Freshwater Life

Scoping study

June 2000

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Executive summary

Freshwater Life is an international project that will bring together, and make readily available, wide-ranging information about the ecology of freshwater plants and animals in Europe and North America.

The project aims to support the needs of scientists, industry, regulators, environmental organisations, teachers, students and the general public by providing a generic resource with high-quality, fully referenced, easily accessible information.

What the Freshwater Life will include

The Freshwater Life database will be developed for use on the world-wide web and will have four main sections:

1. *The habitat and life history of freshwater fauna and flora.* The site's extensive ecological databases will document the ecological attributes of all major groups of freshwater species found in Europe and North America including zooplankton, macroinvertebrates, macrophytes, phytoplankton, amphibians, wetland mammals and birds. For each species the database will describe: (i) conservation status and distribution (ii) habitat preferences (e.g. waterbody category, water chemistry, microhabitat), and (iii) life history attributes (e.g. fecundity, life span, dispersal ability). Information will be held in a comprehensive relational database that will allow users to collate, sort and view life history information in a wide range of formats. Data will also be available as written summaries for each species.

2. *Taxonomic keys*. This section will provide a central access point for information about the identification of freshwater species in Europe and North America. The database will (i) list the range of identification keys and guides available for each major taxonomic group in Europe and the US, and (ii) pioneer the development of on-line keys which extend existing keys through, amongst other things, the innovative use of graphics, video and sound.

3. *Information about biological sampling protocols*. The web site will be used to provide information about standard survey methodologies for gathering freshwater data. This will include a reference list of published survey methods for all major taxonomic groups and habitats. In the longer term, a descriptive 'manual' of standard methods will be created on-line.

4. *A network of contacts*. The site will be developed as a point of contact for freshwater biologists throughout Europe and North America including (i) institutions, groups, individuals working in freshwater and (ii) experts willing to identify/confirm specimens in association with national recording schemes (iii) companies who can supply freshwater survey and monitoring equipment.

Timeframe

The Freshwater Life project will be developed as four phases over a 7 year period.

Phase 1: Establish a market presence and develop funding sources.

Phase 2: Set-out the site's framework in Europe and the US and establish (i) preliminary information in all areas of the site and (ii) detailed, completed data-sets for demonstration sections.

Phase 3: Full development of all sectors of the site.

Phase 4: Long-term maintenance.

Next steps

The first step will be to set down an audience for the project and to develop partnerships and funding sources. Specifically:

(i) *Establish the Freshwater Life Web site* (to be hosted initially by the Freshwater Biological Association), including development of Freshwater Life's home page describing the project elements and targets. The home page will be multilingual, with information available in English, French, German and Spanish.

(ii) *Develop funding and partnerships* within the UK, mainland Europe and the US, capitalising on existing contacts and the growing interest in the project.

Organisations involved in the project

Freshwater Biological Association

The Freshwater Biological Association is an independent organisation, a registered Charity and a company limited by guarantee. It was founded in 1929 and has a long history of achievement in freshwater science. The FBA promotes freshwater science through innovative research, an active membership organisation and by providing sound, independent opinion. It publishes and sells a variety of identification keys, technical manuals and other specialist volumes. It also houses one of the finest freshwater libraries in the world.

Zeneca Agrochemicals

Zeneca Agrochemicals is a world-leading supplier of crop solutions based on chemical and biotechnology products designed to improve crop yield and food quality. The business has a global marketing reach and a broad portfolio of crop protection products for the control of the principal weeds, pests and diseases affecting major crops.

Ponds Conservation Trust

The Ponds Conservation Trust is a charitable organisation. Its objectives are to raise awareness and provide a national focus for pond conservation. The Trust's membership comprises of 23 conservation organisations. These are:

British Dragonfly Society
British Herpetological Society
British Trust for Conservation Volunteers
British Waterfowl Association
De Montfort University
English Nature
Environment Agency
Farming and Wildlife Advisory Group
Freshwater Biological Association
Froglife
Ian Benton Ponds
Institute of Terrestrial Ecology
National Federation of Women's Institutes
Oxfordshire Nature Conservation Forum
PCT: Policy & Research
Pond Life Project Liverpool John Moores University
Surrey Amphibian and Reptile Group.
The Wildlife Trusts
The Association of Local Government Archaeologists
University of Bournemouth
University of Sussex
Wildfowl & Wetlands Trust
WWF-UK

PCT : Policy & Research Division

The Policy & Research Division of the Ponds Conservation Trust (formerly Pond Action) is an independent national centre for applied research on pond ecology and the conservation of freshwater ecosystems. The group, which was established in 1988, is based in Oxford Brookes University and provides technical advice on the ecology of ponds, lakes and rivers to a wide range of governmental and non-governmental organisations.

