MONITORING FOR GLOBAL CHANGE - THE EARTHWATCH EUROPE S'ALBUFERA PROJECT.

Report of the first season's work

1989

by PROFESSOR PALMER NEWBOULD and NICK RIDDIFORD

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MONITORING FOR GLOBAL CHANGE - THE EARTHWATCH EUROPE S'ALBUFERA

PROJECT.

A report of the first season's work to create a "global observatory" at S'Albufera Natural Park, Mallorca.

1. Introduction

In late March 1989 the arrival in Mallorca of a team of ecologists and volunteer fieldworkers heralded the start of Earthwatch Europe's Project S'Albufera . The adoption of this Project by Earthwatch Europe was prompted by the International Council of Scientific Unions' (ICSU) plan to introduce an International Geosphere-Biosphere Programme (IGBP). The aim of the IGBP was to assess global changes of the environment as a result of changes in the upper atmosphere by combining remote sensing work in space with ground based research at a series of "Global Observatories". The Parc Natural de S'Albufera became the testing ground for these global monitoring stations as Earthwatch Europe set out to convert the IGBP from an idea to reality, and to formulate and establish the methodology and resources required for the Programme.

The International Geosphere-Biosphere Programme

The International Geosphere-Biosphere Programme reflects growing concern world-wide at the rapid environmental change threatened by current developments in the Earth's atmosphere, and the lack of a means either to identify those changes or assess their extent. It was considered that studies based solely on remote sensing, single sites or groups of organisms were insufficient to assess the global effect of atmospheric change on

the environment and a multidisciplinary approach was required, based on a geographically wide selection of sites.

Choice of site

It was considered that for qualification as a global observatory a site needed to fulfil several criteria. They were

i) site protection, including the existence of a buffer zone, and long-term security;
ii) ecological importance and interest;
iii) the regular presence of scientifically qualified staff on site;
iv) the availability of documentary evidence about the site, geology, history, management and former flora and fauna;
v) size, if possible coupled with an element of homogeneity;
vi) sensitivity to global change.

The Parc Natural de S'Albufera, abutting on the Bay of Alcudia in the north of Mallorca, met those criteria. It is in state protection, having been designated a Natural Park in 1988; it is a wetland, of intrinsic interest as a rare and diminishing habitat in the Mediterranean as well as an important staging post for migrant birds; it has a staff of 10, supportive and sympathetic to the project and its aims; there is abundant archival material; it comprises an area of 1700 ha largely of reedswamp (dominated by Cladium mariscus and Phragmites australis), including for parts of its boundary a significant reedswamp buffer zone; and it was considered that carefully

selected monitoring processes would filter out local changes particularly if compared with similar studies at other Mediterranean wetlands. A plan of the Park and its location are given in Figure 1 (and a detailed description of the Park in S'Albufera, Guia de Paseo , prepared by the Conselleria d'Agricultura i Pesca and published by the Conselleria de Turisme, Palma de Mallorca).

The Objectives

Five objectives were defined as necessary to establish a Global Monitoring Station. They were

(a) To assemble full & detailed ecological data, including climate, hydrology, soils, pollution, past & present land uses & cultural influences and reconstruction of past conditions to reach an understanding of composition, functioning and dynamics of major ecosystem types.

(b) To provide standardised comparative data for evidence of local, regional & global change, to be reconciled with aerial photography & space sensory data and to be re-recorded at intervals of time; to provide a model for other global monitoring stations.

(c) To afford material for application in further research & reserve management at S'Albufera and in general conservation practice.

(d) To provide resources for comprehensive interpretive programmes & dissemination in all appropriate forms.

(e) To serve as a focus for education of residents & visitors of all age-groups & levels and to help in creating environmental awareness & commitment.

