

MONITORING FOR ENVIRONMENTAL CHANGE  
THE EARTHWATCH EUROPE S'ALBUFERA PROJECT

A summary report of the second season's work 1990

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1. INTRODUCTION

This report outlines the second season of fieldwork for Earthwatch Europe's Project S'Albufera , carried out at S'Albufera Natural Park, Mallorca by a team of ecologists and volunteer fieldworkers. The programme of work followed the pattern established during the first season of combined participation by scientists, students and staff of the Ecology and Conservation Unit of University College London (UCL), Earthwatch and Mallorcan volunteers.

Details of the establishment of the project and choice of site were given in the first season's report (Newbould & Riddiford 1990). Further progress was made towards achieving the objectives of the project, which 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.

To meet the requirements of these objectives fieldwork was divided into three periods of two weeks, with two "rest" days between each for review of information gathered and for further planning. The first team comprised 7 UCL students, 2 UCL staff and 5 volunteers. The second comprised 6 UCL students, 3 UCL staff and 7 volunteers. The third comprised 2 supervising scientists and 13 volunteers. Team dates were 3rd-17th April, 20th April-4th May and 7th-21st May 1990. Volunteers were mainly from the United States but also included three from Mallorca (all students from the Universitat de les Illes Balears) and 3 from Britain, two of whom were from the Princes' Trust. The responsibility of overall planning and supervision was shared by three Principal Investigators, Professor Palmer Newbould, Dr Barrie Goldsmith and Nick Riddiford. The studies also benefited from the expert advice and assistance of a number of short-term visitors to the project, in particular the Park's director, Joan Mayol, and Drs Hoffmann and Hafner of the Tour du Valat Biological Station, France. In all, about 100 people of 8 nationalities contributed to one or more aspects of the fieldwork. Full details of all participants are given in Appendix

1.

## 2. FIELDS OF RESEARCH

Fieldwork was organised into eight categories of research. Seven of these - Hydrology, Aquatic Systems, Marshes, Dunes, Flora, Invertebrates and Vertebrates - involved some repetition of surveys and studies initiated in 1989, but in nearly every category there was also an expansion into new areas of study, while Meteorology was new. These are described below (and see Appendix 2 for more details).

### Hydrology

Work initiated in 1989 was continued and extended. Regular measurements of water table height and its variation were again obtained from a series of piezometers distributed in a variety of sites throughout the Park, and measurements of surface water levels obtained from stageboards sited in the canals. A number of stageboards were new, installed by Park staff during winter 1989-90, which ensured the collection of data from a much greater and more representative sample of sites. A University College London Ecology and Conservation Unit team undertook detailed measurements of water flow, and also accurate levelling of piezometers and stageboards. Flow rates were measured in canals to identify the direction and velocity of water flow through the Park and to "rate" some of the stageboards. Flow rates were measured especially where they were thought to be influenced by the presence of siphons or springs. Conductivity recordings were made at all sites to measure the dissolved salts

in the water. Details of fluctuations in sea level were obtained from measurements on the seaward side of the main sluice of the Grand Canal. Measurements for water level and salinity levels were repeated at wells at the Park's perimeter which had been measured in 1989.

#### Aquatic Systems

Hydrobiological studies were conducted by net-sampling invertebrates, by recording colonisation of sampling squares anchored in selected sites in 1989, and by canal transects. Net-sampling was done at a series of sites and water quality simultaneously tested using a conductivity meter so that the water quality preferences of invertebrate fauna could be identified. Sample sites were chosen to coincide with sites studied for variety and amount of macrophytic growth by Dr Antoni Martinez of the Universitat de les Illes Balears who also compared his results with conductivity data. Transects were done from a boat in as many canals as possible, usually near junctions with other canals. The technique comprised information of the canal profile by measurements of depth at metre intervals, net-sampling for middle and bottom layer aquatic invertebrates and identity, height and density of aquatic macrophytes at the same metre intervals.

#### Marshes

Studies were repeated of the botanical composition of permanent marshland quadrats, established in 1989, and of the density and consumption by caterpillars of *Phragmites australis* .

There were two new studies. One, conducted in association with Park staff, set out through a series of exclosures to monitor the effects of grazing by cattle and horses in two different areas of marshland. The other was a study of biomass production in *Phragmites* and *Cladium mariscus* marsh. This was achieved by cutting, measuring and weighing all above-ground, living material from a series of one metre quadrats in areas of marsh considered representative of various ages (i.e. time since last burn) of *Phragmites* and *Cladium*, and growing in various conditions of water quality and depth.

