

***TAIB Project S'Albufera:
A Mediterranean model for the study of biodiversity and
environmental change***

The Albufera International Biodiversity Group Annual Report 2000

Edited by Nick Riddiford

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TAIB

The Albufera International Biodiversity Group



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PART I

TAIB Project S'Albufera in year 2000



The new Dennis Bishop Laboratory.

Photo by Elizabeth Riddiford.

Introduction

The last report, published in February 2000, took stock of Project S'Albufera achievements and results over the first 12 years. It summarised the structure of our multidisciplinary, international project, the site, the scientific work programme past and present, and exciting new developments for the new millennium. This extensive summary is still available and can be accessed at:

<http://www.oninet.es/usuarios/salbufera/earthw.htm>.

There is, therefore, no reason to repeat that information here. Instead, this document reports on fieldwork carried out in year 2000. The opportunity is also taken, in Part III, to publish results from studies conducted in other recent years.

The field season

Team participation

Spring fieldwork in 2000 followed the recent pattern of two teams in spring and one in autumn. The first team comprised 13 scientists and 6 volunteers and the second team 10 scientists and 2 volunteers. The autumn team comprised 9 scientists and 7 volunteers. There was the usual mix of nationalities: 12 scientists from the UK, 3 from Mallorca, 2 Canadians based in France, one Dutch and one Dutch-American; and 6 volunteers from the UK, 3 from Mallorca, 2 from mainland Spain and one from France. International collaborations included with scientists from the Royal Society for the Protection of Birds, UK, Tour du Valat Biological Station, France and both 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.

Other scientific visits

TAIB Project work outside the designated team periods was undertaken by three representatives from the UK, two from Mallorca and one from Wageningen. Further details of these visits are given in Part II.

Studies

The majority of work in 2000 entailed studies already in progress. However, new avenues of study were introduced in the fields of human management and impact studies (*study of the seagrass Posidonia oceanica ecosystem in the Bay of Alcudia bordering the Parc*); biodiversity studies (*Lichen biodiversity* and a stage 2 extension of the *biodiversity cataloguing work*); ecological and monitoring studies (*a bat pilot study*); park management (*Integrated Assessment of Tourism in s'Albufera Natural Park*); and a new international programme collaboration was launched with a management case study for a planned *European reedbed management handbook*. During the autumn visit, TAIB collaborated extensively with Joan Miquel Bennessar Mas, s'Albufera "artist in residence", in themes of appreciation and interpretation of s'Albufera biodiversity and ecology. A full summary of the 2000 work, including interim results is given in Part II.

Other events

Laboratorio Dennis Bishop

The most important single event in 2000, and one of the most significant so far in the history of the Parc was the establishment of the Dennis Bishop Laboratory. The new Laboratorio Dennis Bishop was officially opened on Friday, 3rd November 2000 by the Balearic Consellera de Medi Ambient (Environment Minister), Margalida Rosselló. The Laboratorio Dennis Bishop, situated in the Casa de les Universitats del Parc (Park Universities House), came to fruition thanks to the patronage of the widow of Dennis Bishop, Pat, and his daughters Claire and Sally. The donation, by family request and via an agreement, is being administered by the Associació Balear d'Amics dels Parcs (Balearic Association of Friends of the Parks).

In the first phase of development, an investment of over 5 million pesetas has been made to equip the laboratory with furniture, computers, four high tech microscopes, video teaching aids, digital photography equipment, GPS equipment and much more. The laboratory is already proving an excellent facility and considerable further investment planned for 2001 will result in a field laboratory of impressive quality.

Pat and Dennis Bishop got to know the Albufera many years ago and since the establishment of the Park in 1988 have collaborated closely in its administration, financing hides, a research grant, scientific and computer equipment and much more, including giving direct and unwavering support to our project from its start in 1989. Dennis is sorely missed, but we are proud and thrilled that his memory will not fade and is rightly commemorated in the Laboratorio Dennis Bishop.

The big fire

On the very same day, 3rd November, just as we were preparing for the grand opening, a major fire broke out on the western fringe of the Parc. It raged for much of that day and through the night, putting eventually extinguished by the Balearic fire service just after dawn on 4th; by which time over 450 ha of reedbed had been cremated between Camí des Polls and the Casa del Parc. It made front page news in many of the Balearic newspapers, along with spectacular colour photos. There was no damage to the Parc buildings and the damage to vegetation, though dramatic, will be short term. Indeed, as I write, a rapid growth of fresh reed occupies the zone which last autumn was reduced to ash.

New faces

We were pleased to work closely and receive the interest and support of new Director General de Biodiversidad, José Manuel Gomez Gonzalez; and to collaborate with Juan Salvador Aguilar, appointed to the post of Parc Director in October 2000. Our collaboration with Juan Salvador goes back a long way. He was one of three Mallorcan volunteers in the first ever Project team, whilst still a student way back in 1989.

Associació Balear d'Amics dels Parcs

Members of ABAP, the Balearic Association of Friends of the Parcs, does a fantastic job for Balearic conservation by offering assistance and support to all the Balearic Parcs, s'Albufera included. Support is provided in many different ways, not least in organising teams to do those extra, often menial jobs such as tidying up litter, which make such a difference to the environment and landscape. We have established a close working relationship with ABAP, and it is a pleasure to collaborate with such an enthusiastic and well-meaning group of people. ABAP has proved

particularly helpful in a number of logistical matters, not least the administration of the Bishop donation towards equipping the Laboratorio Dennis Bishop.

Publications in 2000

The following publications appeared in 2000:

HONEY, M.R. Moths from the Balearic Islands: (i) S'Albufera, Mallorca (ii) S'Albufera des Grau, Menorca (iii) S'Albufereta, Mallorca *In: Hall, N.M. (ed.). 2000. 1999 Annual Exhibition; Foreign Lepidoptera. Brit. Journal of Entomology & Nat. Hist.* 13: 160-167.

POULIN, B. Mediterranean reedbeds: Reedbed passerines. *In: Tour du Valat. 2000. The Integrated Programmes – a Habitat Approach. Annual Report 1999*, Station Biologique de La Tour du Valat, France.

GARAU MUNTANER, J.M. 2000. *Diseño y Propuesta de un Encuesta para el Estudio de la Voz del Cliente en el Parque Natural de S'Albufera de Mallorca – Realización de un estudio cuantitativo y Análisis de resultados*. Thesis, II Master Universitari en Gestió Empresarial: Qualitat; Medi Ambient, Curs 99/00. UIB.

Acknowledgements

Implementing an international field project of this type is a real challenge which relies on the enthusiasm and goodwill of a very great number of people, and there is not space to mention them all. I would, however, like to pay especial tribute to Biel Perello and Pat Bishop. These two wonderful people have given unfailing dedication and support to TAIB Project s'Albufera as an extension of their love for and commitment to conservation and the environment generally, and s'Albufera in particular. We have been equally fortunate in receiving the whole-hearted support and encouragement of the Park authorities and Balearic Conselleria de Medi Ambient and in particular the Consellera Margalida Rosselló, Director General de Biodiversidad Jose Manuel Gomez Gonzalez and Park Director Juan Salvador Aguilar for permission to continue with our studies for a twelfth consecutive year. The efforts of the Associació Balear d'Amics dels Parcs, and its President Miquel Fullana have been very much appreciated, as has help and advice from our many Balearic friends at the University, Environment Ministry and GOB. Further afield we acknowledge the contribution made to collaborative ventures by members of the Environmental Systems Analysis Group & Aquatic Ecology and Water Management Group, Wageningen Agricultural University, Netherlands and the Tour du Valat Biological Station, France – including their Mediterranean projects officer based in Mallorca, Pere Tomas. One of the strengths of the Project is our ability to draw on specialists to advise us and give opinions on matters scientific. Foremost in this is the influential conservationist, Max Nicholson, who originated the Project and, at the remarkable age of 95, still retains a great interest in its development. Experts Dr Michael Archer, Dr Martin Ebejer, Barry Goater, Martin Honey, Dr Gerald Legg, Dr Judith Marshall, Professor Palmer Newbould, Professor Chris Paul, Colin Plant, Dr Guillem Pons, Rod Stern, Dr Carlos Duarte and Nasr-Eddine Taibi all gave freely of their opinions and advice during the year. And of course, there would be no fieldwork, no results and no report without TAIB scientists and the volunteers who assist them. I thank them all, and everyone else who has been so helpful and supportive, including a number acknowledged individually in Part III in the scientists' reports.

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PART II

Project S'Albufera: summary of work in 2000



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: Michelle Chapman.

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: 8-15 April; 29 October-5 November.

Note: a cost-effective technique for guiding management of wetland sites.

Outcome/interim results: A review of this long-running programme was undertaken in 2000. The outcome was a recognition that the current level of monitoring hampered full interpretation of results. This obstacle could be overcome by sampling at all seasons, and this could only reasonably be achieved if the programme was continued by a Mallorcan resident. Juana Garau volunteered to take on this task. The opportunity was taken by Michelle Chapman in autumn 2000 to introduce Juana to the methodology, techniques and sample sites. Further training will be conducted in spring 2001. Advantage was taken of the local input to extend the study to S'Albufereta, where a pilot selection of sample sites have been identified. Michelle Chapman plans to continue her involvement in the project as an advisor and to work more on biodiversity aspects of the aquatic invertebrates.

Title: [Bio-indicators for monitoring water quality regulation and aquatic biodiversity.](#)

Objective: to identify indicator animals and/or plants and incorporate them in a model of the dual functions of water quality regulation and biodiversity conservation which optimizes the two functions and advises the long-term management and conservation of the Park.

Led by: Jeroen Veraart.

Nature of work: implementation of monitoring schemes for aquatic vegetation (including phytoplankton) and zooplankton populations and matching with abiotic variables (including nitrate, phosphate, chlorophyll-a & secci depth measurements) to assess the impact on biodiversity of catchment land use and other impact parameters. Based on recommendations by Jeroen Veraart in *Selection of bio-indicators to monitor effects of agriculture and tourist developments on water quality and aquatic biodiversity in s'Albufera Natural Park, Mallorca*. MSc. Thesis. Wageningen University, Earthwatch Institute and Universitat de les Illes Balears. December 1999.

Fieldwork period: 12-26 April.

Note: An international collaboration with the Environmental Systems Analysis Group & Aquatic Ecology and Water Management Group, Wageningen Agricultural University, Netherlands.

Outcome/interim results: Results of this study are described in the paper "Towards the use of bio-indicators to assess the anthropogenic impacts on aquatic biodiversity and water quality in s'Albufera Natural Park" (Veraart, 2000), *see Part III, Study reports*. A paper "Selection of (bio) indicators to assess conflicting uses of wetland functions and values: a case study of s'Albufera de Mallorca, Spain" (Veraart, de Groot, Perelló, Riddiford & Roijackers, in press) has been prepared for a special issue publication of *Regional Environmental Change* entitled "Key Issues in Environmental Wetland Research".

Title: [Study of the seagrass *Posidonia oceanica* ecosystem in the Bay of Alcudia bordering the Parc Natural de S'Albufera, Mallorca.](#)

Objective: to establish simple monitoring methodologies for the assessment of ecosystem functioning in seagrass habitat in Alcudia Bay.

Led by: Suzy Marshall (Biodiversity Officer, UK Environment Agency).

Nature of work: preliminary investigations of the ecosystem, including mapping and quadrat sampling.

Fieldwork period: 24 April-8 May.

Note: Based on recommendations by Emma Whittingham (Dept. Tropical Coastal Management, University of Newcastle) in *The coastal zone of Alcudia Bay, Mallorca: an assessment of change and potential anthropogenic impacts on the Posidonia oceanica seagrass habitat*. MSc. Dissertation. Centre

for Tropical Coastal Management, University of Newcastle-upon-Tyne. August 1999. **This is a new study.**

Outcome/interim results: The methodology used was based on the Australian Institute of Marine Science (AIMS) seagrass monitoring programme. Density of the seagrass was estimated using the Dafor scale. Environmental parameters such as oxygen content, salinity, pH, as well as temperature of the water at the surface and seabed were noted as well as marine biodiversity species and a description of each transect site. Sediment samples were also taken. During the study period, three 100 m transects and two random sites were assessed, totalling 17 sample sites. The transects were taken 1 km either side of the canal and then one parallel to the canal, all approximately 1 km from the shoreline in an east-west direction. The transect sites revealed very different environments. The transect east of the canal revealed a less dense *Posidonia* within a sandy environment. The transect opposite to the entrance of the canal showed a much denser *Posidonia* and the mollusc *Pinna squamosa* a locally protected species, was commonplace. The transect, north-east of the canal, revealed a filamentous algae smothering the *Posidonia* and sea urchin proliferation, revealing signs of nutrient enrichment in Alcudia Bay. The two sample points were in response to the findings of the third transect, to assess how far the filamentous algae continued. The sample points were taken towards the north-east end of the bay and near to the power station discharge pipe. However, the filamentous algae was not present at the random sample points. It is clear that further studies are required to assess the extent of the nutrient enrichment and the source. Links were established with the University of Balearic Islands, marine biology department Carlos M. Duarte/Joachin Tintore and a resident marine biologist, Nasir Eddine Taibi. Copies of all previous papers by the University on *Posidonia* were received by Suzanne Marshall. SCUBA dive centre at Can Picafort assisted the dive team with daily renewal of tanks and equipment which were kindly donated free of charge. Results of the Pilot study are presented in **Part III, Study reports** below.

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: Rachel King, 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: 8-30 April.

Note: an annual study begun in 1995.

Outcome/interim results: Since the study began large annual changes have been recorded in vegetation cover and species counts. By year 6, no extensive bare patches remain and most early colonisers have been shaded out by grasses and shrubs. With the notable exception of *Pinus halepensis*, all predicted species (based on the communities of an adjacent control site) are well represented within the study area.

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: Elizabeth Riddiford, Nick Riddiford.

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: 8-30 April, 22 October-5 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: remedial works to protect the foredunes have had a remarkable and spectacular positive effect on the pioneer vegetation. From a very impoverished and limited pioneer flora, the band between the brushwood fence and the dunes has been aggressively colonised by a range of plants; and there has even been some colonisation immediately seaward of the fence, where no plant species had been growing previously. The commonest species is *Lotus cytisoides*, recorded at 26 of 30 (87%) of sample sites. Other frequent species were *Elymus farctus* (77% of sites), and *Eryngium maritimum* and *Pancreatum maritimum* (both at 57% of sites). Diversity in autumn was the highest yet. 30 species were

recorded within the random quadrats including such unexpected species as *Sonchus aspera* (6 sites), *Thymelaea myrtifolia*, *Lagurus ovatus* and *Phragmites australis* (2 sites each) and *Anagallis arvensis* (one site). Particularly unexpected were seedlings of *Ceratonia siliqua* and *Pinus halepensis*. A tomato plant *Lycopersicon esculentum* was growing well at one site! The foredune specialist *Euphorbia peplis* was recorded in one quadrat and noted elsewhere outside the sample sites. This was very encouraging, as was the discovery of several well established *Polygonum maritimum* plants – though none falling within the random quadrats. The commonest plant colonising the seaward side of the brushwood fence was *Salsola kali*. The extremely prickly nature of this plant is certain to discourage sunbathers. Many of the plants found, particularly the *Lotus*, were tiny seedlings and will require minimal disturbance to prosper. Percentage cover remains relatively low and quadrats in the most disturbed areas still lacked vegetation. Nevertheless, the rate of re-colonisation is impressive. The most vital plant for its sand-fixing properties is *Ammophila arenaria*. This was recorded at two sites, both near the Ca'n Picafort end of the beach. The results are very encouraging. However, there is no room for complacency. Gaps have appeared in the brushwood fence and the rope barrier beyond; the notice at the Ca'n Picafort end of the beach has been defaced by vandals; the English text on the signs is incorrect and misleading; and there is a tendency for tourists to use the space immediately behind (dune-wards) the brushwood fence as a path and the dune slope for sunbathing. Renewal of the signs, with the English corrected, will help tourists understand that the area is being recuperated and needs to be respected. Maintenance of the brushwood and roped barriers is essential, with gaps being quickly replaced. Tracks from the beach-cleaning vehicle come right up to the barrier in place and may be implicated in collapses of the barrier and fence. In an ideal world, a warden would patrol the area in the summer and politely encourage tourists to respect the area behind the brushwood fence. The remedial works are so close to being an unqualified success that vigilance should be maintained to ensure that the quality of protection is maintained. Without this, there is a danger that the progress already made will be interrupted or reversed. This is currently a success story for which the Park authorities and Environment Department should be proud. TAIB will continue to monitor the foredune regeneration process.

Footnote: the signs currently read “we pretend to restore this coastal dunes. Walk only on the gangway. Use footwear. Excuse the annoyances. Thank you for your collaboration.” They should be amended to “we are attempting to restore these coastal dunes. Walk only on the gangway. Use footwear. Excuse the inconvenience. Thank you for your cooperation.”

- **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: throughout the year.

Note: begun in 1989.

Outcome/interim results: a relatively small amount of new material was added to the herbarium in 2000. The development of the Dennis Bishop Laboratory, and in particular the introduction of dehumidifiers, will greatly benefit the curation of this valuable reference resource.

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.

Note: begun in 1997; an international collaboration with leading Balearic mycologist, Pep Siquier.

Outcome/interim results are presented in **Part III, Study reports.**

Title: Lichen biodiversity

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

Led by: Rose Pride.

Nature of work: sampling of different habitats within and adjacent to the Park to establish a first list of species, curation of existing lichen herbarium and extension of herbarium through the collection of further specimens and species. A preliminary assessment was made of lichen diversity in relation to potential pollution sources.

Note: **This is a new study.**

Outcome/interim results: a range of habitats was visited. Important habitats for lichen diversity included: coniferous woodland which supported many interesting lichens both on the trees and on the soil; and the various bridges and extensive former aquaduct. The limestone used in the building of these is covered in lichens. 27 species have been identified so far from the initial survey. Rose Pride writes: "There is much work still to be carried out and I look forward to a return visit, not just within the Parc but to other interesting areas as well. There is a Power Station opposite the Parc where the trees are black with pollution and an investigation here would be of interest." A report of the study is presented in **Part III, Study reports** below. A proposal to investigate the impact of Es Murterar on the environment, using lichens as an indicator group, was subsequent made by Nick Riddiford, and submitted to the Park Director, Juan Salvador Aguilar.

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.

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

Fieldwork period: 8 April-7 May, 22 October-5 November.

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

Outcome/interim results: A considerable amount of new material has been added to this increasingly important and impressive collection. Martin Honey has been instrumental in preparing, identifying and adding to the Lepidoptera boxes, and we are reaching a stage with other invertebrate groups where a valuable range of named species is available. There were a number of exciting new Lepidoptera finds. Additions to the list were mainly from microlepidoptera families, but the noctuid *Mythimna languida* was new to Spain, as was *Characoma nilotica* (Rogenhofer), another noctuid previously only recorded in Europe from Malta, Greece and Crete – and new to Italy in 1998. These are yet more in the category of species moving north and east from Africa. Both were caught in autumn, as were two *Spoladea recurvalis*, a tropical Pyralid moth caught for the first time at s'Albufera in autumn 1999. The highlight of the spring was the capture of several more *Araeopteron*, including a female that laid some eggs - 13 to be precise. These turned out to be fertile and were hatched out at the Natural History Museum, London. These were the first known eggs and larvae. We still know nothing about their natural foodplant so trying to raise the larvae was a real challenge. The last Balearic Lepidoptera list to be published gave 370 species. The endeavours of TAIB, and especially Martin Honey, have raised that number to about 700. Articles are in preparation to describe the *Araeopteron* (new to science) and publish the new faunal records in internationally recognised entomological journals. Summary reports of activities at s'Albufera and elsewhere in the Balearic Islands are presented in **Part III, Study reports**. The following paper, based on previous years' research, was published in 2000: HONEY, M.R. Moths from the Balearic Islands: (i) S'Albufera, Mallorca (ii) S'Albufera des Grau, Menorca (iii) S'Albufereta, Mallorca In: Hall, N.M. (ed.). 2000. 1999 Annual Exhibition; Foreign Lepidoptera. *British Journal of Entomology & Natural History* 13: 160-167.

Title: Diptera reference collection.

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

Led by: Rachel King, Nick Riddiford.

Nature of work: collecting, preparing specimens for later, expert identification; relating specimens to plant pabulum and/or habitat.

Fieldwork period: 8 April-7 May, 22 October-5 November.

Note: an international collaboration with Dr Martin Ebejer, an expert from Malta who specialises in flies of the Mediterranean islands.

Outcome/interim results: One of the additional invertebrate groups for which we have an increasingly useful collection is the Diptera. Thanks for this are entirely due to Dr Ebejer. A total of 105 specimens have been identified to species and a further 29 to genus or family. So far we have recorded 46 families of flies at s'Albufera. These are still early days of course and Dr Ebejer predicts considerably more. Dr Ebejer is particularly strong on certain Cyclorrhapha group families. The Diptera is such a complex group that we cannot rely on one person alone for all families. Thus, we would welcome help from other specialists who may be able to contribute to and expand our understanding of Diptera biodiversity at s'Albufera.

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 Sarjeant, Pam Hill.

Nature of work: collecting, preparing specimens for later, expert identification; relating specimens to plant pabulum and/or habitat.

Fieldwork period: 8 April-7 May.

Note: in collaboration with Guillem Pons of the Balearic Invertebrate Study Group.

Outcome/interim results: Reference material was collected representing 19 families. 45 have been identified to species. These and a further 57 unidentified species have been passed to Guillem Pons for expert verification or identification. An opinion is still awaited on these.

Title: [Biodiversity catalogue – verification and extension.](#)

Objective: to improve the catalogue (currently standing at 2500 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.

Led by: Nick Riddiford, Elizabeth Riddiford.

Nature of work: targeted survey and collecting; literature searches.

Fieldwork period: 8 April-7 May.

Note: the anticipated date for publication of the catalogue is now 2001.

Outcome/interim results: Originally, it was planned to publish the catalogue in 2000, but peer review and translation into Catalan slowed the process. We took advantage of this to verify and, in a few cases, make amendments to the original text.

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 2500 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: 22 October-5 November.

Note: Ecological information which guides conservation planning for notable species is now a priority target. **This is a new study.**

Outcome/interim results: Groups targeted during the year included Diptera (see above for details), Neuroptera, Pseudoscorpions, Arachnida (see above for details) and Lichens (see above for details). Planning work included investigation of methodologies and formats currently in use nationally and internationally in biodiversity conservation as a first step towards devising a format which could be applied to s'Albufera.

- **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: 8 April-7 May, 22 October-5 November.

Note: annual study, begun in 1990.

Outcome/interim results: the transects continued to give information on how certain bird species use a range of Parc habitats. The most significant event of the year was the large fire of 3rd November 2000, which (temporarily) removed all above ground vegetation along two sections of Transect 1, most notable the Camí d'en Pujol section. Previous monitoring had demonstrated how slowly the Es Rotlos reedbed was recolonised by *Acrocephalus melanopogon* after the last major fire affecting that area, in 1990. Relatively few were recorded in 1991-94. Birds were back in reasonable numbers from 1995 but highest mean spring totals in 1999 and 2000 suggested that full re-occupation of the habitat may have only happened in the last two years. The hypothesis is that a similar slow recolonisation will occur after the most recent fire. Other species, such as *Cettia cetti* appear to recover their numbers much more quickly.

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, Juan Cervantes, 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: 8 April-7 May, 22 October-5 November.

Note: annual study, begun in 1991.

