measures for their conservation and potential sustainable use.

Objective one has been exceeded. A series of GIS based maps and analyses of the coast have been completed (Chatila, Appendix V), 26 sites rather than the planned five have been established along the coast and form an important monitoring network. The Lebanon and UK herbarium based investigations have been completed and has resulted in the production of a new coastal checklist comprising 1530 species of vascular plants. This has been supplemented by the project inventory (objective 2) and now stands at approximately 1800 species (some species remain unidentified due to lack of adequate flowering material). This checklist is currently being prepared for publication.

Objective two has been exceeded. The coastal inventory has been completed based on 25 sites rather than the five originally planned and approximately 1800 specimens collected (Dardas, Dagher, Appendix V). Duplicates of all specimens were collected. One set forms the plant reference collection at AUB, although due to herbarium management problems some of these specimens have deteriorated. The second set has been incorporated into the University of Reading Herbarium where they are held under a material transfer agreement between AUB and University of Reading and remain the sovereign property of Lebanon. Initial assessments have been made of endemic, threatened and potentially useful plant species from the coastal zone (Dardas, Dagher, Zahreddine, Appendix V, Rteil in preparation). An additional vegetation survey was

undertaken along the coastal stretch of the Ibrahim River based on an extra twenty sites established along a 10 km coastal stretch of the river (Abboud, Appendix V). A habitat assessment model was also developed during this study.

In addition to surveys for plants, a survey of insect diversity was undertaken as an extra and complementary study (El Hachem, Appendix V). 2000 insects were collected and form an important reference collection at AUB. Identification of many of these beyond the family or order level remains a problem due to lack of insect taxonomic capacity.

The biodiversity data collected during these seven MSc projects together with other activities undertaken during the Darwin project has provided vital baseline data for us to be able to identify important sites for plant conservation (Objective 3) and we are working on recommendations for action. One interesting outcome of this work is that coastal sites that already have a degree of protection for other reasons will become increasingly important as refugia for plants as coastal development continues. These include archaeological sites such as Byblos and Tyr, offshore islands such as at Raouché in Beirut and the university campus of AUB. The project leaders are further developing these ideas. We do not have sufficient data to produce a redlist for the coast and work will continue beyond the life of this project to try and complete this.

Most of the training activities have been completed successfully (Objectives 4 and 5) and many people have benefited from them. However, taxonomic capacity is not built in three years, and although strides have been made this is an area that needs long-term support and the international partners are maintaining this support. A number of systems remain to be implemented at the Post Herbarium before it can take its full role as a functioning biodiversity support facility. Most of these are in hand and should be in place very soon.

Recovery planning was initially planned for three selected species (Objectives 5) and these have had mixed success. One species, *Pancreatium maritimum*, was followed right through to trial plantings, although these were largely unsuccessful, partly due to a loss of sites and partly due to the use of seeds rather than bulbs. Some work has been done on the other species, *Vagararia parviflora* and *Matthiola crassifolia*, but this has not progressed very far. The take-up for potential commercialisation of some for the commercial plants has been largely unsuccessful partly due to the poor economic situation in Lebanon. AUB will continue to try and achieve this beyond the life of the current project.

Plant biodiversity has been firmly established as a component of teaching and research at the American University of Beirut and some contacts established with other universities, most notably the Lebanese University (Objective 6).

The project has provided many opportunities for the establishment and development of professional and scientific links between UK and Lebanese scientists (Objective 7). Reciprocal visits were made to UK and to Lebanon during the project. Joint papers have been presented at international meetings. AUB has become the Lebanese focal point for the Euro+Med project. Little has been accomplished with regard to botanic garden development, initially due to lack of resources and interest from the horticultural industry, but latterly because we are not convinced that this is a priority area for Lebanon at this time.

#### 4. Scientific, Training, and Technical Assessment

The overall purpose of the project was to improve Lebanon's national capacity for the management of plant diversity, threatened species management and protected area planning and management. This was achieved through a combination of research activities, training and capacity building. The main focus of these research and training activities centred around a group of young Lebanese MSc students who received training in relevant skills and field techniques in order to undertake the fieldwork associated with completing the research thesis component of their Masters programme. Training in these field skills was delivered by the international project partners from RBG Kew and University of Reading who also provided some academic training and background through a series of lectures and workshops at AUB. The rest of their training was provided within the academic framework of their master's programme. Five of the seven Darwin project students were registered in the newly established Ecosystem Management programme within the Faculty of Agricultural and Food Sciences. One majored in Plant Sciences and another in Crop Production. The research projects were devised in such a way as to have their own identity in order to meet the university thesis requirements. They were also designed such that they all were undertaken within the coastal zone and where results would complement each other and contribute to the overall goal of the Darwin project. The entry requirements for students and the examining of all aspects of their progress were subject to the strict university rules and regulations for Masters students. The students' AUB supervisors, Drs Talhouk, Zurayk, Baalbaki and Knio, also participated in various aspects of the field training programme so that there was integration between overseas and AUB supervisors. Regular joint meetings were held whilst UK partners were in Lebanon and specific UK partners were formally part of the students university examination committee.

Dr Stephen Jury from the University of Reading delivered the basic training in botanical inventory, plant identification and herbarium management. This was held annually, usually at the beginning of the spring-early summer collecting season. Dr Mike Maunder (Year 1) and Dr Colin Clubbe from RBG Kew provided the conservation framework and training in field assessment, recovery planning and related techniques. Specialist lectures were delivered as part of various courses offered within the Masters programme.

Project research results were those collectively generated by the seven MSc students and so the research and training activities were intimately tied together within the framework of the Masters programme.

At the start of the project, 26 representative coastal plant communities were established along the Thermomediterranean coastal zone of Lebanon. These were all geo-referenced and incorporated into a Geographic Information System (GIS). At each location standard field techniques were used to assess the habitat, to collect plant and insect samples and to collect data regarding their distribution. Locations were visited regularly on a monthly basis for one whole season during 1999-2000. Four MSc students contributed to this phase of the project providing an understanding of the floristic and insect distribution along the coast and an analysis of the relationship between floristic diversity and landscape physical components of the coastal zone. Major outputs include maps; two reference collections comprising 1800 plant specimens and 2000 insect specimens collected; plant and insect species lists for the coast; a digital image database of habitats,

plant portraits and some insects. Summaries of this work can be seen in the theses abstracts included as Appendix V (Dardas, Dagher, Chatila and El Hachem).

MSc student Hala Zahreddine examined two native coastal bulb species, *Pancratium maritimum* and *Vagaria parviflora*, as case studies using ecogeographic survey, population studies and genetic characterisation as her main methodologies. In addition she looked at possibilities of reintroduction (see Appendix V). MSc student Hiba Rteil followed this approach by reviewing conservation assessment methodologies and focussing on *Matthiola crassifolia*, a potentially threatened coastal endemic as her case study. This thesis has been completed, examined and passed subject to corrections. However, at the time of writing this report these corrections have not been finished and so her abstract is not available for Appendix V. The application of the IUCN redlist categories of threat are being recommended as an important tool for conservation in Lebanon, and although we are beginning to build-up a good body of information we do not yet have enough data to produce a coastal redlist. However, *Matthiola crassifolia* has been assessed as Endangered.

The final MSc student, Maya Abboud, took a slightly different approach and investigated vegetation patterns and assessed riparian habitats along a 10 km stretch of the Ibrahim River, within the defined coastal zone (see Appendix V).

In addition to the focus on the Darwin project students, all training activities were made available to postgraduate students studying in related disciplines who were working with Dr Talhouk and Dr Zurayk's groups (see Table 1). In addition, Drs Jury, Maunder and Clubbe all gave lectures and/or contributed to discussion forums on related undergraduate programmes. This is one of the approaches that we took to ensure that the project achieved its objective to establish biodiversity as a component of training at AUB and consolidate the position of AUB as a regional centre for natural resource and biodiversity management.

Full details of all the results of the research, training and dissemination activities for the project have been compiled into a project CD that is included with this report. The more important results from this work are currently being written up for publication in peer reviewed journals (see section 6).

