TAIB Project S’Albufera

A Mediterranean model for the study of biodiversity and environmental change

The Albufera International Biodiversity Group Annual Report 2001

Investigating the biodiversity of dune grassland, Ses Puntes. Photo: Nick Riddiford
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The Albufera International Biodiversity Group Annual Report 2001

Edited by Nick Riddiford

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PART I

TAIB Project S’Albufera in year 2001

The Dennis Bishop Laboratory. Photo by Elizabeth Riddiford.
Introduction

The year 2001 was the thirteenth consecutive year of TAIB Project S’Albufera (formerly Earthwatch Europe Project S’Albufera). Correspondingly, this is the thirteenth annual report of activities and results. A full description of Project S’Albufera achievements and results over the first 12 years appears on the Albufera website. It summarises the structure of our multidisciplinary, international project, the research site, the scientific work programme past and present, and exciting new developments for the new millennium. This extensive summary can be accessed at: http://www.mallorçaweb.net/salbufera/taib.htm.

The current report describes the research programme, progress and results in 2001. The programme of work has been developing steadily and is expanding, ensuring a very busy and successful year. The wide range of fieldwork undertaken in 2001 is described in Part II below. Results from studies conducted in 2001 are presented in Part III. The scientific work planned for 2002 is given in Part IV.

The field season

Team participation

As in most previous years, there were three fieldwork teams, two in spring and one in autumn. The first team was composed of 10 scientists and 6 volunteers, the second team 12 scientists and 6 volunteers and the autumn team 15 scientists and 2 volunteers. The scientists were drawn from the UK (10), Mallorca (8), France (2), Holland (1), Malta (1) and Greece (1). Two further scientists were Canadians based in France and another was of dual Dutch-American allegiance. The volunteers comprised 6 from Mallorca, 5 from the UK, one from Ibiza, one from mainland Spain and one from France. International collaborations brought scientists from Tour du Valat Biological Station, France, the University of York Research Masters programme, England, and the Aquatic Ecology & Management Group and the Environmental Systems Analysis Group from Wageningen, Holland. Further details of studies and participants are given in Part II.

An important development in 2001 was the establishment of closer links with the University of the Balearic Islands (UIB). The fieldwork teams were especially designed to offer training in field methodologies and research for local students, and a number of young geographers and biologists from UIB took the opportunity to join us, particularly in the spring.

Other scientific visits and activities

The spring and autumn teams were designed to allow scientific fieldwork to be conducted in parallel with a training programme – particularly in the related topics of biodiversity conservation and environmental management. TAIB representation is not restricted to
those periods. To fully understand the functioning of the Park ecosystems, and to obtain the information necessary to plan for effective conservation measures, studies and monitoring tasks are required on a regular basis at other seasons. For a number of years, TAIB has benefited from a collaboration with the Aquatic Ecology & Management Group and the Environmental Systems Analysis Group based at Wageningen University, Holland. Through a series of Masters’ research projects, gaps in knowledge are being filled and more detailed information gathered, particularly regarding impacts on the environmental quality, ecosystem functioning and biodiversity protection of the Park. A new collaboration, with the University of York Research Masters programme, begun in 2001, will extend this programme further.

Over the last few years, the TAIB group has been keen to recruit Balearic and Spanish members who are able to carry out the research and routine monitoring work at regular intervals throughout the year. The new relationship with UIB has been of great benefit in identifying a number of knowledgeable and enthusiastic young scientists who are willing and able to participate. This has allowed us to expand our long-term monitoring work in a number of areas.

Project work by visiting Masters students outside the designated team periods was undertaken by three representatives from Wageningen and one from York. Three local team members undertook fieldwork and collected scientific data on a regular basis throughout the year. Further details of these activities are given in Part II.

Studies

TAIB project s’Albufera is gathering considerable momentum. This is due to a number of factors, including some fruitful collaborations with institutes and individuals and the fortunate availability of internationally recognised specialists who have been willing to participate. The most important factors, undoubtedly, are the new facilities of the Dennis Bishop Laboratory and the on-site accommodation in the new Casa de las Universidades. Comfortable accommodation makes the visit to the Parc much more attractive and the Bishop Laboratory, with its range of good quality equipment provides an excellent working environment for the scientific team.

The biodiversity studies programme received a boost in 2001 through the participation of a number of eminent entomologists. We were very fortunate in the spring to be joined by Dr Martin Ebejer from the University of Malta. His area of expertise is Mediterranean diptera and he undertook an extensive baseline survey during a week’s visit in April. This led to development of a programme which extends the Diptera biodiversity baseline and introduces a systematic trapping scheme in specific habitats - to be undertaken by the Park biologist, Rafel Mas, with the back-up support of Dr Ebejer. Other new developments were also possible due to the participation of specialists. Dr David Agassiz joined us in November to undertake a pilot study of the ecological associations, phenology and habitats of microlepidoptera, with a view to developing a programme for expanding our knowledge of this little known group. Henry Stanier began a similar programme at the same time, but with odonata as his target group. Henry’s work will enhance the study of aquatic invertebrates as indicators of water quality, being undertaken by Juana Garau. The two
scientists worked together to prepare the aquatic invertebrate collection as a full working reference.

Collaborations in 2001 led to a number of extra lines of research in areas of human impact studies and Parc management. The long standing collaboration with the Environmental Systems Analysis Group and Aquatic Ecology & Water Management Group from Wageningen, Holland, took a further step forward with an important study, the *Integrated Assessment of Water Use, Policies and Management in the Sa Pobla-Inca catchment area, Mallorca*. This takes a multidisciplinary approach to these issues. A full assessment will not only provide essential information regarding their impact on the functioning of the Parc and its surrounding area, but enable a more informed management strategy to be developed which favours sustainable resource use and planning for long-term biodiversity conservation and environmental protection.

The first of what is likely to be an ongoing collaboration with the University of York took place in summer 2001, in the form of a Masters study by Leanne Sargeant. Her study was designed to obtain baseline information related to niche partitioning by herons and by invertebrates in the various Parc wetland habitats in order to better understand their requirements. This in turn provides scientific information on which to base conservation management decisions.

A full summary of the 2000 work, including interim results is given in Part II.

**Other events**

**Laboratorio Dennis Bishop**

The Dennis Bishop Laboratory, opened in November 2000, has already made an enormous difference to the range and quality of work which we can accomplish, and added a large measure of comfort and ease to working conditions. The initial investment in equipment was used to good effect by all participants during 2000. This proved the catalyst for a number of new initiatives taken by TAIB in collaboration with the Parc. In particular, sophisticated field and laboratory equipment was used to good effect to begin detailed mapping of the Parc. Work during the spring was related directly to the future preparation of a GIS system for the Parc. Cartographic software was used connected on-line to a GPS with an accuracy of +/- 1 m. Details were recorded of the hydrological sample points, TAIB study transects, areas of grazing, areas of open water, visitor itineraries and a range of other geo-reference material to establish a database for future transfer to GIS. A series of 1:5000 cartographical/topographical maps for the entire Albufera was established in DGN format (using Microstation) and a version of the ArcView program was installed in order to take the first steps towards constructing a GIS.

In addition, the new equipment was used to establish a photographic database. Photographs of major events, including the extensive reedbed fire of November 2000, were transferred digitally to the database. As a pilot study, Miguel Dora of ABAP established a database of macrolepidoptera based on species in the Parc reference collection. This proved to be a
huge success and is the first step towards a more extensive photographic database of s’Albufera fauna and flora, planned for the future. The long term benefits are considerable. One or more CD-ROMs may be developed which provide information on identification features, status, appreciation of the value of lesser known elements of the fauna and flora, and their conservation needs, etc. The Albufera reference collection was originally established to promote the study of invertebrates and other fauna and flora locally. It is conceivable now to allow access to the photographic database through the internet. This would make the Albufera material of value and accessible not just to local researchers but throughout the World.

Participating scientists were delighted (and often very surprised) by the quality and range of equipment. The year proved a good testing period for the facilities and allowed us to canvas scientists for suggestions of further equipment requirements and improvements. This resulted in a range of recommendations which are being followed up for 2002.

Storms and flood

On the night of Saturday 10th November, the Parc (and much of Mallorca) was hit by hurricane force winds. This was followed four days later by storm force winds and very heavy rain. The heaviest rain was in the mountains and this was sufficient to raise the water levels in the Parc from unseasonally low to flood conditions. The flood reached but did not completely inundate the entrance track. The rain and flooding was on balance beneficial because it permitted flushing out of stagnant water. The destructive element was the strength and direction of wind. The initial hurricane did the most damage. A large number of trees were felled. Nearly half the trees in the wood alongside the main entrance were uprooted. The wood is an important roost and breeding site for night herons Nycticorax nycticorax and egrets Egretta garzetta and Bulbucus ibis. We must wait until next spring to establish what impact this will have on the breeding population. A considerable number of mature Pinus halepensis trees were uprooted in Es Comú, and the Ca’n Picafort Woods area of Es Comú was particularly badly affected. A bird transect through the coastal dunes at Es Comú, one week after the hurricane, established that bird densities remained high (perhaps even benefiting short term from exposed invertebrates and other food sources). The exception was finches (Fringillidae) which were scarce. Further census work next spring will give a better measure of the impact of this habitat disturbance.

The storm also had an enormous impact on the foredunes. The direction of wind was north to north-east and this, coupled with high sea levels, was sufficient to drive the full force of the sea on to the coastal dunes. Virtually all the pioneer vegetation was lost, presumably buried under sand, the protective brushwood fencing and rope fence put there to encourage regeneration were both swept away and an estimated one to two metres of erosion of the dune face took place. Only the roots of the first line of Juniperus oxycedrus macrocarpa saved the dunes from more severe erosion. Unfortunately, considerably further damage was done to the dune face population of this internationally important form of Juniperus. Live plants had fallen on to the beach and most others had suffered considerable root exposure which will result in dieback in the future. Other plants which had fallen on to the beach from the dunes including several of the Balearic endemic Thymelaea myrtifolia.
The damage to the foredunes was an immense setback to the good measures which had been put in place to recuperate the fore dunes and their pioneer vegetation. It did, however, demonstrate that protective measures such as fencing and signs need to be supported by a more global management plan for the ecosystem, extending to protection of the very important *Posidonia oceanica* population in the Bay, regulation of promontories and other building activities in the bay which disrupt current flow (with consequential changes in erosion and deposition events) and the end to mechanical cleaning of the beach (which makes the topography of the beach smooth and thus allows the full force of the sea to flow uninterrupted up to the dune in times of strong onshore winds).

**New faces**

Pere Vicens, the Park ornithologist, has taken a two year sabbatical. We did not lose him completely, because he joined the TAIB group to lead our bittern *Botaurus stellaris* population study in April. Pere’s departure led to the appointment of biologist, Rafel Mas. Rafel’s skills are extensive, and he has a good knowledge of invertebrates. This has given us the opportunity to extend biodiversity studies into new areas, with the enthusiastic support and participation of Rafel. Of most importance is his willingness to sample invertebrates during periods when our entomological specialists are absent. He has already taken a number of interesting lepidoptera specimens, including one new to the Balearic Islands.

**Associació Balear d’Amics dels Parcs**

ABAP, the Balearic Association of Friends of the Parcs, was again very supportive to the Project in a number of logistical matters, not least the administration of the Bishop donation towards equipping the Laboratorio Dennis Bishop.

**Future developments**

A number of important new developments are anticipated during the three years. One which is already being planned is a two-week biodiversity training course in March 2002 for members of the University of York Research Masters (MRes) course. Other ambitious and valuable events are still being discussed or funding sought. They include investigations and international field meetings on bryophytes and microlepidoptera, a refresher entomological training course for museum workers and taxonomists, and conservation management research programmes linked to UIB. One very important collaborative project which has been proposed is SAVE, *Socio-economic Assessment and Valuation of Biodiversity Conservation in Europe*. This would be a truly international project, involving participants from Finland, Greece, Holland, Hungary, Italy, Portugal, the UK and of course ourselves as the Spanish representative. The project leader is Dr Rudolf de Groot from Wageningen, Holland. The assessment and valuation elements include a series of case studies for major habitat types throughout Europe. S’Albufera de Mallorca has been selected as the case study for non riverine wetland ecotypes. If funding can be found, the case study will be led by the UIB Department of Earth Sciences, with the full participation and collaboration of TAIB and the Parc Natural de s’Albufera. The project was unsuccessful in obtaining funds from the European Union’s Energy, Environment and
Sustainable Development programme but is being submitted to other international funding programmes. If the proposal is successful, the project should begin in late 2002 and is expected to last three years. Further details of SAVE are given in Part III of this report and details of other 2002 work in Part IV.

Publications in 2001

The following publications appeared in 2001:


Acknowledgements

There is no doubt that TAIB Project S’Albufera would have foundered long ago without the advice, commitment, enthusiasm and goodwill of a large body of people. They have all become good friends. It is my pleasure therefore to record my great thanks to: the Park authorities and Balearic Conselleria de Medi Ambient and in particular the Consellera Margalida Rosselló, Director General de Biodiversidad José Manuel Gomez Gonzalez, Head of Department Joan Mayol and Park Director Juan Salvador Águilar for permission to continue with our studies, and for helping to develop and financially support the training programme for UIB student volunteers; the Associació Balear d’Amics dels Parcs, and its President Miquel Fullana for assistance in the development and equipping of the Dennis Bishop Laboratory, and for other logistic support; the help and advice from our many Balearic friends at the University, Environment Ministry and GOB; the continued interest and enthusiasm of Dr Rudolf de Groot and his associates from the Environmental Systems Analysis Group & Aquatic Ecology and Water Management Group at Wageningen Agricultural University, Netherlands; scientists and friends from the Tour du Valat Biological Station, France, including their Mediterranean projects officer based in Mallorca, Pere Tomas; the MedWetCoast Regional Facilitation Unit, also based at Tour du Valat; and the numerous specialists who advise us and give opinions on matters scientific - Dr David Agassiz, Dr Martin Ebejer, Barry Goater, Martin Honey, Dr Gerald Legg, Professor Chris Paul, Colin Plant and Dr Guillem Pons and Henry Stanier, amongst others. Max Nicholson continues to take a close interest in the development of the project. A big vote of thanks goes to the TAIB scientists and volunteers without whose participation and enthusiasm the project would have foundered long ago. Equally, I gratefully acknowledge the various contributors to this report. We have many friends in Mallorca who help and encourage us. Amongst these, Pat Bishop remains an absolute inspiration to the project (and the Parc). The Parc staff gives us full and enthusiastic support, and 2001 was a good year for integrating them more into our project, to our mutual benefit. In the autumn
particularly, Parc staff and Ibanat representatives provided considerable help, support and advice in the absence of Biel Perelló. They are all to be thanked, but we particularly acknowledge the efforts of Catalina Massutí and Alex Forteza on our behalf. Biel’s absence, for medical reasons, demonstrated clearly to everyone what a key member of staff he is. The Parc staff coped admirably with our requests and needs during November but s’Albufera without Biel was not quite the same. Thankfully, Biel is now back at work and continuing to give us every assistance. We have so many friends and supporters that it is always easy to omit someone. To all who have assisted or supported us, many thanks.
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PART II

Project S’Albufera: summary of work in 2001

Pioneer vegetation on upper beach. Photo by Elizabeth Riddiford
• **Human and management impact studies**

*Title: Aquatic invertebrate communities in relation to water quality.*
*Main objective:* to use aquatic invertebrate communities as water quality indicators.
*Secondary objective:* to develop a replicable methodology which can be adopted in other wetlands throughout the Mediterranean basin.
*Led by:* Juana Garau.

*Nature of work:* systematic sampling of invertebrates using standard sweep-net methodology at representative sites throughout the Park also sampled systematically throughout the year for water quality.
*Fieldwork period:* 12-25 April, 3-17 November.
*Note:* a cost-effective technique for guiding management of wetland sites.
*Outcome/interim results:* This long-term study has been taken over by Juana Garau. She has replaced Michelle Chapman, who devised and initiated the study, and gave Juana initial training. Michelle is no longer able to visit on a regular basis and considered that it was an appropriate moment to hand over the study to a Mallorcan resident. It is hoped that local involvement will allow for more regular sampling to be undertaken, encompassing all four seasons of the year.

*Title: Monitoring of aquatic vegetation and zooplankton in s’Albufera Natural Park.*
*Objective:* to test and develop methodologies which use bio-indicators to assess the anthropogenic impacts on aquatic biodiversity and water quality in s’Albufera Natural Park.
*Led by:* Jeroen Veraart (Foundation for Sustainable Development/Environmental System Analysis Group, Wageningen University).

*Nature of work:* sampling of aquatic vegetation and zooplankton at a selection of baseline monitoring sites to identify the diversity and abundance of the community structure in relation to water quality.
*Fieldwork period:* 12-25 April.
*Note:* a cost-effective technique for guiding management of wetland sites.
*Outcome/interim results:* further details of the study are presented in Part III.

*Title: Vegetation re-colonisation after fire, Es Comú.*
*Objective:* to observe the natural recovery of vegetation in order to understand the long-term implications of the impact of fire on the coastal dune ecosystem.
*Led by:* Nick Riddiford.

*Nature of work:* census of plant species, vegetation cover and proportions of bare ground using a series of 1 x 1 m quadrats positioned randomly (paired random numbers) within a 70 x 50 m zone of uniform vegetation type in an area of coastal dunes burnt out in 1994.
*Fieldwork period:* April, May (both teams).
*Note:* an annual study begun in 1995.
*Outcome/interim results:* This is another long-term study, begun in 1995. After rapid change, in amounts of bare ground, plant species and vegetation structure during the first four years, the rate of change has slowed considerably. The proportion of bare ground continues to decline, but is becoming more difficult to assess as dead plant
material increasingly covers unvegetated patches. Diversity is gradually decreasing as annual plants give way to more dominant grasses and shrubs. The main vegetation structure of the zone is currently grassland with scattered bushes.

Title: Dune regeneration in the foredunes of Es Comú.
Objective: to monitor the success of works undertaken in 1999 by the Balearic Government Ministry of the Environment to protect the foredunes where they meet the beach - using pioneer vegetation as an initial indicator.
Led by: Nick Riddiford, Rachel King (spring); Nick Riddiford, Elizabeth Riddiford (autumn).
Nature of work: identification and recording of species cover within random quadrats along the beach/foredune interface of Es Comú – to assess recovery of pioneer vegetation following remedial works to protect the dunes.
Fieldwork period: April, May (both teams), 3-17 November.
Note: this follows a pilot study in November 1999 prompted by the conservation management actions taken, which themselves were derived from recommendations made by Project S’Albufera following baseline studies in 1996-97.
Outcome/interim results (spring): the spectacular recovery of pioneer vegetation, noted in 2000, continued this spring – both in terms of diversity and plant cover. A total of 35 flowering plant species occurred within the quadrats, a 20% increase from last autumn. In an associated study, Rachel King observed practical aspects of the dune regeneration programme and prepared a report of her findings for the Park.
Outcome/interim results (autumn): a quick visit at the beginning of November by Chris Donnelly confirmed that the spectacular recovery of pioneer vegetation had continued into the autumn. However, before systematic recording could begin two consecutive massive storms took place. The winds for this event were from the north and north-east, sweeping heavy seas up and on to the face of the dunes. The high seas swept away the brushwood fence, buried pioneer vegetation under sand and created substantial erosion damage to the foredunes. It was impossible (and pointless) to repeat the random quadrat survey. Instead, a note was made of the amount of surviving visible pioneer vegetation in each 100 m along the beach – in most 100 m stretches there was none. Estimates were also made of the amount of foredune erosion, based on the position and amount of exposed roots and fallen *Juniperus oxycedrus macrocarpa*. This gave estimates of between one and two metres width of erosion into the foredunes – a substantial loss.

Title: Integrated studies of the socio-environmental issues of the Albufera catchment and Bay; preliminary investigation
Objective: to guide long-term planning for biodiversity and environmental protection through an integrated approach to conservation management.
Led by: Mishka Stuip (Environmental Systems Analysis Group, Wageningen)
Nature of work: a provisional investigation and planning for an integrated approach to the study of socio-economic impacts on the environment in the Alcudia Bay/s’Albufera/Pla de sa Pobla catchment.
Fieldwork period: 5-11 November.
Note: this is a new development drawing from the results of Mishka’s MSc work, published as: *An integrated assessment of interactions between tourism and nature...*
Outcome/Interim results: Mishka began to assemble information and make plans for a full study. The main outcome was an agreement to collaborate with Maciá Blazquez of the UIB Department of Earth Sciences in a study which is likely to be of doctoral status.

**Biodiversity studies**

**Title:** Herbarium development and curation.  
**Objective:** to maintain as complete a reference as possible in pressed material and photographs of the plants of s’Albufera, to be held at the Park as a permanent resource to assist Park staff and other scientists working in the Park.  
**Led by:** Jo Newbould.  
**Nature of work:** changing papers in press; labelling and setting new species for press; adding prepared species to herbarium; general curating procedures to maintain herbarium.  
**Fieldwork period:** 24 April-5 May.  
**Note:** begun in 1989.  
**Outcome/interim results:** with Jo Newbould concentrating on completing the text for the flower guide, herbarium curation was largely restricted to maintenance and general curation of the collection. There was one interesting find in the Ca’n Bateman garden, thought to be *Orobanche purpurea*, which was photographed and individual flowers described and added to the herbarium.

**Title:** Fungi biodiversity.  
**Objective:** to increase our knowledge of Fungi biodiversity and the ecology of this group in relation to the Albufera ecosystems.  
**Led by:** Rachel King.  
**Nature of work:** census work and mapping in specific habitats; collecting, identifying, describing, drawing and preparing specimens.  
**Fieldwork period:** 26 April-9 May.  
**Note:** begun in 1997; an international collaboration with leading Balearic mycologist, Pep Siquier.  
**Outcome/interim results:** it was a particularly dry spring and very little additional material was encountered. A Bishop Laboratory reference collection was initiated, using dried material and photographs from previous years.

**Title:** Development and curation of the Albufera invertebrate collection.  
**Objective:** to maintain as complete a reference as possible in specimen material and photographs of the invertebrates of s’Albufera, to be held at the Park as a permanent resource to assist Park staff and other scientists working in the Park.  
**Led by:** Nick Riddiford, Martin Honey, Martin Ebejer, David Agassiz.  
**Nature of work:** preparing, identifying and labelling specimens; curating, maintaining and reorganising collections; cross-referencing material to database.  
**Fieldwork period:** April, May, November.  
**Note:** an international collaboration with the Natural History Museum, London.
Outcome/interim results: Work in 2001 has concentrated on extending the range and the curation standard of the collection. Martin Honey continued to update and improve the quality and presentational aspects of the Lepidoptera. Martin Ebejer, substantially revised and improved the layout of the Diptera collection during his April visit; and prepared a substantial representative sample of specimens which was integrated into the collection in November. Dr Ebejer also revised the Orthopteran collection and added extra material. He is investigating ways of supporting further improvements to the collection through determinations of specimens. The aquatic invertebrate collection was substantially improved, including the addition of specimens, better labelling and improving accessibility in support of aquatic invertebrate monitoring.

Title: Lepidoptera and habitats.
Objective: to increase our knowledge of Lepidoptera biodiversity and the ecology of this group in relation to the Albufera ecosystems.
Led by: Martin Honey.
Nature of work: investigation of habitats and specific plants, particularly key species for s’Albufera (e.g. the Balearic endemic *Thymelea myrtifolia*), to survey Lepidoptera at all stages of development and gather more detailed information about species’ ecology.
Fieldwork period: 17-31 May.
Note: an international collaboration with the Natural History Museum, London.
Outcome/interim results: Most of the Lepidoptera work at s’Albufera has been conducted in the freshwater wetland area, with other habitats being sampled less frequently. On his May visit, Martin paid considerable attention to the coastal dune habitats of Es Comú, previously under-recorded. This resulted in a noctuid new to Mallorca – *Odice blandula*; and a gelechiid new to the Balearics – *Mesophleps oxycedrella*; plus a nice series of male *Ocneria rubea* to replace the damaged one in the collection. Martin was also pleased to collaborate with Rafel Mas. This collaboration included an element of training, and the supply of collecting materials, such as pins and boxes. Rafel, assisted by others including Angela Medina, has undertaken to sample moths on a regular basis during periods of the year when UK Lepidoptera specialists are absent from s’Albufera. Martin will continue to support and encourage local participation, including assistance with determinations and curation.

Title: Diptera survey and reference collection.
Objective: to increase our baseline knowledge of the diptera, a poorly known but important element of s’Albufera’s biodiversity.
Led by: Martin Ebejer.
Nature of work: baseline survey work; collecting, preparing specimens for later, expert identification; relating specimens to plant pabulum and/or habitat.
Fieldwork period: April.
Note: The baseline survey is new, and is made possible by the field participation for the first time of Dr Martin Ebejer, an expert from Malta who specialises in flies of the Mediterranean islands.
Outcome/interim results: Dr Ebejer found over 240 species, including one new to science which will be described in due course. As a follow up, Dr Ebejer produced a detailed report of his findings (*Diptera of S’Albufera, Report on visit to the Parc S’Albufera 15-23 April 2001*). He has since updated this. The updated version is included in Part III of this
He also prepared a representative sample of specimens which was incorporated
into the recently established Diptera reference collection at S’Albufera during
the autumn. Dr Ebejer indicates that some additional names will eventually emerge as the
requested literature arrives and more effort bears fruit – but he estimates that
determinations have been achieved for more than 95% of the material taken. Dr
Ebejer’s endeavours have considerably increased our knowledge of the diptera of
S’Albufera, allowing us to update substantially the biodiversity database for this group.
Moreover, he is willing to continue looking at S’Albufera material. To make this more
efficient and systematic, he has made recommendations, including methodologies, and
offered to train Parc staff in the collection and curation of diptera. Dr Ebejer also did
some preliminary work on diptera collected at S’Albufereta. Results of this work are
given in Part III (Identifications of Diptera from S’Albufereta).

