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

The Albufera International Biodiversity Project Annual Report 2006
Edited by Nick Riddiford & Macu Férriz
The Albufera Initiative for Biodiversity

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PART I

TAIB Project S’Albufera in 2006

Hyles da hii photo: I Férriz
The Field Season

Team participation

Dates for the two spring teams were 15th to 29th April (team 1) and 15th to 28th May (team 2). The autumn dates were 15th to 31st October though two of the scientific team arrived for preliminary work on 11th October and several members stayed on into November to complete the writing up of activities and results for the Parc and Balearic Environment Department. As usual, the participants were drawn from a range of countries including Morocco, the first from that country. A report of the work undertaken in 2006 is given in Part II and details of the participants and activities in Part III of this report.

In addition, TAIB principal investigator Nick Riddiford led the University of York’s MRes in Ecology and Environmental Management biodiversity and environmental management field course in spring. The dates were 30th April to 13th May and involved 17 students, three demonstrators and two course supervisors.

Training

In a continuation of the collaboration with WWF Mediterranean Programme’s Across the Waters project, WWF sponsored the participation of Hanae Lemseffer, head of the Moroccan government’s Cellule Environnement, for training in May. Other volunteers were drawn from the Balearic Islands and peninsular Spain.

The work programme

Priority was given to the investigations requested by the Parc Directorate. These comprised a continuation of the study of reedbed dynamics in relation to fire, Diptera biodiversity and monitoring of the rare wetland orchid Orchis robusta. Results of these investigations are given in Part II.

In addition, TAIB maintained its ongoing studies into birds, bats, moths, butterflies, aquatic invertebrates as indicators of water quality, wider biodiversity and habitats. The database was extended and considerable effort devoted to setting up a virtual biodiversity library, using moths (Lepidoptera: Heterocera) as a pilot group. It is hoped eventually to make this virtual library available on the internet. The bat work was enhanced by the visit of Jordi Serra and his Catalunya a team in May to give an evening’s demonstration of bat monitoring techniques.

TAIB also responded to a request from the Parc Directorate to ascertain whether the stickleback Gasterosteus aculeatus was still extant in the Parc. The species had not been reported for a number of years and there were fears that it had been lost. Wendy Hayes led the investigation which proved, through sightings and captures, that a population still survived amongst the submerged macrophytes of the Canal des Polls.

In the autumn, Nick Owens joined the team to update and illustrate the Birds of S’ Albufera. The text for this work is already on the website but the long-term objective is to publish it as a book for the general visitor to the Parc. Nick also did some impromptu bird illustration master classes with the team.

Collaborations

Following discussions in autumn 2005 with the Institute for Mediterranean Studies (IMEDEA), it was a pleasure to see two Balearic members of TAIB, Laura Royo and Raquel Vaquer being contracted by IMEDEA. Raquel is undertaking marine studies, which have so far taken her on a cross-Mediterranean cruise and a winter visit to Spitsbergen. Laura is extending the dune erosion study at Es Comú which she began with TAIB. The new study investigates geomorphological trends in relation to utilisation and management of the zone, and the effects
on vegetation. Another of the IMEDEA team, Beni Padrón, investigating the role of insects in pollinating exotic and native flowers at Son Bosc, was able to benefit from the expertise of TAIB invertebrate specialists, David Gibbs, Martin Honey and Martin Ebejer who gave advice on determinations and the ecology of some of the insects Beni was encountering.

**Open day (and evening)**

Members of the general public were shown some of TAIB’s moth study activities at the end of April. This was arranged to coincide with the Third European Moth Night, organised by Hungarian Lepidopterological Society and the Entomological Society of Luzern but with participation throughout Europe. An evening session in Es Comú attracted 19 people and similar numbers visited Sa Roca the following morning to view overnight captures, see the collections and learn about the significance of the group for s’ Albufera and in the Balearic Islands. The event is reported more fully in Part II of this report.

**Other events**

**Supporting other Balearic sites**

*Lepidoptera of Mallorcan pinewoods.* TAIB’s entomological team continued to give support with identifications and database management for the pinewood biodiversity monitoring undertaken by Balearic Environmental Agent volunteers.

*The Lepidoptera: Heterocera of the Parc Natural des ses Salines.* Macu Férriz led this study, with Martin Honey in particular, providing advice and support on identifications and status. The study has revolutionised knowledge of the Ibizan fauna, and to a lesser extent for Formentera. The study was extended to the caterpillars and their food plants, thus extending ecological knowledge of the group.

*The invertebrates of Ibizan offshore islands.* Martin Ebejer and Nick Riddiford visited Ibiza in June to give training to the Parc Natural de Cala d’Hort biologist in the study of invertebrates on the islands of the Cala d’Hort Parc. Special emphasis was placed on Diptera, and on methodologies for the capture, curation and determination of invertebrate species generally. The significance of these sites for biodiversity was demonstrated by a new species for science found by Dr Ebejer during his visit to the island of Conillera.

**The Lebanon project**

High hopes of providing assistance to the Society for the Protection of Nature in Lebanon community wetland project at Kfar Zabad – reported on previously – were dashed when the proposal was turned down by Darwin Initiative. Without the necessary funding it is not feasible to proceed. Nevertheless, SPNL and their partner ARocha Lebanon continue their good work at Kfar Zabad and we wish them well.

**Posters and presentations**

TAIB was involved in two poster presentations at the Noah’s Arc (Arca de Noé) biodiversity conference in October, organised by the Balearic Environment Ministry. One poster described TAIB’s work and the other, in collaboration with IMEDEA outlined the erosion study being undertaken at Es Comú. The text for these two posters is given in Part II of this report.

In November, Nick Riddiford gave a presentation entitled Monitoring Birds at S’Albufera at the Ornithology at the dawn of the 21st Century conference in Bâna, Algeria. He also assisted at the launch of Algeria’s first ever ornithological society, the Association Algérienne des Amis des Oiseaux, which was formed at the same conference.
Special training programme

Nick Riddiford and Macu Férriz travelled to south Wales in December where they received specialist training on Diptera identification from fellow TAIB member, Martin Ebejer.

Publications notified in 2006

The following publications associated with TAIB investigations, activities or data have appeared, or been brought to our attention, since the publication of the 2005 TAIB report.


ROS DÓS DÀ, T. 2005. Selection of indicators for identification and quantification of Wetland goods and services: a case study of S’Albufera de Mallorca, Spain. MSc thesis in Environmental Sciences, Environmental Systems Analysis Group, Wageningen University, Holland.


ACKNOWLEDGEMENTS

It is our pleasure to thank Maties Rebassa, all his PN s’Albufera team, Head of Parks Catalina Massutí and the Conselleria de Medi Ambient for permission and support, and – as always - the scientists and volunteers of TAIB, our growing list of contacts and friends in Mallorca and the Balearic Islands, Jeroen Veraart for his excellent management of our website and the Foundation for Sustainable Development for hosting it, the numerous specialists who have given advice on identifications and other technical matters, IMEDEA, MedWetCoast, ATEN, Tour du Valat Biological Station, WWF Mediterranean for their contributions – in particular Anna Travaset, Sylvie Godet, Naïk Faucon, Pere Tomas and Rafaela Mancini of those institutions – and the many others whose contributions I have not detailed here – including our friends from collaborations in Mallorcan pinewoods, Ibiza and further afield. Macu Férriz, with help from her boyfriend and Balearic members of TAIB, undertook the Catalan version of the report. Pat Bishop and her family remain close and enthusiastic friends to the project. Thanks to you all.

Finally, we extend our gratitude to Meiji Techno UK Limited (www.meijitechno.co.uk) who, in recognition of the conservation value of the project, has given very generous discounts for purchases of microscope equipment.
TAIB Project S’Albufera:  
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PART II

Report of work in 2006

Larval mine in *Plantago* leaf  
photo: I Férriz
REPORT OF REEDBED, DIPTERA AND MARSHLAND ORCHID STUDIES AT DE S’ALBUFERA DE MALLORCA IN 2006

Main Aim
The main aim was to assist the Parc Directorate in its conservation management planning through integrated studies of the dynamics and associated biodiversity of reedbeds of different age, the diversity of flies (Diptera) and the population dynamics of the marshland orchid at s’Albufera de Mallorca.

Location
The location for the studies was the Parc Natural de s’Albufera de Mallorca and its surrounding area.

Work objectives
The dynamics of reedbeds after fire and their associated biodiversity
This study was a continuation of investigations initiated in 2005 on the impacts of fire on reedbed invertebrate communities and populations of the moustached warbler Acrocephalus melanopogon and reed bunting Emberiza schoeniclus – two emblematic species of s’Albufera reedbeds. This was done by investigating parcels of reedbed of different age since the last burn. Amongst the invertebrates, there was special focus on insect groups (Lepidoptera, Orthoptera, Coleoptera, etc.).

Diptera biodiversity at s'Albufera
A detailed study was undertaken of the range of diptera occurring in the Parc Natural de s’Albufera de Mallorca. We were very fortunate to call upon the expertise of specialists to tackle this group of complex taxonomy and challenging identification. Sampling was conducted in a range of Parc habitats during the spring, in April and May.

Monitoring the status and conservation management of the rare orchid Orchis robusta
A census was conducted of all the known populations of the marshland orchid Orchis robusta at s’Albufera. The aim was to use this information along with the results of census work from previous years, to identify trends in the total population; and in particular, the impact of various management measures on the population. The investigators were also asked to use the results to develop proposals for suitable management for the conservation and enhancement of the populations present.
The dynamics of reedbeds after fire and their associated biodiversity by
Gina Prior & Nick J Riddiford

Rationale for the study
This is the second year of a five year study of three reedbeds, a “young” reedbed, recovering from a fire in 2005, a “maturing” reedbed recovering from a fire in 2000 and an “old” reedbed which has not suffered from any intervention or disturbance for at least 35 years. This age difference presented a wonderful opportunity to investigate the biodiversity of reedbeds over a great span of years and to gather important information for the planning and implementation of management measures to benefit all of the rich biodiversity of this habitat, and in particular some internationally important bird (e.g. Acrocephalus melanopogon) and lepidoptera (e.g. Pelosia plumosa) populations.

The full extent of the study, which involves collecting data for birds, invertebrates, vegetation and water quality, was described in last year’s report (Riddiford 2005). These monitoring studies continue, and will do so for the next three years. For 2006 we report on one aspect of the work - reedbed age class and the abundance of flying insects.

Aim
To investigate the abundance of flying insects associated with reedbeds of different age classes

Introduction
Parc Natural de S’Albufera is an area of international importance as recognised by its Ramsar status, and affords protection to 1500 ha of wetland. Reedbeds are habitats of great conservation value in Europe (Dithlogo et al. 1992) and support a diverse and abundance suite of wildlife. Fire is a traditional management technique employed to prevent the succession of reedbeds. The resultant loss of vegetation affects both the abundance and community composition of invertebrates associated with this habitat (Swengel 2001). Invertebrates play a dominant role in ecosystem function due to their unrivalled diversity and faunal biomass, and are a vital food source for many other species. It is therefore important to assess the relationship between invertebrate abundance and reedbed age class.

Methods
Study sites
The study was conducted in May 2006 at the Parc Natural de s’Albufera where three reedbeds of different age structures were identified. Es Colombars is a designated non-intervention zone and has no records of fire or other disturbance for at least 35 years (G. Perelló, pers. comm.). Es Rotlos was burnt in 2000 and a sub-section of the same reedbed was burnt again in 2005. Both fires were accidental and anthropogenic in
origin and destroyed all the above-ground vegetation. Each site is compartmentalized and segregated by a system of canals and wide tracks.

Invertebrate sampling and analysis
Malaise traps were used to collect aerial-terrestrial invertebrates. One trap was placed in each of the three sites and situated near the edge of the reedbed. Samples were collected between 0600-0700 hours and 1800-1900 hours on three consecutive days. Large sample sizes and restricted knowledge prevented identification to species level. Diptera were therefore classified using the system: Nematocera, Acalyptrata, Brachycera, Aschiza and Calyptrata. All other insects were identified to family level.

Data analysis
Correspondence ordination analysis (using ADE-4) enabled community composition to be determined. The Shannon diversity index accounts for abundance and diversity and was used to characterize family diversity within sites. Temporal and site variations in abundance were explored with the Scheirer-Ray-Hare (SRH) test, followed by Mann Whitney tests to compare sites.

Results
In total, 3925 flying insects were collected. Diptera was the dominant insect order with 78% of all individuals belonging to this division (Fig. 1). The abundance of insects significantly differed between sites (SRH: df. = 2, p < 0.05; Fig. 2) with more insects caught in the Es Rotlos 2000 reedbed area. Although 34% more insects were caught during the ‘pm’ session than the ‘am’, there was no significant temporal variation in insect abundance (SRH: df. = 1, p > 0.05; Fig. 1).

Es Rotlos 2005 had the lowest insect abundance (n=464) and was represented by fewer families (n=24), yet had the highest diversity and evenness scores (Table 1). In contrast, both Es Rotlos 2000 and Es Colombars showed similar diversity and evenness values despite differences in insect abundance between sites.

Visual inspection of the COA ordination ’pm’ data (Fig. 3) suggests community composition differed between sites. Data from each collection period were clumped for each site, but the pattern was most distinct for Es Rotlos 2000. There were no differences in community composition in the ‘am’ data (and is hence excluded); this could be due to high intra-site variation in insect abundance.

Discussion
Community composition and the abundance of flying insect fauna differed between reedbeds of different age class, in accord with Dithlogo (1992). Results from this study should be viewed with caution however due to the small sample size and use of only one trap within each site.
Recently burnt reedbeds offer less niche diversity than established or older reedbeds (Swengel 2001). This offers a potential explanation for the observed reductions in the insect abundance at Es Rotlos 2005. Es Rotlos 2000, is characterised by a mixed stand of *Phragmites australis* and *Cladium mariscus* (Riddiford 2005) which may afford a more optimal set of environmental conditions for numerous, and perhaps more generalist species. This may account for the abundance of insects at this site.

High inter-site variation in insect abundance could explain the lack of temporal variation in the dataset and could be linked to en masse emergence of insects from the aquatic larval phase of development.

### Conclusion and Recommendations

Insect community composition and abundance varied between sites. Maintaining reedbeds of different age classes, within Parc de Natural s’Albufera, would therefore promote the greatest insect biodiversity with associated benefits for additional taxonomic groups. Long term studies with regular sampling within each study site would enable a more accurate estimate of the effect of fire-induced vegetation change on insect biodiversity. Incorporating alternative measures of biodiversity would also provide a more complete analysis of the impacts of fire on reedbed biodiversity at Parc Natural de S’Albufera.

### Acknowledgements

Many thanks to Olivier Missa and Dan Chapman of the University of York for providing help and suggestions regarding data analysis and to the Parc Natural de s’Albufera for permission to undertake the investigation. This study was led and reported by Gina Prior with assistance from N Riddiford.

### Bibliography

Figure 1. Log abundance of insects (am & pm combined) from three sites, of different age class, within s’Albufera.
Figure 2  Abundance of insects during the am and pm sampling periods from three sites, of different reedbed age class, within s’Albufera. Data represent means +/- SE. Letters denote significant differences (p < 0.05).
Table 1. A comparison of insect diversity between the three reedbed sites using the Shannon diversity index (H), the number of families (S) and the evenness of families (E) within a community.

<table>
<thead>
<tr>
<th>Site</th>
<th>Es Colombas</th>
<th>Es Rotlos 2000</th>
<th>Es Rotlos 2005</th>
</tr>
</thead>
<tbody>
<tr>
<td>Abundance</td>
<td>911</td>
<td>2550</td>
<td>464</td>
</tr>
<tr>
<td>Diversity (H)</td>
<td>1.73</td>
<td>1.751</td>
<td>2.032</td>
</tr>
<tr>
<td>Families (S)</td>
<td>31</td>
<td>32</td>
<td>24</td>
</tr>
<tr>
<td>Evenness (E)</td>
<td>0.182</td>
<td>0.180</td>
<td>0.318</td>
</tr>
</tbody>
</table>

Figure 3 Correspondence ordination analysis, indicating community composition at the family level, using the 'pm' abundance data from each site.
**Diptera biodiversity at s’Albufera** by Martin J Ebejer, David J Gibbs & Nick J Riddiford

**Rationale for the study**

The flies (Diptera) play a key role in the functioning of ecosystems, particularly in wetlands. They provide food for birds in many habitats, they are an important food source for bats, the larvae of aquatic species are eaten by fish and other aquatic animals, and predatory, parasitoid and saprophytic flies are very influential in keeping other invertebrates under control, and thus not reaching plague proportions.

Despite their importance, very little work has been done on flies at S’Albufera, or more generally in the Balearic Islands. A brief earlier investigation by TAIB recorded 246 species from 45 families at s’Albufera in 2001 (Ebejer 2003). Prior to that, the list of known species stood at 108, showing how little was known.

The Directate of the Park, recognising this major gap in knowledge, proposed Diptera as a major theme for study in 2006. This became possible because we had the very good fortune to procure the assistance of two of Europe’s foremost Diptera specialists, David Gibbs (UK) and Martin Ebejer (Maltese but currently based in Wales). David joined the first team, in April, and Martin the second team in May.

**Fieldwork**

Both were very energetic fieldworkers, and applied a number of different techniques to collect the information they sought. Their main activity during the day was to visit specific habitats where they searched by eye, sweep-netted and checked for signs such as leaf-mines for larvae. Additional material was collected by means of Malaise trap or as secondary capture from the light trap set for moths (Lepidoptera).

Their main activities were within the Park but, because so little is known generally about Diptera biodiversity in the Balearic Islands, they also took some material from other specific habitats outside the Park.

Participants from the Balearic Islands and the Peninsula assisted them with the fieldwork and were also given laboratory training in the preparation of specimens and the use of keys for the determination of species.

**Results**

Both dipterists provided lists of species they encountered during their one-week visits to the Park. Dr Ebejer also undertook to study material collected previously, mainly in 2005 as part of the reedbed biodiversity study launched in that year. The two specialists not only provided lists of determined species, but also the localities in which these
species were found. This information is repeated in Annexes 1 and 2 of this report. Although it was not part of the required investigation, David Gibbs also determined some species of Coleoptera and Hymenoptera encountered during his fly-catching activities. These findings are also included in Annex 1.