Some training activities were undertaken in the UK as four MSc students and one staff member came to the UK for periods of between one and ten weeks for practical experience/ internship (herbarium management, GIS, conservation) or formal courses (Plant Conservation Techniques, Herbarium Techniques). Further details of these are provided in section 6.

Although the full project team contributed to activities, the MSc students took a lead in developing the outreach activities with schoolteachers and other educators, with NGO groups including environmental groups and with ecotourism operators. This provided both excellent training opportunities for the students as well as an immediate outlet for dissemination of project results.



## 5. Project Impacts

The Darwin Project in Coastal Vegetation Survey and Conservation for Lebanon was conceived to support national conservation objectives through the development of plant and habitat conservation skills in Lebanon and so improve national capacity for the management of plant diversity, threatened species and plant protected areas. Success in these objectives would directly help Lebanon meet its obligations under the CBD because of the close linking between project activities and purpose and specific key articles of the CBD. A measure of the success of these objectives is the way in which Dr Talhouk's group at AUB has become directly involved with so many aspects of the Ministry of Environment (MOE), the responsible Ministry for implementing the CBD, during the course of the Darwin project. Since the formal end of the project this shows no signs of changing. Dr Talhouk is one of the CBD National Focal Points, acting as the Access and Benefit Sharing Competent Authority for Lebanon (see [www.biodiv.org/world/map.asp?ctr=lb](http://www.biodiv.org/world/map.asp?ctr=lb)). The MOE are in regular contact for advice on many aspects of conservation, sustainable use and benefit sharing of Lebanon's biodiversity, and Dr Talhouk has been asked to bid for a number of relevant consultancies. Her group contributed most of the Biodiversity and Environment data for the newly completed State of the Environment Report (MOE, 2001) and a significant element of Darwin project results informed this input. The Director of the MOE, Dr Berj Hatjian, opened our key Darwin Seminar Series that reported the results of the Darwin project to an invited audience of 70 academics, civil servants, NGOs and representatives of the business community at the end of the project. He also allowed his presentation 'Discussion of current efforts, future plans and objectives of the Ministry of the Environment' to be reproduced in full on the project CD which has been widely disseminated.

What is arguably a better measure of success of this project is the destination of the MSc students who have graduated from the Darwin programme at AUB (Table 1). Most of them are still in very relevant fields and so are contributing to increased capacity for biodiversity in Lebanon. Three have been snapped up to work on projects directly related to biodiversity activities on Lebanon's coast and all are using the specialist skills that they developed whilst doing their thesis research under the auspices of the Darwin project. Maya Abboud is working on the production of the second Country Report for Lebanon using the new CBD guidelines, employed by the Ministry of Environment. Joanna Chatila has been in demand for her GIS skills and has worked on several biodiversity/ environmental projects since graduating. Hiba Rteil has been hired by MORES (Management of Resources and Environmental Solutions) who have got the contract for the Coastal Area Management Programme (CAMP) project. Ms Rteil is co-ordinating the fisheries, agriculture and biodiversity elements of this project. Mirelle Dardas and Marcelle Dagher have both entered the teaching profession and are bringing biodiversity issues and Darwin project results into the school curriculum. Hala Zahreddine is doing her PhD on indigenous tree species and their potential for domestication. This is likely to be further enhanced by the establishment of an Institute for Biodiversity Studies in Arid Regions at AUB (see Legacy section).

The project has catalysed several other positive outputs in rather unexpected areas. A very fruitful collaboration has been developed with Dr Jala Makhzoumi, a landscape architect who joined the faculty of Agriculture and Food Sciences during the course of the Darwin project. This collaboration has included developing an exercise with the aim of introducing landscape design students to the concept of biodiversity and *in-situ* conservation, and of generating ideas, practical solutions and concepts that carry the research undertaken by the Darwin Initiative into the domain of implementable landscape plans and concepts. The Dalieh site in Beirut was set as a design studio project for second year Landscape Design and Eco-Management Students. Use was made of the data available through the Darwin project to set up a landscape design project that would introduce landscape students to nature conservation in Lebanon, problems and prospects. It made for a challenging project not only because of the diversity of plants on site, the outstanding scenic prospects of the site, but equally because Dalieh is one of the few remaining green spaces in Beirut open to the public. The research ideas generated that guided the Dalieh project have been written up as a paper, 'Towards a holistic approach to biodiversity conservation: establishing nature pockets in coastal Lebanon' by Drs Makhzoumi, Talhouk and Clubbe. Dr Makhzoumi presented this at the International Congress of Ecology in Seoul, South Korea in August 2002 and it will be published in the conference proceeding. This collaboration has now been embedded into other joint courses being taught jointly by Drs Makhzoumi and Talhouk in the 2002-03 academic year with guest input from visiting specialists, including Dr Clubbe during his October 2002 visit to AUB. This collaboration has also rekindled the interest in the use of indigenous species in coastal landscaping, a topic originally explored by Hala Zahreddine during her MSc. A student from the Universite Saint-Esprit Kaslik, Faculte des Sciences Agronomiques is following up her initial work on coastal bulb propagation and re-introduction, this time using bulbs rather than seeds which proven unsuccessful in the earlier trials. This is a 1-year senior thesis undertaken in the final year of this 5-year programme, supervised by Dr Talhouk.

Table 1: Darwin workshop participants

Name and Role in AUB	Current Activity
1. Darwin-funded Scholars	
Hala Zahreddine	MSc awarded. Currently doing PhD at Ohio Sate University, USA on propagation of indigenous Lebanese trees, funded by USDA.
Joanna Chatila	MSc awarded. Currently undertaking conservation-related project work (especially GIS) for the Lebanese Government and other organisations in Lebanon.
Maya Abboud	MSc awarded. Currently undertaking consultancy work for the Ministry of Environment preparing the Second National Report for the CBD.

Hiba Rteil	MSc awarded. Currently working on the Coastal Management Plan project for an environmental company (MORES).
2. Non Darwin-funded MSc students working directly on Darwin project	
Marcelle Dagher	MSc awarded. Currently working as a science co-ordinator in a school in Beirut.
Mirella Dardas	MSc awarded. Currently working as a science teacher in Dubai.
Roland El-Hachem	MSc awarded. Currently working for a pharmaceutical company in Beirut.
3. Other postgraduates at AUB benefiting from training	
Layla Saad	MSc awarded. Currently doing a PhD in ecology in Belgium at the Faculté Universitaire des Sciences Agronomiques de Gembloux (fieldwork being done in Lebanon).
Elsa Sattout	Completing PhD in sustainable utilisation of <i>Cedrus libani</i> , registered with University of Reading, UK.
Ali Al-Khatib	Completing PhD in population genetics and conservation at University of Reading, UK.
Khaled Slim	MSc awarded. Currently field assistant on the Biotechnology project funded by USDA
Lama Abel Samad	MSc awarded.
Nada Sinno Saoud	Instructor, Faculty of Arts and Food Sciences. Registered for PhD in taxonomy at University of Reading, UK
4. AUB Faculty	
Dr Salma Talhouk	Associate Professor, Faculty of Agricultural and Food Sciences
Dr Rami Zurayk	Professor, Faculty of Agricultural and Food Sciences
Dr Riad Baalbaki	Associate Professor, Faculty of Agricultural and Food Sciences
Dr Khouzama Knio	Associate Professor, Faculty of Arts and Sciences
Dr Jala Makhzoumi	Associate Professor, Faculty of Agricultural and Food Sciences