Representatives on the Freshwater Life project

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Contents

Section 1

Introduction

This report describes the development of an international freshwater ecology database, called "Freshwater Life", which will be made accessible on the world-wide web.

The report highlights the objectives, activities and audiences for the web site, and describes the time frame and stages that will be required to develop the project.

1.1 Background and need

Currently, most data about the life history and habitats of freshwater plant and animal species is scattered across a wide range of literature, much of which is obscure and time consuming to obtain.

The Freshwater Life project aims to provide a centralised database with high-quality, fully referenced, easily accessible information about freshwater species, which will:

- Make data more widely available for all levels of users, from Government policy advisers to the general public,
- Facilitate scientific research by accelerating the development of new ideas and highlighting gaps in knowledge,
- Increase the rate at which new data becomes widely available to all sectors, and prevent duplication of effort,
- Promote taxonomic skills and species identification,
- Enhance public understanding of science and increase interest in freshwater life.

1.2 Who's involved?

The Freshwater Life project is being developed by a range of organisations involved in freshwater research and education. The core project group currently includes the Freshwater Biological Association, Zeneca Agrochemicals, the Ponds Conservation Trust and PCT: Policy & Research (see Appendix 1).

The project builds upon the strategic research project "Putting ecology back into ecotoxicology", funded by Zeneca between 1995 and 1998, which developed the Pond-FX database in association with Oregon State University, University of Durham and PCT: Policy & Research.

Pond-FX is an Internet database which has at its core *family-level* aquatic invertebrate life-history data. The database is linked to population models which can be used to explore the effects of xenobiotic or other impacts on invertebrate populations. The database has proved a valuable resource, and its development provides an experience-base upon which the current project will build.

Section 2

Vision: a brief overview of the project

2.1 Scope and objectives

The aim of the Freshwater Life project is to create a generic resource that will summarise taxonomic and life history information for freshwater plants and animals in Europe and North America.

In terms of its ecological scope, the project will cover all freshwaters including lentic and lotic habitats and wetlands. The web site will have at its base information about freshwater species. This will include data covering all the major taxonomic groups found in freshwaters including: aquatic invertebrates, aquatic plants, fish, water birds, amphibians and wetland mammals.

The web site will have four main sections:

- A database describing freshwater species habitat and life history information,
- Information about taxonomic keys making species and family level identification easier for the general public, students, naturalists and professionals,
- Information about biological survey and sampling protocols,
- A network of contacts.

2.2 The market

The limited availability of information about most freshwater plant and animal species means that the web site is likely to have a broad market appeal across a wide range of organisations, groups and individuals who are involved in freshwater science and conservation including:

- Freshwater professionals: scientists, industry, regulatory bodies, freshwater consultants,
- Regional and local public bodies (local authorities, Agenda 21 groups etc.),
- Schools and students,
- Amateur ecologists and natural historians,
- Community groups and members of the public (local conservation groups, anglers etc.).

2.3 Approach

The project will be developed in four phases over a c.7 year period. These phases are:

Phase 1: Establish a market presence and develop funding sources.

Phase 2: Set-out the site's framework and establish (i) skeleton data/preliminary information in all areas of the site and (ii) detailed, completed data-sets for demonstration sections.

Phase 3: Full development of all sectors of the site.

Phase 4. Long-term maintenance.

Section 3

Detailed activities and outputs

3.1 What will the site include?

Table 1 gives a list of Freshwater Life's major elements. These elements are described in more detail below, and a brief summary is given identifying how much information is already available on the world-wide web in each area.

3.1.1 Species checklist and conservation status

Species checklist

A central checklist of freshwater species will form the basis of the new web-site. The broad range of taxa which will be included are listed in Table 2.

The species checklist is likely to be extensive. In the UK alone, for example, there are at least 2000 aquatic macroinvertebrates and aquatic macrophytes and around 3000 algae and micro-invertebrates.

In some EU countries, compiling web-based freshwater checklists should be relatively straightforward for many taxonomic groups. In the UK, for example, checklists have been published for all major taxa, and the majority (e.g. freshwater invertebrates, micro-algae) are available on the Internet (see Section 4.2). For other parts of Europe, checklist availability is more variable. There will also be major taxonomic issues in merging lists from different EU member states. Fortunately, however, a number of pan-European and national taxonomic initiatives are currently in progress, so that that both availability and harmonisation difficulties may improve considerably in the near future (see Section 4.2).