Fieldwork

Nearly 100 people of 7 nationalities assisted with aspects of the fieldwork. Full-time volunteer participants contributed both labour and funding, a type of support unique to the Earthwatch organisation. The project attracted volunteers of varying skills and backgrounds, but all shared a common goal of a willingness to help and learn. To guide these volunteers, guarantee the successful application of objectives and ensure the scientific value of the work, Professor Palmer Newbould was invited by Earthwatch Europe to act as Principal Investigator. Professor Newbould came to the Project with a background in field ecology and practical conservation education as the inaugural head of the University College London (UCL) M.Sc. Course in Conservation, and with the administrative experience of a spell as Acting Vice-chancellor of the New University of Ulster, a post from which he had recently retired.

The project needed an initial specialist input and this was achieved by asking members of the UCL Ecology and Conservation Unit to initiate the study. Additional specialists were also involved, two being present throughout the period of fieldwork and others as short-stay and day visitors.

The fieldwork was divided into four consecutive periods of two weeks. The first team comprised 15 UCL students, 3 UCL staff and 2 volunteers. They were followed by volunteer teams of

10, 6, and 8. Volunteers were mainly from the United States, but also included individuals from Britain and Canada. A total of 7 Mallorcan volunteers also participated. Full details of dates, volunteers and other participants are given in Appendix 1.

2. Fields of Research

Fieldwork was organised into 11 categories of research. They were Hydrology, Aquatic systems, Marshes, Dunes, Flora, Invertebrates, Vertebrates, the Perimeter of the Park, Land use history, Buildings, and Present use (see Appendix 2 for more details).

Hydrology

The influence of water bodies, including a freshwater aquifer flow from inland and some intrusion of sea water, was both considerable and complicated. Understanding this complex system was considered a major key to understanding the Park's ecology. A series of piezometers, distributed in a variety of sites throughout the Park were established at the beginning of the project to allow measurement of height and variations in water table. Stageboards were sited in the canals and readings taken to measure variations in surface water levels. Sifons, sluices & springs were identified and described and some water flow measurements taken. Details of tidal fluctuations were obtained from measurements on the seaward side of the main sluice of the Grand Canal. Wells at the Park's perimeter were mapped, measured for water level and tested for salinity levels.

Aquatic systems

a) Canals . Water quality was tested at numerous sites using a conductivity meter. The variety and amount of macrophytic growth was measured at these sites and compared with the conductivity results. The macrophytes of S'Albufera had been the subject of a detailed recent study by Dr Antoni Martinez of the University of the Balearic Islands. Sample sites were thus chosen to coincide with his, and comparison made. We were also able to liaise and work directly with Dr Martinez. An investigation of freshwater biology was begun by net-sampling invertebrates. To enable a more systematic approach in future years, sampling squares designed to encourage colonisation by freshwater life were anchored in selected sites.

b) Lagoons . Data obtained from lagoon studies were filed separately, but were similar to those described for canals.

c) Salinas . A disused area of saltpans was mapped. This was useful because it was an important and different habitat at the south-east edge of the Park and because a major recent Ordnance map had mapped it incorrectly.

Marshes

The botanical profile of sample sites was obtained by establishing a widely distributed number of permanent marshland quadrats, each 5 m x 5 m in area and recorded as if the perimeter were a line transect 20 m long. Another approach, a phytosociological study of the marsh vegetation, was undertaken by Dr Barrie Goldsmith. A study was conducted of the density and consumption by caterpillars of *Phragmites australis* (one of the dominant marshland plants). Height of vegetation and difficulty of access over large areas precluded the possibility of

attempting an overall vegetation map, but a vegetation map drawn up in 1980 by the University of the Balearic Islands was made available to us.

Dunes

There were two sets of dunes within the Park boundary, coastal dunes currently acting as the Park's buffer with the sea and, running parallel but approximately 400 m inland, a more ancient set known locally as las Dunas Fosiles (The Fossil Dunes). The coastal dunes included an area of dune woodland (Pinus halepensis) and lower garrigue-type vegetation. Some small P. halepensis blocks also existed on the fossil dunes, but other areas were reverting from agricultural use and trees and shrubs were largely absent. Both areas, especially the fossil dunes, were botanically rich, and were an interesting extra dimension to the Park.

a) Coastal dunes . Three re-locatable transects were studied, each running from the road to the sea, a distance of nearly 400 m, and a point quadrat was recorded at 1 metre intervals along each transect. The transects were each recorded twice, the second survey coming about one month after the first to determine the amount of variation due to seasonal change, different observers and imprecise relocation.

b) Fossil dunes . A small number of gridded permanent quadrats were laid out on the fossil dunes and on an area used more recently for agriculture. The corner pegs of the quadrats were left in place and the frequency of plant species in these

quadrats can be re-recorded on subsequent occasions.