Another unplanned development has been the activities aimed at the restoration and redevelopment of the Post herbarium at AUB. The collections made by George E Post in the 1850s were augmented by Ms W.S. Edgecombe in the 1960s and form the majority of the Post herbarium at AUB that contains plant specimens belonging to 177 families and 955 genera including many type specimens of great significance. There has been little activity or additions to the herbarium since Edgecombe's work and the collections have remained in 36 insect proof cabinets, somewhat unavailable. Within the context of the Darwin project efforts have been made to redevelop the Post herbarium to enable it to become once again a valuable resource in the conservation of Lebanon's biodiversity. Lacking a curator, Ms Nada Sinno Saoud, an instructor in the Department of Biology where the herbarium is located has developed a special interest in the herbarium. Capitalising on this interest and recognising the vitally important role a functioning herbarium can play in biodiversity conservation the project leaders encouraged Ms Sinno Saoud and spoke to the Chairman of the Biology Department about possible developments and opportunities for training. This resulted in Ms Sinno Saoud spending a week visiting the University of Reading and the Kew herbaria during project year 1 to get some broader experience. She then attended and successfully completed the 8-week Kew International Diploma course in Herbarium Techniques during 2001. Funds were found for this largely outside the Darwin budget, funded by AUB and RBG Kew. Ms Sinno Saoud has already implemented some of the ideas gained in the UK by introducing new herbarium management system and undertaking a re-organisation of the herbarium so that it is easier to use. AUB has also supported these the rehabilitation efforts. Funds have been made available to purchase additional herbarium cabinets, a freezer, a computer and a scanner for the Post herbarium. In addition the on-going Campus master planning at AUB will consider the relocation of the herbarium to provide more adequate space and exposure to public use. Early in 2002 a consultant from NHM Consulting, UK undertook a consultancy at AUB: 'Scoping study on the proposed AUB natural history museum and a review of the existing collections'. His report has been accepted by the senior administration at AUB and funding is being sought to implement the major recommendations. The report recognised the regional and international importance of the Post herbarium, but commented that it is poorly housed and needs to be moved into a controlled environment and provided with a preparation room for drying and for digitising the collection.

Duplicates of all the plant collections made during the Darwin project have been incorporated into the Reading Herbarium. The importance of having a separate, duplicate collection has been highlighted by a number of problems associated with re-establishing the Post Herbarium as a biodiversity facility. We have been trying to secure extra resources and recognition for the Post Herbarium and so have met with AUB Provost, President, the Dean of Arts and Sciences, and the Dean of Agricultural and Food Sciences. These discussions have included the need for extra space and more fire-proof cabinets in the herbarium to accommodate new specimens and improving the air conditioning. We have also been seeking a release of teaching duties for Ms Sinno Saoud so that she can take a more active role as acting curator and spend more time managing the herbarium and developing the systems needed for it to become fully functional. This has been taking some time, as there is some resistance to do too much until the overall plan for natural history collections has been funded and implemented. However, we have

gained agreement and implementation on a number of issues. The air conditioning has been replaced. The Dean of Agricultural and Food Sciences has agreed funding for new cabinets. The Dean of Arts and Sciences has agreed to re-allocate teaching duties so that Ms Sinno Saoud will be half time managing the herbarium that is adequate for the time being. Although Ms Sinno Saoud has written a new accessions policy for the Herbarium, based on training received at Kew, this has not yet been fully implemented. The one casualty in all this has been the AUB Darwin specimens. Because they could not be incorporated directly into the Post Herbarium they were kept in cabinets where the humidity was too high. Unfortunately this resulted in an outbreak of herbarium beetle that adversely affected the specimens which required another low temperature treatment in a deep freeze to exterminate them. During the freezing process the deep freeze defrosted and the specimens further deteriorated. At the time of writing this report we do not know how bad this is and what proportion of the approximately 1200 specimens being treated will be irrevocably damaged. Fortunately duplicate specimens are being held in ideal conditions in the Reading Herbarium and so will be available for future use as a substitute for any lost at AUB. Learning from this we are now trying to ensure that all systems are fully operational at AUB, and we are confident that with extra time allocated to Ms Sinno Saoud this will happen.

The collections have already been used as a reference collection by external researchers. They were used to verify species included in a new Photographic Guide to Wild Flowers of Lebanon by Dr Ahmad Hourri and Nisrine Machaka Hourri, a popular guidebook published in 2001.

In October 2001 Ms Sinno Saoud registered as an external student to do a PhD in plant taxonomy at the University of Reading supervised by Dr Jury, largely self-funded, but with some support from AUB. It is hoped that this renewed interest in the Post Herbarium and natural history collections at AUB, together with the staff development programme, will result in a new lease of life for the Post Herbarium and the development of a facility that will be of real service to biodiversity conservation in Lebanon.

Collaborations between the major partners have developed into a productive long-term relationship. As ever funding for this is problematic. The University of Reading is providing opportunities for higher degrees for project personnel, especially at the PhD level, as AUB has no PhD programme. Two AUB students and 1 member of staff are currently registered at Reading (Table 1). Dr Stephen Jury at Reading is on the Executive Committee of the European Initiative for the Euro+Med PlantBase and provides the Secretariat for Euro+Med at Reading. The Euro+Med PlantBase ([www.euromed.org.uk](http://www.euromed.org.uk)) is the information resource for Euro-Mediterranean Plant Diversity. It was set-up as a direct response to the needs identified in the CBD and is funded by The European Union, the Linnean Society of London, the Botanical Society of the British Isles, Atlas Flora Europae, and the Organisation for the Phyto-Taxonomic Investigation of the Mediterranean Area (OPTIMA). Dr Jury continues to collaborate with AUB and in particular is providing an identification and verification service for Dr Talhouk and her current USDA-funded Biotechnology Project and duplicate specimens continue to be housed at Reading. These are important additions to the Euro+Med project and will be incorporated into the new Mediterranean checklist, an output of the Euro+Med project. Lebanon, through Dr Talhouk, now participates in the European taxonomic group, OPTIMA, and they presented a joint paper on developments in the Post Herbarium and

results from the Darwin project at the OPTIMA meeting in Palermo, Italy in September 2001.

RBG Kew continues to provide short course training opportunities such as the Plant Conservation Techniques, Botanic Garden Management and Herbarium Techniques courses. Dr Clubbe remains involved in the broader conservation and landscape issues with Dr Talhouk. Dr Maunder retains the links he made in setting-up the project from his new position at the National Tropical Botanic Garden in Hawaii and was able to join us and contribute to the final Darwin seminar series. Partnerships are set to continue to be productive into the future.

## **6. Project Outputs**

UK project staff spent a total of 43 weeks in Lebanon during the course of this project. Much of this time was dedicated to training and teaching activities with the AUB MSc students (Darwin Scholars), both in the field and at the AUB campus. Opportunities were also created for some students and faculty to participate in training activities at UK partner institutions. Consequently all the training outputs have been exceeded. The start of the Darwin Initiative project generated much interest and excitement within AUB and there were several students who also wanted to undertake related projects in the coastal zone and brought funds into the project. Dr Talhouk and Dr Zurayk were able to accommodate these extra students within the Ecosystem Management programme, and so within the Darwin project. Consequently although the project provided scholarships for four Darwin scholars, seven graduated. When formal workshops were being run at AUB or fieldtrips organised invitations were extended to other relevant faculty and postgraduate students so that there was maximum benefit gained from these activities. Consequently, the mean number of participants in any one training activity was close to the 10 estimated in the original proposal and the total numbers over the lifetime of the project exceeded the original estimates.

Four MSc students and one AUB faculty came to the UK as Darwin Scholars to participate in organised training programmes at UK partner institutions. Three of them gained formal qualifications. MSc students Hala Zahreddine and Maya Abboud were awarded the Kew International Diploma in Plant Conservation Techniques. Staff member, Nada Sinno Saoud, was awarded the Kew International Diploma in Herbarium Techniques, and on a separate occasion spend time working in the Reading and Kew Herbaria to gain experience of different types of herbaria. Ms Sinno Saoud has now registered at the University of Reading to undertake her PhD in taxonomy. MSc students Hiba Rteil and Joanna Chatila each undertook 1-month internships at Kew and Reading respectively. Funding for more than half of this was in kind or outside the project budget and so represents additional outputs.

The training packs conceived within the original project proposal were completed in a variety of forms. These have all been incorporated into a project CD that is being widely disseminated. The CD technology has allowed us to add much more information to this and many of the major training, research and dissemination outputs have been packaged together on this one CD, not originally conceived as a project output. The availability and

reduction in price in producing this type of output will enable us to distribute the Darwin project activities and results much more widely and easily than originally anticipated. For example a copy is being sent to everyone who attended any of the training workshops or seminars, and the whole thing will eventually be put onto AUB's website and thus be accessible by anyone with access to the internet. This can be done by AUB at very little cost and so can continue indefinitely after the Darwin project has formally finished.