Conservation status

For each freshwater species on the database, information will be provided about its nature conservation status at national and international levels.

International rarity status

At an international level the site will include IUCN's globally threatened species as well as species listed under international conventions e.g. Berne Convention. IUCN's list is already available on the web at a number of sites e.g. WCMC's database at Cambridge (see Section 4.2).

Table 1. Main elements of the Freshwater Life web site

- Conservation/rarity status for species
- A freshwater life history database
- Taxonomic keys
- Species distribution information
- Information on survey methods

- A network of contacts/experts

Table 2. Taxonomic groups to be included

- Zooplankton
- Algae
- Aquatic macroinvertebrates
- Parasitic invertebrates
- Macrophytes
- Amphibians
- Fish
- Aquatic mammals
- Birds
- Protozoa
- Fungi
- Bacteria

National and regional rarity status

In Europe, national Red Data Books have been created within most EU states covering a wide range of taxonomic groups, each typically listing several hundred species. There are, however, no central or co-ordinated lists of European Red Data Books and at present few are accessible electronically. In contrast to Europe, US endangered species are already listed in web-accessible databases.

The current project will aim to synthesise Red Data Book information, making maximum use of existing electronic data where this is available. An extra layer of status information will be added through inclusion of other protection categories which are not necessarily synonymous with the Red Books e.g. listing in national legislation (e.g. UK Wildlife and Countryside Act species, US Endangered Species Act), or listing as National Biodiversity Action Plan species (UK only). Ultimately, lower levels of rarity status will also be included where categories exist i.e. listing species as common, local or nationally scarce.

3.1.2 Life history database

The life history database will be a key resource for the Freshwater Life web site. It will be fully referenced so that all information is traceable back to published literature or named sources. Components of this database are described below.

Species and family summaries

For each species included in the database there will be a short explanatory text describing the species together with summary information about its habitat requirements and distribution. The text will be made available in four European languages English, French, Spanish and German

These species overviews are likely to be one of the most popular and well used sections of the database since they will be relevant to a wide range of interest groups, including members of the public interested in what's in their pond, consultants interpreting species lists, students etc.

Life history data

For each taxon, a relational database will be used to provide detailed information about:

1. *Habitat preferences* in terms of (i) waterbody category (temporary, lentic, springs, etc.), (ii) water chemistry (acid, eutrophic etc.), and (iii) microhabitat (amongst vegetation, mud etc.).
2. *Life history attributes*, such as number of eggs, life span, food source etc. (see Table 3).

Ecotoxicological susceptibility may also be added in the long term if funding is available.

The database's query structure will allow users to view and summarise life history information in a wide range of formats. This will include the ability to (i) sort species into category lists (e.g. all temporary pond macroinvertebrate species in Germany), and (ii) derive average values and ranges for life history parameters (e.g. averaged number of eggs laid by the water beetle *Dytiscus marginalis*). These data will be generated automatically by the database, allowing continuous up-dating as new information becomes available.

Table 3. Examples of life-history attributes to be included in the database

- Life-span of each stage (e.g. larva, adult)
- Oviposition sites and timing
- Population growth rate ('r')
- Number of generations (voltinism)
- Feeding type (e.g. predator, parasite)
- Oxygen source (e.g. air, water)
- Food
- Reproduction style (e.g. sexual, asexual)
- Number of eggs, seeds or spores
- Number of offspring
- Individual growth rates
- Dispersal ability
- Carrying capacity of different habitats
- Trophic level

Illustrations

For each taxon, high-quality pictures or photographs will be available. Initially, special emphasis will be placed on gathering images for (i) popular species (ii) species with a good research base (iii) species of nature conservation importance (iv) images which are easily available.

Literature database

The life history database will be supported by a full reference database. This will enable the source of all information to be transparent and traceable (see Section 3.4).

3.1.3 Taxonomic keys

The database will provide a central access point for information about the taxonomic keys of freshwater species in Europe and North America.

There are many hundreds (perhaps thousands) of European and American freshwater plant and animal keys: Foeckler *et al*. (1996)[1] list about 500 references to literature concerned with the identification of aquatic macroinvertebrates in Central Europe alone. Most keys are designed for use at country/state level rather than being Pan-European or US based. Currently few freshwater keys are available on the web, although this is beginning to change in a few US states (see Section 4.2).