Flora

a) Species populations . Several species of orchid, *Tamarix* , *Arundo donax* and *Lythrum junceum* were chosen as obvious, interesting or key components of the Park flora and their distribution mapped. In the case of the orchid species the number of flowering spikes observed in each site was recorded. Less obvious, but important as indicators of water purity, were charophytes and work was begun on identification as a prelude to distribution studies.

b) Total list . A comprehensive list of S'Albufera flowering plants was considered essential as a baseline and for reference purposes. Specimens were collected from all parts of the Park and a herbarium established. High quality plant drawings by Dinah MacLennan and photographs were used as an adjunct to the herbarium. The plant and visual material were cross-referenced to a card index which contained the scientific, English and (where possible) Mallorcan names of all plants recorded. All scientific names conformed to the *Flora Europaea* nomenclature. Dr Elspeth Beckett, the author of a recently published flora of Mallorca, Minorca and Ibiza assisted with the botanical work.

Invertebrates

Studies were divided between transect counts of obvious invertebrate groups requiring minimum specialist knowledge and pitfall transects for groups requiring greater specialist knowledge. The former comprised butterflies and dragonflies, both

of which were easy to see and with a relatively small number of readily identifiable species. The initial task was to establish methodology, testing the ability of volunteers to recognise species, developing transects which encompassed a wide range of habitats and which could be described, mapped and repeated, and identifying the `best' time of day, weather conditions and regularity for comparability of counts. A monitoring programme of beetle and spider communities in three habitats (fossil dunes, inundated and dry *Phragmites* marsh) was initiated using straight line transects of pitfall traps (10 at each site at intervals of 5m). The traps were visited every five days and their contents collected for later identification by experts.

Vertebrates

Vertebrate studies were restricted to selected bird and one mammal species.

a) Birds . Great Reed Warbler *Acrocephalus arundinaceus* , Little Grebe *Tachybaptus ruficollis* and Coot *Fulica atra* were identified as obvious, interesting or representative components of the Park avifauna and their distribution mapped and numbers recorded. A detailed study was carried out of Moustached Warbler *Acrocephalus melanopogon* densities. This species has a restricted World abundance and range and the results indicated that densities were high. Methodology was also developed for future more comprehensive monitoring of breeding and migrant birds.

b) Mammals . A survey was made of the distribution and habitat preferences of rabbits *Oryctolagus cuniculus* , and the results described and mapped.

Perimeter of Park

The results of a survey of the habitats, artefacts and human activities (including agricultural) at the Park's perimeter were described and mapped.

Land use history

S'Albufera has had a long history of human activity, much of it well documented. Drainage, rice growing and paper making from reed have each played a major role in shaping the current state of the Park. Research partly comprised on site studies (mainly mapping and measurement of artefacts such as aqueducts) but also included extensive consultation with local people (e.g. old paper mill workers), and access to archival sources. Documents from the Torella Archive were used to trace the steps taken in a nineteenth century attempt by an English company to drain the marsh. Details were also obtained at the Mallorcan central archive at Palma of the influence of legislation on its history and a view of historical changes in habitat was obtained from copies of old maps. In addition, a map produced by Andreu Muntaner Darder indicated the extent of the wetland prior to human attempts at drainage.

Buildings and other human artefacts

As part of the record of human involvement, existing buildings and other artefacts were described, mapped, photographed and sketched. The largest collection of buildings still extant was at Sa Roca. Previously a paper factory, most of the buildings are derelict but parts have been renovated to form

the Park reception area and headquarters.

Evidence of other buildings and artefacts, particularly bridges, were described, mapped and photographed. The aqueduct system was described, mapped and photographed and measurements taken.