Title: Extension of Diptera biodiversity baseline.
Objective: to increase our baseline knowledge of the diptera, a poorly known but
important element of S’Albufera’s biodiversity.
Led by: Nick Riddiford, Rafel Mas.
Nature of work: collecting, preparing specimens for later, expert identification; relating
specimens to plant pabulum and/or habitat; introducing and training on new capture
and monitoring techniques; introduction of Malaise trap monitoring programme.
Fieldwork period: 3-17 November.
Note: an international collaboration with Dr Martin Ebejer, an expert from Malta who
specialises in flies of the Mediterranean islands. This is a new study based on the
pioneer work done by Dr Ebejer in spring 2001 and responding to his
recommendations following his visit.
Outcome/interim results: Dr Ebejer made a series of recommendations for siting and
orientating the malaise trap. The locations he recommended and additional comments
were: “1) about 100 metres beyond the wooden gate/fence on the embankment running
parallel to the Canal des Sol towards Es Forcadet; the high end of the net facing south,
so that it sits across the path.
“2) Es Colombars: walking along the board walk just before sight of the hide, placed
out of sight deep among the tamarisk in the marsh to the right.
“3) Es Ras opposite the pines that are in Ses Puntes and over the fence. Cattle grazed
area, but this is a really good spot. Maybe a small fenced enclosure (3x3 metres) to
stop the animals accidentally walking into the net may be a good idea. It will need to
be close to the boundary wall and sheltered from one side the low end; the high end of
the malaise pointing west.
He further suggested rotating the sites every six days, but clearing the bottle out every
two, thus three collections are made from each site.
Rafel Mas and Nick Riddiford sought to follow his recommendations in November.
However the presence of cattle, including calves, was a problem so a decision was
made to install the trap in a safer location, on the raised bank between the Gran Canal
and the Canal des Sol immediately opposite the Gran Canal main sluice. The trap was
operated for three days, then removed because of an approaching severe storm. This
turned out to be a hurricane, so the decision to remove it was a wise one. The trap was
erected at the same site on the afternoon of 20th November, for a period of six days.
Early results indicate abundant captures of a range of species. The trap is likely to
produce large catches in the warmer months of the year.
Recommendations: 1) the trap should be set for periods of two, four or six days at least once a month throughout the year. 2) the current site is a good location and could be used on a regular basis initially. 3) the other locations recommended by Dr Ebejer can be sampled when grazing animals are not present, or by establishing an enclosure around the trap to deter them. 4) other recommendations by Dr Ebejer should also be followed. 5) diptera captures should be sorted and layered by size in boxes, and the boxes placed in the laboratory freezer for eventual despatch to Dr Ebejer. 6) other groups, particularly coleoptera, hymenoptera, heteroptera, neuroptera and lepidoptera should be kept separately (i.e. by order) in the same freezer.

Title: Extension of the aquatic invertebrate reference collection.
Objective: to obtain a comprehensive collection of reference material in support of the aquatic invertebrate and water quality study.
Led by: Juana Garau.
Nature of work: curate and catalogue current material; obtain new material through collecting at targeted sites; prepare specimens; seek specialist opinions for contentious identifications.
Fieldwork period: 29 April- 5 May.
Note: Though material already exists, this is the first study targeted specifically at making the collection a full working reference.
Outcome/interim results: Collections were made using standard capture techniques at the usual sample sites. The opportunity was taken to utilise the captures as a basis for enhancing the aquatic invertebrate collection, with the primary objective to provide readily accessible on-site identification reference for future work.

Title: Biodiversity catalogue, stage 2 – extension.
Objective: with the imminent publication of the Biodiversity Catalogue, the objective now is to gather information which can advise and guide biodiversity conservation in the Park.
Led by: Nick Riddiford, Elizabeth Riddiford.
Nature of work: to improve the catalogue (currently standing at over 2600 species of 52 faunal and floral groups) by targeting gaps in our knowledge, verifying unconfirmed records and investigating the current status of species known from s’Albufera. This is being done by targeted survey and collecting; literature searches.
Fieldwork period: April, May, November.
Note: Ecological information which guides conservation planning for notable species is now a priority target. This extension will also assist and advise the new TAIB/ UIB/PN s’Albufera case study on Biodiversity Valuation (SAVE) being proposed by Dr de Groot’s Environmental Systems Analysis Group at Wageningen University, Holland.
Outcome/interim results: additional records were gathered for a range of animal and plant groups. In addition, work was begun to collect further information of immature stages (e.g. for Lepidoptera), food plant associations, ecological requirements and phenology. An account of the discovery and clarification of Araeopteron ecphaea as a bona fide species, assisted by a series of males and females from s’Albufera in 1995-2000, has been published. The reference is: Fibiger, M. & Agassiz, D. 2001. Araeopteron ecphaea, a small noctuid moth in the West Palaearctic (Noctuidae: Acontiinae). Nota lepidopterologica 24: 29-35. A copy of this paper has been added to the Park archives.
**Ecological and monitoring studies**

*Title:* Bird population studies - transects.  
*Objective:* to monitor bird population fluctuations as a measure of local environmental change (e.g. in habitat quality or type) or more generally (e.g. in response to climate change).  
*Led by:* Nick Riddiford.  
*Nature of work:* two permanent transects, each of just over 7 km and sampling all major Park habitats, both divided into sections reflecting habitat types: counts of all birds seen and heard within 25 metres of the transect line.  
*Fieldwork period:* April, May, November.  
*Note:* annual study, begun in 1990.  
*Outcome/interim results:* As predicted, the most important changes noted during spring transects involved the bird communities of transect sections affected by the great fire of November 2000, and in particular Transect 1, Section C (the reedbed habitats lining the camí d’en Pujol). Here the numbers of moustached warblers *Acrocephalus melanopogon* detected were very low, in sharp contrast with figures for similar periods in spring 2000. Other reedbed species were also affected. On the other hand, open habitat species such as the yellow wagtail *Motacilla flava* were present in much larger numbers than for pre-fire counts. Transect 2 (coastal dunes) was walked on 18th November, later than usual, with the specific objective of obtaining a quantitative measure of the effect of recent storm damage, particularly in relation to fallen trees in Es Comú dunes. Early analysis suggests that finch (Fringillidae) numbers may have decreased, but other species continued to be present in good numbers. The short-term and long-term impacts of storm damage may be different. Short-term, invertebrates and other food sources may have been exposed and become more accessible to birds. The longer term effects are likely to be negative for some species and positive for others. Continued monitoring, particularly in subsequent springs, will provide a valuable measure of these effects.

*Title:* Butterfly and dragonfly population studies - transects.  
*Objective:* to monitor butterfly and dragonfly fluctuations in a range of habitats as a measure of local environmental change (e.g. in habitat quality or type) or more generally (e.g. in response to climate change).  
*Led by:* Nick Riddiford, Rob Strachan, Angela Medina, Chris Donnelly.  
*Nature of work:* two permanent transects, one of 2 km in the coastal dunes and a longer one of 7 km sampling all major Park habitats, both divided into sections reflecting habitat or habitat structure types: counts of all butterflies and dragonflies within 5 metres of the observers.  
*Fieldwork period:* April, May and November teamwork periods and once a fortnight throughout the summer.  
*Note:* annual study, begun in 1991.  
*Outcome/interim results:* the most notable aspect of this spring’s transects was the late appearance and depressed numbers of dragonflies. This is most reasonably associated with a relatively cold, late spring. These conditions may also have contributed to generally low numbers of several butterfly species, particularly in April. Dry
conditions, both during and prior to the fieldwork period may also have had a depressing affect on butterfly numbers. By contrast, autumn numbers appeared to be similar to previous years. The continuation of the transects throughout the summer was a valuable extension of TAIB work. It also allows PN de s’Albufera to participate in the recently launched Catalunia Butterfly Survey, which uses the same standard methodology.

**Title:** Small mammal studies: Niche partitioning by mice.  
**Objective:** to investigate niche partitioning by three species of mouse in s’Albufera marshland.  
**Led by:** Rob Strachan (Wildlife Conservation Research Unit, Oxford University).  
**Nature of work:** live trapping using ‘Longworth’ small mammal traps laid out in a three-dimensional grid system; identifying and marking three species of mouse for capture-recapture population density and niche partitioning information.  
**Fieldwork period:** 12-25 April.  
**Note:** the situation at s’Albufera of three mouse species sharing a wetland habitat is very unusual and possibly unique in Europe.  
**Outcome/interim results:** Rob continued his long-term study of niche partitioning by *Apodemus sylvaticus*, *Mus musculus* and *Mus spretus* at Es Colombar. Sampling was also carried out at Es Rotlos and Son Carbonell to investigate the rate of re-colonisation by mice of reedbeds burnt in November 2000. This indicated some re-colonisation, by *Mus musculus* and *Apodemus sylvaticus*, but only at the edge.

**Title:** Small mammal studies: Bat studies.  
**Objective:** to continue and extend bat ecology and population monitoring at s’Albufera.  
**Led by:** Rob Strachan, Richard Green.  
**Nature of work:** Part or all of following: trialling bat detector survey techniques; piloting adapted UKNBMP methods of transects through different habitats; training park staff and volunteers in using bat detectors. Identify important flight lines from St Marti cave and within the park as well as feeding areas, by positioning volunteers with detectors. Set up biannual cave roost survey, both inspection and emergence counts. Identify other roosts in and around park.  
**Fieldwork period:** April, May.  
**Notes:** bats are an important but poorly understood part of the ecology of s’Albufera. This work is based on a pilot study undertaken in autumn 2000.  
**Outcome/interim results:** Further feasibility investigations were made. Training was given to participating volunteers in bat detector use and methodologies. The bat detectors confirmed the continued presence of *Barbastella barbastellus*, an extremely rare bat species in Spain, and demonstrated that the newly discovered and poorly known Pipistrelle species *Pipistrellus pygmaeus* occurs in the Park. A male *Pipistrellus kuhlii* was caught. Preliminary contacts were made with Jordi Serra to discuss collaborative Balearic, Spanish and TAIB investigations in the future. Richard also worked with Park staff on techniques for constructing and locating bat boxes. During the summer Parc staff made a series of boxes which have been located on various suitable trees throughout the Parc.

**Title:** Systematic light trapping for moths.
Objective: to survey, monitor and catalogue moth populations and their fluctuations, including in response to climate change. 
Led by: Nick Riddiford, Elizabeth Riddiford, Martin Honey, Rafel Mas, David Agassiz. 
Nature of work: setting up (evening) and emptying (morning) moth trap using mercury vapour ultra-violet lamp; identifying, counting and releasing or collecting captures. 
Fieldwork period: April, May and November teamwork periods; and on a monthly basis throughout the summer. 
Notes: the systematic light trapping for moths is an annual study, begun in 1991; we have also established a collaboration with s’Albufera des Grau Natural Park, in Menorca. 
Outcome/interim results: Nick Riddiford and Martin Honey reported a relatively poor spring for numbers and variety, perhaps due to the cool and dry conditions. Nevertheless, Martin recorded two pyralids new to the Balearics from Sa Roca – *Thopeutis galleriellus* and *Crambus pascuella* - and a new *Momphis*. During his spring visit, Martin gave training in the collection and preparation of moths to Rafel Mas, parc biologist. Rafel is now trapping at least once a month, and in different locations. This has allowed a very useful extension both in periods for which information is available and in habitats sampled. Rafel has already added a number of interesting species to the Parc list.

Title: *Faunal associations with habitat.*
Objective: to investigate species use of habitats in order to improve our knowledge of ecosystem functioning at s’Albufera. 
Led by: Chris Donnelly. 
Nature of work: collecting, sorting and identifying invertebrates in specific targeted habitats (e.g. leaf litter of riverine woodland); field observations of vertebrates in relation to habitat utilisation. 
Fieldwork period: 3-14 November. 
Note: this study is specifically to support development of the biodiversity demonstration programme. 
Outcome/interim results: these are given in Part III (*Habitat Biodiversity Investigations 2001: 1. Habitats for physical structure, species presence and impacts on biodiversity*).

Title: *Habitat mapping - update.*
Objective: to ratify and revise TAIB habitat maps for s’Albufera. 
Led by: Chris Donnelly. 
Nature of work: ground-truth ratification of habitat boundaries and changes since 1994 mapping survey. 
Fieldwork period: 3-14 November. 
Note: this study is specifically to support development of the biodiversity demonstration programme. 
Outcome/interim results: these are given in Part III (*Habitat Biodiversity Investigations 2001: 2. Habitat Mapping - Further analyses of Habitats present within the Park*).

Title: *Ecological associations, phenology and habitats of Lepidoptera.*
**Objective**: to extend our knowledge of ecological associations, phenology and habitats of s’Albufera Lepidoptera.

**Led by**: Dr David Agassiz.

**Nature of work**: Employing a wide range of methods and techniques to gather as much material as possible relating to micro lepidopteran ecology. Techniques include trapping, netting, seeking immature stages and targeting “important” habitats. Immature stages to be immobilised within netting or collected for observation and raising in containers. Special attention to be paid to seeking out leaf mines, and recording rates of parasitisation amongst collected larvae.

**Fieldwork period**: 11-17 November.

**Note**: Dr Agassiz is an acknowledged international expert on micro moths so, not surprisingly, the study will focus especially on lesser known families (micro moths). This is a significant extension of our Lepidopteran studies.

**Outcome/interim results**: unfortunately Dr Agassiz arrived with the hurricane and his entire week was plagued by poor weather. He was particular frustrated by the lack of material such as leaves on trees and flower heads, which had been stripped by the high winds. Nevertheless, he did obtain some interesting and potentially new specimens which he took with him for further examination. He also began a herbarium collection of lepidopteran leaf mines for the Parc. Dr Agassiz indicated that he hoped to return to undertake further studies into the microlepidoptera of s’Albufera at other seasons in the future.

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**Objective**: Ecology, phenology and habitats of Odonata.

**Led by**: Henry Stanier.

**Nature of work**: a combination of sampling, netting and observations will be used to extend knowledge of the Odonata species present, as adults and as larvae. Particular emphasis will be placed on catching larvae to establish species identifications, distribution, phenology and habitat requirements. One important aim of the study will be to extend and improve the current collection of labelled material, particularly on larvae, for future reference purposes.

**Fieldwork period**: 3-14 November.

**Note**: Henry Stanier is Course Director at the British Dragonfly Bio Museum and nature reserve – which is the first of its kind for Odonata in Britain, and possibly the World. This study will significantly improve and extend our knowledge of the ecology of s’Albufera odonata, and in particular the larval stages.

**Outcome/interim results**: Henry undertook sampling in a range of habitats throughout the Parc and took a series of larvae and adults. To increase knowledge of larval development characteristics, he took a sample to raise in captivity. He also gave training in the identification of immature stages and checked and revised the larval identifications in the Parc reference collection.

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**Objective**: Monitoring the structural evolution of Mediterranean reedbeds: Vegetation.

**Led by**: Juana Garau
Nature of work: description of reedbed vegetation: comprising collection of *Phragmites* ecological data (proportion of dead and live stems; maximum height; width at base; number flowering) at 2 m intervals and occurrence and cover of other plants at 4 m intervals within 25 x 25 cm and 50 x 50 cm quadrats respectively along a permanent 250 m transect live; collection of water level and conductivity information within and outside permanent piezometers.

Fieldwork period: transects and vegetation quadrats in autumn, water levels and conductivity once a fortnight.

Notes: begun in 1997. An international collaboration with Tour du Valat Biological Station, the Camargue, France. This is a Mediterranean-wide study being carried out in 40 reedbeds in France, two in Greece and Albania and 4 in s’Albufera (the only Spanish site participating) under the overall project leadership of André Mauchamp (Tour du Valat Biological Station).

Outcome/interim results: the transect and vegetation quadrats study was severely hampered by poor weather and high water levels. Es Cibollar, Son Carbonell and Es Forcadet were completed, but Es Colombar proved inaccessible and was not done. The November visit to Son Carbonell was the first since the 2000 fire. The vegetation structure was more open, with ground plants such as *Plantago major* benefiting. However, all other species recorded prior to the fire were still present this November. The water levels and water quality work was done to schedule.

**Title:** Monitoring the structural evolution of Mediterranean reedbeds: Bird populations.

**Objective:** a study to reach an understanding of the requirements and development of bird populations in relation to vegetation growth, reedbed structure and aspects of hydrology and water quality in Mediterranean wetlands.

**Led by:** Brigitte Poulin, Gaetan Lefevbre (Tour du Valat Biological Station).

Nature of work: standardised mist-netting for birds along two 250 m transects set parallel and 50 m apart through selected reedbeds - mist-netting session comprising 5 hours from first light one day at each site in each season; collection of food samples from trapped birds for later analysis; standardised sweep-netting along transects to establish invertebrate food availability within selected reedbeds.

Fieldwork period: 4-10 November.

Notes: begun in 1997. An international collaboration with Tour du Valat Biological Station, the Camargue, France. This study is being carried out in 40 reedbeds in France, two in Greece and Albania and 4 in s’Albufera (the only Spanish site participating).

Outcome/interim results: mist-netting was undertaken at Es Colombar, Es Forcadet and Son Carbonell. The more open vegetation at Son Carbonell after the fire of 2000 resulted in a good range of bird species being caught. The Tour du Valat team has now provided some very interesting information on food intact by a range of species, based on food samples taken on previous visits. They will undertake further analysis, including for food samples taken in November 2001, during the coming year. The methodology used for this study has been published (POULIN, B., LEFEBVRE, G. & PILARD, P. 2000. Quantifying the breeding assemblage of reedbed passerines with mist-net and point-count surveys. *Journal of Field Ornithology* 71: 443-454).
• **Park management**

**Title:** Bittern population studies.
**Objective:** to make a qualitative assessment of the impact of fire and drought on the Albufera Bittern population.
**Led by:** Pere Vicens.
**Nature of work:** survey of calling Bitterns in the Park, using teams of scientists and volunteers positioned at strategic locations for one hour immediately before dawn.
**Fieldwork period:** April.
**Notes:** This was a repeat survey using the methodology introduced by Glen Tyler (RSPB) in spring 2000.
**Outcome/interim results:** just two territories were detected based on singing birds, a marked decrease on 2000 numbers. The decrease was probably due to short-term habitat change brought about by the November 2000 fire and low water levels after prolonged dry conditions. A report of the 2001 survey is presented in Part III of this report (Determinació de la població reproductora de Queca Botaurus stellaris al Parc Natural de s’Albufera de Mallorca. Cens per detecció de cants); and see the TAIB 2000 report for details the 2000 survey.

**Title:** Integrated Assessment of Water Use, Water Policies and Water Management in the Sa Pobla-Inca catchment area, Mallorca
**Common aim:** to design possible integrated scenarios for future improvements in Water Management, especially in relation to intensive agriculture practices.
**Led by:** Benoit Cathala, Géraldine Ducos & Sergios Karatzos.
**Nature of work:** The supporting objectives are: to compare Mallorcan policies in respect to land use; analyse current pressure on freshwater resources of intensive agriculture situated in the two lowland subcatchments (Sa Pobla and Muro) bordering with the park; assess alternative water management strategies for that area; integrate these objectives into a common objective.
**Fieldwork period:** July-December.
**Notes:** This study will provide important background information in relation to the European Union’s Water Directive; and for the new TAIB/UB/PN s’Albufera case study on Biodiversity Valuation being proposed by Dr de Groot’s Environmental Systems Analysis Group. This new study is the latest in a series of postgraduate research studies promoted by Dr de Groot’s Environmental Group at Wageningen University.
**Outcome/interim results:** the data gathering phase is complete and analysis in progress. The report writing stage is scheduled for this winter with final results (thesis) to be published in March.

**Title:** Marsh orchid *Orchis palustris* census.
**Objective:** to conduct an annual census of the numbers and distribution of flowering *Orchis palustris*, and relate it to Park management and in particular the intensity and timing of grazing by domestic animals.
**Led by:** Nick Riddiford, Ingrid Eunson.
**Nature of work:** a complete census of *Orchis palustris* based on flowering plants at all known sites within and adjacent to the Park.
Fieldwork period: 26 April-9 May.

Notes: A long-term study, begun in 1993. We are beginning to understand the ecology of the species. Grazing favours the species because it needs relatively open marsh, but it is very sensitive to grazing from January or February through until flowering. The best results are obtained if the flowering zones are grazed from about June until the end of January, then left ungrazed. A good example of the impact of grazing regimes is the marsh alongside camí des Polls. In 1997 grazing animals were removed in February, leading to a count of 1690 flowering *Orchis palustris* in late April-early May. In 1998 the animals were not removed and only 35 *Orchis* flowered. The change in grazing management resulted in a 98% decrease in flowering plants between years (numbers in other areas remained relatively constant). A total of 166 *Orchis palustris* were recorded in flower in 2000.

Outcome/interim results: a total of 489 flowering spikes was a satisfactory increase on 2000 counts. However, 103 (21%) were in an area of burnt reedbed outside the Park, and a further 320 (65%) were in the well established Camí des Polls grazing firebreak and contiguously the other side of the enclosure – opened up by the November 1999 fire. Knowledge of the management needs for this species is now well established, and management for the species is being implemented. So further gains may be expected. Management planning should target not only the Camí des Polls site, but also ensure that other strong populations are re-established in other previously important sites – such as southern Es Ras and eastern Camí d’en Pep.

- **International initiatives and programme development**

  **Title**: Digital cartography: development of s’Albufera GPS.
  **Objective**: to position with precision (through mapping) sample points, transects, enclosures and study areas.
  **Led by**: Biel Perelló.
  **Nature of work**: Use of GPS, geo-reference programs and databases utilising exact UTM coordinate references; ground-truthing fieldwork and archive research to check waypoints, tracks, routes, etc.; beginning the task of incorporating a full series of existing and new information gathered for s’Albufera into a database and on digital maps.
  **Fieldwork period**: April, May (both teams).
  **Notes**: assisted by Pere Vicens and Margalida Roig. This is a new study.
  **Outcome/interim results**: a considerable amount of cartographic material was collected by GPS and transferred digitally to computer, including routes and locations of transects and other TAIB long-term studies, areas of grazing, open water, itineraries, tracks and pathways, fences, electricity lines and pylons, elements and points of interest, etc.

  **Title**: Habitat biodiversity investigations.
  **Objective**: to provide baseline data on physical and vegetative structure and species presence for selected habitat types within the Park in order to improve our knowledge of ecosystem functioning at s’Albufera.
  **Led by**: Chris Donnelly.
Nature of work: recording physical structure, vegetation structure, specific niches in randomly selected one-metre blocks within specific habitats; recording, collecting, sorting and identifying invertebrates and lower plants and relating them to niches within the sampled habitats; field observations of vertebrates in relation to habitat utilisation.

Fieldwork period: 10-20 May.

Note: this study is specifically to support development of the biodiversity demonstration Programme; data will be used to aid assessments of the biodiversity of each habitat and the major impacts on the habitat that are affecting its biodiversity.

Outcome/interim results: these are given in Part III (Habitat Biodiversity Investigations 2001: 1. Habitats for physical structure, species presence and impacts on biodiversity)

Title: Habitat mapping – further analyses.

Objective: to ratify and revise TAIB habitat maps for s’Albufera.

Led by: Chris Donnelly.

Nature of work: ground-truth ratification of habitat boundaries and changes since 1994 mapping survey; supported by a fixed point photography programme to record and observe habit change.

Fieldwork period: 10-20 May.

Note: this study is specifically to support development of the biodiversity demonstration programme.

Outcome/interim results: these are given in Part III (Habitat Biodiversity Investigations 2001: 2. Habitat Mapping - Further analyses of Habitats present within the Park)

Title: Development of s’Albufera photographic database.

Objective: to establish a database and reference resource through digitisation of images.

Led by: Biel Perelló, Miguel Angel Dora.

Nature of work: Initiate digitisation of images; collation and collection of photographs and other s’Albufera visual material; set up database; establish archive of existing material.

Fieldwork period: April, May (both teams).

Note: The participation of Miguel Angel Dora of the Associació Balear d’Amics dels Parcs denotes a welcome extension of our collaboration with ABAP to practical elements of the project. This is a new study.

Outcome/interim results: this was essentially a pilot study to verify techniques and establish what was feasible. The Lepidoptera reference collection was used as the pilot and, once small initial difficulties relating to quality and definition were overcome, the work proceeded quickly so that the entire material for Noctuids and other macro moths has now been successfully integrated into a very effective database. The quality of the results was first-class and we have the new prospect of a reference collection set up specifically as a tool for determinations at s’Albufera becoming a potential resource on a much larger scale, particularly if access to the resource is eventually made available through the internet. A series of other photographs, e.g. landscape, Park events, was also incorporated on to the database.
Title: Development of s’Albufera biodiversity practical demonstration programme.  
Objective: to prepare an internationally compatible biodiversity programme structure which links the various studies of the project.  
Led by: Chris Donnelly.  
Nature of work: Demonstration of structure and format; brain-storming sessions on improvements and streamlining of programme.  
Fieldwork period: 3-14 November (plus desk study work during other months away from the Park).  
Outcome/interim results: work focused on creating labels for use in the database in order to facilitate recording of habitats and relating these and locations to Park compartments. A first draft of the structure was completed in November and will be reviewed and improved by TAIB team members during the winter.  
Note: this programme will assist and feed into the new TAIB/ UIB/ PN s’Albufera case study on Biodiversity Valuation being proposed by Dr de Groot’s Environmental Systems Group at Wageningen University.

Title: Socio-economic assessment and valuation of biodiversity conservation (SAVE)  
Objective: to begin preparation for a wetland case study at s’Albufera as part of SAVE, a Wageningen University led proposal (initially) to the European Union’s “Energy, Environment and Sustainable Development” programme.  
Led by: Nick Riddiford, Biel Perelló.  
Nature of work: Definition of data requirements and preliminary investigation of appropriate methodologies. Identification of sources of information for i) biodiversity values (biota with recognised National/International status,[e.g. listed on Conventions (Bernetc.), Red Data lists, etc; but also biota with local/regional significance, & notable species which have not been “caught” in the net of Status listings; ii) the same for notable habitats; iii) ecological, social, economic and cultural values; iv) ecological, social, economic and cultural costs and benefits; iv) legislative processes, policies, etc.; v) management and land use issues  
Fieldwork period: 3rd-17th November. This new study comprises a partnership between TAIB, PN S’Albufera and UIB’s Department of Earth Sciences. S’Albufera will be the wetland case study for a Europe-wide project which also includes case studies for coastal-marine ecosystems (Greece), estuarine systems (Netherlands), riverine and riparian systems (Hungary), grassland and mixed land use (Portugal), Alpine forest and grassland (Italy) and Boreal forest (Finland).  
Outcome/interim results: Funding is being sought from European sources for implementation of the SAVE proposal.
• **Interpretation and education**

*Title:* Guide to the flowers of the Park tracks and paths.
*Objective:* to prepare a colour guide targeted at general visitors so they can appreciate and know the plants they see in flower along s’Albufera tracks.
*Led by:* Jo Newbould (text) and Dinah MacLennan (artwork).
*Nature of work:* collection of information for guide; sketching and painting from live specimens and plants in flower.
*Fieldwork period:* 24 April-5 May.
*Outcome/interim results:* the final stages of this ambitious project have at last been reached, with a completed draft sent to the Parc for comments and translation in July 2001. Publication of the guide is expected in 2002.