In practice, the project database will initially *list* the range of keys available for each major taxonomic group in Europe and the US.

In the long term, the aim will be to develop a range of on-line keys. These will update and extend existing keys through the use of: (a) new information (b) additional drawings, photographs and pictoral aids (c) links to explanations of taxonomic features (d) links to the life history database to provide supplementary information for species identified, and (e) video clips e.g. of live species. This will provide a wider range of background and supporting information than is present in current keys and will enable users to cut, paste and print their own hard copy keys according to their level of experience.

At least two types of on-line keys are likely to be produced: (a) professional keys to identification at species level, and (b) keys to aid identification of difficult groups by the interested public and others. The latter will focus on identification with the naked eye or non specialist equipment (hand-lens, binoculars). For macroinvertebrates, the key will need to be family based.

[1]Foeckler, F., Lindner, S. and Burmeister, E.G. (1996). Compilation of determination-literature of aquatic macroinvertebrates of Central Europe. *Int. Revue. Ges. Hydrobiol*, 81, 25-61.

3.1.4 Spatial data and species distribution information.

The site will seek to include distribution information for all species on the database.

It is not envisaged that the Freshwater Life project will directly undertake the compilation of " dot-map" distribution data, of the sort currently maintained in the UK by the Biological Records Centre (BRC) and local biological records centres. Instead, the main aim will be to (i) link to other sites holding distribution data, (ii) encourage and support other organisations to make distribution data available, and (iii) where no data are available, to provide summary information as map images or text.

In this context it is worth noting that Internet based distribution mapping is now beginning to be developed in the UK for many species as part of the National Biodiversity Network (NBN), and can be anticipated elsewhere in Europe. Similar work is being carried out in the US as part of the National Biodiversity Infrastructure Initiative (NBII). It is possible that collaborative projects could be developed with the NBN and others in order to speed-up the rate at which freshwater information becomes available.

3.1.5 Information on survey methods

The database will provide information about standard survey methodologies. Initially this will simply be a *reference list* of published survey methods for the main taxonomic groups. In the longer term, a descriptive 'manual' of standard methods will be developed on-line.

Examples of the types of methods that could be included are given below for macroinvertebrates.

- Rapid bioassessment techniques (North America).
- Predictive methods: RIVPACS / PSYM.
- Adult dragonfly survey techniques.
- Basic methods: including simple standard methods and information about sampling for specific groups (e.g. water beetles, water bugs, cladocerans, protozoans etc.). This may include video clips of surveyors working or on-line tutorials.
- Preservation and sample preparation techniques.
- Analytical methods (e.g. reference to works dealing with specific statistical methods).

3.1.6 Network of contacts/experts

The site will also be used as a point of contact for freshwater biologists throughout Europe and North America including:

- A database of institutions, groups, individuals and their areas of work (including consultancy).
- A database of experts willing to identify/confirm specimens (in discussion with national recording schemes).

3.2 How the site will be structured?

The Freshwater Life site will maintain its own name and identity. The website names: *freshwaterlife.org.uk* and *freshwaterlife.org* have been registered for the project. There will be a single entry point to the site's home page, with quick access links to different sectors of the site.

Logos of contributing/funding bodies will be located at the main entry point and/or on the entry page for specific sectors as appropriate. Any advertising will be restricted to specific sectors so as not to clutter the site or compromise its authority.

Standard software packages (such as Coldfusion), will be used in site construction to ensure that the site can be easily modified as the site develops in future years.

3.2.1 Design principles

In principle, the Freshwater Life site will be:

- Compatible with minimum specification browsers (e.g. IE3, Netscape 3+) since not all users will be working with the most recent browsers.
- Quick to access and not burdened with slow graphics and JavaScript menus as many anticipated users will be using quite slow links.
- Written in clear simple non-technical English.
- Easy to use so that the main sections can be reached in two or three clicks.
- Visually appealing, with a layout and colour scheme that indicate authority and friendly accessibility.
- Regularly maintained: The site will have regular (weekly) minor updates and maintenance, with a regular schedule of larger developments (monthly, quarterly).

3.3 Intellectual property rights

Intellectual property rights issues are likely to arise in three main areas:

1. *Protection of site data.* In principle, the project will allow free abstraction and re-use of data that have been collated by the Freshwater Life project.

2. *Protection of original data or images*. Wherever possible, information that is provided to the site should be copyright free. However, in some cases, providers may wish to retain the copyright (e.g. original field survey data, taxonomic keys, images). In such cases it will need to be made clear on the web site that this information is only made accessible through the web with specific permission from the copyright holder. Where such information is re-used its source should be acknowledged. If the information is required for commercial purposes, the owner must be contacted for permission.

