Darwin Initiative for the Survival of Species
Conserving the Rare and Endemic Flora of Iran
Final Report, April 2002

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1. DARWIN PROJECT INFORMATION

Project title	Conserving the Rare and Endemic Flora of Iran
Country	Iran
Contractor	University of Sheffield
Project Reference No.	162/07/127
Grant Value	£184450
Staring/Finishing dates	April 1998-March 2001 (extended to October 2001)

2. PROJECT BACKGROUND / RATIONALE

2.1 INTRODUCTION

Iran covers an area of about 1,648,000 km^2. It ranges from 28m below sea level on the shores of the Caspian Sea to 5770m on Mt. Damavand. Climatically, there is the contrast between the humid, almost jungle-like forests of the south Caspian and the arid, in places lifeless, deserts of the Dasht-e Lut; a temperature range from a winter low of –35ºC in the north-west to a summer high of 50ºC on the Persian Gulf. Associated with this major topographical, geological and climatic variation, Iran is rich in plant diversity. The country supports a total of around 8000 plant species. Of these 1727 are endemic to Iran, comprising 22% of the flora. Moreover, Iran is a major centre of endemism with 0.6% of the world's endemic species.

There has been a long history of low-intensity, traditional land management including grazing. For the most part this has not conflicted with, and indeed in many areas has positively contributed to, the maintenance of a diverse species-rich landscape. However, increasing anthropogenic pressures, including deforestation, re-forestation, intensification of agriculture, drainage of wetlands and industrial development, are having a great impact on the landscape, and National Protected Areas are becoming increasingly important for the conservation of rare plant communities and species. These National Protected Areas are critical to and form the basis of Iranian conservation policy. Nevertheless, even these protected areas are not completely buffered against changing land use and maintenance of plant communities and populations of rare species is not guaranteed without further human intervention. Furthermore, there is a lack of background scientific knowledge on which to base sound conservation and management decisions. This project addresses the problem of providing this scientific knowledge. It integrates local strengths, particularly those relating to taxonomy and field survey with British expertise in conservation management and understanding ecological processes.

- The ***ultimate conservation aim*** of the project is to make recommendations to the Government for a programme of adequate protection and management of protected areas.
- The ***ultimate scientific aim*** is to begin to understand the ecological processes that govern how Iranian plant communities function. This information has direct relevance to conservation management. For reasons of time and

logistics the project has concentrated on two protected areas and their rare species and communities.

2.2 ECOLOGICAL BACKGROUND

Major problems for plant ecologists include the large number of species present in the world flora and the poor correspondence between taxonomy and ecology. Knowing to which genus and family a species belongs generally tells us little about the habitat and key ecological characteristics of a species. This is in marked contrast to inorganic chemistry where the Periodic Table provides a classification of elements that strongly relates to their chemical behaviour. Ecology is in desperate need of a similarly simple functional classification for species. A mechanism is needed to reduce the taxonomic complexity of vegetation so that we can understand underlying ecological processes.

Species are taxonomically unique but their ecological properties are not. Some are fast-growing; some are not. Some produce a persistent seed bank in the soil; some do not. Data of this type would allow us to replace the taxonomic complexity of a species list with information on functional characteristics. We would then begin to describe vegetation in terms of what its component species do and we would arguably be in a better position to predict impacts of changing land use on the composition and sustainability of vegetation of conservation importance.

Against this background we have produced an ecological database for a small part of the Iranian flora. The database contains simple functional attributes of plants (i.e. attributes that relate to how plants survive in their natural environment) and provides an ecological profile, albeit fragmentary, for each species. The attributes utilised wherever possible were validated against ‘hard’ laboratory or distributional data. Priority was given to attributes relevant to the study of impacts of land use change.

We can illustrate the functional approach with one example, an assessment as to whether species grow in fertile habitats (see also Appendix VI and Table 4-3). A review of the ecological literature reveals that species from fertile habitats tend to grow rapidly and to produce watery, short-lived leaves. These leaves have a high nitrogen and phosphorus content and are generally palatable to unspecialised herbivores. Attributes such as specific leaf area (leaf area/leaf weight), leaf toughness and leaf dry matter content will be good ecological predictors of habitat fertility. Moreover, they are very quick to measure and we do not need to rely upon a conservationist with a lifetime of experience (a declining resource) for our ecological insights. This approach needs only correctly identified plant material and a competent technician. The database can then be used, alongside more conventional sources, for informed management at the species, community and landscape levels.

2.3 CHOICE OF SITES

Iran is exceptionally rich both in species and in habitats. Effective conservation policy requires information about the distribution of plant diversity and about how this diversity may be maintained. It also must address the issue that the resources available for conservation, both scientific and economic, will be less than one would ideally wish for. In order to achieve our scientific goals protected areas were chosen so as to include a wide spectrum of habitat types and ecological conditions rather than simply focusing upon the site with the most species. The teaching element of the project would not be well served if the differences between species were very small. Thus our sites were deliberately chosen from within less arid areas because the range of variation of plant characters is rather narrow in uniformly arid sites. The two sites chosen for intensive study in the Darwin project were the Arasbaran Protected Area and the Siah-Keshim wetland (part of the Anzali wetlands). Two further contrasted sites, the Touran and Geno Protected Areas, situated in central and southern Iran respectively, were also chosen for botanical survey. We consider that studies of these four ecologically and phytogeographically diverse sites will provide valuable insights into ways of conserving the rich biodiversity of the Iranian flora.

The locations of the four sites are shown in Figure 1.

The Arasbaran Protected Area (see Plate 3) is a mountainous area of 72,465 hectares in NW Iran next to the Azerbaijan border. The altitudinal range is 350 m to over 2840 m. The lowland forests experience 600 mm y^{-1} precipitation and there are various types of dry grassland in the drier (c. 300 mm y^{-1}) uplands. The rocks are Cretaceous in origin and the soils formed from limestone, schist, and conglomerate strata are calcareous to sandy loams of high pH and low available phosphorus. Euro-Siberian and Irano-Turanian phytogeographical elements are well represented in the vegetation.

The Anzali wetland (see Plate 2) is a lagoon connected to the Caspian Sea. It is located on the Sefeidrud river delta near Bandar-e-Anzali, in the north of Iran. The lagoon has been listed under the Ramsar Convention since 1975. It covers an area of about 15000 ha and is a good example of the natural wetlands characteristic of the south Caspian Lowlands. It supports a diverse wetland flora and fauna and is a major tourist attraction. The flora, though containing many species that are rare in Iran, contains no endemics. The Anzali wetland consists of large, shallow, eutrophic, freshwater, shallow lakes, marshes, and seasonally flooded grasslands and is fed by streams from the Talesh Mountains. The entire wetland system drains into the Caspian Sea via the deep harbour of Bandar-e-Anzali.

Anzali lagoon changed considerably over the period between 1929 and 1999. The area of open water greatly decreased, and by 1989 had declined to only 22.5% of the open water area estimated in the late 1930s. Since 1989 there has however been an increase in area of open water with a rising in the level of the Caspian Sea, and adjacent pastures and rice fields have become flooded. There has been an increase in water salinity and a decline of some aquatic macrophytes. Other impacts include an increased sediment load entering the Lagoon, now estimated as *c*.386602 t y^{-1}.

The **Geno Protected Area** is located in southern Iran, in Hormozgan Province. It encompasses Kuh-e-Geno, a single and isolated mountain and its associated ridges above the Persian Gulf Coastal plain, 30 km N–NW of Bandar Abbas. This 27,500 hectare reserve represents an excellent example of transition zone between the Irano-Turanian Region and Saharo-Sindian Region and because of its exceptional situation has rich flora and many endemic species. The main habitats include: outwash plain with very poor semi-savanna like vegetation covered by *Acacia* trees with other Saharo-Sindian elements particularly in gullies (150-500 m altitude); rugged boulder-strewn slopes with patches of open *Amygdalus* and *Pistacia* woodland with understory cover of such species as *Ebenus, Astragalus, Convolvulus* (700-2000 m altitude) and cliffs, crags and summit ridges with mixed *Juniperus, Amygdalus* and *Pistacia* woodland and a ground cover of tragacanthic (thorncushion) bushes of *Astragalus, Acantholimon, Artemisia* (above 2000m). Erosion has resulted in the formation of deep canyons cutting in to the uplifted mountains, creating great microclimatic variation. Average summer temperatures are 35–40°C on the Persian Gulf coastal plain and 17°C on the top of Geno mountain. Annual precipitation varies from 10 to 120mm. There has been some damage from limited charcoal production, overgrazing and illegal hunting in the reserve over the last decades, and there is a recognised need for the prevention of land conversion and restoration of degraded areas.