Outcome/interim results: a particular cold spring delayed the emergence of adults of most Odonata species and depressed the numbers of butterflies. A marked exception was *Pieris rapae*. This butterfly was present in exceptional numbers, particularly in late April. *Lasiommata megera*, a butterfly of warm, open habitats, appeared to have had a good breeding season, judging from above average numbers in late October.

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: 22 October-5 November.

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: New biotopes sampled included the litter layer below scrub in pine woodland on the southern border of the Park (Ca'n Picafort woods) and the marginal vegetation at the base of the aqueduct bordering the Camí des Senyals. The opportunity was taken to investigate the impact on invertebrates of the fire of 3rd November 2000. Within 24 hours of the fire dying down, Chris Donnelly took a volunteer into the burnt area and sifted through the ash layer. The search area was Es Ras. They found Isopods (4 species), Amphipods, a millipede, a beetle pupa, several snail species (including *Physa acuta*, *Lymnaea peregra*, *Cochylidia acuta*, and 2 of the sea shell (!) *Rudicardium tuberculatum*),

spiders, the cockroach *Loboptera decipiens*, and a weevil. The ground structure comprised 3 layers, an upper ash layer, a well-defined decomposing organic layer, and a "soil" layer below that. They took samples separately from each layer. Most animals were in the lower two layers. Most of the live invertebrates were in the soil layer (in which invertebrates were frequent). The soil layer was only investigated down to about 2 cm. Living invertebrates included the cockroach, an *Armidillium* isopod, spiders and the weevil. Invertebrate mortality must have been very high, and most would have been cremated beyond discovery. However, penetration into the soil layer may have been a successful survival strategy for some. Further details of the study are presented in **Part III, Study reports**.

Title: [Habitat mapping - update](#).

Objective: to ratify and revise TAIBG 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: 22 October-5 November.

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

Outcome/interim results: verification of existing habitat maps was piloted through fieldwork conducted at three sites. A start was also made with a fixed point photography programme aimed to record and observe habitat change. Further details of the study are presented in **Part III, Study reports**.

Title: [Small mammal studies: Bat pilot study](#).

Objective: to devise and implement methods to extend and monitor bat ecology and populations at s'Albufera.

Led by: Richard Green (Environment Agency).

Nature of work: Part or all of following: trialing 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 cave and within park as well as feeding areas, by positioning volunteers with detectors. Set up biannual cave roost survey, both inspection and emergence count. Identify other roosts in and around park.

Fieldwork period: 29 October-5 November.

Note: bats are an important but poorly understood part of the ecology of s'Albufera. **This is a new study.**

Outcome/interim results: Bat activity was erratic due to weather and temperature. Survey techniques were trialed, including the UK National Bat Monitoring Programme for Daubenton's bat but adapted for *Myotis capaccini*. Survey on the Gran Canal proved fruitless, however *M. capaccini* were recorded on the Gran Canal at other times. This was probably due to temperature/weather but also survey was initiated 40 minutes after sunset. It may be that bats take longer to reach the Gran Canal from their roosts. Gran Canal is too wide for bats on far side of the canal to be picked up with a bat detector so survey has much room for error. Transects were walked throughout the park on different nights, recording time expanded calls for later computer analysis. Species encountered include: *M. capaccini*, *Pipistrellus pygmaeus*, *Pipistrellus kuhlii*, *Tadarida teniotis* and possible *Nyctalus leislerii*. Mist nets were set on two nights but were unsuccessful due to weather, torrential rain forced abandoning the netting, and temperature, too low for any significant insect activity and hence bat activity. Cova St Marti was visited and approx 200+ *M. capaccini* observed in the cave and counted emerging. Four individuals were measured and parasites taken. These proved to be males and females of the bat fly species *Penicillidia dufouri* (Nycteribidae), determined by Martin Ebejer. Without regular monitoring by a team of experienced volunteers it will be difficult to set up a robust monitoring programme using bat detectors, however, further investigative research into bat ecology within the park will be useful. It is proposed to build and erect bat boxes and bat houses within the park for monitoring purposes, as well as making links with Balearic bat workers. Further work could also involve location of roosts within further caves around the park. It would be very exciting to confirm the presence of *Nyctalus leislerii* by either catching a bat in a mist net or by discovering a roost. These bats are tree roosters and the erection of bat boxes could prove favourable in attracting and recording them.

Title: [Systematic light trapping for moths](#).

Objective: to monitor moth population fluctuations to detect changes, especially in response to climate change; e.g. there is evidence of North African moths colonising Mediterranean Europe.

Led by: Nick Riddiford, Elizabeth Riddiford.

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: 8 April-7 May, 22 October-5 November.

Notes: an annual study, begun in 1991; we have also established a collaboration with s'Albufera des Grau Natural Park, in Menorca.

Outcome/interim results: apart from the captures of African species new to Spain (reported above), the most notable outcome of the trapping programme in 2000 was the scarcity of *Mythimna joannisi*. This moth is normally considered to be of north African origin but with pioneers colonising the north Mediterranean coast in recent years. A pattern has emerged of small numbers captured virtually every night at Sa Roca between the second week of April and into May, and more sparingly in late autumn. However, in 2000 there were no late autumn records and just two in spring, on 12th April and 3rd May. The reason for the marked decrease is unknown. Trapping in 2001 and beyond will tell us whether this is a short-term reversal or the beginning of a contraction of its range to its previous distribution.

Title: [Monitoring the structural evolution of Mediterranean reedbeds: 1. Vegetation.](#)

Objective: to reach an understanding of the relationships between vegetation growth, reedbed structure and aspects of hydrology and water quality in Mediterranean wetlands.

Led by: Carolina Encinas (S'Albufera); André Mauchamp (overall project director for the Mediterranean-wide study).

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 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: two of the reedbed sites were in good condition, Es Forcadet and Bassa des Molí. The Es Cibollar site was notable for the high proportion of dead *Phragmites* stems, almost complete lack of other vegetation and absence of flowering heads. The only additional plant recorded was a solitary *Scirpus maritimus*, and the lack of *Phragmites* flowering heads was as marked outside as within the quadrats. Piezometer measurements indicated that the site is highly saline and this was confirmed when marine crabs were disturbed during the transect. Results also suggest that Es Colombar reedbed is under stress. Flowering *Phragmites* heads were largely absent after the first 20 m and the only additional plant species was a solitary *Tamarix* sapling growing in 20 cm of water. *Tamarix* is tolerant of brackish and saline conditions and its presence may indicate increasing saline intrusion. The Bassa des Molí is an unusually diverse site, and has frequent *Pistacia lentiscus* – a most unexpected component of a reedbed. This site was burnt out during the 3rd November 2000 fire. It will be interesting to see how the reedbed recovers and how the diversity of the site is affected. The piezometer at this site was lost in the fire, but a replacement was installed shortly after.

Title: [Monitoring the structural evolution of Mediterranean reedbeds: 2. Bird populations.](#)

Objective: to reach an understanding of the requirements and structure 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 at regular intervals during the year - mist-netting session comprising 5 hours from first light for 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 for reedbed

Fieldwork period: 8-22 April.

Notes: begun in autumn 1999. This is a new, additional facet of the Carolina Encinas vegetation study outlined above – which is 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: a further substantial sample of birds was trapped at each site during the first spring application of this study; and a series of regurgitations and faecal samples collected. Sweep-netting along the transects contributed further samples of invertebrates. Much of the work now focuses on the painstaking task of identifying the invertebrates and analysing the food samples collected. Unsuccessful attempts were made to encourage GOB ringers to participate. Drs Poulin and Lefevbre do not have the time to make repeated visits and wish to establish a local ringing team to undertake the trapping elements of the study.

The following article, based on previous years' research, was published in 2000: POULIN, B. Mediterranean reedbeds: Reedbed passerines. *In:* Tour du Valat. 2000. The Integrated Programmes – a Habitat Approach. *Annual Report 1999*, Station Biologique de La Tour du Valat, France. [repeated in **Part III, Study reports** below].

- **Park management**

Title: **Bittern population studies.**

Objective 1: to conduct a count of calling Bitterns *Botaurus stellaris* using voice recordings as a basis for understanding numbers and distribution.

Objective 2: to make a qualitative assessment of the impact and influence of the grazing management on the Albufera Bittern population.

Led by: Glen Tyler.

Nature of work: survey of calling Bitterns in the Park, using voice recordings; assessment of site.

Fieldwork period: 8-13 April.

Notes: Glen Tyler and the RSPB have developed methodologies which have led to more accurate assessments of British Bittern numbers and risks to the population. With EU *Life* Project funding, he has recently applied his methodologies and extended his Bittern research to the Continent, including Peninsular Spain.

Outcome/interim results are presented in **Part III, Study reports**.

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, Juana Garau.

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: 23 April-7 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).

Outcome/interim results: The spring 2000 census produced a slightly improved total of 122 flowering *Orchis palustris* at the camí des Polls site. However, this comprised 73% of the entire count. Just 44 flowering plants were found at other sites, and this included 7 outside the Park boundary. Only 3 were found in the Es Ras zone frequented by the buffalos. This is a decrease of 65% on the already low numbers censused in 1999. In response to this alarming result, discussions were held and a management plan proposed for better manipulation of grazing stock to allow the population to recover from its

current perilously low level. *Orchis palustris* can withstand occasional years of low productivity but, unlike many orchid species, individual plants have a relatively short life cycle and the population may not be able to sustain long periods of inappropriate management conditions.

Title: [Integrated Assessment of Tourism in s'Albufera Natural Park, Mallorca:](#)

Objective: to make an integrated assessment of tourism in relation to nature conservation in s'Albufera Natural Park; to contribute to the development of a management plan for sustainable tourism in the park.

Led by: Mishka Stuij.

Nature of work: The main aims are: to define the main functions and values of the park concerning the link between tourism and nature conservation; to define the potential conflicts between current tourism and nature conservation; to analyse the current policies followed by park management and by the local government towards tourism in Natural Parks and assess if and how they address these potential conflicts; to develop a framework or model that integrates the opportunities and constraints in relation to tourism and nature conservation; to assess sustainable use levels for tourism and associated management measures. suitability for, and conflicts with tourism in the park.

Fieldwork period: 28 August-3 November.

Notes: This framework can be used to improve visitor management of s'Albufera Natural Park in the future. The study comprises a MSc. thesis, the latest of a series promoted by Dr de Groot's Environmental Group at Wageningen University. **This is a new study.**

Outcome/interim results: the thesis proposal is presented in **Part III, Study reports**. Publication of results in the form of a thesis will follow shortly.

- **[International Programme Development](#)**

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: 22 October-5 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.

Title: [European reedbed management handbook.](#)

Objective: to contribute a case study to an international guide on reedbed management.

Led by: Nick Riddiford, Juana Garau.

Nature of work: Collect data on management strategies for diversity in s'Albufera reedbeds. This mainly draws from studies already undertaken: monitoring of breeding and migrant birds; reedbed functioning at water quality, bird, vegetation and invertebrate levels; marsh orchid population dynamics in relation to grazing; ecological requirements of a Cladium associated fungus *Psathyrella halophila* endemic to s'Albufera; and reedbed niche partitioning by small mammals.

Fieldwork period: 22 October-5 November (plus desk study work during other months away from the Park). **This is a new study commissioned by a partnership of organisations including Tour du Valat Biological Station and the Royal Society for the Protection of Birds.**

Outcome/interim results: collection and synthesis of information was achieved in October-November 2000 prior to preparation of a case study chapter for the reedbed handbook. The text of this case study is still being drafted, but a preliminary report is presented in **Part III, Study reports**.

- **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: 26 February-5 March; 26 September-12 October.

Outcome/interim results: progress has continued to be steady but slow. Execution of the paintings has been time-consuming, and the objective to paint from living specimens has required field visits to be made at different times of year – lengthening the preparation process further. The guide is very close to completion, but Jo and Dinah will visit again in 2001 to seek out and check a few items. It is already clear that the painstaking and meticulous approach they have taken will result in a publication of high quality.

- **Participants, 2000**

Team 1 (two weeks: 8-22/4)

Principal Investigator: Nick Riddiford (TAIB, UK).

Scientists: Glen Tyler (Royal Society for the Protection of Birds, UK), Brigitte Poulin & Gaetan Lefebvre (Canada; and Station Biologique de la Tour du Valat, France), Jeroen Veraart (Aquatic Ecology and Management Group, Wageningen, Holland), Jo Newbould, Dinah MacLennan, Michelle Chapman, Rachel King, Elizabeth Riddiford (TAIB, UK), *and visiting:* Juana Garau Muntaner, Carolina Encinas Redondo, Inmaculada Mateo Salazar (TAIB, Mallorca).

Volunteers: Caterina Amengual Morro (Mallorca), Jean-Philippe Paul (Tour du Valat, France), Barbara Aldridge, John Clark, Kate Hockley, Christine Lee (Enfield Lock Conservation Group, UK).

Team 2 (two weeks: 23/4-7/5)

Principal Investigator: Nick Riddiford (UK).

Scientists: Elizabeth Riddiford, Rachel King (TAIB, UK), Juana Garau Muntaner (TAIB, Mallorca), Suzanne Marshall & Richard Green (Environment Agency, UK), Jeroen Veraart (Aquatic Ecology and Management Group, Wageningen & TAIB, Holland), Tony Serjeant, Pamela Hill (Peterborough Wildlife Group, UK), *and visiting:* Carolina Encinas Redondo (TAIB, Mallorca).

Volunteers: Nick Foster (University of Newcastle, UK), Ingrid Eunson (UK)

Team 3 (two weeks: 22/10-5/11)

Principal Investigator: Nick Riddiford (UK).

Scientists: Michelle Chapman, Chris Donnelly, Rachel King, Elizabeth Riddiford (TAIB, UK), Juana Garau Muntaner (TAIB, Mallorca), Richard Green (Environment Agency, UK), Mishka Stuij (Environmental System Analysis Group, Wageningen & TAIB, Holland) *and visiting:* Carolina Encinas Redondo (TAIB, Mallorca).

Volunteers: Alfonso Garmendia, Cristina Crespo Sanchez (Madrid, Spain), Rose Pride (Peterborough Wildlife Group, UK), Barbara Aldridge, John Clark (Enfield Lock Conservation Group, UK) *and visiting:* Catí Borrás Vives, Iolanda Grau Coll (Mallorca).

- **Additional field visits**

Twice a month throughout the year

Juana Garau and Carolina Encinas (TAIB, Mallorca): water level and quality measurements as part of a long-term Mediterranean-wide monitoring study (in collaboration with Tour du Valat Biological Station, France) of reedbed structural development.

June to early November

Mishka Stuij (Environmental Systems Analysis Group, Wageningen): Master's study on Integrated Assessment of Tourism in s'Albufera Natural Park, Mallorca

26th February to 5th March, 26th September to 12th October 2000

Jo Newbould & Dinah MacLennan (TAIB, UK): fieldwork in preparation for guide to the flora of the Park tracks

Second half of May and late September-early October 2000

Martin R Honey (The Natural History Museum, London, UK): biodiversity studies in Lepidoptera at S'Albufera and Mallorca

***TAIB Project S'Albufera:
A Mediterranean model for the study of biodiversity and
environmental change***

The Albufera International Biodiversity Group Annual Report 2000

PART III

Study reports

1. Human and management impact studies

- 1.1** Towards the use of bio-indicators to assess the anthropogenic impacts on aquatic biodiversity and water quality in s'Albufera Natural Park by Jeroen Veraart
- 1.2** Pilot Study of the Seagrass *Posidonia oceanica* Ecosystem in the Bay of Alcudia Bordering the Parc Natural de S'Albufera, Mallorca: a preliminary report by Suzanne Marshall
- 1.3** Pilot Study of the Seagrass *Posidonia oceanica* Ecosystem in the Bay of Alcudia Bordering the Parc Natural de S'Albufera, Mallorca: summary of results by Suzanne Marshall

2. Biodiversity studies

- 2.1** Fungi of S'Albufera Natural Park, Mallorca - October/November 2000 by Rachel King
- 2.2** An initial report on some of the Lichens of the Parc Natural S'Albufera de Mallorca, October–November 2000 by Rose Pride
- 2.3** Continuing studies of the moth fauna (Lepidoptera: Heterocera) of s'Albufera de Mallorca and other areas of the Balearic Islands – towards an up-dated check list of the Lepidoptera by Martin R. Honey & Nick J. Riddiford

3. Ecological and monitoring studies

- 3.1** Habitat Biodiversity Investigations: Sampling of Habitats for physical and vegetative structure, species presence and impacts on biodiversity by Chris Donnelly
- 3.2** Habitat Mapping: Further analyses of Habitats present within the Park by Chris Donnelly
- 3.3** Reedbed passerines by Brigitte Poulin
- 3.4** A comparison of the results of a bird ringing project at S'Albufera in November 1997 with those of a repeat project in November 1999, by D M Hanford, H F Coats, R Evans and R J Rigdon

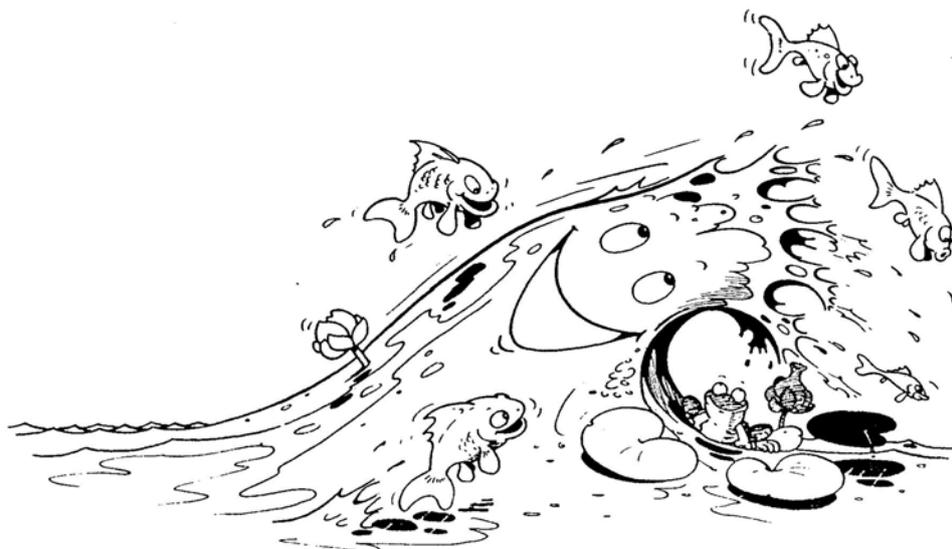
4. Park management

- 4.1** Monitoring bitterns at S'Albufera by Glen Tyler
- 4.2** Thesis Proposal: An Integrated Assessment of Tourism in the S'Albufera Natural Park region on Mallorca; a contribution to the development of a management plan for sustainable tourism by Mishka Stuij

5. International programme development

- 5.1** Menorcan moths by Martin R. Honey, Marga Orfila and Nick Riddiford
- 5.2** European reedbed management handbook case study, Managing for diversity in the Mediterranean coastal wetland of s'Albufera de Mallorca. Starting point by Nick Riddiford, Gabriel Perelló and Juana Garau

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



Fieldwork Project Albufera, spring 2000

Jeroen Veraart
Environmental System Analysis Group
Wageningen University

June, 2000



Preface and acknowledgements

It was great to visit s'Albufera Parc Natural last spring again after my internship. My objectives were to discuss the results of my study of the previous year and to do some additional fieldwork. I would thank all the people who gave me recommendations about my dissertation. Special thanks go to Nick Riddiford and to Biel Perelló because without their efforts my study could not be carried out. I also really appreciated the recommendations of Dr. Luis Santamaria and Dr. Antoni Martínez.

Wageningen, September 2000

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1. 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. In 1989 S'Albufera de Mallorca was declared a natural park. The structure of emerged and submerged aquatic vegetation and hydrological situation before 1989 were a result of the drainage projects of the past two centuries in order to expand agricultural production. A rehabilitation project was carried out in 1991. The objective was to manage the nature reserve in such a way that the ecosystem would return into the process of natural succession (Martinez-Taberner et al., 1990).

One of the most important ecological functions of the Albufera wetland is the nursery and migration habitat function for birds. The community structure of the submerged vegetation is an important factor that determines the functioning of the wetland as a nursery and habitat for birds. 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. In order to select bio-indicators to monitor the impact of agriculture, tourism and management on these environmental factors research was carried out in the summer of 1999 (Veraart, 2000). It appeared that the diversity and the community structure of the aquatic vegetation are suitable bio-indicators to monitor anthropogenic impacts on aquatic biodiversity and water quality. This report aims to provide more in-depth information about the functional role of the aquatic vegetation within the (aquatic) ecosystem of coastal wetlands, like s'Albufera.

Floating leafed species (like *Enteromorpha* sp., angiosperms (like *Potamogeton pectinatus* and *Ruppia* spp.) and Charophyceae differ strongly in shape and physiology. These differences are important with respect to their functional role in aquatic ecosystems. As a result changes in vegetation structure may result in changes in the diversity and abundance of waterfowl in wetlands:

- Macro-invertebrate abundance and diversity is often much higher in *Chara* stands than in angiosperm stands. Charophytes and their associated invertebrates are important sources of foods for ducks. Seeds from angiosperms are on the other hand food for migratory birds in winter. Invertebrate food is especially important to ensure a proper protein level in the diet of young ducks and duckling survival has been shown to increase with invertebrate abundance (Scheffer, 1998).
- The shape 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 shape of macrophytes defines also the capacity of an aquatic ecosystem to provide a refuge for fish against predating waterfowl and piscivorous fish.
- Submerged vegetation provides food for herbivorous birds.

1.1 Research objectives

- A) Identification of the diversity and abundance of Charophyte taxa at the baseline monitoring sites in the Albufera (Martinez-Taberner, 1988; Veraart, 2000). The inventory will be compared to the inventory of the period 83-85 (Martinez-Taberner, 1988). It is an objective to reconsider and to improve the formulated monitoring objectives and hypotheses for charophytes (Veraart, 2000) in relation to water quality, temporality and biodiversity.
- B) It is an objective to prolong the monitoring of the community structure of the aquatic vegetation in a selection of the baseline monitoring sites (Martinez-Taberner, 1988; Veraart, 2000). The monitoring programme should provide information in order to assess the functional role of aquatic vegetation for the habitat and nursery function for waterfowl of the wetland.
- C) It was an objective to formulate recommendations and provide background information for future zooplankton sampling. It is an objective of project s'Albufera to include zooplankton sampling into long-term monitoring and research (Riddiford, pers. com).
- D) It was an objective to discuss the results of the fieldwork of 1999 (Veraart, 2000) with park management and Project s'Albufera in order to facilitate the incorporation of the selected bio-indicators and hypotheses (Veraart, 2000) into long-term monitoring programmes and research.

1.2 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). They species were identified and their abundance was estimated in terms of (R)are, (M)oderate or (D)ominant. For a more detailed description of the vegetation mapping method see Veraart(2000).

Specimens, tubers and seeds of *Ruppia* spp. and *Zannichellia* spp. were collected for identification at the Netherlands Institute for Ecology (NIOO). This was done to check for the possible presence of *Ruppia drepanensis* Tineo and *Zannichellia obtusifolia* in the ephemeral ponds (Santamaria, pers. com).

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. It was not necessary to take vertical migration of zooplankton into account as the sites were very shallow (<20cm). The collected volume was measured in the laboratory. Samples were filtered through a 250 µm mesh net. Preparation of the samples was done with formalin (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.

2. Fieldwork results

2.1 Water quality

In table 1 and figure 1 are the most important water quality data in relation to this research presented.