Present use

Since becoming a Natural Park, S'Albufera has recorded steadily increasing visitor numbers. The project set out to study the use made of the Park by visitors. This was done by questionnaire and survey. Visitors were presented with the questionnaire (prepared in English and Mallorcan language versions) when they entered the reception centre. The first 139 questionnaires completed have been analysed and the results are presented in the UCL Conservation Course Report (Wood 1989).

The survey was carried out on three occasions and was a team effort, observers being sited at or near major thoroughfares and cross tracks. By recording in hour intervals the number of people and the directions they took flow charts were constructed of movement through the whole of the Park. As an adjunct to the visitor survey, a map was drawn of all the points of access to the Park.

Management was the other major current human influence on the Park. Present and future management were recorded from observations, information from Park staff and reference to a draft management plan made available to the project by Park Director, Joan Mayol.

3. Results and Objectives

Many of the fields of study were inter-related. Information gathered for one field was frequently appropriate for others and the data obtained for one line of study often impinged or were dependent on another. Thus, for instance, the study of old buildings and settlements within the Park was of value to the Land Use and Present Use data banks, while the tidal fluctuations studied under Hydrology also had a bearing on the Aquatic Systems studies, particularly with regard to the conductivity results. The fieldwork was organised by line of study because it was the most efficient manner of collecting and storing the information.

Project S'Albufera was not only the start of the most wide-ranging series of studies ever carried out at S'Albufera but also a new concept in ecological information gathering. Therefore, with tried and tested methods unavailable, much of the work was experimental and an emphasis placed on the design and development of suitable methodology. Inevitably a large proportion of the first season's work was devoted to understanding the system and establishing a baseline - objective a . A start was also made, however, with all other objectives. The relationship between objectives and fields of study is given in Appendix 2.

In addition to assessing such aspects as the methodology most suited to the project and its objectives, particular scrutiny was given (both during and after the fieldwork period) to the viability of the entire idea of global monitoring stations. The results of the first season's work demonstrated that the IGBP could be applied effectively using a combination of volunteers and scientists. However, the fieldwork experience

generated some suggestions for refinement. Volunteers were more than just a novel means of obtaining financial support to the project. Their contribution to the fieldwork was substantial and their continued involvement is probably essential, particular in relation to monitoring tasks. However, a higher proportion of scientists was considered necessary to allow for greater instruction and supervision, ensuring the use of volunteers to their maximum potential.

A limiting factor to be addressed in future years was the availability of specialists and specialist equipment. The collection of meteorological data, for instance, was identified as a very important element of the long-term work of the project but that line of study was deferred until a later season because of inadequate on site equipment. Some areas of research identified as significant to the Park's ecosystem (e.g. fish studies) were also deferred pending availability of specialist expertise.

Other problems identified include the need to be meticulous over data analysis and storage and to keep duplicate sets of data in the Park and in London. Small improvements at Sa Roca, like mains electricity and telephone (which are indeed planned) will make the logistics much simpler. There is a need to record plant productivity, animal populations and behaviour and hydrological phenomena at least once a month between April and October. Decisions on and resources for repeated aerial survey or analysis of satellite imagery need to be progressed. There is a need to ensure that monitoring sites and park management are more closely coordinated. Also if the Albufera work is to be a

component of IGBP, that programme needs to get on with developing its network of global observatories and to set out guidelines for minimum recording programmes at them.

Future Project S'Albufera planning includes studies in all relevant disciplines, but not necessarily all as part of the volunteer-related fieldwork. A need has been identified to devolve some of the specialist studies to scientists outwith the current framework. The first of these additional studies was carried out in summer 1989 when Chris Howe of UCL returned to S'Albufera to extend the hydrological studies initiated in April and May. The cost of extra studies cannot be met by current financing arrangements and will require Earthwatch Europe to seek funding from additional sources.

Earthwatch Europe's volunteer programme goes ahead again in April and May 1990 with an amended format. Three teams are planned. We again have the services of the UCL Conservation Unit students and staff, but they will be split between the first two teams to raise the supervisor/volunteer ratio. Details of the 1990 Project S'Albufera programme are given in Appendix 3.