Iran's largest reserve, the **Touran Wildlife Refuge and Biosphere Reserve**, lies at the northeastern edge of the great Dasht-e-Kavir desert, about 100km southeast of Shahrud. Established in 1973 and covering 18,000 square kilometers, this vast reserve protects a wide range of semi-desert and desert habitats from *Artemisia* steppe in the arid foothills of the Alborz in the north through bushy *Zygophyllum* steppe, sparsely vegetated sand dunes and bare stony plains to the immense salt wastes of the Dasht-e-Kavir proper in the south.

2.4 MOTIVATION FOR PROJECT

Scientific ties have been maintained between Dr Jalili and the University of Sheffield since Dr Jalili completed his PhD under the supervision of Professor Grime in 1991. Both parties had wanted scientific links to be stronger and mechanisms of effecting collaboration had been discussed for several months prior to the application. As deputy director of his research institute Dr Jalili was particularly keen to work on conservation related topics. He identified the need for this work on the grounds that:

- The flora of Iran is both very diverse and extremely rich both in species in general (*c*. 8000 species) and in endemics in particular (*c*. 22% of the flora). In short, it is a global 'biodiversity hotspot.'
- There are inadequate resources and ecological knowledge available within the country to ensure the conservation of such an internationally important flora.

Dr Jalili is rightly proud of the flora of Iran and regards it as an important part of his country's heritage. There is evidence of his deep commitment to conservation in many parts of the report. Here, for brevity, we mention three examples, one showing his direct commitment to the Darwin project, one showing a more general commitment to conservation and one relating to an initiative with which the Darwin project interacted.

- The number of staff (usually c.12 people at any one time) involved in the project and the number of hours that they spent greatly exceeded what had been promised in the proposal.
- Dr Jalili has secured funding (£500,000) to build a seed storage facility along the lines of that at the Wakehurst Place (Royal Botanic Gardens, Kew) for the national flora.
- The Red Data Book of Iran was a project initiated by Dr Jalili. At his request Dr Shaw, and the Darwin Project, had a minor involvement in an editorial capacity.

3. PROJECT SUMMARY

3.1 OBJECTIVES OF PROJECT

The initial objectives were as follows:

- to use British expertise for collaboration with and training of local scientists in relevant field survey and experimental techniques, database management, resource assessment and conservation management.
- to develop and set up a database and appropriate support programs
- to develop a functional understanding of the causes of rarity and decline in the Iranian flora
- to review and evaluate existing conservation measures, and make recommendations to the Iranian Government for the adequate future protection of the botanical resource of rare and endemic species.
- to develop a conservation programme at regional level;
- to establish close links between the UK and Iran to provide advice and to monitor progress.

These original objectives remained intact throughout the project. There have been two main departures from the work schedule.

- The completion date for the project was considerably delayed. We had agreed with the Darwin Secretariat that the project should finish in April 2001 with a series of high profile lectures in Tehran. This event was cancelled well in advance due to health problems. The lectures were rescheduled for September 15th 2001, but these were cancelled at the last minute due to the uncertainties surrounding the aftermath of the terrorist attacks on the World Trade Centre on September 11th. The Foreign Office, and the Darwin Secretariat, advised us that it was safe to travel but the University of Sheffield would not sanction the visit. Dr Jalili hosted a successful meeting on September 15th and Sheffield scientists gave their lectures in January 2002. The Final Report is also later than anticipated. This is primarily because its production turned out to be a bigger job than expected. This delay was compounded by difficulties in transferring the rough draft to Iran via e-mail and periods of absence of Dr Jalili from Tehran.
- Due to the commitment and hard work of our Iranian colleagues the quantity of output greatly exceeded that initially proposed. This means that ultimately the scientific output from the project will greatly exceed that originally envisaged and that the scientific exploration of the database is still in its infancy. In consequence, data analysis and the writing of scientific papers will extend well beyond the period of funding by Darwin. Both partners are happy with this arrangement and remain committed to a continuing collaboration. The Darwin Secretariat will from time to time be sent additional scientific outputs that can be appended to this final report.

Another objective has with the approval of the Secretariat been added since the start of the project.

- to produce ecological papers that address topics relevant to global conservation

The Iranian datasets have been created so as to be partially compatible with others collected in Argentina (under another Darwin project – Grant 162/8/116), Spain and

UK. We are attempting to combine these data sources to produce broadly based papers relevant to globally important issues relating to ecology and conservation. Participants have agreed to commit additional 'unpaid' time and resources to this objective. No redeployment of resources from the other parts of the project has been involved.

3.2 ARTICLES UNDER THE CONVENTION ON BIOLOGICAL DIVERSITY (CBD) MOST RELEVANT TO PROJECT

The Iranian flora is large, poorly studied and extremely diverse. Thus the articles under the Convention on Biological Diversity (CBD) most relevant to project are

- Research and Training (30%) – many scientifically knowledgeable conservationists are required to secure the long-term survival of the biodiversity of the Iranian flora.
- Identification and Monitoring (25%) – vegetation surveys and effective monitoring are essential to conserve biodiversity at a time of changing land use (and ?climate).
- Public Education and Awareness (15%) – biodiversity and the natural landscape cannot be conserved without it being appreciated and valued by the Iranian people.

See also Appendix 1.

3.3 EXTENT TO WHICH OBJECTIVES WERE MET

To use British expertise for collaboration with and training of local scientists in relevant field survey and experimental techniques, database management, resource assessment and conservation management.
Seventeen students have received training in laboratory and field techniques during the course of the project. All have also improved their computing skills during the project.

To develop and set up a database and appropriate support programs
Four large databases have been compiled during the project, one for Anzali and three for Arasbaran.

To develop a functional understanding of the causes of rarity and decline in the Iranian flora
The Iranians committed many more people and much more time into collecting data than had initially been envisaged. As a consequence, the quantity of data collected has greatly exceeded expectations and data input into the computer has been a limiting step. Two papers have already been published, and one is at the review stage (see Appendix VI and VI). However, much data analysis remains to be done, and both UK and Iranian partners are committed to continuing this collaboration and to writing scientific papers after the project has formally ended.

To review and evaluate existing conservation measures, and make recommendations to the Iranian Government for the adequate future protection of the botanical resource of rare and endemic species.
Dr Jalili has made an in depth study of Iranian conservation policy (see pamphlets in Appendix V). His work has been aided in this respect by a parallel project, the preparation of the Iranian Red Data Book (to which the Darwin project was a minor contributor) and re-enforced by a floristic study of four Iranian protected areas.

Essentially he concluded that current Iranian conservation policies were inadequate. Protected areas had been chosen to include the major vegetation types in each climatic zone. However, most endemics, which constitute 22% of the flora, do not occur within the protected areas. He concluded that a new conservation initiative is required for endemics. Dr Jalili has started to canvass for an increase in the size of protected areas from 5 to 10% of the total area of Iran. This recommendation was included in Article 8 of the CBD Iranian 2nd National Report of May 2001.

To develop a conservation programme at regional level
See previous objective

To establish close links between the UK and Iran to provide advice and to monitor progress
Regular contact has been maintained throughout the project. The development of a computer network at RIFR, independent of Darwin funding, means it is now much easier to communicate and advise all of the Iranian team involved in data collection and analysis.

To produce ecological papers that address topics relevant to global conservation
This is an additional objective of recent origin and involves international collaboration. A paper has been written based on a functional analysis of data from Iran, Argentina, Spain and UK (see Appendix VI). Powerful evidence is provided (a) for the existence of global patterns of ecological specialisation and (b) the possibility of assessing these from the simple measurements used in the project. Other more applied papers are planned.

4. SCIENTIFIC, TRAINING, AND TECHNICAL ASSESSMENT

4.1 SCIENTIFIC WORK UNDERTAKEN

The principal scientists involved in the project were as follows:

UK: Dr J.G. Hodgson, Dr K. Thompson, Dr S.C. Shaw, Dr B.D. Wheeler.
Iran: Dr A. Jalili, Dr. Y. Asri, B. Hamzeh'ee, F. Zarrinkamar, Z. Jamzad.