Since the primary objectives of this project were capacity building and training some of the research outputs have only been achieved towards the end of the project and will only be completed after the project has been completed. This is particularly so with regard to the research papers. Five or six papers were originally conceived to be possible from the project. None have yet been accepted for publication, and only one has been submitted from the floral inventory work. Three are currently in preparation and will be completed by the two main project leaders after the end of the project. A further three or four papers are possible from this project, either for international or national journals. The papers may be of a slightly different nature than those originally conceived. Insufficient data have been collected to enable us to put together a definitive Red List for the coast, although we do have some important information and will be following this up. Similarly the work on propagation protocols extended to only one species, *Pancratium maritimum*, rather than the five target taxa originally estimated.

We had originally envisaged plants as being the only Computer-based databases and species reference collections that the project would produce. However, the work on insects has doubled these estimates and the development of an important image database has added another extra output. Collectively these provide a very important biodiversity information resource at AUB. Duplicates of all the plants collected are also held in the University of Reading herbarium adding to security of these data. The computer-based information is also held on several different computer systems for extra security.

The dissemination outputs were not fully quantified in the original proposal and so most of them appear as additional. Opportunities were taken wherever possible to publicise activities and results of the Darwin project and the project CD will be a good vehicle to continue this dissemination. Importantly results and experiences from the Darwin project have been fully integrated into the academic teaching at AUB, including the new programme in Landscape Design and Ecosystem Management. Results are also used as case-study examples in various teaching programmes at Kew and Reading.

A project website was created at AUB <<http://staff.aub.edu.lb/~webeco/darwin.htm>> within the 'e-cosystem' programme area. Indeed it was largely as a result of the Darwin project that the new MSc programme in Ecosystem Management has become established within the AUB curriculum. The Darwin project gave a subject focus and studentships just as this programme started.

In terms of physical outputs, a Darwin library has been established at AUB within the Faculty of Agricultural and Food Sciences, with many books and references donated by UK partners. Because of the nature of the sampling methodology and the intensity of the fieldwork undertaken we were able to greatly exceed the number of permanent field plots established during the lifetime of the project and these should provide valuable opportunities for longer-term studies.

## **7. Project Expenditure**

The Darwin Grant was managed through the Finance Department at RBG Kew and there was good communication between Kew Finance and the Darwin Initiative on both rescheduling the grant during the first year to take account of the changes in personnel and agreed changes in timing of some activities. In addition there was regular dialogue between AUB Office of Grants and Contracts and RBG Kew Finance. As the project developed a number of requests were made for carry-over and for virement between budget lines all of which were agreed by the Darwin Initiative within the appropriate financial year. The main causes for these requests were due to an increase in costs of scholarships at AUB and increased conference costs, hence these two budget lines showing as over budget. These costs were transferred from other lines, notably Printing and Travel and Subsistence where savings could be made. Thus the overall budget balances.

## **8. Project Operation and Partnerships:**

The project was conceived as a collaboration between RBG Kew, with University of Reading providing specialist support for Mediterranean taxonomy, and the American University of Beirut. Local counterparts were fully involved in the planning of the project from the outset, for the development of the workplan and key objectives, and the training strategy. AUB is the leading university in Lebanon playing a key role in research, teaching and advice. An annual planning meeting in Beirut reviewed the progress of the project and planned the forward workplan. Any changes were agreed collectively and if necessary the Darwin Initiative consulted. The nature of the changes were minor and were largely change timings of some activities such as workshops. Contact was maintained between the steering group via email, fax or telephone as necessary. Communications worked well. There was a change in project leader early on in the project when Dr Maunder left Kew to take up a new position at the National Tropical Botanical Garden in Hawaii. Dr Clubbe took over as project leader and the hand-over was straightforward. Drs Maunder and Clubbe were able to go to Beirut together to ensure there was continuity with partners at AUB.

Dr Jury from the University of Reading is a taxonomist who specialises in the Mediterranean region. He is currently running the Euro+Med (see section 12). AUB has become the focal point for Lebanon for the Euro+Med project and so there is an on-going collaboration between Reading and AUB that will continue well beyond this Darwin project. Until sufficient taxonomic capability is build at AUB Dr Jury is continuing to



identify and verify specimens collected during the USDA funded Biotechnology Project (2001-2004). Dr Talhouk continues to send duplicates of all specimens collected in this project to Reading and these are incorporated in the Reading University herbarium under a material transfer agreement between the two institutions. Dr Talhouk's confidence in this arrangement has developed as a direct consequence of the collaboration during this Darwin project.

Dr Talhouk is a national focal point for the CBD and is in regular contact with the Ministry of Environment, the ministry with responsibility for the CBD. This is an on-going situation. Dr Talhouk and two of recently graduated masters students (one a former Darwin scholar) are currently doing the bulk of the data collection and reporting for Lebanon's second country report. We can confidently expect this strong relationship with the Ministry of Environment to continue.

At the end of the project a number of other potentially beneficial partnerships are developing with environmental NGOs and ecotourism operators. Formed during the workshop given for these groups during year 3 of the project, it is a unfortunate that the Darwin project funding is ending just as we are at a point where sufficient biodiversity information has been generated by the project to meet the needs of these groups. A small grant proposal to take this forward by establishing a dedicated website and produce other biodiversity materials for their use was unsuccessful, but we are confident that we will be able to take this forward successfully. A number of other private sector groups have shown some interest and these are being pursued. The formation of a new biodiversity institute within AUB may help in this respect (see section 12).

## **9. Monitoring and Evaluation, Lesson learning**

Because the project management team was small with only one local and two international partners and all had good access to email, fax and phone, communication was good and the partners were able to keep in close contact. The annual planning meeting served as a forum for evaluating whether the project was on track as well planning the next series of activities. Both international partners made regular visits to Beirut for training and other project activities so that personal contacts were also kept up and any problems or changes could be deal with efficiently.

AUB masters' students were collecting the scientific data and so this was firmly embedded within the university's monitoring and evaluation system. The students had to make the grade point average to be accepted onto the programme. Each student had a supervisory committee with which they met on a regular basis for tutorials and to review progress against the objectives agreed for each thesis. These thesis objectives nested within the project objectives. Dr Clubbe was an external advisor for each of the students. Dr Talhouk held a regular lab meeting for all masters' students on the first Monday of each month where students would present their finding and there was a formal opportunity for comment and discussion. Drs Jury, Maunder and Clubbe attended this whenever possible. Theses are examined in a rigorous manner, the regulations being clearly laid down by the university. Each student has to do a comprehensive examination which is a viva with a 3 or 4 person committee where they present their draft thesis

outline and talk about the project and results and respond to questions. This is followed by the thesis defence that comprises two elements. Firstly they give a PowerPoint presentation of their work to an open university audience. These are advertised widely on campus and typically attract a good audience. There is an open question session following the presentation. After the presentation the student takes their viva with a Faculty appointed examination committee. The committee can demand minor or major changes before the thesis is finally bound and submitted to the Library and the degree awarded.

The major finding from all the projects will be subject to peer review as they are written up for publication. Some of the work is of a scope that it is being submitted to international journals. Other results are of more local relevance and are being written up for the Lebanese Journal of Science. All journals are peer reviewed.

Although there has been no formal external evaluation of the project as a whole there was a commissioned review of the natural history collections to evaluate their significance and state of curation with a view to re-housing them in a new Museum. The Natural History Museum's NHM Consulting undertook this. Neither Dr Talhouk nor Dr Clubbe met the consultant as neither was at AUB during the consultancy. He made the following comments about the Post Herbarium and Ms Sinno Saoud's training:

“This is an internationally significant collection that is being well curated by Nada Saoud. She was trained at Reading and Kew as part of the recent Darwin Initiative grant and the collections bear testament to the advantages of sending AUB curators away to be trained in modern collections management techniques. I recommend that other curators be given a similar opportunity, especially as training is much less expensive than remedial curation at a later date”.