*Title:* International volunteer biodiversity training.
*Objective:* to provide training in the study of biodiversity and biodiversity conservation for Balearic, Peninsular and foreign biologists, geographers, environmentalists and natural world enthusiasts.
*Led by:* Nick Riddiford and the TAIB team.
*Fieldwork period:* 12-25 April, 26 April-9 May, 3-17 November 2001.
*Nature of work:* volunteer participation in individual studies described above; plus the opportunity to work alongside experienced scientists and experts; and to participate in seminars and presentations on biodiversity and conservation field research.
*Notes:* The project has hosted and trained volunteers from over 20 countries and 5 continents since the beginning in 1989. Many have gone on to important positions in the World of conservation and the environment.
*Outcome/interim results:* eight Balearic volunteers, the majority graduates or students from UIB, participated in the spring teams, experiencing the wide range of studies undertaken. They were all of high quality and brought a great deal of energy, enthusiasm and ideas to the project. Two volunteers continued to help with TAIB studies throughout the summer. Training on specific topics (e.g. diptera curation; bird transect studies) was also given to members of the Parc staff and monitors. The teams also included four UK volunteer participants in spring and one plus a French volunteer in autumn.

• **Participants, 2001**

*Team 1* (two weeks: 12-25/4)
*Principal Investigator:* Nick Riddiford (UK)
*Scientists:* Elizabeth Riddiford (TAIB, UK), Juana Garau Muntaner, Pere Vicens, Margalida Roig (TAIB, Mallorca), Jeroen Verraart (Environmental System Analysis Group, Wageningen & TAIB, Holland), Rob Strachan (Oxford University Wildlife Conservation Research Unit & TAIB, UK), Miguel Angel Dora (ABAP, Mallorca), Dr Martin Ebejer (University of Malta)
*Parc Natural de s’Albufera scientific collaborator:* Biel Perelló (Geographer)
**Volunteers:** Irene Moya, Isabel Mozo, Catalina Servera, Gaspar Guaita, Maria Vidal (UIB, Balears), Jackie Counter (UK)

**Team 2** (two weeks: 26/4-9/5)

**Principal Investigator:** Nick Riddiford (UK)

**Scientists:** Jo Newbould, Dr Dinah MacLennan, Chris Donnelly, Elizabeth Riddiford, Rachel King, Richard Green (TAIB, UK), Juana Garau Muntaner, Pere Vicens, Margalida Roig (TAIB, Mallorca), Miguel Angel Dora (ABAP, Mallorca)

**Parc Natural de s’Albufera scientific collaborator:** Biel Perelló (Geographer)

**Volunteers:** Angela Medina (UIB, Balears), Fina Prats (UDG, Ibiza), Marta Asensi (Complutense Madrid), Ingirid Eunson, Barbara Aldridge, Kate Hockley (UK)

**Team 3** (two weeks: 3-17/11)

**Principal Investigator:** Nick Riddiford (UK)

**Scientists:** Chris Donnelly, Elizabeth Riddiford, Dr David Agassiz (TAIB, UK), Juana Garau Muntaner (TAIB, Mallorca), Mishka Stuip (Environmental System Analysis Group, Wageningen & TAIB, Holland), Henry Stanier (British Dragonfly Bio Museum & Reserve, Northampton & TAIB, UK), Dr Brigitte Poulin, Dr Gaetan Lefevbre (Tour du Valat Biological Station, France), Benoit Cathala, Géraldine Ducos, Sergios Karatzos (Environmental Systems Analysis Group, Wageningen);

and visiting: Marta Asensi, Angela Medina (TAIB, Mallorca)

**Parc Natural de s’Albufera scientific collaborator:** Rafel Mas (Biologist)

**Volunteers:** Yoann Perrot (France), Dot Agassiz (UK)

- **Additional field visits**

Additional studies undertaken during the summer on behalf of or in collaboration of TAIB were:

**Reedbed studies**

Juana Garau (TAIB, Mallorca) continued to make fortnightly readings of water level and quality measurements in four s’Albufera reedbeds as part of a long-term Mediterranean-wide monitoring study (in collaboration with Tour du Valat Biological Station, France) of reedbed structural development.

**Butterfly transects**

Maintenance throughout the summer of the long running butterfly transects through the marsh (Transect 1) and Es Comú coastal dunes (Transect 2) by Angela Medina, Marta Asensi and Rafel Mas.

This was an important development because 1) it repeated a study undertaken by Mari-Angels Ferragut ten years earlier; 2) it allowed PN de s’Albufera to participate in the recently launched Catalanian Butterfly Survey, which uses the same methodology.
**Biodiversity studies in Lepidoptera**

Martin R Honey (The Natural History Museum, London, UK) undertook biodiversity studies in Lepidoptera at S'Albufera from 17-31 May 2001 and elsewhere in Mallorca in late September.

**Flora guide**

Jo Newbould and Dinah MacLennan (TAIB, UK) undertook the final period of fieldwork preparation for their guide to the flora of the Park tracks in the first half of May 2001. Dinah MacLennan visited again in late September to present draft text and illustrations for guide to the flora of the Park tracks, and to liaise with Park authorities over the publication process.

**Bird guide**

Nick Owens (TAIB, UK) visited in October 2001 to update text for a guide to the common birds of the Park, and to liaise with Park authorities over the publication process.

**Collaboration with Wageningen Agricultural University**

Three post graduate students (Benoit Cathala, Géraldine Ducos, Sergios Karatzos) undertook fieldwork from July to December 2001 as part of their research project for The Center for Environment and Climate Studies, Wageningen, title *Integrated Assessment of Water Use, Policies and Management in the Sa Pobla-Inca catchment area, Mallorca. A multidisciplinary approach.*

**Collaboration with University of York**

A Masters study by Leanne Sargeant, University of York Masters Research Course, was conducted at s’Albufera from 14th June to end of August 2001, with the title *What factors determine niche partitioning in Ardeidae and invertebrates on an island wetland in the Mediterranean, under conservation management?*

The hypotheses for this study were

- The different species of herons and egrets use different parts of the habitat for feeding and breeding.
- Heron and egret diversity is correlated with habitat diversity, food availability and environmental factors, such as water quality.
- The different species of invertebrates use different parts of the habitats and/or reed structures.
- Invertebrate diversity is correlated with reedbed age, structural diversity and quality of the habitat.
TAIB Project S’Albufera: 
A Mediterranean model for the study of biodiversity and environmental change

The Albufera International Biodiversity Group Annual Report 2001

PART III

Study reports

Post hurricane damage to internationally important Juniper.
Photo: Nick Riddiford
1. **Human and management impact studies**
   1.1 Monitoring of aquatic vegetation and zooplankton in s’Albufera Natural Park by Jeroen Veraart
   1.2 Dune observation, Parc Natural de S’Albufera, 22/5/01 by Rachel King

2. **Biodiversity studies**
   2.1 Diptera of S’Albufera de Mallorca – updated report on visit to Parc Natural S’Albufera, 15-23 April 2001 by Martin Ebejer
   2.2 Identifications of Diptera from S’Albufereta (and one sample from S’Albufera) by Martin Ebejer

3. **Ecological and monitoring studies**
   3.1 Monitoring of reedbed passerines in Mallorca by Brigitte Poulin

4. **Park management**
   4.1 Determinació de la població reproductora de Queca *Botaurus stellaris* al Parc Natural de s’Albufera de Mallorca. Cens per detecció de cants per Pere Vicens
   4.2 What factors determine niche partitioning in Ardeidae and invertebrates on an island wetland in the Mediterranean, under conservation management? by Leanne Sargeant
   4.3 The Integrated Assessment of Water Use, Water Policies and Water Management in the Sa Pobla-Inca catchment area, Mallorca by Benoit Cathala, Geraldine Ducos & Sergios Karatzos

5. **International initiatives and programme development**
   5.1 SAVE by Nick Riddiford, Gabriel Perelló and Maciá Blazquez
Human and Management Impact studies

III.1.1 Monitoring of aquatic vegetation and zooplankton in s’Albufera Natural Park by Jeroen Veraart

Towards the use of bio-indicators to assess the anthropogenic impacts on aquatic biodiversity and water quality in s’Albufera Natural Park

Gran Canal, Sa Roca, April 1999: turbid, and June 1999: clear

Spring 2001

Jeroen Veraart
Foundation for Sustainable Development/
Environmental System Analysis Group
Wageningen University
Introduction

S’Albufera de Mallorca is a 1700 ha freshwater coastal wetland in the north east of Mallorca, Spain. In the north, tourist developments extend to the boundary of the park. The other boundaries mainly comprise agricultural land.

One of the most important ecological functions of the Albufera wetland is the nursery and migration habitat function for birds. Submerged vegetation is an important factor that determines the performance of the wetland as a nursery and habitat for birds:

Direct influence:
Charophytes and their associated invertebrates are important sources of food for ducks. Seeds from angiosperms are food for migratory birds in winter. Submerged vegetation provides food for herbivorous birds.

Indirect influence
The structure of macrophytes defines also the capacity of an aquatic ecosystem to provide a refuge for zooplankton against fish predation (Scheffer, 1998). The availability of prey (zooplankton) for fish is also a factor that determines the fish stock in the ecosystem and thus also the abundance of fish-feeding waterfowl. The structure of macrophytes defines also the capacity of an aquatic ecosystem to provide a refuge for fish against predating waterfowl and piscivorous fish.

The development of the submerged vegetation and ultimately also the development of associated fauna are determined by a lot of environmental factors, like water quality, optical conditions, desiccation, hydrology and meteorological conditions. The diversity and the community structure of the aquatic vegetation are suitable bio-indicators to monitor the impacts of increasing water use (salinisation) and eutrophication on aquatic biodiversity in the Sa Pobla catchment and the coastal zone of Alcudia.

Research objectives

Systematic monitoring of changes in water quality, water quantity and the aquatic ecosystem is needed to find a balance between human water demand and the “water-needs” of natural ecosystems. In order to determine the optimal, sustainable use and management of water in the Albufera watershed the following environmental policy indicator was proposed (Veraart et al., in prep.):

\[
IS_{adj} = \frac{\text{Average groundwater recharge (Hm}^3/\text{yr}) + \text{Manmade water resources(desalinisation fact.)}}{\text{Average socio-economic water exploitation (Hm}^3/\text{yr}) + \text{Natural water demand (Hm}^3/\text{yr})}
\]

with the following constraints:

1) \( IS_{adj} > 1 \)
2) The natural freshwater supply function of aquifers should be optimised before expensive man-made water freshwater resources are incorporated.
3) Socio-economic water exploitation (irrigation, drinking water extraction) should be efficient as possible before expensive man-made water freshwater resources are incorporated.
4) Economic, ecological and social-cultural costs and benefits of all the variables of \( IS_{adj} \) should be evaluated in order to determine the sustainability of current water management in the Albufera watershed.

The monitoring of the aquatic vegetation and zooplankton in combination with ongoing water quality monitoring by park staff provides useful information in relation to the natural water
demand. Eventually it might be possible to formulate the natural water demand of the wetland, and to find a balance between the socio-economic water demand and the natural water “demand”. In order to achieve this general objective the following information is collected:

A) Identification of the diversity and abundance of the community structure of the aquatic vegetation at a selection of the baseline monitoring sites (Martinez-Taberner, 1988; Veraart, 2000). The monitoring programme provides information that can be used to assess the impact of increasing water use and eutrophication on the functional role of the aquatic vegetation for the habitat and nursery function of the wetland.

B) Identification of the diversity and abundance of the zooplankton community at a selection of the baseline monitoring sites.

Research methods

Water quality
Salinity, conductivity and pH were measured at all the sampling sites with WTW conductivity and pH meters. The locations of the visited sampling sites can be found in appendix A.

Aquatic Vegetation
Specimens were collected at some selected baseline monitoring sites (Martinez-Taberner, 1988; Veraart, 2000). The species were identified and their abundance estimated in terms of (R)are, (M)oderate or (D)ominant. For a more detailed description of the vegetation mapping method see Veraart (2000).

Zooplankton
The zooplankton community was sampled in the ephemeral ponds. At least 4 samples between 0.5 and 1.0 litre were taken at each site with bottles. The collected volume was measured in the laboratory. Samples are filtered through a 250 µm mesh net. Preparation of the samples was done with formol (4%). The number of Cladocera and Copepoda taxa were counted for each sample. Cladocera/Copepoda ratios and concentrations (individuals/litre) were calculated for each sample.


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Human and Management Impact studies

III.1.2 Dune observation, Parc Natural de S’Albufera, 22/5/01 by Rachel King

[Editor’s note: this study was undertaken before the November 2001 hurricane destroyed all the advances which had been made under the foredune recuperation programme. Nevertheless, the contents of this paper remain valid, particularly in planning for future work to restore and protect this important and severely threatened habitat. The detail relating to fence damage and recommendations for repair are no longer relevant. However, it is worth noting that some concerns expressed in this paper have turned out to be prophetic as the November hurricane did indeed undo all the benefits the programme had created]

Contents

1. Introduction and aims
2. Methods
3. Results
4. Discussion- The problem as I see it and possible solutions/ actions to be taken
4a. The problem
4b. Solutions/ action to be taken
5. Further information
6. Summary

1. Introduction and aims

In an attempt to counter serious erosion of the Es Comú foredunes, a brushwood fence was erected in early 1999 along the entire Park section of the dune/beach interface. The fence, constructed at the head of the beach approximately one to two metres short of the dune face was not a complete barrier to movement by people but would at least reduce access to the fragile dune face area and afford pioneer vegetation the opportunity to recolonise. The overall aim was to halt the erosion and aid regeneration of the foredunes.

The brushwood fence also serves the process of trapping sediment and for that reason an alternative name is “sand fence”. The one constructed had an above-ground height which varied between 0.5-1.5 m. It is made out of “espartina” and was constructed by an outside contractor, Dunas Baliares. A further barrier was constructed immediately seaward of the brushwood fence, comprising a fence of rope supported by wooden posts. This was to act as a further limit to access. Signs were also erected, informing people of the fragility of the
dunes and the actions being taken to protect them. Since then TAIB has been monitoring the vegetation succession changes along this area. We are carrying out transects at random points along the length of the beach and recording the plant species present and % cover in one metre quadrats from the brushwood fence landwards until mature dune is reached (defined as the presence of juniper or top of the dune face). The objective of the monitoring is to use pioneer vegetation recovery as a measure of the success of the restoration management works.

The following observations carried out by RK were supplementary to this work. They were carried out on 22nd May 2001 following 3-4 days of strong NE winds. The intention was to take a subjective look at the condition of the dunes with respect to the restoration works and to record my observations in a way which could be used for future comparative evaluation.

In reading this paper, it should be borne in mind that the restoration works being carried out are only one measure in addressing a complicated problem in which many factors are involved. The immediate source of the problem, and one which shows no sign of abating, is increased anthropogenic pressure on the area. It is not just a problem of people on the beach either but relates to the functioning of the whole bay in terms of water quality and destruction of the littoral zone and its important sea grass, *Posidonia oceanica*, communities. Without a plan which takes into account all the various elements which threaten the integrity of the littoral ecosystem, it would appear to be impossible to actually solve this problem. We can, however, at least do our best to delay the effects by ensuring that the restoration works are as effective as possible.

**2. Methods**

I began at the south end of the Alcudia beach. Access to this point is as follows. Approaching Ca’n Picafort from the north (along the Alcudia-Ca’n Picafort road), the first roundabout is immediately before the town of Ca’n Picafort. Take the last (NE) turning on this roundabout and head towards the beach. The rope fence begins just before the track meets the beach. This is where I began my observations. The post marked as number 1 was the one next to the (graffiti) sign explaining the dune recuperation and also next to a low concrete rectangle on the ground.

From there I headed N writing a number in pencil on the back of every tenth post, 10, 20, 30 and so on. These numbers are not intended to be permanent but to help me keep track of my position. So that the observations collected can be compared to future observations, I made cross-referencing notes for posts which corresponded with concrete markers, paths, obelisks, or any other permanent markers. As I moved along the beach I made general observations on the condition and effect of the brushwood fence: noting if it was short, broken, in need of repair and whether sand accumulation and/or vegetation regeneration were occurring. I also assessed which areas would benefit from additional fencing or the blocking of a path, or perhaps the opening and sign-posting of a path if it is already heavily used.
3. Results (see below)

The areas highlighted in yellow are where immediate work is needed, (eg. rope fence down) and the areas highlighted in red are permanent markers, including waste bins which may not be so permanent. Path entrances noted will also prove useful as reference points. The brushwood fence is referred to as B fence to avoid confusion with the rope fence on the seaward side of this. * refers to a sketched diagram of the site (deposited in files, Laboratorio Dennis Bishop).

<table>
<thead>
<tr>
<th>Post no</th>
<th>Observations</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Next to graffitied information sign</td>
</tr>
<tr>
<td></td>
<td>Waste bin</td>
</tr>
<tr>
<td>20</td>
<td>Back from here there is 1 large and 2 small angled B fences which though heavily broken have caused some collection of sand and stabilisation of vegetation though not quite in keeping with the previous dune shape</td>
</tr>
<tr>
<td></td>
<td>Level with concrete marker, where a path enters</td>
</tr>
<tr>
<td>21-30</td>
<td>Very little accumulation of sand and only small amounts of vegetation</td>
</tr>
<tr>
<td></td>
<td>Marker and also level with an entrance, not path but shelter area</td>
</tr>
<tr>
<td>30-40</td>
<td>Regeneration as 20-30</td>
</tr>
<tr>
<td>44*</td>
<td>Propose new B fence plus block path behind fence S of 44</td>
</tr>
<tr>
<td>44-53</td>
<td>no rope, some collection of sand but little vegetation</td>
</tr>
<tr>
<td>55-56</td>
<td>as above</td>
</tr>
<tr>
<td>64*</td>
<td>gap of 1.4 m in B fence should be repaired because allows access.</td>
</tr>
<tr>
<td>68*</td>
<td>path through dunes which could be blocked. Remains of a small B fence visible</td>
</tr>
<tr>
<td>70-71</td>
<td>B fence only about 0.7 m and very worn. Having no effect</td>
</tr>
<tr>
<td>72*</td>
<td>Propose new B fence see diagram</td>
</tr>
<tr>
<td>78</td>
<td>Bin</td>
</tr>
<tr>
<td>80</td>
<td>Patch of Ammophila</td>
</tr>
<tr>
<td>84*</td>
<td>Corner of entrance S of obelisk. Veg and sand accumulating around B fence. Entrance to 2 paths needs Closing</td>
</tr>
<tr>
<td>94-95</td>
<td>Between these there is a fallen concrete marker</td>
</tr>
<tr>
<td>95-96</td>
<td>Path blocked by B fence but has been opened</td>
</tr>
<tr>
<td>100</td>
<td>Below obelisk</td>
</tr>
<tr>
<td>102</td>
<td>Major opening in B fence across path between mature juniper dunes. Needs to be well blocked. N of tower</td>
</tr>
<tr>
<td>105-107</td>
<td>Fence very low, 0.5 m and broken</td>
</tr>
<tr>
<td>110</td>
<td>Large sloping sand bank with juniper above. Could possibly be stabilised with planting of Ammophila</td>
</tr>
<tr>
<td>114</td>
<td>Level with concrete marker</td>
</tr>
<tr>
<td>110-115</td>
<td>as 110</td>
</tr>
<tr>
<td>115-116</td>
<td>as 110 or possibly second barrier very little veg. Bare sand and roots</td>
</tr>
<tr>
<td>116-117</td>
<td>Between these there is a path cutting back through the high dunes which could be blocked</td>
</tr>
<tr>
<td>119-125</td>
<td>A lot of vegetation and sand accumulation around fence especially large Eryngium plants</td>
</tr>
<tr>
<td>120</td>
<td>Another marker</td>
</tr>
<tr>
<td>125-130</td>
<td>A lot of sand accumulating but lacks vegetation</td>
</tr>
<tr>
<td>129-130</td>
<td>Large path leading back. Either should be blocked or walk way put in or partly blocked to extend dune. Entrance some 7 m wide</td>
</tr>
<tr>
<td>131-133</td>
<td>Pulled up concrete marker</td>
</tr>
<tr>
<td>132-135</td>
<td>B fence badly broken and low</td>
</tr>
<tr>
<td>139</td>
<td>Pathway partly blocked by now broken B fence. Could be better blocked</td>
</tr>
<tr>
<td>140</td>
<td>Pulled up concrete marker</td>
</tr>
<tr>
<td>Page</td>
<td>Observation</td>
</tr>
<tr>
<td>------</td>
<td>-------------</td>
</tr>
<tr>
<td>130-143</td>
<td>Quite a lot of sand accumulating but no veg</td>
</tr>
<tr>
<td>146-147</td>
<td>3 deep path cutting which could be closed</td>
</tr>
<tr>
<td>143-150</td>
<td>Patches where vegetation accumulates</td>
</tr>
<tr>
<td>151</td>
<td>Path blocked by B fence (not a deep path) needs to be better blocked and possibly planted</td>
</tr>
<tr>
<td>155</td>
<td>Large bare bank at base of juniper where nothing is growing</td>
</tr>
<tr>
<td>156</td>
<td>Next to this there is a path blocked by a B fence which has been opened, path is not too deep</td>
</tr>
<tr>
<td>150-160</td>
<td>Patches of vegetation</td>
</tr>
<tr>
<td>161</td>
<td>Sign &quot;prohibido manipular las materials de obras, Zona de regeneracion dunar...&quot;</td>
</tr>
<tr>
<td>162</td>
<td>Entrance in B fence to enter paths.</td>
</tr>
<tr>
<td>163-166*</td>
<td>Low open sand area with traces of vegetation which could benefit from a barrier to aid sand accumulation.</td>
</tr>
<tr>
<td>166-170</td>
<td>Front B fence also very low, 0.5 m and broken - this extends to 170-171</td>
</tr>
<tr>
<td>166</td>
<td>Same as above. Another opening N of juniper island also would benefit considerably from a second barrier extending to 170-171</td>
</tr>
<tr>
<td>170</td>
<td>Wooden pole laid against the dune marked with &quot;2&quot; in green paint</td>
</tr>
<tr>
<td>170-180</td>
<td>B fence in better state, some sand and small amounts of vegetation accumulating but dune behind is steep and almost bare below juniper</td>
</tr>
<tr>
<td>180-190</td>
<td>as above</td>
</tr>
<tr>
<td>190</td>
<td>Rubbish bin and marker</td>
</tr>
<tr>
<td>201-202*</td>
<td>Very large path entrance, 5 m wide - but later closes up so should be blocked</td>
</tr>
<tr>
<td>200-210</td>
<td>A little accumulation of sand a some vegetation</td>
</tr>
<tr>
<td>217</td>
<td>This post is marked because after this the fence is down, 2 posts burried</td>
</tr>
<tr>
<td>218</td>
<td>Almost completely burried, this post is the other side of the gap. Gap about 6 posts wide. Rope buried too B fence begins again here</td>
</tr>
<tr>
<td>219</td>
<td>Also almost completely burried</td>
</tr>
<tr>
<td>220*</td>
<td>Bin</td>
</tr>
<tr>
<td>228</td>
<td>next to wooden walk way coming from recreation area. Some sand and vegetation collecting at corner S of this</td>
</tr>
<tr>
<td>229</td>
<td>other side of wooden walkway</td>
</tr>
<tr>
<td>232-233</td>
<td>Sign with &quot;pretend&quot; explaining dune regeneration</td>
</tr>
<tr>
<td>234</td>
<td>Diagonal B fence working well to collect sand and beginning to collect vegetation (Posidonia pile at path entrance)</td>
</tr>
<tr>
<td>236</td>
<td>Post out needs to be put back in</td>
</tr>
<tr>
<td>240</td>
<td>Bin: B fence begins again here</td>
</tr>
<tr>
<td>245</td>
<td>S of this there is an entrance in the dunes, not sure how it can be dealt with</td>
</tr>
<tr>
<td>240-250</td>
<td>Some sand, not markedly accumulating, and some vegetation</td>
</tr>
<tr>
<td>251</td>
<td>Major path leading back. Once blocked by B fence, needs something stronger, 3-4 m wide. Also poss of 2nd S fence behing (8-10 m wide) as vegetation present but little (more than previous sites) &amp; some sand accumulation</td>
</tr>
<tr>
<td>251</td>
<td>Bin, gentle dune slope behind with vegetation taking hold</td>
</tr>
<tr>
<td>252-260</td>
<td>Some sand accumulating but more than anything it is protecting the area behind where vegetation continues to extend down slope rather than forming another dune</td>
</tr>
<tr>
<td>265*</td>
<td>Another open area with small paths leading off. Blocked by fence but open</td>
</tr>
<tr>
<td>260-270</td>
<td>Some sand and vegetation accumulating, not particularly noticeable</td>
</tr>
<tr>
<td>271</td>
<td>Small deep path opening which could be blocked with wood?</td>
</tr>
<tr>
<td>271</td>
<td>Bin</td>
</tr>
<tr>
<td>277-278</td>
<td>opening to path, doesn’t seem to be very heavily used. Elymus farctus doing well in places</td>
</tr>
<tr>
<td>270-280</td>
<td>as 260-270</td>
</tr>
<tr>
<td>282-286</td>
<td>A lot of Eryngium. Not marked sand accumulation</td>
</tr>
<tr>
<td>284-287</td>
<td>opening in dunes but grasses doing quite well. A second small B fence further back could help (4.5 m long)</td>
</tr>
<tr>
<td>287</td>
<td>Post out, needs to be put back in - apparent storm damage</td>
</tr>
<tr>
<td>285-298</td>
<td>Cut sand bank below rope fence</td>
</tr>
<tr>
<td>287</td>
<td>Cut sand bank 1.5m from post</td>
</tr>
<tr>
<td>287-289</td>
<td>B fence flattened</td>
</tr>
<tr>
<td>289-92.5</td>
<td>No B fence, rope fence present but flattened by sea/wind?</td>
</tr>
<tr>
<td>292.5-94</td>
<td>B fence there but flattened with fence</td>
</tr>
</tbody>
</table>
A brief summary of what was seen

The effect of the B fence was varied. There were areas where some accumulation of sand and/or vegetation could be seen, highlighted in blue. Other areas where sand was accumulating but no vegetation seemed to be taking hold, are highlighted in grey and finally, areas where the B fence appears to be having no or a very slight effect are marked in dark grey. Also some of the areas marked in yellow are where the fence is down (218, six posts, 287-294 and 392 till the end) these are all areas where there is no or almost no B fence or rope fence protection.

It could also be seen that the sand accumulation was most marked on the leeward side of the barrier. This is due to the reduction in surface sheer stress being greater there. However, due to the fact that the rope barrier is often very close, 1-2 m, from the B fence and people often sit right up against it using it to hang clothes, the area is constantly being compressed and this may reduce the accumulating effects on the seaward side of the B
Another problem observed is that in many places, as the beach is very narrow, the brushwood fence has been placed very close to a fairly steep slope base and there is simply no room for sand to accumulate and form a foredune. Also, perhaps due to recent winds and lack of protection by a barrier of Posidonia debris on the beach, two areas were seen where the sea had cut into the beach forming a sand bank very close to the regeneration area, marked in pink. These areas could continue to extend and cut into the dune front.