A species list for the sites studied is given in Appendix VIII. Species marked with an asterisk are included in the functional databases. Professor A.J. Willis (co-ordinator of the *Biological Flora* series published in *Journal of Ecology*) has been provided with a copy of this list so that Iranian data can be used by others on request.

Conservation recommendations were only made after the fullest consultation and with the full agreement of both Iranian and UK members of the Darwin project. Moreover, to ensure that work has been both relevant and carried out to a high standard all papers of substance will be submitted to 'refereed journals'. Thus, peer review of the work will be an automatic consequence of publication.

4.1.1 Assessing conservation priorities for Iran

Work carried out

The vegetation of four Protected Areas, Arasbaran, Siah-Keshim (Anzali), Geno and Touran (see Section 2.3) has been investigated to provide background information on the floristic content of important Iranian conservation sites. These data provide illustrative material for Dr Jalili's desk study to review the conservation policy of Iran. A key reference work was the *Red Data Book of Iran.* Dr Jalili was the instigator and, together with Dr Jamzad, has been the key person in producing the *Red Data Book.* Dr Shaw played a small but important editorial role in the production of the book and her contribution, and that of Darwin, is acknowledged in the preface (a copy of the book has already been sent to the Darwin Secretariat). The *Red Data Book of Iran* has been favourably reviewed in scientific journals (see Appendix V).

Conclusions and Outputs

Data from Table 4-1 illustrate some of the problems facing those entrusted with conserving the Iranian flora.

- Siah-Keshim is an internationally important "Ramsar" site and is important for the conservation of the wetland flora of Iran. It supports two Red Data Book species, but does not however contain any Iranian endemics and many of its species are cosmopolitan. Its conservation is important because it is a well-preserved and large example of a declining habitat, valuable not only for its resident fauna and flora but also as a stopping off point for migrating birds.
- Arasbaran is very species-rich and is home to the brown bear and leopard. The flora includes a strong Euro-Siberian element including many species that are in the Iranian Red Data Book. There are also many Irano-Touranian species, some of which are globally rare. However, similar sites exist in nearby Azerbaijan and there are no species that are narrowly endemic to Iran.
- The remaining two sites, Geno and Touran, combine a diversity of important habitats and vegetation types that are strongly characteristic of Iran. They are also relatively species-rich and contain both endemics and species rare in Iran. Touran contains 2.5% and Geno 1.3% of the Iranian endemic flora.

These reserves illustrate the main problems relating to the current distribution of Protected Areas in Iran. Whilst the reserves already established in Iran appear to provide good cover of the major habitats in each climatic region, most Iranian endemics remain unprotected. These conclusions simply re-enforce the findings of Dr Jalili's much more exhaustive desk study (see Appendix V for Dr Jalili's analysis of the problem of endemics). He has therefore made far-reaching recommendations for the flora of Iran (see Appendix V for pamphlets submitted to the Iranian Parliament). He concludes that past conservation policies have been incomplete. Protected Areas have been set up so as to include the full diversity of habitats within each climatic zone but little has been done for the conservation of the endemic species, which represent 22% of the flora. The conservation of endemics will be difficult; 10% of the total flora (nearly 800 species) are endemics confined to a single province. Inevitably, therefore, most endemics do not occur within protected areas. Dr Jalili is proposing a new national initiative specifically aimed at endemics. He estimates that this would require a doubling of amount of land designated as Protected Areas from 5 to 10% of the country and will need to be underpinned by scientific study. Dr Jalili has already produced supporting documents for the Iranian Parliament and has started lobbying politicians. This recommendation was included in Article 8 of the CBD Iranian 2nd National Report of May 2001.

Table 4-1. Floristic analysis for four Iranian Protected Areas.

(Pluriregional includes species found in more than two climatic regions; those restricted to two regions were given a score of ½ for each.)

	Siah-Keshim wetland	Arasbaran	Touran	Geno
Locality	NW Iran	NW Iran	C Iran	S Iran
Size of Protected Area (ha.)	15,000	72,465	1800,000	27500
Major climatic element in flora	Cosmopolitan	Euro-Siberian in lowlands; Irano-Turanian in uplands	Irano-Turanian	Irano-Turanian; Saharo-Sindian
Pluriregional	74%	21%	12%	19%
Euro-Siberian	17%	29%	+	-
Mediterranean	8%	9%	2%	6%
Irano-Turanian	2%	40%	80%	47%
Saharo-Sindian	-	+	5%	28%
No. of plant communities	c.32	c.25	c.55	unknown
No. of species	103	1020	608	247
No. of Red Data Book species	2 (2%)	75 (7%)	63 (10%)	29 (12%)
No. of Iranian endemics	0 (0%)	0 (next to Azerbaijan border; many regional endemics)	43 (7%)	23 (9%)
Life-form				
Perennial herbs + subshrubs	63%	64%	41%	33%
Annuals	31%	26%	44%	50%

4.1.2 Anzali wetlands

Work carried out

32 plant communities have been recognised at Anzali (see Appendix VIII); details of the extent of 18 communities are given in Table 4-2. A total of 53 quadrats were recorded with 3 to 5 replicates in each community. As well as recording percentage cover of species within each quadrat, we also measured water depth and collected a water sample from 10 cm depth and a sediment sample. Water and sediment samples were analysed as follows:

Water: conductivity, pH, NO_2-N, NO_3-N, HCO_3, total N, total P, Cl,

Sediment: P, K, and soil SP (Saturation Percentage)

Functional measurements were also made for the 36 species recorded during the field survey (see Appendix VII for methodology). The species attributes measured were as follows:

- **Morphology** [canopy height; diameter of canopy / lateral vegetation spread; canopy structure; angle of leaves]

- **Leaf structure** [leaf area; leaf water content; specific leaf area (leaf area /leaf weight); leaf thickness; leaf toughness; leaf width; inrolling of lamina; pubescence and thorniness (type and extent); ash content; photosynthetic pathway; length of stomatal guard cell; stomatal distribution]
- **Stem structure** [stem diameter and density]
- **Root and rhizome/stolon structure** [root porosity]
- **Phenology** [life-form sensu Raunkiaer (1934); phenological measurements (times of flowering and fruiting)]
- **Regeneration** [seed size and shape (relates to persistence in the soil); mechanisms of seed dispersal]
- **Life history**

Table 4-2. Communities recorded at Anzali wetland

Number	Communities	Area (Hectares)	Percentage
1	*Phragmites australis*	1299.6	30.9
2	*Trapa natans-Potamogeton crispus*	466.5	11.1
3	*Sparganium neglectum-Typha australis*	345.1	8.2
4	*Sparganium neglectum*	261.5	6.2
5	*Polygonum hydropiper-Paspalum distichum*	249.9	5.9
6	*Phragmites australis-Sparganium neglectum*	212.7	5.1
7	*Trapa natans-Potamogeton pectinatus*	84.1	2.0
8	*Sparganium neglectum-Phragmites australis*	69.7	1.7
9	*Lemna minor-Azolla filiculoides*	51.8	1.2
10	*Paspalum distichum*	35.1	0.8
11	*Typha australis*	30.8	0.7
12	*Solanum persicum-Phragmites australis*	22.8	0.5
13	*Hydrocharis ranunculoides*	18.4	0.4
14	*Polygonum hydropiper*	16.7	0.4
15	*Nelumbo nucifera*	15.8	0.4
16	*Potamogeton pectinatus*	14.7	0.4
17	*Phragmites australis-Typha australis*	11. 5	0.3
18	*Nasturtium officinale*	3.8	0.1
19	Open water	989.9	23.6
	Total	4188.9	100

A simplified vegetation map is shown in Figure 2.

Conclusions and Outputs

A Microsoft Access database has been constructed including floristic and environmental data from 53 quadrats, and functional data for 36 species. Our preliminary analyses of this database were consistent with those of other workers in revealing that variation in water depth has a critical influence on fundamental ecological processes within the protected area. In particular we found a negative relationship between water depth and both nutrient availability and habitat productivity.

We had been particularly concerned about the potential invasiveness of *Azolla filiculoides*, a small alien floating fern native to N. America (see Plate 2). *Azolla* had been introduced to the adjacent rice fields to boost crop yields; it has a symbiotic association with a nitrogen-fixing alga. Our analysis showed that *Azolla*, though locally dominant, was restricted to shallow, sheltered, nutrient-rich waters. We found no evidence that *Azolla* will overrun the wetland areas of greatest botanical value, those dominated by *Trapa natans* and *Nelumbo nucifera* (the rosettes of *Trapa natans* also provide a floating nest-site for whiskered terns (*Chlidonias hybrida*) (see Plate 2). We concluded that the most pressing management requirement for the site was the maintenance of high water levels. The wetland areas of greatest floristic and faunistic interest have uniformly-low values for water conductivity and Cl^- concentration, which suggests that these areas have been least affected by enrichment, but water quality should continue to be monitored.