Between them Martin Ebejer and David Gibbs have expertise for a wide range of Diptera families (and for other insect groups too). However, the group is so complex that no dipterist would claim extensive knowledge of all families, and therefore some families, particularly those which require large amounts of time and laboratory equipment, are poorly represented in the lists – including the Chironomidae and Ceratopogonidae which are very abundant in the Park. Nevertheless, 63 families with at least one species named is a phenomenal effort – helped by the intervention of other specialists for difficult species. More information may be expected in the future because material from certain families, e.g. Hybotidae, Psychodidae and Tipulidae, are being sent to further experts for an opinion. Martin and David also have material which is still being studied. They include several apparently new species for science, both within and outside the Park.

Some of Europe’s best known experts in Europe helped with difficult identifications. M. Carles-Tolrà (Asteiidae), P.J. Chandler (Keroplatidae, Mycetophilidae), M. Chvála (Empididae), J.W Ismay (Chloropidae), Iain McGowan (Lonchaeidae), P. Tschornig (Tachinidae), S.P.M. Roberts (Hymenoptera, Apidae & Scolidae) and P. Westrich (Hymenoptera, Apidae) responded to requests for their specialist opinion, and we are pleased to thank them all for their prompt and helpful response.

Preliminary analysis of the records indicate that the range of habitats help to boost the diversity of species recorded. Es Comú dunes, for instance, support a distinct community of species not found in wetlands, thus adding to the interest of the Park. Son Bosc, just outside the Park boundaries, is also very rich and a number of additional species were found there.

Notable species and trends

_Asteia mahunkai_

Although _Asteia mahunkai_ was originally described from Tunisia, the Fauna Europaea database describes its distribution as the East Palearctic. The only European record was one taken in a Malaise trap at the Parc Natural de S’Albufera des Grau in autumn 1997. A male was taken on 20-21 April 2006 at Es Colombars, again in a Malaise trap (as part of the reedbed biodiversity study) and the species was found to be present at Son Bosc in May. Dr Ebejer found another at Torre de ses Portes, PN ses Salines, Ibiza, at the end of May. The species is therefore confirmed for the three largest Balearic islands. These remain the only records for Europe.
Aulacigaster neoleucopeza

This species has been recorded from Andorra but a female from Sa Roca on 21st April 2006 is the first record from anywhere else in the Iberian region (Cales-Tolrá 2002). The family to which it belongs, Aulacigastridae, is also new to the Balearic Islands.

Island archipelago specialists

An intriguing pattern appears to be emerging regarding Diptera apparently not present in the Iberian Peninsula but found in some or all of the archipelagos. Details of this apparently specialised community are given in Table 1. With the exception of Psilopa pulicaria (recorded from Ibiza), all have been recorded by this study at S' Albufera.

Table 1. Species shared by the Balearics and other archipelagos but not known from the Iberian Peninsula

<table>
<thead>
<tr>
<th>Species</th>
<th>Family</th>
<th>Azores</th>
<th>Canaries</th>
<th>Madeira</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calamoncosis minima</td>
<td>Chloropidae</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Oscinella frit</td>
<td>Chloropidae</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Oscinella orphographoides</td>
<td>Chloropidae</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Siphunculina ornatifrons</td>
<td>Chloropidae</td>
<td></td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Coenia palustris</td>
<td>Ephydridae</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Psilopa pulicaria</td>
<td>Ephydridae</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Schema durrenbergensis</td>
<td>Ephydridae</td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Brontaea eremophila</td>
<td>Muscidae</td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Philosepedon humeralis</td>
<td>Psychodidae</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Tethina nigrofemorata</td>
<td>Tethinidae</td>
<td></td>
<td></td>
<td>X</td>
</tr>
</tbody>
</table>
One analysis we are able to do now is to evaluate the great advance which this study has made in extending knowledge of biodiversity in the Parc and more generally in the Balearic Islands. We are able to do this thanks to the impressive piece of work by Miguel Carles-Tolrà Hjorth-Andersen and colleagues to produce a Catalogue of the Diptera of Spain, Portugal and Andorra, including the islands (Carles-Tolrà 2002). Carles-Tolrà lists 559 species of Diptera for the Balearic Islands. TAIB has now recorded 539 species for the Balearic Islands, 440 of which have been recorded at s’Albufera. The list includes 329 new species for the Balearic Islands, 99 of which are also new to Spain. The new checklist is presented in Table 2 below, with the new species for the Balearic Islands highlighted in italics and the new species for Spain in bold.

Conclusions and Recommendations

In a short series of visits, Martin Ebejer and David Gibbs have revolutionised knowledge of the Diptera biodiversity of S’Albufera de Mallorca, and for the Balearic Islands generally. The results already show that S’Albufera has a large abundance of species and that the variety of habitats in and around the Park makes an important contribution to this diversity. S’Albufera currently supports over 80% of the known Balearic Diptera species. This is not a true measure of diversity for the islands, because attention on Diptera has been heavily concentrated within the Park. Nevertheless, the total achieved in such a short period and at very restricted periods of the year demonstrate that there is still much more to be discovered both within the Park and in other of the Balearic Islands’ rich habitats. Our work boosts the Balearic Islands list to 886. Dr Ebejer estimates that the Balearic Islands will be home to at least 1300 species, a total which current results suggest may be conservative. More work is clearly needed in the islands.

The work undertaken in 2006 helps to establish a baseline. Much more information is needed of the significance of these species, including their role in the food chain (e.g. for bats), the ecology of key species during their entire cycle and any significant management measures which may be required in order to protect or enhance more important and vulnerable species or communities.

This report is a preliminary to wider dissemination of our finds. A series of publications are planned so that the information reaches a much wider audience and can be incorporated into national and regional databases. They may also stimulate more interest and investigation into this fascinating and important order of insects both at S’Albufera and more widely in the Balearic Islands.

David Gibbs and Martin Ebejer have both indicated their willingness to continue giving support to TAIB and the task of extending the knowledge of Balearic Diptera. This is a golden opportunity for the Balearic Islands. Their commitment to S’Albufera is very much welcomed and appreciated. In addition, we recommend that the Balearic Conselleria de Medi Ambient may wish to consider their services in other projects within the Balearic Islands, particularly in relation to other protected areas and sensitive habitats.
Acknowledgments

We gratefully acknowledge all the many participants in The Albufera International Biodiversity team activities for their help with fieldwork and other aspects of the study; and the staff of the Parc Natural S’Albufera de Mallorca for their input. Our thanks too to M. Carles-Tolrá, P.J. Chandler, M. Chvála, J.W. Ismay, Iain McGowan, P. Tschomig, S.P.M. Roberts and P. Westrich for their prompt and learned assistance with determinations. This part of the report was prepared by N. Riddiford with major contributions from M.J. Ebejer and D.J. Gibbs.

Bibliography


Table 2. Checklist of the Diptera of s’Albufera de Mallorca

<table>
<thead>
<tr>
<th>Family</th>
<th>Species Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>lit. = record taken from the literature</td>
<td>* = species so far found only outside S’Albufera</td>
</tr>
<tr>
<td>? = determination doubtful</td>
<td>species in italics = new to the Balearic Islands (based on Carles-Tolrà 2002)</td>
</tr>
<tr>
<td></td>
<td>species in bold = new to Spain (based on Carles-Tolrà 2002)</td>
</tr>
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</table>

**ACROGERIDAE**

1. *Ogcodes etruscus* Griffini 1896

**AGROMYZIDAE**

2. *Agronyza-badica* Griffis, 1963
3. *Agronyza-graminicola* Hendel 1931
4. *Agronyza-nana* Meigen 1830
5. *Agronyza-nigrescens* Hendel 1920
6. *Agromyza-phragmitidis* Hendel 1922
7. *Amauromyza-monfalconensis* (Strobl 1909) *
8. *Calypomyza* sp.
9. *Cerodontha-denticornis* (Panzier 1806)
10. *Chromatomyia-horticola* (Goureau 1851)
11. *Chromatomyia-succisa* (Haring 1922) *
12. *Chromatomyia* sp. C
13. *Gynmophytomyza-heteroneura* (Hendel 1920)
14. *Japanagromyza-salicifolii* (Gillin 1911)
15. *Liriomyza-eupatorii* (Kaltenbach 1873) ?
16. *Liriomyza-flaveda* (Fallen 1823)
17. *Liriomyza-sp. aff. flavopicta* Hendel 1931
18. *Liriomyza-orbona* (Meigen 1830)
19. *Liriomyza-phryne* Hendel 1931 ?
20. *Liriomyza-pusilla* (Meigen 1830) ?
22. *Melanagromyza-cunctans* (Meigen 1830)
23. *Melanagromyza* sp. B
24. *Metopomyza-scuedata* (Fallen 1823)
25. *Napomyza-lateralis* (Fallen 1823)
26. *Pegomya-ulmaria* Rondani 1866
27. *Phytomyza-anemones* Hering 1925
28. *Phytomyza-cyzae* Hendel 1920
29. *Phytomyza-plantaginis* Robineau-Desvoidy 1851
30. *Pseudonapomyza* sp.

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31. *Adiacinorhina* (Fallen 1825)
32. *Anthomyia-litura* (Robineau-Desvoidy 1830) *
33. *Anthomyia-pluvialis* (Linnaeus 1758)
34. *Anthomyia-quinquemaculata* Macquart 1839
35. *Delia-bractea* (Rondani 1866)
36. *Delia-platura* (Meigen 1826)
37. *Fucellia-tegina* (Zettstedt 1845) *
38. *Lasionymul-apenninum* Hennig 1967 *
39. *Pegomya-ulmaria* Rondani 1866

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40. *Amygdalops-thomasseti* Lamb 1814
41. *Anthomyza-celiini* Andösen 1976
42. *Anthomyza-sp. (gracilis group)
43. *Santhomyza-inermis* Rohácek 1984 *
ASILIDAE
44. Dioctria ochrifacies Becker 1906 *
45. Epitriptus cingulatus (Fabricius 1871) *
46. Holopogon sp.*
47. Saropogon sp.*
48. Stichopogon sp. 1 *
49. Stichopogon sp. 2 *

ASTEIIDAE
50. Asteia ambena Meigen 1830
51. Asteia caesia Lyneborg 1969 *
52. Asteia floricola Papp 1979
53. Asteia ibizana (Endelevin 1935)
54. Asteia inanis Lyneborg 1969
55. Asteia (Subanarista) mahunkai Papp 1979
56. Phlebotomella mollis Duda 1927 *

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57. Aulacigaster neoleucopeza Mathis & Freidberg 1994

BIBIONIDAE
58. Bibio hortulanus Linnaeus 1758
59. Diolphius femoratus Meigen 1804

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60. Anastoechus hyrcanus (Pallas 1818) *
61. Bombylus minor Linnaeus 1758 *
62. Bombylus posticus Fabricius 1805
63. Hemipenthes mirio (Linnaeus 1758)
64. Hemipenthes velutina (Meigen 1820) *
65. Ptenomyia hepera Rossi 1790
66. Phthiria sp.*
67. Systoechus gradatus (Wiedemann in Meigen 1820) *
68. Villa hortentotta (Linnaeus 1758) *
69. Villa panisca (Rossi 1790) ?

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70. Calliphom vicina Robineau-Desvoidy 1830
71. Chrysomya albiceps (Wiedemann 1819)
72. Lucilia sericata (Meigen 1826)
73. Lucilia sivarum (Meigen 1826)
74. Pollenia sp.
75. Pollenia leclerianna (Lehrer 1978)
76. Pollenia radiata (Fabricius 1794)
77. Stomorhina lunata (Fabricius 1805)

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78. Camilla acutipennis (Loew 1865)
79. Camilla glabella (Fallen 1823)
80. Camilla nigrifrons Collin 1933

CAMPIOCHETIDAE
81. Campiocheta grandiola MeAlpine JF 1962 *

CARNIDAE
82. Macroleuro glaberrima Becker 1910 *

CECIDOMYIIDAE
83. Baldratia salicorniae Kieffer 1897

CERATOPOGANIDAE
84. unidentified genera (and many species)

CHAMAEMYIIDAE
85. Chamaemyia flavipennis (Strobl 1902)
86. Chamaemyia junconum (Fallen 1823)
87. Chamaemyia polistigma (Meigen 1830)
88. Leucopis argentata Heeger 1848
89. Leucopis gyspinivora Tanasijtshuck 1979 *
90. Leucopis palumbi Rondani 1872
91. Parodthiphila cornuta (Loew 1858)
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<td>95. Aphanotrigonum inermis Collin 1946</td>
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<td>96. Calamocoris duinensis (Strobl 1909)</td>
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<td>98. Calamocoris stipae Nartshuk 1962 *</td>
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<td>99. Camarota curtispennis (Latreille 1805)</td>
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<td>100. Cryptoneura sp.</td>
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<td>101. Cryptoneura flavitarsis (Meigen 1830) or sp.n</td>
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<td>102. Cryptoneura nigritarsis (Duda 1933)</td>
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<td>104. Elachiptera cornuta (Fallén 1820)</td>
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<td>105. Elachiptera rufifrons Duda 1932</td>
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<td>106. Eurina dacalisk Costa 1885</td>
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<td>107. Eutropha fulvifrons (Haliday 1833)</td>
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<td>108. Incertella zurchen (Collin 1946)</td>
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<td>109. Lasiosina sp.</td>
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<td>110. Lasiosina hepini (Guérin-Méneville 1843)</td>
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<td>111. Lipara lucem Meigen 1830</td>
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<td>113. Lipara similis Schiner 1854</td>
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<td>114. Melanochea pubescens (Thalhammer 1898)</td>
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<td>115. Oscinella sp.</td>
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<td>125. Pseudopachychaeta pachychaeta Strobl 1902 *</td>
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<td>126. Siphonellopsis lacteibasis Strobl 1906</td>
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<td>127. Siphunculina ornatifrons (Loew 1858)</td>
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<td>128. Speccafrons coxalis (Duda 1930) ?</td>
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<td>129. Speccafrons halophila (Duda 1933)</td>
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<td>130. Thaumatomyia notata (Meigen 1830)</td>
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<td>131. Trachysiphonella ruficeps (Macquart 1835)</td>
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<td>132. Tricimba sp. aff. fungio la</td>
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<td>133. Tricimba humeralis (Loew 1858)</td>
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<td>CHYROMYIDAE</td>
<td>134. Aphaniosoma claridgei Ebejer 1997</td>
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<td>135. Aphaniosoma hackmani Lyneborg 1972</td>
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<td>136. Aphaniosoma melitensis Ebejer 1993</td>
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<td>137. Aphaniosoma micromacro Carles-Tolrà 2002</td>
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<td>138. Aphaniosoma propinquans Collin 1949</td>
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<td>COELOPIDAE</td>
<td>145. Malacomyia sciomyzina (Haliday 1833) *</td>
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<td>CONOMIDAE</td>
<td>146. Leopoldius coronatus (Rondani 1857) ?</td>
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<td>150. Aedes echinus (Edward 1920)</td>
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151. *Aedes rusticus* (Rossi 1790) 
152. *Anopheles algeriensis* Theobald 1903
153. *Culex pipiens* Linnaeus 1758

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154. *Dixidla attica* (Pandazis 1933)

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155. *Aphrocyclus varior* Loew 1857 *
156. *Argyro argentina* (Meigen 1824)
157. *Argyro a. grata* Loew 1857
158. *Argyro perplexa* Becker 1918
159. *Asynuda comac* (Becker 1902)
160. *Asynuda separata* (Becker 1902) *
161. *Campsonemus magius* (Loew 1845)
162. *Chrysotoma palustris* Verrall, 1876
163. *Dolichocephus dixidem* Haliday 1832
164. *Dolichopus grisipennis* Stannius 1831
165. *Dolichopus nibilus* Meigen 1824
166. *Dolichopus sabinus* Haliday 1838
167. *Dolichopus stigma* Verrall 1875
168. *Hercostomus* sp. *
169. *Hydrophorus praex* (Lehmann 1822)
170. *Lampodromus* sp. *
171. *Liancalus virios* (Scopoli 1768) *
172. *Medetera flavipes* Meigen 1824
174. *Medetera saxatilis* Collin 1941 *
175. *Medetera tenuicauda* Loew 1857 ?*
176. *Micromorphus albipes* (Zetterstedt 1843)
177. *Micromorphus sp.* B
178. *Ortochile nigrocoerulea* Latrille 1809
179. *Raphium* sp. *
180. *Schoenophilus versatus* (Haliday 1851)
181. *Sciapus heteropygas* Parent 1926
182. *Sciapus pallens* (Wiedmann 1830)
183. *Sciapus* sp. A
184. *Sciapus* sp. B
185. *Syntomor denticulatum* (Zetterstedt 1843) *
186. *Syntomor pallipes* Fabricius 1798)
187. *Syntomor pallipes* (Fabricius 1798)
188. *Teuchophorona cristulata* Mueffels & Grootaert 1990
189. *Thrips* flavipalpis (Zetterstedt 1848)
190. *Thrips* ruficornis (Haliday 1838) *
191. *Thrips* pumilus (Zetterstedt 1848)

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192. *Drosophila picta* Zetterstedt 1847
193. *Drosophila subobscursa* Gillin 1936
194. *Dictasisora camara* (Haliday 1833)
195. *Leucopa maculata* (Dufour 1839) *
196. *Loripha fenestrorum* (Fallen 1823)
197. *Scaptomyza pallida* (Zetterstedt 1847)

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198. *Climacerta stagnalis* (Hailey 1833) *
199. *Dolichosphila sp.* *
200. *Hilara longiculata* Strobl 1906
201. *Rhamphomyia* sp.