This system is having some positive effects but maintenance and revision are essential to make the investment worthwhile. See possible solutions.

4. Discussion - The problem and possible solutions/action to be taken

Following my own investigations, reading and discussions with Xisco Roig in Menorca and Jaume Servera at Palma University, both very experienced in the subject of dune restoration, I have come to a better understanding of the problem and have also arrived at a number of conclusions.

There are two issues. The first is how to obtain maximum benefit from steps taken so far to mitigate or remedy the immediate problem. The second is to find long-term solutions to a problem which has serious implications not just for the Es Comú dunes but eventually for the general integrity of the coastline, including its role as a physical barrier against the sea.

4a. The Problem

1- the problem of dune erosion at Alcudia is very serious and the brushwood fence will do nothing more than temporarily delay the erosion of the dune front.

Brushwood fences must not only be well constructed and positioned, (taking into account distance from sea, porosity, drift direction, height of fence, distance from the dune base) but the effect they are having must also be continually monitored (Jaume Servera suggested monthly) and any negative effect should result in immediate alterations. Sand fence construction is also not a one-off event but a continual construction process, as one fence is filled another needs to be constructed to continue the rebuilding of the sand dune. Employing an outside contractor to undertake specific works without provision for continued maintenance and improvements is therefore insufficient. Follow-up is an essential part of the process.

2- As well as, or even preferably before, sand fence construction the movement of people in the area must be controlled, to keep them out of the most sensitive areas, and the reason why explained to them. There is absolutely no point in investing huge amounts of work and money in perfecting sand trapping techniques if people have no idea of what it is all about and no understanding of the importance of them staying out of the area. In Alcudia this particular problem needs to be delt with before the barriers are improved. (see suggestions)
Another problem in Alcudia, possibly the most important element in this story is *Posidonia*. Jaume Servera described its role to me using the analogy of the human body and an open wound. *Posidonia* beds are the defence mechanism, they act both as a dissipator of wave energy and as a sediment trap. Both of these roles are essential for the protection of sand dunes. *Posidonia* beds protect the dunes from direct wave action by dissipating wave energy and also supply the dunes with new sediment (Whittingham 1999). Their leaf litter also collects on the beach (when not removed by cleaning) acting as a further wave break during heavy seas. The problem here is the disequilibrium of this system through the removal of *Posidonia* litter from the beach, and the destruction of the *Posidonia* beds by boat anchors, pollution (from agricultural and tourism sources) and possibly by swimmers, etc. Allowing the destruction of this defence mechanism is like having an open wound and losing your defence mechanism. Not only will it not heal but there will be nothing to fight against infection.

**The sediment problem.** Due to the bathymetric isolation of the island, terrigenous sediment supplies are extremely limited. The natural system of sediment deposition aided by the *Posidonia* beds would, in an ideal situation (the previous natural situation), be sufficient to maintain both the beach and the dynamic dune system. However, we are not in this situation. The system has been knocked out of equilibrium by excessive anthropogenic impacts and the sediment deposition, it would appear, is no longer sufficient to counteract the erosion. Sediment deposition has also been affected by the construction of concrete piers where the Gran Canal enters the sea. As the main current direction is northward, accretion is occurring around the south side of the pier but is being removed further south in the bay. Jaume Servera has also floated another idea relating to sediment availability. He proposes that bioclasts (bivalves, crustaceans, prosobranchs etc, where the shells or exoskeletons of these animals later contribute to sediment formation) which contribute 50%+ % of beach sediment production in the Balearics, could also be suffering from both pollution and trampling by swimmers. This could also have an affect on present and future sediment availability. As no research has been carried out, this remains merely an hypothesis – but an hypothesis which needs to be tested urgently.

**4b. Possible solutions/actions to be taken**

1- **People.**

*Educate.* There needs to be more signs on the beach and in parking areas to explain to both tourists and local people how and why the sand dunes are being restored. Time and much thought needs to go into the design and positioning of signs. Most people found picnicking behind the brushwood sand fences or sunbathing in the dunes have no idea of what sand dune regeneration means or how they contribute to the problem.
At present there are only three signs on the beach explaining the situation. One at each end and one in the middle where the path from the recreation area reaches the beach. The one at the South end is completely covered with graffiti and is unreadable. The one at the North end is also very worn and the diagrams are almost impossible to see. The signs are in Spanish, Catalan and English. Many visitors are German and not all of them understand English. These signs at some point, soon if possible, will need to be revised and I would suggest that a number of smaller “please keep out of regenerating dune system” type signs be erected in the large area of beach between these three signs. Also more information could perhaps be supplied in the recreation area where many people park. In revising the signs, I strongly recommend that the English text is checked by a qualified English speaker first. The current statement “we pretend to restore ...” is incorrect and causes great amusement amongst British people. It should be “we are attempting to...” or “we are trying to...”.

As well as on-site information, another idea would be to produce an information leaflet for distribution in neighbouring hotels. Or if this proved too costly a number of small posters which could be displayed in the hotels, perhaps designed by local school children with information added by park staff or TAIB members. The poster could have a title of the type Help to protect our beaches with people’s attention being further drawn to the information on it by including a colourful but relevant drawing by local school children.

Control movement. At present there are 3 official routes to the beach, these are wooden walkways which work well to control the movement of people. Most people on finding such a walkway are happy to keep to it, trusting that it will take them to the beach. Other paths which have developed over the years have, in theory, been closed by brushwood fences at the beach end and some by posts, actually within the dune system. Unfortunately, the brushwood fences are an incomplete deterrent because in many places people simply push through and create an opening. This situation is problematic as there is a network of paths through the dunes and it is hard for visitors, who wander around out of curiosity, to know where they can and can’t go and how exactly to find their way out or to the beach. These paths need to be either closed or well sign-posted to control the movement of people both for the good of the dunes and for the satisfaction of visitors. This was one of the main demands from the visitors in a survey carried out by Juana Mª Garau in July 2000: “more information and more sign posts”.

To summarise. Unfortunately, in terms of practicality, it is impossible to remove and probably to control numbers of visitors on the beach so the only positive action which can be taken is to first educate the visitor and then request their co-operation in limiting their impact on the beach and dune system.

2- Posidonia. Again there is a need for a combination of action and education. An agreement needs to be made, and put into practice, that Posidonia clearing will stop along the beach section which is designated park. Along areas of the beach outside the park the Spanish national government grants local municipalities permission to
“clean” the first 10-15 m of *Posidonia*. The park does not fall into local government jurisdiction but is managed by Ibanat. This, in short, means it should be managed according to the park’s principle management responsibilities, nature conservation and restoration.

An element of education is required here too. The current mentality is that *Posidonia* on the beach is “dirty” and a negative factor for the tourist industry. This public misconception is due, to a large extent, to a lack of understanding of the major role that it plays in protecting the beach. Education is needed to alter this viewpoint.

3- **Sand Fences.** Sand fences undoubtedly can be a useful tool in the regeneration of the sand dune if used together with the control of public movement on the beach, education and the cessation of *Posidonia* removal. If used out of this context, with no follow up or maintenance, it will do nothing more than collect a little sand and vegetation before being knocked down by sea, wind or people with the result that any benefit is quickly lost.

However, if sand fences are used correctly (as explained above) then work should begin first with the repairing of the broken/buried rope fence, to keep people out of the area while further work is done. Then I would suggest bringing someone in who is experienced in dune restoration to walk the length of the beach identifying key sensitive areas where more sand fences should be constructed. This person can also serve to inform and educate both TAIB and park staff members and any local influential people who can be persuaded to join an informal but informative walk along the beach. Sand fence construction is a continual process and serious thought would need to go into the practicalities of finance and labour involved. If more fencing is constructed and an ongoing program is developed and financed, thought should also be given to accompanying this with some amount of planting of appropriate plants such as *Ammophila arenaria* to help fix the dune in areas where vegetation is not taking hold.

4- **Sediment.** *Posidonia* is the key line of defence as far as sediment production and retention is concerned, they are often referred to as “sediment factories” (Rodríguez Perea *et al*. 2000). As far as the role which bioclasts may play this is a possible area of further research. Although we cannot imediately alter sediment production we can at least try to avoid its loss. This is one of the aims of sand fences but we can also take action at a different level. Inevitably there is a net loss of a few grammes of sand by every visitor to the beach. This may not seem a lot, but taken over a season and taking into account the heavy concentrations of people on Mallorcan beaches, the annual loss People should be encouraged to remove as little as possible. Every little bit adds up as the beach can only support a certain amount of sediment loss. This information should be included in signs or any other informative material produced.
5. Future planning

I have been informed that the Minister of the Environment for the general government based in Madrid has produced a dune regeneration proposal for the park entitled “Ordenación del uso público del litoral y protección del corón dunar de la playa de Es comun de Muro, TM. De Muro”. This was written in December 2000 but the park staff have only very recently seen a copy. It would appear that the wetland has nothing to do with the project but for some reason there is constant reference to it. There was no consultation process with the Park staff or other local specialists prior to the production of this proposal.

In short the plan is to

1- Erect more sand fences, principally to block pathways (very short fences, only 30 cm high)
2- Plant sand dune vegetation after the sand fence construction. Principally Elymus and Ammophila.
3- Construct two new raised walk-ways (one leading to the recreation area, one simply into the pine woodland),
4- Fence off all the sand fence area. This involves two long rectangular fences, one enclosing the north sand fences, behind and in front, and one enclosing the southern sand fences.
5- Fence off the dunes to vehicles. Along the C’an Picafort–Alcudia road (even where there is no problem or even possibility of vehicles entering) and in the recreational area, where vehicle access is already controlled. They have not however, as Juan Salvador points out, fenced off the access point where the beach cleaners enter to remove Posidonia. (see next section)
6- Erect signs along the beach and in the woodland (46 in total).
7- Erect 15 wooden benches, 9 of which are on the beach itself.
8- Erect 2 bicycle stands, one at each end of the beach, each holding a total of 5 bicycles.

All of the following is planned to take some nine months and cost 20.605.806 ptas. The work will be carried out by a contractor.

There are a lot of good elements in this proposal. However, the effectiveness of the proposed works, and in the long-term their cost-effectiveness, will be compromised if other factors are not taken into account. It is of concern that a number of elements have not been taken into account.

1- There is no mention at all of Posidonia (which seems incredible when it is such an important element in Mediterranean sand dune dynamics) nor of the clearing of it from the beaches. There is, however, a full list of all the bird species that have been found in S’Albufera, which is not particularly relevant.

2- There is no mention of any follow up or maintenance of the structures which they plan to install. Sand fences could easily be pulled up or blown away, the rope fences removed, the planted vegetation die, as much probably will, and who will be
there to deal with it? The role that the present sand barriers play also receives no mention. I assume they will be left but given no further attention.

3- The information signs seem a little too numerous and it would also appear that they are only to be written in Spanish. They also contain information which may be true for a Spanish mainland dune system but is erroneous for the park. *Armeria pungens* and *Helichrysum picardii* are quoted as being in the “dunas tercierias”. Neither are Balearic species. There is also reference to the bird life being represented by *Phalacrocorax carbo*, *Tringa totanus*, *Numenius arquata* and *Charadrius alexandrinus*. These occur in the wetland parts of s’Albufera but, with the exception of *Ch. alexandrinus* which is occasionally encountered on the beach, are not associated with the dune system. A more appropriate list would be *Saxicola torquata*, *Sylvia melanocephala*, *Serinus serinus* and *Lanius senator*.

4- The erection of benches is mentioned only briefly and without explaining how this would benefit the programme. This measure may be both unnecessary and inappropriate unless it can be shown that this will assist visitor control and promote enhancement measures for the dunes.

5- The provision of two bicycle racks, holding a total of 10 bicycles, also seems a token measure. If racks are to be constructed surely provision for more than 10 bicycles should be made or nothing at all.

6- There also seems to be no real evaluation of the disruption that all of this construction work may cause the fragile dune system.

7- The sand fences will be enclosed by fences to keep the public out but all of this fencing will need to be constructed, which will involve workers entering into well vegetated parts of the dune system. The amount of fencing involved seems excessive and its construction could be destructive. It also detracts from the “open” landscape values of the site.

8- The proposed height of the sand fences is very short (50 cm total, 20 cm of which will be buried), possibly too short to keep people out or to have much of an effect, in terms of accumulating sand.

6. **Summary**

An integrated approach needs to be taken with respect to addressing the erosion problem in the dune system. There are many key factors involved in promoting a healthy dune system and failure to address just one of these will result in the invalidation of the other work carried out. However many fences are built, if the *Posidonia* is continually removed, the sea will continue to erode the dune face whenever storms occur.
Practical actions, such as sand fences, planting, controlling access and stopping *Posidonia* clearance on the beach, must go hand in hand with education and an attempt to bring to the public eye the problems which exist and how they can help. To gain ongoing co-operation from both locals and tourists there must be more emphasis on education and, where possible, locals should be involved in informing others.

The most recent proposals for dune protection at Es Comú have been made with minimum local consultation. There is considerable local expertise on coastal processes, including dune development and conservation, which has not been used. This omission should be redressed. Without this, the measures being proposed are likely to be short-term without any real long-term gains for the dune system. Failure of the short-term measures will require further more extensive measures in the future. It is better to address all the issues and implement all the procedures required at the catchment area level, rather than proceeding with a programme which will not be cost effective if it fails.

7. **Reference**

Biodiversity studies

III.2.1 Diptera of S’Albufera de Mallorca – Updated report on visit to the Parc Natural S’Albufera, 15-23 April 2001 by M.J. Ebejer

Introduction

Diptera are a very important group in any ecosystem. Among a large number of interrelationships, they form complex insect/plant, insect/insect communities. They are an essential fauna in the first phase of biodegradation of both plant and animal matter. They are a major food source for insectivorous birds and aquatic animal life. Because of their diverse biology and their strong affinities to specific biotopes, they can be useful for environmental monitoring and as subjects of various ecological studies.

At the invitation of the reserve authorities I visited S’Albufera for a week in order to explore the diversity of the Diptera in the Reserve and their potential use in ecological studies.

Objectives

i. To produce a baseline list of species.
ii. To identify the groups of Diptera which have a strong association with the various biotopes in the reserve.
iii. To identify major host plants and the Diptera associated with them.
iv. To suggest areas for future research.

Laboratory work

The material that was collected was examined microscopically, sorted and prepared in the Dennis Bishop laboratory for later identification. Live material was placed in appropriate containers for rearing. Notes and labeling were completed on site.

The specimens in the reference collection, belonging to the Acalypterate group of Families that were previously collected, were rearranged to accommodate the new material resulting from this visit.
Field work

Weather permitting, field sorties were carried out between approximately 09.00 and 19.00 hours. Collecting was entirely by sweep netting. Vegetation was systematically swept from ground level to its top or to a height of 3 m in the case of trees and reeds. Common plants were occasionally searched for galls and mines.

A total of 14 collecting sorties were carried out within the S’Albufera reserve, visiting the following sites:

1. Es Comú: coastal dunes  a) *Pinus* with undergrowth of *Pistacia*, Graminae.
   b) exposed consolidated dunes, mixed low herbage, mainly *Cistus*.


5. Es Colombars: marsh with *Tamarix*, *Salicornia*.

6. Sa Roca: vegetation near watercourses mostly under *Populus*.

7. Es Forcadet: mixed vegetation along track, mainly Graminae and low flowering shrubs; and vegetation along canal mainly rushes, *Ranunculus* and *Euphorbia*.


10. Es Comú: coastal dunes, *Pinus* undergrowth with mainly Graminae and one area with *Juncus*; exposed dunes with tracks among *Pistacia*, *Cistus* and *Thymus* (and numerous other low flowering plants).

11. Es Cibollar: north end of marsh (wet zones) with *Tamarix*, *Salicornia* and *Juncus*.

13. Es Cibollar: south end of marsh (dry zones) with *Tamarix* and *Salicornia*.


15. Sa Roca: vegetation around buildings and canal.

In addition, 5 sorties were undertaken outside the reserve. The first two, at Cova St Martí and at Son Serra beach, are relevant to the fauna within the reserve S’Albufera. The first, because it abuts the reserve to the north and provides the only broadleaved wood on dry ground; and the second, because it substituted fore shore fauna since the *Posidonia* wrack had already been removed from that part of the beach which falls within the reserve. S’Albufereta was visited briefly and very late in the afternoon. A strong wind was blowing and temperatures were already too low for insects to be active. Only three species were taken, all of which were represented in the reserve at S’Albufera. However, S’Albufereta appeared very promising and should be investigated in the future.

1. **Alcudia**: maquis with *Quercus* and *Olea* around Cova St Martí.

2. **Sta Margalida**: Son Serra beach: *Posidonia* wrack, *Tamarix* with various low plants as undergrowth.

3. **Sa Pobla**: Son Ton woodland with *Pinus* dominating, but including *Quercus*, *Olea*, *Pistacia*, *Rhamnus* and *Arbutus*.

4. **Pollença**: Vale De Son March: watercourse with *Quercus*, *Olea*, *Rhamnus* and *Populus*.

5. **Pollença**: S’Albufereta: sandy meadow adjacent to marsh, *Tamarix*. 
Discussion

1. The reference collection.

The scope of the reference collection of Diptera was discussed and it was concluded that representatives of all families known from S’Albufera or expected to be found there, should be available on site for examination. The Diptera form a large Order with most of the species presenting difficult taxonomic problems for the non-specialist. It would therefore be unnecessary to maintain a comprehensive collection particularly where, many small species can only be separated by specialists using microscopic examination after dissection. Nevertheless, some provision may need to be made for space to accommodate more material of specific groups should these be chosen for ecological studies.

2. Curation of the collections.

The collections are currently curated by one person, with occasional assistance from non-specialists. It is clear that as the collections grow, and as more scientific visitors, students and volunteer workers visit the reserve, the task of maintaining these collections will be too much for one person. In order to keep them organized and up to date, someone may need to be trained in proper curation including the compilation of the relevant biological and ecological data. Ideally, this same individual should be involved in maintaining the database and the links with the various taxonomic specialists. Also, this individual is more likely to succeed if he or she has a special interest in an insect group other than Lepidoptera. I can offer one or two weeks of training an individual in the curation of entomological collections. More details are given in Appendix I.

3. Literature.

I was asked for some ideas regarding taxonomy books and one or two relevant papers that deal with Diptera and ecology/marshes/dunes/reed beds.

**Books.** The following are suggested titles that may prove useful to staff in the Reserve as well as visiting scientists and volunteers. Not all titles will have the same degree of appeal. I suggest a list is obtained from Lydie Rigout, 4 St Martin’s Road, Canterbury, Kent; and from Ian Johnson, Pemberly Books, P.O. Box 334, Hayes, Middlesex, UB4 0XX.

Faune de France
3. All the Hemiptera series 1952-1995. Approx. £300.

Fauna D’Italia
All the Coleoptera series: vols 8, 12, 14, 16, 17, 18, 19, 25, 26, 28, 32, 33, 34, 35. Approx £400.

Papers. The following is obviously not a comprehensive list, but it, and references therein, should serve as an introduction.


Conclusions regarding the Diptera of S’Albufera

A total of 246 species were noted of which 237 were collected and a reference collection of 98 species has been returned to the Park. This number of species returned supplements the specimens already housed at S’Albufera. Prior to this visit about 136 species were recorded in 45 families. These numbers have risen to 246 and 56 respectively. The number of species recorded is somewhat less than expected for the time of year. However, the weather was not favourable. Temperatures were well below average and it rained on two days. More than 750 species are estimated to occur at S’Albufera. Clearly much remains to be done.

It may be unwise to come to too many conclusions on the biodiversity of Diptera of S’Albufera on the basis of this one visit and the previous scant collecting. However, I have undertaken several such short visits in several localities around the Mediterranean (Malta, Sicily, France, Israel, Greece, Turkey, Tunisia) and by comparison, S’Albufera on this visit has yielded less than expected. Some reasons are already apparent:

1) This was an abnormal year with a very early spell of warm weather followed by (during the visit) an unusually cold spell.

2) There is a marked scarcity of nectar bearing flowers particularly Umbelliferae and Compositae.

3) Dry ground is scarce and either over grazed or still in the early stages of recolonization.

4) Wooded areas are dominated by Pine. Poplar and Oak would considerably increase diversity.
5) Some additional sites could not be visited owing to bad weather; and for the same reason, repeat visits to some of the more productive sites that were visited on the first day, were not undertaken.

Some management of the reserve with a view to increasing food resources for insects may enhance not only the aesthetic value of the reserve, but it may also increase the number of species of visiting and nesting birds. A small broadleaved wood with clearings would probably increase the insect fauna by 30%. Some parts of the wetlands as well as the dry sandy meadows should have more restricted grazing. The foreshore and fore dunes are threatened because of excessive human interference, such as trampling on the dunes and excessive “cleaning” of the beach, namely removal of the Posidonia.

As a result of this visit, the list of species now known from S’Albufera has almost doubled and additional families have been recorded. The checklist has been updated and appended to this report. However, it will be necessary from time to time, to keep it up to date and to add newly discovered taxa. I am happy to do this on a yearly basis along with further indentifications and advice.

**Suggested areas for further study.**

It should be one of the aims to maintain and add to a comprehensive list of species extant in the reserve. However, other studies could be undertaken over a specific time frame to examine the way Diptera make use of the different niches or resources in the reserve. The following are a few suggestions based on what is known of the biology and ecology of Diptera, the range of species that are known to occur in S’Albufera and the available expertise, the following are some suggested examples:

1. Dolichopodidae and Ephydridae are two families whose member species, in the majority, live close to water and many have semi-aquatic larval stages. They also tend to remain very close to their breeding site throughout their adult stage. Identification is not difficult. A study can be undertaken to assess the distribution and species composition across the different biotopes within the reserve.

2. Specific plants have an interesting fauna of Diptera (and many other arthropods) associated with them. The reserve has plant communities dominated by particular species. Comparative studies of the fauna associated with these dominant species can be undertaken (population densities, seasonal variation, regional variation etc). The selection of the associated fauna to be studied can be as comprehensive or as limited as time, local knowledge or ability permits. Suggested host plants are: *Arundo, Phragmites, Tamarix, Dittrichia, Salicornia, Populus*.

3. Population densities and zonation of larvae of Chironomidae, Culicidae and Dixidae in the various water bodies can be studied and monitored over the seasons. These can be used to monitor water quality. The adults of Chironomidae are a rich food resource for small insectivorous birds, especially hirundines. Numbers of adults also can be assessed with flight intercept and/or water traps.
4. A diversity of parasitic Diptera implies a diversity of hosts that in turn have stable, viable populations. A survey could be undertaken specifically to study these groups and to ascertain whether or not they show affinities to particular areas within the reserve. Their generally large size will allow field observations to be made, in many cases, without the need for capture (e.g. Tachinidae, Bombyliidae).

5. The Agromyzidae are leaf miners and they could form the basis of another study linked to the botany of the reserve (faunistics, distribution, density of the population of individual species can be assessed by mines).

6. A quantitative and diurnal assessment of the Diptera feeding at the flowers of e.g. *Ranunculus* can be undertaken over just one season.

7. Using a selection of Diptera families, faunistic and ecological data can be collected in order to draw comparisons between S’Albufera and S’Albufereta. They appear to be sufficiently different to yield potentially interesting results.
The following Appendices are attached to this report:

Appendix I. Training in curation: scope, method and suitability

Appendix II. Table of species and habitats.

Appendix III. Specimens forwarded for reference collection.

Appendix IV. Status of the Diptera of S’Albufera

Appendix V. Checklist of all known Diptera of S’Albufera

Appendix VI. Supplementary records to append to original report (received Feb. 2002)

Acknowledgements

I wish to express my sincere thanks to the Parc authorities, in particular, Biel Perelló, for making this visit possible. I would like to thank the team leader Nick Riddiford and his wife Elizabeth, for much help and for ensuring that my stay was fruitful and comfortable; the fellow scientists and volunteers whose company was excellent and stimulating. Thanks also are due to my colleague in Malta, Dr Paul Gatt who indentified the families Culicidae, Keroplatidae, Hybotidae, Phoridae and Sphaeroceridae. All these people made my task easier and I am grateful for their support.

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APPENDIX I

Proposal for instruction in curation of entomological collections.

Scope.
There is a growing need for someone with knowledge and technical skill to look after the reference collections at S’Albufera. This same person would be the ideal link between specialists working abroad and local biologists. This person will know what’s what and what’s where as regards the local collections. He/she will have the confidence and ability to communicate with specialists, sending them well prepared material and receiving from them identified specimens. He/she will be able to house the specimens properly and in their correct systematic grouping. He/she will be in a position to maintain accurate and up to date checklists/databases. In the long term, this will be a rewarding task for the individual as well as the team based at S’Albufera. It will hopefully minimize repetition or unnecessary work and retain a high percentage of the efforts put in by all parties in the form of well curated collections, which ultimately should be a “user-friendly” product.

Objectives:

1. What to pin and how. What to preserve in alcohol and how.
2. Data on labels: what to include and why.
3. How to pack for shipment.
4. Arranging the specimens and labels in store boxes.
5. Preserving the collections; pesticides and fungicides.
6. Keeping records, checklists and databases.
7. Dealing with large miscellaneous samples from fieldwork.

Method of instruction.

A. Reading material.
1. Relevant books, catalogues and periodicals.
2. A “hand-out” which was prepared for our local entomology group as part of a lecture and workshop on curation of entomological collections.

B. Demonstration of properly kept collections (initials refer to the different persons):
1. Diptera – MJE and PG
2. Lepidoptera – PS
3. Orthoptera - LC
4. Coleoptera – DM

C. Hands-on experience:
1. Dealing with a sample of miscellaneous insects, fresh from the field.
2. Preparing mounts and labels. Pinning, setting, packing and shipping a selection of the material home.
3. Sorting a collection of Odonata: finishing off basic determinations, cataloguing the data, arranging the collection and labeling it.
Location and costs.

Most of the work can be carried out at the private residence of MJE. The attendee will have his/her own bedroom, but will share the two bathroom/shower facilities with the host family. Accommodation is free and includes full board i.e., joining in the family meals. All transport is provided. The only anticipated cost is the airfare and any personal expenses. The usual traveller’s modest medical and personal insurance is advisable. The only absolute rule is NO SMOKING anywhere in the house.

Suitable person.

Anyone with some biological knowledge, approximately to “A” level standard, would be suitable. Must be keen on insects and willing to work with them. Must be computer literate. He/she should have a good working knowledge of English and preferably be reasonably familiar with one other language apart from Spanish and Catalan.