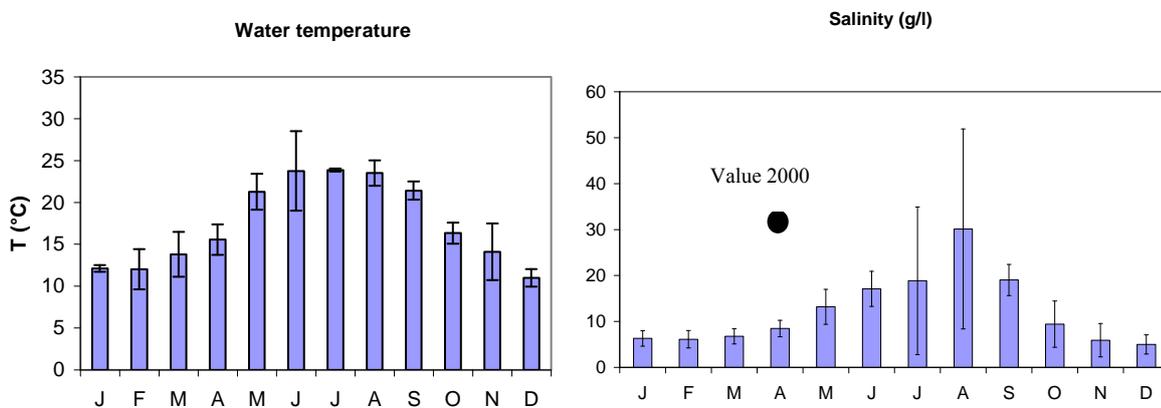


Figure 1, Average seasonal fluctuations in water temperature (°C) and salinity (g/l) in Estany Canyissar (derived from monthly monitoring data 94-98) park management

Seasonal patterns in water temperature, salinity/conductivity and desiccation are important factors controlling the phenology of aquatic vegetation and zooplankton. Statistical analysis with data of these variables in order to identify seasonal patterns (figure 1) and (long-term) trends provides very useful information for the interpretation of ecological data. If more sampling sites are included also spatial differences can be detected that can be used to explain differences in distribution of selected indicator species.

Table 1, Salinity, Conductivity and pH levels at the sampling sites on the sampling date. The habitat description is based on salinity modifiers (Vives, 1996; Veraart, 2000) based on salinity time series (1994-1998) measured by Park management

Sampling date	location	salinity (g/l)	conductivity (mS/cm)	pH	Habitat description
4/15/00	C12N1_B	1.7	2.89	7.9	oligohaline
4/18/00	Ses Salines	34	46.8	7.89	mixohaline
4/19/00	Estany Canyissar (EPHA)	32.3	44.4	7.82	mixohaline
4/20/00	Canal Sa Siurana (C4N3)	4	6.52	7.85	oligohaline/mesohaline
4/21/00	Pont farm Margalida (C1N4)	2.8	4.65	7.78	oligohaline
4/21/00	Es Ras	3.6	5.88	7.83	(not monitored by Park staff)
4/23/00	Pond Can Piccafort	0.5	1.05	7.78	fresh??? (not in park)

The levels of conductivity and salinity in April 2000 (Table 1) were within the range of the average measured levels in April in the period 94-98 (water quality data 94-98) at most of the baseline sampling sites. An exception was Estany Canyissar (figure 1). Average conductivity in April was 8.4 ± 1.8 g/l in the period 94-98. The salinity was at this sampling site 32.3 g/l in April 2000.

The very high value might be ascribed to the very dry summer and winter this year (Perelló, pers. com.). The summer and winter of 1999/2000 were the driest seasons since 20 years.

A pond near the roundabout of Can Piccafert was visited because it was suggested that this pond was one of the few places near the park where still freshwater molluscs can be found (Paul, pers. com; Riddiford, 1993). The salinity was indeed very low (the lowest value measured near the park since 1994). Probably this place is not fed by seepage of the Sa Pobla aquifer but by seepage from the Sa Marineta aquifer.

2.2 Zooplankton

The results of the zooplankton sampling are presented in table 2 and figure 2. Three *Daphnia* species found in the temporary pond situated parallel to Sigiua des Pollo (C12N1_B) and in the pond near the roundabout of Can Piccafert, were new for the biodiversity list (Riddiford, in prep.) of project s'Albufera. The species in question do not tolerate higher salinities than 3.5 g/l (Veraart, 2000). The salinity was indeed lower than 3.5 g/l at the locations where they were found.

Table 2, An overview of found zooplankton taxa in the summer of 2000 at a selection of baseline monitoring sites (Martinez-Taberner, 1988; Veraart, 2000)

Locations -->												
Taxa	C12N1(A) S. des Pollo	C12N1(B) (temporary)	Ses Salines (temporary)	EPHA (temporary)	C2N3 (C.Sol,Sa Roca)	C4N3 (C. Sa Siurana)	C3N3 (Gran Canal, Sa R	C1N4 (Farm Margalida)	Es Ras (temporary)	Pond Can Piccafert	EPON (Estany du Ponts)	Biodiversity status
<i>Daphnia magna</i>		D						X			X	<u>New to the Albufera, common species in world</u>
<i>Daphnia longispina</i>								X	P		X	New to the Albufera, common species in the world
<i>Daphnia pulex pulex</i>		P						X	P	P	X	New to the Albufera, common species in the world
<i>Daphnia mediterrana</i>				P				X			X	Tolerates higher salinities than 3.5 g/l (env. tolerance Cladocera Western Europe)
<i>Moina salinas</i>			D					X			X	Tolerates higher salinities than 3.5 g/l (env. tolerance Cladocera Western Europe)
<i>Ceriodaphnia laticaudata</i>								X	P	P	X	
<i>Simocephalus sp.</i>		P						X			X	
<i>Cladocera sp. (1)</i>		P						X			X	
Copepoda sp.(1) (Calanoida)			D					X			X	
Copepoda spp. (2)		P			R			X			X	

R= Rare (only some individuals), P= present, D =Dominant (conc >300 ind l⁻¹), X= not sampled

Daphnia mediterrana and *Moina salinas* are exceptions within the Cladocera with regard to their tolerance for salinity (Armengol et al., 1986; Veraart, 2000). This explains why these species are found in mixohaline habitats (table 1) in the Albufera. Large concentrations of copepoda taxa (level Calanoida) were only found in Ses Salines. You would expect also high concentrations of Copepoda taxa in Estany Canyissar, assuming that Copepoda taxa would dominate over Cladocera taxa in mixohaline habitats. However, this was not the case. Something else than salinity is probably the determining factor explaining the Cladocera/Copepoda ratio in the zooplankton community at these locations. Ses Salines and Estany Canyissar may suffer in a different way from sewage leakages near the tourist coastal zone. As a result the eutrophic and saprobic

degree may differ at both locations, which might explain the differences in zooplankton community structure.

The species composition of the temporary pond in Es Ras (table 2) differs from the sampling sites in Ses Salines and Estany Canyissar. In Es Ras species occur that are also often found in freshwater habitats.

Zooplankton was absent or very scarce (table 2) at the visited sampling sites in the canal system. This explains the moderate clarity of these waters. The poor clarity are probably explained by very small or absent top-down control of phytoplankton by zooplankton.

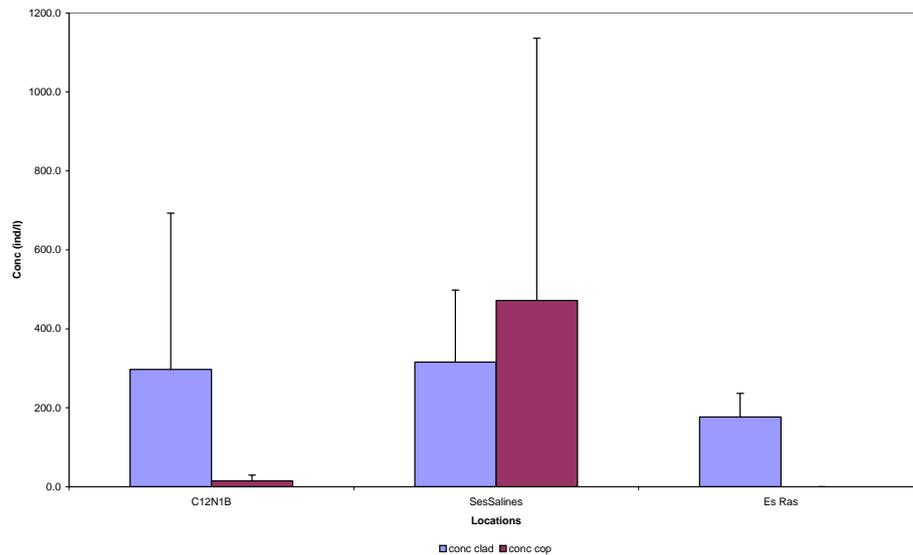


Figure 2, Estimated concentrations (individuals/litre) zooplankton taxa at three temporary ponds in the Albufera

Figure 2 shows that Cladocera concentrations were comparable at all the three of the sampling sites, despite differences in salinity. The high zooplankton concentrations indicate a high eutrophic and saprobic degree of the surface water (Veraart, 2000). However, the 3 sampling sites from figure 2 were highly transparent as a result of the high filter feeding capacity of the Cladocera community. The high eutrophic conditions and high zooplankton concentrations at location C12N1_B and the temporary pond in Es Ras were probably explained by nitrogen rich water originating from agriculture. The water at location Ses Salines had probably a high saprobic degree and high zooplankton concentrations explained by sewage leakage that is rich in organic matter.

Maximum Cladocera and Copepoda concentration were respectively 12 and 200 individuals/litre in April 1999 (Veraart, 2000). At Ses Salines both Cladocera and Copepoda concentrations were considerably higher compared to April 1999 (figure 2). The composition of the zooplankton community at Ses Salines shows that the ecosystem still not is recovered from the sewage accident in the summer of 1999.

2.3 Aquatic vegetation

The aquatic vegetation community structure of the visited baseline sampling sites (table 3) did not much differ from the survey done in the summer of 1999. The seagrass *Zostera marina* that was found in Estany des Ponts was wrong identified in the summer of 1999. This sampling site was again visited and the specimens in question appeared to be *Cymodocea nodosa* (Newbould and Riddiford, pers. communication). *Cymodocea nodosa* is also a sea grass. This species was also not present in 83-85 at this location. The

conclusion (Veraart, 2000) that the presence of the observed taxa is indicative for increased sea influence is thus still valid.

Lamprothamnium papulosum was found at location Estany Canyissar (EPHA) in April 2000, while *Chara* sp. was found in the summer of 1999. This can be ascribed to the very high salinity this year in the early growing season (figure 1). The salinity in April 2000 (32.3 g/l) was clearly higher than the estimated environmental tolerance (Veraart, 2000) of stoneworts for salinity (6-12.4 g/l). Moore (1986) mentions that *Chara* sp. does not tolerate a salinity above 8-10 g/l. The estimated environmental tolerance from this research is thus within the known range of literature.

Two of the found stonewort species were new to the park: *Chara imperfecta* and *Nitella syncarpa*. *Chara imperfecta* is often found at the Iberian Peninsula but is rare for the whole of Europe (Moore, 1986). *Chara imperfecta* was present in the upper part of the Albufera. In earlier research (Martinez-Taberner, 1988) it was assumed that charophytes were absent in the upper part of the Albufera because of lower alkalinity levels. This hypothesis should be rejected based on the observations in the summer of 2000. The biodiversity status of *Nitella syncarpa* should be looked up in literature.

It seems that *Chara vulgaris* is currently the most widely distributed Charophyte taxa in the Albufera based on the survey in 2000 and the survey of 1999. Two different varieties were identified *C. vulgaris* var. *crassicaulis* and a not identified variety at sampling location C2N3.

Zannichellia spp. and *Ruppia* sp.

Specimens are collected identification will be done at the NIOO soon, to see if *Ruppia Drepanensis* Tineo and *Zannichellia obtusifolia* are present at some of the visited temporary ponds.

Zannichellia pedunculata was present at sampling locations C4N3 and C12N1 (both canals). In the temporary ponds not enough material was collected to determine if *Z. pedunculata* or *Z. Obtusifolia* was present at the visited sampling sites. However, enough botanical knowledge was gathered by the author in order to identify the *Zannichellia* species in an accurate way in future. In the ponds, subjected to prolonged drought *Z. Obtusifolia* is better able to survive than *Z. Pedunculata* (van Vierssen, 1982). In this aquatic ecosystems of the Albufera (Es Ras, Ses Puntetes) it is good possible that these species are present.

Ruppia maritima was present at most of the sampling sites at the sites where *Ruppia* sp. was found. It was not possible yet to identify the *Ruppia* species from Estany du Ponts. The plant material is sent to botanical experts of the NIOO institute, because it could be *Ruppia drepanensis* Tineo.

Table 3, An overview of found aquatic vegetation taxa in the summer of 2000 at a selection of baseline monitoring sites (Martinez-Taberner, 1988; Veraart, 2000)

Locations -->												
Taxa	C12N1(A) S. des Pollo	C12N1(B) (temporary)	Ses Salines (temporary)	EPHA (temporary)	C2N3 (C.Sol,Sa Roca)	C4N3 (C. Sa Siurana)	C3N3 (Gran Canal, Sa R)	C1N4 (Farm Margalida)	Es Ras (temporary)	Pond Can Picaford	EPON (Estany du Ponts)	<u>Biodiversity status</u>
<i>Zannichellia spp (2?)</i>	P*	D				P*			D			<u>Check NIOO</u>
<i>Ruppia maritima</i>			D	D								Common
<i>Ruppia sp. (Cirhosa?)</i>											P	<i>Check NIOO</i>
<i>Cymodocea nodosa</i>											P	In 1999 wrong identified as <i>Zostera marina</i>
<i>Potamogeton pectinatus</i>	P				D			P				Common
<i>Potamogeton crispus</i>	D											Common
<i>Apium inundatum</i>	P											
<i>Rorippa nasturtium aquaticum</i>	P											
<i>Myriophyllum spicatum</i>	P				P		P					Common
<i>Ranunculus sceleratus</i>		R										
<i>Ranunculus trichophyllus</i>							P					
<i>Chara vulgaris</i>					R	D		D				Currently most common stonewort in the Albufera
<i>Chara imperfecta</i>		P										New to the Albufera
<i>Lamprothamnium papulosum</i>			P	P								Increasing distribution since 83-85, rare species for Europe, salinisation indicator
<i>Nitella Syncarpa</i>								R				New to the Albufera
<i>Spirogyra spp.</i>	P							D		P		Eutrophication indicator (N)
<i>Cladophora sp.</i>							P					Eutrophication indicator (pers.com. Santamaria)
<i>Rhodopyceae sp.</i>											P	
<i>Chaetomorpha sp.</i>	P				P						P	Salinisation indicator
<i>Enteromorpha sp.</i>	D											Eutrophication indicator (N)

R= Rare (only some individuals), P= present, D =Dominant (coverage >75%)

*= *Zannichellia pedunculata*

3. Discussion of the results

3.1 Objective A: Charophyte abundance and diversity

It was not possible to visit all the baseline locations due to breeding birds and time restrictions. As a result it was not possible to make a complete inventory of the charophyte community in the Albufera. Based on the available data from the summer of 1999 and the spring of 2000 it seems that *Chara vulgaris* and *Lamprothamnium papulosum* are currently the most widely distributed species. These species tolerate higher salinities than other stonewort taxa (Martinez-Taberner, 1988; Moore, 1986).

The increasing salinities (Veraart, 2000) are a threat for the diversity in stoneworts in the temporary ponds. Five different stonewort species were present in this habitat in 83-85: *Lamprothamnium papulosum*, *C. canescens*, *C. aspera*, *C. galliodes* and *C. hispida*. It can be predicted that as a result of increasing salinities eventually only *Lamprothamnium papulosum* will be present in the temporary ponds near the coast. This is for example showed by the changes in Estany Canyissar between 1999 and 2000.

It should be mentioned that the average salinity in the newly created ponds in Es Ras Sa Roca and Ses Punes is probably considerably lower than in the temporary ponds sampled in 83-85 (estany Canyissar, Joncar and Salicornar). In other words: in the temporary ponds in Es Ras, Ses Punes and Sa Roca are potential new suitable habitats for stoneworts created. Indeed stoneworts were found at these sites in June 1999 (Veraart, 2000). In April 2000 these sites could not be fully explored due to breeding birds. However, the abundance and coverage percentage of stoneworts in the newly created ponds is determined by a lot of environmental factors. Like eutrophic conditions, competition with vascular submerged vegetation (*Zannichellia* sp.) and seasonal patterns in desiccation. Based on the ecological data it seems that in the Albufera two types of temporary ponds can be distinguished:

- A) Ses Salines, Estany Canyissar, Joncar and Salicornar. The ponds are under sea influence, as a result salinity is high. The habitat could be described as meso/mixohalien. The eutrophic degree is probably low caused by seawater dilution. Nitrate and phosphate concentrations are considerably lower in seawater than in freshwater. Estany Canyissar is currently included into the water quality monitoring program.
- B) The newly created ponds in Sa Roca, Ses Punes and Es Ras. The ponds are fed from inland water originating from the wells. The water is probably nutrient rich (nitrates). The salinity is lower than in the ponds from type A. The habitat could be described as oligo/mesohalien. This conclusion is based on the ecological monitoring programme, this new type of habitat is not (yet?) included into the water quality monitoring program.

3.2 Objective B: long-term monitoring of the aquatic vegetation

Based on the fieldwork results from 1999 and 2000 and the discussion with experts (Dr. Martinez and Dr. Santamaria) it seems worthwhile to set up a long-term monitoring programme for aquatic vegetation. In Veraart (2000) suggestions for a monitoring protocol (objectives, frequency, sampling sites and data analysis) and strategy can be found, the study of Martinez (1988) could be used as a baseline study. The set up of table 3 could be used as a standard fieldwork form, used by volunteers. The relationships between the environmental impacts in the two types of temporary ponds and the bio-indicators within the aquatic vegetation are summarised in figure 3 (Santamaria, pers. comm.).

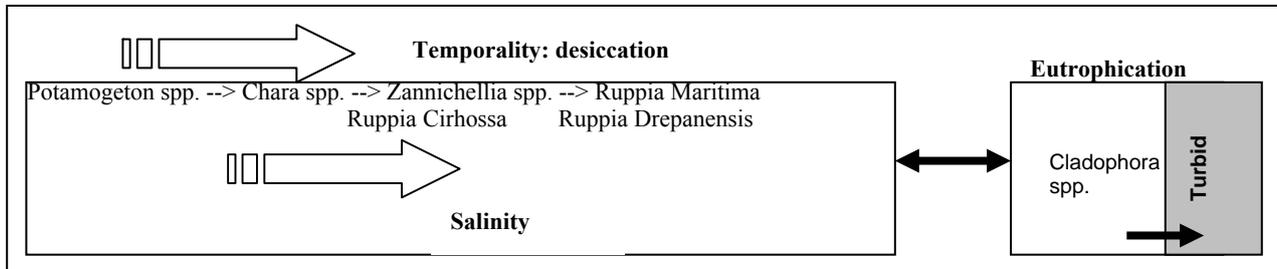


Figure 3, Bio-indicators within the aquatic vegetation of temporary ponds in relation to temporality, salinity and eutrophication

3.3 Objective C: Zooplankton sampling

A lot of the zooplankton taxa found in the spring of 2000 in the newly created ponds were not recorded before (De Manuel, 1995; Jaume, 1995). The found species are common in the whole world (cosmopolitan), but it shows that within the Crustaceae and Rotifera the current species lists of the park are not complete yet.

The quantitative sampling method (concentrations Cladocera and Copepoda) should be improved in order to provide reliable statistical results. In the shallow temporary ponds sampling with bottles might be correct but to sample the deeper baseline sampling sites professional equipment is necessary. Vertical migration of zooplankton should be taken into account at locations like the frog pond or Estany d'en Mama. It is recommended to do future monitoring and research in relation to the zooplankton community (quantity and quality) as the ecological function of these taxa (phytoplankton grazing) is crucial in maintaining the most diverse state of clear water dominated by submerged macrophytes (Veraart, 2000).

3.4 Objective D: Recommendations for future research and monitoring

- It is recommended to add one of the newly created temporary ponds in Es Ras, Sa Rocca or Ses Punes to the current on-going monitoring program for water quality. The ecosystem structure of these ponds differs much from the temporary ponds which are already in the monitoring program (Estany Canyissar and Ses Salines). At least 2 years of monthly data are necessary to draw conclusions about the habitat characteristics based on seasonal variations in salinity, temperature, oxygen and desiccation. At least 4 years of monthly data is necessary to draw conclusions about (long term) trends for the water quality variables. After respectively 2 (seasonality) and 4 years (trends) conclusions could be drawn from statistical analysis. If the necessary information is obtained to describe the habitat, it should be re-considered to prolong chemical monitoring. Ideally, this protocol should be considered for all the water quality sampling sites, see also the monitoring cycle in Veraart (2000).
- It is recommended to add trend and seasonality analysis to the current analysis of the water quality and water level data in order to obtain necessary information about the determining factors for the life cycle of present species and community structure of the aquatic ecosystem.
- It is recommended to carry out a charophyte survey during a whole summer (bird breeding restrictions in spring) at all the baseline monitoring sites and newly created habitats to assess the diversity in stoneworts in the Albufera. Then it becomes possible to assess changes in diversity since 83-85.

4. Possible thesis subjects for Mallorcan and foreign (Dutch) students

4.1 Aquatic Ecology

1. Title : *Assessment of potential environmental impacts on the life cycle of submerged aquatic macrophyte community in temporary Mediterranean marshes: the Albufera wetland as a study case*

Time period : 3 -6 months

Examination/supervision: Dr. R.S. de Groot /Ir. J.A. Veraart (Dutch students)

Examination/supervision: Dr. A. Martínez, dep. d'Ecologia (students UIB)

In co-operation with : PN s'Albufera, Aquatic Ecology WUR, MEDWET(?), NIOO(?)

Research strategy : literature survey, time series analysis, modelling

Interesting for : Environmental Sciences, Biology, Nature Conservation

Contents

The community structure of the submerged vegetation is an important factor that determines the functioning of temporary marshes as a nursery and habitat for birds. The development of the submerged vegetation and ultimately also the development of associated fauna are (waterfowl) determined by a lot of environmental factors, like water quality, optical conditions, desiccation, hydrology and meteorological conditions. In this research you are asked to assess the potential impacts of changes in these environmental factors for the community structure of the submerged vegetation in the temporary ponds of the Albufera wetland in Mallorca. Monthly data for water quality, water levels and meteorology are available for data analysis. Eventually, your results can be used for model development in order to assess the habitat and nursery function of submerged macrophytes for waterfowl in temporary wetlands.

2. Title : *Towards the use of the submerged macrophyte seed bank as an performance indicator for the habitat and nursery function of temporary Mediterranean marshes*

Time period : 6-9 months, preferable in spring/summer

Examination/supervision : Dr. R.S. de Groot/Ir. J.A. Veraart (Dutch students)

Examination/supervision: Dr. A. Martínez, dep. d'Ecologia (students UIB)

In co-operation with : PN s'Albufera, UIB (dep. Ecologia), NIOO (?), Aq. eco. WUR

Research strategy : Fieldwork combined with literature survey

Interesting for : Environmental Sciences, Biology, Nature Conservation

contents

The seed bank of temporary ponds in coastal marshes may play important role for the maintenance of a nursery and habitat of waterfowl. Both the long-term survival of the seedbank and the recolonization from seeds from neighbouring wetlands by waterfowl seem to be important factors to explain recovery of vegetation after unfavourable years. The maintenance of a high diversity in the seed-bank may be an important mechanism for the maintenance of the macrophyte-dominated state. In this research you are asked to make an inventory of the abundance and composition of the submerged macrophyte seed bank and vegetation in the temporary ponds in s'Albufera de Mallorca. You are asked to compare your inventory with research done in other Mediterranean wetlands (Donana, Spain or Camargue, France).