3. Liability. It will be necessary to include one or more site disclaimers so that those involved in the project have no liability for use of information published on the site. Organisations involved in the project will explore these issues independently.

3.4 Mechanisms for gathering life-history and other information

There will be a three-stage protocol for gathering data for the core project databases.

Stage 1: Review published literature.

Stage 2: Fill gaps by searching grey literature and eliciting expert information.

Stage 3: In the long term, generate new data to cover remaining gaps by initiating projects.

Sources of information are discussed in more detail below.

Published literature searches and collation.

The principal sources of information for the project will be:

- Published scientific literature.
- Reputable grey literature (information should at least be available in one of the partner organisations libraries).
- PhD theses (BSc and MSc theses only if retained in an appropriate library).
- Books and leaflets with an ISBN number.

Other databases

A number of web databases are likely to provide information that may be incorporated into the Freshwater Life site. These include:

- Other life history databases (e.g. FishBase and LarvalBase).
- Checklists published by national environmental organisations (e.g. Checklists of the Iberian Fauna).
- Information collected by national biodiversity inventory projects (e.g. UK NBN Gateway).

Requests for information from project partner's members, experts etc.

Where there are gaps in information, experts and organisations with expert members may be asked to collate data for specific species or areas to fill information gaps across Europe.

Expert advice could potentially be obtained as part of partnership projects, or as part of commissioned work, perhaps when requests exceed a certain size (e.g. beyond 1 day of free work). It should be noted, however, that there could be conflicts with the interests of organisations that are developing web sites/databases of their own (e.g. in the UK, the British Dragonfly Society).

Developing new projects to collect data

Development of the database will enable researchers, conservationists, policy makers and regulators to more readily identify remaining gaps in knowledge. This will encourage new projects to be developed at a variety of levels including schemes which encourage consistent field observations from good amateur naturalists, MSc's and PhD's, student projects, post-doctoral research projects, contract researchers or initiatives with NGOs.

This is likely to be an effective way of interacting with many groups since it involves a partnership approach with joint planning and decisions about the work to be undertaken.

Validation

All information placed on the web site will be referenced back to an original source (e.g. literature reference, authority, other website). The group will explore the potential for using academics or other authorities to referee grey literature or other unpublished data.

3.5 Languages used

The base language for the site will be English. However, all sections of the site that are likely to be used regularly by the general public will be available in the three other major European languages: French, German and Spanish. This includes (i) the site's home page, (ii) explanatory pages for each of the major sectors of the site (iii) summary life history and status information for all species.

3.6 Funding the site

The development of the site will be funded by project grants. However, in the long-term, the site will need to be self-financing to ensure that it can be maintained and updated.

Funding options for maintaining the database include:

1. Long term grant aid or sponsorship.
2. Advertising on the website e.g. (i) a list of consultants (ii) list of suppliers for equipment for freshwater scientists and amateur naturalists including optical equipment, nets, sieves, trays, forceps, dredges etc.
3. Top slicing of consultancy work or premium phone lines associated with the site.

Whichever funding sources are used, all financial aspects of the project will be transparent.

To ensure best financial management the project may at some stage need to become a legal entity e.g. a not-for-profit company limited by guarantee.

Information gathered by the FBA suggests that, provided that income generated through advertising etc. is used to further the purposes of a charity, and that there is a balance between its 'charitable' work and its income generation, then the charitable status of *partner organisations* should not be compromised by such trading.

3.7 Advertising the site

Once established, the site will be advertised extensively including through the member partner's organisations (e.g. the 23 partners of the Ponds Trust) together with national and international networks.

Section 4

The audience

4.1 Who will use the site?

The broad scope and variety of information levels included in the Freshwater Life site is likely to be attractive to a wide range of endusers. This section summarises likely audiences for the project's outputs.

Scientific community

The scientific community are likely to be major users of all sectors of the web site. The taxonomic keys will provide support for species-level identification. The life history data will provide a resource that will facilitate research in many fields including: biodiversity analysis, biogeography and landscape ecology, population modelling, development of bioassessment methods, ecotoxicology and strategic risk assessment.

Industry

The life history database is likely to be a resource for:

Agrochemical, pharmaceutical and other chemical manufacturing industries: Increasing demands for aquatic risk assessment means that better understanding of aquatic ecology is needed in order to ensure that environmental obligations and targets are met. A key part of this is knowing what organisms live where, what they do, and how they are likely to respond to chemical stress. The development of the Freshwater Life database will provide a valuable resource for companies involved in this area.