#### Dunes

a) Coastal dunes . Three botanical transects established in 1989 were repeated in 1990. Each ran 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. In addition a simultaneous survey of the molluscs associated with the habitat was undertaken along two of the transects by searching for all live specimens in one metre quadrats at 10 metre intervals along the transect. A start was also made in mapping dune vegetation communities using a combination of aerial photographs and ground studies.

b) Coastal dune study plot . A small area of wooded coastal dune was chosen for more intensive study in 1990. An historical perspective was gained by taking cores from the trunks of a large sample of mature Aleppo pine *Pinus halepensis* trees for measurement of annual growth rates. The trees were also individually marked and mapped to allow for future repeat corings. The vegetation, invertebrate and vertebrate communities

within the plot were also recorded.

c) Fossil dunes . Studies were repeated of the botanical composition of a small number of gridded permanent quadrats laid out on the fossil dunes. It was not possible to relocate quadrats established in an area used more recently for agriculture because, since establishing the quadrats, the area had again been returned to agriculture. However, the ensuing wheat field produced an exceptional variety of cornfield flowers, and a survey was done of wildflower diversity within the crop.

#### Flora

a) Species populations . The distribution was mapped of the marsh orchid *Orchis laxiflora* ssp. *palustris* and *Tamarix* species. In the case of the marsh orchid the number of flowering spikes observed in each site was recorded. Work was continued on the identification of charophytes as a prelude to distribution studies.

b) Total list . A comprehensive list of known S'Albufera flowering plants was recorded on card index, though additions continue to be made. The herbarium established in 1989 was continually augmented with specimens collected from all parts of the Park. High quality plant drawings by Dinah McLennan and photographs were used as an adjunct to the herbarium. The herbarium and illustrations are already proving their worth to Earthwatch Europe scientists and Park staff alike. Dr Elspeth Beckett, the author of *Wild Flowers of Majorca, Minorca and Ibiza* again assisted with the botanical work.

## Invertebrates

a) Butterfly and dragonfly transects . The butterfly transect work was continued with improved methodology and transect route. Dragonflies were recorded on the same transect, but an effective methodology designed to count this group in their commonest habitats, canals and marshes, has yet to be devised.

b) Invertebrate database . An on-site reference collection of specimens was established, initially restricted to moths and hoverflies, and work begun on recording on index card/data base all insect species known to occur at S'Albufera.

c) Molluscs . Studies were introduced in 1990 of mollusc abundance in relation to habitat. This was achieved by searching for live specimens over a 10 minute period in 1 metre quadrats positioned randomly in as many habitats and sites as possible within the Park. Specimens were identified and ranked at each site in order of abundance. A reference collection of specimens was initiated.

## Vertebrates

a) Breeding birds . The distribution of Great Reed Warbler *Acrocephalus arundinaceus* was mapped for the second consecutive year and Nightingale *Luscinia megarhynchos* for the first time. An intensive study of Moustached Warbler *Acrocephalus melanopogon* densities was undertaken by a UCL team using capture-recapture techniques and observations of colour-marked individuals. Breeding population levels of a wide range of species were

ascertained using British Trust for Ornithology Common Bird Census techniques. Coverage of all accessible areas of Park was achieved with the help of volunteers and members of the Grupo Ornitologico Balears (GOB). An assessment of the importance of S'Albufera for colonially nesting herons and egrets was made in May by Dr Hafner and Dr Hoffmann of the Station Biologique de la Tour du Valat.

b) Migrant birds . UCL teams carried out a study of migrant birds passing through the Park during a four week period in April.

c) Mammals . Small mammal trapping was attempted in the coastal dunes using Longworth traps, but without success.

d) Fish . Plans for a detailed study using electrofishing techniques had to be postponed when fish scientist Dr Javier Lobon Cervia became unavailable at the last minute, but preliminary work was done using funnel traps at the Grand Canal sluice. Trapped fish were identified, weighed and measured.

e) Reptiles and amphibians . Studies were undertaken of marsh frogs, geckos and snakes. Frog studies comprised developing a methodology to assess densities of marsh frogs *Rana ridibunda perezi* . The gecko study comprised a transect along a 1500 m long aqueduct wall. Moorish gecko *Tarentola mauretania* was the only species found (though Turkish gecko *Hemidactylus turcicus* is also known from S'Albufera). Preliminary results established that time and weather, particularly temperature, contributed to daily variations in transect counts. The snake study comprised identification, mapping of distribution and measurements of trapped individuals. All snakes seen or trapped were viperine snakes *Natrix maura* . Snakes were also counted on the gecko

transect.