3. Title* : *The importance of migrating waterfowl for long distance dispersal in aquatic key species*

Time period : 6-9 months

Examination/supervision : Dr. R.S. de Groot/Ir. J.A. Veraart (Dutch students)

Examination/supervision: *Dr. A. Martínez (UIB)/mr. N.J. Riddiford (TAIBG)*

In co-operation with : PN s'Albufera, UIB (dep. Ecologia), NIOO (?), Aq. eco. WUR

Research strategy : Literature survey (combined with fieldwork?)

Interesting for : Environmental Sciences, Biology, Nature Conservation

contents

Waterfowl migration might be an important factor for wetland diversity in aquatic plants and zooplankton. Waterfowl connect different ecosystems with each other. In on-going research at the Netherlands Institute for Ecology (NIOO) they try to determine the carrier ability of different waterfowl species feeding on seeds and resting eggs of clonal aquatic organisms, namely pondweeds and Cladocerans. Also they try to investigate the ecological requirements of individuals coming from different pondweed populations, and how this requirements constrain their future establishment when carried to other (ecologically-different) wetlands. In this context it is interesting to compare the ornithological and aquatic ecological data from the Albufera wetland with other different (Mediterranean) wetlands, for example Donana(Spain) or Camargue (France). The research might be combined with aquatic ecological and ornithological fieldwork in the Albufera.

4. Title** : *The potential impact of water level fluctuations and sluice management on the community structure in the canal system of the Albufera*

Time period : 3-9 months

Examination/supervision : Dr. R.S. de Groot/Dr. R.M.M. Roijackers/Ir. J.A. Veraart

Examination/supervision: *Dr. A. Martínez (UIB)/mr. N.J. Riddiford (TAIBG)**

In co-operation with : PN s'Albufera, UIB (dep. Ecologia), Aquatic ecology WUR

Research strategy : Modelling and literature survey

Interesting for : Environmental Sciences, Biology, Nature Conservation

contents

In the canal system of the Albufera nuisance growth of *Enteromorpha* sp. and *Potamogeton pectinatus* was observed at several locations before and after rehabilitation of the wetland. Both species are known to become dominant under eutrophic conditions. Low growing structural macrophytes, like Charophyceae, are in disadvantage when *Enteromorpha* sp. or *Potamogeton pectinatus* are dominant. It seems that also water level fluctuations may affect the community structure in the canal system. Maybe sluice management can be used to reduce nuisance growth of *Enteromorpha* sp. Ecological models are developed to determine the factors that may influence the competition between structural different (submerged) macrophytes. Try to analyse the potential impacts of water fluctuations on the community structure of the canal system of the Albufera with the available data and the use of such a model, like CHARISMA.

* This research is only possible in co-operation with the NIOO (Luis Santamaria)

** This research is only possible in co-operation with the aquatic ecology and water management group, Wageningen University

5. Title* : *Towards modelling of the potential environmental impacts on the submerged aquatic macrophyte community in temporary Mediterranean marshes: the Albufera wetland as a study case*

Time period : 3-6 months

Examination/supervision : Dr. R.S. de Groot/Dr. R.M.M. Roijackers/Ir. J.A. Veraart
*Examination/supervision: Dr. A. Martínez (UIB)/mr. N.J. Riddiford (TAIBG)**

In co-operation with : PN s'Albufera, UIB (dep. Ecologia), Aquatic ecology WUR

Research strategy : Modelling and literature survey (in comb. with fieldwork?)

Interesting for : Environmental Sciences, Biology, Nature Conservation

contents

Desiccation (water level fluctuations), eutrophication (nitrogen), reduced light conditions (cattle trampling) and increasing salinity levels are processes in the Albufera that may also affect competition between angiosperms (*Potamogeton* sp., *Ruppia* sp.) and Charophyceae in the ephemeral ponds of the Albufera. You are asked which of these factors is probably the most important by doing modelling research (CHARISMA). Compare your results with fieldwork data (ecological and chemical) and/or experiments. Try to find how these environmental changes may affect the competition between Charophytes and angiosperms in the ephemeral ponds. Eventually the results may be used to formulate criteria for grazing and sluice management.

* This research is only possible in co-operation with the aquatic ecology and water management group, Wageningen University

6. Title : *Towards a better understanding of the impact of introduction of exotic species into the aquatic food web in the Albufera*

Time period : 3-6 months

Examination/supervision : Dr. R.S. de Groot/Ir. J.A. Veraart (Dutch students)
Examination/supervision: Dr. A. Martínez (UIB)/mr. N.J. Riddiford (TAIBG)

In co-operation with : PN s'Albufera, UIB (dep. Ecologia), Aquatic ecology WUR

Research strategy : Literature survey (in comb. with fieldwork and experiments)

Interesting for : Environmental Sciences, Biology, Nature Conservation

contents

Mosquito fish (*Gambusia affinis*) and American Crayfish (*Procambarus Clarkii*) are two introduced species in the Albufera. Small Mosquito fish feed mostly on zooplankton, whereas larger individuals feed on freshwater invertebrates and terrestrial fauna. Dietary preferences are also determined by habitat and seasonal factors. The large numbers of mosquito fish may effect the grazing efficiency of the zooplankton community on phytoplankton biomass. American Crayfish intensively grazes the submerged vegetation, it also may affect the competition between herbivorous and fishfeeding waterfowl. In this research to assess to potential changes in the foodweb relationships due to the introduction of these species by literature survey. The research might be expanded with fieldwork (zooplankton and fish sampling) in combination with experiments.

*This research is only possible in co-operation with the aquatic ecology and water management group, Wageningen University

7. Title* : *Assessment of the impact of pesticides on the aquatic ecosystem of the Albufera and the selection of bio-indicators*

Time period : 6-9 months

Examination/supervision : Dr. R.S. de Groot/Ir. J.A. Veraart(/Dr. A.A. Koelmans*)
*Examination/supervision: Dr. A. Martínez (UIB)/mr. N.J. Riddiford (TAIBG)**

In co-operation with : PN s'Albufera, UIB (dep. Ecologia), Aquatic ecology WUR

Research strategy : Literature survey (in comb. with experiments/modelling*)

Interesting for : Environmental Sciences, Biology, Nature Conservation

Contents

The large use of pesticides in the agricultural areas around the Albufera is worrying. A list of used pesticides is available, but not complete. An inventory of the fate and impacts of these chemicals is needed in order to analyse the potential risks of use for wetland functioning, drinking water supply and human health. This could be done by means of literature survey. In co-operation with the Aquatic Ecology Group it is probably also possible to do some ecotoxicological modelling (AQUATOX?) and laboratory experiments.

*This research is only possible in co-operation with the aquatic ecology and water management group, Wageningen University

4.2 Hydrology and water quality

8. Title : *Statistical analysis of water quality and hydrology data from on-going monitoring programmes*

Time period : 3-6 months

Examination/supervision : Dr. R.S. de Groot/Ir. J.A. Veraart/Ir. A.J.H. van Vliet
Examination/supervision: Dr. A. Martínez (UIB)/mr. G. Perelló

In co-operation with : PN s'Albufera, UIB (dep. Ecologia)

Research strategy : Literature survey and statistical data analysis

Interesting for : Environmental Sciences, Biology, Nature Conservation

Contents

Seasonal patterns in water temperature, salinity/conductivity, water level fluctuations and desiccation are important factors controlling the phenology of flora and fauna in the aquatic ecosystem. Statistical analysis with data of these variables to identify seasonal patterns and trends provides very useful information for the interpretation of ecological data, which may facilitate the selection of indicator species for environmental change. You are asked to perform time series analysis with the available data, and to discuss the results in relation to a selected compartment of the aquatic ecosystem (vegetation, zooplankton, etc.). Discuss your results in relation to the monitoring objectives from Park Management in order to make recommendations to improve the current monitoring protocol for water quality and hydrology.

9. Title* : *Towards a monitoring protocol to monitor the impact of eutrophication in the Albufera: the light conditions*

Time period : 6-12 months (preferably 12 months)

Examination/supervision : Dr. R.S. de Groot/Ir. J.A. Veraart (Dutch students*)
*Examination/supervision: Dr. A. Martínez (UIB)/mr. G. Perelló**

In co-operation with : PN s'Albufera, UIB (dep. Ecologia), Aquatic Ecology WUR

Research strategy : Literature survey and fieldwork

Interesting for : Environmental Sciences, Biology, Nature Conservation

Contents

It is an aim of park management to include nutrients and light conditions (chlorophyll-a/Secchi depth/light intensity) into the long-term monitoring programmes of the Albufera. Lack of clarity caused by algal blooms and suspended solids affects many biological mechanisms. Therefore, understanding the functioning of aquatic communities requires basic understanding of under-water optics. You are asked to do a pilot study into the field in order to select key sampling sites and monitoring frequency.

* This research is preferably carried out by/or in combination with a Mallorcan student as it is recommended to do measurements during a whole year.

10. Title : *nutrient kinetics between sediment, water and biota*
Time period : 3-6 months
Examination/supervision : Dr. R.S. de Groot/Ir. J.A. Veraart (Dutch students)
Examination/supervision: Dr. A. Martínez (UIB)
In co-operation with : PN s'Albufera, UIB (dep. Ecologia), Aquatic Ecology (WUR)
Research strategy : Literature survey/ data analysis
Interesting for : Environmental Sciences, Biology, Nature Conservation

Contents

Phosphorus release from the sediment might have delayed a decrease in phosphorus concentrations in the Gran canal despite phosphorus load reduction. Enhanced mineralisation and sulfide-immobilisation resulting in phosphite-mobilisation might be important explanatory processes. The sediment was analysed in 1993. In this research you are asked to compare the results of these data with water quality data from park staff in order to study the geochemical mechanisms that govern sediment phosphorus release in the Gran Canal. The results can be used for setting up future research in relation to the chemical composition of the sediment.

4.3 Integrated Environmental Function Analysis

11. Title : *Towards the assessment of the natural water demand of ecosystems and development of indicators for sustainable water use*
Time period : 6 months
Examination/supervision : Dr. R.S. de Groot/Ir. J.A. Veraart (Dutch students)
Examination/supervision: Geography department/ Mr. G.Perelló
In co-operation with : PN s'Albufera, UIB (dep. Geografia)
Research strategy : Literature survey/ data analysis
Interesting for : Environmental Sciences, Biology, Nature Conservation, Physical Planning, geography

Contents

In Mallorca water demand increased rapidly since Spain became a member of the European Union. The water use has increased because of intensified use of irrigation techniques in the agricultural sector. Drinking water demand increases every year as a result of the increasing number of tourists. Sea water intrusion is becoming a major problem for drinking water production and agriculture. It is an objective of the Balearic government to achieve a sustainable balance between socio-economic freshwater demand and natural freshwater supply (precipitation). However, in order to maintain the freshwater habitat in Mallorca (in the past only found in the Albufera) also the natural water demand should be taken into account in Balearic environmental policy. In this thesis you are asked to perform an analysis in order to figure out potential conflicts and potential win-win situations between socio-economic water demand and the natural water demand of the wetland ecosystems in Mallorca. Eventually, sustainability indicators for environmental policy may be formulated that also include the natural water demand.

12. Title : *Towards a integrated environmental function model for sluice management and canal cleaning*
Time period : 6 months
Examination/supervision : Dr. R.S. de Groot/Ir. J.A. Veraart (Dutch students)
Examination/supervision: Geography department/ Mr. G.Perelló
In co-operation with : PN s'Albufera, UIB (dep. Geografia), TON WUR?
Research strategy : Literature survey/ data analysis
Interesting for : Environmental Sciences, Biology, Nature Conservation, Physical Planning, geography

Contents

Sluice management in the Albufera aims to control water levels, reduce currents and to avoid completely desiccation of the temporary marshes. The current sluice management is potentially beneficial for nutrient removal by emergent macrophytes, the recharge of the aquifer and it provides protection for saltwater intrusion. The construction of the dam in the Gran Canal reduces the nutrient loads into the Alcuia Bay, but a large pool of nutrients is built up into the sediment behind the dam. Water level manipulation may have its impact on the submerged vegetation community structure (see also subject 4 and 5). However, open sluices are important for the regulation of agricultural runoff and to provide an entrance for eels and mullets between the wetland and the Alcuia Bay. The canals should be cleaned in order to maintain agricultural runoff. In this research you are asked to analyse the potential beneficial and disadvantageous impacts of the sluice management for the main regulation functions of the wetland. Eventually a decision support model could be developed in order to formulate sluice management criteria for all the regulation functions.

13. Title : *Towards a integrated environmental function model for grazing management in Mediterranean wetlands*
- Time period : 6-9 months (preferable you start in March/April)
- Examination/supervision : Dr. R.S. de Groot/Ir. J.A. Veraart (Dutch students)
- Examination/supervision:* *Geography department/ Mr. G.Perelló/Mr. N.J. Riddiford*
- In co-operation with : PN s'Albufera, UIB (dep. Geografia), TON WUR?
- Research strategy : Literature survey/ data analysis/fieldwork
- Interesting for : Environmental Sciences, Biology, Nature Conservation, Physical Planning, geography

Contents

Cattle grazing has successfully resulted in an increase of the feeding possibilities for the birds. The number of birds are increased since this type of management. However, the colonisation of the created open water areas by submerged vegetation may be negatively affected by cattle trampling. Terrestrial species, like *Orchis palustris* and *Orchis italica* may profit from cattle grazing but it should be taken into account that these species do poorly if grazing is maintained immediately prior to the flowering season. The cattle are an important source of income for the park and the mean as well an integration between agriculture outside the park and nature conservation. In this research you are asked to analyse the potential beneficial and disadvantageous impacts for the different wetland functions. An objective would be to formulate grazing management criteria based on aquatic ecological, floristic and economical criteria. Fieldwork may consist of an Orchid census, vegetation mapping and studying grazing behaviour.

14. Title : *Towards a GIS model to assess anthropogenic impacts on biodiversity conservation in s'Albufera*
Time period : 6 months
Examination/supervision : Dr. R.S. de Groot/Ir. J.A. Veraart (Dutch students)
Examination/supervision: Geography department/ Mr. G.Perelló
In co-operation with : PN s'Albufera, UIB (dep. Geografia)
Research strategy : Literature survey/ data analysis
Interesting for : Environmental Sciences, Biology, Nature Conservation, Physical Planning, geography

Contents

Agriculture, tourism and management may interfere with the complex ecological relationships that exist in the Albufera. In order to analyse potential conflicts between those human activities and biodiversity conservation it is recommended to integrate the collected ecological and chemical data into a GIS system. In near future GIS equipment will be available for park management. In this research you are asked to think of a possible set up of such a system in order to analyse the potential impacts of human activities on the different ecological functions. Your results may be used for the construction of a system that can identify the close relationships between ecosystem functioning and human activities.

15. Title : *Analysis of the water use structure and decision-making structure in the Albufera watershed*
Time period : 6 months
Examination/supervision : Dr. R.S. de Groot/Ir. J.A. Veraart (Dutch students)
Examination/supervision: Geography department/ Mr. G.Perelló
In co-operation with : PN s'Albufera, UIB (dep. Geografia), NIOO(?)
Research strategy : Literature survey/ data analysis
Interesting for : Environmental Sciences, Biology, Nature Conservation, Physical Planning, geography

Contents

Parc Natural s'Albufera enjoys international credit as a major wintering and stopover area for a wide array of migratory birds. However, it is difficult to protect the area caused by its position in a heavily used watershed. In this research you are asked to analyse the water use structure and its associated decision-making network in the Albufera catchment. Fragmentation in both the praxis and the conceptualisation of water use and management may explain loss in biodiversity in the wetland. In this research you are asked to describe the historical process behind the construction of socio-nature in Mallorca and to describe the institutional and socio-technical organisation of Mallorcan environmental policy in relation to water issues. Try also to situate the Mallorcan environmental policy into the Spanish and European framework of territorial and environmental management.

16. Title : *Wetland management integrating within its watershed: towards a global framework for nature conservation*
Time period : 6 months
Examination/supervision : Dr. R.S. de Groot/Ir. J.A. Veraart (Dutch students)
Examination/supervision: Geography department/ Mr. G.Perelló
In co-operation with : PN s'Albufera, UIB (dep. Geografia)
Research strategy : Literature survey/interviews?
Interesting for : Environmental Sciences, Biology, Nature Conservation, Physical Planning, geography

Contents

The sustainable use of wetlands and water resources requires management approaches that incorporate explicitly the spatial and temporal interconnections among different aquatic ecosystems. Current management practices in Europe, on the contrary, are characterised by conceptual, thematic and spatial divisions. As a lot of the environmental impacts take place outside the borders of the wetlands it is important to point to the necessity of integrated watershed/aquifer management approaches. Ideally, Integrated management approaches should also incorporate a number of inter-connected processes, although geographically or temporarily separated (like migratory waterfowl) . In this research you are asked to make an inventory of multiple directives and regulations affecting European wetlands policy. Try to analyse how inter-connected processes could be institutionalized into European directives.

17. Title : *Assessment of potential conflicts between agriculture and biodiversity conservation in the Albufera catchment*
Time period : 6 months
Examination/supervision : -
Examination/supervision: Geography department/ Mr. G.Perelló/Mr. N.J. Riddiford
In co-operation with : PN s'Albufera, UIB (dep. Geografia)
Research strategy : Literature survey/ interviews/data analysis
Interesting for : Environmental Sciences, Biology, Nature Conservation, Physical Planning, geography

Contents

In 1986 Spain became a member of the European Union. As a result the use of irrigation techniques, pesticide use and fertilizer use increased rapidly in the Albufera catchment. These developments do not only mean negative impacts for biodiversity conservation. Drinking water is becoming scarce and contaminated with pesticides. Increased saltwater intrusion is also a problem for agriculture. In this research you are asked to make an inventory of the opinion of the farmers around the Albufera about biodiversity conservation in context to above mentioned environmental problems. This research is preferably carried out by Mallorcan students.

18. Title : *Towards an integrated coastal zone management approach for the coastal zone of Alcudia*
Time period : 6 months
Examination/supervision : Dr. R.S. de Groot/Ir. J.A. Veraart (Dutch students)
Examination/supervision: Geography department/ Mr. G.Perelló
In co-operation with : PN s'Albufera, UIB (dep. Geografia)
Research strategy : Literature survey/ data analysis
Interesting for : Environmental Sciences, Biology, Nature Conservation, Physical Planning, geography

Contents

Alcudia Bay, in the northeast of Mallorca, is a site of extensive urban development, associated principally with tourism. It is also the site of internationally recognised coastal wetlands and sand dunes, with a significant area now protected. High levels of human activity in the coastal zone represent a threat to the adjacent natural ecosystems. These natural ecosystems provide vital services which form the basis of a functioning coastal zone. In an earlier study (Whittingham, 1999) the concept of integrated coastal zone management (ICZM) was introduced. Existing coastal management in the Alcudia Bay is characterised by a fragmented sectoral approach, whereby municipalities, regional and national government appear to pursue independent management objectives. In this research you are asked to perform an analysis in order to make an inventory about the potential conflicts between tourism in the coastal zone and the value of the services provided by the underlying natural systems around the coastal zone (the Albufera wetland and the Alcudia Bay). Eventually you may do recommendations towards the introduction of ICZM.

19. Title : *The importance of the ecological functions of the Albufera wetland ecosystem for the coastal zone and Alcudia Bay*
Time period : 6 months
Examination/supervision : Dr. R.S. de Groot/Ir. J.A. Veraart (Dutch students)
Examination/supervision: Geography department/ Mr. G.Perelló
In co-operation with : PN s'Albufera, UIB (dep. Geografia)
Research strategy : Literature survey/data analysis/interviews
Interesting for : Environmental Sciences, Biology, Nature Conservation, Physical Planning, geography

Contents

Wetlands act like a sink for nutrients and contaminants. This function is important for the marine ecosystem of the Alcudia Bay and tourist developments in the coastal zone. Seagrass ecosystems, for example, are highly productive and supporting rich communities of flora and fauna. Seagrass is also well recognised for its role in sedimentary processes and provides an important hydrodynamic barrier, which protect the near shore from erosion (beneficial for the tourist sector). High nutrient loads from coastal waters (as a result of agriculture) may have its impact on the seagrass ecosystem. In this research you are asked to make a cost/benefit analysis for tourism and the ecological units involved (the wetland, Alcudia Bay and the Coastal zone).

20. Title : *Towards the valuation of the ecological functions of the Albufera for Mallorcan society with special attention to the tourist sector and/or agriculture*

Time period : 6 months

Examination/supervision : Dr. R.S. de Groot/Ir. J.A. Veraart (Dutch students)

Examination/supervision: *Geography department/ Mr. G.Perelló*

In co-operation with : PN s'Albufera, UIB (dep. Geografia)

Research strategy : Literature survey/ data analysis

Interesting for : Environmental Sciences, Biology, Nature Conservation, Physical Planning, geography

Contents

The functional integrity of the Albufera wetland is a reflection of the health of the natural ecosystems, which are shaped both by natural and anthropogenic factors. On the other hand the functional integrity of the Albufera wetland provides goods and services for socio economic activities (tourism and agriculture) in the catchment and coastal zone. In this research you are asked to (e)valuate some of these services of the ecosystem. Eventually, you may try to incorporate this (ev)valuation into a economical cost and benefit analysis.