The problems caused by speeding boats, such as erosion by boat wash, as well as disturbance, were also identified, and recommendations made for better controls on boating within the area.

Prospects

Other potential or pending developments from this work include:

- **Greater liaison with other interested bodies** is required to ensure that the fauna and commercially important fish stocks are also conserved.
- **Scientific publications**. One paper describing the site and the problem with *Azolla* is in draft form. Other papers are planned relating plant functional characteristics to field distribution.

4.1.3 Arasbaran

Work carried out

220 releveés have been recorded from the reserve. From this vegetation survey, four major habitats and 33 plant communities have been recognised (see Appendix VIII, and simplified vegetation map in Figure 3).

A seed bank study has also been undertaken (see Plate 1). One representative area was selected from within each community. Twenty five soil cores were collected from each site and divided into upper (0-5cm) and lower (5-10 cm) portions. Seeds from the soil cores were germinated in a greenhouse experiment and the seedlings identify to species. Soil analyses were also carried out at each site used for the seed bank study. The following attributes were measured: soil pH; % clay, silt, sand and organic matter; $CaCO_3$ and available P.

Functional measurements were also made for all 471 of the species recorded from the seed bank sampling sites. The species attributes measured were the same as those measured at Anzali (see above) except that root porosity was excluded. [Root porosity gives an estimate of the plant’s capacity for oxygen diffusion from the shoot to the rhizosphere. It represents an important mechanism allowing plants to survive in waterlogged soils that are otherwise anoxic. Thus, it has little relevance in the predominantly dry habitats prevailing at Arasbaran.]

Conclusions and Outputs

As a consequence of our fieldwork the number of species found in the reserve has increased from 781 to 1020 including 5 species new to Iran. 2 papers have been prepared for Iranian journals recording the presence of new species (see Appendix VI).

The 220 relevées have been put in an EXCEL database and have been analysed using a number of programs including CANOCO and TWINSPAN. This phytosociological work has revealed that the communities present are similar to those recorded in nearby Azerbaijan. One community has, however, been recorded for the first time.

Two other databases have been set up. The first combines seed bank and vegetational data; the second includes functional and anatomical attributes of 471 species.

There has been much erosion in the short, scrubby, hill top grasslands dominated by *Astragalus* spp (Plate 3). This is clearly the result of overgrazing and our recommendation that grazing intensity in this community should be reduced has been accepted. The situation at Arasbaran is, however, dissimilar to the type of overgrazing problems that the UK author's had previously experienced. UK grazing units often contain several plant communities. Frequently one community occurs on more fertile soils, and its vegetation is generally more palatable and more heavily grazed. In Arasbaran the situation appears to be the opposite. The nomadic tribesmen camp on the hill tops and mainly graze their shepherded stock close to their camp. Our data on functional traits suggests that the vegetation of the hill tops is less productive and less suitable for heavy grazing, than that of the valley sides (see Table 4-3). Nevertheless, the predominant use of the hill tops is understandable; camping is only feasible here and livestock is safer. Closer to the forest edge, livestock is more vulnerable to leopards and other potential predators. There is no evidence of the encroachment of taller species onto the grassland slopes or of succession to woodland but the vegetation will need to be carefully monitored. The current problem may, however, be transitory. Many of the children of the nomadic herdsmen now have the opportunity of going on to higher education. After this they are likely to reject the hard life-style of their parents. Soon nomads may no longer visit the reserve and the problem may turn into one of undergrazing – grazing may have to be supervised by shepherds living in the lowlands.

Table 4-3. A preliminary analysis of selected functional data from Arasbaran.

[These attributes were chosen as species of fertile habitats tend to have high specific leaf area, low leaf toughness and a low value for Principal Component Analyses axis 1 (see Figure 4).]
Standard errors are shown in brackets

Community	No. of sub-communities	Specific leaf area (mm^2 mg^{-1})	Leaf toughness (N mm^{-1})	Mean value for PCA axis 1	Canopy height (cm)
Dwarf shrub plateau grassland	9	15.69 (1.02)	1.18 (1.05)	-0.14 (0.10)	20 (1)
Hillside grassland	4	18.22 (1.03)	0.93 (1.04)	-0.65 (0.07)	17 (1)
Mann-Whitney U-test		**2.78 P=0.0028**	**2.47 P=0.011**	**2.78 P=0.0028**	0.77, ns

We looked at the correspondence between the buried seed bank and the vegetation. Good correspondence would have suggested that the seed bank was a valuable resource, allowing recolonisation after damage to the vegetation. Unfortunately, we found that the soil seed bank was small and unrepresentative of the flora. This means we have no room for error in our management prescription for conserving the flora of Arasbaran. The seed bank study did, however, also reveal a success story relating to recent management. The lowland forest has a long history of over-exploitation for firewood and timber. This practice was restricted by the conservation authority 25

years ago. As a result, the forest is now much less disturbed than formerly and weedy species once common in the vegetation persist mainly in the seed bank.
Two scientific publications have been prepared from the seed bank study. One paper shows that seed size and shape predict persistence in the soil seed bank. This has been published in *Seed Science* (see Appendix VI). The other paper, on the relationship between the seed bank and the vegetation and its implications for conservation, has just been accepted subject to minor revision by *Biological Conservation* (summary included in Appendix VI). No clear-cut relationship between seed bank and the physical and chemical nature of the soil was detected. We anticipate that soil characteristics will prove more useful in papers characterising the nature of the vegetation and the site in general.

Prospects

Other potential or pending developments from the work at Arasbaran include:

- **Greater liaison with other interested bodies** is required to ensure that the fauna, particularly leopard and brown bear, is also conserved. Dr Jalili is consulting with Iranian zoologists known to be working in the area.
- **Scientific publications**. The combination of a large phytosociological survey and major functional database provides the prospect of the identification of additional important axes of functional specialisation. Initially we are concentrating on two subject areas, shade tolerance and climatic restriction. Papers on the phytosociology of Arasbaran and on the relationship between functional traits and climatic distribution are in preparation; those on the impacts of grazing and upon the distribution of shade and glade species in the forested area are planned.
- **Databases.** RIFR have just produced an annotated list for the flora of Iran. We regard it as an urgent priority to use this as the taxonomic reference for our databases and to amalgamate data for Anzali, Arasbaran and Touran into one unifying Access database together with other RIFR data holdings.