## Meteorology

Meteorological data were collected primarily as an adjunct to the migrant birds study. Weather readings of temperature, cloud cover and type, wind direction and strength and air pressure were made four times each day during a four week period. Additional information including precipitation amounts, minimum and maximum temperatures and daily synoptic charts was obtained from Park records and the National Institute for Meteorology at Palma. Much of the information was obtained using University College London equipment. There is a need for more sophisticated meteorological equipment, probably in the form of an automatic weather station, permanently on site.

### 3. PROGRESS AND FUTURE PLANNING

Main assessment after two seasons has concentrated on reviewing preliminary results in relation to the methodology used and on refining methodology in the light of fieldwork experience. The objectives of the project remain the same, in particular to observe and measure the nature, rate and significance of local, regional and global change at S'Albufera, to trace its causes and development, and to consider its consequences. Three main approaches are seen as the means to achieve this objective: satellite imagery/aerial photography to gain an overall picture; ecological survey to provide "ground truth" in support of satellite imagery; and appropriate measurements of the physical

environment, especially meteorological and hydrological.

Studies in the first two seasons have concentrated heavily on the latter two approaches. This has already generated a welter of information, original documentation which is stored at a number of sites and with a number of researchers. Duplicate sets have, however, now been established both at the Park and at Earthwatch Europe's Oxford (UK) headquarters. After two seasons of fieldwork it has been possible to define more closely the time scale needed to achieve the project objectives. The programme of work is planned to proceed in three phases. During the first phase the emphasis has been on testing of different approaches and methodologies on site. This leads naturally in phase 2 to the introduction of a definitive programme of studies. This in turn will lead in phase 3 to integration of that programme with, and input into the international work of the International Union for the Conservation of Nature (IUCN), the United Nations Environmental Programme (UNEP) and the International Geosphere-Biosphere Programme (IGBP).

The first phase, begun in spring 1989, is scheduled to end in 1991. A major part of this initial phase is to establish baseline information, both current and historical, which will allow the assessment of environmental change. Work so far has been described above and by Newbould & Riddiford (1990). The satellite imagery and much aerial photography work still needs to be done. Work with applications for management, interpretative programmes and educational development within the Park has been conducted and will continue.

By the end of 1991 we shall have enough information to

develop a definitive programme of studies for implementation during the second phase (1992-1995). The disciplines of research will require specialist scientists in a number of fields and will include the setting up of a computerised data base. There will, nevertheless, be a continued role for Earthwatch volunteers, particularly in carrying out the many routine tasks that the studies require. Scientific links have already been forged with a number of British Universities, but the long-term success of the project also depends on active Balearic and Spanish co-operation and support. Strong support has been received from the Balearic authorities, particularly the Park's Director, ecologist Joan Mayol; and the co-operation of Antoni Martinez of the Department of Biology of the Universitat de les Illes Balears, a biologist active in S'Albufera, was formalised in 1990 with the signing of a co-operation agreement between Earthwatch Europe and UIB.

The third phase will be full integration with the IUCN, UNEP and IGBP. Research prior to this phase is intended to identify key indicator species and systems for assessing environmental change, and also to act as a proving ground for the IGBP concept - including identification of problems in achieving the long-term objectives.

Though Earthwatch volunteers have a key role to play in future fieldwork, we envisage greater specialist input of scientists and equipment as essential to the overall success of the programme. We also envisage scientist involvement in studies at periods other than the two spring months presently allocated to Project S'Albufera fieldwork. Securing additional funding to make this possible is currently being addressed. There are signs

too that some logistic problems, most notably the lack of mains electricity and telephone on site, will soon be resolved.

Volunteers will again be a major component of 1991 fieldwork. We shall be without UCL Ecology and Conservation Unit services for this third season, but three volunteer teams are planned in April-May and, for the first time, we shall be putting an autumn team into the field, in October. Professor Newbould has relinquished the position of Principal Investigator for 1991 to concentrate on his Phragmites and Cladium productivity studies but we are most fortunate to obtain the services of the experienced and well-known botanist, Dr Franklyn Perring, in his place. The role of PI is shared by Nick Riddiford, maintaining continuity with the last two seasons, and Professor Newbould retains an involvement with the project, both with his specialist studies and in advising the scientific programme. Details of the 1990 Project S'Albufera programme are given in Appendix 3.