Water industry: Water suppliers, both public and private, have a wide range of duties relating to the conservation of aquatic species and require readily accessible data on the life-histories of species of environmental concern to assist them with planning and risk assessment.

Environmental consultants: Ecological consultants represent the environmental interests of a wide range of industries. They regularly require information about species' life histories, survey methodologies, conservation status, particularly as part of work that assesses the impact of development processes on the environment.

Statutory Agencies, Government departments, local authorities

Legislation places duties on statutory agencies, Government departments and local authorities to protect and conserve aquatic species. For these organisations the database will assist their activities in a number of ways:

- *Ensuring that staff have access to the most recent technical information*. Staff in many statutory organisations have little or no time to review original literature, making it difficult to keep up-to-date with ecological developments in freshwater ecology.
- *Enhancing the effectiveness of R&D programmes*. Organisations with extensive R&D programmes concerned with the aquatic environment, such as the Environment Agency, often need access to species data; for example, environmental monitoring programmes based on species recording (e.g. fish, aquatic plants) often require detailed species knowledge which is time consuming to derive from scattered technical literature.
- *Improving the interpretation of survey data*. For organisations holding extensive freshwater species survey data (e.g. English Nature, Scottish Natural Heritage) life history data is often needed to interpret the results of these surveys (e.g. to aid management plan development for NNRs, SSSIs etc.).

- Assisting with the interpretation of aquatic ecotoxicological studies or risk assessments. For many regulatory authorities where aquatic ecological expertise may be limited such a database would provide a useful source of information for interpreting ecotoxicological data.

Examples of organisations that could be expected to make use of the database include:

- National and Regional nature conservation organisations (e.g. English Nature, State and County Governments, US Fish & Wildlife Service).
- National environment agencies (e.g. Environment Agency of England and Wales; US EPA).
- National agencies regulating pesticides (e.g. MAFF).
- European Environment Agency and EEA Topic Centres (e.g. Nature Conservation Topic Centre, Inland Water Topic Centre).
- Pesticide regulatory authorities such as the UK Pesticide Safety Directorate, the German Biologische Bundesanstalt fur Land und Forstwirtschaft (BBA), the EU DG Health and Consumer Protection Standing Committee on Plant Health, etc.

NGOs

The large number of NGOs involved in protecting the aquatic environment suggests that there is likely to be a considerable market for both summary and detailed species level information about aquatic organisms.

Levels of involvement in freshwater vary from international NGOs like WWF which campaign at policy level and undertake research programmes into current issues (e.g. effects of pesticides, endocrine disrupters), to groups such as RSPB who manage large sites and require information about individual species to ensure that habitat management is as effective as possible.

Examples of NGOs that could be expected to benefit from the database include: WWF, RSPB, FBA, the Wildlife Trusts, Balfour Browne Club, IUCN-SSC, Anglers Co-operative Association, Atlantic Salmon Trust, River Restoration Project, Mammal Society etc.

Higher education teachers and students

The site is likely to be widely used by higher education teachers and students working on aquatic ecology courses or modules, as well as by those requiring general information about aquatic ecosystems as part of wider ranging environmental management and conservation courses.

About 50 UK Universities and Colleges[2] run courses on ecology, conservation or environmental management which include some element of freshwater biology. In addition, ten Universities or Colleges run undergraduate MSc, BSc or HND programmes specialising in aquatic ecology. The web-site is a potential tool for all of these institutions.

Schools

Most schools are at some time or other involved in studies of freshwater ecosystems, particularly at primary level. It is likely that many would use the type of data that will be available on the web-site, particularly life history information for common freshwater species and simple taxonomic keys - and especially if the latter are linked to good graphics.

Amateur naturalists

Amateur naturalists will be an important group of users of the database, particularly those interested in amphibians, water beetles, and dragonflies and plants. Organisation representing amateur naturalists interested in these groups probably have between 5000 and 10,000 members in the UK.

[2]Source: Universities and Colleges Admissions Service (UCAS), 2000.

Public and interest groups

The database will provide information about the identification and ecology of popular species, providing people with answers to a variety of common questions about species, and leading public knowledge in areas where new developments have rapidly changed traditional ideas. Areas which are commonly of public interest include:

Life histories of amphibians: timing, life cycle, returning to natal ponds, dispersal distances, population dynamics (i.e. what proportion of eggs need to survive), what is the ideal habitat for particular species?