It would be an advantage to have been exposed to S’Albufera, its staff and the visiting teams because this “course” will be tailor made and the attendee ought to see everything in the context of S’Albufera. The ideal person will also be a good communicator, an individual who is adaptable, resourceful and self motivated.
APPENDIX II

List of the Diptera recorded in April 2001 at S’Albufera and arranged according to habitat.

Those from three sites outside the reserve are included.
Species that were found everywhere are listed separately after the table.

<table>
<thead>
<tr>
<th>Species</th>
<th>Es Comu</th>
<th>Es Ras</th>
<th>Son Serra</th>
<th>Es Cibollat</th>
<th>Sex Pantes</th>
<th>Es Colombars</th>
<th>Sa Roca</th>
<th>Canal Des Sol</th>
<th>Es Forcadet</th>
<th>Cova St.Marti</th>
<th>Vale Son March</th>
<th>Son Ton</th>
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<tbody>
<tr>
<td>1. Actinoptera meigeni</td>
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<td>2. Aedes detritus</td>
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<td>3. Agromyza ? nigrescens</td>
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<td>Thaumatomyia notata</td>
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* = seen and checked in the field, but not taken.

Miscellaneous Nematocera

No special effort was made to collect Nematocera as I can identify only very few groups and only in some families. What I could identify is included in the table above. However, a number of specimens were taken within the reserve either at the canals or in the marshes. They have been pooled together in alcohol and they include the following:

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**APPENDIX III**

List of Diptera specimens forwarded to form part of the reference collection.

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<td>3. Anthomyia quinquemaculata</td>
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<td>30. Euthycera alaris</td>
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<td>33. Gymnochiromyia fallax</td>
<td>CHYROMYIDAE</td>
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<tr>
<td>34. Helina reverso</td>
<td>MUSCIDAE</td>
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<td>35. Hydrellia griseola</td>
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<td>36. Hydrophorus praecox</td>
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<td>Phytomyza conyzae</td>
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<td>Platypalpus albiseta group</td>
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<td>Polyodaspis sulcicollis</td>
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<td>Psilopa compta</td>
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<td>Psilopa nigritella</td>
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<td>Psilopa nitidula</td>
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<td>71</td>
<td>Psilopa rutilans</td>
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<td>Rachispoda fuscipennis</td>
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<td>73</td>
<td>Scatella paludum</td>
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<td>Scatella stagnalis</td>
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<td>75</td>
<td>Scathophaga stercoraria</td>
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<td>76</td>
<td>Schoenophilus versutus</td>
</tr>
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<td>77</td>
<td>Scolioccephalus pallidisetis</td>
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<td>78</td>
<td>Sepsis fulgens</td>
</tr>
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</table>
79. Sepsis punctum
80. Sepsis thoracica
81. Siphona sp.
82. Sphenella marginata
83. Stevenia deceptroria
84. Syntornon pallipes
85. Tephrisis formosa
86. Tephrisis praecox
87. Tethina grisea
88. Tethina nigrofemorata
89. Tethina strobliana
90. Thaumatomyia notata
91. Themira minor
92. Thinophilus flavipalpis
93. Tomosvaryella sp. B
94. Trixoscelsis approximata
95. Trixoscelsis curvata
96. Trixoscelsis obscurella
97. Trixoscelsis sanctiferdinandi
98. Tunisimyia excellens

<table>
<thead>
<tr>
<th>Orthoptera: Acrididae</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Tropidopola cylindrica</em> (Marschall) – 1 male, the <em>Phragmites</em> grasshopper.</td>
</tr>
</tbody>
</table>
### APPENDIX IV

**Status of Diptera Families known from S’Albufera**

*Note: * = increasing degree of difficulty on a scale from * to *****

<table>
<thead>
<tr>
<th>Family</th>
<th>Number known</th>
<th>Number Expected</th>
<th>Comments (relevant to S’Albufera)</th>
<th>Identification</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Tipulidae</td>
<td>1</td>
<td>5</td>
<td>semi-aquatic larvae; useful ecological indicators</td>
<td>***</td>
</tr>
<tr>
<td>2. Limoniidae</td>
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<td>12</td>
<td>semi-aquatic larvae; useful ecological indicators</td>
<td>****</td>
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<td>3. Trichoceridae</td>
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<td>not useful</td>
<td>**</td>
</tr>
<tr>
<td>4. Psychodidae</td>
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<td>15</td>
<td>semi-aquatic larvae; limited ecological indicators</td>
<td>****</td>
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<td>5. Ptychopteridae</td>
<td>1</td>
<td>1</td>
<td>semi-aquatic larvae; not useful</td>
<td>**</td>
</tr>
<tr>
<td>6. Dixidae</td>
<td>1</td>
<td>4</td>
<td>aquatic larvae; useful bio-indicators</td>
<td>***</td>
</tr>
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<td>7. Culicidae</td>
<td>3</td>
<td>10</td>
<td>aquatic larvae; useful bio-indicators</td>
<td>***</td>
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<td>8. Ceratopogonidae</td>
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<td>15</td>
<td>some aquatic larvae; not useful</td>
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<td>9. Chironomidae</td>
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<td>30</td>
<td>aquatic larvae; useful bio-indicators</td>
<td>*****</td>
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<tr>
<td>10. Keroplataida</td>
<td>2</td>
<td>3</td>
<td>saprophagous and mycophagous; not useful</td>
<td>***</td>
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<tr>
<td>11. Maceroceridae</td>
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<td>8</td>
<td>saprophagous and mycophagous; not useful</td>
<td>*****</td>
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<td>15. Cecidomyiidae</td>
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<td>15</td>
<td>many gall-forming species; useful ecological indicators</td>
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<td>16. Scatopsidae</td>
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<td>not useful</td>
<td>***</td>
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<td>17. Bibionidae</td>
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<td>not useful</td>
<td>**</td>
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<td>19. Stratiomyidae</td>
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<td>10</td>
<td>not useful</td>
<td>**</td>
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<td>20. Tabanidae</td>
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<td>**</td>
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<td>not useful</td>
<td>****</td>
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<td>22. Asilidae</td>
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<td>parasitoids of insects; useful biodiversity indicators</td>
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<td>Family</td>
<td>Number known</td>
<td>Number Expected</td>
<td>Comments (relevant to S’Albufera)</td>
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<td>not useful</td>
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<td>Tethinidae</td>
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<td>7</td>
<td>shore/dune-flies; useful ecological indicators</td>
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<td>30</td>
<td>good biodiversity indicators</td>
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<td>Braulidae</td>
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<td>not useful</td>
</tr>
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<td>2</td>
<td>not useful</td>
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<td>Fanniidae</td>
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<td>Muscidae</td>
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<td>35</td>
<td>diverse biology; good biodiversity indicators</td>
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<td>5</td>
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<td>76.</td>
<td>Tachinidae</td>
<td>5</td>
<td>40</td>
<td>parasitoids of insects; useful biodiversity indicators</td>
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</table>

**Total**: 289 identified, 769 estimated.
Comments.

Beyond a scale of *** considerable experience and/or technical skill is required even for dipterists, for example, preparation of slides or dissection of the post abdomen. Up to and including a scale of ***, identification is possible even by non-dipterists although some expert guidance or training is generally required. Some groups are difficult because they contain a very large number of species and inadequate identification keys.

With regard to their usefulness as ecological indicators, bioindicators or biodiversity indicators, the following remarks should be noted:

- The term ecological indicator is here meant to convey the meaning that the family in question is strongly associated with a particular type of habitat wherein there are plant and/or animal communities that impact on the population and diversity of the family of flies in question.

- A bioindicator is here used to describe the usefulness of that family of Diptera in monitoring the quality of an abiotic factor in the environment, for example, water quality.

- A biodiversity indicator is a family whose member species are heavily dependent on specific host plants or animals, which generally have well established populations. The Diptera in question are potentially useful tools with which to monitor important changes in the general plant and insect diversity of a habitat or sections within that habitat.

- Some families are considered “not useful” because of the small number of species within them or because they have a non-specific biology or ecology, for example, carrion feeders, detritus feeders. However, combined with other groups they can still be useful as indicators of the general biodiversity of the reserve.

The above table indicates that a lot more collecting needs to be done before a clearer picture of the Diptera of the reserve emerges. There are three important flight periods when the diversity and population density of Diptera peak in the Mediterranean. In general they can be said to follow these patterns:

1. March-April, about two weeks of mean daytime temperatures at or above 18°C are required.
2. Early July, provided that, no major heat wave with temperatures at or above 40°C has occurred.
3. Mid October, provided that significant rain occurred about 4 weeks previously and daytime temperatures have not fallen to 15°C or less.
APPENDIX V

Checklist of the Diptera recorded at S’Albufera

April 2001

lit. = record taken from the literature
*    = species found only outside S’Albufera
?    = determination doubtful

Literature (incomplete).


Suborder NEMATOCERA

TIPULIDAE
Nephrotoma Meigen 1803
sp.    *
Tipula Linnaeus 1758
mediterranea Lackschewitz 1930

LIMONIIDAE
unidentified genera and species

PTYCHOPTERIDAE
unidentified genus

PSYCHODIDAE
unidentified genera and species

DIXIDAE
Dixella Dyar & Shannon 1924
attica (Pandazis 1933)

CULICIDA

ANOPHILINAE
Anopheles Meigen 1818
algeriensis Theobald 1903

CULICINAE
Aedes Meigen 1818
detritus (Haliday 1833)
rusticus (Rossi 1790)    ?
Culex Linnaeus 1758
pipiens Linnaeus 1758

CERATOPOGONIDAE
unidentified genera and species

CHIRONOMIDAE
Chironomus Meigen 1803
riparius Meigen 1804
unidentified genera and species
KEROPLATIDAE
KEROPLATINAE
Antlemon Loew 1871
halidayi (Loew 1871) *
Pyratula Edwards 1929
sp.

SCIARIDAE
unidentified genera and species

CECIDOMYIIDAE
CECIDOMYIINAE
Baldratia Kieffer 1897
salicorniae Kieffer 1897

SCATOPSIDAE
SCATOPSINAE
Parascatopse Cook 1955
minutissima (Verrall 1886)

Suborder BRACHYCERA

STRATIOMYIDAE
Nemotelus Geoffroy 1762
sp.
Stratiomys Geoffroy 1762
singularior (Harris 1776)
Odontomyia Meigen 1803
discolor Loew 1846

TABANIDAE
Tabanus Linnaeus 1758
bovinus Linnaeus 1758
quatuornotatus Meigen 1820
sudeticus Zeller 1842

THEREVIDAE
Thereva Latreille 1796
binotata Loew 1847
sp.

BOMBYLIIDAE
Villa Lioy 1864
paniscus (Rossi 1790) *

MICROPHORIDAE
Microphor Macquart 1827
rostellatus (Loew 1860)
intermedius (Collin 1961)

HYBOTIDAE
Platypalpus Macquart 1827
albiseta group
pallidiventris-cursitans group
praecinctus (Collin 1926)
Drapetis Meigen 1822
sp.
Crossopalpus Bigot 1857
setiger (Loew 1859)
sp.
Chersodomia Walker 1849
sp. A
sp. B
sp. C
Oropezella Collin 1926
sphenoptera (Loew 1873)
Stilpon Loew 1859
sp.

EMPIDIDAE
Hilara Meigen 1822
sp.
Doliococephala Macquart 1823
sp.
Clinocera Meigen 1803
stagnalis (Haliday 1833) *

DOLICHOPODIDAE
SCIAPODINAE
Sciapus Zeller 1842
heteropygus Parent 1926
pallens (Wiedemann 1830)
sp. A
sp. B
DOLICHOPODINAE
Dolichopus Latreille 1796
diadema Haliday 1832
nubilus Meigen 1824
sabinus Haliday 1838
strigipes Verrall 1875

MEDETERINAE
Medetera Fischer von Waldheim 1819
flavipes Meigen 1824
saxatilis Collin 1941 *
Thrypticus Gerstäcker 1864
pollinosus Verrall 1912

HYDROPHORINAE
Hydrophorus Fallen 1823  
praecox (Lehmann 1822)  
Schoenophilus Mik 1878  
versutus (Haliday 1851)  
Thinophilus Wahlberg 1844  
flavipalpis (Zetterstedt 1843)  
RHAPHIINAE  
Syntormon Loew 1857  
denticulatum (Zetterstedt 1843)  
Raphinium Meigen 1803  
sp.  
DIAPHORINAE  
Asyndetus Loew 1869  
sp.  
Teuchophorus Loew 1857  
sp.  
SYMPYCNINAE  
Campsicnemus Haliday 1851  
magius (Loew 1845)  
Micromorphus Mik 1878  
albipes (Zetterstedt 1843)  
LONCHOPTERIDAE  
Lonchoptera Meigen 1803  
bifurcata (Fallen 1810)  
lutea (Panzer 1809)  
PHORIDAE  
Dohrniphora Dahl 1898  
cornuta (Bigot 1857)  
undertermined genera and species  
SYRPHIDAE  
SYRHINAE  
Chrysotoxum Meigen 1803  
elegans Loew 1841  
intermedium Meigen 1822  
Dasysyrphus Enderlein 1938  
albostriatus (Fallen 1817)  
Episyphus Matsumura et Adachi 1917  
balteatus (De Geer 1776)  
Euepides Osten-Sacken 1877  
corollae (Fabricius 1794)  
luniger (Meigen 1822)  
latifasciatus (Macquart 1829)  
Melanostoma Schiner 1860  
mellinum (Linnaeus 1758)  
scalare (Fabricius 1794)  
Meliscaeva Frey 1946  
auricollis (Meigen 1822)  
Paragus Latreille 1804  
bicolor (Fabricius 1794)  
haemorrhous Meigen 1822  
tibialis (Fallen 1817)  
Platycheirus Le Peletier et Serville 1828  
clypeatus (Meigen 1822)  
fulviventris (Macquart 1829)  
scambus (Staeger 1843)  
Sphaerophoria Le Peletier et Serville 1828  
ruepellii (Wiedemann 1830)  
scripta (Linnaeus 1758)  
Syrphus Fabricius 1775  
ribesii (Linnaeus 1758)  
vitripennis Meigen 1822  
MILESIINAE  
Neoascia Williston 1886  
podagrica (Fabricius 1775)  
Eristalinus Rondani 1845  
aeneus (Scopoli 1763)  
Eristalis Latreille 1804  
arbustorum (Linnaeus 1758)  
tenax (Linnaeus 1758)  
Myathropa Rondani 1845  
florea (Linnaeus 1758)  
Helophilus Meigen 1822  
trivittatus (Fabricius 1805)  
Parhelophilus Girschner 1897  
consimilis (Malm 1863)  
frutetorum (Fabricius 1775)  
versicolor (Fabricius 1794)  
Anasimyia Schiner 1864  
interpuncta (Harris 1776)  
Syritta Le Peletier et Serville 1828  
pipiens (Linnaeus 1758)  
PIPUNCULIDAE  
Eudorylas Aczel 1940  
sp.  
Tomosvaryella Aczel 1939  
sp. A  
sp. B  
Verrallia Mik 1899  
aucta (Fallen 1817)
ACALYPTRATA

CONOPIDAE
Leopoldius Rondani 1843
coronatus (Rondani 1857)  ?

LONCHAEIDAE
Silba Macquart 1851
adipata McAlpine JF 1956

TEPHRITIDAE
MYOPITINAE
Myopites Blot 1827
sp.
TEPHRITINAE
Sphenella Robineau-Desvoidy 1830
marginata (Fallen 1814)
Actinoptera Rondani 1871
meigeni Hendel 1927
Diosynia Frey 1945
bidentis Robineau-Desvoidy 1830
Tephritis Latreille 1804
formosa (Loew 1844)
paeon (Loew 1844)
Trupanea Schrank 1795
amoena (Frauenfeld 1857)

TERELLINAE
Acanthiophilus Becker 1908
helianthi (Rossi 1790)
Ensina Robineau-Desvoidy 1830
sonchi (Linnaeus 1767)

ULIDIIDAE
Ceroxys Macquart 1835
urticae Linnaeus 1758

PSILIDAE
Chamaepsila Hendel 1917
nigrigometis (Meigen 1826)

SEPSIDAE
Sepsis Fallen 1810
fulgens Meigen 1826
punctum Fabricius 1794
thoracica (Robineau-Desvoidy 1830)
violacea Meigen 1826

Themira Robineau-Desvoidy 1830
minor (Haliday 1833)

SCIOMYZIDAE
Pherbellia Robineau-Desvoidy 1830
cinerella (Fallen 1820)
Euthyca Latreille 1829
alaris Vala 1983

CHAMAEMYIIDAE
Chamaemyia Meigen 1803
flavicornis (Strobl 1902)
juncorum (Fallen 1823)
polystigma (Meigen 1830)
sp.
Leucopis Meigen 1830
argenticoloris Zetterstedt 1848

LAUXANIIDAE
Prosopomyia Loew 1856
pallida Loew 1856
Minetitia Robineau-Desvoidy 1830
rivosa (Meigen 1826)
sp. A
sp. B  *
Sapromyza Fallen 1810
sp.  *

HELEOMYZIDAE
Suillia Robineau-Desvoidy 1830
notata (Meigen 1830)  *
variegata (Loew 1862)  *
sp.  *

TRIXOSCELIDIDAE
Trixoscelis Rondani 1856
approximata (Loew 1865)
obscura (Fallen 1823)
curvata (Loew 1865)
sanctiferdinandi (Czerny 1909)

CHYROMYIDAE
Aphaniosoma Becker 1903
claridgei Ebejer 1997
hackmani Lyneborg 1972
melitensis Ebejer 1993
micromacro Carles-Tolrá ms
propinquans Collin 1949
sp. nov.
Gymnochiromyia Hendel 1933
fallax Ebejer 1998

**SPHAEROGERIDAE**
**SPHAEROGERINAE**
**LIMOSININAE**
Coproica Rondani 1861
vagans (Haliday 1833)
Leptocera Olivier 1813
fontinalis (Fallén 1826)
nigra Olivier 1813
Opacifrons Duda 1918
coxata (Stenhammar 1854)
Phthitia Enderlein 1938
plumosula (Rondani 1880)
Pseudocollinella Duda 1924
humida (Haliday 1836)
Pullimosina Rohacek 1973
heteroneura (Haliday 1836)
Rachispoda Liyi 1864
fuscipennis (Haliday 1833)
kabuli (Papp 1978)
longior Rohácek 1991
modesta (Duda 1924)

**AGROMYZIDAE**
**AGROMYZINAE**
Agromyza Fallen 1810
nigrescens Hendel 1920
Melanagromyza Hendel 1920
sp.
**PHYTOMYZINAE**
Calycomyza Hendel 1931
sp.
Cerodontha Rondani 1861
denticornis (Panzer 1806)
Liriomyza Mik 1894
orbona (Meigen 1830)
pedestris Hendel 1931
pusilla (Meigen 1830)
sp.
Napomyza Westwood 1840
lateralis (Fallen 1823)
Phytomyza Fallen 1810
anemones Hering 1925
conyzae Hendel 1920
Chromatomyia Hardy 1849
horticola (Goureau 1851)
sp.

**ANTHOMYZIDAE**
Anthomyza Fallén 1810
sp. (gracilis group)

**ASTEIIDAE**
Asteia Meigen 1830
amoena Meigen 1830
floricola Papp 1979

**XENASTEIIDAE**
Tunisimyia Papp 1980
excellens (Papp 1980)

**CAMILIDAE**
Camilla Haliday 1838
acutipennis (Loew 1865)
glabra (Fallén 1823)
nigrifrons Collin 1933

**CAMPICHOETIDAE**
Campichoeta Macquart 1835
grandiloba McAlpine JF 1962

**EPHYDRIDAE**
**EPHYDRINAE**
Ephydra Fallen 1810
bivittata Loew 1860
flavipes (Macquart 1843)
macellaria Egger 1862
Coenia Robineau-Desvoidy 1830
palustris (Fallen 1823)
Paracoenia Cresson 1935
fumosa (Stenhammar 1844)
Scatella Robineau-Desvoidy 1830
gea Canzoneri & Meneghini 1979
lutos (Haliday 1833)
paludum (Meigen 1830)
stagnalis (Fallen 1813)
subguttata (Meigen 1830)
Philotelma Becker 1896
rossii (Canzoneri & Meneghini 1979)
PARYDRINAE
Ochthera Latreille 1802
manicata (Fabricius 1794)
Parydra Stenhammar 1844
fossarum (Haliday 1833)
pubera Loew 1860
Pelina Haliday 1839
nitens Loew 1873

NOTIPHILINAE
Hyadina Haliday 1839
pollinosa Oldenberg 1923
Notiphila Fallen 1810
cinerea Fallen 1813
riparia Meigen 1830
Hydrellia Robineau-Desvoidy 1830
argyrogetis Becker 1896
griseola Fallen 1813
mayoli Canzoneri & Rallo 1996 lit
Zeros Cresson 1943
invenatus (Lamb 1912) lit

PSILOPINAE
Homalometopus Becker 1903
ibericus Mathis 1984 lit
Atissa Curtis 1837
hepaticoloris (Becker 1903)
limosina (Becker 1896)
Ptilomyia Coquillett 1900
angustigenis Becker (1926) lit
Schema Becker 1907
durrenbergensis (Loew 1864) lit
Hecamede Curtis 1837
albicans (Meigen 1830) lit
Allotrichoma Becker 1896
filiforme Becker 1896 lit
laterale (Loew 1860)
Scoliocephalus Becker 1903
pallidisetis Becker 1903
Discocerina Macquart 1835
obscurella (Fallen 1813) lit
Diclasiopta Hendel 1917
niveipennis (Becker 1896) lit
Polytrichophora Cresson 1924
duplosetosa (Becker 1896) lit

Psilopa Fallen 1823
biskrae (Becker 1907)
compta (Meigen 1830)
nigritella Stenhammar 1844
nitidula (Fallen 1813)
rutilans Canzoneri & Meneghini 1972
Clanoneurum Becker 1903
cimiciforme (Haliday 1855)

DROSOPHILIDAE
Drosophila Fallen 1823
subobscura Collin 1936 *
Scaptomyza Hardy 1949
pallida (Zetterstedt 1847)

MILICHIIDAE
Desmometopa Loew 1866
m-nigrum (Zetterstedt 1848)

TETHINIDAE
Tethina Haliday 1838
grisea (Fallen 1823)
nigrofemorata Beschovski 1997
strobliana (Mercier 1923)
yaromi Freidberg & Beschovski 1996

CHLOROPIDAE
SIPHONELLOPSINAE
Siphonellopsis Strol 1906
lacteibasis Strol 1906
OSCINELLINAE
Elachiptera Macquart 1835
cornuta (Fallen 1820)
rufifrons Duda 1932
Melanochaeta Bezzi 1906
pubescens (Thalhammer 1898)
Polydaspis Duda 1933
sulcicollis (Meigen 1838)
Calamoncosis Enderlein 1911
minima (Strol 1893)
Lipara Meigen 1830
lucens Meigen 1830
rufitarsis Loew 1858
similis Schiner 1854
Speccafrons Sabrosky 1980
halophila (Duda 1933)
Oscinimorpha Lioy 1864
longirostris (Loew 1858)
Trachysiphonella Enderlein 1936
ruficeps (Macquart 1835)
Aphanotrigonum Duda 1932
cinctellum Zetterstedt 1848 ?
Tricimba Lioy 1864
humeralis (Loew 1858)
CHLOROPINAE
Cryptonevra Lioy 1864
consimilis (Collin 1932)
diadema (Meigen 1830)

Eurina Meigen 1830
ducalis Costa 1885

Thaumatomyia Zenker 1833
notata (Meigen 1830)

Lasiosina Becker 1910
cinctipes (Meigen 1830)

Pseudopachychaeta Strobl 1902
pachycera Strobl 1902

Eutropha Loew 1866
fulvifrons (Haliday 1833)

SCATHOPHAGIDAE
Scathophaga Meigen 1803
stercoraria (Linnaeus 1758)

ANTHOMYIIDAE
Anthomyia Meigen 1803
quinquemaculata Macquart 1839

Delia Robineau-Desvoidy 1830
platura (Meigen 1826)

Pegomya Robineau-Desvoidy 1830
sp.

FANNIIDAE
Fannia Robineau-Desvoidy 1830
canicularis (Linnaeus 1761)
sp.

MUSCIDAE
MUSCINAE
Musca Linnaeus 1758
autumnalis Degeer1776
domestica Linnaeus 1758
tempestiva Fallen 1817
Neomyia Walker 1859
cornicina (Fabricius 1781)

Haematobia Le Peletier et Serville 1828
irritans (Linnaeus 1758)

MYDAEINAE
Hebecnema Schnabl 1889
vespertina (Fallen 1823)

Myospila Rondani 1856
meditabunda (Fabricius 1781)

PHAONIINAE
Atherigona Rondani 1856
varia (Meigen 1826)

Helina Robineau-Desvoidy 1830
reversio (Harris 1780)
sexmaculata (Preyssler 1791)

Phaonia Robineau-Desvoidy 1830
sp.

COENOSIINAE
Limnophora Robineau-Desvoidy 1830
obsignata (Rondani 1866)  *

Lispe Latreille 1796
nana Macquart 1835
pygmaea Fallen 1825

Lispocephala Pokorny 1893
brachialis (Rondani 1877)

Orchidia Rondani 1877
costata (Meigen 1826)

Coenosia Meigen 1826
antennata (Zetterstedt 1849)
humilis Meigen 1826

HIPPOBOSCIDAE
HIPPOBOSCINAE
Hippobosca Linnaeus 1758
equina Linnaeus 1758

2 NYCTERIBIIDAE
Nycteribia Latreille 1796
pedicularia Latreille 1805
Penicillidia Kolenati 1863
dufourii (Westwood 1835)

CALLIPHORIDAE
CALLIPHORINAE
Calliphora Robineau-Desvoidy 1830
vicina Robineau-Desvoidy 1830

Lucilia Robineau-Desvoidy 1830
silvarum (Meigen 1826)

CHRYSOMYINAE

Chrysomya Robineau-Desvoidy 1830
albiceps (Wiedemann 1819)

POLLENIINAE

Pollenia Robineau-Desvoidy 1830
rudis (Fabricius 1794)

RHINIINAE

Stomorhina Rondani 1861
lunata (Fabricius 1805)
SARCOPHAGIDAE
PARAMACRONYCHIINAE
* Nyctia Robineau-Desvoidy 1830 halterata (Panzer 1798)
*SARCOPHAGINAE
Sarcophaga Meigen 1826 lasiostyla Macquart 1835

RHINOPHORIDAE
* Stevenia Robineau-Desvoidy 1830 deceptoria (Loew 1847)
* obscuripennis (Loew 1847)

TACHINIDAE
TACHININAE
*Tachina Meigen 1803

Lydella Robineau-Desvoidy 1830 thompsoni Herting 1959
*Siphona Meigen 1803

sp.
PHASIINAE
*Cylindromyia Meigen 1803

sp.
Gymnosoma Meigen 1803
clavatum (Rohdendorf 1947)
*Dionaea Robineau-Desvoidy 1830
aurifrons (Meigen 1824)
Phasia Latreille 1804
sp.