Much has been achieved by the project in three years, but the project leaders feel that we are just at the point of achieving much more, just as the project finishes. The investment in MSc students is good for the future of Lebanese biodiversity, but it means that much of the experience gained during the project does not remain within the project as students graduate and move into employment. The agreement by the Darwin Initiative to some redeployment of funds during the project to allow us to employ two graduating students as short-term research assistants ensured an important degree of continuity within the project where one experienced student worked closely with the two newly started MSc students. Indeed the flexibility within the Darwin Initiative with regard to moving times and training activities and the funds for those components had a very positive effect on project management and success.

Taxonomic capacity is not built-up in three years when the starting point is virtually zero and more sustained support is required, although funds have not been identified for this. The Darwin Initiative might consider the possibility of an extension or follow-on application from countries where conservation capacity is just being built and where projects have not been funded before by the Initiative. In the present case an extra one to two years funding would enable a number of activities to be followed through. For example the actual establishment of a NGO/tour operator network with a dedicated biodiversity website with information generated by the project but adapted to the needs of tourists and the tour operators. This might also include an image bank of plant and habitat portraits that could be purchased by the tour operator for incorporation into their own brochures or publicity material. Funding is currently being sought for this. Tourism in

Lebanon and especially ecotourism is still relatively underdeveloped and it is important that biodiversity and conservation issues are firmly embedded within this developing sector. There are similar needs within the schools sector, some of which were clearly highlighted during the workshop for educators at the end of the project.

The conservation threats to the coastal area identified at the beginning of the project continue to pose problems. Three of the 26 coastal field study sites were lost during the course of the first 18 months of this project, affecting the work of four students. One was ploughed up and fenced for agriculture, one burned and cleared, and one cleared for a car park and related beach development. This not only highlighted the urgent need for conservation planning, based on sound data, an objective of the project, but also the urgency of the situation. Fortunately no further sites were lost, but coastal development, habitat fragmentation and loss continue to affect the coast at an accelerating rate.

We were unable to undertake any significant fieldwork in the far south of the country and this remains a hole in our dataset. We had hoped to be able to survey the southern areas after the Israeli withdrawal in May 2001, but were unable to fit this into the available time and resources. However, Hiba Rteil did include this area in her survey for *Matthiola crassifolia* and so was able to do a full survey for this threatened coastal endemic.

## 10. Darwin Identity

The use of the Darwin name in the title of the project and so in all correspondence about the project ensured that the name Darwin was kept in the forefront of all project activities. This included all internal AUB actions and relationships with the Grants Office, the President, Provost and Deans and the whole staff and student body. This is the only Darwin Initiative project to be awarded for work in Lebanon. Consequently the project was widely known as the Darwin project and developed its own key identity intimately linked with the Darwin name. Since this was also a clearly identifies stand-alone project it was not lost in any other bigger programme. Likewise the Darwin logo was used wherever possible (see products included with this report).

A resource centre was established at AUB based in Dr Talhouk's office and lab and known as the Darwin Library. People who wanted to know more about the Darwin initiative were referred to the Darwin Initiative Secretariat and the ECTF Darwin websites for full information.

Students funded from the Darwin grant were referred to as Darwin Scholars and this term was used in reports. The Darwin Initiative was acknowledged as the funding agency for their Masters work and a credit included in each thesis, which is lodged in AUB's Main Library.

It is difficult to gauge to what degree this information permeated the general population and so how familiar society is with the Darwin Initiative. There is a general lack of understanding and concern about biodiversity issues within many sectors of Lebanese society. It is for this reason that much effort was put in towards the end of the project to broadcast as widely as possible the results and activities of the Darwin project by engaging with NGO groups (environmental and non-environmental), school teachers and ecotourism groups. The wide distribution of the project CD with its distinct Darwin

identity together with the establishment of a biodiversity information website will, we hope, go a long way to addressing these issues. Both of these products are aimed at the community level rather than at the academic or government specialist. Both of these groups have been well served by information, publications and reports throughout the life of the project. This will continue beyond the end of the project, as there is still much scientific data to write-up for publication.

## **11. Leverage**

The budget was drawn up realistically. The funds available were sufficient to undertake all aspects of the project planned and so little effort was put into trying to secure extra funds. As the project developed the timetable of some activities was modified. This had an impact on when some particular funds were required and there was some virement between funding lines as the reality of transport costs, inflation etc became evident. The Darwin Initiative approved all of these changes (see section 7: project expenditure).

Some training opportunities arose that were not planned for in the original application and were funded from external funds. Nada Sinno Saoud's participation in Kew's Herbarium techniques course was funded by AUB (airfares) and RBG Kew (course fees, subsistence and accommodation). Maya Abboud's participation in Kew's Plant Conservation Techniques course and Hiba Rteil's 1-month internship at Kew were funded in a similar way. These extra training costs amounted to £7,5000 added to the project activity.

The three extra Darwin MSc projects attracted to the programme effectively brought in US\$60,000 (£40,000). This represents the scholarship fees (US\$20,000 per student) that were funded through Darwin for the four planned studentships in the original application.

The UK partners donated books for the Darwin Library and plant collecting materials amounting to approximately £200.

The confidence built and the track record established during the Darwin project was an important factor in Dr Talhouk securing a 3-year, US\$ 1million grant from the USDA for a Biotechnology Project in partnership with Ohio State University and the University of Toledo. This has a bioprospecting component looking for medicinal applications from plant compounds plus a capacity building element providing studentships for AUB students to do PhDs in Ohio. One of the Darwin scholars is on this programme (see table 1).

Dr Talhouk and several of the graduated Darwin Scholars have undertaken biodiversity-related consultancies as a direct result of the success of the Darwin project.

## **12. Sustainability and Legacy**

The core training completed during the lifetime of the project has produced a cadre of committed young conservationists who we hope will eventually take up key positions in conservation-related activities in Lebanon, whether in the public or private sector. This will be a lasting legacy of the project. Several graduates are already making their mark in this field (see Section 5). Biodiversity and conservation studies are now firmly embedded within core teaching at AUB across a range of programmes, including biology,

agriculture and landscape design and eco-management. Drs Clubbe, Jury and Maunder remain affiliated to AUB and will continue to contribute to teaching and other training whenever possible and are investigating other opportunities for collaboration. The Darwin Library of books, references and photos build up during the project remains functional and available as a valuable biodiversity reference facility.

Inevitably when project funding runs out there is a dip in activity and a lag phase. At the end of this project all the students have graduated and are employed and so that collective experience has been lost from the immediate environs of the Dr Talhouk's research group. This is exacerbated at AUB because of the lack of a PhD or post-doctoral programme. During the life of the project the Darwin Initiative approved the re-allocation of money to enable the short-term employment of Mirella Dardas and Maya Abboud as Research Assistants. This ensured a degree of continuity and time for completion of activities and products that might otherwise be delayed or not completed. This included valuable additional products such as the plant portrait and habitats image database and the project CD that were not planned for in the original proposal, but are proving to be amongst the most valuable products and ones with enduring legacy.

A very exciting development is currently under serious consideration by the university Deans and the Provost. Recognising the fact that continuity of staff and activities between projects is vital Dr Talhouk has been lobbying to form a centre for biodiversity studies within AUB. Under the working title of IBSAR (Institute for Biodiversity Studies in Arid Regions) a vision document has been produced and 22 founders members have committed to the idea. These founder members represent staff from a wide variety of disciplines across AUB (Faculties of Agricultural and Food Sciences, Arts and Sciences, Business, Medicine and Health Sciences). This proposal has been catalysed by the Darwin project and Dr Clubbe has had input into the proposal. An added benefit if the name IBSAR is adopted is that 'ibsar' is Arabic for 'to see' or a 'vision' and would translate in an easily recognisable logo and identity. The three key elements of the vision are to develop knowledge, to create a proactive interface with business, and to deepen dialogue with society. Dr Talhouk has informally asked Dr Clubbe to become a member of the international board of advisers.