What's in my pond? how to identify the plants and animals present, life cycle information about common taxa (e.g. dragonflies, snails, shrimps and slaters etc.).

Alien plants: a wide range of organisations are currently drawing attention to the problems associated with alien aquatic plants. There is a need for a common source of information about these plants because they are often spread by the public from garden ponds to semi-natural habitats.

Information on fish: anglers have wide interest in the species they catch, so new up-to-date information on common angling species, and rarer species of conservation interest, is likely to be of interest.

The database will also assist other organisations working with non-technical audiences by providing them with a source of authoritative information in a readily accessible form.

4.2 Competition or overlap

Clearly, if the website is to be successful, it needs to fill an existing information gap and to be sufficiently unique that the work is not likely to be undertaken by others in the near future.

To investigate how distinctive the web site will be, a review was undertaken of existing UK, other European and US web-based projects. In addition, preliminary discussions were held with Lawrence Way (Information Manager, JNCC/National Biodiversity Network) to identify the UK NBN's plans in more detail.

The main conclusion from this review is that there appear to be no direct analogues for any major sector of our project. However, a number of web sites are beginning to develop parts of some sectors in some geographic areas.

The main areas of competition and/or overlap are described below for each major sector of the proposed web-site. A list of some of the most relevant existing web-sites, together with their email addresses is given in Table 3. More detail about major web-sites is included in Appendix 3.

4.2.1 Taxonomic lists

A range of taxonomic checklists are available on the web, and this number is likely to increase considerably as a result of national, international and global initiatives to list biodiversity. The current availability of checklists in the UK, continental Europe and US is summarised below.

UK: A coded checklist of freshwater animals occurring in fresh water in the British Isles is accessible via the web from the Institute of Freshwater Ecology. A coded list of the freshwater algae is available from CEH Wallingford. At present there appear to be no web-based lists of vascular plants, ferns or bryophytes.

Continental Europe: Web-based checklists are beginning to be built up at national level, but no central lists are yet available. EUNIS (the European Nature Information System) is currently developing a European synonyms database to facilitate inter-state comparisons of species lists but no outputs are available on the web at present. Pan-European lists may also become available through the Expert Centre for Taxonomic Identification (ETI) World Biodiversity Database based in the Netherlands (part of the Species 2000 project). Existing examples of national lists in Europe include the Swedish checklist of beetles (including water beetles), the Catalogue of French Chironomidae and the checklists of the Iberian fauna.

Note that the creation of a European register of marine organisms is currently the subject of a specially funded EU project called the "European Register of Marine Species" undertaken by a consortium centred on Southampton University. There appears, however, to be no direct Freshwater equivalent.

US: A large number of checklists of various taxonomic groups are available on the NBII at State and Federal level. Examples of national lists are stoneflies and birds; examples of regional lists include mayflies of the south-eastern United States and aquatic molluscs of North Dakota.

4.2.2 Conservation status data

At a global level, information on the conservation status of internationally threatened species is accessible through the World Conservation Monitoring Centre (WCMC) site in Cambridge. This site lists IUCN species globally threatened species.

UK: Lists of all UK Biodiversity Action Plan species are accessible on the Joint Nature Conservation Committee (JNCC) web-site. Information about the conservation status of threatened plants in the UK is also given on the JNCC web-site including (i) UK Red Data Book species (ii) Wildlife & Countryside Act scheduled species and (iii) Biodiversity Action Plan 'long list' species. These data are currently being linked together in the new National Biodiversity Network data gateway. Examples of the type of data that will become available about UK species can be seen on the trial NBN Gateway.

Continental Europe: Lists of Habitats Directive and Birds Directive species are available on the EU server as part of the listing of EU legislation. Lists of species protected under the provisions of the Berne Convention are accessible on the Berne Convention server. National Red Lists of threatened species are gradually becoming available on the web (see for example: amphibians in Germany, birds in Luxembourg), but are not yet compiled centrally.

US: Endangered Species in the United States are listed on a single Internet-accessible database maintained by the US Fish and Wildlife Service.

4.2.3 Life history data

Life history data are available for some groups of freshwater organisms but web coverage appears to be patchy. It is likely that, in the near future, there will be an increasing number of web sites with summaries that describe the life history of *protected* species. However, with the exception of fish, there appear to be few plans (i) to provide descriptive information for common freshwater species, with the exception of dragonflies, or (ii) to develop relational databases containing life history data.