Siphona Meigen 1803
sp.
APPENDIX VI

Supplementary records to original report

(sent February 2002)

Additions to APPENDIX II

Supplement to the List of the Diptera recorded in April 2001 at S’Albufera and arranged according to habitat.

Those from three sites outside the reserve are included. Species that were found everywhere are listed separately after the table.

<table>
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<th>Es Ras</th>
<th>Son Serr a</th>
<th>Ses Cibollar</th>
<th>Ses Puntol</th>
<th>Es Colombar s</th>
<th>Sa Roca</th>
<th>Canal Des Sol</th>
<th>Es Forcadet</th>
<th>Cova St.Marti</th>
<th>Vale Son March</th>
<th>Son Ton</th>
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<td>Dolichocephala ocellata</td>
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<td>Eudorylas jenkinsoni</td>
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<td>195</td>
<td>Pegomyia cunicularia</td>
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<td>196</td>
<td>Pegomyia versicolor</td>
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<td>197</td>
<td>Tomosvaryella cilifemorata</td>
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</table>

Additions to APPENDIX V

Supplement to the Checklist of the Diptera of S’Albufera.

ANTHOMYIIDAE

Pegomyia Robineau-Desvoidy 1830
cunicularia (Rondani 1866)
versicolor (Meigen 1826)

EMPIDIDAE

Dolichocephala Macquart 1823
ocellata (Costa 1814)

PIPUNCULIDAE

Eudorylas Aczel 1940
jenkinsoni Coe 1966
Tomosvaryella Aczel 1939
cilifemorata (Becker 1907)
**Biodiversity studies**

**III.2.2 Identifications of Diptera from S’Albufereta (and one sample from S’Albufera) by Martin Ebejer**

The following specimens, received in June 2001, have been identified. Apart from one collection taken at Es Rotlos, S’Albufera de Mallorca on 25th April 2001, they all refer to specimens taken at S’Albufereta de Mallorca.

For complete nomenclature, please see checklist of Diptera from S’Albufera.

**S’Albufera, Es Rotlos, 25.iv.2001, NJR**

- *Coenosia antennata*
- *Chromatomyia* sp.
- *Chironomidae* spp. x5
- *Phoridae* sp. x1

**S’Albufera, Es Rotlos, 25.iv.2001, NJR**

- *Melanochaeta pubescens*
- *Thaumatomyia notata*
- *Chromatomyia* sp.
- *Thaumatomyia* notata
- *Ceratopogonidae* sp. x1
- *Sciariidae* sp. x1

**Pollença, S’Albufereta, on Tamarix, 23.iv.2001, Guaita G., Moya Pais I., & Mozo Fornari I.**

- *Aphaniosoma propinquans*
- *Parascatopse minutissima*
- *Thaumatomyia* notata
- *Tricimba humeralis*
- *Ceratopogonidae* sp. x1
- *Chironomidae* spp. x2
- *Sciaridae* sp. x1

**Pollença, S’Albufereta, on low vegetation, 23.iv.2001, Guaita G.**

- *Culicidae* sp. x1


- *Atissa limosina*
- *Parascatopse minutissima*
- *Scatella stagnalis*
- *Thaumatomyia* notata

- *Micromorphus albipes*
- *Psilopa nitidula*
- *Tethina nigrofemorata*

- *Chironomidae* spp. x2
Ecological and Monitoring studies

III.3.1 Monitoring of reedbed passerines at Mallorca by Brigitte Poulin
(received 22 October 2001)

The initial objectives of this project were to understand the ecological requirements of reedbed passerines and estimate the potential impact of habitat management on the arthropod and bird fauna through a comparative analysis of several reedbed sites in the Mediterranean region. This monitoring can also be useful to highlight temporal trends or identify the impact of local disturbances.

Site description

1. Es Colombar: flooded reedbed with brackish water, monospecific vegetation with short and relatively sparse reed stems.
2. Es Forcadet: medium to low water levels, very tall reed with a few other plant species.
3. Son Carbonell: dry reedbed of medium height with a dense and diverse vegetation (namely *Cladium mariscus* and *Calystegia sepium*).

Bird sampling

Relative abundance of passerine species at three reedbed sites is estimated by means of mist netting conducted during a single day in each season (Poulin et al. 2000). At each site, netting is carried out along two parallel lines located 100 m apart and at least 50 m within the habitat edge. Each line comprised 20 nets (2.6 X 12 m, 30-mm mesh) abutting each other along an 80-cm-wide path where reed had been cut. This net positioning was chosen to (1) minimise habitat perturbations caused by reed cutting and walking trails and (2) have all nets similarly exposed to the sun and wind, both of which affect capture rates. Nets are opened well before dawn and are operated during five hours after sunrise. Each net line is sampled during a single day under rainless and windless conditions. Nets are visited every 45 min and the location of each bird captured is noted on a four-net basis (50 m).

Note: Should this protocol be followed, it is important to use a similar mesh size for the bird netting. The nets I use are good and relatively cheap (Association for Field Ornithologists - US). I have chosen to maximise the number of nets and minimize the number of netting day because I wanted to sample many sites within a short period. However if a single site is involved, you can certainly split this netting effort over 2 days. Birds are ringed with a metal band, measured (maximum wing chord, body weight), and checked for the presence of cloacal protuberance and active brood patch (breeding season).
or sub-cutaneous fat (migration and winter). Bearded tits are checked for the presence of
cysts (caused by acariens) at the articulation of the wing. Sex and age are determined
whenever possible.

To get information on the species' diet, about 10 individuals per species are forced to
regurgitate starting one or two hours after sunrise using tartar emetic or apomorphine. For
all species except Bearded tits (Panurus biarmicus) and Reed buntings (Emberiza
choeniclus) we use a 1% solution of antimony potassium tartrate (Poulin and Lefebvre
1995) made one month before sampling. Each bird is given 0.08 ml of solution per 10 g
body mass through a 1.5-mm diameter flexible plastic tube attached to a 1-ml syringe. The
tube is inserted through the bird's throat as far as possible, presumably into the gizzard.
The chemical is then slowly administered (2-3 minutes for a 10-g bird), and the bird placed
in a small dark box lined with absorbent paper. Birds are released 20-30 minutes later, and
regurgitated items are preserved in 70% ethanol. For Bearded tits and Reed buntings we
use apomorphine (Valera et al., 1997). Two drops of a fresh (< 24 h) saturated solution of
apomorphine (0.04 g of hydrochloride hemihydrate per ml of water) are deposited on each
eye with the bird kept in hand until complete absorption of the liquid. Birds are then
placed in a small dark box and released after 10-15 minutes. Regurgitated items are again
preserved in 70% ethanol and kept frozen until their identification under a stereoscope.
Note: it is not necessary to collect diet data every year.

**Arthropod sampling**

Arthropods are sampled by sweeping the vegetation 500 times with a 30-cm insect net
along each transect in late afternoon the day before bird netting. We chose this technique
because it samples a wide variety of arthropod taxa from the main bird foraging substrate
within a short time (Poulin and Lefebvre, 1997). Each sweep consisted of hitting the
vegetation from the bottom up with the net ring at an angle of 45°, alternating with the left
and right side of the trail (approximately one sweep per metre on each side). Captured
insects are killed in a soap-water solution, and the vegetation debris are carefully
discarded. The two samples from a site are kept separately and preserved in 70% ethanol.
This method sampled 98% of the items found in the bird regurgitates, the only exceptions
involving vegetable matter, bivalve and fish. Captured arthropods are identified to order,
measured, counted, and transformed into a food availability index using the equation
(Poulin and Lefebvre 1997):

\[ \sum_{i=1}^{k} p_i \frac{x_{ij}}{y_i} \]

where \( x_{ij} \) is the number of arthropods from group \( i \) (taxon and size) sweep-netted on
transect \( j \), \( y_j \) is the number of arthropods from group \( i \) collected on all transects, and \( p_i \)
is the proportion of arthropods from group \( i \) in the bird (or species) overall diet. Thirty-eight
groups of arthropod prey combining 16 taxonomic categories and five size classes (0-2.5;
2.6-5; 5.1-7.5; 7.6-10 and >10 mm) were used in this index. Size classes were
occasionally combined so that each group included a minimum of 20 items sampled on at
least four transects to avoid overweighting of rare taxa (Poulin and Lefebvre, 1997). We
distinguished ants from wasps, and classified arthropod developmental stages as eggs,
pupa, and larva without taxonomic differentiation. A food availability index value was
calculated for each transect, for the whole bird assemblage, as well as for each bird species.
In all cases, a single diet estimation was used for each species, based on the dietary samples collected from all sites.

**Vegetation sampling**

Density of dry and growing reed is determined by counting all stems within 25 quadrats of 25 X 25 cm located every 10 m along each transect. Other plants found in the quadrats are identified and later assigned to either emergent (e.g. *Scirpus, Juncus, Cladium, Carex, Typha*) or terrestrial species (e.g. *Aster, Atriplex, Calystegia, Galium, Oenanthe, Polypogon, Sonchus*). Height and diameter of one green (growing) and one dry stem chosen randomly are estimated within each quadrat. The number of dry stems with flower head (panicle) is estimated within 25 quadrats of 50 X 50 cm located every 10 m along each transect. The vegetation sampling effort was determined based on the variance of the data collected in a classification study of 36 reedbed sites (André Mauchamp, unpubl. data).

**Sampling of abiotic factors**

Fortnightly data on water level and water conductivity are taken from a PVC tube of 6-cm diameter installed 50-cm deep into ground. These data are used to estimate the duration of the flooding/drawdown period at each site. Drawdown refers to the absence of surface water and the 50-cm deep reading is useful for correcting water level values in case of topographical differences between the tube and the bird-transect locations. During the bird/arthropod sampling, the ground substrate is categorized as being dry, wet (wet litter or muddy ground) or flooded (standing water or algae) at a single random point every 10 m along each transect.

**References**


Ecological and Monitoring studies

III.3.2 Habitat Biodiversity Investigations 2001: 1 Habitats for physical and vegetative structure, species presence and impacts on biodiversity by Chris Donnelly (received 13/11/2001)

Summary

The habitats present within the Park have been classified into a total of 22 habitat types (e.g. Dune Scrub, Swamp). Each habitat type is divided into an appropriate number of sectors (i.e. compartments) representing its location within the Park (e.g. Habitat Type Dune Scrub, Sector/Location Es Comú, reference 21001). Analyses of present data held and collection of new data are needed to assess the importance of each habitat type to the Park’s overall biodiversity.

Aim

To obtain data that can be used to assess the biodiversity of each habitat. This consists of baseline data on the factors affecting its biodiversity (physical and vegetative structure, species presence and impacts on the habitat – both external and internal). Note was also made of the apparent ecological niches present and any flora/fauna or fauna/fauna associations noticed.

Method

A sample site for the habitat was chosen based on accessibility and apparent ‘typical’ representation of the type. The sites were not randomly selected and judgement on site suitability was made by the team carrying out the assessments. Where possible an area approximately 1 metre square was sampled but in some habitats another configuration was used (e.g. a linear area for the wall habitat). The presence of species or groups was recorded but not the number of individuals within a species or group. For these two reasons, some comparative quantitative tests (e.g. abundance of a particular species) cannot be applied to the data collected although some comparisons can be made e.g. percentage of total number of species or groups represented by particular species or groups). Significant species noted in the habitat (nearby) but outside of the sample area were also recorded.
The following information was recorded:-

- Type of habitat and name and reference number of habitat sector
- Location of sample (and approx grid reference)
- Physical Structure 1 – Substrate/Base (i.e. soil, bare rock, water or sand)
- Physical Structure 2 - Water Input (Groundwater, Flowing water/flooding, Standing water/flooding)
- Vegetation Structure/ Niches (4 Layers - 4 Canopy, 3 Understorey, 2 Herb, 1 Ground/below ground) and main vegetation species forming structure of habitat
- Specific niches present (e.g. dead wood, leaf litter)
- Observed impacts on habitat (e.g. grazing, intermittent flooding, pollution)
- Other vegetation species present
- Faunal species present
- Other species present (e.g. fungi, lichens, bryophytes)

In addition, records of grazing were obtained and will be analysed where relevant to impacts on certain habitats. Additional sampling was carried out in one of the Habitats (Swamp) immediately after the major fire in autumn 2000 to obtain data on survival of species present (invertebrates).

This work was started in autumn 1999 and continued in autumn 2000 and spring 2001. Further work is needed on the other habitats present and to supplement the data collected on the habitats already sampled.

**Results**

Seven habitats were sampled – Broad-leaved woodland, Swamp (2 sites), Coniferous woodland, Species-rich grassland, Dune scrub, Marginal vegetation, Bare ground. The data for each habitat will be incorporated into a summary once further work is carried out in Spring 2002.
Synopsis

The habitats present within the Park have been classified into a total of 22 habitat types (e.g. Dune Scrub, Swamp). The methodology used for the habitat classification was adapted from the Phase 1 Survey methodology developed in the UK. Maps of each KM square were produced, supported by an analysis of estimated area coverage for each habitat in the square and target notes for specific grid references detailing species presence and other relevant information. The initial mapping was carried out in autumn 1994.

Spring 2001 Update: Work carried out in Autumn 2000 and Spring 2001

1. Marginal vegetation, Species-rich grassland, Walls, Bare Ground and Built-up areas have since been mapped more* correctly (these were not mapped consistently originally). The following habitats still need reviewing -

   - Dune heath – this was only mapped in areas outside the park that have now been urbanised but there is possibly habitat of this type in the Es Comu area that was recorded incorrectly as Dune scrub.

   - Running water – now that a map showing all the channels (named) is available, these need to be re-assessed as several were not obvious from the viewpoints used.

*Note: Due to the inaccessibility of some areas of the Park, some habitat sections may not be shown e.g. there may be areas of marginal vegetation along small channels in the middle of the reed-bed.

2. There has been a re-assessment and re-mapping of some areas where habitat type has changed, e.g. scrub, woodland and scattered trees which have changed due to tree die-back and tree and scrub clearance.

3. The database summary list of habitats and sectors has been completed.

4. Fixed-point photography on selected habitats has commenced and a collection of photographs of various areas taken over the last 12 years has started to be compiled.

5. Further work carried out as part of Habitat Biodiversity studies has included sampling of species present in selected habitat sectors to provide a base-line picture of the main component plant species forming the habitat structure, other plant species present and the faunal communities that occur.

6. There has been a comparison of the habitat classifications used in this mapping to those used in the European Union Habitats - Natural Habitat Types of Community Interest whose Conservation Requires the Designation of Special Areas of Conservation (interpretation of habitat types is given in the ‘Interpretation Manual of as approved by the
committee set up in Article 20 'Habitats Committee' and published by the European Commission) and the Ramsar Classification System for Wetland Type. An initial assessment of Plant Communities present has also been made (La Vegetacio de Les Illes Balears, Comunitats de Plantes, Oriol de Bolos i Capdevila, Institut D’Estudis Catalans).

7. Each habitat has been described more fully based on data and observations from various studies. Implications on habitat character and changes to the habitat have been suggested.

Suggestions for Future work

In order to provide a fuller picture of the habitats present, their species constitution, the impacts on them and, consequently, their biodiversity and conservation value and the threats to them, the following work is needed:

1. Using the GIS system when available.
   - transfer of the map data of each habitat type onto overall maps of the park.
   - assessment of hectares covered by each habitat type.
   - supplementary mapping of habitats according to the European and Ramsar

2. Recording of species in relation to habitat using new data and that already obtained from other studies (started in Spring 2001 using Access Database but to be transferred to GIS when available).

3. Analysis of project work already carried out for data on the impact on the habitat by significant groups or species.

4. Further investigation into the plant communities present.

5. Assessment of biodiversity or conservation value of each habitat type and the threats to it, including descriptions of each sector of each habitat to highlight areas of particular biodiversity or conservation importance.
Park Management

III.4.1 Determinació de la població reproductora de Queca *Botaurus stellaris* al Parc Natural de s’Albufera de Mallorca. Cens per detecció de cants per Pere Vicens (received April 2001).

Introducció.

Amb aquesta actuació es vol donar continuitat amb la detecció de cants territorials de Queca *Botaurus stellaris* al Parc, per tal de determinar l’evolució de la població primaveral i nidificant. A tal efecte es va preparar un grup de voluntaris que foren repartits sobre el terreny de manera molt semblant a la de l’any 2000. Així es va poder controlar tot el Parc d’una manera relativament fiable (figura nº 1).

Mètode.

El sistema és el mateix que l’emprat l’any anterior: dues persones per grup, 60 minúts seguits d’escolta (des de les 06’00 h. fins a les 07’00 h. del matí) anotant el minut, la direcció i el número de cants de cada detecció, per després comparar totes les dades alhora.

Els resultats i les circumstàncies que envolten la realització del primer cens ens obligaren a repetir-lo alguns dies més tard, amb una variació, però, de les zones de escolta. Es va comprovar que el nivell d’aigua sobre el prim era mínim o inexistent a la gran majoria de les zones del Ras, Rotlos, Son Serra i s’Illot. A més, la poca vegetació existent a tota la zona dels Rotlos i Ras és molt baixa i poc espessa, degut als l’incendis del darrer any. Aquests dos detalls, junt amb l’absència d’aliment (peix i/o amfibis) per la manca d’aigua, ens va fer concentrar l’esforç de detecció a les zones més inundades del Parc: Colombars i Cibollar. Zones amb més probabilitat de presència però de més dificultat de cens per l’abundància de soroll als voltants (central tèrmica d’Es Murterar i carreteres i carrers de les zones urbanitzades).

Resultats.

Dia 18 d’abril de 2001.

Els participants, repartits en 8 grups de 2 persones cada un i de manera que cobriren la pràctica totalitat del Parc, no varen poder realitzar amb normalitat el cens degut a les males condicions metereològiques. El fort vent i la lleugera pluja que durant la nit van començar (a l’observatori metereològic de Sa Canova de Sa Pobla hi ha registrats vents de direcció N-NE de fins a 29 Qmtrs/hra) impediren la bona detecció dels cants. Per aquest motiu es va decidir tornar a intentar-ho en els propers dies.

De tota manera, però, hi va haver la detecció de dues zones de cant des del punt del Pont de Sa Ciurana (grup nº 5), vora el Gran Canal.
1. Al Cibollar, s’anotaren 4 vegades:
   a. 2 cants els minuts 12’ i 14’ en la direcció 67º, amb una sèrie de 2 i 1 cops de veu, respectivament.
   b. 2 cants els minuts 45’ i 49’ en les direccions 63º i 59º, amb sèries de 5 i 2 cops de veu, resp.

2. Al Colombars, s’anotaren 2 vegades:
   a. 2 cants els minuts 31’ i 39’ en les direccions 314º i 317º, amb sèries de 2 i 1 cops de veu, resp.


Els participants, els mateixos 8 grups, es distribuiren de manera diferent. Aquest dia es varen disposar al voltant del Cibollar, Colombars, Patrimoni i Forcadet. També gaudiren d’unes bones condicions metereològiques, pel que varen poden tenir un bon control sobre gran part dels Rotlos.

Solament hi va haver un grup, el del Camí dels Senyals (grup nº 3), que va realitzar deteccions clares:

3. Al Colombars, s’anotaren 2 vegades.
   a. 2 cants. El primer deu minuts abans de l’hora del recompte, en la direcció 250º i el segon en el minut 37’ en la direcció 187º, amb sèries de 2 i 4 cops de veu, resp.

Un altre grup, el del Pont de Sa Roca (grup nº 4), incomprensiblement no va detectar cap dels cants anteriors, però sí va tenir dubtes sobre una possible detecció molt poc clara:

4. Al Rotlos, 1 cant molt llunyà el minut 01’ en la direcció 204º amb 1 sol cop de veu.

Altres.

Els dies 13, 16 i 22 de gener es va observar un ex. de Queca a diferents localitats del Parc, fet que confirma una hivernada poc quantificada. De tota manera, les deteccions sonores dels mascles, aquesta primavera, han passat desapercèudes per a la majoria del personal del Parc, fet que ha despertat una mica de sorpresa entre els guardes, acostumats a escollir els cants a primeres hores del matí.

Un altre factor a contemplar és la minva de personal de recerca en els llocs i a les hores adequades. Les Queques comencen a cantar sense esperar a que algú les escolti... i sol esser molt prest i a zones on no hi ha massa tendència a estar-s’hi. El naturalista del Parc no ha treballat des del gener i el seu substitut ha començat ja ben entrada la temporada, sense massa coneixements de la zona i amb poca experiència sobre aquesta espècie. Tampoc no han servit de massa ajud els clams i les peticions d’informació que s’han enviat... i les dades dels naturalistes que més visiten s’Albufera no són massa diferents de totes aquestes.
Conclusions

Per l’estudi de les direccions i horaris de cant, penso que solament hi ha dos territoris clarament definits, el del centre del Colombars, detectat els dos dies, i el del Cibollar (amb la detecció del dia 18). La detecció poc clara del dia 23 de la zona dels Rotlos no és descartable però tampoc és segura.

Els cants molt curts de quasi totes les deteccions pot indicar que els dos mascles ja estan en l’etapa “d’eclipsi” sonor, és a dir, a les acaballes de la temporada. La manca de deteccions sonores anteriors, per part del personal del Parc i visitants, podria esser deguda a la presència de fortes perturbacions sonores a la zona (central tèrmica, urbanització, etc).

La manca de cants a la resta de zones habitualment emprades es pot atribuir clarament a la minva enorme d’aigua en superfície i de vegetació coberta, factors claus per a l’alimentació i pel recer.

De tota manera, poques conclusions clares es poden treure amb tan poques dades, però sí que es constata una minva quasi total dels cants a les zones on tradicionalment s’havien escoltat: Es Ras, Ses Eres, Son Serra i Es Rotlos. En canvi, es mantenen els cants a les zones del Colombars i Cibollar, amb les mateixes (o semblants) intensitats que els altres darrers anys (figura nº 2).
Figura 1

Punts de detecció del 18 d’abril

Punts de detecció del 23 d’abril

Deteccions clares

Deteccions imprecises
Figura n° 2

Zones de cant segur al 2001
Zona de possible cant al 2001
Zones de habituals de cant dels darrers anys
Zones afectades pels incendis (molt poca vegetació) i per la sequera (no hi ha aigua) al 2001
Information board informing tourists about dune regeneration project.

Photo: Elizabeth Riddiford
Park Management

III.4.2 What factors determine niche partitioning in Ardeidae and invertebrates on an island wetland in the Mediterranean, under conservation management? by Leanne Sargeant

(Editor’s note: this item comprises the MRes field study proposal by Leanne Sargeant, University of York; the field work was carried out during summer 2001)

I plan to study Ardeidae and invertebrates in numerous wetland sites at S’Albufera.

Hypotheses:
• The different species of herons and egrets use different parts of the habitat for feeding and breeding.
• Heron and egret diversity is correlated with habitat diversity, food availability and environmental factors, such as water quality.
• The different species of invertebrates use different parts of the habitats and/or reed structures.
• Invertebrate diversity is correlated with reedbed age, structural diversity and quality of the habitat.

The aim of this research is to benefit S’Albufera for the purpose of providing information about the preferred habitat of Ardeidae. This will enable future management to focus on optimal habitat requirements for these species. It will also identify the areas that have a higher diversity of invertebrate in the reedbed. This will assist in the management of suitable invertebrate habitat with the aim of encouraging insectivorous birds. This research will contribute to the wider aims of the reserve, specifically directed towards conservation of the wetland.

The research will identify the criteria for suitable habitat sites for herons and egrets, which will be determined by a detailed assessment of their present niches. It is likely that heron and egret diversity will increase in areas that are particularly diverse. These areas may have a higher availability of food for Ardeidae, which in turn may be influenced by other environmental factors, such as water quality. There will also be suitable shelter for breeding sites. However, it is possible that large numbers of Ardeidae may occupy some of the habitat of lower quality, due to competition for habitat of a better quality. Therefore, providing more habitats of higher quality may improve breeding success, through a greater abundance of food.

It is possible that invertebrate diversity is increased in structurally diverse reedbeds, which may be mature reedbeds or may have mixed ages of reeds. Invertebrates may use different niches in the reeds, as particular species may have individual feeding preferences. Some may feed lower in the reeds, whilst others monopolise the top area of the reeds. This will establish the importance of maintaining reeds of particular heights.
Methods

Herons and egrets

Carry out a timed watch of the birds, recording each species, what it is feeding on, the time spent searching for food and the quantity of food taken. Also identification of the time spent at different habitats. Establish the habitat that the different species are using for breeding. The vegetation structure, the water level and any features that seem to be important to the birds for habitat classification.

A basic vegetation survey, to give estimates of percentage cover of graminoids and sedges, will be carried out at each site.

If it is possible to establish breeding success of different species in different habitats without causing too much disturbance to the birds, then the number of eggs laid and the number of hatchlings will be calculated at the different sites.

The air temperature and wind speed will be measured at each site. Where there is ground water the water quality will be established by measuring temperature, nitrate levels, pH content, phosphate levels and the Biochemical Oxygen Demand (BOD), to measure the amount of organic pollutants in the water. These will be measured at all sites where the timed watches are carried out.

The aim is to have three sites that are going to be used for the timed watches from each of the habitat types; open water areas, shallow water areas, recently burnt areas, newly established reedbed and mature reedbed.

Invertebrates

Invertebrates will be surveyed by using sticky traps placed at lower levels of the reed structure and sweep net surveys in the top area of the reeds, the height of the sticky traps will be measured and the height of the reeds. These will be carried out in different habitat types, areas with shallow water around the reeds, a recently burnt reedbed, newly established reedbed, mature reedbed and if there is a small patch with mixed ages of reeds.

A basic vegetation survey, to give estimates of percentage cover of graminoids and sedges, will be carried out at each site for the invertebrates.