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202. *Allotrichoma filiforme* Becker 1896 lit
203. *Allotrichoma laterale* (Loew 1860)
204. *Asmeringa inermis* Becker 1903 *
205. *Atissa hepatica* (Becker 1903)
206. *Atissa limosina* (Becker 1896)
207. *Atissa pygmaea* (Haliday 1833)
208. *Clanoneurum cimiciforme* (Haliday 1855)
209. *Comia palustris* (Fallen 1823) lit
210. *Diclasiopa niveipes* (Becker 1896) lit
211. Discocerina obscurella (Fallen 1813) lit
212. Ephydra bivittata Loew 1860 lit
213. Ephydra flavipes (Macquart 1843)
214. Ephydra macellaria Egger 1862
215. Glenanthe ripicola (Haliday 1839)
216. Haloscatella achaeta (Loew 1860)
217. Hecamede albicans (Meigen 1830) lit
218. Hecamedades costatus (Loew 1860)
219. Homlometopus ibericus Mathis 1984 lit
220. Hydrellia argyrogonis Becker 1896
221. Hydrellia oscura (Meigen 1830)
222. Notiphila cinerea Fallen 1813
223. Homalometopus ibericus Mathis 1984 lit
224. Notiphila nubila Dahl, 1973
225. Hydrellia obscura (Meigen 1830)
226. Notiphila cinerea Fallen 1813
228. Notiphila riparia Meigen 1830
229. Ochtheramanica (Fabricius 1794)
230. Ochthesembria Rundani 1847
231. Paracoeris funesta (Stenhammar 1844) lit
232. Parydra fossarum (Haliday 1833)
233. Parydra pabena Loew 1860
234. Parydra p. sp
235. Pelina nitens Loew 1873
236. Philethus rossii (Canzoneri & Meneghini 1979)
237. Phlygriapida (Fallen 1813)
238. Phlygria posticata (Meigen 1830)
239. Phlygria vitripennis (Zetterstedt [1838])
240. Polythocophora duplosetosa (Becker 1896) lit
241. Psilopa biskræ (Becker 1907)
242. Psilopa umpta (Meigen 1830)
243. Psilopa leucostoma (Meigen 1830)
244. Psilopa maritima (Perris 1847)
245. Psilopa nana Loew 1860
246. Psilopa nigritella Stenhammar 1844
247. Psilopa nitidula (Fallen 1813)
248. Psilopa pulicaria (Haliday 1839) *
249. Psilopa rutilans Canzoneri & Meneghini 1972
250. Pt limbia angustigenis Becker (1926) lit
251. Scatella gea Canzoneri & Meneghini 1979
252. Scatella lutosas (Haliday 1833) lit
253. Scatella paludum (Meigen 1830)
254. Scatella rossii Canzoneri & Meneghini 1979
255. Scatella nupis (Strobl 1906)
256. Scatella stagnalis (Fallen 1813)
257. Scatella subguttata (Meigen 1830)
258. Scatella temuicosta Collin 1930
259. Schema durrenbergensis (Loew 1864) lit
260. Scoliocephalus pallidisatis Becker 1903
261. Zeros invenatus (Lamb 1912)

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262. Fannia canicularis (Linnaeus 1761)
263. Fannia lepida (Wiedemann 1817) *
264. Fannia monilis (Haliday 1838) *

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265. Suillia afinis (Meigen, 1830) *
266. Suillia humilis (Meigen 1830) *
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268. Suillia variegata (Loew 1862)

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269. Hippobosca equina Linnaeus 1758

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270. Chersodromia albospilosa Chvála 1970
271. Chersodromia sp. A
272. Chersodromia sp. B
273. Crossoplatypus sp.
274. Crossoplatypus setiger (Loew 1859)
275. Crossoplatypus sp.
276. Drapetis hutsoni Smith 1967
277. Platypalpus albiseta (Panzer 1806)
278. Platypalpus chrysonotus (Strobl 1899)
279. Platypalpus aff. flavicornis (Meigen 1822)
280. Platypalpus pallidiventris (Meigen 1822)
281. Platypalpus praecinctus (Collin 1926)
282. Stilpon linatus (Walker 1851)
283. Stilpon subsinuatus Chvala 1988

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284. Antlemon halidayi (Loew 1871) *
285. Macrocerus sp.
286. Pyntula sp.

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287. Calliopus hispanicus (Mik 1881) *
288. Minettia fasciata Fallen 1826
289. Minettia rivosa (Meigen 1826)
290. Minettia subvittata (Loew 1847)
291. Minettia tabidiventris (Rondani 1877)
292. Prosopomyia pallida Loew 1856
293. Sapromyza sordida Haliday 1833 *

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295. Lamprolonchaea smaragdi (Walker 1849)
296. Lonchaea subneatosa Kovalev 1974
297. Lonchaea tarsata Fallén 1820 *
298. Sila adipata McAlpine JF 1956

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299. Lonchoptera bifurcata (Fallen 1810)
300. Lonchoptera lutea (Panzer 1809)

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301. Microphor intermedius (Collin 1961) ?
302. Microphor rostellatus (Loew 1860)

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303. Desmometopa m-nigrum (Zetterstedt 1848)
304. Leptometa sp. (Meigen 1830) *
305. Madiza gabaFallén 1820 *

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306. Atherigona varia (Meigen 1826)
307. Brotoria ephedra (Brauer & Bergenstamm 1894)
308. Comosia antennata (Zetterstedt 1849)
309. Comosia attenuata Stein 1903 *
310. Comosia bilineata (Zetterstedt 1838) *
311. Comosia humilis Meigen 1826
312. Comosia sp.? infantula Rondani 1866
313. Comosia molliculata (Fallén 1825)
314. Comosia testacea (Robineau-Desvoidy 1830)
315. Comosia tricolor (Fabricius 1775)
316. Haematobia iritana (Linnaeus 1758)
317. Hebecnema vespertina (Fallén 1823)
318. Helina akieriensis (Strobl 1906)
319. Helina evecta (Hamp 1780)
320. Helina revenio (Harris 1780)
321. Helina sexmaculata (Preysler 1791)
322. Helina vicina (Czerny 1900)
323. Limnophora obsignata (Rondani 1866)
324. Limnophora tigrina (Ammans 1860)
325. Lispe caesia Meigen 1826
326. Lispe cardalis Kowarz 1892 *
327. Lispe nana Macquart 1835
328. Lispe pygmaea Fallén 1825
329. Lispe testacea De Geer 1776 *
330. Lispecephala banchalis (Rondani 1877)
331. Musca autumnalis De Geer 1776 *
332. Musca domestica Linnaeus 1758
333. Musca osinis Wiedemann 1830 *
334. Musca tempestiva Fallen 1817
335. Myopelia meditubularia (Fabricius 1781)
336. Neomyiacoecina (Fabricius 1781)
337. Orchistacostata (Meigen 1826)
338. Phaonia tricuspila (Bouché 1834) *
339. Phaonia sp. aff. errans (Meigen 1826) *
340. Phaonia sp.
341. Stomoxys calitrans (Linnaeus 1758)

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342. Megophthalmidia ionia Chandler 2006*
343. Mycetophila sp.
344. Novakia satopsiformis Stroh, 1893 *
345. Sciofila sp.

NYCERIBIDAE
346. Nycteribia pedicularia Latreille 1805
347. Penicillidia dufouri (Westwood 1835)

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348. Geomyza triquartata Fallen 1823

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349. Cliostomphalma dilatata (DeMeyer 1997)
350. Eudorylas bernerii Kehlmaier 2005
351. Eudorylas mediterraneus DeMeyer & Ackland 1997 *
352. Eudorylas obliquus Col 1966
353. Eudorylas wahsi DeMeyer 1997
354. Pipunculus carolestriatus Kaczerov, 1998 *
355. Tomosvaryella clindonis Strohl 1910
356. Tomosvaryella frontata (Bekier, 1898)
357. Tomosvaryella geniculata (Meigen 1824)
358. Tomosvaryella kuhlai (Aczél 1944)
359. Tomosvaryella sepulta DeMeyer 1997
360. Verrallia aucta (Fallen 1817)

PHORIDAE
361. Dohrniphora cornuta (Bigot 1857)
362. undetermined genera and species

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363. Chamaepsila nigricornis (Meigen 1826)

PSYCHODIDAE
364. Philosopha humeralis (Meigen 1818)
365. unidentified genera and species

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366. unidentified genus

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367. Melanophora roralis (Linnaeus 1758)
368. Stevenia deceptroria (Loew 1847)
369. Stevenia obscuripennis (Loew 1847)

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370. Bereraea africa (Wiedemann 1824)
371. Metopia argyrocephala (Meigen 1824)
372. Nychta hirtarata (Panzer 1798)
373. Sarcophaga filia Rondani 1860
374. Sarcophaga laiostyla Macquart 1835*
375. Sarcophaga lehmanni Mueller 1922
376. Sarcophaga maicura Pandele 1896
377. Sarcophila laitfrom (Fallen 1817) *
378. Senotinia tricuspis (Meigen 1838)
379. *Taxigramma multipunctata* (Rondani 1859)

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380. *Norella typularia* (Fabricius 1794)
381. *Scathophaga kiusia* (Fabricius 1794)
382. *Scathophaga stercoraria* (Linnaeus 1758)

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383. *Coboldia fuscipes* (Meigen 1830)
384. *Parascatops minutissima* (Verrall 1886)
385. *Swammerdamella brevicornis* (Meigen 1830)

**SCATOPSIDAE**
386. *Scenopinus albicinctus* (Rossi 1794)
387. *Scenopinus fenestralis* (Linnaeus 1758)

**SCIARIDAE**
388. unidentified genera and species

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389. *Euthycera alaris* Vala 1983
390. *Pherbellia cinerella* (Fallen 1820)
391. *Pherbellia aff. pallidicarpa* (Rondani 1868)
392. *Tetanocera ferruginea* Fallen 1820

**SEPIDAE**
393. *Saltella sphondylii* (Schrank 1803)
394. *Sepsis fulgens* Meigen 1826
395. *Sepsis lateralis* Wiedemann 1830
396. *Sepsis punctum* Fabricius 1794
397. *Sepsis thoracica* (Robineau-Desvoidy 1830)
398. *Sepsis violacea* Meigen 1826
399. *Themiraminor* (Haliday 1833)

**SPHAEROCERIDAE**
400. *Coproica vagans* (Haliday 1833)
401. *Leptocera fontinalis* (Fallén 1826)
402. *Leptocera nigra* Olivier 1813
403. *Opacifrons ooxata* (Stenhammar 1854)
404. *Phthitia plumosulata* (Rondani 1880)
405. *Pseudocellinida humida* (Haliday 1836)
406. *Pulimosina heteroneura* (Haliday 1836)
407. *Rachispoda fuscipennis* (Haliday 1833)
408. *Rachispoda kubali* (Papp 1978)
410. *Rachispoda modesta* (Duda 1924)

**STRATIOMYIDAE**
411. *Hermetia illucens* (Linnaeus 1758)
412. *Nemotelus brachystomus* Loew 1846
413. *Nemotelus daniellsoni* Mason 1989
414. *Nemotelus notatus* Zetterstedt 1842
415. *Nemotelus partherinus* (Linnaeus 1758)
416. *Odontomyia angulata* (Panczer 1798)
417. *Odontomyia discolor* Loew 1846
418. *Pachygaster atra* (Panczer 1798)
419. *Stratiomys longicornis* (Scopoli 1763)
420. *Stratiomys singularis* (Harris 1776)

**SYRPHIDAE**
421. *Anasimyia interpuncta* (Harris 1776)
422. *Ceriana vespaformis* (Latreille 1804)
423. *Chrysotoxum elegans* Loew 1841
424. *Chrysotoxum implectum* Meigen 1822
425. *Dasysyrphus albostratus* (Fallén 1817)
426. *Episyrphus balteatus* (De Geer 1776)
427. *Eristalis aeneus* (Scopoli 1763)
428. *Eristalis septulchralis* (Linnaeus 1758)
429. *Eristalis teniops* (Wiedemann 1818)
430. *Eristalis arbustorum* (Linnaeus 1758)
431. *Eristalis tenax* (Linnaeus 1758)
432. *Eumerus barbarus* (Coqueberg 1804)
433. Eumerus emarginatus Loew 1848 *
434. Eumerus pusillus Loew 1848 *
435. Eupeodes corollae (Fabricius 1794)
436. Eupeodes latifasciatus (Macquart 1829)
437. Eupeodes luniger (Meigen 1822)
438. Helophilus trivittatus (Fabricius 1805)
439. Lelops vitatus (Mégen 1822)
440. Melanostoma mellinum (Linnaeus 1758)
441. Melanostoma scalaris (Fabricius 1794)
442. Meliscena auricollis (Meigen 1822)
443. Memnon genialis Stoll 1909
444. Myathropa florea (Linnaeus 1758)
445. Neascia balanica Kaesche 2002
446. Paragus bicolor (Fabricius 1794)
447. Paragus haemorrhous Meigen 1822
448. Paragus quadri fasciatus Meigen 1822
449. Paragus tibialis (Fallen 1817)
450. Parhelophilus consimilis (Mélin 1863)
452. Parhelophilus versicolor (Fabricius 1794)
453. Platycheirus dypeatus (Meigen 1822)
454. Platycheirus fuliventris (Macquart 1829)
455. Platycheirus scambus (Staeger 1843) *
456. Scaeva albomaculata (Macquart 1842)
457. Sphaenophora rupeppii (Wiedemann 1830)
458. Sphaenophora scripta (Linnaeus 1758)
459. Syrta piarius (Linnaeus 1758)
460. Syrphus ribesii (Linnaeus 1758)
461. Syrphus striipennis Meigen 1822
462. Volucella zonaria (Poda 1761)

TABANIDAE
463. Hybomitra expollicata (Pandelle 1883)
464. Tabanus bovinus Linnaeus 1758
465. Tabanus bromius Linnaeus 1758
466. Tabanus quadriannulatus Meigen 1820
467. Tabanus sudeticus Zeller 1842

TACHINIDAE
468. Clavinilla piniae Kugler 1971 *
469. Cylindromya auriceps (Meigen 1838) *
470. Cylindromya brassicaria (Fabricius 1775) *
471. Cylindromya rubripes (Meigen 1824)
472. Dinera sp. ? *
473. Dionaea aurifrons (Meigen 1824)
474. Ectophasia olfanga (Robineau-Desvoidy 1830)
475. Eliozeta helluo (Fabricius 1805)
476. Gymnosoma clavatum (Rohdendorf 1947)
477. Gymnosoma nudifrons Herting 1966
478. Leucostoma semibarbatum Tschorsnig 1991 ?*
479. Lydella thompsoni Herting 1959
480. Microphthalma europaea Egger 1860
481. Pelateria varia (Fabricius 1794)
482. Pelateria varia (Fabricius 1794)
483. Penhaeatiibialis (Robineau-Desvoidy 1851)
484. Phasia puilla Meigen 1824 *
485. Siphona sp
486. Tachina magnicorhis (Zetterstedt 1844)
487. Triarthria setipennis (Fallen 1810)
488. Xysta holoscutica (Fabricius 1805) *

TEPHRITIDAE
489. Acanthiophilus helianthi (Rossi 1790)
490. Actinoptera meigen Handel 1927
491. Bactrocera oleae (Gmelin 1790)
492. Campiglossa producta (Loew 1844) *
493. Campiglossa solidaginis (White 1956) *
494. Capitites ramulosa (Loew 1844) *
495. Diaoyna bidertis Robineau-Desvoidy 1830
496. Ensina sochii (Linnaeus 1767)
497. Euleia heraclea (Linnaeus 1758)
498. Myopites sp.
499. Spathulina siula Rondani 1856
500. Sphenella marginata (Fallen 1814)
501. Tephritis divisa Rondani 1871
502. Tephritis formosa (Loew 1844)
503. Tephritis matricariae (Loew, 1844)
504. Tephritis nigricauda (Loew 1856)
505. Tephritis praecox (Loew 1844)
506. Tephritis tanaceti Hering 1956
507. Tephritis vesperina (Loew, 1844)
508. Terellia kingicauda (Meigen 1838)
509. Terellia serrata (Linnaeus 1758)
510. Trupanea amoena (Frauenfeld 1857)
511. Trupanea stellata (Resslin 1775)
512. Urophora mauritanica Macquart 1851

TETHINIDAE
513. Tethina alboguttata (Strobl 1900)
514. Tethina abrostulosa (Strobl 1900)
515. Tethina flavigenis (Hendel 1934)
516. Tethina grisca (Fallen 1823)
517. Tethina incisuralis (Maquart 1851)
518. Tethina sp. aff. longirostris (Loew 1865)
519. Tethina nigrofemorata Beschovski 1997
520. Tethina ochracea (Hendel 1913)
521. Tethina simplex (Collin, 1966)
522. Tethina strobiliana (Mercier 1923)
523. Tethina yaromi Freidberg & Beschovski 1996

THEREVIDAE
524. Thereva binotata Loew 1847
525. Thereva spilosperma Wiedemann 1824
526. Thereva sp.