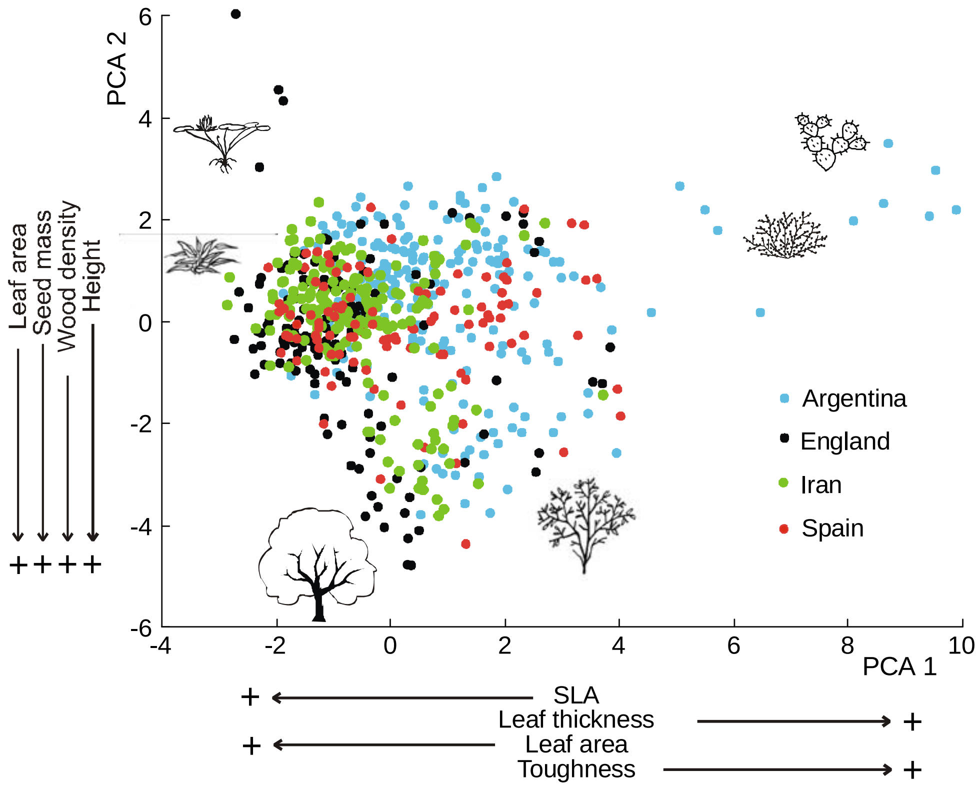
4.1.4 International collaboration

Both Dr Jalili and the collaborators in our Argentina project, Drs Diaz and Cabido, (Grant 162/8/116) have a major commitment to conservation. In addition, however, they were keen to do some major ‘high-impact’ science either within the project itself or as a spin-off from the Darwin collaboration. To these ends we have instituted a new, international element to the work, combining the Darwin dataset with other similar data. Our aim has been to identify general rules relating to ecological specialisation and to conservation and biodiversity. Our first goal was to identify the extent to which the simple functional attributes measured in the project were useful for examining the way that ecosystems function. We used eleven easily measured plant traits (leaf area, specific leaf area, leaf toughness, inrolling of lamina, leaf thickness, canopy height, twig density, mean distance between ramets, shoot phenology, life span, seed mass and seed shape). Our database included 640 vascular plant taxa from four countries (Argentina, 207 species; Iran, 186; Spain, 104 and UK, 143) and three continents. We used Principal Component Analyses to identify major axes of variation in functional traits in each of the four floras. [It should be re-emphasised that this work has the approval of the Darwin Secretariat and that no resources are being taken from other parts of the Darwin project; we are simply putting more time into the collaboration.]

The results from our first ‘international’ analysis, using a subset of 186 Iranian species, were very encouraging. Using Principal Component Analyses we have identified the same major axes of variation in functional traits in each of the four floras (see Figure 4). The main axis of variation represented a fundamental trade-off between rapid acquisition of resources and conservation of resources within well-protected tissues. This axis was closely correlated with other independently-measured traits known to be strongly linked to ecosystem functioning, including relative growth rate, leaf nutrient concentration, litter decomposition rate and resistance to generalist herbivores. This trend was largely independent of phylogeny, land use and climate, suggesting it may be broadly applied to contrasting floras, environments and growth forms, and offering the prospect of a globally relevant functional classification of species. We were very pleased with the results and submitted them in a paper to *Science*. The paper was rejected at the review stage in Science primarily as a consequence of one unsympathetic American reviewer who argued on the basis of high profile work on experimental plots that a functional separation of plants into legumes, grasses and herbs was sufficient for understanding ecosystem processes. We strongly disagree! The manuscript is currently being modified for resubmission to *Proceedings of the National Academy of Science.*

Figure 4. PCA ordination of 640 vascular plant species from Argentina, England, Iran and Spain, on the basis of 12 vegetative and regenerative traits.

PCA was based on the correlation matrix of variables, in which data are centred and standardized by standard deviation. PCA axes 1and 2 accounted for c. 40 % of the variance in the database (PCA 1 = 23.87; PCA 2 = 16.71). Labels display traits with the highest loading factors on PCA axes 1 and 2, with highest loading nearest axis. Stylised figures indicate extreme types, such as aquatics and tender-leaved ephemerals at the lower end of PCA axis 1, Cactaceae at the higher end of PCA axis 1, and large-leaved deciduous trees and shrubs at the lower end of PCA axis 2. A separate PCA excluding desert succulents produced very similar results, including the same rank of loading factors along both axes.



4.2 TRAINING AND CAPACITY BUILDING ACTIVITIES

The training activities undertaken were agreed between the UK Darwin team and Dr Jalili. We were impressed by the competence of senior members of the Iranian team in the descriptive recording of vegetation and field surveys. In addition RIFR had a small analytical unit dedicated to soil chemical analysis. The training element for students, therefore, has concentrated upon the measurement of the functional traits in the field and the laboratory and upon understanding the underpinning ecological theory. The UK team provided 10 days of training on their first visit. These consisted of supervised laboratory exercises and field trips, talks on theory and methodology, data checking and problem solving. A number of training documents were produced for the RIFR team and students (see Appendix VII). Copies of relevant scientific papers were deposited at the Institute for staff and students to read. This collection of references provides the theoretical background to the project. The Iranians found the schedule for functional measurements useful but have suggested improvements to both the wording and methodology. Senior Iranian staff were in charge of the day to day running of the project. More specialised training in the use of CANOCO for analysing combinations of vegetation and environmental data was provided for experienced field ecologists.

There has been a core of 12 staff (+ Dr Jalili) involved in the Darwin project from its onset to the present day.

At all stages of the project the key staff and other participants had various opportunities for improving their skills due to different training elements within the project, including:

- language skills
- ecological survey and field sampling techniques
- identification of vascular plants
- laboratory skills
- database development and population
- data manipulation (including multivariate analysis)
- interpretation of ecological/functional data with respect to conservation needs
- working as a team

We consider that all of these skills are useful components of improving the capacity within the host country to conserve biodiversity in the future. The knowledge gained during the project, and also the computer databases of vegetation relevées and functional attributes will be widely used in the future.

Seventeen students, selected because of their good academic record and interest in ecology, have received training in laboratory and field techniques during the course of the project. Three PhD and four MSc students contributed to the Darwin project on a part-time basis. They gained valuable experience in new ecological techniques and scientific teamwork and were able to incorporate data from the project into their theses. Seven graduate and three undergraduate students worked on the project for a period of between two months and one year. They too came to the project with impressive academic references. These students received no formal qualification from their work on the project but their academic prospects have been enhanced through their participation. All major student contributors to the project are now in higher education or employment. Moreover, several are now employed in research stations in other parts of Iran, where their training can be put to good use. On our most recent visit (January 2002) we interviewed some of the Iranian graduate students working on the project. They said that the quality of training that they had received during the project exceeded that which they would have expected to receive had they done an MSc. This unsolicited commendation is a tribute to the quality of Iranian supervision of the Darwin project.

5. PROJECT IMPACTS

The collaboration in a Darwin project provided two clear signals (a) the Iranian flora is of international interest and (b) a group of Iranian scientists were involved in a prestigious collaboration with a UK University. Both of these perceptions of the Darwin project have had a major, positive impact as to how our work has been received. Public lectures at RIFR were very well attended, on occasions by major political and scientific figures, and the project has had very good coverage in the Iranian media.

The greatest bonus to the project in terms of impact stems, however, from Dr Jalili's promotion from Deputy Director to Director of RIFR during the life-time of the project. As a consequence Dr Jalili has been able to contribute much more local resources to the project and through his dealings with politicians and government ministers, has been in a position to profoundly influence the conservation policy in Iran. His work on the Red Data Book and the Darwin project are likely to lead to a major new conservation initiative to protect the 22% of species that are endemic to Iran. At present only a minority of these occur within protected areas. He has therefore made far-reaching recommendations for the flora of Iran (see (see Section 4.1.1 and Appendix 5).

The legacy of training provided by the project means that there are now trained scientists in other institutes particularly in the provincial research centres in different parts of the country. This will assist in the implementation and development of national conservation initiatives.

The major databases produced during the project are likely to have a major impact on the way Iranians view both their reserves in particular and ecological studies in general, particularly as we publish more papers on the subject. To date there has been an emphasis on traditional phytosociological studies. The databases make more mechanistic studies of ecosystem function more tenable.

The project has focussed upon National Protected Areas rather than the greater landscape and has therefore had little impact on local communities. However, the work may indirectly impact upon local communities in the future. For example, it has highlighted the problems of overgrazing in the mountains, but also the possible problems of habitat conservation if the nomadic way of life is abandoned.

The project was seen as being able to help Iran to meet its CBD obligations in the following specific ways:
1. collection and analysis of extensive data on the plants of Iran;
2. establishment of databases and reference collections of plant materials;
3. training of local people in field survey and identification of flora;
4. training of local people in scientific laboratory techniques;
5. contribution to the development of a programme for national and regional networks of protected sites;

6. contribution of information on rare species for Red Data Books;
7. herbarium collections have been enhanced
8. dissemination of information to the international scientific and conservation communities.