Equipment

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<th>Anometer</th>
<th>pH kit</th>
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<td>Phosphate kit</td>
<td>Oxygen meter</td>
</tr>
<tr>
<td>Stop watch</td>
<td>Sticky traps</td>
<td>Sweep net</td>
</tr>
<tr>
<td>Invertebrate identification book</td>
<td>Metre rule</td>
<td></td>
</tr>
</tbody>
</table>

Plan of priority of work:

1. Choose suitable sites.
2. Carry out timed watches.
3. Evaluate the environmental factors at the site.
4. Carry out the invertebrate survey and vegetation survey.
5. Establish breeding success of the birds.
# Park Management

**III.4.3 Integrated Assessment of Water Use, Water Policies and Water Management in the Sa Pobla-Inca catchment area, Mallorca** by Benoit Cathala, Geraldine Ducos & Sergios Karatzos

## RESEARCH PROPOSAL FOR MALLORCA

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APPENDIX I
1. **Introduction**

The Sa Pobla-Inca catchment, which is situated at the NE end of the Mediterranean island of Mallorca, comprises a Mediterranean ecosystem with dry periods during the summer months. This uneven distribution of rain makes the water resources of Mallorca more vulnerable to anthropogenic driving forces, especially during these months. With the growing tourism industry and the predominant agricultural activities, as well as the creation of «S’Albufera de Mallorca park natural» (the delta or ‘mouth’ of the catchment) in 1988, developments have led to increasing conflicts over water quality and quantity (Vives, 1996). Moreover, Mallorca being a relatively small island, increasing water demand means increased salt intrusion with «negative impacts» on ecological values and agricultural yields.

Expensive Plans for the water security of the island have been considered such as building desalinisation plants in Palma. Current water developments include a systematic drainage network with a main dam and a number of sluices, a water-treatment plant and a number of artificial outlets (boreholes). Research done by TAIB (formerly Earthwatch), UIB (Universitat de les Illes Balears), Wageningen University, and Newcastle University indicate augmenting pressures on the ecological and socio-economic values of the wetland, and possible solutions to the problem need to be assessed. We will concentrate on the interactions of land-use linked with water resources and more particularly on agriculture, since it seems from relevant literature to be important for water pollution of the area (and consequently the Wetland), and agricultural irrigation uses most of the exploited Sa Pobla aquifer (Veraart, 1999). This trend has been growing since the green revolution of the 70’s and the introduction of the Common Agricultural Policy (CAP) subsidies until the recent CAP reform, and tree crops have been giving their place to water demanding intensive monocultures such as potatoes (root crops) and tomatoes (vegetables). This shows how practices and the current land use tend to be embedded in the recent developments of social structures and policies.

The main purpose of the research is to offer possible future improvements in water use and management by using an integrated approach, based on previous work by Dolf de Groot and his team (see Veraart, 1999; Feenstra, 1998; van der Perk, 1997; Terpstra, 1996), and participatory methods. An integrated approach requires integration of all relevant policy areas, sectors (cross-sectoral), and levels of administration, the integration of those stakeholders whose actions significantly influence the quantity or quality of water resources and environments, and the integration of the terrestrial and marine components of the target territory. This is also in accordance with the new water framework directive from the EU, which calls for the catchment, floodplain approach (WWF, 2000).

2. **Problem statement**

In the catchment, expanding tourism and agriculture place increasing pressure on scarce/vulnerable freshwater resources. This scarcity of freshwater results in potential conflicts between stakeholders. These conflicts are easily intensified by fragmentation in both the praxis and the conceptualisation of land use, water use, nature conservation, physical planning and tourist management. It is expected that policy measures will be more effective if views from local stakeholders are taken into account in the process of formulating and implementing policy objectives and if, whenever possible, a consensual approach to decision-making is taken. The EU-directives for water mean for the Sa Pobla-Inca catchment that in future water, environmental, agricultural, physical planning and nature conservation policies should be co-ordinated on a catchment level.

Within the catchment, agricultural activities, among others, are becoming increasingly intensive to the sub-catchments of Sa Pobla and Muro, which are located right next to the
S’Albufera natural park. Its influences are getting progressively more important for the wetlands’ ecological balance and tend to threaten mainly its’ water resources. It is very important that this impact is reduced since the wetland (being the mouth of the overall catchment) comprises an indicator for the environmental health of the whole catchment.

3. **Aim and objectives.**
   
   **Common Aim:**
   
   Design possible integrated scenarios for future improvements in Water Management especially as far as intensive agricultural practices are concerned.
   
   **Objectives:**
   
   **A)** *To compare Mallorcan policies in respect to land use (environmental policies, physical planning, water management and agricultural policies, i.e. DOT, MOPTA, Naturaleza, etc)*
   
   **A1)** Which are the existing policies (especially agri-environmental) for water use and management from an international (EU) scale to a local scale?
   
   **A2)** How are these policies viewed and applied by farmers and other stakeholders?
   
   **A3)** Which are the main conflict issues and how social, cultural and economic aspects affect the situation (i.e. age, education, demand, prices, subsidies, religion, local beliefs, history)?
   
   **A4)** How do the present communication systems between stakeholders function?
   
   **B)** Analyse current pressure on freshwater resources of intensive agriculture situated in the two lowland subcatchments (Sa Pobla and Muro) bordering with the park, from a quantitative point of view, as well as from a qualitative (N & P, pesticides, and salinity) point of view.
   
   **B1)** What is the total impact (water depletion and pollution) of the AOI (Area Of Interest) on groundwater, local aquifer and as total surface runoff.
   
   **C)** *Assess alternative water management strategies for the AOI of objective B*
   
   **C1)** What alternative farming management decisions (e.g. rotation planning, irrigation techniques, amount of water used, timing of irrigation etc..) can be applied in order to reduce impact of AOI on water without deteriorating crop productivity.
   
   **C2)** (if enough time) What is the water situation in the wetland itself and how does it compare with the surrounding AOI?
   
   **D)** Integrate objectives A, B and C (or «common objective» ). *To compare the scenarios of objective B with the limitations from objective A and formulate best achievable scenarios of policy measures in order to achieve improved environmental quality within and around the park while taking into account all water stakeholders of the given catchment including those outside farming.*

4. **Research method**

   ~ Objective A
   
   **Researcher:** Mr. Cathala
   
   **Supervision:** Ir. Kris van Koppen (WUR- Environmental policy group) & Dr. Dolf de Groot (WUR- Centre for Environment and Climate Studies), Jeroen Veraart (informant).
**Participatory methods**

- **Policy analysis**
  - Literature study, data collection and analysis in Wageningen.
  - Arrival in Mallorca and meeting with local stakeholders.
  - Gathering of information regarding national, regional, and local policies and policy instruments.
  - Familiarisation with the Water Management Framework in the region.

- **Conflict and perception analysis**
  - Transects, mapping, informal interviewing in the area (period of familiarisation with the region).
  - First Interviews (acquaintance) with members of the municipalities involved (i.e. Sa Pobla, Muro, Inca, Alcudia, etc…), as well as with relevant university teachers and members of the Generalitat in Palma.
  - Assessment of communication methods within and between policy-makers, park officials, farmers, and other stakeholders.
  - Reading of local newspapers and attend meetings within the region.
  - Involvement in agricultural activities and further relationship building so as to gain greater understanding of the economics of the cultivation systems, the requirements of the machinery, and the habits of the farmers.
  - Informal interviews with different stakeholders (i.e farmers, hotel managers, tourists, shopkeepers, coal industry…).
  - Make a survey of the area on water issues and check the conclusions with key informants.

~Objectives B and C

**Researchers:** Ms. Ducos and Mr. Karatzos

**Supervisors:** Dr Dolf de Groot (WUR- Centre for Environment and Climate Studies), Jeroen Veraart (informant), Annemiek Verhallen (WUR- Sub-department of Water Resources), Allard de Wit (WUR- Laboratory of Geo-Information Science and Remote Sensing)

**Step1 (data collection)**
1. Field observations in the catchment, mapping with GPS and remote sensing data, analysing municipal data etc… *(Karatzos, Ducos)*
2. Arrange data and convert obtained-figures to a modelling-compatible form
3. Use digital topographic maps to delineate the topology of the AOI (possibly process remote sensing images with IDRISI) *(Karatzos)*

**Step2 (data input)**
1. Collected data for SOIL and LANDUSE for a selection of one dry one relatively wet and an intermediate year –so as to select a representative ‘3 year average’ on which to base our management scenarios) will be **accurately** put into a GIS-database structure in order to find what soil combines with what landuse at each field. *(Karatzos, Ducos)*
2. The rest of the data required for SWAP (see section 5) (again for a selection of one dry one relatively wet and an intermediate year) will also be inputed in the GIS database structure and extrapolated across the whole view.

The visualisation and analysis of the GIS database with ARC/VIEW will indicate which fields will be simulated with SWAP (preferably 3 or 4 fields) which we will use as an estimate for the whole AOI and on which we will build our scenarios for the ‘3 year average’ representative year. The selection criteria will be: representativeness and data availability. (Karatzos, Ducos).

Step 3 (Objective B) estimate agricultural impacts on water over an estimated average growing season (or more, depending on data)

1. Estimate water element concentration (N&P, pesticides and salinity) and water quantity at all layers of the soil profile for the representative fields and estimate crop growth (using the ‘simple crop growth model’ option of SWAP) for the ‘3 year average’ on these fields with SWAP model (Karatzos, Ducos)

2. (Optional) Groundtruthing (use current data measurements of flow and concentrations to validate the model estimations) (Karatzos, Ducos)

Step 4 (Objective C1) Scenario formulation and assessment

1. «Reference scenario» will be the ‘3 year average’ estimation

2. Use observations (derived from exploratory field observations and GIS querying + other GIS actions) (Karatzos) and technical background (Ducos and Karatzos) to formulate alternative scenarios (on a yearly or monthly basis, depending on data availability) regarding GIS database variables such as rotation planning, irrigation techniques, amount of water used, timing of irrigation etc...

3. Impact of each scenario on quality, quantity and crop growth will be estimated using SWAP (scenarios with conflicting consequences for quality and quantity objectives, will be given exceptional emphasis)

Step 5 (Optional) extra data collection for N & P since data on these 2 elements is expected to be scarce and to take into account the biotic processes of the N and P cycles

Sampling on key locations for water N&P (analysis will be done in UIB laboratories, if chemical expenses allow for it.) (Ducos)

‘Step 6 (Optional, Objective C2) Simulation and estimation of the recharge and ‘filtration’ functions of the wetland itself using SWAP too.

The same process will be applied on the wetland itself and the results of the SWAP model will be compared with the ones of the AOI in order to identify the relationship between the functions of the 2 areas and to depict the most conflicting or strongly related ones.

~Objective D

Common step (discussion of results and comprehensive Scenarios’ and GIS maps’ presentation in order to exchange knowledge and ideas with stakeholders associated with agricultural water impact.)

1. By integrating our findings, comparing them and discussing them between the three of us

2. Discuss our conclusions with key actors and finally…

3. If possible, organise a round table discussion group with all parties involved.

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1 Note: SWAP (Soil, Water, Atmosphere and Plant) simulates vertical transport of water, solutes and heat in unsaturated/saturated soils. The program is designed in WAU to simulate the transport processes at field scale level and during entire growing seasons. (for more info look Óôûéiá! Ááï Yéâé îôéôåáô óàéêéïáåôéôçô.)
5. **Data needed**

**Mr. Cathala (Objective A):**

A. **Sociological information:** Some important requirements include the following: resource dependency; historic use patterns including methods; factors determining historic use patterns; identify current use patterns; identify whether current use patterns are sustainable; demography; socio-cultural information; land and sea tenure.

B. **Economics:** Resources and resource use patterns should be given economic values. Qualitative values (resources and resource-use patterns that cannot be economically valued) have to be considered. Specific economic pursuits that should be included in data collection are: fisheries, tourism, agriculture, energy, settlements, transportation, aquaculture, mining, oil/gas, waste treatment and disposal, cities, traditional practices.

C. **Issues:** It is necessary to identify the groups with a stake in the use and management of water resources, and potential conflicts among them.

D. **Institutional mechanisms** (international, national, state, and local): ministries and their division of responsibility, organisation and hierarchy; legislation on zoning, pollution, water use and management; interagency councils; advisory panels; standing agreements with private parties; permitting and other administrative processes to carry out legislation; farming cooperatives; NGO’s; etc.

**Ms. Ducos and Mr. Karatzos (Objectives B):**

Input requirements for SWAP model:

**Water Flow**

- Daily (or weekly) evapotranspiration (either basic methodological data of air temperature, solar radiation, windspeed and air humidity, or reference evapotranspiration like Pan data) second option most likely in our case (i.e. Pan data)
- Daily (Weekly) rainfall and/or irrigation data (if runoff should be calculated, also actual rainfall intensities are needed) If runoff will be calculated is still to be decided
- Soil Hydraulic properties (retention function and Hydraulic conductivity function for each soil layer, if they are not available, at least soil texture should be collected
- Drainage conditions (Groundwater Levels, or drainage system) second option most likely in our case and depth of impermeable layers in the subsoil, if available

**Crop Development**

- Development stage during growing period (from standard literature data based on crop type)
- LAI during growing period (from standard literature data based on crop type)
- Soil cover during growing period (from standard literature data based on crop type)
- Rooting depth during growing period (from standard literature data based on crop type)
- Sensitivity of crop root water extraction to high and low water pressure heads (from standard literature data based on crop type)
- Sensitivity of crop root water extraction to salinity concentration (from standard literature data based on crop type)
Solute transport

- Initial solute concentration in the soil
- Amount of solute applications and/or solute concentrations in deliverable irrigation water
- Solute concentrations in groundwater
- No model calibration is going to be carried out since for the detail needed at this regional scale it is said by the model designers not to be necessary.

Extra requirements:

B. Landuse and farming practices
- Digital Maps at least 1:10000 for Topology of farm fields (possibly process the images with IDRISI if necessary)

C. Monitoring infrastructure
- Monitoring points (to locate the measurement points (from past data) for both water quantity and quality (N&P)) (again time frequency basis will depend on data availability). Freshwater outlets (bore-holes and wells) will be used to extrapolate the groundwater level measurements that will most likely come from municipal monitoring of these boreholes). These data sets will be used for the extrapolation of the data over the whole ARCVIEW view for the visualisation prior to the selection of the representative fields to be modelled

P.S. Whether a lot of this data is available is still under investigation since the potential information sources have not been all contacted yet.

6. Equipment needs

Park
- GIS software ARC/INFO ARCVIEW
- Global Positioning System receiver (to locate points of interest that may not be mapped yet)
- Computers with internet (if possible)
- Library literature and databases
- Water Sampling equipment (for possible need to cross-check extrapolation of data)
- Accommodation facilities

University (UIB)
- Library literature and databases (especially remote sensing images, other digital material – e.g. 1:25,000 topographic digital maps) and conventional relevant paper maps)
- GIS software ARC/INFO ARCVIEW IDRISI and possibly others (e.g. ArisFlow or MapInfo)
- Possibly water samples’ analysis using the Laboratory facilities of UIB
7. **Workplan**

*Strategic research plan:*

The research will be based in the S’Albufera de Mallorca National Park, and will focus on the whole catchment basin involved. Institutions collaborating in this research are the University of Wageningen (NL), the park management, Earthwatch (UK), the Universitat de les Illes Balears (Spain), and possible others.

The researchers are listed below together with their academic backgrounds which are relevant to this research:

1. Mr Benoit Cathala (Human Geography, Anthropology and Social Economics),
2. Miss Geraldine Ducos (Water Quality and Applied Farm Management), and

*Logistics (for detailed logistics see Appendix I):*

- *15th July 2001:* Arrival in Mallorca.
- *15th July – 5th August 2001:* Familiarisation with the study region and observatory field transects on relevant areas of the landscape.

*Depending on accessibility and availability of data, the research phase in Mallorca could be extended.*

8. **Research team**

**Benoit Cathala** (English, 22)
BA(Hons) Geography with Development Studies at Sussex University (UK)
MSc Environmental Sciences at Wageningen University (NL)
Languages: English, French, Spanish
Experience:
- Team Leader in a medical anthropology research expedition in the Khumbu Region of Nepal, sponsored by the Royal Geographical Society and based on participatory methods.
- Field research for 3rd year project on ecotourism in the Amazon region of Ecuador.
- Restoration of a cave in the Ciudadela region of Menorca.
Qualifications: - First Aid Course.
- Practical Rescue Management Course.
- Full clean driving license.

**Géraldine Ducos** (French, 22)
BSc(Hons) Agricultural Engineering at Ecole Superieure d’Agriculture de Purpan (Fr.)
MSc Environmental Sciences at Wageningen University (NL)
Languages: French, English, Spanish.
Experience:
- Training periods in a dairy farm in France and in a cattle farm in the U.S.A.
- Survey on the sustainability of farming practices in Southwestern France.
Qualifications: - First Aid Course.
- Full clean driving license.

Sergios Karatzos (Greek, 21)
BSc(Hons) Agriculture and the Environment at Wye College, University of London (UK)
MSc Environmental Sciences at Wageningen University (NL)
Languages: Greek, English, intermediate Spanish, conversational French.
Experience:
- Work on trial sites aiming at the restoration of degraded agricultural land under the ‘20 year Set-aside’ EU scheme.
- Lambing on the Wye College Sheep Unit.
- Final year project on abandoned agricultural land and vegetation development in ‘Pindos’ mountains (Greece).
Qualifications: - Full clean driving license.

9. References

• Baldock et al., 1993, Nature Conservation and New Directions in the EC Common Agricultural Policy: the potential role of EC policies in maintaining farming and management systems of high nature value in the community, IEEP, Arnhem-NL.
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• Terpstra, S., 1996, Towards the operationalisation of the environmental function assessment in a GIS-application: a case study of Natural Park S’Albufera de Mallorca, WAU, Wageningen-NL.
• Veraart, J., 1999, Selection of bio-indicators to monitor effects of agriculture and tourist developments on water quality and aquatic biodiversity in s’Albufera Natural Park, Mallorca, WAU, Wageningen-NL.
• Veraart, J., de Groot, R. S. (Perello, G., Riddiford, N. J., Roijackers, R. M. M.) 2000, Selection of bio-indicators to assess conflicting issues of wetland function and values: A case study of s’Albufera de Mallorca, Spain, WAU, Wageningen-NL.
• Vives, P., T., 1996, Monitoring Mediterranean Wetlands, a methodological guide, Wetlands International and Instituto da Conservacao Natureza, Portugal
• Wascher, D. M., 2000, Agri-environmental indicators for sustainable agriculture in Europe, ECNC, Tilburg-NL.

• Selected literature from local newspapers (Ultima Hora…) and political party magazines.
• Selected websites on regional organisations.

Notes
Nitrogen Data (N measurements, biological processes) will be searched at the very beginning of the fieldwork in order to be able to set up a monitoring strategy (if necessary) and use the results in the SWAP model and to make conclusions.
Activities will most likely overlap while the above time periods are only an estimate.
Depending on accessibility and availability of data, the research phase in Mallorca could be extended (or shortened) for some or all of the researchers or optional objectives might be taken up.
Getting familiar with the practice of the SWAP model is an important important task although not indicated in the table above since it will be spread over the whole research period (before starting to use it in September) with practical exercises and some rough elementary simulations.
International Initiatives and Programme Development

III.5.1 International collaborations: The SAVE project by Nick Riddiford, Gabriel Perelló & Maciá Blazquez

[Editor’s note: The following excerpts have been taken from the SAVE project proposal to illustrate the objectives and workplan as they involve s’Albufera de Mallorca. The proposal failed to gain entry to the original EU programme, but rather than lose this innovative project, alternative funding sources are being sought]

B1. TITLE PAGE;

Proposal full title: SOCIO-ECONOMIC ASSESSMENT AND VALUATION OF BIODIVERSITY CONSERVATION IN EUROPE

Proposal acronym: SAVE

Addressing Theme: Reconciling conservation of biodiversity with potentially conflicting human activities

Date of Preparation: 12 October 2001

B3. OBJECTIVES AND EXPECTED ACHIEVEMENTS

Problem statement
In order to reconcile the conservation of biological diversity with economic activities in general, and changing demands on land use and natural resources in particular, it is essential that the economic, social-cultural and ecological values of biodiversity are fully taken into account in planning and decision making, at the local, national European Union level. This relates in particular to spatial, agricultural and nature conservation policies. The need for better integration of the costs of biodiversity loss, and benefits of biodiversity conservation in decision making is recognised in various national and international treaties, assessments and conservation programs (e.g. Convention on Biological Diversity, Global Biodiversity Assessment, Millennium Ecosystem Assessment) and many European policy documents (e.g. agri-environmental measures program (Regulation 2078/92), Environmental Sensitive Area, Countryside Stewardship, and Habitat Schemes (Hanley et al., 1999, Billing, 1998).
Yet, in spite of the increasing awareness on the importance of biodiversity conservation, the many functions and values of biodiversity are still not sufficiently taken into account in land use planning and economic decision making for several reasons (9, 21, 32, 41)²

- The lack of quantified information on ecological, social-cultural and economic values of biodiversity functions, goods and services.
- The lack of a generic ecosystem valuation framework and models that integrate ecological, social-cultural, and economic valuation methods
- The lack of involvement of (local) stakeholders in assessing the costs and benefits of biodiversity conservation (leading to a lack of commitment in managing biodiversity)
- The lack of standardization and accessibility of information on biodiversity services and values.
- The shortcomings of conventional Cost-Benefit Analysis, which does not, and by definition cannot, take these values and interdependencies into account.

**Main objective(s)**
The main objective of the SAVE-project is to improve the information-base and the analytical tools for integrated assessment of the costs and benefits of biodiversity conservation in natural and semi-natural ecosystems in Europe (within the EU, as well as the Central and Eastern European countries that are EU membership candidates).

This general objective leads to several more specific aims:
1. Develop methods and tools for Integrated Assessment of the costs of biodiversity loss and the benefits of conservation and sustainable use of biodiversity services
2. Increase involvement of local stakeholders and end users in managing natural and semi-natural ecosystems by increasing their awareness and acceptance of the “full value” of biodiversity and provide incentives for sustainable management and more equal benefit-sharing.
3. Identify and quantify the ecological, socio-cultural and economic values of the biodiversity services provided by the main European natural ecosystems and semi-natural (including agro- and forestry) landscapes
4. Improve the standardization and accessibility of information on biodiversity services and values.
5. Improve human and institutional capacities to undertake integrated Cost-Benefit Analysis of conflicts between human activities and biodiversity conservation
6. Improve public perceptions and awareness of biodiversity functions and values.

**The SAVE objectives and aims will be achieved through 6 Parts (which coincide with the 6 main aims) with in total 13 Work Packages.**

**Among the 39 deliverables (described in B6-4), the main products are:**

<table>
<thead>
<tr>
<th>Part</th>
<th>Achievement / product</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>A. An integrated ecological-economic <strong>valuation framework and model</strong> for analysis and synthesis of ecological services and socio-economic benefits of biological diversity in Europe.</td>
</tr>
<tr>
<td>2</td>
<td>B. A <strong>protocol</strong> for the structural involvement of <strong>stakeholders</strong> in the valuation and integrated assessment of costs and benefits of biodiversity conservation in Europe&lt;br&gt; C. <strong>Meta-analysis techniques</strong> for transfer of biodiversity values (monetary and non-monetary), and a protocol to validate the use of these values in the analysis of conflicts between human activities and biodiversity conservation</td>
</tr>
</tbody>
</table>

² part B has to be anonymous, references are numbered. Full details are provided in a separate appendix to part C
D. A series of case studies and workshops to provide empirical data on the costs and benefits of biodiversity conservation in the main European ecosystem and landscape types.

E. A prototype interactive GIS-based web-accessible database on the services and values of European biodiversity and ecosystems.

F. Dissemination material to support institutional change and local capacity building to apply integrated valuation and CBA-techniques for sustainable ecosystem management, rehabilitation, and conflict resolution.

G. Practical guidelines (and handbook) for ecosystem valuation and integrated CBA as a tool in environmental planning, management, and policy-making.

The last 2 products focus on disseminating the results to the main stakeholders and end-users. This will be facilitated by a series of workshops in the case study areas throughout the project, as well as a larger conference towards the end of the SAVE project. In both the workshops and conference, SAVE researchers will work together closely with selected stakeholders and end-users to ensure the practical applicability and use of the tools to be developed on assessing the costs and benefits of biodiversity conservation in Europe.

Good links between SAVE researchers and various external groups and related projects ensure complementarity and input of the latest insights in, for example, the modelling and data base development.

### B6-4 DETAILED PROJECT DESCRIPTION BROKEN DOWN INTO WORKPACKAGES;

**Form WP1 Work package list**

<table>
<thead>
<tr>
<th>WP No</th>
<th>Work Package Title</th>
<th>Lead Person</th>
<th>Cont.#</th>
<th>Person Months</th>
<th>Start Month</th>
<th>End Month</th>
<th>Deliverable No</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.1</td>
<td>Development of a Framework for Ecosystem valuation and Integrated Cost-Benefit Analysis</td>
<td>01 (+ 07)</td>
<td>18 (+ 6)</td>
<td>01</td>
<td>36</td>
<td>1,2,3,4,5</td>
<td></td>
</tr>
<tr>
<td>1.2</td>
<td>Development of a Dynamic Ecosystem Valuation model</td>
<td>02</td>
<td>12</td>
<td>09</td>
<td>33</td>
<td>6,7,8</td>
<td></td>
</tr>
<tr>
<td>2.1</td>
<td>Stakeholder participation &amp; workshop organisation</td>
<td>03 (+ 02)</td>
<td>24 (+ 8)</td>
<td>01</td>
<td>36</td>
<td>9,10,11</td>
<td></td>
</tr>
<tr>
<td>2.2</td>
<td>Meta-analysis and Value Transfer</td>
<td>06</td>
<td>24</td>
<td>01</td>
<td>36</td>
<td>12,13,14</td>
<td></td>
</tr>
<tr>
<td>2.3</td>
<td>GIS-base Value Function Transfer</td>
<td>07</td>
<td>18</td>
<td>12</td>
<td>33</td>
<td>15,16,17</td>
<td></td>
</tr>
<tr>
<td>3.1</td>
<td>Case study-coordination</td>
<td>04</td>
<td>21</td>
<td>01</td>
<td>36</td>
<td>18,20,21,22</td>
<td></td>
</tr>
<tr>
<td>3.2</td>
<td>Kalloni Bay, Greece</td>
<td>08</td>
<td>15</td>
<td>03</td>
<td>33</td>
<td>19-22a</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Waddensea, Netherlands</td>
<td>09</td>
<td>15</td>
<td>03</td>
<td>33</td>
<td>19-22b</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Albufera Mallorca, Spain</td>
<td>10</td>
<td>15</td>
<td>03</td>
<td>33</td>
<td>19-22c</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Danube Green Corridor, Romania</td>
<td>04</td>
<td>15</td>
<td>03</td>
<td>33</td>
<td>19-22d</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Alentejo, Portugal</td>
<td>11</td>
<td>15</td>
<td>03</td>
<td>33</td>
<td>19-22e</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Belluna Valley, Italy</td>
<td>12</td>
<td>15</td>
<td>03</td>
<td>33</td>
<td>19-22f</td>
<td></td>
</tr>
<tr>
<td></td>
<td>N.Karelia Biosphere Reserve, Finland</td>
<td>13</td>
<td>15</td>
<td>03</td>
<td>33</td>
<td>19-22g</td>
<td></td>
</tr>
<tr>
<td>4.1</td>
<td>Data Base development</td>
<td>02</td>
<td>12</td>
<td>01</td>
<td>36</td>
<td>23,24,25</td>
<td></td>
</tr>
<tr>
<td>4.2</td>
<td>Mapping biodiversity functions &amp; values</td>
<td>01</td>
<td>18</td>
<td>06</td>
<td>36</td>
<td>26,27,28,29,30</td>
<td></td>
</tr>
</tbody>
</table>
Workpackage number : 3.2 Data collection in the case study areas
Start date or starting event : Month 3
Lead contract number : 04, 08, 09,10,11,12,13 (= all case study leaders)
Person months per partner : 15 per partner -> total 7 x 15 = 105 person-months

Objectives
The general objective of the case studies is:
- To provide empirical data on biodiversity functions and values in the main European ecosystem types,
- To assess the main conflicts associated with biodiversity conservation in the case study areas
- To test the valuation-framework and CBA-approach developed in the SAVE project
- To involve local stakeholders in biodiversity valuation and conflict analysis

Seven case studies have been selected covering the main European landscape-types in a wide range of ecological and socio-economic settings:

<table>
<thead>
<tr>
<th>Case Study</th>
<th>Landscape Type</th>
<th>Country</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kalloni bay</td>
<td>Coastal wetland</td>
<td>Greece</td>
</tr>
<tr>
<td>Waddensea</td>
<td>Estuarine system</td>
<td>The Netherlands</td>
</tr>
<tr>
<td>S’Albufera de Mallorca NP</td>
<td>Freshwater wetland</td>
<td>Spain</td>
</tr>
<tr>
<td>Lower Danube Green Corridor</td>
<td>Riverine &amp; riparian system</td>
<td>Romania</td>
</tr>
<tr>
<td>Alentejo</td>
<td>Mediterranean pseudo-steppe</td>
<td>Portugal</td>
</tr>
<tr>
<td>Belluna Valley</td>
<td>Alpine forest and grassland</td>
<td>Italy</td>
</tr>
<tr>
<td>N. Karelia Biosphere Reserve</td>
<td>Boreal forests &amp; peatland</td>
<td>Finland</td>
</tr>
</tbody>
</table>

Methodology/work description (max 350 words)

Each Case Study will follow a common methodology and timetable:
**Step 1** (months 3-6): Definition of data requirements and agreement on methodology. Case study leaders will receive preliminary guidelines for data collection on ecosystem goods and services (month 3). Each case study leader will investigate information gaps, leading to a list of required data and questions related to methodology.