TIPULIDAE
527. Nephrotoma sp.
528. Tipula mediterranea Lackschewitz 1930
529. Tipula oleracea Linnaeus 1758

TRIOSCELIDIDAE
530. Trioscelis approximata (Loew 1865)
531. Trioscelis carva Carles-Tolrà 1993
532. Trioscelis flagellata Carles-Tolrà 2001
533. Trioscelis obscurella (Fallen 1823)
534. Trioscelis pederis (Loew 1865)
535. Trioscelis sanctifirdinnandi (Czerny 1909)

ULIDIIDAE
536. Cerroxy urticae Linnaeus 1758
537. Herina oscillum (Meigen 1826)
538. Herina parva (Loew 1864)

XENASTEIIDAE
539. Tunisimyia convergens Ventura & Carles-Tolrà 2002
SPAIN, MALLORCA 2006 INVERTEBRATE RESULTS. LEG. D. GIBBS (UNLESS STATED OTHERWISE)

Albufera, Sa Roca N 39°47.47' E 003°06.19', 2m 19 April 2006

DIPTERA

Hybotidae
Platypalpus chrysonotus (Strobl, 1899) 3♂1♀
Platypalpus pallidiventris (Meigen, 1822) 6♂1♀

Empidace
Hilara longeciliata Strobl 2♂

Dolichopodidae
Dolichopus sabinus Haliday, 1838 1♂
Micromorphus sp A. 3♂1♀

Syrphidae
Syntitta pipiens (Linnaeus, 1758) 1♀

Pipunculidae
Tomosvaryella frontata (Becker, 1898) 1♀

Chaemyidae
Leucopis argentata Heeger, 1848 3♂3♀

Sepsidae
Sepsis violacea Meigen, 1826 1♂

Sphaeroceridae
Lotophila atra (Meigen, 1830) 1♂

Agromyzidae
Ophiomyia cunctata (Hendel, 1920) 1♂

Chloropidae
Cryptonevra nigritaaria (Duda, 1933) 1♂ (conf. J.W.Ismay)
Melanochaeta pubescens (Thalhammar, 1898) 1♂1♀ (conf. J.W.Ismay)

Ephydridae
Allotricoma laterale 1♂
Notiphila riparia Meigen, 1830 1♂ (intermediate between riparia & umbrosa)
Parydra puberatus Loew, 1860 4

Muscidae
Atherigona varia (Meigen, 1826) 1♂
Albufera, ses Puntes, N 39° 47' E 003° 07' 2m 19 April 2006

**COLEOPTERA**

**Cerambycidae**
*Phytoecia virgula* (Carpentier, 1825) 1

**Chrysomelidae**
*Cryptocephala saucius* Truqui 1 ♂

**DIPTERA**

**Tipulidae**
*Tipula paludosa* Meigen, 1830 1 ♂

**Empididae**
*Hilara longeciliata* Strobl 1 ♂ 1 ♀

**Dolichopodidae**
*Dolichopus sabinus* Haliday, 1838 1 ♂
*Micromorphus* sp. A 2 ♂ 1 ♀
*Sciapus* sp. 1 ♀

**Syrphidae**
*Melanostoma mellinum* (Linnaeus, 1758) 1 ♂
*Sphaerophoria rueppellii* (Wiedemann, 1830) 1 ♂

**Sciaridae**
*Pherbellia cinerella* (Fallén, 1820) 1 ♂

**Agromyzidae**
*Cerodontha denticornis* (Panzer, [1806]) 1 ♂ 2 ♀
*Phytomyza plantaginis* Robineau-Desvoidy, 1851 1 ♂

**Heleomyzidae**
*Trixoscelis obscurella* (Fallén, 1823) 1 ♀

**Tethinidae**
*Tethina simplex* (Collin, 1966) 2 ♂ 1 ♀

**Chloropidae**
*Aphanotrigonum inerme* Collin, 1946 2 ♂ (det. J.W.Ismay)
*Lipara rufa rufa* s Loev, 1858 1 ♂ (det. M.J.Ebejer)
*Lipara similis* Schiner 3 ♂ (conf. J.W.Ismay)
*Elachiptera rufifrons* Duda, 1932 1 ♀ (conf. J.W.Ismay)
*Oscinella frig group* 2 ♂ (det. J.W.Ismay)
*Thaumatomyia ?notata* (Meigen, 1830) 1 ♂ (det. J.W.Ismay)

**Ephydridae**
*Notiphila nubila* Dahl, 1973 1 ♂ 1 ♀
*Parydra fossanum* (Haliday, 1833) 1 ♂
Scatella paludum (Meigen, 1830) 1♂1♀
Coenosia humilis Meigen, 1826 1♂1♀

Muscidae
Atherigona varia (Meigen, 1826) 1♀
Helina reversio (Harris, [1780]) 1♂
Lispe pygmaea Fallén, 1825 1♂
Orchisia costata (Meigen, 1826) 1♀

Albufera, Es Comú, Dunes, N 39°46′34″ E 003°08′27″ s.l. 20 April 2006

COLEOPTERA
Carabidae
Lophyridia littoralis (Fabricius, 1787) 1

HYMENOPTERA
Tenthridinidae
Tenthredo (Cephaledo) meridiana Serville 1823 1♀

Ichneumonidae
Banchus pictus (Fabricius) 1♂

Scolidae
Dasyscolia ciliata (Fabricius, 1787) 1♂1♀ det. conf. S.P.M. Roberts

Pompilidae
Priocnemis propinqua (Lepeletier, 1845) 1♀ (conf. R. Wahis)

Apidae
Anthophora balearica 1♀ (det. P. Westrich)
Chalicodoma sculum 1♂1♀ (conf. P. Westrich)
Rhodanthidium septendentatum (Latreille, 1809) 1♂
Osmia latreillei 2♀ (det. P. Westrich)

DIPTERA
Therevidae
Thereva binotata Loew 1♂1♀
Thereva spiloptera Wied. Loew 1♂1♀

Hybotidae
Chersodromia albopilosa Chvála, 1970 3♂4♀
Platypalpus albiseta (Panzer, 1806) 1♂2♀
Platypalpus pallidiventris (Meigen, 1822) 1 ♀

**Dolichopodidae**
Dolichopus sabinus Haliday, 1838 2 ♀
Micromorphus sp. A 10♂3 ♀
Sciapus sp. 2 ♀

**Syrphidae**
Panagus bicolor Fabricius 1♂
Panagus tibialis (Fallén, 1817) 2♂1 ♀
Eristalis aeneus (Scopoli, 1763) 1♂
Eristalis sepulchralis (Linnaeus, 1758) 1♀

**Pipunculidae**
Clistoabdominalis dilatatus (DeMeyer, 1997) 4♂2 ♀
Eudorylas obliquus Coe, 1966 2♂
Temosvaryella sepulta DeMeyer, 1997 3♂

**Tephritidae**
Ensina sonchi (Linnaeus, 1767) 1♀
Tephritis prae cox (Loew, 1844) 5♂

**Chamaemyidae**
Chamaemys polystigma (Meigen, 1830) 3♂1 ♀

**Sciomyzidae**
Pherbellia cinerella (Fallén, 1820) 3♀

**Agromyzidae**
Cerodontha denticornis (Panzer, [1806]) 1♂2 ♀

**Chloropidae**
Aphanotrigonum inerme Collin, 1946 2♀ (det. J.W. Ismay)
Lipara similis Schiner 2♀
Eutropha fulvifrons (Haliday, 1833) 1♀

**Agromyzidae**
Chromatomyia horticola (Goureau, 1851) 2♂

**Ephydridae**
Hydrellia griseola (Fallén, 1813) 3♂
Scatella paludum (Meigen, 1830) 1♂1 ♀
Scatella tenuicosta Collin, 1930 1

**Muscidae**
Atherigona variata (Meigen, 1826) 1♂
Coeno sia humilis Meigen, 1826 1♂

**Tachinidae**
Peribaea tibialis R.D. 1♂ (conf. P.Tschorsnig)
Albufera, Sa Roca, N 39°47’47” E 003°06’19”, 2m, 21 April 2006

DIPTERA

Dolichopodidae
Medetera flavipes Meigen, 1824 2♀ poplar trunks
Medetera saxatilis Collin, 1941 4♂5♀ poplar trunks

Aulacigastridae
Aulacigastra neoleucopeza Mathis & Freidberg, 1994 1♀

Chloropidae
Lipara rufitarsis Loew, 1858 1♂ (det. M.J.Ebejer)
Cryptonevra nigritarsis (Duda, 1933) 1♀

Anthomyiidae
Pegomya ulmaria Rondani, 1866 1♂

Albufera, Son Bosc N 39°47’ E 003°07’2m 21 April 2006

COLEOPTERA

Carabidae
Lophyra flexuosa (Fabricius, 1787) 1

Bupestridae
Acmaeodera cylindrica (F.) 1 (det. B. Levey)
Anthaxia parallela Gory 1 (det. B. Levey)

HYMENOPTERA

Scoliidae
Megascotia bidens (L. 1767) 1♂

Eumenidae
Eumenes coarctatus (Linnaeus, 1758) 1♂

Vespidae
Polistes gallicus 1♀ (conf. M.E. Archer)

Apidae
Andrena agilissima 1♂ (det. P. Westrich)
Osmia versicolor Latreille, 1811 1♀ (conf. P. Westrich)
Centrula dallatorreana 1♀ det. S.P.M. Roberts

DIPTERA

Therevidae
Thereva bnotata Loew 1♂

Dolichopodidae
Chrysotus palustris Verrall, 1876 1♀
Dolichopus sabinus Haliday, 1838 2♂
Medetera saxatilis Collin, 1941 2♀
Micromorphus sp. A 1♂
Micromorphus sp. B 1♂
Schoenophilus versutus (Haliday in Walker, 1851) 1♂
Thinophilus flavipalpis (Zetterstedt, 1843) 1♂2♀

Hybotidae
Platypalpus chrysonotus (Strobl) 1♀
Platypalpus pallidiventris (Meigen, 1822) 1♀

Syrophidae
Panagus tibialis (Fallén, 1817) 1♂

Tephritidae
Tephritis praecox (Loew, 1844) 1♂1♀

Sepsidae
Themina minor (Haliday, 1833) 1♀

Agromyzidae
Cerodontha denticornis (Panzer, [1806]) 2♂

Chloropidae
Melanochaeta pubescens (Thalhammer, 1898) 1♂

Tethinidae
Tethina simplex (Collin, 1966) 1♂

Ephydridae
Hydrellia griseola (Fallén, 1813) 1♂
Panydala fossanum (Haliday, 1833) 1♂
Scatella paludum (Meigen, 1830) 4

Albufera, ses Puntes, N 39°47'E 003°07' 2m 21 April 2006

COLEOPTERA
Cleridae
Trichodes um bellatarum 2

HYMENOPTERA
Chrysididae
Chrysura trimaculata Forst. 1

Sapygidae
Sapyga quinquepunctata (Fabricius, 1781) 1♀

Apidae
Sphecodes monilicornis (Kirby, 1802) 1♀(conf. P. Westrich)
Centina dallatorreana 1♀ det. S.P.M. Roberts
DIPTERA

Stratiomyidae
Stratiomys longicornis (Scopoli, 1763) 1♂

Empididae
Hilara longeciliata Strobl 1♂ 1♀

Dolichopodidae
Dolichopus sabinus Haliday, 1838 1♂
Medetera flavipes Meigen, 1824 1♀
Micromorphus sp. A 2♂

Syrphidae
Paragus haemorrhous Meigen, 1822 1♂
Chrysotoxum intermedium agg. 1♀
Eristalis sephulcralis (Linnaeus, 1758) 1♂

Muscidae
Atherigona varia (Meigen, 1826) 1♀

Calliphoridae
Stomorhina lunata (Fabricius, 1805) 1♂

Albufera, Es Colombar, saltmarsh, 2m, 22 April 2006

COLEOPTERA

Oedemeridae
Oedemera flavipes (F.) 1 (det. B. Levey)

HYMENOPTERA

Sphecidae
Ectemnus confinis (Walker, 1871) 1♂

Apidae
Halictus scabiosae 1♀ (conf. P. Westrich)

DIPTERA

Stratiomyidae
Stratiomys longicornis (Scopoli, 1763) 1♀

Empididae
Hilara longeciliata Strobl 1♂

Dolichopodidae
Dolichopus sabinus Haliday, 1838 3♂ 6♀
Micromorphus sp. A 3♂

Syrphidae
Eristalis sephulcralis (Linnaeus, 1758) 1♀
**Phritidae**
*Tephritis vespertina* (Loew, 1844) 4♂1♀

**Chamaemyiidae**
*Leucopis argentata* Heeger, 1848 3♂1♀

**Sciomyzidae**
*Euthycera alaris* 1♂
*Pherbellia cinerella* (Fallén, 1820) 1♂

**Sepsidae**
*Sepsis punctum* (Fabricius, 1794) 2♂1♀

**Chloropidae**
*Lipara similis* Schiner 1♂1♀ (conf. J.W.Ismay)
*Cryptonevra nigritarsis* (Duda, 1933) 1♂ (conf. J.W.Ismay)
*Aphanotrigonum femorellum* Collin, 1946 1♀ (conf. J.W.Ismay)
*Melanochaeta pubescens* (Thalhammar, 1898) 4♂2♀ (conf. J.W.Ismay)

**Agromyzidae**
*Agromyza baetica* Griffiths, 1963 1♂??
*Cerodontha denticornis* (Panzer, [1806]) 1♂

**Ephydridae**
*Hyadina guttata* (Fallén, 1813) 1♀
*Notiphila nubila* Dahl, 1973 1♂1♀
*Parandrosas ussienii* (Haliday, 1833) 1♂
*Philygria vittipennis* (Zetterstedt, [1838]) 1♂
*Psilopa nana* Loew, 1860 1♂1♀

**Muscidae**
*Orchisia costata* (Meigen, 1826) 1♂1♀
*Coenosia antennata* (Zetterstedt, 1849) 1♂

*Albufera, Sa Roca, N 39°47'47" E 003°06'19", 2m, 22 April 2006*

**DIPTERA**

**Stratiomyidae**
*Stratiomys longicornis* (Scopoli, 1763) 2♀

**Dolichopodidae**
*Medetera flavipes* Meigen, 1824 2♂ poplar trunks
*Medetera saxatilis* Collin, 1941 4♂2♀ poplar trunks

**Lonchaeidae**
*Lonchaea subnea tosa* Kovalev, 1974 1♂ poplar trunks Photo det. Iain McGowan
Puig de Sant Marti, N 39°49’29” E 003°05’51”, 23 April 2006

**COLEOPTERA**

**Bupestridae**
*Anthaxia rugicollis* Lucas 1 (det. B. Levey)

**Cerambycidae**
*Agapanthia cardui* (Linnaeus, 1767) 1
*Calamobius filum* (Rossi, 1790) 4

**HYMENOPTERA**

**Vespidae**
*Polistes dominulus* (Christ, 1791) 1♀ (conf. M.E. Archer)

**Sphecidae**
*Cerexis quadricincta* (Panzer, 1799) 1♂

**Apidae**
*Andrena agilissima* 1♂ (det. P. Westrich)
*Lasio glossum punctatissimum* (Schenck, 1853) 1♀
*Osmia cornuta* (Latreille, 1805) 1♀ (conf. P. Westrich)
*Rhodanthidium septemdentatum* (Latreille, 1809) 1♂ (conf. P. Westrich)
*Sphecodes ruficrus* 2♀ (det. P. Westrich)

**DIPTERA**

**Tipulidae**
*Nephrotoma lempkei* Oosterbroek, 1978 (conf. P. Oosterbroek)

**Keroplatidae**
*Antlemon halidayi* 2♂ det. P.J. Chandler

**Asilidae**
*Dioctria ochrifacies* Becker 1♂ 1♀

**Doli chopodidae**
*Ortochile nigrocerulea* Latreille, 1809 7♂6♀
*Medetera mixta* Negrobov, 1967 1♂ needs checking
*Medetera saxatilis* Collin, 1941 2♂14♀♀
*Micromorphus* sp. A 6♂3♀

**Syrphidae**
*Eumerus pusillus* Loew 1♀ (det. M.J. Ebejer)
*Eumerus barbarus* (Coqueberg) 1♀ (det. M.J. Ebejer)
*Panagis* sp. 2♀

**Pipunculidae**
*Verrallia aucta* (Fallén, 1817) 9♀
*Clistoabdom inalis dilatatus* (DeMeyer, 1997) 1♂
*Eudorylas obliquus* Coe, 1966 2♂♀
*Pipunculus carlestolrai* Kuznetsov, 1993 1♂2♀
*Tomosvaryella sepulta* DeMeyer, 1997 1♀
Te phritidae
Acanthophilus ramulosus 3♂
Ensina sonchi (Linnaeus, 1767) 1♂
Tephritis matricariae (Loew, 1844) 2♂3♀
Tephritis praecox (Loew, 1844) 7♂1♀
Tephritis vespertina (Loew, 1844) 1♀
Trupanea am oena (von Frauenfeld, 1857) 2♀
Trupanea stellata (Fuessly, 1775) 1♀

Chamaemyiidae
Chamaemyia polystigma (Meigen, 1830) 2♂5♀

Sciomyzidae
Pherbellia cinerella (Fallén, 1820) 1♂

Drosophilidae
Scaptomyza pallida (Zetterstedt, 1847) 1♂

Agromyzidae
Melanagromyza cunctans (Meigen, 1830) 1♂
Amauromyza monfalconensis (Strobl, 1909) 1♂
Cerodontha denticornis (Panzer, [1806]) 8♀
Chromatomyia succisa (Hering, 1922) 1♂

Chloropidae
Aphanotrigonum inerme Collin, 1946 2♂ (det. J.W. Ismay)
Oscinella frit group 1♀ (det. J.W. Ismay)
Polydaspis sulcicollis (Meigen, 1838) 2♂ (det. J.W. Ismay)
Thaumatomyia notata (Meigen, 1830) 2♂
Oscinornopha longirostris 3♀1♀ (det. M.J. Ebejer)

Ephydridae
Hydrellia griseola (Fallén, 1813) 5♂1♀
Psilopa nitidula (Fallén, 1813) 7♀

Scathophagidae
Scathophaga lutaria (Fabricius, 1794) 1♀ (det. M.J.Ebejer)

Anthomyiidae
Anthomyia pluvialis (Linnaeus, 1758) 1♂ (conf. M. Ackland)
Delia platura (Meigen, 1826) 3♂

Muscidae
Coenosia testacea (Robineau-Desvoidy, 1830) 1♂

Sarcophagidae
Nyctaia halberata (Panzer, [1798]) 1♀ (form with yellow basico st a & petioate cell R4+5)

Calliphoridae
Stom ohina lunata (Fabricius, 1805) 1♀
Tachinidae
_Ectophasia oblonga_ 1♂ (det. P. Tschorsnig)
_Phasia pusilla_ Meigen, 1824 1♀ (det. P. Tschorsnig)
_Xysta holosericea_ 1♀ (det. P. Tschorsnig)

_March Valley, Es Castel, N 39°52'11" E 002°57'15" 24 April 2006_

**HYMENOPTERA**

**Apidae**
_Xylocopa violacea_ 1♂

**DIPTERA**

**Hybotidae**
_Oropezella sphenoptera_ (Loew, 1873) 1♀

**Tephritidae**
_Tephritis vespertina_ (Loew, 1844) 1♂

**Sciomyzidae**
_Euthycera alaris_ 1♂

**Heleomyzidae**
_Suillia affinis_ (Meigen, 1830) 1♀

**Chloropidae**
_Thaumatomyia notata_ (Meigen, 1830) 1♂

**Ephydridae**
_Psilopa niitidula_ (Fallén, 1813) 1

**Muscidae**
_Coenosia testacea_ (Robineau-Desvoidy, 1830) 1♂

_Cuber, c.900m, N 39°46'57" E 002°48'27" 24 April 2006_

**HYMENOPTERA**

**Vespidae**
_Polistes dominulus_ (Christ, 1791) 1♀ (conf. M. E. Archer)

**Apidae**
_Andrena sardoa_ Lat. 3♂2♀ (det. P. Westrich)
_Chalicodoma siculum_ 1♂ (conf. P. Westrich)
_Rhodanthidium septemdentatum_ (Latreille, 1809) 1♂
_Halictus scabiosae_ 1♀ (conf. P. Westrich)
_Osmia versicolor_ Latreille, 1811 1♀ (conf. P. Westrich)
DIPTERA