The key component of the project that has helped Iran to meet its CBD, and other, obligations has been the mix of experience and enthusiasm that the Iranian team has brought to the project. In particular:

a) Dr. Jalili, the Iranian leader of the project, as well as being Director of RIFR, is also a member of the National Committee for Sustainable Development and the Research Council for Natural Resources. He has regular high-level meetings with two leading organizations in conservation, the Forests & Rangelands Organization and The Department of Environment. He was involved in the review and revision of the CBD Iranian 2nd National Report (published May 2001).
b) Dr Y. Asri (PhD), an experienced field worker and taxonomist, will take part in a nationwide project to survey major plant communities in different part of the country particularly in the protected areas. He is also member of the national committee for the Ramsar Convention.
c) F. Zarinkamar (PhD), has a strong laboratory-based background and is an expert in plant anatomy. She is keen to relate the rigorous anatomical work of her group to the functional approaches adopted in the study. She also wishes to extend measurements to other areas and habitats.
d) B. Hamzaee (MSc) is a respected phytosociologist. He will carry on his efforts to link his research on phytosociology with studies of plant biodiversity.
e) Z. Jamzad (PhD) plays a leading role in the studies of Iranian Flora study, and also is very active in plant biodiversity research in Iran. She is one of a group of people involved in preparing and reviewing the "Iranian national document for biodiversity".

See also Section 4.2

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6. PROJECT OUTPUTS

Project outputs, both those promised and those additionally achieved, are quantified in Appendix II using the coding and format of the Darwin Initiative Standard Output Measures. In addition, information has been disseminated in the form of scientific papers (see Appendix VI and VI). This has two purposes. It raises the profile of conservation issues important in Iran and makes Iranian experience available to a wider audience. Moreover, the only significant cost for continuation with this type of output will be one of time. Correspondence and the transfer of data, so essential to a continuing collaboration, can be readily effected by e-mail**.**

7. PROJECT EXPENDITURE

	Predicted	Actual	% variation
Staff salary costs:			
Postage, telecoms & stationery			
Travel etc.:			
Printing etc.			
Conferences, seminars etc.:			
Other: Capital items, consumables, computerware, laboratory analysis			
Total			

8. PROJECT OPERATION AND PARTNERSHIPS

There has been only one local partner throughout the project, the Research Institute of Forests and Rangelands, Tehran (RIFR), under the able guidance of its Director, Dr Jalili. However, through RIFR, it was possible to involve staff and students from regional research facilities, and the University of Tehran.

Project planning centered around face-to-face discussions and e-mails about conservation needs and work priorities. Dr Jalili has a good knowledge of the problems facing the Iranian flora and sits on a number of important committees (see Section 5). He also has strong ideas as to what was needed for the conservation of the flora. These ideas made eminent sense and we were happy for them to be incorporated into the project. UK partners have made suggestions, primarily about the scientific content of the work. These have been discussed and either accepted or rejected on grounds of relevance and feasibility. Dr Jalili was very supportive of our ideas since he sees the need for conservation activities to be science-based.

Staff of Iranian bodies with similar interests have been kept informed of our activities and have attended the public talks given by Iranian and UK scientists at RIFR. More formal co-operation will be sought now that the project is drawing to an end so as to ensure that conservation policies for the flora and fauna are integrated.

The Darwin project is still on-going even though funding has now ceased. The four scientists who have been involved from the outset are still involved and three students are still helping with data collation. Both partners are committed to maximizing the conservation and scientific output of the project. There are valuable underexploited databases to explore and major new conservation initiatives to prepare.

9. MONITORING AND EVALUATION, LESSON LEARNING

Dr Jalili has kept a close check on progress in carrying out the Iranian part of the project. In accordance with good laboratory practice, there has been a high level of replication of measurements, checking for errors and some re-measurement to ensure that the database is of high quality. Some guidelines sent from Sheffield for checking the data are included in Appendix VII. The Iranians have also assessed the sensitivity of their laboratory apparatus to ensure that quantities of material routinely used are appropriate. They have also suggested improvements to some of the protocols, and improved the design of some of the instruments (Plate 1). We have also been at pains to assess whether the procedures undertaken will maximize the conservation and scientific benefits of the project. We are now confident that all measurements undertaken can be incorporated into either a management plan or a scientific paper or both. Moreover, we are constantly looking for ‘added relevance’ of conservation outputs by consultation and ‘added value’ by increasing scientific outputs.

There are lessons to be learnt from the project. Because of the enthusiasm of our Iranian colleagues the project was very ambitious and consequently the project has overrun. This ‘added value’ to the project has meant that the full impact of the ‘functional type’ approach both in relation to conservation and scientific outputs will not be realised for some time.

There are also two organisational problems that could have been foreseen:

1. Because the study sites were far from Tehran, there were major logistical problems in collecting material. Re-collecting plant material for checking and making field visits for seed collecting put excessive strain upon the staff of RIFR.
2. We have concentrated on scientific problems associated with the project. With hindsight we should have addressed computing issues more thoroughly at the outset. There are experts on the various packages that we routinely use (e.g. Excel and Access) at our partner-Institute, but some of those directly involved in the project had limited computing skills. This is not a major problem since in-house learning has taken place, but it is another reason why progress with the database has been slower than expected. Initially there were major problems because (a) there was a large amount of data being generated, (b) many of those carrying out the measurements had had little computing experience and (c) the number of computers dedicated to the project was small. Now participants are much more computer-literate and Dr Jalili has secured additional funding to provide a computer room with a suite of new networked computers and someone dedicated to keeping the system running.

10. DARWIN IDENTITY

On our first visit to Iran the Darwin Initiative was promoted through a formal twenty minute talk by Dr Shaw attended by c 200 scientists, some from the Institute, others from other research institutions. In this talk the origins, objectives and opportunities for funding associated with the Initiative were clearly explained. All other talks have acknowledged the Darwin Initiative and displayed the logo at some point, usually on the title overhead or slide. Any laboratory apparatus large enough to support a Darwin logo sticker was so decorated and we are pleased to report that the stickers, though slightly battered, were still attached at the end of the project. Dr Jalili was officially a Darwin Fellow during his visit to UK. However, in the informal atmosphere prevailing in Sheffield, this title was never really used.

The Darwin Initiative has a good reputation in Iran. It is seen as a mechanism for collaboration with British Universities, whose educational standards are well respected. In addition, grants are regarded as apolitical in a way that money from British Council is not.

Because it involved collecting large quantities of data the main body of the project had a clear scientific and conservation identity. The project also impacts on national conservation initiatives. These were unplanned, being the consequence of Dr Jalili's activities as director, and the role of Darwin less overt. The Red Data Book includes an acknowledgement of Darwin; proposals for conservation prepared for the Iranian Parliament do not, but one pamphlet prepared by Dr Jalili includes pictures of both Darwin study sites (see Appendix V).

11. LEVERAGE

Dr Jalili was impressed by the scientific background to the project and as a result provided much more resources (money, people, equipment) to the project than was initially promised. This was particularly noticeable after he had been appointed Director of RIFR in 1997. A number of students also elected to transfer from Tehran University to do a higher on the project.

There is a major problem in securing further funding while a Darwin project is ongoing. Potential international donors are impressed by achievements – these are greater and can therefore be sold much more effectively once a project has been successfully completed. No attempt has, therefore, yet been made to apply for funds from international donors. However, during his work as Director, Dr Jalili regularly meets leading politicians and senior officials from development agencies. Moreover, he has a proven track record of securing funds for major projects (see 12 Sustainability and Legacy, below). UK project staff will continue to advise and to help in the search for additional funding but regard their role as secondary to that of Dr Jalili, particularly in the current climate of international political sensitivities.