4. References

- Armengol J., et al.**, 1986. Història natural dels Països Catalans. Artropodes(I), vol. 9, Barcelona.
- Beckett E.**, 1993. Illustrated flora of Mallorca. Editorial Moll, Palma de Mallorca
- Bloemendaal F.H.J.L., Roelofs J.G.M.**, 1988. Waterplanten en waterkwaliteit.stichting uitgeverij van de Koninklijke Nederlandse Natuurhistorische Vereniging en Vakgroep Aquatische Oecologie en Biogeologie, Katholieke Universiteit Nijmegen.
- Comelles M.**, 1985. Clave de identificación de las especies de carófitos de la Península Ibérica. Asociacion española de limnologia, publicacion no 1, Edicions Universitat Barcelona.
- Grillas P., Garcia-Murillo P., Geertz-Hansen O., Marbá, Montes C., Duarte C.M., Tan Ham L., Grossmann A.**, 1993. Submerged macrophyte seed bank in a Mediterranean temporary marsh: abundance and relationship with established vegetation. *Oecologia* (1993) 94: 1-6
- Jaume, D.**, 1995. Una llista dels crustacis de s'Albufera. From s'Albufera de Mallorca. (Monografies de la Soc. Hist. Nat. Balears, 4),pp 119-124. Ed. Moll, Palma de Mallorca.
- Haslam S., Sinker C., Wolseley P.**, 1975. British water plants. Reprinted from field studies, Vol. 4 no.2 (1975)
- Manuel De J.**, 1995. Aportacio de la fauna de rotifers de les aigues de S'Albufera de Mallorca. From s'Albufera de Mallorca. (Monografies de la Soc. Hist. Nat. Balears, 4). Pp 113-118. Ed. Moll, Palma de Mallorca.
- Martinez-Taberner**, 1988. Carateristiques limnologiques de S'Albufera de Mallorca, tesi doctoral, Palma de Mallorca.
- Moore J.A.**, 1986. Charophytes of Great Britain and Ireland. BSBI Handbook no5, Botanical society of the British Isles, London
- Santamaria L.E.**, 1995. The ecology of *Ruppia drepanensis* tinea in a Mediterranean brackish marsh (Doñana National Park, SW Spain) A basis for the management of semi-arid floodplain wetlands, postgraduate thesis, Wageningen Agricultural University and IHE Delft, AA Balkema, Rotterdam.
- Santamaria L.E., Montes C., Hootsmans M.J.M.**, 1996. Influence of environmental parameters on the biomass development of *Ruppia drepanensis* populations in the Doñana National Park: the importance of conditions affecting the underwater light climate. *Salt lake research* 5: 157-180, Kluwer Academic Publishers, Holland.
- Santamaria L.E., Hootsmans M.J.M., Vierssen W. Van**, 1995. Flowering time as influenced by nitrate fertilisation in *Ruppia drepanensis* Tineo. *Aquatic botany* 52 45-58
- Santamaria L.E., Amezaga J.M.**, 1999. Improving the managment of large protected wetlands: Learning the lessons from the Doñana nature reserves. *Ecosystems and Sustainable Development*, second international conference on ecosystems and sustainable development
- Scheffer M.**, 1998. Ecology of shallow lakes. Chapman and Hall, London.
- Streble H., Krauter D.**, 1988. Das leben im wassertropfen mikroflora und microfauna des süßwassers, ein bestimmungsbuch. Kosmos Gesellschaft der Naturfreunde Franckh'sche Verlagshandlung Stuttgart.
- Veraart J.A.**, 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, msc thesis, Wageningen University, Holland.
- Vierssen W. van**, 1982. The ecology of communities dominated by *Zannichellia* taxa in western Europe. phd thesis, Katholic University of Nijmegen, Holland

Appendix A: Sampling locations

Pilot Study of the Seagrass *Posidonia oceanica* Ecosystem in the Bay of Alcudia Bordering the Parc Natural de S'Albufera, Mallorca: a preliminary report by Suzanne Marshall

Nick Riddiford, Project Co-ordinator of Albufera Parc Natural, arranged for a marine science team to study the seagrass *Posidonia oceanica* ecosystem in the Bay of Alcudia, bordering the Parc Natural de S'Albufera for a two week period through April-May earlier this year.

The marine science programme is ongoing and was co-ordinated by Suzanne Marshall with marine research assistants Richard Green and Nick Foster. Suzanne Marshall (Thames Regional Biodiversity Co-ordinator) and Richard Green (Devon Conservation and Recreation Officer) both work for the Environment Agency in UK, which is the environment regulator of the water industry and Nick is a Masters student at Newcastle University. Suzanne has previously worked on seagrasses in the East African Region, predominantly around the island of Mafia, Tanzania and the Seychelles islands.

Posidonia oceanica is listed as a rare species under the EU Habitats Directive, very little is known about this seagrass which promoted the area of study in an area adjacent to a natural parc. The scientific marine study was based on recommendations by Emma Whittingham, a Masters student at the Dept of Tropical Coastal Management, University of Newcastle in the MSc dissertation: "The Coastal Zone of Alcudia Bay, Mallorca: an assessment of change and potential anthropogenic impacts on the *Posidonia oceanica* seagrass habitat."

The pilot study took place from April 24 to May 8. Approximately two dives a day were carried out over a one week period. The methodology used was based on the Australian Institute of Marine Science (AIMS) seagrass monitoring programme, using 100 m transects with quadrat sampling, every 25 m. Density of the seagrass was estimated using the Dafor scale. Environmental parameters such as oxygen content, salinity, pH, as well as temperature of the water at the surface and seabed were noted as well as marine biodiversity species and a description of each transect site. Sediment samples were also taken. During the study period, three 100 m transects and two random sites were assessed, totalling 17 sample sites. The transects were taken 1km either side of the canal and then one parallel to the canal, all approximately 1 km from the shoreline in a east - west direction. The transect sites revealed very different environments. Basic results revealed that the transect east of the canal revealed a less dense *Posidonia* within a sandy environment. The transect opposite to the entrance of the canal showed a much denser *Posidonia* and the mollusc *Pinna squamosa* a locally protected species, was common place. The transect, north-east of the canal, revealed a filamentous algae smothering the *Posidonia* and sea urchin proliferation, revealing signs of nutrient enrichment in Alcudia Bay. The two sample points were in response to the findings of the third transect, to assess how far the filamentous algae continued. The sample points were taken towards the north-east end of the bay and near to the power station discharge pipe. However, the filamentous algae was not present at the random sample points.

It is clear that further studies are required to assess the extent of the nutrient enrichment and the source. Links were established with the University of Balearic Islands, marine biology department Carlos M. Duarte/Joachin Tintore and a resident marine biologist, Nasir Eddine Taibi. Copies of all previous papers by the University on *Posidonia* were received by Suzanne Marshall. SCUBA dive centre at Can Picafort assisted the dive team with daily renewal of tanks and equipment which were kindly donated free of charge. In a future visit, the dive centre has offered to video further transect sites. [Editor's note: results of the Pilot study follow]

Pilot Study of the Seagrass *Posidonia oceanica* Ecosystem in the Bay of Alcudia bordering the Parc Natural de S'Albufera, Mallorca: report of findings by Suzanne Marshall

1.0 Introduction

The aim of this short report is to describe the status of the seagrass *Posidonia oceanica*, at the chosen locations within Alcudia Bay, north-east Mallorca (see location map 1) and report the findings.

Posidonia oceanica is listed as a rare species under the EU Habitats Directive, very little is known about this seagrass which promoted the area of study in an area adjacent to a natural parc. The scientific marine study was based on recommendations by Emma Whittingham, a Masters student at the Dept of Tropical Coastal Management, University of Newcastle in the MSc. dissertation: "The Coastal Zone of Alcudia Bay, Mallorca: an assessment of change and potential anthropogenic impacts on the *Posidonia oceanica* seagrass habitat."

2.0 Background

The Project Co-ordinator, Nick Riddiford of The Albufera International Biodiversity group (TAIB), arranged for a marine science team to study the seagrass *Posidonia oceanica* ecosystem in the Bay of Alcudia, bordering the Parc Natural de S'Albufera for a two-week period through April-May 2000.

The marine science programme was co-ordinated by Suzanne Marshall with marine research assistants Richard Green and Nick Foster. Suzanne Marshall (Thames Regional Biodiversity Co-ordinator) and Richard Green (Devon Conservation and Recreation Officer) both work for the Environment Agency in UK, which is the environment regulator of the UK Water Industry. Nick Foster is a Masters student at Newcastle University. Suzanne has previously worked on seagrasses in the East African Region, predominantly around the island of Mafia, Tanzania and the Seychelles islands.

3.0 Methodology

The pilot study took place from April 24th to May 8th 2000. Approximately two dives a day were carried out over a one-week period.

The methodology used was based on the Australian Institute of Marine Sciences (AIMS) seagrass monitoring programme, using 100 m transects with 1 m² quadrat sampling every 25 m. Density of the seagrass was estimated using the Dafor scale (1= rare to 5= dominant).

Dafor Scale:

- 1=1-4%
- 2=5-19%
- 3=20-25%
- 4=26-50%
- 5=51-75%
- 6=76-100%

Environmental parameters such as oxygen content, salinity, pH, as well as temperature of the water at the surface and seabed were noted as well as marine biodiversity species and a description of each transect site. Sediment samples were also taken. During the study period, three 100 m transects and two random sites were assessed, totalling 17 sample sites. The transects were carried out approximately 1 km either side of the canal and then one parallel to the canal, all approximately 1 km from the shoreline in an east - west direction.

4. Results

The species list is an amalgamation of the marine species that were encountered during the marine science programme between April 22nd to May 8th 2000.

4.1 Species list

Pinna squamosa

Calliostoma zizyphinum
Membranipora membranacea
Echinaster sepositus
Gamthia sp.
Murex trunculus
Symphodus mediterraneus
Diplodus annularis
Holothuria tubulosa
Paracentrotus lividus
Labrus viridis
Crenilabrus tinca
Acantholabrus palloni
Coris julius
Chromis chromis
Eunice harassii
Crenilabrus mediterraneus
Labrus bimaculatus
Spirastrella cf cunquatatrix
Dictyota dichotoma var. *intricata*
Caulerpa prolifera
Eudotea petiolata
Acetabularia mediterranea
Dascycladus clavaeformis
Halimeda tuna
Diplodus puntazzo
Gobius geniporus
Pontogenia chrysocoma
Brissus unicolor
Padina pavonia
Halocynthia papillosa
Femela ouigera
Arbacia lixula
Cerithium vulgatum
Ircinia fasciculata
Aplysia depilans
Aplidium conicum

4.2 Sediment samples

The sediment samples were oven dried at 150°C for 36 hours. Particle size analysis of the dried substrate was achieved using a stack of nine 20 cm wide sieves and a base retainer sitting on a Fritsch Analysette mechanical shaker. The sieves followed a geometric series of mesh sizes so that particles would grade into the class intervals of Wentworth (1922). The top sieve had a mesh size of 16 mm and the ninth sieve had a mesh of 63 µm. Pebbles and cobbles that might be larger than 32 mm were removed before mechanical sieving and their class assessed by whether they could pass through 32 mm or 64 mm square holes cut in cardboard.

After 15 minutes of mechanical sieving, each size class was weighed to the nearest 10 mg. The weight of any particles found in the base retainer was added to the weight of the particles retained by the 63 µm mesh sieve. No further analysis was carried out other than to display the results below as it was felt that not enough samples were taken to carry out statistical analysis.

Results are listed below, please refer to site location map 2 for transect site locations.

Transect One

Sample size: 27.45 g

SEDIMENT SAMPLES				
Min. diam.	Particle	Phi	Weight (g)	Description
32 mm		-5		
16 mm		-4	15.65	All <i>Posidonia</i> structures

8 mm	-3	4.21	All smaller <i>Posidonia</i> structures
4 mm	-2	4.11	Shells & silt, plus <i>Posidonia</i> fragments
2 mm	-1	5.10	Finer shells & silt, plus <i>Posidonia</i> fragments
1 mm	0	5.03	Finer silt, plus <i>Posidonia</i> fragments
500 μ	1	4.83	Finer silt
250 μ	2		
125 μ	3	5.24	Finer silt
63 μ	4	2.80	Finer silt
<63 μ	4		
<63 μ (silt anal.)	6		

Transect Two

Sample size: 58.44 g

SEDIMENT SAMPLES				
Min. diam.	Particle	Phi	Weight (g)	Description
32 mm		-5		
16 mm		-4	5.62	Shells
8 mm		-3		
4 mm		-2	5.82	Shells & silt
2 mm		-1	7.65	<i>Posidonia</i> fragments, shells & silt
1 mm		0	11.65	<i>Posidonia</i> fragments, shells
500 μ		1	18.23	<i>Posidonia</i> fragments, shells
250 μ		2		
125 μ		3	19.86	Shells & silt
63 μ		4	5.21	Silt
<63 μ		4		
<63 μ (silt anal.)		6		

Transect Three

Sample size: 39.27 g

SEDIMENT SAMPLES				
Min. diam.	Particle	Phi	Weight (g)	Description
32 mm		-5		
16 mm		-4	14.87	<i>Posidonia</i> fragments
8 mm		-3	17.25	<i>Posidonia</i> fragments
4 mm		-2	4.66	<i>Posidonia</i> fragments & shells
2 mm		-1	6.92	<i>Posidonia</i> fragments & shells

1 mm	0	4.00	<i>Posidonia</i> fragments
500 μ	1	3.49	<i>Posidonia</i> fragments
250 μ	2		
125 μ	3	3.76	<i>Posidonia</i> fragments
63 μ	4	2.93	<i>Posidonia</i> fragments
<63 μ	4		
<63 μ (silt anal.)	6		

Random Sample One

Sample size: 23.10 g

SEDIMENT SAMPLES				
Min. diam.	Particle	Phi	Weight (g)	Description
32 mm		-5		
16 mm		-4	10.90	<i>Posidonia</i> fragments
8 mm		-3	10.27	<i>Posidonia</i> fragments
4 mm		-2	4.14	<i>Posidonia</i> fragments & shells
2 mm		-1	3.87	<i>Posidonia</i> fragments & shells
1 mm		0	3.16	<i>Posidonia</i> fragments
500 μ		1	3.10	<i>Posidonia</i> fragments
250 μ		2		
125 μ		3	3.73	<i>Posidonia</i> fragments
63 μ		4	2.79	<i>Posidonia</i> fragments
<63 μ		4		
<63 μ (silt anal.)		6		

Random Sample Two

Sample size: 14.91 g

SEDIMENT SAMPLES				
Min. diam.	Particle	Phi	Weight (g)	Description
32 mm		-5		
16 mm		-4		
8 mm		-3		
4 mm		-2		
2 mm		-1	2.89	<i>Posidonia</i> fragments & finer silt
1 mm		0	5.82	<i>Posidonia</i> fragments & finer silt
500 μ		1	5.46	<i>Posidonia</i> fragments & finer silt
250 μ		2	8.00	<i>Posidonia</i> fragments & finer silt
125 μ		3	4.31	Fine silt
63 μ		4		
<63 μ		4		
<63 μ (silt anal.)		6		

4.3 Transects and Random Sample Points

The transect sites revealed very different environments. Using graphic resection, the transect sites were plotted onto the map (see location map 3). Each 100m transect was started towards the bay with 25 m intervals for the next 4 random quadrat sampling round the transect line.

Transect One

Bearings: canal 257°, chimneys 342°, Atalaya de Moray 114°, Atalaya de Alcudia 10°

Date and Time of Dive: 29/04/00, 12.20 h. Good visibility to bottom depth of 15 m.

Water sample: Surface: pH 7.8, salinity 37.6, oxygen 5.0 m/l, temp. 17°C.

Bottom: oxygen 4.4 m/l, pH 7.8, temp. 16°C, salinity 37.6

Description: large sand hollows with dense *Posidonia* growth on the ridges.

Cover, Dafor scale:

Sample Point One: 0 m

Quadrat 1	Quadrat 2	Quadrat 3	Quadrat 4
45443	34432	33345	33333
34332	44432	33344	33333
23222	44333	33344	33333
22234	33222	33344	33332
22332	43332	33345	33332

Description: *Pinna squamosa* were noted at 2 m intervals adjacent to a large sand gully.

Sample Point Two: 25 m

Quadrat 1	Quadrat 2	Quadrat 3	Quadrat 4
44222	42101	33332	44443
34210	32013	44322	44333
33012	22345	44433	43334
23222	22555	44555	43443
22222	21113	32555	44442

Description: *Pinna squamosa* were noted at 2 m intervals adjacent to a large sand gully.

Sample Point Three: 50 m

Quadrat 1	Quadrat 2	Quadrat 3	Quadrat 4
33200	44456	11233	22210
22124	44456	11223	43110
21224	44455	22333	44400
22333	44445	55533	44444
43344	44433	65533	22345

Description: Holothurians common on seabed. Approx. 30 *Chromis* on ridge around gully. Gully length approx. 10-20 m.

Sample Point Four: 75 m

Quadrat 1	Quadrat 2	Quadrat 3	Quadrat 4
65544	44433	34210	23444
33344	12344	43210	44443
33333	12333	44421	44344
33322	13344	44544	44333
22222	23344	22244	44430

Description: More dense in patches, away from gully. Thicker clumps of *Posidonia* and larger sand gullies.

Sample Point Five: 100 m

Quadrat 1	Quadrat 2	Quadrat 3	Quadrat 4
55333	33442	11445	34444
33212	23442	11445	34444
23134	11242	12445	44554
22114	11124	12445	33331
12223	22333	12446	22232

Sampling: Depth 15.6 m, temp. 16°C.
 Water sample: Surface: pH 7.8, salinity 37.6, oxygen 5.0m/l. Temp. 17°C.
 Bottom: oxygen 4.4 m/l, pH 7.8, temp. 16°C, salinity 37.6

Transect Two

Bearings: chimneys 0°, Atalaya de Moray 100°, Atalaya de Alcuia 20°, Power Station 310°.
 Date and Time of Dive: 30/04/00, 11.30 h. Depth 15 m.

Water sample: Surface: 7.85pH, 37.6 salinity, oxygen 5m/l. Temp. 16.5°C.
 Bottom: 15.5°C temp.

Description: *Posidonia* on ridges, less raised than Transect 1, more sandy environment, quadrats along sandy ridge; *Petiola sp.* and *Caulerpa prolifera* on edge of ridge. *Posidonia* clumps noted on each mound approximately 2-3 sq.m and more sand gullies.

Sample Point One: 0 m

Quadrat 1	Quadrat 2	Quadrat 3	Quadrat 4
31003	00010	22333	20000
32113	00011	22232	10000
32223	00111	33223	00000
32221	00011	22221	00000
33221	01100	22221	00100

Sample Point Two: 25 m

Quadrat 1	Quadrat 2	Quadrat 3	Quadrat 4
01456	42241	00112	00110
11232	44331	00110	00000
11001	44134	10121	01011
00002	44333	00000	10010
00012	00011	22210	10001

Description: More holothurians, approximately 8/m2. Sandy gully every 2m2.

Sample Point Three: 50 m

Description: All sand and more sandier patches. *Posidonia* not as dense. Large *Posidonia* ridge between these two sample points.

Quadrat 1	Quadrat 2	Quadrat 3	Quadrat 4
01000	00110	00000	00100
00110	01103	00011	20000
10121	01013	11001	00000
00000	01023	00000	00000
22210	10002	01000	00000

Sample Point Four: 75 m

Description: *Posidonia* ridge. *Pinna squamosa* embedded in sand gully.

Quadrat 1	Quadrat 2	Quadrat 3	Quadrat 4
54444	55555	55555	45555
45555	55555	55555	55544
45554	55555	55555	55544
53333	14455	45554	55544
54333	45555	55222	55000

Sample Point Five: 100 m

Quadrat 1	Quadrat 2	Quadrat 3	Quadrat 4
00000	00000	00000	00000
00000	00000	00000	00000
00000	00000	00000	00000
00000	00000	00000	00000
00000	00000	00000	00000
00000	00000	00000	00000

Description: Depth 16 m. Sand gully with approximately four holothurians per quadrat.

Transect 3

Bearings: canal 220°, chimneys 2°, Atalaya de Moray 100°, Atalaya de Alcudia 25°

Date and Time of Dive: 30/04/00, 17.00 h

Water Sample: Surface: 7.82 pH, 37.9 salinity, oxygen m/l. 16°C temp.
Bottom: 15°C temp.

Description: Thick white ?algal cover over seabed. Sand channel man made?

Sample Point One: 0 m

Quadrat 1	Quadrat 2	Quadrat 3	Quadrat 4
02221	00011	00013	12210
22044	11111	32111	44555
00033	22233	00002	44555
10030	33444	22003	23343
10111	44445	00003	10113

Sample Point Two: 25 m

Quadrat 1	Quadrat 2	Quadrat 3	Quadrat 4
55520	100022	33410	44422
33331	22222	44433	33333
33322	22255	33333	11333
11110	21333	22333	12233
11110	21000	33344	00033

Description: Less *Posidonia* with this white ?algal cover

Sample Point Three: 50 m

Description: Quadrats in a trench in white growth area.

Quadrat 1	Quadrat 2	Quadrat 3	Quadrat 4
00000	43321	44333	22334
00010	33211	33433	33233
00000	33433	43433	44343
00011	44422	43322	43344
00000	33322	34333	34443

Sample Point Four: 75 m

Description: After the channel, more sparse vegetation, very thin *Posidonia*.

Quadrat 1	Quadrat 2	Quadrat 3	Quadrat 4
00001	11000	23322	33322
01000	22200	33323	23333
00200	00010	43323	33323
00010	00001	43332	33323
00001	00200	34322	33344

Sample Point Five: 100 m

Description: White cover disappearing.

Quadrat 1	Quadrat 2	Quadrat 3	Quadrat 4
44444	33322	33323	00010
44444	32222	33223	00002
43433	20111	33323	00033
43344	11001	33233	00233
33433	00012	22333	00024

Random Sample One

Bearings: canal 200°, chimneys 42°, Atalaya de Moray 105°, Atalaya de Alcudia 38°, power station 248°.

Date and time of dive: 02/05/00, Time: 11.00 h

Depth: 9 m

Description: Cable on seabed, breeze blocks, waste.
Holothurians 5 per m², sea squirts and a dead *P. squamosa*

Quadrat 1	Quadrat 2	Quadrat 3	Quadrat 4
22223	33443	44444	33333
22332	22233	44344	32343
32222	32223	44332	33211
33211	22222	44332	33332
23332	33334	33332	33232

Random Sample Two

Bearings: chimneys 40°, canal 260°, power station 185°.

Dive Depth: 10-11 m

Description: *Posidonia* on ridge (9 m). Many Holothurians, *P. squamosa* near to *Posidonia*.

Quadrat 1	Quadrat 2	Quadrat 3	Quadrat 4
00122	00000	00321	00000
00112	00000	22321	00000
01222	00000	21112	00000
21000	00001	10000	00000
21000	00001	10000	01000

Basic results revealed that the transect east of the canal revealed less dense *Posidonia* within a sandy environment. The transect opposite to the entrance of the canal showed a much denser *Posidonia* and the mollusc *Pinna squamosa*, a locally protected species, was common place. The transect, north-east of the canal, revealed a filamentous alga or fungus(?) smothering the *Posidonia*; and sea urchin proliferation, revealing signs of nutrient enrichment in Alcudia Bay. The two sample points were in response to the findings of the third transect, to assess how far the filamentous alga/fungus(?) continued. The sample points were taken towards the north-east end of the bay and near to the power station discharge pipe. However, the filamentous alga/fungus(?) was not present at the random sample points.

5.0 Conclusions and Recommendations

This brief report summarises the results of the marine science programme in Alcudia Bay. However, no particular analysis of the findings was carried out as it was an exercise to investigate the marine environment in Alcudia Bay in order to establish a more in depth study; and establish some permanent transect sites with links with the dive centre mentioned below who offered future videotaping of the transects. Further studies are also required to assess whether the AIMS seagrass methodology is suitable for an oceanic seagrass, i.e. *Posidonia*.

Consequently, it is clear that further studies are required to assess the extent of the nutrient enrichment and the source in Alcudia Bay.

In anticipation of further research, links were established with the University of Balearic Islands marine biology department, Carlos M. Duarte/Joachin Tintore, and a resident marine biologist, Nasr Eddine Taibi. Copies of all previous papers by the University on *Posidonia* were received by Suzanne Marshall. SCUBA dive centre at C'an Picafort assisted the dive team with daily renewal of tanks and equipment which were kindly donated free of charge.

Location Map 1: Area of study

Location Map 2: Site location

Location Map 3: Random sample & Transect positions

Fungi of S'Albufera Natural Park, Mallorca - October/November 2000 by Rachel King

INTRODUCTION

Between 28th October and 2nd November 2000 fungi were collected by myself and other members of the team from as many different habitats in the park as possible. The aim was to continue to add to our knowledge of the fungi species present in the park and their relationship with the various vegetation communities and habitat types. This report details the findings.

METHODS

When identification could not be achieved in the field, fresh specimens were collected and when possible slide photos of the specimen taken. Later each species was drawn and described in a fresh state (see notes) then the specimen was dried with a fan heater for microscopic examination. Microscopic examination was carried out in the Dennis Bishop Laboratory at S'Albufera Natural park and later in León University botanical department, Spain with assistance from Basilio Llamas Frade and Arsenio Terrón Alfonso.