**Mycetophilidae**
*Novakia scatopsiformis* Strobl, 1893 1 ♂ det. P.J. Chandler

**Empididae**
*Clinocera stagnalis* (Haliday, 1833) 2 ♀

**Dolichopodidae**
*Hydrophorus praecox* (Lehmann, 1822) 3 ♂ 3 ♀

**Lonchaeidae**
*Lonchaea tarsata* Fallén, 1820 6 ♂ 2 ♀

**Syrphidae**
*Eumerus emarginatum* 1 ♀ (det. M.J.Ebejer)

**Chloropidae**
*Cakum oncosis stipae* Nartshuk 2 ♀ (det. M.J.Ebejer)
*Oscinom opha longirostris* 1 ♂ (det. M.J. Ebejer)

**Ephydridae**
*Paryndra fossanum* (Haliday, 1833) 5
*Scatella paludum* (Meigen, 1830) 10

**Muscidae**
*Lispe nana* Macquart, 1835 1 ♂
*Lispe pygmaea* Fallén, 1825 2 ♂

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**Gorg Blau, c.900m, N 39°46’ E 002°48’ 24 April 2006**

DIPTERA

**Mycetophilidae**
*Megophthalmidia ionica* Chandler, 2006 2 ♂ det. P.J. Chandler

**Bombyliidae**
*Hemipenthes morio* (Linnaeus, 1758) 1 ♂

**Dolichopodidae**
*Dolichopus griseipennis* Sannius, 1831 1 ♀

**Lonchopteridae**
*Lonchoptera lutea* Panzer, 1809 2 ♂

**Lonchaeidae**
*Lonchaea tarsata* Fallén, 1820 1 ♂ 1 ♀
Albufera, Es Comú, Dunes, N 39°46’34” E 003°08’27” s.l. 25 April 2006

COLEOPTERA

Carabidae
Lophyra flexuosa (Fabricius, 1787) 2
Lophyridia littoralis (Fabricius, 1787) 2

Scarabaeidae
Scarabaeus typhon (Fischer-Waldheim, 1823) 1

Bupestridae
Anthaxia scutellaris Gare 1 (det. B. Levey)
Anthaxia confusa Gory 1 (det. B. Levey)

HYMENOPTERA

Chrycididae
Chrysura trimaculata Forst. 1

Vespidae
Polistes gallicus 1♀ (conf. M.E. Archer)

Sphecidae
Podalonia tydei (Le Guillou, 1841) 1♀

Apidae
Ceratina cucurbitina 1♀ det. S.P.M. Roberts

DIPTERA

Hybotidae
Chersodromia albopilosa Chvála, 1970 3♂1♀
Platypalpus albiseta (Panzer, 1806) 1♂2♀

Dolichopodidae
Micromorphus sp. A 1♂1♀

Pipunculidae
Clistoabdom inalis dilatatus (DeMeyer, 1997) 1♀
Eudorylas obliquus Coe, 1966 1♂1♀
Eudorylas bermeri Kehlmaier, 2005 1♂
Eudorylas wahisi DeMeyer, 1997 1♀
Tomosvaryella citifarsis (Strobl, 1910) 1♂

Syrphidae
Panagus tibialis (Fallén, 1817) 1♂1♀

Ulididae
Herina ?parva 1♀

Tephritidae
Spathulina sicula Rondani 1♂ (det. M.J. Ebejer)
Tephritis praecox (Loew, 1844) 1♂
**Lauxanidae**
*Minettia tabidiventris* (Rondani, 1877) 1♀

**Chamaemyiidae**
*Chamaemyia polystigma* (Meigen, 1830) 1♂?? provisional det.

**Muscidae**
*Atherigona varia* (Meigen, 1826) 2♂
*Orchisia costata* (Meigen, 1826) 2♀
*Coenosia testacea* (Robineau-Desvoidy, 1830) 1♂

**Hybomitra**

**Albufera, Son Boxe**

**Hymenoptera**

**Scoliidae**
*Megascolia bidens* (L. 1767) 1♂1♀

**Pompilidae**
*Anoplius infuscatus fimelanisante* 1♀ (det. D. Baldock)

**Diptera**

**Stratiomyidae**
*Odonomia discolor* Loew, 1846 2♂2♀

**Spain, Mallorca 2006 Malaise Trap Results. Leg. N.J. Riddiford**

**Albufera, Es Colombar EC3, Malaise Trap 20-21 April 2006 leg. N.J. Riddiford**

**Diptera**

**Bibionidae**
*Dilophus humeralis* Zetterstedt, 1850 2♂

**Psychodidae**
*Philosepedon humeralis* (Meigen, 1818) 1♂

**Embiidae**
*Hilara longeciliata* Strobl 290♂158♀

**Hybotidae**
*Stilpon lunatus* (Haliday in Walker, 1851) 2♀
*Stilpon subnubilus* Chvala, 1988 7♂♀6♀
*Platypalpus albiseta* (Panzer, 1806) 1♂
Platypalpus pallidiventris (Meigen, 1822) 1 ♀

Dolichopodidae
Dolichopus diadema Haliday, 1832 3 ♀
Dolichopus nubilus Meigen, 1824 2 ♂
Dolichopus sabinus Haliday, 1838 3 ♀
Ortochile nigrocoerulea Latreille, 1809 1 ♂
Micromorphus sp. A 2 ♀ 3 ♀

Syrphidae
Eupeodes co rollae (Fabricius, 1794) 1 ♂
Eumerus sogdianus Stackelberg 1 ♂

Asteiidae
Asteia (Subanarista) mahunkai Papp, 1979 1 ♂ det. Miguel Charles-Torda

Chloropidae
Thaumatomyia glabra (Meigen, 1830) 1 ♀

Rhinophoridae
Melanophora toralis (Linnaeus, 1758) 1 ♀

Muscidae
Lispocephala brachialis (Rondani, 1877) 1 ♂
Coenosia antennata (Zetterstedt, 1849) 13 ♀
Coenosia humilis Meigen, 1826 14 ♂ 12 ♀
Lispe nana Macquart, 1835 1 ♂
Orchisia costata (Meigen, 1826) 1 ♂

Albufera, 2RNC, Malaise Trap 21-22 April 2006 leg. N.J.Riddiford

DIPTERA
Limoniidae
Erioptera fuscipennis Meigen, 1818 3 ♂
Molophilus pleuralis de Meijere, 1920 1 ♂

Psychodidae
Boneoclyturus ocellaris (Meigen, 1804) ♂
Paninus maynei (Tonnoir, 1920) ♂
Psychoda cinctera Banks, 1894 ♂

Dolichopodidae
Dolichopus sabinus Haliday, 1838 1 ♀
Micromorphus sp. A 1 ♀

Empididae
Hilara longeciliata Strob 1 ♀ 1 ♂

Hybotidae
Stilpon lunatus (Haliday in Walker, 1851) 1 ♂
Stilpon subnubilus Chvala, 1988 1♂ 2♀
Platypalpus chrysonotus (Strobl, 1899) 1♂
Platypalpus pallidiventris (Meigen, 1822) 1♂ 2♀

Lonchopteridae
Lonchoptera lutea Panzer, 1809 1♂

Heleomyzidae
Suillia variegata (Loew, 1862) 1♂

Campichoetidae
Campichoeta grandiloba McAlpine, 1962 1♂

Chloropidae
Lipara rufitarsis Loew, 1858 1♂

Muscidae
Coenosia humilis Meigen, 1826 1♂ 3♀

Albufera, Es Rotlos, IRC, Malaise Trap 22-23 April 2006 leg N.J. Riddiford

DIPTERA
Tipulidae
Tipula oleracea Linnaeus, 1758 1♂
Tipula mediterranea Lackschewitz, 1930. 3♂ 2♀ (conf. P. Oosterbroek)

Limoniidae
Erioptera fuscipennis Meigen, 1818 1♂
Molophilus pleuralis de Meijere, 1920 1♂

Dolichopodidae
Dolichopus nubilus Meigen, 1824 1♂
Dolichopus sabinus Haliday, 1838 3♀
Micromorphus sp. A 2♀

Hybotidae
Platypalpus chrysonotus (Strobl, 1899) 1♀
Platypalpus pallidiventris (Meigen, 1822) 1♀
Stilpon subnubilus Chvala, 1988 4♂ 5♀

Empididae
Hilara longeciliata Strobl 2♂

Ephydridae
Haloscatella dichaeta (Loew, 1860) 1

Chloropidae
Lipara similis Schiner, 1854 1♂
Melanochaeta pubescens (Thalhammar, 1898) 1♀
Muscidae
Coenosia humilis Meigen, 1826 1♂
Coenosia hygina (Fabricius, 1775) 1♂
Lispe nano Macquart, 1835 1♂
Lispe pygmaea Fallén, 1825 2♂1♀
Phaonia pratensis (Robineau-Desvoidy, 1830) 1♀

Albufera, Sa Roca, Light Trap N 39°47′47″ E 003°06′19″, 2m, 22 April 2006

DIPTERA
Hybotidae
Platypalpus chrysoneanus (Strobl, 1899) 1♂
Platypalpus aff. flavicornis (Meigen, 1822) 1♂

Mondragó, fumigated zone, Light Trap 23 March 2006 leg. P Hervàs

DIPTERA
Dolichopodidae
Hydrophorus praecox (Lehmann, 1822) 1♂

Tephritidae
Tephritis praecox (Loew, 1844) 1♂

Agromyzidae
Phytomyza plantaginis Robineau-Desvoidy, 1851 1♂

Albufera, Camí d’es Polls, 26 April 2006 (leg. I. Férriz)
Chromatomyia horticola (Goureau, 1851) 1♀ x mine in Sonchus maritimus

Species collected by Martin J. Ebejer (det. D.J.Gibbs)

COLEOPTERA: Cerambycidae

Mallorca, Albufera, Camí des Polls, on Ulmus 21.v.2006
Xylotrechus arvicola (Olivier, 1795)

Mallorca, Albufera, Son Bosc, marsh, dune grassland, Helichrysum 25.v.2006
Chlorophorus trifasciatus (Fab. 1781) 1

Mallorca, Albufera, Camí des Polls, Ulmus, Phragmites marsh 28.v.2006
Saperda punctata (L., 1767) 1
DIPTERA: Pipunculidae

*Mallorca; Albufera, Son Bosc, marsh, dune grassland, Helichrysum 24.v.2006*
Tomosvaryella kuthyi (Aczél, 1944) 1♂ 1♀

*Mallorca, Albufera, Cami des Polls, marsh 21.v.2006*
Tomosvaryella frontata Hardy, 1967 1♀

*Ibiza; P.N. Ses Salines, Torre de ses Portes, Pinus, rocky shore, meadow 30.v.2006*
Eudorylas ?bereri Kehlmaier, 2005 1♀

*Ibiza; P.N. Ses Salines, Es Cavallet, Juniperus dune, Salicornia & Juncus marsh 1.vi.2006*
Eudorylas mediterraneus DeMeyer & Ackland, 1997 1♀
Annex 2. List of Diptera from Balearics from 21st to 28th May 2006, Martín J. Ebejer; S’Albufera records

- * for locality see end of document
- italics = new for Albufera
- blue = new for Balearics

<table>
<thead>
<tr>
<th>Family</th>
<th>Species</th>
<th>Cami des Polls</th>
<th>Es Cibollar</th>
<th>Es Forcadet</th>
<th>Es Comu</th>
<th>Les Salinetes</th>
<th>Sa Roca</th>
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<td>12. Psocelia termiina</td>
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**HYBOTIDAE**

**KEROPLATIDAE**

**LAUXANIIDAE**

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**TACHINIDAE**

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|280| *Cylindrotrichius auriculus* |   |   |   |   |   |
|281| *Cylindrotrichius brassiariae*|   |   |   |   |   |
|282| *Cylindrotrichius rufipes*   |   |   |   |   |   |
|283| *Dinera sp*                   |   |   |   |   |   |
|284| *Ectophasia oblonga*          |   |   |   |   |   |
|285| *Eliozeta helio*              |   |   |   |   |   |
|286| *Leucostomis semifasciata*    |   |   |   |   |   |

**TEPHRITIDAE**

|287| *Acanthophorus helianthi*     |   |   |   |   |   |
|288| *Campiglossa producta*       |   |   |   |   |   |
|289| *Campiglossa ? soleiagnus*   |   |   |   |   |   |
|290| *Capitites ramulosa*         |   |   |   |   |   |
|291| *Ensina sonchii*              |   |   |   |   |   |
|292| *Eulena huncle*              |   |   |   |   |   |
|293| *Myopites sp.*               |   |   |   |   |   |
|294| *Spathulina sicula*          |   |   |   |   |   |
|295| *Tephrus divisa*             |   |   |   |   |   |
|296| *Tephrus formosus*           |   |   |   |   |   |
|297| *Tephrus nigricans*          |   |   |   |   |   |
|298| *Tephrus praecox*            |   |   |   |   |   |

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A. liturata taken from Sa Dragonera
D. ochrifacies taken from Alaró
Eladiptera species x2 reared from Phragmites collected from Es Ras
I. zuercheri reared from Phragmites collected from Es Ras
P. picardi reared from Phragmites collected from Es Ras
L. virens noted at Sollier

1 family new to Albufera
2 families new to Balearics
58 species added to list of Albufera
84 species added to list of Balearics
Monitoring the status and conservation management of the rare orchid Orchis robusta by Florent Prunier, Inmaculada Férriz & Nick J Riddiford

Rationale for the study

Recent DNA based work on the Albufera marsh orchid, previously known as Orchis palustris Jacquin, suggests that it is a separate species, Orchis robusta (T. Stephenson) Götz & H.R. Reinh. Whether Orchis robusta or Orchis palustris robusta, the taxon is only known from S’Albufera and single sites in Algeria and Morocco. Therefore it is one of the priority species in P.N. S’Albufera de Mallorca. Because of its special conservation value and habitat requirements, it was selected as a key species for a monitoring programme as long ago as 1991. Since then it has been monitored every year. The basis of the survey is an annual census of the flowering spikes, which are thought to be representative of the true population estimates, and mapping of its distribution. In 1991 there were 624 flowering spikes in 1991 and in 2006 there were 383. However, the annual variation has been much greater, from 166 to 3057. The survey has improved our understanding of habitat requirements. One observation has been that grazing livestock can have either a helpful or damaging impact on the Orchis population. Cattle, horses and buffalo permanently in place had a negative effect at s’Albufera on the numbers of Orchis in flower, but the partial presence of stock could be beneficial. One of the objectives of the Orchis survey in recent years has been evaluating the effects of rotational grazing by the Parc in one experimental plot at Camí de Ses Polls. The results of these 15 years of monitoring are reported here, and include an analysis of annual fluctuations, their causes, the ecological requirements of the species and recommendations for the conservation and enhancement of the only European population of this internationally rare taxon.

Taxonomy

There is no current consensus on the taxonomy of the Marsh orchid in S’Albufera de Mallorca Natural Park, Alcudia (Mallorca, Spain). Traditionally named Orchis palustris Jacqin 1787 (synonymy by Kerguélen 1999 appears in Annex 1), some authors consider it a subspecies of Orchis laxiflora Lamarck 1779 (Galán Cela & Gamarra 2003) but this view is currently in a minority among taxonomists and genetic research tends to prove the two species are different (e.g. Arduino et al. 1996). S’Albufera plants have been identified as Orchis robusta (T. Stephenson 1931) Götz & H.R.Reinh 1976 in recent years by various botanists and the park staff (Cozzolino in litt. from DNA analysis of leaves; Delorges 1994, Herbari virtual de la Universitat de les Illes Balears 2006) while this later name is argued to be a synonym by others (Aedo 2005, Kerguélen 1999). More recent genetic advances show that the genus Orchis is polyphyletic so that the O. laxiflora s.l. group belongs in fact to the genus Anacamptis (Bateman et al. 2003) and our species to the taxon Anacamptis robusta (T. Stephenson 1931) R.M. Bateman 2003 (Bateman et al. 2003, Cozzolino et al. 2003). The debate seems still to be in progress, and the taxon robusta remains “controversial” (in Bateman & Hollingsworth 2004). However, because the species is widely recognised by the botanical authorities of the Balearic Islands, we refer to the taxon as Orchis robusta for this report.
As a footnote, it should be noted that an hybrid *Anacamptis x albuferensis* R.M. Bateman 2004 between *O. robusta* and *O. fragans* (the *O. coriophora s.l.* group) was recently described from S’ Albufera (Bateman & Hollingsworth 2004).

**Morphology**

*Orchis robusta* is a tall, robust species with spectacular pink and magenta flowers. Detailed descriptions of the species can be found in Flora Iberica (Aedo 2005) and the Balearic Red Data Book (Sáez & Rosseló 2001) among others.

**Habitat**

Generally, the Marsh orchid group *Orchis palustris s.l.* prefers sunny open habitats, and most typically fenland, swamps, wet meadows and fen meadows on wet calcareous substrates. Due to these habitat preferences, the distribution is at low altitude: 0-500 m; and the group can occur on saline substrates (Aedo 2005, Société Française d’Orchidophilie 1998, Bolós & Vigo 1984-1995). The etymology is also consistent, from the latin *paluster*, meaning swamp, marsh. In Catalan this orchid group is called “Orquidia de prat” (meaning marsh orchid).

**Phenology**

There are no records of when exactly the leaves of *Orchis robusta* appear but this is thought to be between January and March. The first flowers appear around 20th April and the main flowering season is the last week of April through to about 10th May.