12. SUSTAINABILITY AND LEGACY

The major achievements of the project are in two main areas:

Science and Education

The flora of Iran is species rich (c. 8000 species) and the range of habitats and climates is great. Moreover 22% of the flora is endemic to Iran. Despite its high biodiversity and endemism the flora has been poorly studied from an ecological point of view. Conventional approaches to making good this deficiency are neither economically nor logistically feasible. The functional approach adopted in this project does, however, provide a potential solution to the problem of understanding both how ecosystems work and the habitat requirements of little-studied endemics. Moreover, Dr Jalili appreciates this and is in a position to carry on this study. The possibility of extending this approach to other areas of Iran will be made easier because five students involved in the Darwin project are now employed in other research institutes and universities. These trained scientists represent a further legacy of ecological knowledge and expertise from the Darwin project. Unfortunately, because the databases were so large and time-consuming to assemble, we are only just beginning to use functional data in management prescriptions for nature reserves. Much more development work will be needed before functional data can be used without expert advice in conservation management. We intend to continue collaborating informally towards this end and expect the existing data to provide a rich source of information for exploring pure and applied ecological problems. The paper included as Appendix 7 validates the use of simple plant traits in ecological studies and suggests that the approach is globally useful.

A new working group (Plant Ecology Group) was set up in the host institute (RIFR) to undertake the Darwin project work. This group will stay together after the end of the project, with the intention of taking forward similar lines of research.

Conservation

Advice on how to management the Anzali wetlands and Arasbaran grasslands and forests has been accepted by those responsible for the day to day management of the reserve (Department of Environment) and will be implemented. More importantly Dr Jalili has used his experience of preparing the Red Data Book and participating in the Darwin project to review the conservation policy of Iran (see Appendix V). He concluded that past conservation policies have been incomplete. In the past, Protected Areas have been set up so as to include the full diversity of habitats within each climatic zone but little has been done for the conservation of the endemic species, which represent 22% of the flora. Moreover, 10% of the total flora (nearly 800 species) are endemics confined to a single province. Inevitably, therefore, most endemics do not occur within protected areas and details of their habitat requirement and autecology remain unknown. Dr Jalili wishes to commence a new initiative specifically aimed at endemics. A major collection of floristic, habitat and autecological data are required to understand the nature and complexity of the management problems. Coupled with this is the need to extend the conservation areas specifically for endemics and to provide wildlife corridors between conservation areas. He estimates that this would require a doubling of amount of land designated as Protected Areas from 5 to 10% of the country. Dr Jalili has already produced supporting documents for the Iranian Parliament and has started lobbying politicians. He is also arranging meetings with international agencies. To help kick-start the project we will be applying for another Darwin project to devise a conservation strategy for one of the most endemic-rich provinces. International interest in the Iranian flora has a very positive effect on national funding. Dr Jalili has considerable drive, vision and political acumen and is already delivering on a number of major conservation initiatives. He initiated and saw to completion the production of the Iranian Red Data Book. He resurrected the Botanical Garden Project – this had been started in 1963, before the Islamic Revolution and then abandoned. Dr Jalili restarted the project in 1992 and with major government funding it will be completed in 2004. Dr Jalili has also secured funding (£500,000) for a permanent refrigerated seed store, similar to that at Wakehurst Place, Kew. Here, he intends to conserve seeds of the full

Iranian flora. We have no doubt that he will also deliver with respect to the conservation of endemics. We regard the formulation of this new initiative as the most important achievement of the current project. We hope that we, and Darwin, will help to guide it through its early stages. The international Darwin collaboration has brought prestige to RIFR in general and Dr Jalili in particular and has undoubtedly given greater authority to conservation recommendations.

13. VALUE FOR MONEY

The project represents excellent value for money.

- The collaboration is viewed within Iran as a high prestige project. This is reflected by the fact that some students have preferred to carry out their PhDs at RIFR rather than Tehran University and several BSc graduates considered that their training at the Institute was superior to that which they would have received during an MSc.
- The project is relevant to Iran's conservation and scientific needs. Dr Jalili's appointment as Director of RIFR has necessitated regular contact with national politicians and administrators as well as scientists. He is thus well able to seek informed opinions and to judge priorities. Moreover, Dr Jalili has carefully canvassed opinion before making recommendations and to date all his suggestions have been implemented.
- The work was conducted on a much larger scale than originally envisaged due to the commitment of Dr Jalili and his team. Many scientists have received training. Detailed studies have been undertaken within four Protected Areas and major autecological databases have been set up to complement the field information from two of the most intensively-studied sites.
- The project will eventually generate a large number of papers relevant to conservation (to date two are published, one has been accepted for publication and one is at the review stage). One of the papers, a collaboration between scientists from four countries, is expected to have a large impact on ecological thinking in the current biodiversity debate (see Appendix VI).
- Most importantly, the Darwin Project has had a role in shaping Iranian conservation policy. It has assisted in a minor way the preparation of the Iranian Red Data Book and in the preparation of a new initiative aimed at conserving the large endemic flora of Iran.

Author(s) / Date

John Hodgson, Adel Jalili, Sue Shaw. 10 April 2002

14. APPENDIX I: PROJECT CONTRIBUTION TO ARTICLES UNDER THE CONVENTION ON BIOLOGICAL DIVERSITY (CBD)

Project Contribution to Articles under the Convention on Biological Diversity		
Article No./Title	**Project %**	**Article Description**
6. General Measures for Conservation & Sustainable Use	**5**	Develop national strategies which integrate conservation and sustainable use.
7. Identification and Monitoring	**25**	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.
8. In-situ Conservation	**10**	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.
9. Ex-situ Conservation	**0**	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.
10. Sustainable Use of Components of Biological Diversity	**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.
11. Incentive Measures	**0**	Establish economically and socially sound incentives to conserve and promote sustainable use of biological diversity.
12. Research and Training	**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).
13. Public Education and Awareness	**15**	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.
14. Impact Assessment and Minimizing Adverse Impacts	**5**	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.
15. Access to Genetic Resources	**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

Project Contribution to Articles under the Convention on Biological Diversity		
Article No./Title	**Project %**	**Article Description**
		country's genetic resources should ensure sharing in a fair and equitable way of results and benefits.
16. Access to and Transfer of Technology	**1**	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.
17. Exchange of Information	**4**	Countries shall facilitate information exchange and repatriation including technical scientific and socio-economic research, information on training and surveying programmes and local knowledge
19. Bio-safety Protocol	**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.
Total %	**100%**	**Check % = total 100**

15. APPENDIX II: OUTPUTS

* Outputs additional to those originally agreed have been marked with an asterisk.

Code No.		*Quantity*	*Description*
1	Number of people submitting thesis for PhD qualification	*(3*)*	[The following PhD's were not directly funded by Darwin, but students participated in the project and included information collected by and/or incorporated approaches taken during the Darwin project] Z. Jamzad [Iranian] (2001). *Comparative study of Nepeta genus in Iran*. PhD Thesis, University of London. [In English] U. Asri [Iranian]. (2000). *An ecological survey of plant communities of arid regions – Case Study: Touran Biosphere Reserve, Semnan Province.* Azad University. [In Persian] Pile-var [Iranian]. *Plant Biodiversity in Caspian Forests.* Tarbiat Modarres University. [In Persian]
2	Number of people attaining Masters qualification	*(4*)*	[The following MSc's were not directly funded by Darwin, but students participated in the project and included information collected by and/or incorporated approaches taken during the Darwin project] M. Rabei-e [Iranian] (2000). *Comparative study of* Artemisia *genus in the North of Iran*. Tehran University. [In Persian] Mir-haji [Iranian] (2000) *Comparative study of* Artemisia *genus in the central part of Iran*. M.Sc. thesis, Tarbiat-Modarres University. [In Persian] S. Yazdani [Iranian] (2001). *Forest ecosystem management*. Emam-Khomaini Higher Education Centre, Tehran. [In Persian] Ghasemi. [Iranian]. (2000). *Comparative study of Populus genus in Iran.* Tarbiat Modarres University. [In Persian]
4a	Number of undergraduate students receiving training	3	Maryam Dehgan, Mohammad Dehgan, R. Azimi [all Iranian]
4b	Number of training weeks provided to undergraduate students	114	
4c	Number of postgraduate students receiving training	7	M. Akabarzadeh, M. Khoshnevis, F. Kazemi, A. Shirvani, M. Najibzadeh, H. Ramazani, & A. Ghasemi [all Iranian]
4d	Number of training weeks provided to postgraduate students	282	