RESULTS

From some 58 species described, 42 were identified to species level - 18 of which were not cited on the previous park fungi list (these last species highlighted in bold below). The unidentified species are included at the end of this report (as incomplete entries or as tentative identifications accompanied by question marks). Dry specimens have been kept of all species, identified or otherwise. Field notes are also given for reference at the end of the report.

COMMENTS

It was interesting to find what I believe to be *Arcyria carnea* growing on *Phragmites australis* as I understood it to be associated with mountain habitats.

With the various different habitat types present in the reserve I am sure there is a wealth of fungal flora still to be found. There are likely to be considerably more *Inocybe* species to name just one genus, in the dunes and pine woodland.

An intriguing observation was made of the ecological niche being held by *Psathyrella ammophila* in the dune fronts. An artificial brush wood barrier has been constructed to help protect the dune front from erosion and encourage regeneration of vegetation. Based on the vegetation work being carried out this is being quite effective. From a very limited pioneer flora, the band between the brushwood fence and the dunes has been aggressively colonised by over 30 higher plant species (N. Riddiford, pers.comm.). It was interesting to note that *P ammophila* could be found in places forming a line between the front edge of the dune vegetation and the barrier. This raises the question of whether the mycorrhizal association of this fungus with the vegetation present could be aiding the re-colonisation of the eroded dune front.

Species List

Class **MYXOMYCETES**
Mucilago crustacea

Physarum natans
Arcyria sp (carnea)

Class **BASIDIOMYCETES**
order **AGARICALES**

family **Hygrophoraceae**

Hygrocybe conica var chloroides
Hygrocybe aurantiolutescens

family **TRICHOLOMATACEA**

Clitocybe cerussata
Tricholoma fractum
Marasmiellus caesioater
Mycena seynii (= M. seynesii)
Xeromphalinus fellea

family **ENTOLOMATACEA**

Entoloma clypeata

family **PLUTEACEA**

Volvariella murinella

family **AMANITACEAE**

Amanita ovoidea
Limacella subfurnacea
Limacella illineta

family **AGARICACEAE**

Agaricus ?
Leucoagaricus pudicus/ subpudicus ? (= L. leucothites?)

family **COPRINACEAE**

Coprinus comatus
Coprinus niveus
Coprinus picaceus
Psathyrella ammophila
Psathyrella candoleana
Psathyrella halophila
Psathyrella paneoloides

family **BOLBITEACEA**

Agrocybe agarita
Bolbitius vitellinus

family **CORTINARIACEA**

Inocybe heimii
Inocybe phaeoleuca
Inocybe subporospora
Inocybe rimosa (= fasciculata)
Cortinarius mucosus

order **RUSSULALES**

family **RUSSULACEA**

Russula delica
Russula sanguinea
Lactarius ?

order **POLYPORALES**

family **POLYPORACEA**

Pleurotus ostreatus
Polyporus meridionalis

order **Boletales**

family **PAXILLACEAE**

Paxillus panuoides

family **BOLITACEAE**

Suillus bovenoides
Suillus collinitus
Xerocomus chrysenteron

order **PORIALES**

family **SCHIZOPHYLLACEAE**

Schizophyllum commune

family **HYMENOCHAETACEAE**

Phellinus ? inotus (inotus tamaricis?)

subclass **PHRAGMOBASIDIOMYCETIDAE**

order **AURICULARIALES**

family **AURICULARIACEAE**

Auricularia auricula-judae

subclass **GASTEROMYCETIDAE**

order **SCLERODERMATALES**

family **SCLERODERMATACEAE**

Pisolithus arhizus

Class **ASCOMYCETES**

order **PEZIZALES**

family **HUMARIACEAE**

Geopora arenicola

The following table lists alphabetically the species found, with notes on habitat. Species in bold are new for the park list. This does not mean that they had not previously been seen in the reserve, simply that they had not been recorded.

<i>Species</i>	<i>Habitat</i>
Agrocybe agarita	On Populus alba wherever Populus is found.
Amanita ovoidea	Es Comu, in sandy soil, usually under pine.
Arcyria species (?carnea)	On Phragmites.

Agaricus ?	
Auricularia auricula-judae	On wood along various tracks in the park.
Bolbitius vitellinus	On the west side of Es Comu road among plantain and graminaceae.
Clitocybe cerussata	Under pine among a thick needle layer.
Coprinus comatus	Es Comu.
Coprinus niveus	Cami d'en Polls.
Coprinus picaceus	Es Comu.
Cortinarius mucosus	Under pine, Es Comu.
Entoloma clypeata	Under hawthorn, path to Bishop 2 hide. Unexpected because it is generally a spring species.
Geopora arenicola	Under pine in sandy soil, Es Comu.
Hygrocybe aurantiolutescens	Es Comu
Hygrocybe conica var chloroides	Es Comu
Inocybe heimii	Path edges, on sand or with mosses, Es Comu (near dunes) Many specimens.
Inocybe phaeoleuca	In sandy soil at path edges. Es Comu (near dunes) only 2 specimens seen.
Inocybe rimosa (= fasciculata)	In Es Comu (Can Picafort, not seen elsewhere) along paths under pine.
Inocybe subporospora	In Es Comu, edge of sandy path, dunes. Only 1 specimen.
Lactarius ?	
Leucoagaricus pudicus/subpudicus ? (= L. leucothites?)	Cami d'en Polls among rotting plant debris, also on east side of road before Es Comu.
Limacella illineta	Es Comu, under pine.
Limacella subfurnacea	Es Comu, under pine. More abundant than above.
Marasmiellus caesioater	On Phragmites, reed beds (mostly along Cami d'en Polls)
Mucilago crustacea	Es Comu on wood debris.
Mycena seynii (= M. seynesii)	On pine cones.
Paxillus panuoides	Es Comu and Ca'n Eixut woodland.
Phellinus ? inotus (inotus tamaricis?)	On juniper and pine, Es Comu.
Physarum natans	On pine debris forming a carpet under trees, Es Comu.
Pisolithus arhizus	Es Comu.
Pleurotus ostreatus	Es Comu.
Polyporus meridionalis	Es Comu, on rosemary and other shrubs. Especially in previously

	burnt area.
<i>Psathyrella halophila</i>	With <i>Phragmites</i> and <i>Cladium</i> open and closed reed beds. Cami d'en Polls.
<i>Psathyrella paneoloides</i>	Es Comu under pine among needles.
<i>Psathyrella ammophila</i>	Es Comu dunes, in places forming a parallel line in front of new pioneer vegetation.
<i>Psathyrella candoleana</i>	Cami d'en Polls.
<i>Russula delica</i>	West side of Es Comu road under pine.
<i>Russula sanguinea</i>	Es Comu, under pine.
<i>Schizophyllum commune</i>	Sa Roca, etc.
<i>Suillus bovenoides</i>	Es Comu, under pine.
<i>Suillus collinitus</i>	Es Comu, under pine. More common than above species.
<i>Tricholoma fractum</i>	Es Comu, under pine.
<i>Volvariella murinella</i>	In small groups under pine, Es Comu.
<i>Xerocomus chrysenteron</i>	Es Comu, under pine. Not found as close to the beach as <i>Suillus</i> species.
<i>Xeromphalinus fellea</i>	Es Comu, under pine. Only a couple of specimens.

An initial report on some of the Lichens of the Parc Natural S'Albufera de Mallorca, October–November 2000 by Rose Pride

A visit to the Parc Natural from 23rd October to 6th November gave me the opportunity to make preliminary observations in a range of habitats. S'Albufera, a large rich and diverse marshland and dune area of 1708 hectares has had much human interference especially over the past two centuries. The Parc is criss-crossed with canals which, of course, means walls, bridges and a now ruined aqueduct. Limestone was used in the building of these, and they are covered in lichens. A coniferous wood gave many interesting lichens both on the trees and on the soil. Twenty-five species were identified from the initial survey. They are:

Acaraspora fuscata
Aspicilia calcarea
Caloplaca aurantia
Caloplaca teicholyta
Caloplaca flavescens
Caloplaca citrina
Caloplaca holocarpa
Candelariella vitellina
Cladonia pyxidata

Cladonia rangiformis
Cladonia cervicornis
Cladonia convoluta
Evernia prunastri
Graphis scripta
Lecanora campestris
Lecanora albescens
Opegrapha atra

Physcia adscendens
Ramalina fastigiata
Ramalina lacera
Ramalina canariensis
Tephromela atra
Verrucaria nigrescens
Verrucaria baldensis
Verrucaria hochstetteri

Apart from one small collection of specimens by non specialists, no previous lichen work appears to have been conducted at S'Albufera. There is much work still to be carried out and I look forward to a return visit, not just within the Parc but to other interesting areas as well. There is a Power Station opposite the Parc where the trees are black with pollution and an investigation here would be of conservation value.

Continuing studies of the moth fauna (Lepidoptera: Heterocera) of s'Albufera de Mallorca and other areas of the Balearic Islands – towards an up-dated check list of the Lepidoptera by *Martin R. Honey*¹ & *Nick J. Riddiford*²

Summary

An annual programme to survey, monitor and catalogue the night-flying Lepidoptera of the *Parc Natural de s'Albufera de Mallorca* was started by NJR in 1991, under the auspices of *Earthwatch Europe*.. At around the same time MRH took what was to become the first of many holidays to the island and began to study the local Lepidoptera fauna, joining the *Earthwatch Europe* s'Albufera team a few years later, in the mid-1990s. The tenth anniversary of the commencement of those two investigations seems an appropriate point at which to assess some of the progress to date and to outline plans for future studies.

Methodology

Nightly moth trapping surveys are undertaken at selected times of the year by NJR with the assistance of teams of volunteers. Additional surveys are undertaken by MRH, either with the above-mentioned groups or independently, in an attempt to increase the number of weeks during the year for which data from moth trapping is available. The ideal would be to have continuous light trapping for a few days either side of the new moon through every month of the year in order to build up a more complete list and add important phenological data.

The most effective survey tool at our disposal is a Robinson light trap fitted with a 125 watt mercury vapour bulb. This is used at Sa Roca and at other locations on Mallorca (MRH holiday villas, etc.) where mains electricity is available. A battery operated Heath trap, fitted with an 8 watt actinic tube, is used elsewhere in s'Albufera (e.g. Ses Puntes) or in other areas of Mallorca (e.g. s'Albufereta and on sa Dragonera) where the use of the Robinson trap is inconvenient or impossible. Another Heath trap is on permanent loan for use at s'Albufera des Grau, Menorca. On the one opportunity to trap on sa Dragonera, a Skinner trap fitted with a 125 watt mv bulb was also used, powered by their on-site generator [for details of moth traps and their use see: Fry & Waring, 1996].

Day-time surveys for larvae are also undertaken, either by searching visually or with the aid of a beating tray. Any larvae found are reared through to the adult moth for identification. Any parasites thus obtained, or other orders of insects attracted to the light trap, are retained and prepared for identification by specialists in those groups, where available.

Early in the morning following each night's trapping session, the contents of the trap are examined. As many specimens as possible are immediately identified to species, using a detailed knowledge of the local fauna or by consulting the project's reference collection, which is now housed in the new *Laboratory Dennis Bishop* at Sa Roca. Each species recorded, and its relative abundance, is logged onto nightly data-sheets. Once this is done, all identified material is released into surrounding vegetation. Unidentified material, including voucher specimens of any species newly recorded for s'Albufera, Mallorca, or the Balearic Islands is retained and prepared for later identification, primarily by comparison with the reference collections and library of The Natural History Museum, London, or in consultation with experts throughout Europe. The information from the data-sheets is subsequently added to a *Microsoft Excel* database maintained by NJR and with a copy held at s'Albufera. The data is also added to a distributional check list of the Lepidoptera of the Balearic Islands, maintained by MRH which, for reasons of convenience, and until the list is published, is kept in London (Honey, *unpubl.*).

¹ Department of Entomology, The Natural History Museum, London

² The Albufera International Biodiversity Group

In addition, other lepidopterists from Britain (e.g. Barry Goater and David Agassiz) have also visited s'Albufera to undertake studies of the reserve's moth fauna. Some of their results have been published (e.g. Goater, 1994) but all are incorporated into the above mentioned lists, as well as providing useful additions to the reference collection.

As an adjunct to the work being done at s'Albufera, and to build up a more complete picture of the Lepidoptera fauna of the islands, MRH has taken advantage of the opportunity to collect in other areas of Mallorca.

Facilities were made available for MRH and NJR to conduct an over-night survey of the Lepidoptera of the small off-shore island of sa Dragonera on 7 April 1999. A few specimens from that survey have been sent to other specialists in Europe for determination. As soon as they are identified the names can be added to the report and a complete list of the species recorded submitted for publication.

During a two week visit to s'Albufera in autumn 1999, MRH was given permission to conduct an over-night survey of Lepidoptera in part of s'Albufereta (on 8 October) and was also flown to Menorca, to trap in s'Albufera des Grau (13-14 October). The full results of the latter (Honey *et al.*, *in press*, 2001) have already been submitted for publication and the final identifications for the former have just been completed.

As mentioned in the Summary, MRH has also taken the opportunity during holidays on Mallorca to trap in other areas, mainly in localities around the old town of Pollensa or near Puerto Pollensa but also on excursions into the mountains near the monastery of Lluc.

Contact has also been made with other lepidopterists, mainly (but not exclusively) from Britain. Some have collected Lepidoptera whilst on holiday (e.g. Tony Dobson and Anthony Ezard) but others (e.g. Peter Cramp) are lucky enough to own property on the island and are therefore able to collect more frequently and at different times of the year (i.e. outside the summer holiday period), providing many new additions to the check list.

A number of European lepidopterists have also visited the island(s) and have published their results in the entomological literature, adding many new, or presumed new, records for the islands (e.g. Kobes, 1991 and Loser, 1999). The discovery and description of a new species of diurnal moth, *Bembecia abromeiti*, by Kallies & Riefenstahl (2000) (Lepidoptera: Sesiidae), highlights the fact that much remains to be learnt about the fauna of the islands. The species was discovered primarily in coastal habitats but was also found up in the mountains. Adult moths were attracted to pheromone traps (a collecting technique particularly successful for Sesiidae) but larvae were also found and reared from two different host plants (both Leguminosae), *Lotus cytisoides* Linnaeus near the coast and *Astragalus balearicus* Chater in the mountains.

Selected Results

Macrolepidoptera

Single examples of two species of Noctuidae, *Mythimna languida* (Walker, 1858) and *Characoma nilotica* (Rogenhofer, 1882), have recently been taken at s'Albufera. Both occur in North Africa and have been expanding into Europe in recent years. A male specimen of *M. languida* was swept from vegetation during the day by NJR on 18 November 1999 and represents the first record of this species for Spain and the Balearic Islands. Previously known in Europe only from Malta, Greece and Crete (Karsholt & Razowski, 1996), specimens have also been taken in Italy (Rezbanyai-Reser & Hausmann, 2000a), in Germany (Heinicke, 1997) and in Macedonia (Rezbanyai-Reser & Hausmann, 2000b). *Characoma nilotica* has only recently been added to the Spanish list (Gastón & Revilla, 1998). A male, in very poor condition, was taken at mv light at Sa Roca by NJR on 26 October 2000 and represents the first record of this species for the Balearic Islands. As with the previous species, *C. nilotica* has only been recorded relatively recently from parts of the Mediterranean region (Greece in 1979 and 1984 and Crete in 1991 (Fibiger, 1992), Italy in 1995 (Zilli & Peria, 1998) and Spain in 1996 (*loc. cit.*)). It is perhaps worth noting that all of the specimens from Europe have been recorded during the autumn months of September to November but, from data extracted from specimens in the NHM collection, it would appear to be double, if not continuously, brooded elsewhere in its range. There are published records of its larvae as a pest on species

of *Tamarix* (Tamaricaceae), at least one species of which grows close to the trap site at Sa Roca. A search will be made for larvae in 2001.

Microlepidoptera

In spring 1999, several plants of *Thymelaea myrtifolia* (Poir.) D.A. Webb (Thymelaeaceae), a Balearic endemic which occurs in s'Albufera only on the dunes at Es Comu, were found with their terminal shoots spun together. Some affected shoots were collected and taken back to the laboratory at Sa Roca. There they were found to contain the larvae of an unrecognised species of microlepidoptera. The shoots were retained in order to rear out the adult moths. After a few weeks a short series of adult moths emerged and were subsequently identified as *Tecmerium anthophaga* (Staudinger) (Lepidoptera: Blastobasidae). Not only is the moth a new species record for the Balearics but the hostplant is a new family record for that particular species, larvae of which were previously known to feed only on species of *Rosmarinus* and *Lavandula* (Labiatae). The foodplant is apparently confined to Mallorca and Menorca, mainly in or near coastal areas (see ORCA (URL: <http://www.bio.uib.es/bioveg/orca/gifs/mapes/1210.gif>) under the name *Thymelaea velutina* (Pourr. ex Camb.) Endl.), as such it is under constant threat from loss of habitat resulting from development for tourism.

A short series of *Batrachedra parvulipunctella* Chrétien (Lepidoptera: Batrachedridae) were identified recently by MRH as new to Mallorca from material collected in May/June 2000. The larvae of this species have an interesting life-history (Heckford, 1994), feeding exclusively on the waxy secretions produced by the scale insect *Aclerda berlesii* Buffa, 1897 (Acleridae), whose nymphs and adults feed as sap-suckers on common reed, *Phragmites australis* (Cav.) Trin. ex Steud., and giant reed, *Arundo donax* Linnaeus (both Gramineae), both of which occur prolifically at s'Albufera. A search for larvae and their host(s) is planned for 2001.

Agdistis neglecta Arenberger, 1976 (Lepidoptera: Pterophoridae) was originally described from material collected near Paguera, Mallorca. MRH has collected specimens of it from both s'Albufereta and s'Albufera. It is also known from France, Spain, Corsica, Sardinia and Italy (Karsholt & Razowski, 1996) and has recently been recorded from Portugal (Corley *et al.* 2000). Its known foodplants are *Atriplex portulacoides* Linnaeus (Chenopodiaceae), *Euphorbia pithyusa* Linnaeus (Euphorbiaceae) and an unspecified species of *Frankenia* (Frankeniaceae) (Gielis, 1996). [Three species of *Frankenia* are known to occur on the Balearics according to *Flora Europaea*, *F. hirsuta* Linnaeus, *F. laevis* Linnaeus and *F. pulverulenta* Linnaeus, but none is listed on ORCA]

A single specimen of a *Pleurota* sp. (Lepidoptera: Oecophoridae), as yet unidentified, was found by MRH during the day near the Cuber reservoir. A visit to the same site to try to discover additional material to aid its identification is planned for 2001.

Other records have come from surprising sources. The first record for Mallorca of *Phyllonorycter joviella* (Constant) (Lepidoptera: Gracillariidae), a colourful micro-moth whose larvae mine the leaves of evergreen oak, *Quercus ilex* Linnaeus (Fagaceae), came from a paper describing a new species of encyrtid wasp (Hymenoptera) that had been reared from parasitised larvae of what were thought to be this species (Askew, 1983). A short series of bred specimens of *P. joviella* from a number of localities on Mallorca have since been located in the NHM collection, all reared from *Quercus ilex*.

Conclusions

At the start of the project there was little in the way of published information about the Lepidoptera of the Balearic Islands as a whole and hardly any for s'Albufera other than records of butterflies (Rhopalocera). A provisional distributional check list of the Lepidoptera of the Balearic Islands was published by Josep Cuello (1981), just ten years before the current project. This brought together much of what was previously known from the entomological literature about the Lepidoptera fauna of Mallorca, Menorca and Ibiza. Inevitably, that list had its omissions but even so, it comprised records of a total of 370 species. A list of moths occurring at s'Albufera was published by Goater (1994). Some species recorded from s'Albufera des Grau, Menorca, were published by Cardona ([1999]) and further records by Honey *et al.* (*in press*, 2001). The list for s'Albufera alone now stands at over 400 species, a figure greater than was known for the entire Balearic Islands fauna in 1981. The list maintained by MRH of the Lepidoptera of the

Balearic Islands, including records from Cabrera, sa Dragonera, Formentera, Ibiza, Mallorca and Menorca, now comprises in excess of 700 species and is still increasing with each visit to the islands. The new species of Sesiidae, mentioned above, was reared from larvae collected in the field but little is known of the biology of many of the other species known to occur on the islands, their ecological requirements, or even their distribution within the islands. As an additional example, the endemic Mallorcan moth *Micropterix minimella* Heath, the Balearic's only (and Europe's smallest) representative of the primitive Lepidopteran family Micropterigidae (which are unique among the Lepidoptera in possessing functional chewing mouthparts in the adult moth), has not been found since the original 12 specimens were first discovered among the grass *Brachypodium ramosum* Roem. & Schult. (Gramineae) near Paguera in May 1969 and April 1970 by the famous Austrian collector Dr Joseph Klimesch, and which were subsequently described by the late John Heath (Heath, 1973).

The future

It is clear from the above that there is much still to be learnt about the Lepidoptera fauna of s'Albufera and the Balearic Islands. What can be done in the future?

- Continue and hopefully expand the monitoring programme to include other areas of the Balearics.
- Continue to make the information available to the scientific community, e.g. a paper is being submitted by MRH to the Spanish lepidopterological journal *SHILAP Revista de Lepidopterologia* giving details of 14 species, some briefly mentioned above, that have been recorded from s'Albufera and elsewhere on the Balearic Islands that are new to the Spanish fauna, i.e. not listed in Vives Moreno's catalogue or its supplements (Vives Moreno, 1994, 1995, 1996) (Honey, *in prep.*).
- Publish the check list (Honey, *unpubl.*), giving full details of the Balearic Islands Lepidoptera, including those species that are already known from Spain but which are newly recorded for one or more of the islands.
- Publish further papers dealing with those species that have been discovered on Mallorca that are thought to be new to Europe or Science.
- Continue to collaborate with other Lepidopterists visiting the islands.
- Train local volunteers to undertake seasonal light-trapping throughout the year to build up phenological data (as instigated at s'Albufera des Grau) - especially at times of the year when it is not possible, through other work commitments, to visit the islands personally.
- Continue to develop and maintain the on-site reference collection and perhaps, in the long term, to set up a virtual identification guide to the Lepidoptera of s'Albufera, Mallorca or even the Balearics.
- Provide distributional data to other projects (e.g. Vives Moreno's revised Spanish catalogue, Fauna Iberica, Fauna Europaea, Microlepidoptera of Europe, etc.).

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Bibliography

- Askew, R. R. 1983. A revision of the encyrtid genus *Holcothorax* (Hymenoptera). *Syst. Ent.* **8**: 131-136.
- Cardona, L. [1999] 1998. Catàleg general de les espècies del Parc de s'Albufera des Grau, Illa den Colom i Cap de Favàritx. *Inventaris tècnics de Biodiversitat - 1*. [v] + 38 pp. Govern Balear, Palma.
- Corley, M. F. V., Gardiner, A. J., Cleere, N. & Wallis, P. D. 2000. Further additions to the Lepidoptera of Algarve, Portugal (Insecta: Lepidoptera). *SHILAP Revista de Lepidopterologia* **28**: 245-319.

Cuello, J. 1981. Els Lepidòpters de les Illes Balears. Cens provisional. *Treballs de la Societat Catalana de Lepidòpterologia* **40**: 33-53.

Fibiger, M. 1992. *Autophila libanotica osthelderi* Boursin, 1940 and *Characoma nilotica* (Rogenhofer, 1882) new to Europe (Lepidoptera, Noctuidae: Catocalinae, Ophiderinae [sic]). *Nota lepidopterologia* **14**: 297-301.