The scientific results, especially the new coastal plant checklist and our understanding of community patterns on the coast, are already being used by the Ministry of Environment (MOE) in their documents and planning. The MOE completed a new State of the Environment report at the end of 2001 and cite results from the Darwin project. The MOE approach Dr Talhouk directly for advice and information regarding biodiversity, as do NGOs and other types of organisations. However, we cannot point to any concrete change in policy based on Darwin results, yet.

As a component of the developing collaboration between Dr Talhouk and Dr Makhzoumi at the interface between biodiversity conservation and landscape architecture we are actively pursuing our ideas for developing the AUB campus as a refuge for native biodiversity and in particular the less developed Middle Campus, already an important green space in Beirut. RBG Kew will remain an active partner in this and we are seeking funding to develop a landscape masterplan that will guide AUB in the utilisation of the Middle Campus. The masterplan will eventually take in the whole campus area and apply Local Agenda 21 ideas for enhancing native biodiversity and explore areas as potential refugia for threatened plants. Some significant areas of relatively natural habitat remain and populations of the endemic bulb *Vagararia parviflora* are already being monitored.

Sufficient publicity has been generated about the importance of the coastal biodiversity and AUB role in conservation by the Darwin project that a number of approaches have been made for help with development plans. There are two coastal development plans currently in the planning stages and AUB have been approached for advice and help with enhancing natural landscapes and using indigenous plant species in the planting schemes.

### **13. Value for money**

Like all Darwin projects the total amount of the grant was relatively modest. However, the project has achieved a lot, engaged a large number of people and raised the awareness of conservation issues, and the importance of biodiversity and because of this represents excellent value for money. It has confirmed Dr Talhouk and AUB as a centre of excellence for biodiversity information and advice and forged excellent working relationship between AUB and the Ministry of Environment. Closely allied to the CBD this relationship will enable Lebanon to better meet its commitments and do so with more reliable data and decision making. The project has also engaged a number of key sectors in society including schools, NGOs and the private sector.

The project was run with a large element of in kind support, including all the AUB staff time and capital facilities. Extra in-kind support and funding were generated during the project that enabled additional training opportunities in the UK for AUB project personnel.

The project was catalytic in a number of ways. It provided opportunities for exciting student projects so that instead of the four MSc theses produced that were originally planned and funded by Darwin, seven were actually completed, almost doubling the amount of biodiversity information generated. It is fair to say that the Darwin project has firmly established the Masters programme in Ecosystem Management at AUB. The experience and success of running the Darwin project was a key element in Dr Talhouk securing a US\$1 million grant from USDA to undertake a collaborative Biotechnology Project. The whole experience has prompted a group of faculty members at AUB to try and establish a biodiversity institute in order to take these approaches forward and to be able to respond to future opportunities.

Several of the Darwin scholars after graduation are now working on other key biodiversity projects in Lebanon and so putting their experiences directly into practice and spreading the Darwin philosophy. The Project's concentration on capacity building and its demonstrated success are an extremely important legacy for the future.

**Colin Clubbe, RBG Kew (Project Leader)**  
**Salma N. Talhouk, AUB (Project Co-ordinator, Lebanon)**  
**October 2002**

## Appendix I: Project Contribution to Articles under the Convention on Biological Diversity (CBD)

Please complete the table below to show the extent of project contribution to the different measures for biodiversity conservation defined in the CBD Articles. This will enable us to tie Darwin projects more directly into CBD areas and to see if the underlying objective of the Darwin Initiative has been met. We have focused on CBD Articles that are most relevant to biodiversity conservation initiatives by small projects in developing countries. However, certain Articles have been omitted where they apply across the board. Where there is overlap between measures described by two different Articles, allocate the % to the most appropriate one.

<b>Project Contribution to Articles under the Convention on Biological Diversity</b>		
<b>Article No./Title</b>	<b>Project %</b>	<b>Article Description</b>
<b>6. General Measures for Conservation &amp; Sustainable Use</b>	5	Develop national strategies which integrate conservation and sustainable use.
<b>7. Identification and Monitoring</b>	30	Identify and monitor components of biological diversity, particularly those requiring urgent conservation; identify processes and activities which have adverse effects; maintain and organise relevant data.
<b>8. In-situ Conservation</b>	>5	Establish systems of protected areas with guidelines for selection and management; regulate biological resources, promote protection of habitats; manage areas adjacent to protected areas; restore degraded ecosystems and recovery of threatened species; control risks associated with organisms modified by biotechnology; control spread of alien species; ensure compatibility between sustainable use of resources and their conservation; protect traditional lifestyles and knowledge on biological resources.
<b>9. Ex-situ Conservation</b>	5	Adopt ex-situ measures to conserve and research components of biological diversity, preferably in country of origin; facilitate recovery of threatened species; regulate and manage collection of biological resources.
<b>10. Sustainable Use of Components of Biological Diversity</b>	<5	Integrate conservation and sustainable use in national decisions; protect sustainable customary uses; support local populations to implement remedial actions; encourage co-operation between governments and the private sector.
<b>11. Incentive Measures</b>	<5	Establish economically and socially sound incentives to conserve and promote sustainable use of biological diversity.
<b>12. Research and Training</b>	30	Establish programmes for scientific and technical education in identification, conservation and sustainable

		use of biodiversity components; promote research contributing to the conservation and sustainable use of biological diversity, particularly in developing countries (in accordance with SBSTTA recommendations).
<b>13. Public Education and Awareness</b>	>5	Promote understanding of the importance of measures to conserve biological diversity and propagate these measures through the media; cooperate with other states and organisations in developing awareness programmes.
<b>14. Impact Assessment and Minimizing Adverse Impacts</b>	0	Introduce EIAs of appropriate projects and allow public participation; take into account environmental consequences of policies; exchange information on impacts beyond State boundaries and work to reduce hazards; promote emergency responses to hazards; examine mechanisms for re-dress of international damage.
<b>15. Access to Genetic Resources</b>	0	Whilst governments control access to their genetic resources they should also facilitate access of environmentally sound uses on mutually agreed terms; scientific research based on a country's genetic resources should ensure sharing in a fair and equitable way of results and benefits.
<b>16. Access to and Transfer of Technology</b>	<5	Countries shall ensure access to technologies relevant to conservation and sustainable use of biodiversity under fair and most favourable terms to the source countries (subject to patents and intellectual property rights) and ensure the private sector facilitates such assess and joint development of technologies.
<b>17. Exchange of Information</b>	<5	Countries shall facilitate information exchange and repatriation including technical scientific and socio-economic research, information on training and surveying programmes and local knowledge
<b>19. Bio-safety Protocol</b>	0	Countries shall take legislative, administrative or policy measures to provide for the effective participation in biotechnological research activities and to ensure all practicable measures to promote and advance priority access on a fair and equitable basis, especially where they provide the genetic resources for such research.
<b>Total %</b>	<b>100%</b>	<b>Check % = total 100</b>



## Appendix II Outputs

Please quantify and briefly describe all project outputs using the coding and format of the Darwin Initiative Standard Output Measures.