There were many questions implicit in the launch of Project S'Albufera. How would the Park staff react to the arrival of a succession of outside researchers and would we still be welcome after two months of work? How would the volunteers cope with the scientific work? Was it possible to convert the ambitious IGBP idea into reality? And was S'Albufera the site to initiate it? Any such doubts were firmly dispelled in 1989 and the proof is the return of the project for a second season. The

task is to consolidate the first season's work and to advance the project using the methodology evolved in 1989. Much remains to be done, but the key element lies in the long-term nature of the project. The first steps have been taken and a firm base laid for a monitoring programme whose importance will increase with time and the steady accumulation of environmentally sensitive data.

4. Acknowledgements

Project S'Albufera owes a debt of thanks to numerous people and organisations. The excellent start to the project and the amount and quality of work done is a tribute to the dedication and skill of all the volunteers and scientists involved in the field work, and to the financial and organisational help of Earthwatch members and staff both in Boston and in Oxford. Another vital ingredient was the support from the very outset of the Estructures Agraries i Medi Natural section of the Balearic Conselleria d'Agricultura i Pesca , through the good offices of its Director General, Sr. Miguel Angel Borras Llabres, Sr. Mateo Castello Mes, and Director of Natural Parks, Sr. Joan Mayol Serra. We were particularly grateful to them for the secondment of Park Technical Director, Josep Antoni Aguilo (Pepe) as liaison officer to the Project. Pepe's resourcefulness and boundless enthusiasm were appreciated as much as his immense knowledge of local sources and contacts. We were equally grateful to the other Parc Natural de S'Albufera staff for their help and advice. Mallorcan Residents Pat and Dennis Bishop, the officials and members of the Friends of S'Albufera and Tony Bonner were also particularly helpful. The

experience of the University College London Ecology and Conservation team in carrying out this type of project was invaluable. Sr. Gual de Torella, whose family owned the Albufera at one time, showed us around the extensive Torella archive in the National Archive in Palma. Dinah MacLennan (plants) and John Taylor (birds) kindly provided vignettes for this report. To all these people, and to the many others whose names are listed in Appendix 1, we owe an enormous debt of gratitude. Finally, we would like to mention that the Project was the brain-child of Earthwatch Europe trustee, Max Nicholson, and its success is a tribute to his energy and vision.

APPENDIX 1 - List of Participants

Principal Investigator

Professor Palmer Newbould

Scientific Assistants

Mrs Jo Newbould (Botany), Nick Riddiford (Ornithology, Entomology), Dinah MacLennan (Botanical illustrator), Hilary MacLennan (Logistics)

Seconded to Project by Balearic Conselleria d'Agricultura i

Pesca, Estructures Agraries i Medi Natural section

Josep Antoni Aguilo (S'Albufera Natural Park Technical Director).

Cooks

Francisca Rayo Payeras, Margalida Serra Cresp¡ (Sa Pobla, Mallorca)

Team 1, University College London Ecology & Conservation Unit (30th March-13th April)

Supervisors

Dr Brian Wood, Dr Roderick Fisher, Dr Barrie Goldsmith (from 12th April)

Students

Leticia Domingues Brandao, Sandra Charity, Laura de Moraes Mourao (all Brazil), Mathew Matemba (Malawi), Charles Kibi Otim, Frederick Muttuamba Vateego (both Uganda), Nigel Bourn, Philip Eckersley, Anna Evans, Angus Ferguson, Neil Hill, Chris Howe, Miles King, Myra Park, Jenny Schofield (all U.K)

Volunteers

Pere Tomas Vives (S'Albufera Natural Park Information Officer), Juan Salvador Aguilar Gonzalez, Carlota Viada Sauleda (Mallorca)

Team 2, First Volunteer Group (15th-29th April)

Supervising Scientists

Dr Barrie Goldsmith (to 27th April)

Amyan MacFadyen (Ecologist, Northern Ireland), Matthew MacFadyen (Ornithologist, Northern Ireland)