Fry, R. & Waring, P. 1996. *A guide to moth traps and their use*. Amateur Entomologists' Society Booklet. Volume 24.

Gastón, J. & Revilla, T. 1998. *Characoma nilotica* (Rogenhofer, 1882) nueva especie para la Península Ibérica (Lepidoptera: Noctuidae). *SHILAP Revista de Lepidopterologia* **26**: 175-177.

Gielis, C. 1996. *Microlepidoptera of Europe. Volume 1. Pterophoridae*. 222 pp. Apollo Books, Stenstrup.

Goater, B. 1994. Lepidoptera (Heterocera) recorded at s'Albufera Natural Park in 1992-1993. *Bulletí del Parc Natural de s'Albufera de Mallorca* **1**: 55-60.

Heckford, R. J. 1994. *Batrachedra parvulipunctella* Chrétien (Lepidoptera: Momphidae), a surprising addition to the British list. *Entomologist's Gazette* **45**: 261-265.

Heinicke, W. 1997. Erster Fund des Eulenfalters *Mythimna languida* (Walker, 1858) in Deutschland (Lep., Noctuidae). *Entomologische Nachrichten und Berichte* **41**: 198-200.

Honey, M. R. (*in prep*). Fourteen species of moths (Lepidoptera: Heterocera) apparently new to Spain recorded recently from Mallorcan (Balearic Islands). *SHILAP Revista de Lepidopterologia*

Honey, M. R. (*unpubl.*) A systematic and distributional check list of the Lepidoptera of the Balearic Islands.

Honey, M. R., Orfila, M. & Riddiford, N. J. (*in press* 2001) Moth research in s'Albufera des Grau (Insecta: Lepidoptera). *Bulletí Científic dels Parcs Natural de les Balears*

Kallies, A. & Riefenstahl, H. G. 2000. A new species of *Bembecia* Hübner, [1819] from the Balearic Island of Mallorca (Lepidoptera: Sesiidae). *Entomologisches Zeitschrift, Stuttgart* **110**: 359-363.

Karsholt, O. & Razowski, J. (eds). 1996. *The Lepidoptera of Europe. A Distributional Checklist*. 380pp. Stensrup.

Losser, E. 1999. Ein weiter Beitrag zur Schmetterlingsfauna der Baleareninsel Mallorca (Lepidoptera). *Entomologisches Zeitschrift, Stuttgart* **109**: 94-102.

ORCA (Organització per a la Cartografia de les plantes dels Països Catalans)

URL: <http://www.bio.ub.es/bioveg/orca/WelcomeOrca.html>

Rezbanyai-Reser, L. & Hausmann, A. 2000a. Über *Mythimna (Morphopoliana) languida* (Walker, 1858), eine neue, tropische Wanderfalterart Europas, und ihre Fundangaben in Nord- und Süditalien (Lepidoptera: Noctuidae). *Atalanta* **31**: 77-85.

Rezbanyai-Reser, L. & Hausmann, A. 2000b. Eine Berichtigung: *Mythimna (Morphopoliana) languida* (Walker, 1858) auch Deutschland und Makedonien (Lepidoptera: Noctuidae). *Atalanta* **31**: 529-530.

Vives Moreno, A. 1994. *Catálogo sistemático y sinónimo de los lepidópteros de la Península Ibérica y Baleares*. (Segunde Parte) x + 775 pp. Madrid

Vives Moreno, A. 1995. Primera addenda et corrigenda al “Catálogo sistemático y sinonímico de los lepidópteros de la Península Ibérica y Baleares (Segunde Parte)” (Insecta: Lepidoptera). *SHILAP Revista de Lepidopterologia* **23**: 307-341.

Vives Moreno, A. 1996. Segunda addenda et corrigenda al “Catálogo sistemático y sinonímico de los lepidópteros de la Península Ibérica y Baleares (Segunde Parte)” (Insecta: Lepidoptera). *SHILAP Revista de Lepidopterologia* **24**: 275-315.

Zilli, A. & Peria, E. 1998. *Characoma nilotica* (Rogenhofer) new to Italy (Lepidoptera Noctuidae). *Bollettino della Societa Entomologica Italiana* **130**: 75-76.

Habitat Biodiversity Investigations: Sampling of Habitats for physical and vegetative structure, species presence and impacts on biodiversity by Chris Donnelly

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 Comu, 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

In autumn 1999 and autumn 2000, sampling was carried out on some of the habitats present to provide data that can be used to assess the biodiversity of each habitat and provide baseline data on the factors affecting its biodiversity (physical and vegetative structure, species presence and impacts). The sampling included recording of ecological niches present and faunal associations with the habitat. Further work is needed on the other habitats present and to supplement the data collected on the habitats already sampled.

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).

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 2001.

Habitat Mapping: Further analyses of Habitats present within the Park by Chris Donnelly

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. Recommendations for future work were:

- a repeat of the mapping exercise on a regular basis to determine habitat changes
- production of more detailed maps using the 1:25,000 maps of the Park
- further refinement of the classification to distinguish between the different saltmarsh and swamp communities
- digitisation of the maps and habitat boundaries.

The data from the habitat maps has since been summarised onto a database (Access) which categorises the various habitats into individual 'sectors' (i.e. compartments) each with a reference number, name and KM square reference (**e.g. Habitat Type: Dune Scrub, Sector/Location: Es Comu, reference: 21001**). The estimated number of .01 KM squares covered by the sector is also recorded.

The following work has now been started in order to provide more comprehensive habitat information on the Park –

1. review of habitat classification where needed and corrections to original data (started in 1998).

The following corrections were known to be needed:-

- **Marginal vegetation** – this was not mapped.
- **Walls** – these were overlooked in many areas.
- **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.
- **Built-up areas** – these were overlooked in many areas.
- **Bare ground** – this was recorded in the centre of a few tracks but not consistently.

- **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.
 - **Species-rich grassland** – this was mapped on several tracks but not consistently (there are many small areas).
2. completion of database summary of habitats present including assessment of hectares covered (started in 1998).
 3. transfer of the map data of each habitat type onto overall maps of the park (started in 1999).
 4. re-assessment and re-mapping of 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 (started in autumn 2000).
 5. 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 (work carried out as part of Habitat Biodiversity studies, started in autumn 1999)
 6. investigation of the use of and impact on the habitat by significant groups or species (analyses of other project work with direct relevance - ongoing)
 7. instigation of fixed-point photography on selected habitats (started in autumn 2000).

Reedbed passerines by Brigitte Poulin

Editorial note: this information was extracted from the Station biologique de la Tour du Valat Annual Report for 1999

This project analyses the impact of modes of management associated with economic activities on the organisation of passerine communities in reedbeds. The study on the classification of reedbeds as breeding habitat for marsh-nesting passerines continued this year with 8 new sites of which four were exploited for thatch. Data analysis from the 16 sites sampled in 1998 and 1999 will make it possible to evaluate what are the principal biotic and abiotic factors influencing abundance and composition of marsh-nesting passerines. The sites are part of the network studied in the “Mediterranean reedbed typology” project.

Preliminary results suggest a predominant impact of food resources; an entomofauna section was developed in 1999 and integrated in the classification study. This project, carried out in collaboration with the University of Göttingen (Dr T. Tschardt) as part of the “Diplomarbeit” of Martin Schmidt sought (1) to estimate the richness and composition of the entomofauna, in particular of coleoptera and spiders which are taxa much consumed by birds; (2) to qualify the impact of reedbed cutting on these taxa; and (3) to determine the frequency of these taxa in the diet of birds, and whether the latter have a depredatory effect on the abundance of prey.

Preliminary results show first of all high species richness with nearly 70 species of spider and over 200 species of coleoptera for all the sites. The impact of cutting on arthropods varies according to taxa and affects the various passerine species differently throughout the trophic chain. Cutting distinctly modifies species corteges and simplifies arthropod communities (variation between cut sites is lower than between uncut sites). Passerines consume a large number of spider species, but are very selective about coleoptera, while the *Cyphon* genus (Scirtidae family), slightly more abundant in reedbeds, represents alone more than 80% of items consumed. Despite this peculiarity, exclusion cages have revealed no depredatory effect of passerines on their prey.

Three sites were also sampled at S'Albufera de Mallorca (Balearic Islands) in the Mediterranean extension: this nature park holds nearly 1500 ha of *Phragmites australis* var. *gigantea* reedbeds. A passerine section was developed in it in collaboration with the National Park Service with a view to evaluating the impact of plant structure on the organisation of animal communities and to acquiring better knowledge of the movement dynamics of marsh-nesting passerines in the Mediterranean region. The sampling, carried out in autumn, will be repeated in the breeding season in order to be able to compare the results to those of the study in France.

A comparison of the results of a bird ringing project at S'Albufera in November 1997 with those of a repeat project in November 1999, by D M Hanford, H F Coats, R Evans and R J Rigdon

Procedure

A net ride was positioned parallel to the Gran Canal at the southern edge of Colombar Gran. Five 18 metre mist nets were set in one continuous line from 0700 hrs to 1200 hrs for five days: November 9th-13th in 1997 and November 10th-14th in 1999.

In the period between the two visits much, if not all of the emergent vegetation in the Gran Canal and the smaller canal de Sa Siurana adjacent to the ringing site had been removed. This action increased the measure of 'edge effect' (the interface between reed bed and open water) especially at the ringing site.

Table 1 lists all individual birds processed (retraps as well as newly ringed birds) during the two visits.

Table 1

		1997	1999
Little Bittern	<i>Ixobrychus minutus</i>	1	1
Kingfisher	<i>Alcedo atthis</i>	0	3
Robin	<i>Erithacus rubecula</i>	2	8
Stonechat	<i>Saxicola torquata</i>	1	2
Blackbird	<i>Turdus merula</i>	2	4
Song Thrush	<i>Turdus philomelos</i>	0	1
Blackcap	<i>Sylvia atricapilla</i>	0	1
Sardinian Warbler	<i>Sylvia melanocephala</i>	2	2
Moustached Warbler	<i>Acrocephalus melanopogon</i>	49	63
Reed Warbler	<i>Acrocephalus scirpaceus</i>	1	0
Cetti's Warbler	<i>Cettia cetti</i>	13	15
Chiffchaff	<i>Phylloscopus collybita</i>	38	40
Great Tit	<i>Parus major</i>	1	4
House Sparrow	<i>Passer domesticus</i>	0	2
Goldfinch	<i>Carduelis carduelis</i>	1	1

The Little Bitterns, a juvenile in 1997 and an adult male in 1999, were different birds. The increase in number of species and of individuals in 1999 perhaps reflects the more open nature of the site. This manifests in the figures for Kingfisher, Robin, Blackbird, Song Thrush, Blackcap, Great Tit and House Sparrow.

Looking at Moustached Warbler figures, there is a significant increase in 1999. Twenty-eight of the 63 were retraps (birds ringed previously). Not all data are at hand, but retraps included 12 ringed at the same site in November 1997 and 8 there in February 1998. These figures show a remarkable degree of site fidelity and indicate a minimum two year survival rate of 31.7% for that particular time period - and probably considerably higher.

Cetti's Warbler figures suggest a stable population for that very limited area.

The Chiffchaff numbers are very similar for the two visits, yet not one retrap was obtained in 1999. The site is obviously a good feeding area for this species but there is little evidence that they hold winter territories there. During a much reduced ringing effort at the site in February 1998, only one bird from November 1997 was retrapped plus one which had been ringed elsewhere in the Parc prior to that date.

Thanks are due to Srs. Gabriel Perelló and Pere Vicens and to Nick Riddiford and Graham Hearl

Fungi of S'Albufera Natural Park, Mallorca - October/November 2000 by Rachel King

INTRODUCTION

Between 28th October and 2nd November 2000 fungi were collected by myself and other members of the team from as many different habitats in the park as possible. The aim was to continue to add to our knowledge of the fungi species present in the park and their relationship with the various vegetation communities and habitat types. This report details the findings.

METHODS

When identification could not be achieved in the field, fresh specimens were collected and when possible slide photos of the specimen taken. Later each species was drawn and described in a fresh state (see notes) then the specimen was dried with a fan heater for microscopic examination. Microscopic examination was carried out in the Dennis Bishop Laboratory at S'Albufera Natural park and later in León University botanical department, Spain with assistance from Basilio Llamas Frade and Arsenio Terrón Alfonso.

RESULTS

From some 58 species described, 42 were identified to species level - 18 of which were not cited on the previous park fungi list (these last species highlighted in bold below). The unidentified species are included at the end of this report (as incomplete entries or as tentative identifications accompanied by question marks). Dry specimens have been kept of all species, identified or otherwise. Field notes are also given for reference at the end of the report.

COMMENTS

It was interesting to find what I believe to be *Arcyria carnea* growing on *Phragmites australis* as I understood it to be associated with mountain habitats.

With the various different habitat types present in the reserve I am sure there is a wealth of fungal flora still to be found. There are likely to be considerably more *Inocybe* species to name just one genus, in the dunes and pine woodland.

An intriguing observation was made of the ecological niche being held by *Psathyrella ammophila* in the dune fronts. An artificial brush wood barrier has been constructed to help protect the dune front from erosion and encourage regeneration of vegetation. Based on the vegetation work being carried out this is being quite effective. From a very limited pioneer flora, the band between the brushwood fence and the dunes has been aggressively colonised by over 30 higher plant species (N. Riddiford, pers.comm.). It was interesting to note that *P ammophila* could be found in places forming a line between the front edge of the dune vegetation and the barrier. This raises the question of whether the mycorrhizal association of this fungus with the vegetation present could be aiding the re-colonisation of the eroded dune front.

Species List

Class **MYXOMYCETES**
Mucilago crustacea

Physarum natans
Arcyria sp (carnea)

Class **BASIDIOMYCETES**
order **AGARICALES**

family **Hygrophoraceae**

Hygrocybe conica var chloroides
Hygrocybe aurantiolutescens

family **TRICHOLOMATACEA**

Clitocybe cerussata
Tricholoma fractum
Marasmiellus caesioater
Mycena seynii (= M. seynesii)
Xeromphalinus fellea

family **ENTOLOMATACEA**

Entoloma clypeata

family **PLUTEACEA**

Volvariella murinella

family **AMANITACEAE**

Amanita ovoidea
Limacella subfurnacea
Limacella illineta

family **AGARICACEAE**

Agaricus ?
Leucoagaricus pudicus/ subpudicus ? (= L. leucothites?)

family **COPRINACEAE**

Coprinus comatus
Coprinus niveus
Coprinus picaceus
Psathyrella ammophila
Psathyrella candoleana
Psathyrella halophila
Psathyrella paneoloides

family **BOLBITEACEA**

Agrocybe agarita
Bolbitius vitellinus

family **CORTINARIACEA**

Inocybe heimii
Inocybe phaeoleuca
Inocybe subporospora
Inocybe rimosa (= fasciculata)
Cortinarius mucosus

order **RUSSULALES**

family **RUSSULACEA**

Russula delica
Russula sanguinea
Lactarius ?

order **POLYPORALES**

family **POLYPORACEA**

Pleurotus ostreatus
Polyporus meridionalis

order **Boletales**

family **PAXILLACEAE**

Paxillus panuoides

family **BOLITACEAE**

Suillus bovenoides
Suillus collinitus
Xerocomus chrysenteron

order **PORIALES**

family **SCHIZOPHYLLACEAE**

Schizophyllum commune

family **HYMENOCHAETACEAE**

Phellinus ? inotus (inotus tamaricis?)

subclass **PHRAGMOBASIDIOMYCETIDAE**

order **AURICULARIALES**

family **AURICULARIACEAE**

Auricularia auricula-judae

subclass **GASTEROMYCETIDAE**

order **SCLERODERMATALES**

family **SCLERODERMATACEAE**

Pisolithus arhizus

Class **ASCOMYCETES**

order **PEZIZALES**

family **HUMARIACEAE**

Geopora arenicola

The following table lists alphabetically the species found, with notes on habitat. Species in bold are new for the park list. This does not mean that they had not previously been seen in the reserve, simply that they had not been recorded.

<i>Species</i>	<i>Habitat</i>
Agrocybe agarita	On Populus alba wherever Populus is found.
Amanita ovoidea	Es Comu, in sandy soil, usually under pine.
Arcyria species (?carnea)	On Phragmites.

Agaricus ?	
Auricularia auricula-judae	On wood along various tracks in the park.
Bolbitius vitellinus	On the west side of Es Comu road among plantain and graminaceae.
Clitocybe cerussata	Under pine among a thick needle layer.
Coprinus comatus	Es Comu.
Coprinus niveus	Cami d'en Polls.
Coprinus picaceus	Es Comu.
Cortinarius mucosus	Under pine, Es Comu.
Entoloma clypeata	Under hawthorn, path to Bishop 2 hide. Unexpected because it is generally a spring species.
Geopora arenicola	Under pine in sandy soil, Es Comu.
Hygrocybe aurantiolutescens	Es Comu
Hygrocybe conica var chloroides	Es Comu
Inocybe heimii	Path edges, on sand or with mosses, Es Comu (near dunes) Many specimens.
Inocybe phaeoleuca	In sandy soil at path edges. Es Comu (near dunes) only 2 specimens seen.
Inocybe rimosa (= fasciculata)	In Es Comu (Can Picafort, not seen elsewhere) along paths under pine.
Inocybe subporospora	In Es Comu, edge of sandy path, dunes. Only 1 specimen.
Lactarius ?	
Leucoagaricus pudicus/subpudicus ? (= L. leucothites?)	Cami d'en Polls among rotting plant debris, also on east side of road before Es Comu.
Limacella illineta	Es Comu, under pine.
Limacella subfurnacea	Es Comu, under pine. More abundant than above.
Marasmiellus caesioater	On Phragmites, reed beds (mostly along Cami d'en Polls)
Mucilago crustacea	Es Comu on wood debris.
Mycena seynii (= M. seynesii)	On pine cones.
Paxillus panuoides	Es Comu and Ca'n Eixut woodland.
Phellinus ? inotus (inotus tamaricis?)	On juniper and pine, Es Comu.
Physarum natans	On pine debris forming a carpet under trees, Es Comu.
Pisolithus arhizus	Es Comu.
Pleurotus ostreatus	Es Comu.
Polyporus meridionalis	Es Comu, on rosemary and other shrubs. Especially in previously

	burnt area.
<i>Psathyrella halophila</i>	With <i>Phragmites</i> and <i>Cladium</i> open and closed reed beds. Cami d'en Polls.
<i>Psathyrella paneoloides</i>	Es Comu under pine among needles.
<i>Psathyrella ammophila</i>	Es Comu dunes, in places forming a parallel line in front of new pioneer vegetation.
<i>Psathyrella candoleana</i>	Cami d'en Polls.
<i>Russula delica</i>	West side of Es Comu road under pine.
<i>Russula sanguinea</i>	Es Comu, under pine.
<i>Schizophyllum commune</i>	Sa Roca, etc.
<i>Suillus bovenoides</i>	Es Comu, under pine.
<i>Suillus collinitus</i>	Es Comu, under pine. More common than above species.
<i>Tricholoma fractum</i>	Es Comu, under pine.
<i>Volvariella murinella</i>	In small groups under pine, Es Comu.
<i>Xerocomus chrysenteron</i>	Es Comu, under pine. Not found as close to the beach as <i>Suillus</i> species.
<i>Xeromphalinus fellea</i>	Es Comu, under pine. Only a couple of specimens.

An initial report on some of the Lichens of the Parc Natural S'Albufera de Mallorca, October–November 2000 by Rose Pride

A visit to the Parc Natural from 23rd October to 6th November gave me the opportunity to make preliminary observations in a range of habitats. S'Albufera, a large rich and diverse marshland and dune area of 1708 hectares has had much human interference especially over the past two centuries. The Parc is criss-crossed with canals which, of course, means walls, bridges and a now ruined aqueduct. Limestone was used in the building of these, and they are covered in lichens. A coniferous wood gave many interesting lichens both on the trees and on the soil. Twenty-five species were identified from the initial survey. They are:

Acaraspora fuscata
Aspicilia calcarea
Caloplaca aurantia
Caloplaca teicholyta
Caloplaca flavescens
Caloplaca citrina
Caloplaca holocarpa
Candelariella vitellina
Cladonia pyxidata

Cladonia rangiformis
Cladonia cervicornis
Cladonia convoluta
Evernia prunastri
Graphis scripta
Lecanora campestris
Lecanora albescens
Opegrapha atra

Physcia adscendens
Ramalina fastigiata
Ramalina lacera
Ramalina canariensis
Tephromela atra
Verrucaria nigrescens
Verrucaria baldensis
Verrucaria hochstetteri

Apart from one small collection of specimens by non specialists, no previous lichen work appears to have been conducted at S'Albufera. There is much work still to be carried out and I look forward to a return visit, not just within the Parc but to other interesting areas as well. There is a Power Station opposite the Parc where the trees are black with pollution and an investigation here would be of conservation value.

Continuing studies of the moth fauna (Lepidoptera: Heterocera) of s'Albufera de Mallorca and other areas of the Balearic Islands – towards an up-dated check list of the Lepidoptera by *Martin R. Honey*¹ & *Nick J. Riddiford*²

Summary

An annual programme to survey, monitor and catalogue the night-flying Lepidoptera of the *Parc Natural de s'Albufera de Mallorca* was started by NJR in 1991, under the auspices of *Earthwatch Europe*.. At around the same time MRH took what was to become the first of many holidays to the island and began to study the local Lepidoptera fauna, joining the *Earthwatch Europe* s'Albufera team a few years later, in the mid-1990s. The tenth anniversary of the commencement of those two investigations seems an appropriate point at which to assess some of the progress to date and to outline plans for future studies.

Methodology

Nightly moth trapping surveys are undertaken at selected times of the year by NJR with the assistance of teams of volunteers. Additional surveys are undertaken by MRH, either with the above-mentioned groups or independently, in an attempt to increase the number of weeks during the year for which data from moth trapping is available. The ideal would be to have continuous light trapping for a few days either side of the new moon through every month of the year in order to build up a more complete list and add important phenological data.

The most effective survey tool at our disposal is a Robinson light trap fitted with a 125 watt mercury vapour bulb. This is used at Sa Roca and at other locations on Mallorca (MRH holiday villas, etc.) where mains electricity is available. A battery operated Heath trap, fitted with an 8 watt actinic tube, is used elsewhere in s'Albufera (e.g. Ses Puntes) or in other areas of Mallorca (e.g. s'Albufereta and on sa Dragonera) where the use of the Robinson trap is inconvenient or impossible. Another Heath trap is on permanent loan for use at s'Albufera des Grau, Menorca. On the one opportunity to trap on sa Dragonera, a Skinner trap fitted with a 125 watt mv bulb was also used, powered by their on-site generator [for details of moth traps and their use see: Fry & Waring, 1996].

Day-time surveys for larvae are also undertaken, either by searching visually or with the aid of a beating tray. Any larvae found are reared through to the adult moth for identification. Any parasites thus obtained, or other orders of insects attracted to the light trap, are retained and prepared for identification by specialists in those groups, where available.

Early in the morning following each night's trapping session, the contents of the trap are examined. As many specimens as possible are immediately identified to species, using a detailed knowledge of the local fauna or by consulting the project's reference collection, which is now housed in the new *Laboratory Dennis Bishop* at Sa Roca. Each species recorded, and its relative abundance, is logged onto nightly data-sheets. Once this is done, all identified material is released into surrounding vegetation. Unidentified material, including voucher specimens of any species newly recorded for s'Albufera, Mallorca, or the Balearic Islands is retained and prepared for later identification, primarily by comparison with the reference collections and library of The Natural History Museum, London, or in consultation with experts throughout Europe. The information from the data-sheets is subsequently added to a *Microsoft Excel* database maintained by NJR and with a copy held at s'Albufera. The data is also added to a distributional check list of the Lepidoptera of the Balearic Islands, maintained by MRH which, for reasons of convenience, and until the list is published, is kept in London (Honey, *unpubl.*).