#### 4. ACKNOWLEDGEMENTS

As in 1989, Project S'Albufera owes a debt of thanks to numerous people and organisations. We once again pay 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 and Earthwatch Europe members and staff in Boston and Oxford. We again received the valued support 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 Borrás 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 Assistant, Gabriel (Biel) Perello, as liaison officer to the project. His patient and willing assistance was of enormous benefit to the project, particularly in solving problems of logistics. The other Parc Natural de S'Albufera staff were equally supportive in their help and advice. Mallorcan residents, Pat and Dennis Bishop, and the officials and members of the Friends of S'Albufera were also particularly helpful. The help of the University College London Ecology and Conservation Unit teams was also appreciated, as was the input to the project by an enthusiastic and skilled series of scientific supervisors. The logistics co-ordinators, Dinah McLennan and Tessa Prior, worked hard and effectively to assure the smooth running of the project. Dinah's contribution also included some fine plant sketches some of which she has kindly provided to illustrate 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.

## APPENDIX 1 - List of Participants

### Principal Investigators

Professor Palmer Newbould (Team 1), Dr Barrie Goldsmith (Team 2),  
Nick Riddiford (Team 3)

### Scientific Assistants

Mrs Jo Newbould and Dr Elspeth Beckett (Botanists), Dinah  
MacLennan (Botanical illustrations, Logistics), Tessa Prior  
(Logistics)

Parc Natural de S'Albufera Liaison Officer to Project  
Biel Perello ( Conselleria d'Agricultura i Pesca, Estructures  
Agraries i Medi Natural )

### Cooks

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

Team 1 (3rd-17th April)

### Supervisors

Dr Roderick Fisher and Christopher Howe (University College  
London Ecology & Conservation Unit)

UCL Ecology & Conservation Unit Students

Hrisoula Athanasiou, Henry Barbour, Tom Brereton, Angus Davies,  
Phil Grice, Tim Norman, Pere Tomas Vives

Volunteers

Alex Ide, Ann Mitchell, Beula Sheaffer (USA), Victoria Font  
Jaume, Maria Bordoy Amengual (Mallorca)

Team 2 (20th April-4th May)

Supervisors

Dr Brian Wood, Dr Andrew Warren and Christopher Howe (UCL)

University College London Ecology & Conservation Unit Students

Richard Dealler, Anna Haigh, Rachel Harding-Hill, Ilyssa

Manspeizer, Kevin Patrick, Gavin Saunders

Volunteers

Rosalie Enos, Betty Falk, Richard Falk, Celia Foss, Bob Foss,

Sonia Osborne (USA), Nancy Walker (UK),

Team 3 (7th-21st May)

Supervisors

Keith Bowey (Conchologist), Simon McKelvey (Entomologist)

Volunteers

Cait Ni Fhinn, Steve Brogan (both Princes Trust), Salud Deudero

Company (Mallorca), Anya Averill, Katy Averill, Jim Averill, Dale

Engstrom, Rita Gallacher, Susan Hollyday, Ernest Igou, Amie van

Itallie, Jack Lipscomb, Sam Kaufman (USA), Betty Parfenuk

(Earthwatch)

Visitors to the Project

Pat & Dennis Bishop (Friends of S'Albufera)

Luis Berbiela (ICONA)

Gabriel Bardi (FODESMA)

Dr Lucas Hoffmann & Dr Heinz Hafner (Station Biologique de la  
Tour du Valat, Camargue, France)

Joan Mayol (Director of Balearic Natural Parks, Mallorca)

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

Toni Nicholson, Barbara McKelvey, Stewart McLennan (UK)

Antoni Martinez Taberner, Enrique Descals, Martin Llobera,

Antonia Ferriol (Dept. Biologia, Univ. Illes Balears)

Brian Walker (Executive Director, Earthwatch Europe)

Max Nicholson, Pat Koechlin Smythe, Pepe Mayorga (Earthwatch  
Europe Trustees)

Josep Antoni Aguilo (Mallorca)

Rob Magrath (Dept of Zoology, Univ of Oxford)

Bernie Glancy, John Alcock (Independent Television News, UK)

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

Enrique & Heidi Gildemeister (Mallorca)

Henry & Barbara Leimbacher (Mallorca)

Alfredo Baron Periz (hydrologist, Mallorca)

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

Census helpers from the Grupo Ornitológico Balears

Staff, Parc Natural de S'Albufera

Joan Mayol - Director of Balearic Natural Parks

Gabriel Perello- Technical Assistant

Xisco Lillo - Chief Warden

Alexandre Forteza - Reception Centre

Pilar Lacalle - Reception Centre

Pere Vicens - Ornithologist

Llorenc Serra - Guard

Jaume Gamundi - Guard

Manolo Coello - Maintenance

Vicens Lillo - Maintenance

Miquel Frontera - Monitor

Xesca Crespi - Monitor

Carlota Viada - Monitor

## APPENDIX 2 - 1990 Fields of Research

The following is a catalogue of information collected in 1990. This information, along with 1989 material, has been deposited at Earthwatch Europe's Oxford (UK) headquarters. A second set of the material has been established at S'Albufera Natural Park. Details of published material are given in Appendix 4.