**Ecology**

*Orchis robusta* is an opportunist, taking advantage of areas of marsh which have been opened up in order to flower and set seed before the growth of the reedbed closes the space again. An individual *Orchis robusta* plant at S’ Albufera may live for no more than 4 years and it is thought that the entire population attempts to flower every year (Terry Wells, personal communication). In this way it invests heavily in its seed. Records of flowering plants after a zone has been opened up for the first time for many years suggest that the seeds survive for long periods in the substrate, or that the species has high powers of colonization.

**Corology**

*Orchis palustris* is widespread throughout the Western Palearctic: it covers the euromediterranean area from Anatolia (Turkey) to Tunisia and reaches north as far as Sweden. In the Iberian Peninsula, it is present in 13 Spanish provinces, fundamentally the eastern calcareous and Mediterranean ones, but extending as far west as Valladolid.
without being recorded in Portugal (Aedo 2005). In the rest of Europe (e.g. France, Italy, Sweden), it is scarce with a localised distribution and is rarely abundant in its localities (Société Française d’Orchidophilie 1998, Grünanger 2000, Hoegstroem 1991). The five largest Italian populations, centred around the Po, add up to slightly more than 800 individuals [range: 100-5000] (Cozzolino et al. 2003) and in Gotland there are about circa 4000 individuals [interannual range: 600-7000] (Hoegstroem 1991). It is also present in various Mediterranean islands such as Crete and Kos in Greece (Ettlinger 1996) and Corsica (Société Française d’Orchidophilie 1998).

By contrast, Orchis robusta is only known from north Africa and the Balearic Islands (Delforges 1994); and its only locality in the Balearic archipalego is s’Albufera de Mallorca (Sáez & Rosseló 2001, Mus i Amézquita 1993).

Status

Orchis robusta was not reported by the early botanists in Mallorca (Cambessèdes 1827, Barceló y Combis 1867, Willkomm 1876, Barceló y Combis 1879-1881, Mares & Virginieix 1880, Burnat & Barbe 1882, Knoche 1921-1922). It appears that although S’Albufera was already somewhat of a classical locality for its wildlife, it did not attract the attention of the botanists who were drawn more by the endemics of the Tramuntana mountains and the surroundings of Palma. A dramatic change was witnessed by later botanists. When the wetland was drained and canalized in the 19th century, especially from 1863 to 1870 by the New Majorca Land Company (Picornell & Ginard 1995), and farmed so that the ecosystem had lost most of its naturalness, marshland, the natural habitat of Orchis robusta was amongst the first habitats to be lost. The first mentions of “the Marsh orchid” in published lists appeared as late as the 1970s (Duvigneau 1979, Bonafé 1978).

There is a similar story for Orchis palustris. Throughout its global area of distribution, Orchis palustris has experienced a dramatic decline in its populations due to the destruction of its biotopes. It has diminished and disappeared from many regions of Europe (e.g. Hoegstroem 1991, Société Française d’Orchidophilie 1998, Grünanger 2000) and has not been seen in Belgium since 1936 (Flora database 2006). No particular threat has been identified in mainland Spain (Aedo 2005). Nevertheless, in the Balearic archipelago, (Sáez & Rosseló 2001) classified it (as Orchis palustris) as “Vulnerable”.

If we accept the taxon as Orchis robusta taxon, the status of the species is of even greater concern, S’Albufera being one of very few strongholds for the species. Whatever the taxonomical approach chosen, the Marsh orchid is one of the priority species in S’Albufera for its special conservation value and, because it is greatly appreciated for its beauty and rarity, contributes very positively to the public use of the park by the local community, tourists and naturalists.
Parc management

P.N. S’Albufera de Mallorca is recognised in numerous conventions, designations and published material as an internationally important Mediterranean coastal wetland. Through time and human actions, the wetland has been transformed from a lagoon wetland (albufera) to a landscape dominated by emergent vegetation. It now constitutes one of Europe’s largest reed *Phragmites australis* and sedge *Cladium mariscus* beds, fringed by substantial areas of salt marsh, coastal and inland (fossil) dunes. In total, the protected area of S’Albufera covers an area of more than 1600 ha. An important part of the wetland is managed by the use of domestic livestock to control the growth of the reed and provide open areas. Since 2005, after modifications of some enclosures, there are 19 grazing compartments covering 385 ha in the park (15 pre-2005 compartments are considered in this paper) which contribute to the conservation of the marsh ecosystem. Information relative to the management of the park by cattle can be found in regular reports from the grazings manager (unpublished reports to the park). Three types of herbivores are used: Mallorcan cattle (equivalent to 0.8 LU “Livestock unit” /ha), Camargue horses (1 LU/ha) and Water buffalos (1.5 LU/ha) all of them special, regional breeds perfectly adapted to life in wetlands and with a long tradition of human exploitation. It is known that Mallorcan cattle have been present in the archipelago for two millennia and had their maximum numbers in the 13th and 14th centuries. Another outstanding example is the Water buffalos which has been the base of the economy of many wetlands throughout the History, such as the Arab Marshes in Iraq (Thesiger 1964) and the Greek wetlands up to a recent period (Kazoglou & Jerrentrup 2005). Both Water buffaloes and Camargue horses were introduced in Mallorca for the ecological management of the park. The intention of the grazing in the park is to create and maintain habitat that would encourage wading bird species, maximise plant diversity and increase visibility of the marsh (Anonymous 1998). Riddiford (2005) describes the general philosophy of the grazing management and puts particular emphasis on the link between open areas and success of waterfowl.

Numbers of animals present in December in the park and areas grazed each year are well known to the staff so that the overall grazing pressure during the period that S’Albufera has been a park is known (Figure 1). However, precise details of the grazing regime (i.e. which compartment the animals were in and for how long) for the first 10 years of this study are often lacking. It is only possible to calculate an estimate of the overall grazing pressure from data regarding cattle present in December. This lack of data at times limits conclusions which can be drawn on the effects of grazing on the flowering of *Orchis robusta*. Since 2003 a systematic collection of grazing data has been put in place.
Two main periods can be distinguished: the first one corresponds with a strong increase in the amount of open area each year from 1989 (75 ha) to 1993 (385 ha) as a result of a programme of restoration of marshland which had previously been dense reedbed (Anonymous 1998) and the second period corresponds with a phase of stabilization of the grazed surface area (around 385 ha). Conversely there has been a general decrease of the grazing pressure up to 1994 (0.4 LU/ha) and a certain stability since then (0.3 LU/ha), apart for an intermittent loss of animals in years 1997 and 1998.

**Note:** the number of grazing animals per compartment and per year varies considerably so that in some areas grazing pressure will have been much greater than the overall mean.

The Monitoring Programme

In s’Albufera, *Orchis robusta* has been selected as a bio-indicator for the health of the grazing coastal marshes for its special conservation value and habitat requirements. A monitoring programme dedicated to this species was established in 1991 in order to guide the park management in the conservation of this species (Elzinga et al. 2001). The main objectives of the monitoring programme are as follows:

- To measure the abundance and map the location of *Orchis robusta* each year in the different compartments of the park.
- To study the changes of abundance of the population in function of the park’s management (i.e. grazing regime).
- To improve the management, especially when it has negative effects on the orchids.

In 1991, Terry Wells, an orchid specialist from Britain, initiated the study of *Orchis palustris* and surveys were carried out by two scientific groups: Earthwatch Europe followed by The Albufera International Biodiversity group (TAIB). From 1991 to 2006, data have been collected annually using slight variations of the same methodology. The Park has been kept informed of the results but, to date, no one document has been produced which contains all these data.
Methodology of the survey

Survey areas

Survey areas were based on habitat and management homogeneity, following Pamela Hill’s work in the spring of 2003 season (unpublished) and modified in April 2004. Figure 2 below illustrates the location of the survey areas. In the spring of 2004, following investigation of all the *Orchis robusta* data collected, key monitoring areas were identified based on homogeneity criteria. It was decided to define areas in function of orchid abundances, of their position in the management compartment and the presence of practical physical barriers. Maps were produced for each of these areas and a database created to hold all the survey results. This database will be updated annually and is available for any consultation.

Figure 2: Survey areas for the monitoring of *Orchis robusta*

Each one of the areas (or plots) A to L have been divided into different sub-areas and allocated to one of the grazing compartment set up by the park (Annex 2). This has been worked out in collaboration with Miquel Cantallops, the grazings manager.
Survey methods

An annual survey of flowering Orchis robusta spikes is carried out each year between the last two weeks of April and first two weeks of May, depending on the timing of flowering which may vary slightly between years. The survey is timed to coincide with the peak flowering. All records are entered in a database. Tools for further surveys have been added as annexes. These are a protocol for the census (Annex 3) and a set of blank maps for entering data (Annex 4). Within the data, absence is recorded as a “zero”. However within the first years of survey, “zero” may have at times indicate a lack of survey rather than a true absence. The establishment of the database and reinforced protocol has been designed to ensure more accurate results.

Data analysis

It should be stated at the very outset that census results represents absolute numbers of the Balearic population.

Despite being most frequently used to evaluate trends in wildlife populations, the freeware TRIM (Pannekoek & Van Strien 2002) was not used for two main reasons. Firstly, count values from the data set shows very high level of over-deposition (>100 calculated by TRIM) so that they does not fit well a Poisson distribution. Secondly, the strength of the software which calculates indices in place of missing values is not usable in our context where we must assume that absent values from the database mean a count of zero. Pearson correlation coefficients were calculated to look the synchrony of the flowering spikes between plots.

Results

Results of the census for each area by year

Figure 3 presents the results of the survey of Orchis robusta counts across the park. The total for 2006, 383 spikes, is only 61% of the 624 flowering spikes recorded in 1991. However, a range of 166 to 3057 over the monitoring period reflect the fact that the situation is far from being either a trend of steady decrease nor within the range of oscillations of a stable population.

Closer analysis of the data reveals that the large variations were both in time and between compartments. A dramatic increase of the Orchis robusta population in s’Albufera in 1994 resulted from the conversion of large Phragmites australis beds through fire and subsequent grazing management to open water and marsh. The general decrease after 1997 is best explained as the results of overgrazing, or poor grazing management. The poor success of orchids in 1995 is not explained.
Census results (Annex 4) shows that no linear regression fits the trends of the orchid populations. It was also noted that few areas showed a continuous presence of the orchids.

No significant correlations were found (Pearson's coefficients of correlation were not significantly different from zero and are not presented here) between the Management compartments results (8 compartments) and between Census areas results (38 sub-areas). Within any one flowering season, there is no consistency in the amount of flowering across different compartments in contrast to what is often found in surveys of other orchid species. Each local sub-population has fluctuated independently.

**Figure 3: Development of *Orchis robusta* at S’Albufera from 1991 until 2004.**

**Habitat preferences**

Historical records for S’Albufera indicate that the *Orchis* was found in wet areas, close to Font de Son Sant Joan (Llorens in Bonafè 1978). The first short report written in 1989 stated that “casual observations had shown that many orchids were to be found on tracks through the marshes and on the more open, grassy areas and on the dunes, but not in the reed-beds” (Eckersley et al. in Wood 1989). The present distribution of *Orchis palustris* across the park continues to reflect that described in 1989 (observations by N. Riddiford and P. Vicens) except for its doubtful presence in the dunes. However, it has been found in small ponds in the fossil dune at Can Eixut.

**Table 1** presents the results sorted for each grazing compartment between 1991 and 2004 of orchids found in each compartment. On 15 compartments, the most important for orchids are Camí des Polls (Plot G), Es Ras (Plot L) and Sa Sinia (Plot B), the three of them are marshland of fresh and slightly mixohaline waters. Various compartments have never hosted Marsh orchids because they are salmarshes (Es Cibollar) or lagoons with high water levels in spring (Turó Ses Eres, Es Racó) and, apart from a few plants along the Camí d’es Senyals, orchids have never observed in the north of the park. Despite being large compartments, Es Ras and Sa Sinia had their orchids localized in the same small areas at Siquia Aigua Bona in Es Ras and along the path in Sa Sinia. It is also important to note that an important proportion of Orchids are found every year outside of any grazing compartment (none) so that the conservation of the species is not totally dependant of the grazing management.
Table 1: Results of census by Grazing Compartment (1991-2004) and % of total counted spikes (n= c.14000 spikes).

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Table 2: Results of census by Habitat type (1991-2004)

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Table 2 presents the results per habitat type for each sub-census areas (note that this classification can differ from the one using the grazing compartment nomenclature). Data show that from 1994 onwards following the establishment of the fire break in Camí des Polls, the bulk of the population lies in marshes, opened up in the reed-bed after fire events or management activities (i.e. grazing). Significant habitat can also be found along the tracks and their adjacent canals. This habitat was particularly important when management activities resulted in a lack of marshland habitat. This was the case prior to 1994 when paths may have acted as a refuge for this species. In years of poor success in the marshes (e.g. 1995) the proportion of orchids in both biotopes tends to equalize. In the last three years of the survey, a tendency for the paths to be proportionally more important has been observed. Shallow ponds in the fossil dunes at Can Eixut (Plot E) are interesting in that they are considered likely to mimic a natural habitat of the species before desiccation of the lagoons of S'Albufera but these are under threat because of the development of a golf course.
Management of the grazing marshes

Two areas found to support large numbers of flowering *Orchis robusta* have been selected for further comparison. These areas are the fresh marsh Camí des Polls (7.8ha) and the slightly salty marsh Es Ras (122.5ha) (in fact Siquia Aigua Bona represents a fifth of it). Up to 2005, these areas had different grazing regimes, one has been managed for *Orchis robusta* since the late 1990s and to maintain a fire-break (0.78 LU/year in 2003), while the other site has had grazing animals on a permanent basis since the mid-1990s (0.15 LU/year in 2003), including water buffalos. Figure 5 below shows the development of the *Orchis robusta* populations in the two surveyed areas through the years.

Figure 5: Development of the *Orchis robusta* population at Camí des Polls (G) and at Es Ras (L).

In both cases, the areas contained few or no orchids before they were opened up and grazed. Spectacular flowering occurred in 1994 in Es Ras and in 1996 and 1997 in Camí des Polls in immediate response to habitat creation. The almost total failure of Orchids in Es Ras in 1995 was due to the destructive powers of the buffalo. They had opened up the area to the benefit of the Orchis in 1994 but by 1995 had severely damaged the vegetation by grazing and trampling. Because they had used up all the forage in this area, they crossed the canal into the western part of Es Ras, opening up an area which had previously been dense *Cladium mariscus* marsh. Orchids took advantage of this
newly opened part of Es Ras, contributing to the upsurge in numbers from 1996. Unfortunately, by 1999 the buffalos had largely eliminated the supporting vegetation which previously gave the orchids protection against grazing and trampling and the population was lost. A different management was put into place in Cami des Polls, based on grazing cattle which were removed from January to May, a critical growing period for the orchids. Thus a different tendency was observed at the two sites: a population crash in Es Ras (1999) and a steady population growth in Cami des Polls after the 1998 crash.

The main difference between these two sites seems to lie in the grazing regime. The removal of stock from January to May (as a management action set up for orchids) at Cami des Polls has allowed for the gradual but progressive increase in orchid numbers at this site. The continuous presence of grazing animals in Es Ras, however, appears to have been detrimental to orchid flowering. The apparent overgrazing in Es Ras would have resulted in changes in the vegetative species composition and an increase in bare soil coverage conducing to a depleted Orchis palustris population with its disappearance predicted at this site in a few years. This scenario is our best proposed hypothesis, although we need experimental confirmation. It is also supported by direct observations of orchids grazed by cattle and in some places by the better success of orchids beyond the fence, where grazers have no access.

Grazing is not the only way to provide early successional stage in place of dense reedbed. Recurrent fires occur in the margins of the park (and sometimes devastate it) and also create regularly suitable conditions such as in Son Sant Joan, plot K, outside the boundaries of the park. Here, the numbers of orchids have been varying in function of fire frequency and are globally diminishing now as a consequence of the invasion of the small populations by reedbed (Phragmites australis) and Provencal cane (Arundo donax).

Son Bosc

In spring 2005, Parc naturalist Pere Vicens discovered a substantial new population just outside the Park boundary at Son Bosc. It was not only a new site but a different habitat, comprising botanically rich dune grassland – which it shared with high densities of other orchids.

The count for this new colony was 266. In 2006 this number rose to 441, substantially more than the entire count within the Parc.

Discussion

Grazing management at s’Albufera – a review

In the early years, the grazing system worked extremely well at achieving its conservation and public use objectives - giving many opportunistic species the chance
to prosper. Some of these, such as the marsh orchid and *Scirpus maritimus* (an important food source for ducks) are key species for S’Albufera. Both species are indeed very important for the park, demonstrating a clear example of the advantages of grazing as a tool to enhance biodiversity. In addition, the buffalos were something of a visitor attraction in their own right. Those observations are common with the Greek experience of grazing wetlands with buffalos (Kazoglou & Jerrentrup 2005). Nevertheless after three years of the introduction of the buffalos in the enclosure of Es Ras, they had eaten and trampled much of the vegetation and *Orchis robusta* declined severely. Because the buffalos had eaten everything they went in search of food elsewhere. A deep canal kept cattle away from the pure *Cladium* stand the other side of the grazing area, but the water was no obstacle for the buffalo which crossed over and gradually over a period of years trampled and ate their way through the stand so that today it is represented by low scattered plants.

Due to continual presence of livestock, and *Scirpus* being their favourite food plant, new shoots were being eaten virtually as they appeared. The only *Scirpus* to flower was that growing amongst clumps of *Juncus acutus* or similar dense vegetation. Towards the end of the 1990s, there was concern regarding the lack of flowering *Scirpus* in the park. The winter duck numbers, however, continued to grow and new species were breeding (including the first Balearic breeding Shovelers *Anas clypeata*). Concern was that the ducks would eventually use up the *Scirpus* seed reserves leading to a consequent reduction in numbers of wintering ducks.