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In addition, other lepidopterists from Britain (e.g. Barry Goater and David Agassiz) have also visited s'Albufera to undertake studies of the reserve's moth fauna. Some of their results have been published (e.g. Goater, 1994) but all are incorporated into the above mentioned lists, as well as providing useful additions to the reference collection.

As an adjunct to the work being done at s'Albufera, and to build up a more complete picture of the Lepidoptera fauna of the islands, MRH has taken advantage of the opportunity to collect in other areas of Mallorca.

Facilities were made available for MRH and NJR to conduct an over-night survey of the Lepidoptera of the small off-shore island of sa Dragonera on 7 April 1999. A few specimens from that survey have been sent to other specialists in Europe for determination. As soon as they are identified the names can be added to the report and a complete list of the species recorded submitted for publication.

During a two week visit to s'Albufera in autumn 1999, MRH was given permission to conduct an over-night survey of Lepidoptera in part of s'Albufereta (on 8 October) and was also flown to Menorca, to trap in s'Albufera des Grau (13-14 October). The full results of the latter (Honey *et al.*, *in press*, 2001) have already been submitted for publication and the final identifications for the former have just been completed.

As mentioned in the Summary, MRH has also taken the opportunity during holidays on Mallorca to trap in other areas, mainly in localities around the old town of Pollensa or near Puerto Pollensa but also on excursions into the mountains near the monastery of Lluc.

Contact has also been made with other lepidopterists, mainly (but not exclusively) from Britain. Some have collected Lepidoptera whilst on holiday (e.g. Tony Dobson and Anthony Ezard) but others (e.g. Peter Cramp) are lucky enough to own property on the island and are therefore able to collect more frequently and at different times of the year (i.e. outside the summer holiday period), providing many new additions to the check list.

A number of European lepidopterists have also visited the island(s) and have published their results in the entomological literature, adding many new, or presumed new, records for the islands (e.g. Kobes, 1991 and Loser, 1999). The discovery and description of a new species of diurnal moth, *Bembecia abromeiti*, by Kallies & Riefenstahl (2000) (Lepidoptera: Sesiidae), highlights the fact that much remains to be learnt about the fauna of the islands. The species was discovered primarily in coastal habitats but was also found up in the mountains. Adult moths were attracted to pheromone traps (a collecting technique particularly successful for Sesiidae) but larvae were also found and reared from two different host plants (both Leguminosae), *Lotus cytisoides* Linnaeus near the coast and *Astragalus balearicus* Chater in the mountains.

Selected Results

Macrolepidoptera

Single examples of two species of Noctuidae, *Mythimna languida* (Walker, 1858) and *Characoma nilotica* (Rogenhofer, 1882), have recently been taken at s'Albufera. Both occur in North Africa and have been expanding into Europe in recent years. A male specimen of *M. languida* was swept from vegetation during the day by NJR on 18 November 1999 and represents the first record of this species for Spain and the Balearic Islands. Previously known in Europe only from Malta, Greece and Crete (Karsholt & Razowski, 1996), specimens have also been taken in Italy (Rezbanyai-Reser & Hausmann, 2000a), in Germany (Heinicke, 1997) and in Macedonia (Rezbanyai-Reser & Hausmann, 2000b). *Characoma nilotica* has only recently been added to the Spanish list (Gastón & Revilla, 1998). A male, in very poor condition, was taken at mv light at Sa Roca by NJR on 26 October 2000 and represents the first record of this species for the Balearic Islands. As with the previous species, *C. nilotica* has only been recorded relatively recently from parts of the Mediterranean region (Greece in 1979 and 1984 and Crete in 1991 (Fibiger, 1992), Italy in 1995 (Zilli & Peria, 1998) and Spain in 1996 (*loc. cit.*)). It is perhaps worth noting that all of the specimens from Europe have been recorded during the autumn months of September to November but, from data extracted from specimens in the NHM collection, it would appear to be double, if not continuously, brooded elsewhere in its range. There are published records of its larvae as a pest on species

of *Tamarix* (Tamaricaceae), at least one species of which grows close to the trap site at Sa Roca. A search will be made for larvae in 2001.

Microlepidoptera

In spring 1999, several plants of *Thymelaea myrtifolia* (Poir.) D.A. Webb (Thymelaeaceae), a Balearic endemic which occurs in s'Albufera only on the dunes at Es Comu, were found with their terminal shoots spun together. Some affected shoots were collected and taken back to the laboratory at Sa Roca. There they were found to contain the larvae of an unrecognised species of microlepidoptera. The shoots were retained in order to rear out the adult moths. After a few weeks a short series of adult moths emerged and were subsequently identified as *Tecmerium anthophaga* (Staudinger) (Lepidoptera: Blastobasidae). Not only is the moth a new species record for the Balearics but the hostplant is a new family record for that particular species, larvae of which were previously known to feed only on species of *Rosmarinus* and *Lavandula* (Labiatae). The foodplant is apparently confined to Mallorca and Menorca, mainly in or near coastal areas (see ORCA (URL: <http://www.bio.uib.es/bioveg/orca/gifs/mapes/1210.gif>) under the name *Thymelaea velutina* (Pourr. ex Camb.) Endl.), as such it is under constant threat from loss of habitat resulting from development for tourism.

A short series of *Batrachedra parvulipunctella* Chrétien (Lepidoptera: Batrachedridae) were identified recently by MRH as new to Mallorca from material collected in May/June 2000. The larvae of this species have an interesting life-history (Heckford, 1994), feeding exclusively on the waxy secretions produced by the scale insect *Aclerda berlesii* Buffa, 1897 (Acleridae), whose nymphs and adults feed as sap-suckers on common reed, *Phragmites australis* (Cav.) Trin. ex Steud., and giant reed, *Arundo donax* Linnaeus (both Gramineae), both of which occur prolifically at s'Albufera. A search for larvae and their host(s) is planned for 2001.

Agdistis neglecta Arenberger, 1976 (Lepidoptera: Pterophoridae) was originally described from material collected near Paguera, Mallorca. MRH has collected specimens of it from both s'Albufereta and s'Albufera. It is also known from France, Spain, Corsica, Sardinia and Italy (Karsholt & Razowski, 1996) and has recently been recorded from Portugal (Corley *et al.* 2000). Its known foodplants are *Atriplex portulacoides* Linnaeus (Chenopodiaceae), *Euphorbia pithyusa* Linnaeus (Euphorbiaceae) and an unspecified species of *Frankenia* (Frankeniaceae) (Gielis, 1996). [Three species of *Frankenia* are known to occur on the Balearics according to *Flora Europaea*, *F. hirsuta* Linnaeus, *F. laevis* Linnaeus and *F. pulverulenta* Linnaeus, but none is listed on ORCA]

A single specimen of a *Pleurota* sp. (Lepidoptera: Oecophoridae), as yet unidentified, was found by MRH during the day near the Cuber reservoir. A visit to the same site to try to discover additional material to aid its identification is planned for 2001.

Other records have come from surprising sources. The first record for Mallorca of *Phyllonorycter joviella* (Constant) (Lepidoptera: Gracillariidae), a colourful micro-moth whose larvae mine the leaves of evergreen oak, *Quercus ilex* Linnaeus (Fagaceae), came from a paper describing a new species of encyrtid wasp (Hymenoptera) that had been reared from parasitised larvae of what were thought to be this species (Askew, 1983). A short series of bred specimens of *P. joviella* from a number of localities on Mallorca have since been located in the NHM collection, all reared from *Quercus ilex*.

Conclusions

At the start of the project there was little in the way of published information about the Lepidoptera of the Balearic Islands as a whole and hardly any for s'Albufera other than records of butterflies (Rhopalocera). A provisional distributional check list of the Lepidoptera of the Balearic Islands was published by Josep Cuello (1981), just ten years before the current project. This brought together much of what was previously known from the entomological literature about the Lepidoptera fauna of Mallorca, Menorca and Ibiza. Inevitably, that list had its omissions but even so, it comprised records of a total of 370 species. A list of moths occurring at s'Albufera was published by Goater (1994). Some species recorded from s'Albufera des Grau, Menorca, were published by Cardona ([1999]) and further records by Honey *et al.* (*in press*, 2001). The list for s'Albufera alone now stands at over 400 species, a figure greater than was known for the entire Balearic Islands fauna in 1981. The list maintained by MRH of the Lepidoptera of the

Balearic Islands, including records from Cabrera, sa Dragonera, Formentera, Ibiza, Mallorca and Menorca, now comprises in excess of 700 species and is still increasing with each visit to the islands. The new species of Sesiidae, mentioned above, was reared from larvae collected in the field but little is known of the biology of many of the other species known to occur on the islands, their ecological requirements, or even their distribution within the islands. As an additional example, the endemic Mallorcan moth *Micropterix minimella* Heath, the Balearic's only (and Europe's smallest) representative of the primitive Lepidopteran family Micropterigidae (which are unique among the Lepidoptera in possessing functional chewing mouthparts in the adult moth), has not been found since the original 12 specimens were first discovered among the grass *Brachypodium ramosum* Roem. & Schult. (Gramineae) near Paguera in May 1969 and April 1970 by the famous Austrian collector Dr Joseph Klimesch, and which were subsequently described by the late John Heath (Heath, 1973).

The future

It is clear from the above that there is much still to be learnt about the Lepidoptera fauna of s'Albufera and the Balearic Islands. What can be done in the future?

- Continue and hopefully expand the monitoring programme to include other areas of the Balearics.
- Continue to make the information available to the scientific community, e.g. a paper is being submitted by MRH to the Spanish lepidopterological journal *SHILAP Revista de Lepidopterologia* giving details of 14 species, some briefly mentioned above, that have been recorded from s'Albufera and elsewhere on the Balearic Islands that are new to the Spanish fauna, i.e. not listed in Vives Moreno's catalogue or its supplements (Vives Moreno, 1994, 1995, 1996) (Honey, *in prep.*).
- Publish the check list (Honey, *unpubl.*), giving full details of the Balearic Islands Lepidoptera, including those species that are already known from Spain but which are newly recorded for one or more of the islands.
- Publish further papers dealing with those species that have been discovered on Mallorca that are thought to be new to Europe or Science.
- Continue to collaborate with other Lepidopterists visiting the islands.
- Train local volunteers to undertake seasonal light-trapping throughout the year to build up phenological data (as instigated at s'Albufera des Grau) - especially at times of the year when it is not possible, through other work commitments, to visit the islands personally.
- Continue to develop and maintain the on-site reference collection and perhaps, in the long term, to set up a virtual identification guide to the Lepidoptera of s'Albufera, Mallorca or even the Balearics.
- Provide distributional data to other projects (e.g. Vives Moreno's revised Spanish catalogue, Fauna Iberica, Fauna Europaea, Microlepidoptera of Europe, etc.).

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Bibliography

- Askew, R. R. 1983. A revision of the encyrtid genus *Holcothorax* (Hymenoptera). *Syst. Ent.* **8**: 131-136.
- Cardona, L. [1999] 1998. Catàleg general de les espècies del Parc de s'Albufera des Grau, Illa den Colom i Cap de Favàritx. *Inventaris tècnics de Biodiversitat - 1*. [v] + 38 pp. Govern Balear, Palma.
- Corley, M. F. V., Gardiner, A. J., Cleere, N. & Wallis, P. D. 2000. Further additions to the Lepidoptera of Algarve, Portugal (Insecta: Lepidoptera). *SHILAP Revista de Lepidopterologia* **28**: 245-319.

Cuello, J. 1981. Els Lepidòpters de les Illes Balears. Cens provisional. *Treballs de la Societat Catalana de Lepidòpterologia* **40**: 33-53.

Fibiger, M. 1992. *Autophila libanotica osthelderi* Boursin, 1940 and *Characoma nilotica* (Rogenhofer, 1882) new to Europe (Lepidoptera, Noctuidae: Catocalinae, Ophiderinae [sic]). *Nota lepidopterologia* **14**: 297-301.

Fry, R. & Waring, P. 1996. *A guide to moth traps and their use*. Amateur Entomologists' Society Booklet. Volume 24.

Gastón, J. & Revilla, T. 1998. *Characoma nilotica* (Rogenhofer, 1882) nueva especie para la Península Ibérica (Lepidoptera: Noctuidae). *SHILAP Revista de Lepidopterologia* **26**: 175-177.

Gielis, C. 1996. *Microlepidoptera of Europe. Volume 1. Pterophoridae*. 222 pp. Apollo Books, Stenstrup.

Goater, B. 1994. Lepidoptera (Heterocera) recorded at s'Albufera Natural Park in 1992-1993. *Bulletí del Parc Natural de s'Albufera de Mallorca* **1**: 55-60.

Heckford, R. J. 1994. *Batrachedra parvulipunctella* Chrétien (Lepidoptera: Momphidae), a surprising addition to the British list. *Entomologist's Gazette* **45**: 261-265.

Heinicke, W. 1997. Erster Fund des Eulenfalters *Mythimna languida* (Walker, 1858) in Deutschland (Lep., Noctuidae). *Entomologische Nachrichten und Berichte* **41**: 198-200.

Honey, M. R. (*in prep*). Fourteen species of moths (Lepidoptera: Heterocera) apparently new to Spain recorded recently from Mallorcan (Balearic Islands). *SHILAP Revista de Lepidopterologia*

Honey, M. R. (*unpubl.*) A systematic and distributional check list of the Lepidoptera of the Balearic Islands.

Honey, M. R., Orfila, M. & Riddiford, N. J. (*in press* 2001) Moth research in s'Albufera des Grau (Insecta: Lepidoptera). *Bulletí Científic dels Parcs Natural de les Balears*

Kallies, A. & Riefenstahl, H. G. 2000. A new species of *Bembecia* Hübner, [1819] from the Balearic Island of Mallorca (Lepidoptera: Sesiidae). *Entomologisches Zeitschrift, Stuttgart* **110**: 359-363.

Karsholt, O. & Razowski, J. (eds). 1996. *The Lepidoptera of Europe. A Distributional Checklist*. 380pp. Stensrup.

Losser, E. 1999. Ein weiter Beitrag zur Schmetterlingsfauna der Baleareninsel Mallorca (Lepidoptera). *Entomologisches Zeitschrift, Stuttgart* **109**: 94-102.

ORCA (Organització per a la Cartografia de les plantes dels Països Catalans)

URL: <http://www.bio.ub.es/bioveg/orca/WelcomeOrca.html>

Rezbanyai-Reser, L. & Hausmann, A. 2000a. Über *Mythimna (Morphopoliana) languida* (Walker, 1858), eine neue, tropische Wanderfalterart Europas, und ihre Fundangaben in Nord- und Süditalien (Lepidoptera: Noctuidae). *Atalanta* **31**: 77-85.

Rezbanyai-Reser, L. & Hausmann, A. 2000b. Eine Berichtigung: *Mythimna (Morphopoliana) languida* (Walker, 1858) auch Deutschland und Makedonien (Lepidoptera: Noctuidae). *Atalanta* **31**: 529-530.

Vives Moreno, A. 1994. *Catálogo sistemático y sinonímico de los lepidópteros de la Península Ibérica y Baleares*. (Segunde Parte) x + 775 pp. Madrid

Vives Moreno, A. 1995. Primera addenda et corrigenda al “Catálogo sistemático y sinonímico de los lepidópteros de la Península Ibérica y Baleares (Segunde Parte)” (Insecta: Lepidoptera). *SHILAP Revista de Lepidopterologia* **23**: 307-341.

Vives Moreno, A. 1996. Segunda addenda et corrigenda al “Catálogo sistemático y sinonímico de los lepidópteros de la Península Ibérica y Baleares (Segunde Parte)” (Insecta: Lepidoptera). *SHILAP Revista de Lepidopterologia* **24**: 275-315.

Zilli, A. & Peria, E. 1998. *Characoma nilotica* (Rogenhofer) new to Italy (Lepidoptera Noctuidae). *Bollettino della Societa Entomologica Italiana* **130**: 75-76.

Habitat Biodiversity Investigations: Sampling of Habitats for physical and vegetative structure, species presence and impacts on biodiversity by Chris Donnelly

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 Comu, 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

In autumn 1999 and autumn 2000, sampling was carried out on some of the habitats present to provide data that can be used to assess the biodiversity of each habitat and provide baseline data on the factors affecting its biodiversity (physical and vegetative structure, species presence and impacts). The sampling included recording of ecological niches present and faunal associations with the habitat. Further work is needed on the other habitats present and to supplement the data collected on the habitats already sampled.

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).

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 2001.

Habitat Mapping: Further analyses of Habitats present within the Park by Chris Donnelly

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. Recommendations for future work were:

- a repeat of the mapping exercise on a regular basis to determine habitat changes
- production of more detailed maps using the 1:25,000 maps of the Park
- further refinement of the classification to distinguish between the different saltmarsh and swamp communities
- digitisation of the maps and habitat boundaries.

The data from the habitat maps has since been summarised onto a database (Access) which categorises the various habitats into individual 'sectors' (i.e. compartments) each with a reference number, name and KM square reference (**e.g. Habitat Type: Dune Scrub, Sector/Location: Es Comu, reference: 21001**). The estimated number of .01 KM squares covered by the sector is also recorded.

The following work has now been started in order to provide more comprehensive habitat information on the Park –

1. review of habitat classification where needed and corrections to original data (started in 1998).

The following corrections were known to be needed:-

- **Marginal vegetation** – this was not mapped.
- **Walls** – these were overlooked in many areas.
- **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.
- **Built-up areas** – these were overlooked in many areas.
- **Bare ground** – this was recorded in the centre of a few tracks but not consistently.

- **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.
 - **Species-rich grassland** – this was mapped on several tracks but not consistently (there are many small areas).
2. completion of database summary of habitats present including assessment of hectares covered (started in 1998).
 3. transfer of the map data of each habitat type onto overall maps of the park (started in 1999).
 4. re-assessment and re-mapping of 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 (started in autumn 2000).
 5. 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 (work carried out as part of Habitat Biodiversity studies, started in autumn 1999)
 6. investigation of the use of and impact on the habitat by significant groups or species (analyses of other project work with direct relevance - ongoing)
 7. instigation of fixed-point photography on selected habitats (started in autumn 2000).

Reedbed passerines by Brigitte Poulin

Editorial note: this information was extracted from the Station biologique de la Tour du Valat Annual Report for 1999

This project analyses the impact of modes of management associated with economic activities on the organisation of passerine communities in reedbeds. The study on the classification of reedbeds as breeding habitat for marsh-nesting passerines continued this year with 8 new sites of which four were exploited for thatch. Data analysis from the 16 sites sampled in 1998 and 1999 will make it possible to evaluate what are the principal biotic and abiotic factors influencing abundance and composition of marsh-nesting passerines. The sites are part of the network studied in the “Mediterranean reedbed typology” project.

Preliminary results suggest a predominant impact of food resources; an entomofauna section was developed in 1999 and integrated in the classification study. This project, carried out in collaboration with the University of Göttingen (Dr T. Tschardt) as part of the “Diplomarbeit” of Martin Schmidt sought (1) to estimate the richness and composition of the entomofauna, in particular of coleoptera and spiders which are taxa much consumed by birds; (2) to qualify the impact of reedbed cutting on these taxa; and (3) to determine the frequency of these taxa in the diet of birds, and whether the latter have a depredatory effect on the abundance of prey.

Preliminary results show first of all high species richness with nearly 70 species of spider and over 200 species of coleoptera for all the sites. The impact of cutting on arthropods varies according to taxa and affects the various passerine species differently throughout the trophic chain. Cutting distinctly modifies species corteges and simplifies arthropod communities (variation between cut sites is lower than between uncut sites). Passerines consume a large number of spider species, but are very selective about coleoptera, while the *Cyphon* genus (Scirtidae family), slightly more abundant in reedbeds, represents alone more than 80% of items consumed. Despite this peculiarity, exclusion cages have revealed no depredatory effect of passerines on their prey.

Three sites were also sampled at S'Albufera de Mallorca (Balearic Islands) in the Mediterranean extension: this nature park holds nearly 1500 ha of *Phragmites australis* var. *gigantea* reedbeds. A passerine section was developed in it in collaboration with the National Park Service with a view to evaluating the impact of plant structure on the organisation of animal communities and to acquiring better knowledge of the movement dynamics of marsh-nesting passerines in the Mediterranean region. The sampling, carried out in autumn, will be repeated in the breeding season in order to be able to compare the results to those of the study in France.

A comparison of the results of a bird ringing project at S'Albufera in November 1997 with those of a repeat project in November 1999, by D M Hanford, H F Coats, R Evans and R J Rigdon

Procedure

A net ride was positioned parallel to the Gran Canal at the southern edge of Colombar Gran. Five 18 metre mist nets were set in one continuous line from 0700 hrs to 1200 hrs for five days: November 9th-13th in 1997 and November 10th-14th in 1999.

In the period between the two visits much, if not all of the emergent vegetation in the Gran Canal and the smaller canal de Sa Siurana adjacent to the ringing site had been removed. This action increased the measure of 'edge effect' (the interface between reed bed and open water) especially at the ringing site.

Table 1 lists all individual birds processed (retraps as well as newly ringed birds) during the two visits.

Table 1

		1997	1999
Little Bittern	<i>Ixobrychus minutus</i>	1	1
Kingfisher	<i>Alcedo atthis</i>	0	3
Robin	<i>Erithacus rubecula</i>	2	8
Stonechat	<i>Saxicola torquata</i>	1	2
Blackbird	<i>Turdus merula</i>	2	4
Song Thrush	<i>Turdus philomelos</i>	0	1
Blackcap	<i>Sylvia atricapilla</i>	0	1
Sardinian Warbler	<i>Sylvia melanocephala</i>	2	2
Moustached Warbler	<i>Acrocephalus melanopogon</i>	49	63
Reed Warbler	<i>Acrocephalus scirpaceus</i>	1	0
Cetti's Warbler	<i>Cettia cetti</i>	13	15
Chiffchaff	<i>Phylloscopus collybita</i>	38	40
Great Tit	<i>Parus major</i>	1	4
House Sparrow	<i>Passer domesticus</i>	0	2
Goldfinch	<i>Carduelis carduelis</i>	1	1

The Little Bitterns, a juvenile in 1997 and an adult male in 1999, were different birds. The increase in number of species and of individuals in 1999 perhaps reflects the more open nature of the site. This manifests in the figures for Kingfisher, Robin, Blackbird, Song Thrush, Blackcap, Great Tit and House Sparrow.

Looking at Moustached Warbler figures, there is a significant increase in 1999. Twenty-eight of the 63 were retraps (birds ringed previously). Not all data are at hand, but retraps included 12 ringed at the same site in November 1997 and 8 there in February 1998. These figures show a remarkable degree of site fidelity and indicate a minimum two year survival rate of 31.7% for that particular time period - and probably considerably higher.

Cetti's Warbler figures suggest a stable population for that very limited area.

The Chiffchaff numbers are very similar for the two visits, yet not one retrap was obtained in 1999. The site is obviously a good feeding area for this species but there is little evidence that they hold winter territories there. During a much reduced ringing effort at the site in February 1998, only one bird from November 1997 was retrapped plus one which had been ringed elsewhere in the Parc prior to that date.

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