Category : Hydrology

Title of Work Done :

Piezometer and stageboard readings.

Water flow measurements.

Conductivity readings.

Sea level fluctuation measurements.

Conductivity and water level measurements of wells.

Catalogue Reference Number : 90/18

Category : Aquatic Systems

Title of Work Done :

Net-sampling data at sample sites.

Canal profile transects.

Catalogue Reference Number : 90/3

Category : Marshes

Title of Work Done :

Permanent marshland quadrats.

Quadrat 9 re-recorded 1990, compared with 1989)

Catalogue Reference Number : 90/2

Category : Marshes

Title of Work Done :

Effects of grazing.

Catalogue Reference Number : 90/5

Category : Marshes

Title of Work Done :

Density and consumption of *Phragmites australis*.

Biomass and Production study.

Catalogue Reference Number : 90/9

Category : Dunes

Title of Work Done :

Coastal dune study plot.

Catalogue Reference Number : 90/16

Category : Dunes

Title of Work Done :

Coastal dune transects.

Permanent quadrats on fossil dunes.

Catalogue Reference Number : 90/17

Category : Flora

Title of Work Done :

Species populations (Tamarix, marsh orchids)

Catalogue Reference Number : 90/14

Category : Flora

Title of Work Done :

S'Albufera plant list and herbarium notes.

Catalogue Reference Number : 90/19

Category : Invertebrates

Title of Work Done :

Butterfly and dragonfly transects.

Catalogue Reference Number : 90/1

Category : Invertebrates

Title of Work Done :

Invertebrate collection database.

Catalogue Reference Number : 90/10

Category : Invertebrates

Title of Work Done :

Molluscs.

Catalogue Reference Number : 90/12

Category : Vertebrates

Title of Work Done :

Frog densities.

Catalogue Reference Number : 90/4

Category : Vertebrates

Title of Work Done :

Migrant birds survey.

Catalogue Reference Number : 90/6

Category : Vertebrates

Title of Work Done :

Moustached Warbler study.

Catalogue Reference Number : 90/8

Category : Vertebrates

Title of Work Done :

Mammal studies.

Catalogue Reference Number : 90/11

Category : Vertebrates

Title of Work Done :

Bird population surveys.

Catalogue Reference Number : 90/13

Category : Vertebrates

Title of Work Done :

Fish weights and measurements.

Gecko transect.

Snake studies.

Catalogue Reference Number : 90/15

Category : Meteorology

Title of Work Done :

Meteorological recording.

Catalogue Reference Number : 90/7

APPENDIX 3 - 1991 programme details

Project Title

Biodiversity of Wetlands at S'Albufera, Mallorca.

Research Site

Parc Natural de S'Albufera, Mallorca, Spain.

Principal Investigators

Nick Riddiford (Teams I, II and III)

Dr Franklyn Perring (Teams III and IV)

Team Dates in Field

TEAM I      April 2-April 16, 1991

TEAM II     April 19-May 3, 1991

TEAM III May 6-May 20, 1991

TEAM IV October 14-October 28, 1991

Team Composition: integrated teams of Earthwatch Volunteers,  
Mallorcan Students and Scientific Supervisors.

#### APPENDIX 4 - List of publications

The first two seasons' work have generated the following  
publications.

HAFNER, H. & HOFFMANN, L. 1990. The Albufera de Alcudia  
(Mallorca): an assessment of the importance of this wetland for  
colonially nesting Ardeidae . Station Biologique de la Tour du  
Valat cyclostyled report.

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. 1990. The Albufera, Mallorca, as a Global  
Observatory. Jornades del Medi Ambient de les Balears 2:  
173-174.

NEWBOULD, P. 1991. Phragmites and Cladium on Albufera .

Manuscript.

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).

NEWBOULD, P. J. and RIDDIFORD, N. J. 1990. *Monitoring for Global Change: The Earthwatch Europe S'Albufera Project*. Earthwatch Europe, Oxford.

WOOD, B. (ed.). 1989. *A monitoring programme for S'Albufera, Mallorca*. Discussion Papers in Conservation No. 52. Ecology & Conservation Unit, University College London.

WOOD, B. (ed.). 1991 (in press). *Report on the 1990 Field Season*. Ecology & Conservation Unit, University College London.

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