Code	Total to date (reduce box)	Detail (←expand box)
<b>Training Outputs</b>		
1a	0	0 planned
1b	0	0 planned
2	7	7 Lebanese students awarded MSc (4 planned, 3 additional)
3	3	2 Lebanese students awarded Kew International Diploma in Plant Conservation; 1 Lebanese student awarded Kew International Diploma in Herbarium Techniques (1 planned, 2 additional)
4a	0	0 planned
4b	0	0 planned
4c	6	6 Lebanese postgraduate students received training (not counted in 1-3)
4d	43 weeks	43 wk training provided at AUB, Kew, Reading. (26 planned, 17 additional)
5	0	0 planned
6a	5	5 AUB Faculty participated in some of training programmes
6b	5	3 wk Faculty involvement; 2 wk training in Egypt for 2 MSc students
7	1	4 training packs planned – all have been incorporated into project CD (copy enclosed)
<b>Research Outputs</b>		
8	24 weeks	24 weeks spent in Lebanon by Kew staff (2) and Reading staff (2); (24 wk planned)
9	1	Florula for coastal plant species produced (1 planned)
10	0	0 planned
11a	0	Up to 6 papers planned; 4 in preparation, soon to be submitted
11b	0	1 in preparation (0 planned)
12a	2	Database of coastal plant species (planned); plant portrait and habitat image database (additional)
<b>12B</b>	2	Both databases regularly updated with new information
13a	2	Herbarium plant reference collection established at AUB (planned); Insect reference collection established at AUB (additional)
13b	2	Herbarium plant reference collections enhanced at AUB and Reading
<b>Dissemination Outputs</b>		
14a	6	1 day herbarium workshop; 1 day horticultural workshop; 1 day photographic workshop; 1 day NGO/teachers workshop; 1 day conservation seminar; 1 day riverine NGO workshop (3 planned, 3 additional)
14b	4+	Meeting of Heads of Municipalities, Tripoli; Darwin

Code	Total to date (reduce box)	Detail (←expand box)
		seminar; International Congress in Ecology, Seoul, OPTIMA meeting in Italy (4 additional) Results from Darwin project incorporated into AUB, Kew and Reading academic teaching
15a	6	2 press releases at start of project; Steps towards the conservation of the Lebanese flora (Booklets - English and Arabic versions); <i>Pancratium maritimum</i> , symbol of the sea (leaflet); Herbarium Techniques manual (in English and Arabic) (6 additional)
15b	0	0 planned
15c	5	Article in Kew Scientist; article in University of Reading Herbarium News; 3 articles in OnCourse (5 additional)
15d	0	0 planned
16a	0	0 planned
16b	-	
16c	-	
17a	0	NGO/ ecotourism network in planning
17b	2	OnCourse alumni; Kew Scientist distribution network (2 additional)
18a	2	News broadcast announcing start of project; Riverine NGO workshop filmed for Orbit TV (2 additional)
18b	0	0 planned
18c	0	0 planned
18d	0	0 planned
19a	0	0 planned
19b	1	World Service interview (1 additional)
19c	0	0 planned
19d	0	0 planned
<b>Physical Outputs</b>		
20	£200	Books for Darwin library; Herbarium materials
21	0	0 planned
22	44	26 coastal and 18 riverine (10 planned, 34 additional)
23	£47,500	£40,000 AUB scholarships; £7,500 Kew training

### Appendix III: Publications

Provide full details of all publications and material that can be publicly accessed, e.g. title, name of publisher, contact details, cost. Details will be recorded on the Darwin Monitoring Website Publications database which is currently being compiled.

Mark (\*) all publications and other material that you have included with this report

<b>Type *</b> (e.g. journals, manual, CDs)	<b>Detail</b> (TITLE, AUTHOR, YEAR)	<b>Publishers</b> (NAME, CITY)	<b>Available from</b> (e.g. contact address, website)	<b>Cost £</b>
Project CD*	Talhok, Abboud & Clubbe, 2002	AUB, Beirut	ntsalma@aub.edu.lb	Postage and packing only

## Appendix IV: Darwin Contacts

To assist us with future evaluation work and feedback on your report , please provide contact details below.

<b>Project Title</b>	
<b>Ref. No.</b>	
<b>UK Leader Details</b>	
Name	Dr Colin Clubbe
Role within Darwin Project	Darwin project leader
Address	Royal Botanic Gardens Kew, Richmond, Surrey, TW9 3AB, UK
Phone	
Fax	
Email	
<b>Other UK Contact (if relevant)</b>	
Name	Dr Stephen Jury
Role within Darwin Project	Taxonomist
Address	Centre for Plant Diversity and Systematics, School of Plant Sciences, University of Reading, Reading RG6 6AS, UK
Phone	
Fax	
Email	
<b>Partner 1</b>	
Name	Dr Salma Talhouk
Organisation	American University of Beirut
Role within Darwin Project	Darwin project co-ordinator - Lebanon
Address	Faculty of Agricultural and Food Sciences, The American University of Beirut, PO Box 11-0236, Beirut, Lebanon
Fax	
Email	
<b>Partner 2 (if relevant)</b>	
Name	
Organisation	
Role within Darwin Project	
Address	
Fax	
Email	

## Appendix V: MSc Thesis Abstracts of Darwin Scholars



Dardas, M. M. (2000) Floristic assessment of selected communities along the Lebanese littoral zone.

El Hachem, R. C. (2000) Insect Diversity along the Lebanese coast in selected plant communities.

Chatila, J. M. (2001) Analysis of the relation between floristic diversity and landscape physical components in the Lebanese coastal zone.

Dagher, M. R. (2001) Floristic assessment of selected communities along the Lebanese coastal zone.

Zahreddine, H. G. (2001) Plant distribution, genetic characterisation and horticultural applications for the conservation management of two coastal plant species in Lebanon.

Abboud, M. M. (2002) Ibrahim River: a case study for investigating vegetation patterns and assessing riparian habitats

# AN ABSTRACT OF THE THESIS OF

Mirella Maurice Dardas for Master of Science

Major: Ecosystem Management

Title: Floristic assessment of selected communities along the Lebanese Littoral zone.

Biodiversity is being lost at an alarming rate both nationally and globally, caused mainly by habitat loss. Current status of the vegetation in Lebanon is based on old herbarium data and their associated flora produced by early botanical explorers (Post and Dinsmore, 1933; Mouterde, 1970). Current patterns of species richness along the Lebanese littoral zone are unknown. The objective of this study was to assess the floristic richness currently sustained in the Lebanese littoral zone and to establish a possible basis for conservation priorities. For this purpose, permanent collecting lines were established in 9 selected communities of the littoral zone of Lebanon, at four different locations in semi-natural habitats found on different soil types. A monthly- based collection of plant species was undertaken between October 1999 and July 2000. A total of 271 species from 181 genera and 45 families were recorded in the study locations. Species richness varied considerably between communities, ranging from as low as 6 species in the pavement of Dalieh to 70 species in the first rocky beach of Amshit. Much of the species richness in the different littoral communities resulted from a large number of species occurring at low frequency. The cluster analysis performed using the Sorensen similarity index indicated a trend towards clustering of communities within locations rather than community types. However, the cluster analysis based on littoral-specific species grouped communities more closely together than locations, which may reveal a constancy of core littoral species in each community type. The littoral zone plant communities are perhaps the most threatened in Lebanon requiring urgent conservation. The identification of littoral-specific species points to their potential use as indicator species for the selection and establishment of protected areas within the coastal zone. The low community similarity and patchy species distribution revealed in this study points towards the need for complementary *ex-situ* conservation, for example within a botanic garden.

# AN ABSTRACT OF THE THESIS OF

Roland Charbel El Hachem for Master of Science

Major: Ecosystem Management

Title: Insect diversity along the Lebanese coast in selected plant communities.

Insects far surpass any other animal species in number and diversity and represent a key component in the right functioning of ecosystems. In almost all Mediterranean coastlines insect diversity is poorly documented, while rapid tourist and urban developments are destroying habitats of many specialized species. The objective of this study was to produce an inventory of selected insect groups and determine species richness and diversity in different plant communities along the Lebanese coast. More than 2000 insects were compiled from monthly collections that were initiated in October 1999 and ended on August 2000. In each site, 100 sweeps were performed following four selected lines to ensure consistency between collections and minimize possible bias. Species richness, Shannon-Weaver diversity index, and Sorensen similarity index were calculated for each order in each site. The present study provides a new baseline inventory for insect species on the Lebanese coast. Eighty four percent of the collected insects belonged to the Hymenoptera (19.1%), Lepidoptera (20.5%), Diptera (14.1%) and Coleoptera (30.3%) orders. Similarity indices between sites were low. However, cluster analysis grouped insect communities from littoral habitat together, separated the least disturbed site of Naameh on its own, and grouped insect communities in Nahr El Kalb and Deyr El Nourieh which are experiencing ongoing agricultural activities. Total site species richness varied from 89 in Raouche to 128 in Naameh, while H' varied between 3.4 in Raouche and 4.3 in Naameh. The study revealed a change in status for 25 Lebanese butterflies for which previous literature related to their abundance was available. Ten species have become rare whilst seven were abundant including five species known to be agricultural pests. The potential effects of these pests on the wider biodiversity need to be closely monitored. Further investigations on status of butterflies could lead to their use as indicators of environmental disturbances. No definite associations between plant and insect diversity could be established in this study. For this purpose, specific collection techniques, assessment of plant-associated insects, and additional data on plant communities are needed.