Observations of invertebrates, especially *Orthoptera* (Prunier 2004) also pointed out that a greater diversity is achieved in the parts of the marsh which retain denser grassland and tussocks than in much trampled areas by cattle. *Tropidopola cylindrica*, *Conocephalus conocephalus*, *Ruspulia nitidula*, *Eyprepocnemis plorans* were much more numerous in dense vegetated marsh. *Trigonidium cicindeloides* and *Acrida ungarica* are also likely to be favoured by this habitat. However *Eyprepocnemis plorans* is widely dispersed in the wetland, mostly present in sunny places like woodland edges and especially in *Juncus acutus* tussocks. For Water beetles (*Coleoptera Adephaga* and *Polyphaga*) (unpublished data), it was observed that waters covering mud and large patches of bare soil due to the continual presence of the Buffalos were hosting very few individuals in Es Ras, Sa Sinia and Turó Ses Eres. Coastal lagoons are naturally poor for aquatic invertebrates and those are most often associated with vegetation, macrophyte beds or detritus accumulation. Early successional stages are indeed very important for rare invertebrates but less so in meadows which flood (Kirby 1992).

This situation of continuous grazing leads to the increasing population of *Juncus acutus* in heavily grazed areas. Several zones are now dominated by this plant, in the form of scattered but dense clumps of individual plants. Observations indicate that it is the least favoured of all the emergent plant species for S'Albufera livestock. A similar response has been observed in the Lavours marshes (France) where heavy grazing stock to eliminate *Phragmites* reed finally favoured the growth of *Alnus glutinosa*, a much less palatable species, thus hindering the original goal of the grazing programme (Darinot & Morand 2001).
Marsh orchid responses to management by the marsh orchid

The marsh orchid population has followed complex patterns of distribution over time in the park. As an opportunist species, the local population reacts strongly to its changing environment. It colonizes new sites quickly when conditions are appropriate and disappears equally fast. It is thought that park management, especially grazing throughout the park, is the key factor in explaining the success or failure of orchids in the marshlands areas. Positive and negative effects of management have been identified for *Orchis robusta*.

(a) **Positive effects of management.** Introduction of grazing livestock creates:

1) Wet meadows instead of dense reed and sedge beds;
2) bare ground and early successional stages. Such features of the habitat are favourable to the colonization by opportunist species, such as *Orchis robusta*. Other species showing the same explosive colonisation pattern include the cricket *Pteronemobius heydennii*.

(b) **Negative effects of management.**

1) The absence of grazing animals leads to plant succession, comprising denser and taller vegetation. The orchids are unable to compete and are shaded out.
2) At the other end of the scale continuous grazing leads to a dramatic decrease in *Orchis robusta* numbers after a few years. Animals present during the *Orchis* growing period were either trampling plants or actually eating the leaves. Permanent grazing also leads to fertilization of the habitat, which may be a negative factor as is known for wetland orchids of the genus *Dactylorhiza* (Dijk & Eck 1995), although this would need to be studied more because those authors noted important variations between species.

As a general rule, management recommendations for levels of grazing of wet meadows and marshland are 0.5 to 1 LU/ha (VVAA 1997, Colas & Hébert 2000), 2LU/ha (Burges & Al 1995), 0.25-1 LU/ha (Ausden & Treweek 1995). Overall grazing levels at S’Albufera meet this rule, but many compartments are not equally grazed and the presence of high water levels in some of them (Es Rás, Ses Puntes) reduces the useful above water grazing surface for stock and increases the impact.

**Son Bosc**

The remarkable find at Son Bosc was a surprise. The Orchids here grew taller and more robust than those in the marsh and were apparently growing in much drier soil. However, a glance at the accompanying vegetation which included scattered plants of *Phragmites australis* and extensive patches of *Panicum repens*, a grass associated with damp soils, indicated that the water table was not far from the surface — at least at certain times of the year. The habitat had previously been grazed by horses, but had lain fallow for some years.
Because of the robust nature of the orchids, they were very noticeable to passers-by. A track running past the site is well used by visitors and local people alike, so a notice was erected asking people to respect this rare plant and not to pick it. The request appeared to be well respected. However, the colony does lie in an area proposed for incorporation into a golf course. The area is generally botanically rich and with an important fauna too. Indeed Son Bosc may support one of the highest biological diversities in the whole of Mallorca. The *Orchis robusta* can be seen as the flagship species for a very rich habitat which needs to be valued and protected. It must be of considerable concern to the Parc Directorate and management team that more than half of the Albufera and the European population lies beyond their protection.

**Management recommendations**

There is no strong reason for the livestock to be in the zone in the first half of the year because vegetation growth is at its minimum and there is little grazing available for the stock. Because of the shortage of fodder during this period, the *Orchis* leaves may be more vulnerable to grazing animals (M. Cantallops, personal communication).

Monitoring has shown that the Cami des Polls population has benefited from a grazing regime which comprises the removal of livestock from the beginning of the year until after the flowering period (mid to late May) followed by heavy grazing until the end of the year. This management system has maintained a substantial population of *Orchis robusta* for ten years.

The only other sub-population exceeding 100 flowering spikes is outside of the Parc and its protection. The species remains vulnerable in other parts of the parc and to have only one substantial guaranteed sub-population for a taxon which is not known elsewhere in Europe places that population at unnecessarily high risk. In current circumstances, *priority consideration should be given to implementing a sympathetic rotational grazing regime in other traditional sites for the species within the Parc*, so that the vulnerability of a good population only at Cami des Polls can be severely reduced. *Siquia Aigua Bona at Es Ras and Sa Sinia* appear to be the most suitable candidates for such sympathetic management. The selection of additional sites would also allow for some experimentation, for instance by varying the timings and density of livestock and monitoring the results, in order to further improve management.

There is still much to learnt about *Orchis robusta* at s’Albufera and its ecological requirements. The current population level at Cami des Polls, though still substantial, is less than it was at its peak. Clearly grazing management is just one of the issues and others, such as variations in aspects of hydrology or meteorological conditions will also affect population levels. Fifteen years of monitoring have proved of immense value in understanding the ecology of the species, but more intensive investigation of the many factors determining the ecological needs of *Orchis robusta* is required to protect the taxon in the long term. Our final recommendation, therefore, is that an *in-depth*
ecological study, preferably at doctoral level, is required throughout the year to understand better the needs of the taxon and the most appropriate management actions to conserve and enhance S’Albufera’s unique European population.

Acknowledgments:

We gratefully acknowledge all the many participants in the Albufera International Biodiversity team activities for their help with fieldwork and other aspects of the study; and the staff of the Parc Natural S’Albufera de Mallorca for their friendly support and in particular Matias Rebassa, Biel Perello, Pere Vicens (naturalist) and Miquel Cantallops (grazings manager) all of who provided important additional information. This part of the report was prepared by F Prunier, N Riddiford, I Férriz and C Portero.

Bibliography


ANNEXES

Annex 1: Synonymy following Kerguélen 1999


- var. *minor* Bréb. [1859, Fl. Normandie, éd. 3 : ] = var. *palustris*
- var. *palustris*

**Orchis laxiflora** Lam. [1779, Fl. Fr., 3 : 504] subsp. *laxiflora* 2n = 36 Co, Ga 1, 2, 3, 4, 5, 6

- subsp. *dielsianus* Soó [ ] = *O. palustris* var. *palustris*
- subsp. *elegans* (Heuffel) Soó [ ] = *O. palustris* ? var. *palustris*
- subsp. *laxiflora* 1, 4, 6


## Annex 2: Characteristics of sample sites

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<th>Census Area</th>
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Annex 3: Census protocol (by Pamela Hill)

INTRODUCTION

The survey method to be used will depend on the area being surveyed.

NB: Please, copy the maps of survey and use them as far as you can to locate orchids spikes. It is useful to understand the differences within an sample sites.

LINEAR AREA: VERGES ALONGSIDE PATHS, WATERWAYS <5M WIDE

No. of OBSERVERS:

1 – 2

EQUIPMENT:

Recording form, Map, Pencil, Clipboard

METHOD:

Walk the length of the linear area.

If 2 people are surveying each can record one side.

If one person is surveying they should record one side first and record the other side on the return walk.

BLOCK AREA: ALL AREAS >5M WIDE

No. of OBSERVERS:

3 (minimum)

EQUIPMENT:

Ranging rods (8 - as two sets of four), Recording form, Map, Pencil, Clipboard, Wellington boots

METHOD:

The area should be surveyed in strips.

Use one of the edges of the block area as the initial linear boundary feature to follow (e.g. fence, ditch)

The width of each survey strip is dependent on the number of observers and vegetation height.

The surveyors should be spaced sufficiently close together so they can view the entire area between themselves and the person to their left.

The surveyor who walks the line furthest away from the initial boundary feature should set ranging poles at the start and at intervals approximately ¼, ½ and ¾ along their line.

The recorder should walk the central line through the strip in order to be able to hear the observations of the other surveyors. If there is a high density of orchids, each surveyor should complete a recording form for their respective strips.

Each surveyor should note the orchid spikes to their left hand side only to ensure that duplicate records are not made.
The surveyor responsible for setting the first set of ranging poles should remove them on their return walk in strip 2.

A second surveyor should set the next boundary with the second set of 4 ranging poles. In order to maintain surveying on the left hand side the surveyor will need to cross their survey area at \( \frac{1}{4} \), \( \frac{1}{2} \), and \( \frac{3}{4} \) intervals to set the surveying rods in place. The same procedure will need to be repeated to remove the rods when the surveyor walks up their section of strip 3.

On completion of the survey the results should be entered onto a map (master copy in the Orchis palustris file in lab cabinet) showing all the areas surveyed and the areas where O. palustris was found. This will allow us to build a clearer picture of its distribution over the years.

Count data should be entered onto the computer under:

\[ TAIB/AUDIT_Species_data/5.2 PLANTS/5.2.1_Orchis_palustris_census \]

**COMMENTS**

NB. The above protocol may only be viable when the ground conditions are suitably firm. As with all field work the leader should undertake a risk assessment once onsite. Experience has shown that the conditions at each of the main block survey areas can vary considerably each year as a result of the water level in the park.

Where there are open areas of water there is no need to survey, primarily because this is unsuitable habitat for Orchis palustris and secondly because of the increased likelihood that wading birds such as Himantopus himantopus (black-winged stilt) are breeding there. Where there is deep mud (> 30cm) which will make progress difficult then surveying should be done with binoculars using the following procedure:

The surveying team should agree the section to be viewed. This should follow distinct linear features where possible e.g. a raised bank; line of Juncus acutus.

A ranging rod should be set at each accessible corner of the area.

The survey should be undertaken on as many sides of the area as possible in order to achieve the widest visual cover. If only one side is accessible, the surveyors should be spaced evenly along this linear route.

Using binoculars each surveyor should count all the Orchis palustris spikes they can see in the area.

Total numbers from each surveyor should be compared and repeat counts made if the figures are greatly different (> 5%).
Annex 4: Maps for survey areas
SURVEY OF Orchis palustris. **SAMPLES SITES B & E**
PORTERO PRUNIER 2004
SURVEY OF Orchis palustris. SAMPLES SITES C & D
PORTERO PRUNIER 2004
SURVEY OF Orchis palustris. SAMPLES SITES G, H, I, K
PORTERO PRUNIER 2004
SURVEY OF Orchis palustris. SAMPLES SITES J
PORTERO PRUNIER 2004
Annex 5: Results per area

Survey results for flowering *Orchis palustris* for each area from 1991 to 2004. In 2003 and 2004, absence of flowering spikes were recorded as “zero”. Previous to 2003, “zeros” have not been used.

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<tr>
<td>16.- Turó des Blat</td>
<td>Duna fósil</td>
<td>3</td>
<td>Exploitar zona de cultivo</td>
<td>Orquídeas, Euphorbia terránea, nidos alcaraván</td>
<td>Cultivos y ruderales</td>
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Till 2003. In 2004 and 2005, some compartments were redesigned.
Annex 6: Final recommendation, expert in-depth investigation

Need for experimentation

Knowledge have been certainly acquired, and results mostly descriptive. Explanations remain essentially hypothetical and/or are based on general plant ecology. To be precise in term of grazing management we need to manipulate the variables and perform experiments in-situ or accept guidance as experts’ point of view.

Translocation

In 1991, a translocation of 36 orchids individuas was carried out in the path of Cami en Pujol (D8). Result of the survey of this population are shown in the next table.

Table 3:

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<tbody>
<tr>
<td>D8</td>
<td>36</td>
<td>26</td>
<td>1</td>
<td>12</td>
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</table>

No recruitment was observed. After a few years of resilience, the population disapperead. This result is not surprising in that a colonist species should have established in the path if the conditions were good enough. The lack of suitability of the biotope hampered the translocation. In light of these results, no further translocations have been implemented as they cannot be relied upon to provide a good management tool for this species.

Seedlings in reed-bed

Are seedlings present in the reedbed?

What is the seed availability for germination?

Does Orchids have seed bank into the soil? What factor triggers germination?

What is the availability of pollinators?

In orchids, cross-pollination is achieved by means of insects. For that, orchids have developed special (and sometime “sexy”) flowering structures to appeal to their potential pollinators. This is long known and spectacular in the case of Ophrys species. Auto-pollination is another mechanism orchids use, especially important in the absence of insects.

The genus Orchis presents a medium size and large spur. This is indeed the case with O. robustas. This type of structure is particularly (co)-adapted for insects with medium size tongue, such as hymenopterans: Apoidea (e.g. bees, bumble-bees) and Scoliidae. Less frequently Orchis species can be pollinisated by flies (Diptera). Though no pollinator has been yet described for the O. palustris group it is likely to belong to these groups of insects (reviewed in SOCIETE FRANÇAISE D’ORCHIDOPHILIE 1998).
Some of the Apoidea and Scoliidae are abundant species. In S’Albufera, the abundant species include *Apis mellifera*, *Bombus* sp., *Doufourea* sp, *Campsoscolia ciliata*, *Scolia flavifrons* (Riddiford 2002). Note that, in the absence of pines, active and fossil dunes are richer and more diverse than any other ecosystem in the park for Hymenoptera. Diptera are also abundant in S’Albufera.

No data are available concerning pollinisation of *O. robusta* in the park. At first sight, a paucity of pollinators is unlikely to be a major constraining factor for *O. palustris* because the types of insects likely to be involved are normally common and widespread. If they are lacking orchids can potentially compensate by auto-fertilization.

Nevertheless, it would be interesting to test this hypothesis. Does the destruction of fossil dunes habitats and the simplification of its structures lead to insect population depletions and a consequent impoverishment of wet meadows and *O. robusta* populations?

These are questions which can only be answered by an intensive, in-depth study, best carried out at doctoral level. Because of the extreme rarity of this taxon and because of its flagship importance for s’Albufera, Mallorca and the Balearic Islands as the only European site, we strongly urge that such measures be taken with some urgency.
European Moth Night by Martin Honey & Inmaculada (Macu) Férriz

Despite somewhat adverse weather conditions on the night chosen 131 specimens of 61 different species of moths were recorded from two light traps.

Among the resident moths recorded were a number of species that are known migrants, either to the Balearic Islands themselves or to parts of continental Europe and the UK (e.g. Autographa gamma, Heliothis peltigera, Hyles livornica, Mythimna albipuncta, Mythimna vitellina, Orthonama obstipata, Plutella xylostella, Spodoptera exigua).

19 people attended the light trapping session in the dunes at Es Comú, enjoying the opportunity to see at close quarters some of the varied and spectacular moths of the Balearic Islands, as well as discovering a little about the biology and life-history of these often unobserved night-flying insects.

Once the remaining species have been identified the data from the session will be sent to the organizers of the European Moth Night to be collated with other data from all over Europe. This will provide a picture of the biodiversity and distribution of moths within Europe as well as providing useful additional data for the monitoring of the varied and diverse fauna of s’Albufera.
Bat Notes, May 2006 by Eleanor Jones

I did not attempt any systematic survey effort, either in locating roosts or surveying bats. All bat recordings were on Bat Box Duet, using Bat Sound software.

Roosts

There is a small soprano pipistrelle *Pipistrellus pygmaeus* roost (three recorded coming out, but I did not stay there for more than half an hour) in the main office/kitchen block (Casa del Parc). They are behind an external pillar midway along the northern wall, in the obvious cavity below the house sparrow nest.

There is a feeding perch for one of the largest bats (*Serotine Eptesicus serotinus* or European Free-tailed bat *Tadarida teniotis*) behind the tank at the north-west corner of the same building.

In the information centre there are two roosts beneath the metal flashing on the pillar tops on the southern side. During a single night’s emergence survey (from 2050 to 2125 h), I had two soprano pipistrelles from the left (westernmost) roost, seven soprano pipistrelles and one serotine from the right (easternmost) one. More may have emerged later; emergence time was quite late as well, presumably because of the exposed nature of the roost entrance.

The artificial roost in the pine tree along the Cami des Puntes has no evidence of occupation, despite lots of pipistrelle activity near by (observations with binoculars).

The artificial roosts in the derelict building (Casa des Puntes) further down have no signs of occupancy either, but not all were looked at (binoculars and torch). Lots of space for bat roosts in the walls as well.

The derelict buildings at Prat Tancat may provide cavity roosts beneath the remaining cork tiles, but I did not see any emerge (survey from 2045 to 2110 h, pipistrelle emergence elsewhere was at 2055 h). There was a lot of early bat activity in the egret colony to the NW, implying that there is a large roost of soprano pipistrelles nearby. From the Pont dels Anglesos I observed about 30 small bats in two minutes cross into the parc from the NW side, supporting the idea that there are big roosts near this corner. There is potential to use the river crossing activity to monitor the size of these roosts.

There may be a roost in the final arch of the bridge into Prat Tancat, in the obvious cavity that can be seen from the other side of the river.
La investigación del TAIB (The Albufera International Biodiversity group) en el Parque Natural de s’Albufera de Mallorca por Inmaculada Férriz y Nick Riddiford

El TAIB (The Albufera International Biodiversity group) es un grupo científico multidisciplinario de expertos independientes (Reino Unido, España y otros países europeos) que realiza un seguimiento de la biodiversidad del Parque Natural de s’Albufera, Mallorca, ininterrumpidamente desde 1989. Su principal objetivo se centra en generar información que sea útil para asesorar en la planificación y gestión de la zona. Otra de sus prioridades es la formación de estudiantes y gestores de otras zonas húmedas.