Volunteers

Margalida Ballester Gost, Lucia Prats Rotger (both Mallorca)

Amy Ballin, Claudia Estes, Deborah McIlwaine, John McIlwaine, Barbara Mitchell, Sarah West (all USA), Jonathan Hodge, Jon

Stokes, David Wege (University College London, all UK)

Team 3, Second Volunteer Group (29th April-13th May)

Francisca Bover Pons, Xavier Manzano Mulet (both Mallorca)

Armand Ball, Beverley Ball, Jacqueline Paul (USA)

Eric Grace (Canada)

Team 4, Third Volunteer Group (13th-27th May)

Helen Callbeck, Judith Daniels, Nancy Eldblom, Jennifer Johnson,

Robert Schilling, Valerie Winkler (USA)

Tessa Prior, John Taylor (UK)

Visitors to Project

Pat & Dennis Bishop (Friends of S'Albufera)

Paul Isenmann (Centre National de Recherche Scientifique,

Montpellier, France)

John Walmsley (Station Biologique de la Tour du Valat, Camargue,

France)

Joan Mayol (Director of Balearic Natural Parks, Mallorca)

Marti Mayol, Juan Miguel Gonzalez Mulet, Alexandre Forteza i

Pons, Guillem Xavier Pons i Buades, Immaculada Alcover (all The

Balearic Ringing Group, Mallorca)

Juan Carlos Muntaner Cerda (Treasurer, Friends of the Albufera)

Stewart MacLennan (UK)

Jane Madgwick (ecologist, UK)

Jane MacLennan (UK)

Elizabeth Newbould, Susan Newbould (photography, UK)

Martin Llobera, Antonia Ferriol, Antoni Martinez Taberner (Dept.

Biologia, Universitat Illes Balears)

Dave Schott (Earthwatch member, USA)

Max Nicholson (Earthwatch Europe Trustee)

Neville Parmenter (Royal Society for the Protection of Birds)

Mateo Castello Mas, Estructures Agraries i Medi Natural de la Conselleria d'Agricultura i Pesca (Mallorca)

Enrique & Heidi Gildemeister (Mallorca)

Henry & Barbara Leimbacher (Mallorca)

Wendy Sisson (Earthwatch USA)

Dick Steele (International Union for Conservation of Nature)

Alfredo Baron Periz (hydrologist, Mallorca)

Jorge Muntaner Yanguela (Mallorca)

Andreu Muntaner Darder (historian, Mallorca)

Andreu Muntaner Sans (Mallorca)

Tony Bonner, President, Grupo Balear d'Ornitologia i Defensa de la Naturalesa (GOB)

Antonia Pemberton (UK)

Jack Poll (Canada)

Ian Hepburn (RSPB, UK)

Elspeth Beckett (Mallorcan botanical expert, UK)

Catherine Stoye (UK)

Juan Pallares (journalist, Mallorca)

Miguel Angel Borras Llabres (Director General, Estructures Agraries i Medi Natural de la Conselleria d'Agricultura i Pesca (Mallorca)

Edward O'Hana (retired power station engineer, Mallorca)

Staff, Parc Natural de S'Albufera

Joan Mayol - Director of Balearic Natural Parks

Josep Aguilo - Technical Director

Xisco Lillo - Chief Warden

Alex Forteza

Pere Tomas

Pere Vicens

Llorenc Serra

Jaume Gamundi

Jordi Monterde

Vicens Lillo

APPENDIX 2 - 1989 Fields of Research

The following is a catalogue of information collected in 1989. This information has been deposited with the University College London Conservation and Ecology Unit. Details of published material are given in Appendix 4.

Category : Hydrology

Title of Work Done :

D escription of Sifons, Sluices & Springs and water flow measurements.

Tidal Cycle (2/4/89, 16-18/4/89).

Cards for Piezometers: Stageboards and readings.

Objectives : a, b.

Category : Aquatic systems

Title of Work Done :

Conductivity Study (17-26/4/89).

Cards for Martinez sites 1, 2, 4-12, 14 16-23, 27-35.

Wells 1-13 MAP 1A 1:10,000.