**Step 2** (month 6): a workshop with all SAVE participants will (a) determine the project methodology; (b) discuss information gaps and guidelines on collecting, processing and validating the required data; (c) identify main stakeholders to be involved.

**Step 3** (months 6-12): further field & literature research will be conducted, and a *first workshop* (month 12) with the stakeholders will assess main biodiversity functions and values in the case study areas.

**Step 4** (months 12-18): results of the first workshop will be processed and made available to the other SAVE WP’s (especially the database and model WP’s).
Step 5 (months 18-24): research will focus on possible (actual and potential) conflicts in the study area regarding conservation and sustainable use of the main biodiversity functions and values identified in step 3.

Step 6 (month 24): a second workshop (with same stakeholders as the first) will discuss the outcome of the conflict-analysis (step 5), and identify main costs and benefits associated with biodiversity conservation in the case study area.

Step 7 (months 24-30): case study leaders will analyse information gathered for both the main biodiversity functions and values, and the associated conflicts, in order to formulate conclusions and recommendations regarding policy options for biodiversity conservation and sustainable management of the sites.

Step 8 (months 30-33): case study leaders will finalise a position paper, summarising the results and including recommendations regarding improvement of the SAVE framework and possible implications for EU-policies and programs (e.g. Rural Development Regulation (incl. agri-environment measures and plans); nature conservation policies such as Natura 2000). To increase public awareness, case study leaders will translate the scientific results into dissemination material on the main biodiversity values, and associated conflicts, to be used by the capacity building and institutional change WP’s (Part 5).

**Deliverables**
- Seven data sets on the ecological, socio-cultural and economic values of biodiversity in the case study sites (del.# 19a-g): 7x 48,220 Euro = 337,540 Euro (1.8% x 7 = 12.7%)
- Seven reports, summarizing the results of the first workshop (on values) and data-collection on the ecological and socio-economic values of biodiversity services in the case study site (del # 20a-g). 7x 27,600 Euro = 193,200 Euro (1.0% x 7 = 7%)
- Seven report, summarizing the results of the second workshop (on conflicts) including chapters on the regarding the costs and benefits of biodiversity conservation in the study area. (del # 21a-g) 7x 27,600 Euro = 193,200 Euro (1.0% x 7 = 7%)
- Seven synthesis report on functions, services, and values of the case study area, including overview of costs and benefit of biodiversity conservation in the case study area (del # 22a-g) 7x 13,800 Euro = 96,600 Euro (0.5% x 7 = 3.5%)
TAIB Project S’Albufera: A Mediterranean model for the study of biodiversity and environmental change

The Albufera International Biodiversity Group Annual Report 2001

PART IV

Scientific Research Programme in 2002

Orchis palustris survey. Photo by Nick Riddiford.
Fieldwork in 2002

A busy period of fieldwork is anticipated for 2002. In addition to the normal Project teams, a number of other investigations and courses are planned. The programme has not yet been finalised, particularly for the second half of the year, but the current plan is as follows:

Field investigation: 6th to 12th March

Scientists

Rod Stern (Conservation Officer, British Bryological Society)
Nick Riddiford (Principal Investigator, TAIB)

Field of Research

The Bryophytes of PN s’Albufera and other Mallorcan conservation areas.

Biodiversity Training Course: 14th to 29th March

Scientists

Nick Riddiford (Principal Investigator, TAIB)
Calvin Dytham (University of York)

Course participants

Members of the University of York Masters Research course
2 UIB or Spanish University graduate students

TAIB Team 1: 30th March to 12th April

TAIB Team 2: 14th to 26th April

Details of the two TAIB teams and a summary of the scientific research programme for spring 2002 follow:
Fieldwork in Spring 2002

Team 1: 30th March to 12th April

Scientists
Nick Riddiford (Principal Investigator, TAIB)
Biel Perelló (Geographer, Parc Natural de s’Albufera), Liaison officer
Rafel Mas (Biologist, P.N. de s’Albufera), Park scientific collaborator
Ingrid Eunson (TAIB Logistics)
Juana Garau (TAIB Aquatic Biologist)
Chris Donnelly (TAIB Biodiversity & Programme Development)
Henry Stanier (British Dragonfly Bio Museum & Reserve, Northampton; odonata ecology)
Brian Eversham (Conservation Director; Beds, Cambs, Northants & Peterborough Wildlife Trust)
John Hollingdale (TAIB Entomologist)
Pere Vicens (TAIB Ornithologist)
Angela Medina (TAIB butterfly transects; lepidoptera studies)
Marta Asensi (TAIB butterfly transects; dune studies)

Volunteers
Balearic/Peninsular volunteers (4, to be determined)

Team 2: 14th to 26th April

Scientists
Nick Riddiford (Principal Investigator, TAIB)
Biel Perelló (Geographer, Parc Natural de s’Albufera), Liaison officer
Ingrid Eunson (TAIB Logistics)
Chris Donnelly (TAIB Biodiversity & Programme Development)
Henry Stanier (British Dragonfly Bio Museum & Reserve, Northampton; odonata ecology)
Brian Eversham (Conservation Director; Beds, Cambs, Northants & Peterborough Wildlife Trust)
Martin Honey (Natural History Museum, London)
Pere Vicens (TAIB Ornithologist)
Angela Medina (TAIB butterfly transects; lepidoptera studies)
Marta Asensi (TAIB butterfly transects; dune studies)
Tony Serjeant (TAIB spider studies)
Pam Hill (TAIB Mollusc studies)

Volunteers
Balearic/Peninsular volunteers (4, to be determined)
Barbara Aldridge, Kate Hockley (Enfield Lock BTCV)
Hélène Au-Duong (France)
**Fields of Research**

1. **Human and management impact studies**

   1.1 Aquatic invertebrate communities in relation to water quality (Juana Garau).
   1.2 Vegetation re-colonisation after fire, Es Comú (Maria Vidal).
   1.3 Dune regeneration in the foredunes of Es Comú (Marta Asensi, Nick Riddiford).
   1.4 Impacts on the ecology of Es Comú dune systems (Marta Asensi, Angela Medina).

2. **Biodiversity studies**

   2.1 Herbarium development and curation (Maria Vidal).
   2.2 Development and curation of the Albufera invertebrate collection (Nick Riddiford).
   2.3 Lepidoptera and habitats (Martin Honey).
   2.4 Diptera survey and reference collection (Nick Riddiford, Rafel Mas).
   2.5 Coleoptera survey and reference collection (Brian Eversham, Henry Stanier).
   2.6 Extension of the aquatic invertebrate reference collection (Juana Garau, Henry Stanier).
   2.7 Arachnid studies - spiders (Tony Serjeant).
   2.8 Biodiversity catalogue – extension (Nick Riddiford).

3. **Ecological and monitoring studies**

   3.1 Bird population studies – transects (Nick Riddiford).
   3.2 Butterfly and dragonfly population studies – transects (Angela Medina, Chris Donnelly).
   3.3 Ecology, phenology and habitats of Odonata (Henry Stanier).
   3.4 Carabid beetles and their habitats (Brian Eversham, John Hollingdale).
   3.5 Survey of mollusc distribution and habitats (Pam Hill).
   3.6 Habitat descriptions and communities (Chris Donnelly).
   3.7 Systematic light trapping for moths (Nick Riddiford, Martin Honey).

4. **Park management**

   4.1 Census of migrant and breeding birds (Nick Riddiford).
   4.2 Bittern population studies (Pere Vicens).
   4.3 Marsh orchid *Orchis palustris* census (Maria Vidal, Ingrid Eunson).

5. **Programme development**

   5.1 Biodiversity and conservation management studies: forward planning (Chris Donnelly).

6. **Interpretation and education**

   6.1 Guide to the birds of the Park (Pere Vicens, Nick Riddiford).
   6.2 International volunteer biodiversity training (Nick Riddiford & the TAIB team).

7. **International initiatives and collaborations**

   7.1 International volunteer biodiversity training (see 6.2).
Scientific Research Programme

Summary of Work for Spring 2002
Nick Riddiford, Principal investigator

Human and management impact studies

Title: Aquatic invertebrate communities in relation to water quality.
Main objective: to use aquatic invertebrate communities as water quality indicators.
Secondary objective: to develop a replicable methodology which can be adopted in other wetlands throughout the Mediterranean basin.
Led by: Juana Garau.
Nature of work: systematic sampling of invertebrates using standard sweep-net methodology at representative sites throughout the Park also sampled systematically throughout the year for water quality.
Fieldwork period: 29 March-26 April.
Note: a cost-effective technique for guiding management of wetland sites.

Title: Vegetation re-colonisation after fire, Es Comú.
Objective: to observe the natural recovery of vegetation in order to understand the long-term implications of the impact of fire on the coastal dune ecosystem.
Led by: Maria Vidal, assisted by Nick Riddiford.
Nature of work: census of plant species, vegetation cover and proportions of bare ground using a series of 1 x 1 m quadrats positioned randomly (paired random numbers) within a 70 x 50 m zone of uniform vegetation type in an area of coastal dunes burnt out in 1994.
Fieldwork period: 29 March-26 April.
Note: an annual study begun in 1995.

Title: Dune regeneration in the foredunes of Es Comú.
Objective: to study the impact on Balearic Government Ministry of the Environment recuperation work and consider conservation management needs of the foredunes after the damaging hurricane of November 2001.
Led by: Marta Asensi, Nick Riddiford.
Nature of work: assessment of damage along the beach/foredune interface of Es Comú; non quantitative evaluation of pioneer vegetation surviving or recovering; if recovery marked, quantitate evaluation through identification and recording of species cover within random quadrats.
Fieldwork period: 29 March-26 April.
Note: this is a new study which replaces a monitoring study of pioneer vegetation recovery following remedial works to protect the dunes dating from 1999. Abandonment of the previous study was prompted by a devastating storm with hurricane force winds in November 2001 which buried or swept away the pioneer vegetation along with the remedial works designed to protect and recover the foredunes.

Title: Impacts on the ecology of Es Comú dune systems; pilot study.
Objective: to study the various impacts which are threatening the quality and ecological integrity of Es Comú dunes.
Led by: Marta Asensi, assisted by Nick Riddiford.
Nature of work: a preliminary assessment of the levels and types of threat to the integrity of the system; simple monitoring techniques to record current state of the ecosystem as a precursor to evaluating the range and amount of damage occurring.
Fieldwork period: 29 March-26 April.
Note: this is a new study which addresses a range of issues, including tourist use, policy regulations and management procedures and their impact on the dune ecosystem. Natural
events such as storm damage will also be taken into account. Initial aims are to evaluate the stresses on the ecosystem. It is hoped that this can form the basis for formulating recommendations for an integrated approach to the long-term conservation of this internationally important system. The study is a collaboration with Dr Macià Blazquez and his team from the UIB Department of Earth Sciences.

**Biodiversity studies**

*Title: Herbarium development and curation.*

*Objective:* to maintain as complete a reference as possible in pressed material and photographs of the plants of s’Albufera, to be held at the Park as a permanent resource to assist Park staff and other scientists working in the Park.

*Led by:* Maria Vidal.

*Nature of work:* changing papers in press; labelling and setting new species for press; adding prepared species to herbarium; general curating procedures to maintain herbarium.

*Fieldwork period:* 29 March-26 April.

*Note:* begun in 1989.

*Title: Development and curation of the Albufera invertebrate collection.*

*Objective:* to maintain as complete a reference as possible in specimen material and photographs of the invertebrates of s’Albufera, to be held at the Park as a permanent resource to assist Park staff and other scientists working in the Park.

*Led by:* Nick Riddiford, Henry Stanier, Brian Eversham, Martin Honey.

*Nature of work:* preparing, identifying and labelling specimens; curating, maintaining and reorganising collections; cross-referencing material to database.

*Fieldwork period:* 29 March-26 April.

*Note:* an international collaboration with the Natural History Museum, London.

*Title: Lepidoptera and habitats.*

*Objective:* to increase our knowledge of Lepidoptera biodiversity and the ecology of this group in relation to the Albufera ecosystems.

*Led by:* Martin Honey.

*Nature of work:* investigation of habitats and specific plants, particularly key species for s’Albufera, to survey Lepidoptera at all stages of development and gather more detailed information about species’ ecology.

*Fieldwork period:* 14-26 April.

*Note:* an international collaboration with the Natural History Museum, London.

*Title: Diptera survey and reference collection.*

*Objective:* to increase our baseline knowledge of the diptera, a poorly known but important element of s’Albufera’s biodiversity.

*Led by:* Rafel Mas, Nick Riddiford.

*Nature of work:* collecting, preparing specimens for later, expert identification; relating specimens to plant pabulum and/or habitat; introduction to and training on new capture and monitoring techniques; use of Malaise (interception) trap to sample different habitats.

*Fieldwork period:* 29 March-26 April.

*Note:* This study is based on the pioneer work done in spring 2001 by Dr Martin Ebejer, an expert from Malta who specialises in flies of the Mediterranean islands, and responds to his recommendations. Dr Ebejer continues to give curation and identification support, and advises on the development of biodiversity and monitoring studies using flies.
**Title:** Coleoptera survey and reference collection.  
**Objective:** to increase our baseline knowledge of various coleoptera groups, an incompletely known but important element of s’Albufera’s biodiversity.  
**Led by:** Brian Eversham, Henry Stanier.  
**Nature of work:** baseline survey work; collecting, preparing specimens for later, expert identification; relating specimens to plant pabulum and/or habitat; introduction of trapping techniques.  
**Fieldwork period:** 8-22 April.  
**Note:** This is a new baseline study. Target families include Carabid and Staphylinid beetles.

**Title:** Extension of the aquatic invertebrate reference collection.  
**Objective:** to obtain a comprehensive collection of reference material in support of the aquatic invertebrate and water quality study.  
**Led by:** Juana Garau, Henry Stanier.  
**Nature of work:** curate and catalogue current material; obtain new material through collecting at targeted sites; preparing specimens; seeking specialist opinions for contentious identifications.  
**Fieldwork period:** 29 March-26 April.  
**Note:** Progress has already been made towards establishing a full working reference but more material is needed. The study is leading towards the pioneering of new techniques and knowledge for the identification of difficult larval stages.

**Title:** Arachnid studies - spiders.  
**Objective:** to increase our baseline knowledge of the diversity and distribution of Park spiders, another poorly known but important element of s’Albufera’s biodiversity.  
**Led by:** Tony Serjeant.  
**Nature of work:** collecting, preparing specimens for later, expert identification; relating specimens to plant pabulum and/or habitat.  
**Fieldwork period:** 14-26 April.  
**Note:** in collaboration with Guillem Pons of the Balearic Invertebrate Study Group. This is a continuation of a study begun in 2000 during which Tony collected reference material representing 19 families, 45 of which have currently been identified to species.

**Title:** Biodiversity catalogue – extension.  
**Objective:** with the imminent publication of the Biodiversity Catalogue, the objective now is to gather information which can advise and guide biodiversity conservation in the Park.  
**Led by:** Nick Riddiford.  
**Nature of work:** to improve the catalogue (currently standing at over 2600 species of 52 faunal and flora groups) by targeting gaps in our knowledge, verifying unconfirmed records and investigating the current status of species known from s’Albufera. This will be done by targeted survey and collecting; literature searches.  
**Fieldwork period:** 29 March-26 April.  
**Note:** Ecological information which guides conservation planning for notable species is now a priority target.
Ecological and monitoring studies

**Title:** Bird population studies - transects.

**Objective:** to monitor bird population fluctuations as a measure of local environmental change (e.g. in habitat quality or type) or more generally (e.g. in response to climate change).

**Led by:** Nick Riddiford.

**Nature of work:** two permanent transects, each of just over 7 km and sampling all major Park habitats, both divided into sections reflecting habitat types: counts of all birds seen and heard within 25 metres of the transect line.

**Fieldwork period:** 29 March-26 April.

**Note:** annual study, begun in 1990.

**Title:** Butterfly and dragonfly population studies - transects.

**Objective:** to monitor butterfly and dragonfly fluctuations in a range of habitats as a measure of local environmental change (e.g. in habitat quality or type) or more generally (e.g. in response to climate change).

**Led by:** Angela Medina, Chris Donnelly.

**Nature of work:** two permanent transects, one of 2 km in the coastal dunes and a longer one of 7 km sampling all major Park habitats, both divided into sections reflecting habitat or habitat structure types: counts of all butterflies and dragonflies within 5 metres of the observers.

**Fieldwork period:** 29 March-26 April.

**Note:** annual study, begun in 1991. The value of this study has been enhanced by a new collaboration with the mainland, begun in 2001 when the transects became part of a Catalunya wide butterfly monitoring scheme.

**Title:** Ecology, phenology and habitats of Odonata.

**Objective:** to extend our knowledge of the ecology, phenology and habitats of s’Albufera Odonata.

**Led by:** Henry Stanier.

**Nature of work:** a combination of sampling, netting and observations will be used to extend knowledge of the Odonata species present, as adults and as larvae. Particular emphasis will be placed on catching larvae to establish species identifications, distribution, phenology and habitat requirements; and on finding exuviae of emerging adults. One important aim of the study will be to extend and improve the current collection of labelled material, particularly on larvae, for future reference purposes. The opportunity will also be taken throughout the period of TAIB presence at s’Albufera to record the sequence of first emergence for adults of the various Odonata species.

**Fieldwork period:** 8-22 April.

**Note:** Henry Stanier is Course Director at the British Dragonfly Bio Museum and nature reserve – which is the first of its kind for Odonata in Britain, and possibly the World. This study builds on pilot studies undertaken by Henry in November 2001 and occurs at a time when advanced larval stages are likely to be readily available.
Title: Carabid beetles and their habitats.
Objective: to extend our knowledge of ecological associations and habitats of s’Albufera Carabid beetles.
Led by: Brian Eversham, assisted by John Hollingdale.
Nature of work: Employing a wide range of methods and techniques to gather as much material as possible relating to carabid beetles and their habitats. A range of techniques will be employed and “important” habitats targeted.
Fieldwork period: 8-22 April.
Note: Brian Eversham is a well-known British entomologist with a particular interest in ground beetles. This study extends our baseline knowledge of Carabid beetles (supplied by Miquel Palmer and Guillem Pons) and is an important extension of our Coleoptaran studies.

Title: Survey of mollusc distribution and habitats.
Objective: to repeat the surveys undertaken in 1991-92 and to extend our knowledge of the ecology and habitats of s’Albufera molluscs.
Led by: Pam Hill.
Nature of work: molluscs will be found and mapped mainly through searching and litter sampling. Identifications will be checked against the Parc reference collection. Any new material will be added.
Fieldwork period: 14-26 April.
Note: Pamela Hill is an ecologist with a particular interest in molluscs. This study builds on the extensive baseline work done by Professor Chris Paul of the University of Liverpool in 1991-92.

Title: Habitat descriptions and communities.
Objective: to provide baseline data on physical and vegetative structure and species presence for selected habitat types within the Park in order to improve our knowledge of ecosystem functioning at s’Albufera.
Led by: Chris Donnelly.
Nature of work: recording physical structure, vegetation structure, specific niches in randomly selected one-metre blocks within specific habitats; recording, collecting, sorting and identifying invertebrates and lower plants and relating them to niches within the sampled habitats; field observations of vertebrates in relation to habitat utilisation.
Fieldwork period: 8-22 April.
Note: this study has been designed to support the biodiversity programme and uses a habitat rather than a species specific approach; data will be used to aid assessments of the biodiversity of each habitat and the major impacts on the habitat that are affecting its biodiversity.

Title: Systematic light trapping for moths.
Objective: to survey, monitor and catalogue moth populations and their fluctuations, including in response to climate change.
Led by: Nick Riddiford, Martin Honey.
Nature of work: setting up (evening) and emptying (morning) moth trap using mercury vapour ultra-violet lamp; identifying, counting and releasing or collecting captures.
Fieldwork period: 29 March-26 April.
Notes: the systematic light trapping for moths is an annual study, begun in 1991. Captures in recent years have included migrants from Tropical Africa – perhaps related to climate change. We have also established a collaboration with s’Albufera des Grau Natural Park, in Menorca.
**Park management**

*Title:* Census of migrant and breeding birds.

*Objective:* to record birds for the Park records which provide information for visitors of the diversity and results of the breeding and migration seasons.

*Led by:* Nick Riddiford.

*Nature of work:* general counts and casual records of migrant birds; birds of prey hunting over the marsh, waterfowl on specific water bodies; herons and egrets attending roost sites.

*Fieldwork period:* 29 March-26 April.

*Notes:* results of census work entered onto the Park’s ornithological daily log sheets.

*Title:* Bittern population studies.

*Objective:* to make a qualitative assessment of the impact of fire and drought on the Albufera Bittern *Botaurus stellaris* population.

*Led by:* Pere Vicens.

*Nature of work:* survey of calling Bitterns in the Park, using teams of scientists and volunteers positioned at strategic locations for one hour immediately before dawn.

*Fieldwork period:* March, April.

*Notes:* This is the third year of a survey using a methodology introduced by Glen Tyler (RSPB) in spring 2000. Calling Bitterns declined alarmingly in 2001, probably due to short-term habitat change brought about by the November 2000 fire and low water levels after prolonged dry conditions. The survey is the best means of monitoring population levels and distribution of this very secretive and internationally important reed bed bird species.

*Title:* Marsh orchid *Orchis palustris* census.

*Objective:* to conduct an annual census of the numbers and distribution of flowering *Orchis palustris*, and relate it to Park management and in particular the intensity and timing of grazing by domestic animals.

*Led by:* Maria Vidal, Ingrid Eunson.

*Nature of work:* a complete census of *Orchis palustris* based on flowering plants at all known sites within and adjacent to the Park.

*Fieldwork period:* 14-26 April.

*Notes:* A long-term study, begun in 1993. We are beginning to understand the ecology of the species. Grazing favours the species because it needs relatively open marsh, but it is very sensitive to grazing from January or February through until flowering. The best results are obtained if the flowering zones are grazed from about June until the end of January, then left ungrazed. A good example of the impact of grazing regimes is the marsh alongside camí des Polls. In 1997 grazing animals were removed in February, leading to a count of 1690 flowering *Orchis palustris* in late April-early May. In 1998 the animals were not removed and only 35 *Orchis* flowered. The change in grazing management resulted in a 98% decrease in flowering plants between years (numbers in other areas remained relatively constant). Very few *Orchis palustris* were recorded in flower in 2000 and only slightly more in 2001. The grazing management at camí des Polls has now been adjusted to take into account *Orchis palustris* needs, so the results for 2002 at this site will be very interesting indeed.
Programme Development

Title: Biodiversity and conservation management studies: forward planning.
Objective: to prepare an internationally compatible biodiversity programme structure which links the various studies of the project and sets clear aims and targets for participants and users of the results.
Led by: Chris Donnelly.
Nature of work: Demonstration of structure and format; brain-storming sessions on improvements and streamlining of programme; setting timetables and priorities.
Fieldwork period: 8-22 April.

Interpretation and education

Title: Guide to the birds of the Park
Objective: to prepare a guide for the birds most frequently encountered in the Park and/or internationally important as a contribution to the knowledge resource for general visitors wishing to get more from their visit.
Led by: Nick Riddiford (fieldwork), Pere Vicens (text). [The main author is Nick Owens. He is unavailable this spring].
Nature of work: collection of information for guide.
Fieldwork period: 29 March-26 April.

Title: International volunteer biodiversity training.
Objective: to provide training in the study of biodiversity and biodiversity conservation for Balearic, Peninsular and foreign biologists, geographers, environmentalists and enthusiasts for the natural world.
Led by: Nick Riddiford and the TAIB team.
Fieldwork period: 29 March-12 April, 14-26 April.
Nature of work: volunteer participation in individual studies described above; plus the opportunity to work alongside experienced scientists and experts; and to participate in seminars and presentations on biodiversity and conservation field research.
Notes: The project has hosted and trained volunteers from over 20 countries and 5 continents since the beginning in 1989. Many have gone on to important positions in the World of conservation and the environment.

International initiatives and collaborations

Title: International volunteer biodiversity training.
Notes: Described in Interpretation and education above, but equally applicable here.