La investigación del TAIB se engloba dentro de las siguientes áreas de estudio:

- biodiversidad, conociendo y determinando las especies prioritarias.
- impacto de las actividades humanas y de gestión, evaluando su influencia sobre s’Albufera y determinando el grado de impacto ambiental.
- gestión del Parque, optimizando las estrategias de gestión actual con los resultados obtenidos a través de los estudios de impacto.
- ecología y seguimiento, describiendo los requerimientos ecológicos de la flora, fauna y hábitats de la zona, así como documentando los cambios a largo plazo a través de poblaciones bio-indicadoras (insectos, etc.)

En la actualidad podemos destacar las siguientes líneas de investigación:

- Seguimiento de los Heteróceros (mariposas nocturnas) del parque.
- Censo anual de la población de orquídea de prado, Orchis robusta.
- Estudio de la biodiversidad de dípteros (moscas, mosquitos y afines) de la zona.
- Uso de los invertebrados acuáticos como indicadores del nivel de calidad de las aguas de s’Albufera.
- Seguimiento del proceso erosivo que sufre la zona protegida de las dunas costeras en Es Comú.

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Nick Riddiford: nick.riddiford@lineone.net
El estudio del sistema playa-duna en Es Comú de Muro (Parque Natural de s’Albufera) como ejemplo de la Gestión Integrada del Medio Costero
por Laura Royo¹, Anna Traveset¹ y Jaume Servera²

¹ Departamento de Ecología terrestre - Recursos Naturales del IMEDEA (Institut Mediterrani d’Estudis Avançats)
² Departamento de Ciencias de la Tierra – Geografía de la Universitat de les Illes Balears

El IMEDEA (Instituto Mediterráneo de Estudios Avanzados) está desarrollando el proyecto UGIZC (Unidad de Gestión Integrada de la Zona Costera) destinado a fomentar el desarrollo sostenible de la zona costera. Uno de los proyectos específicos es VegeDuna, que estudia la evolución geomorfológica i de la vegetación dunar en Es Comú de Muro, gestionado por el Parque Natural de s’Albufera de Mallorca, para entender la interacción entre al erosión y el establecimiento de la primera línea de vegetación.

Los sistemas playa-duna se caracterizan por ser confluencia de diversos factores como la climatología, geología de la zona y relaciones con organismos vivos (*Posidonia oceanica*, vegetación dunar, el ser humano), por esta razón el estudio de estos sistemas debe plantearse desde un punto de vista interdisciplinar.

En la fase de inicio de VegeDuna se reconoce la necesidad de estudiar la zona de Es Comú de Muro a causa de la importante regresión de la línea de costa y las primeras dunas (foredunes). La pérdida de este frágil ecosistema incrementa la probabilidad de riesgos geológicos para las construcciones adyacentes, así como la salinización de tierras de cultivos y pérdida del espacio más utilizado por el turismo en Baleares. Los agentes identificados implicados en la pérdida de la costa engloban diversos sectores, por lo que se hace indispensable, entonces, la cooperación entre instituciones, científicos y sociedad para dar solución al problema. Este proyecto pretende, a partir del conocimiento, poder identificar y sustentar alternativas para restaurar la zona costera y fomentar el desarrollo sostenible.

Contactos:
Laura Royo: laura.royo@uib.es, lauraroyo@yahoo.es
Anna Travesset: a Travess.et@uib.es
Jaime Servera: vdcjtsn0@uib.es
TAIB Project S’Albufera: 
A Mediterranean model for the study of biodiversity and environmental change

The Albufera International Biodiversity Project Annual Report 2006

PART III

The Training Programme

Female Crocothemis erythraea

photo: TAIB archive
Report on the capacity building monitoring and conservation courses by Nick Riddiford

Main Aim

The main aim was to given training and capacity building opportunities to volunteers from the environmental sector in conservation monitoring and field research at the Parc Natural de s’Albufera de Mallorca.

Location

The location for the courses was the Parc Natural de s’Albufera de Mallorca and it surrounding area.

Course objectives

Coordination of courses comprising the participation of a group of volunteers (near-graduates and post-graduates in biological, earth and environmental sciences) with a maximum of 5 persons per course.

Priority was given to volunteers from the Balearic Islands and to managers and other officials working in wetland conservation and protected areas in the Mediterranean. Each volunteer participated for two weeks in conjunction with TAIB scientists who acted as their trainers and supervisors for the duration of the course.

The training programme

The courses were held at s’Albufera and comprised two in spring and one in the autumn. Advertising of places on the courses and the selection of candidates were conducted by the Conselleria de Medi Ambient and Parc Director, Maties Rebassa.

The courses were entirely practical with volunteers working alongside the scientific team in all activities, and in a series of workshops. This approach is very effective, particularly for recent graduates and students who learn applied techniques in monitoring, research, management and biodiversity conservation directly in the field. They also have the chance to see how the field data are used, and assist in ensuring that data are safely handled.
The courses attracted volunteers from Mallorca and Ibiza and, as usual, from Catalunya and other regions of Spain. One volunteer also attended from Morocco. Balearic Islands and Spanish scientists are not part of a truly international team, drawn in 2006 from five different countries. The Moroccan volunteer was the first from that country, bringing the number of countries represented during 18 years of courses and fieldwork to 36.

The international nature of the participants is demonstrated in the following table:

<table>
<thead>
<tr>
<th>Place of origin</th>
<th>Spring 2006</th>
<th>Autumn 2006</th>
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<tbody>
<tr>
<td><strong>Volunteers</strong></td>
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<tr>
<td>Balearic Islands</td>
<td>3</td>
<td>3</td>
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<tr>
<td>Peninsular Spain</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Morocco</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td><strong>Scientists</strong></td>
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<td></td>
</tr>
<tr>
<td>Balearic Islands</td>
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<td>1</td>
</tr>
<tr>
<td>Peninsular Spain</td>
<td>2</td>
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<td>United Kingdom</td>
<td>3</td>
<td>7</td>
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<tr>
<td>Italy</td>
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<td>Malta</td>
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<td>United States</td>
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<td><strong>Científics visitants</strong></td>
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<tr>
<td>Balearic Islands</td>
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<td>3</td>
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<tr>
<td>Canary Islands</td>
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<tr>
<td>Peninsular Spain</td>
<td>4</td>
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The volunteers undertook a wide range of activities during their two weeks. The main activities were applying the various methodologies required for TAIB’s 2006 investigations into the ecology of reedbeds of different age since the last fire, censusing of s’Albufera’s internationally important *Orchis robusta* population and the biodiversity of Diptera in the parc.

The volunteers were also shown techniques for the study of biodiversity, ecosystem functioning and ecological management for a number of other groups of species or habitats. These are described in Annex 1.

In addition to the fieldwork, the volunteers were introduced to laboratory work and to the establishment and maintenance of relational databases. They also took part in a number of tutorials and workshop on aspects of biodiversity, ecological systems and wildlife management.
The volunteers worked alongside the scientific team in all these ventures, and all recognised the huge opportunity this gave them to receive tuition from some very experienced and well known experts. The groups were also able to benefit from input from the Park staff, and from visiting scientists.

Matias Rebassa, Conservation Director of the Park, gave a very useful tutorial on Managing the Park, which not only gave background to the field course but explained to the volunteers how the information they gathered with TAIB helped the management process.

The Park’s education team, Mari-Angels Ferragut and Gero Corró, gave up some of their free time to hold a workshop about Environmental Education for children and adults with special emphasis on S’ Albufera and the comarca (the surrounding district). The workshop was also planned as an exchange of information, which participants from other Mediterranean countries always appreciate.

TAIB has established some very good collaborative links with both Balearic and International Organisations. Our foreign volunteer, Hanae Lemseffer, was sent by WWF Mediterranean as part of its Across the Waters programme, the second year we have been involved in this programme. Mme Lemseffer is head of the Environmental Cell of the Moroccan Ministry of Agriculture. MedWetCoast also planned to send volunteers from Morocco but, unfortunately, family and work circumstances prevented the nominated people from attending.

TAIB also benefited from visiting scientists, who were undertaking separate studies of their own. Thus, TAIB volunteers were able to experience and learn from the methodologies applied by IMDEA staff working on recuperation measures for the dunes and beach at Es Comú, and in the study of the pollinisation by insects of exotic plants.

In addition, we had the good fortune to be joined in May by Jordi Serra and his Catalunya bat group for an evening of demonstration of field methods for the identification and study of bats – part of an investigation Jordi and his team were conducted generally in Mallorca.

Specific details of the main work undertaken by the volunteers can be found in the separate report on Investigations in 2006 by TAIB (in Part II): and the additional activities in which they were involved, organised in a series of headings to indicate their relevance to the various activities and interests of the Park, in Annex 1 below.
ANNEX 1: Additional training activities for volunteers, organised by theme

Human management and impacts 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:* Raquel Vaquer.
*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.
*Note:* a cost-effective technique for guiding management of wetland sites.

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:* Laura Royo.
*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.

*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.

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

*Title:* Butterfly and dragonfly population studies - transects.
*Objective:* to monitor butterfly and dragonfly fluctuations in a range of habitats as a measure of local environmental change (e.g. in habitat quality or type) or more generally (e.g. in response to climate change).
*Led by:* Nick Riddiford.
*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.

*Note:* annual study, begun in 1991.

**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:* Jordi Serra (Catalunya Bat Group).

**Nature of work:** demonstrating bat detector survey techniques; training park staff and volunteers in using of bat detectors. Mist-netting for bats.

*Note:* bats are an important but poorly understood part of the ecology of s' Albufera.

**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:* Martin, Honey, Nick 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.

*Notes:* an annual study, begun in 1991.

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**Park Management Studies**

**Title:** Bittern population studies.

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

*Organised by:* Pere Vicens (Park naturalist).

**Nature of work:** early morning survey of calling Bitterns, using volunteers placed at strategic listening points throughout the Park.
Participants and field dates

**Team 1: 15th to 29th April**

**Scientists**
- Nick Riddiford (Principal Investigator, TAIB)
- Macu Férriz (TAIB ecologist; orchids, moths, coastal processes; logistics)
- Laura Royo (TAIB coastal processes/IMEDEA)
- Martin Honey (Natural History Museum, London; Lepidoptera studies)
- David Gibbs (UK Diptera specialist)
- Raquel Vaquer (TAIB aquatic biologist)
- Joana Guiu (TAIB ecologist)
- Alessandro Aleghetti (TAIB geomorphologist, Italy)

**Visiting**
- Nick Owens (TAIB ornithologist)

**Volunteers**
- Josep Borràs Vives (Mallorca), Marina Arias (Spain)

**IMEDEA collaboration**
- Benigno Padrón Mendez (Canary Islands)

**Team 2/WWF Mediterranean Across The Waters Training Course: 15th to 28th May**

**Scientists**
- Nick Riddiford (Principal Investigator, TAIB)
- Macu Férriz (TAIB coastal processes; logistics)
- Martin Ebejer (TAIB Mediterranean Diptera specialist)
- Wendy Hayes (TAIB aquatic ecologist)

**Visiting**
- Jordi Serra-Cobo, Marc López, Cisco Guasch González, Xavier Bayer (Catalunya Bat Group)

**Across The Waters (WWF sponsored) Volunteer**
- Hanae Lemsiffer (Head of the Cellule Environnement, Morocco)

**IMEDEA collaboration**
- Laura Royo (TAIB coastal processes)
- Benigno Padrón Mendez (pollination of flowers by insects; Canary Islands)

**Team 3: 15th to 31st October**

**Scientists**
- Nick Riddiford (Principal Investigator, TAIB)
- Macu Férriz (TAIB coastal processes; logistics)
- David Agassiz (TAIB entomologist; micro Lepidoptera)
- Martin Honey (Natural History Museum, London; Lepidoptera studies)
- Pamela Hill (TAIB ecologist; reedbeds)
- Tony Serjeant (TAIB ecologist; reedbeds)
- Nick Owens (TAIB ornithologist)
- Josep Borràs Vives (TAIB photographic archive)

**Visiting**
- Raquel Vaquer (TAIB aquatic biologist/IMEDEA)
- Juan Garau (TAIB aquatic biologist/Balearic Government Environmental Scientist)
- Paula Goberna (Director, PN ses Salines de Eivissa i Formentera)

**Logistics support**
- Elizabeth Riddiford, Dot Agassiz (UK)

**Volunteers**
- Mika Nogueira Ferrando, Joan Lladó Señán, Susana Ruiz Pico (Balearics), Ángel Luis Femández Mansilla (Spain)
University of York MRes in Ecology & Environmental Management course: 30th April to 13th May

Leaders
Nick Riddiford (Principal Investigator, TAIB); Calvin Dytham, Olivier Missa (Univ. York)

Demonstrators
Nick Askew, Eleanor Jones, Daniel Chapman

Students
Amy Buckenham, Sarah Dale, Laura Downton, Katie Frith, Deborah Marchant, Elizabeth Masden, Rachael Maskill, Gina Prior, Victoria Pudner, Bethany Stoker, Jenny Storey, Anna Swift, Ann Weddle, Jessica Wiegand (England), Gwilym Rowlands (Wales), Jennifer McCullough, Humi Pai (USA)
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PART IV

TAIB Research and Training Programme for 2007

TAIB October group  
photo: Elizabeth Riddiford
**Fields of research and capacity building programme in 2007**

The fieldwork timetable for 2007 is as follows:

**University of York Biodiversity Training Course:** 28th April to 12th May
- **TAIB Team 1:** 14th to 27th May
- **TAIB Team 2:** 28th May to 10th June
- **TAIB Team 3:** to be announced

The teams comprise TAIB scientists working alongside protected area managers, personnel from environmental NGOs and others from the voluntary sector with an interest in ecology, biodiversity, conservation, physical geography or similar subjects. The work involves monitoring and investigations within the Parc Natural de s’Albufera while at the same time acting as a practical training experience for volunteers. The official fieldwork language is English but TAIB scientists also include a good number of Spanish and French speakers so these languages can also be accommodated.

**The training element**

TAIB training courses are designed to be entirely practical. The aims of the courses are to: provide participants with practical experience of monitoring techniques, species identification and data collection; undertake capacity building in wetland management and protected area management generally; and permit participants to study and experience all aspects of nature reserve management alongside TAIB scientists and the Parc management team. TAIB’s principal activity is to gather information which can advise and guide biodiversity conservation in the Park. This is achieved by means of:

- **Biodiversity studies:** evaluating biodiversity to determine priority species within the Park. TAIB specialises in a broad taxonomic approach, effectively achieved through the engagement and support of leading taxonomists.

- **Human and management impact studies:** evaluating the influence of human-induced activities (largely originating outside the park boundaries) on s’Albufera and determining the degree of environmental impact.

- **Park management studies:** optimising current park management strategies from the findings of impact studies.

- **Ecological and monitoring studies:** These encompass two elements:
  1) Describing the ecological requirements of the flora, fauna and habitats of s’Albufera.
  2) Documenting long term changes in bio-indicator populations, such as insects.

**The Fieldwork element**

Fieldwork in 2007 will concentrate on three themes: the ecology of the reed bunting; management of a protected fossil dune system; and interpreting birds for visitors. The courses will also demonstrate a series of long-term monitoring techniques; and explore the link between monitoring and management through a series of workshops.
Reed bunting ecology:
A series of field techniques will be employed to investigate the distribution and abundance of the reed bunting *Emberiza schoeniclus* at s’Albufera de Mallorca. Factors to be investigated include habitat preferences, preferred vegetation structure and food resources available for the population. The reed buntings breeding in the parc belong to the thick-billed race *E.s.witherbyi*. This sub-species has a restricted world range and specialized habitat requirements, being found in large reedbeds in the Mediterranean. A population decrease at s’Albufera in recent years has coincided with similar declines in other sites. The Parc directorate wishes to reverse the trend of decline and recognizes that knowledge of how the species uses its preferred habitat and other related factors such as food availability is essential in order to devise and implement management to the benefit of the bunting.

Activities will include

- Mapping of occupied territories by
  - detecting singing birds;
  - observations of breeding activities, such as carrying food;
- Description of preferred habitats through quantitative evaluation of plant diversity and reedbed structure;
- Sampling for invertebrate availability based on known and observed feeding preferences of s’Albufera reed buntings.

Fossil dune management:
Following concern about the impact of cattle and horses on the vegetation of the fossil dune at Turó de ses Eres, the Parc directorate took the decision in 2006 to exclude livestock a portion of the dune by the erection of a fenced plot. We have been asked to monitor the outcome of this management measure, with particular reference to vegetation structure and diversity of the experimental plot.

Activities will include

- Baseline assessment of plant diversity inside and outside the experimental fenced plot set aside for conservation purposes on Turó de ses Eres;
- Establishing and implementing a monitoring regime to measure plant structure and density within the experimental plot;

Some assessment of vertebrate and invertebrate use of the experimental plot may also be trialled.
Interpreting birds for visitors:

The main aim is to produce material destined for general visitors with no or little knowledge of birds. S’Albufera is famous throughout Europe for its birds, but birdwatchers make up only a small proportion of the quarter of a million visitors who enter the Parc each year. The emphasis therefore is on the commoner birds and those most likely to be seen during a visit. Whereas identification is the main driving force for many birdwatchers, the interest of the general visitor is as likely to be captured by information about the life of birds and the significance of S’Albufera for their survival and wellbeing.

Activities will include

- Supporting author/artist Nick Owens in his efforts to produce illustrations and checking text for a book on the common birds of s’ Albufera, destined for general visitors;
- A workshop on interpretation of the parc and its values, in conjunction with the Parc education and public awareness team.

Long-term monitoring: Activities will include:

- Bird transects, in dunes and woodland as well as wetland habitats;
- Bird ringing as a monitoring tool;
- Dune management and coastal erosion studies – in conjunction with Laura Royo of the Institute for Mediterranean Studies (IMEDEA);
- Butterfly and dragonfly transects;
- Studies of the Lepidoptera communities;
- Studies of the Diptera and their role in the ecology of key habitats.

Workshops: Workshops planned for the course include:

- Public use and management issues at s’ Albufera - introduced by Maties Rebassa, the Director of the Park;
- Environmental education in the Park and Mallorca - led by the Albufera Education Team;
- Data analysis: how the data collected are used, in particular through the linked MS Access databases established by TAIB to hold the wide range of information collected.