Jackie Paul's Macrophytes & Conductivity.

Bob Schilling's Macrophytes & Conductivity.

Freshwater Biology - Ferguson, Fisher et al.

Map of Freshwater and Hydrology sites 1:10,000

Map of aquatic sample sites

Martinez map of macrophyte distribution.

Diagram of salines area, Armand & Beverley Ball (7/5/89).

Objectives : a, b.

Category : Marshes

Title of Work Done :

Density and consumption of Phragmites.

Marshland permanent quadrats.

Phytosociology of Marsh Vegetation, Barrie Goldsmith.

Objectives : a, b, c.

Category : Dunes

Title of Work Done :

Coastal dune transects.

Permanent quadrats on fossil dunes.

Objectives : a, b.

Category : Flora

Title of Work Done :

Orchid distribution, Hodge et al .

Distribution of Tamarix, Arundo, Lythrum junceum.

Information about herbarium.

Dinah Maclennan's plant drawings.

Plant photographs.

Albufera flora.

C ard index of flora and herbarium. Cards for English and Mallorquin names, cross-referenced to Latin names.

Charophytes.

Vegetation Map, Univ. of Palma c1980.

Objectives : a, b, c, d.

Category : Invertebrates

Title of Work Done :

B utterly transects. Eric Grace, also N Riddiford, T Prior, J Taylor.

Invertebrate pitfall trap data.

Dragonfly transects.

Objectives : a, b.

Category : Vertebrates

Title of Work Done :

Bird Surveys;

Map of Coots.

Map of Great Reed Warblers, Little Grebes.

Matthew Macfadyen's annotated bird list.

John Taylor's census walks.

Moustached Warbler census map & related data.

Rabbit survey.

Objectives : a, b, c.

Category : Perimeter of the Park

Title of Work Done :

Survey of perimeter (initial survey).

Survey of perimeter (completed/corrected survey by John Taylor).

Objectives : a, c.

Category : Land use history

Title of Work Done :

A queduct information. Elizabeth Newbould & Eric Grace; Bob Schilling.

Documents from Archive Torella.

Old maps of Mallorca/Albufera assembled by Francisca Bover.

History and legislation.

Copy of p re-Lopez map, given by Andreu Muntaner Darder (roll).

Objectives : a, d, e.

Category : Buildings

Title of Work Done :

Description of buildings, bridges etc.

Three Watercolours by Barbara Mitchell.

Objectives : a.

Category : Present use of Park

Title of Work Done :

Access map.

Visitor survey.

Management information.

Photographic panorama of Park (Matthew Macfadyen).

Objectives : a, c, d, e.

APPENDIX 3 - 1990 programme details

Project Title

Biodiversity of Wetlands at S'Albufera, Mallorca.

Research Site

Parc Natural de S'Albufera, Mallorca, Spain.

Principal Investigators

Professor P. Newbould (Team I)

Dr F. B. Goldsmith (Team II)

Mr N. J. Riddiford (Team III)

Team Dates in Field

TEAM I April 3-April 17, 1990 Volunteers: Min 4, Max 5

TEAM II	April 20-May 4, 1990	Volunteers: Min 4, Max 5
TEAM III	May 7-May 21, 1990	Volunteers: Min 8, Max 12

Overall Team Size and Composition: Minimum 14, comprising integrated teams of Earthwatch Volunteers, University College London Students, Mallorcan Students and Scientific Supervisors.

APPENDIX 4 - List of publications

HOWE, C. 1989. Albufera: Aspects of Hydrology, Vegetation, History and Management . University College London M.Sc. in Conservation dissertation.

NEWBOULD, P. 1989. The Albufera as a Global Monitoring Station . Earthwatch Europe cyclostyled report.

NEWBOULD, P. J., RIDDIFORD, N. J. and GRACE, E. 1989. Consumption of Phragmites australis at S'Albufera, Mallorca. In The Albufera as a Global Monitoring Station (Newbould 1989).

WOOD, B. (ed.). 1989. UCL S'Albufera Studies, 1989 . University College London Ecology & Conservation Unit.