Code No.		*Quantity*	*Description*
6a/b	Number of people receiving other forms of education/training	17	A workshop was held at RIFR (Tehran) in June 1998 involving 2 UK scientists with 13 Iranian scientists and students. 5 days were spent in the RIFR and 6 days in the field, with seminars, practical training workshops and discussions about the project. Two more scientists were involved in the field trips. In 1998, field and laboratory work was undertaken over 3 months by a total of 18 scientists and students (excluding the Institute Director, Dr Jalili). The original stated output for year 2 was for a training workshop to be run involving 5 local scientists over 3 days. However, as the visits by the 4 UK scientists were split into two separate occasions, this was achieved in a less formal manner than originally envisaged, with the workshop taking the form of 'trouble-shooting' sessions and discussions with the 5 main Iranian scientists involved, as well as some students, both in the laboratory and field. In 1999, fieldwork was carried out over 6 months, and laboratory work over the full 12 months. This involved a total of 25 RIFR staff and students: 11 scientists, 4 PhD students, 1 MSc student, 3 BSc students and 6 technicians.
8	Number of weeks to be spent by UK project staff on project work in the host country	10	2 UK staff spent 2 weeks in Iran in June 1998 training and discussing structure of work; 4 UK staff spent a combined total of 6 weeks in Iran in April/May 1999 training and discussing the work etc.; 2 UK staff spent 1 week in Iran in January 2002 discussing the final outputs etc.
9	Number of species/habitat management plans (or action plans) produced for Governments, public authorities or other implementing agencies in the host country (s)	2	Dr Jalili prepared two reports to the Iranian government (see Appendix V). These are the Institute's recommendations about plant conservation in Iran, and were circulated within relevant Departments in the whole country.
11a	Number of papers published or accepted for publication in peer reviewed journals	2 + 1*	Asri, Y., Jalili, A., Assadi, M., & Diyanat-Nejat, H., (2000) A contribution to the Flora of Touran biosphere reserve. *Pajouhesh & Sazandegi*, 47:4-19. [In Persian] K. Thompson, A. Jalili, J.G. Hodgson, B. Hamzeh'ee, Y. Asri, S.C. Shaw, A. Shirvany, S. Yazdani, M. Khoshnevis, F. Zarrinkamar, M. Ghahramani, R. Safavi. (2001). Seed size and shape and persistence in the soil in an Iranian flora. *Seed Science Research* **11**: 345-355. A. Jalili, B. Hamzeh'ee, Y. Asri, A. Shirvany, S. Yazdani, M. Khoshnevis, F. Zarrinkamar, M. -Ali Ghahramani, R. Safavi, S. Shaw, J. G. Hodgson, K. Thompson, M. Akbarzadeh, and M. Pakparvar (in press). Soil seed banks in the Arasbaran Protected Area of Iran and their significance for conservation management. *Biological Conservation*
12a	Number of computer-based databases established (containing species/generic information) and handed over to host country	1+3*	The information gathered has been split between four databases: (1) Anzali database; (2) Arasbaran functional database; (3) Arasbaran phytosociological database; (4) Arasbaran plant anatomy database.

Code No.		*Quantity*	*Description*
12b	Number of computer-based databases enhanced (containing species/generic information) and handed over to host country	1*	(1) Endangered and rare species database
14a	Number of conferences/seminars/ workshops **organised** to present/ disseminate findings from Darwin project work in **host country**	2*	A conference took place at RIFR (Tehran) on 18th September 2001 (but in the absence of UK partners as. Sheffield University would not sanction our visit so soon after the terrorist attacks of September 11th 2001). Dr Jalili spoke to an audience of c. 300 scientists, experts from implementation organisations, the media and politicians about the project and the future challenges for conserving the Iranian flora for 2½ hours. He then answered questions for c. ½ hour. A further conference took place at RIFR on 22nd January 2002 during which Dr Hodgson and Dr Thompson gave four papers, including one on behalf of Dr Shaw *in absentia*. c. 150 scientists and experts from implementation organisations attended. During this conference Dr. Jalili was exclusively interviewed by IRNA (Iran News Agency)
14b	Numbers of conferences/ seminars/workshops **attended** at which findings from Darwin project work have been presented/disseminated	2	Dr Thompson presented a paper "*Seed size and shape and persistence in the soil in an Iranian flora*" at the 21st Annual Seed Biology Meeting, Millennium Seed Bank, Wakehurst Place, UK, on 24 April 2001. Dr Sandra Diaz (Argentinean partner in Darwin project – Grant 162/8/116) presented a paper "*The plant traits that drive ecosystems: evidence from three continents*", at the 45th Symposium of the International Association for Vegetation Science (Vegetation Dynamics in Time and Space), held at Porto Alegre, Brazil, 3–8 March, 2002. [Note that attendance at these meetings was not funded by this project. The original stated output of attendance by 2 people at an international conference in the final year was changed (in agreement with the Darwin Secretariat) to RIFR organising and hosting two conferences in Tehran – see 14a, above]
15a	Number of **nationa**l press releases or publicity articles **in host country**(s)	6	In an interview with Iran News Agency (IRNA) in May 1999, Dr Jalili explained the main aims of the Darwin project. The interview was subsequently broadcast on national television and radio. Dr. Jalili was exclusively interviewed on 12 December 2000 by IRNA (Iran News Agency) about the Darwin Project in Iran, and this interview was broadcast to a wider audience by different TV news networks and some national newspapers. Dr. Jalili was also interviewed by IRNA during the conference in January 2002. There was national publicity in Iran for the public lectures given by the visiting UK scientists in 1998, 1999 and 2002.

Code No.		*Quantity*	*Description*
15c	Number of **nationa**l press releases or publicity articles **in UK**	2	A press release was issued by University of Sheffield publicity office in July 1998 to around 60 contacts in the UK (plus 40 within Sheffield University) in order to promote local and national awareness of the project. A poster about the project was displayed at two Darwin seminars (1999 and 2000), and displayed within the Department of Animal and Plant Sciences at the University of Sheffield.
18a	Number of national TV programmes/features in **host country**(s)	1	*see 15a above*
19a	Number of national radio interviews/features in **host country**(s)	1	*see 15a above*
21	Number of permanent educational/training/research facilities or organisations established	1*	A new working group (Plant Ecology Group) was set up in the host institute (RIFR) to undertake the Darwin project work. This group will stay together after the end of the project, with the intention of taking forward similar lines of research.
23	Value of resources raised from other sources (i.e. in addition to Darwin) for project work.	£69,000 + >£76,000*	Over £145,000 has been raised from local Iranian sources for project work, mainly in supporting salaries, computing facilities and additional travel/ subsistence. In addition, other facilities have been provided to which it has not been possible to put costs. For example, the plant anatomy laboratory at the Institute has been occupied completely by the project team during the project, and about 30% of technical staff time and resources available in the soil and water laboratory were allocated to the project; two vehicles, relevant field instruments and also guest-houses of regional research stations have been made available to the group during the field work.

16. APPENDIX III: PUBLICATIONS

The text of these papers is provided in Appendix VI.

Type	Detail	Publishers	Available from	Cost
Paper	K. Thompson, A. Jalili, J.G. Hodgson, B. Hamzeh'ee, Y. Asri, S.C. Shaw, A. Shirvany, S. Yazdani, M. Khoshnevis, F. Zarrinkamar, M. Ghahramani, R. Safavi (2002). *Seed size and shape and persistence in the soil in an Iranian flora*. Seed Science Research ***11****: 345-355.*	CAB International, Wallingford, Oxford, UK	Through normal library channels	Standard library charges
Paper	Asri, Y., Jalili, A., Assadi, M., & Diyanat-Nejat, H., (2000). A contribution to the Flora of Touran biosphere reserve. *Pajouhesh & Sazandegi*, 47:4-19. [In Persian]		Through normal library channels	Standard library charges
Paper	A. Jalili, B. Hamzeh'ee, Y. Asri, A. Shirvany, S. Yazdani, M. Khoshnevis, F. Zarrinkamar, M. -Ali Ghahramani, R. Safavi, S. Shaw, J. G. Hodgson, K. Thompson, M. Akbarzadeh, and M. Pakparvar (**in press**). *Soil seed banks in the Arasbaran Protected Area of Iran and their significance for conservation management.* Biological Conservation	Elsevier Applied Science , Oxford, UK	Through normal library channels	Standard library charges
Paper	B. Hamzeh'ee (2000). Some new and noteworthy plant records from Iran. *Iranian Journal of Botany*, **8 (2)**, 271–277.		Through normal library channels	Standard library charges
Paper	B. Hamzeh'ee, A. Jalili, (in press). *Melilotus neapolitanus* ten. A new record for the flora of Iran. *Iranian Journal of Botany*.		Through normal library channels	Standard library charges

17. APPENDIX IV: DARWIN CONTACTS

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

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