## AN ABSTRACT OF THE THESIS OF

Joanna Mahmoud Chatila

for

Masters of Science

Major: Ecosystem Management

Title: Analysis of the relation between floristic diversity and landscape physical components in the Lebanese coastal zone

Semi-natural habitats in the coastal zone are considered as the most threatened in Lebanon due to the fast and uncontrolled urban expansion. This zone was therefore selected for a study project in an attempt to generate conservation management recommendations. In the first phase of the study, field expeditions were conducted to sample vegetation from representative communities. The main aim of this study was to select appropriate methods for multivariate vegetation/environment analysis, identify and characterize coastal vegetation communities, species compositional gradients and environmental gradients, and investigate the complex vegetation/environment relationships, establish a relational database, and generate recommendations for future management planning and conservation. Vegetation and environmental data were sampled from the 26 selected sites (600 m<sup>2</sup> transects). Environmental data included elevation, % rock, % bare ground, landform, soil depth, aspect, disturbance, soil texture, pH, electrical conductivity, soil organic matter, and calcium carbonate content. TWINSpan identified eight main coastal communities: pavements, beaches and coastal cliffs, rocky beaches, riparian, abandoned fields, oak thickets, oak/pine, and southern disturbed communities. Indirect gradient analysis involved Detrended Correspondence Analysis (DCA) of vegetation data, which suggested one main elevation and texture compositional gradient, and Principle Component Analysis (PCA) and DCA of environmental factors, which suggested two main complex environmental gradients, the first determined by disturbance, elevation, soil organic matter and soil depth, and the second determined by soil texture, aspect, pH, EC, and % bare rock. Direct gradient analysis involved Canonical Correspondence Analysis (CCA) where the emphasis is on determining the correlation between individual samples or species with underlying environmental factors in order to relate vegetation patterns to environmental gradients. CCA showed that the distribution of plants is determined by a disturbance gradient associated with elevation and soil organic matter, and a physical gradient controlling soil moisture associated with soil texture, soil depth, and soil pH. This study demonstrated that there is predictable structure in coastal vegetation communities related to various environmental factors particularly elevation and soil texture and affected by disturbance, and that such use of various multivariate techniques could serve to improve objectivity in management and conservation planning.



## AN ABSTRACT OF THE THESIS OF

Marcelle Robert Dagher for Master of Science  
Major : Crop Production

Tilte: Floristic assessment of selected communities along the Lebanese coastal zone

Global awareness has risen in the past few years concerning biodiversity, since it is being lost at an alarming rate, both nationally and globally, mainly due to habitat loss. Existing information regarding the patterns of species richness along the Lebanese coastal zone are unknown. The status of vegetation in Lebanon is based on old herbarium data and their associated flora produced by early botanical explorers (Post and Dinsmore, 1933; Mouterde, 1970). The coastal zone plant communities are among the most threatened in Lebanon, necessitating urgent conservation. In this regard, the following study aimed at assessing the floristic richness presently harbored in the Lebanese coastal zone and to establish possible basis for conservation priorities. For this purpose, permanent collecting lines were established in 17 selected communities of the coastal zone of Lebanon, at seven different locations in relatively, semi-natural habitats found on different soil types. A monthly-based collection of plant species was undertaken between October 1999 and July 2000. A total of 508 species from 278 genera and 68 families were recorded in the study locations. Species richness differed considerably between semi-natural and relatively disturbed communities, ranging from as low as 20 species in the oak woodland of Hamat to 119 species in the abandoned terraces of Al Dalhamieh. Much of the species richness in the different coastal communities resulted from a large number of species occurring at low frequency. The cluster analysis done using the Sorenson similarity index resulted in a low similarity between the selected coastal communities. Even with respect to the riparian specific species, the three riparian vegetation types were not quite similar. The low community similarity and irregular species distribution uncovered in the study, point towards the need for complementary ex-situ conservation, such as within a botanic garden. The identification of riparian species points to their potential use as indicator species for the selection and establishment of protected areas within the coastal zone.

# AN ABSTRACT OF THE THESIS OF

Hala Ghassan Zahreddine for Master of Science

Major: Plant Sciences

Title: Plant Distribution, Genetic Characterization and Horticultural Applications for

The Conservation Management of Two Coastal Plant Species in Lebanon

Despite providing ecological services and products valued at \$ 33 billions annually, biodiversity is currently facing many environmental threats. These include fragmentation and destruction of natural habitats and over exploitation of natural resources. These threats are prevalent in Lebanon and have been compounded by the lack of compliance to and implementation of regulations protecting remaining semi-natural ecosystems. Therefore, there is an urgent need for biodiversity conservation.

Usually, the first step in undertaking any plant conservation project is ecogeographic survey. Once the actual distribution of the target taxon is determined, studies on the population and age structure are performed. These studies provide information on the behavior, status of the target species and the ecological requirements of the species in its natural habitat. This information is helpful because it indicates the requirements for the potential cultivation and reintroduction of the studied plant species. Following that genetic studies help in identifying population of key importance for conservation.

As a case study, two coastal plant species native to Lebanon were selected, *Pancratium maritimum* and *Vagaría parviflora*. Three approaches were followed in the study: an ecogeographic survey, population studies and genetic characterization held out on these plants showed that some historical sites reported for these plants had been lost while others were newly discovered. Population structure helped in identifying location that harbors the highest plant density, the populations that are expanding, and that possibly include high genetic diversity in them. Reintroduction and cultivation trials were performed and resulted in providing recommendations for the appropriate way of reintroducing and cultivating specific plants, in this case *P. maritimum*. As a final step, genetic characterization using RAPD technique is still going on for both plant species. Forty primers were screened over the populations of *Panocratium maritimum* and ten were selected for showing polymorphic bands among and between the populations of the plant species. Geographical distribution of the populations doesn't seem to affect the distribution of genetic variation among the populations of *P. maritimum* in Lebanon.

# AN ABSTRACT OF THE THESIS OF

Maya Malak Abboud

for

Master of Science

Major: Ecosystem Management

Title: Ibrahim River: a case study for investigating vegetation patterns and assessing riparian habitats

Lebanon has been internationally recognized as a global center of plant diversity as well as a global hotspot due to its exceptionally high endemism in the face of great threats. In response to the growing concerns for conserving the remaining flora in Lebanon, several research studies were conducted at the American University of Beirut along the coast to provide updated information on the status of biodiversity. As part of these efforts, this study aimed at characterizing the vegetation along the coastal stretch of Ibrahim River and at developing a habitat assessment model for the study area. Twenty collection sites were systematically chosen along a 10 km coastal stretch of the river, in which floristic and environmental data were gathered between April and November 2001. The identification process, which is still underway, has revealed, so far, the presence of 59 families, 147 genera and 367 species. The relationship between the flora and environmental parameters was investigated using principle components analysis. The results indicated that four components with the following main parameters accounted for 64% of the variation: percentage sand, organic matter, water flow (summer) and tree diversity. Correlation analysis including quantitative parameters revealed a significant relation between percentage silt and plant diversity and percentage silt and species richness. Analysis of qualitative parameters, based on the Chi square test, indicated that site accessibility and species richness were highly related. Despite these noted associations, species richness and diversity indices did not follow a pattern along the study site. However, a high number of weeds (57) and invasive (13) species was observed with an increasing downstream trend in agriculture-dominated sites while the number of riparian species was relative low with 26 riparian species with no noticeable trend in their distribution. A holistic assessment model was developed based on thirteen-sub indicators spanning floristic, habitat and landscape parameters. The model integrated biological and physical parameters within a social utilization context. Four conservation actions were recommended depending on the overall assessment score: conservation/protection, restoration to natural state, rehabilitation to new functions and intervention to limit further damage.