UK: The main databases of interests are the National Biodiversity Network (particularly the NBN 'Gateway'), MarLIN, for UK marine organisms and FishBase/LarvalBase for fish world-wide, including UK species (although data appear to be fairly patchy).

- The NBN expects to make species-level data available on dragonflies, threatened plants and crayfish shortly (April 2000) for initial testing. This will incorporate some species life history data but not in the format proposed by the present project (more likely as text summaries from existing documents e.g. the Atlas of the dragonflies of Britain and Ireland). An indication of the NBN format is given at the demonstration NBN 'Gateway' (currently located on the Joint Nature Conservation Committee server (JNCC). This gives a single example of the kind of data the NBN Gateway will give access to for one species, the rare Norfolk hawker dragonfly (*Aeshna isosceles*). The NBN has been working in partnership with the BDS in the preparation of these data.

  Preliminary discussions with NBN staff indicate that there would be mutual benefits in further discussion with them in terms of (i) sharing data (ii) gaining access to database tools that could assist the present project.

  Also likely to be incorporated in the NBN are Species Action Plans (for UK Biodiversity Action Plan species) which include some habitat and life history information. These can also be accessed through the JNCC web-site.

- *MarLIN* is a marine database, but is of interest in that it provides a possible model for the work of the present project. At present *MarLIN* has very limited species data, but in the medium to long-term *MarLIN* aims to provide species-level information on: taxonomy and identification, general biology, habitat preference and distribution, reproduction and longevity, sensitivity and recoverability and nature conservation status ('Importance'). Trial data for the bloody henry starfish can be viewed in the demonstration of the *MarLIN* Biology and Sensitivity Key Information Sub-programme.

- FishBase and LarvalBase are global fish databases that have information rather similar to that proposed for the present project. It is possible to enter into partnerships with FishBase, or to download data from the database to a third party site.

Continental Europe. No national or Pan-European life-history databases appear to be available in continental Europe although global initiatives (e.g. FishBase, IUCN Species Under Threat programme) do cover some European species. EUNIS, the European Nature Information System, although collecting species data, appears to be restricted to distribution and nature conservation status information.

US. There is currently limited species life history data available in the US on the web. However, proposals are currently being made by a number of organisations to establish database with species life history information, particularly for threatened species (e.g. the NatureServe: Online Encyclopedia of Species and Ecological Communities, US Fish and Wildlife Service).

- NatureServe will provide information about the taxonomy, conservation status, distribution, life history and management of the following U.S. and Canadian species: (i) vertebrate animals, (ii) invertebrate animals, including freshwater mussels, crayfish, dragonflies and more than 8,000 species in other invertebrate groups, and (iii) plants including vascular plants, and protected bryophytes and lichens. No pilot data are available with which to assess the likely format of the site.
- US Fish and Wildlife Service has limited descriptions of the biology of federally threatened species. However, at present, there appear to be no databases providing comprehensive life-history data under the auspices of the FWS.

At global level, the Species Under Threat programme located at the World Conservation Monitoring Centre's web site (part of IUCN) includes brief descriptions of about 150 threatened species (mainly birds and mammals plus a small number of marine fish and reptiles). IUCN is also currently developing the SSC Species Information Service. The project will link existing databases using a distributed data custodian management model (a common format for many current projects linking pre-existing datasets). The exact specification of this project is unclear from available information but it seems likely to include descriptive life history data available to the Species Survival Commission specialist groups of IUCN.

4.2.4 Keys

In the US a small number of freshwater keys are currently available on the Internet. However, UK or continental European keys have yet to appear. The keys that are currently accessible vary in quality with some well-illustrated and others without illustrations (and therefore virtually unusable). At present there appears to have been no keys developed which properly exploit Internet capabilities.

UK. No recognised UK identification guides to any aquatic taxa appear to be available on the Internet.

Continental Europe. A limited number of keys are available for Continental European fauna and flora (e.g. Key for the Swedish damselflies). http://home9.swipnet.se/~w-90582/dragonfly/key.html.

US. Several keys are available on the Internet including:

- a key to the anuran tadpoles of the United States and Canada
- a key to the aquatic and wetland vascular plants of the Northern Great Plains
- a field guide to the freshwater snails of Florida).

4.2.5 Methods

There appear to be no systematic summaries of survey and sampling methods available on the Internet in the UK and Europe. However, a small number of equipment manufacturers have web sites that list equipment that can be used for aquatic ecology.

4.2.6 Networks

A large number of lists of users have built up for a variety of groups of freshwater organisms. Generally these are World-wide in scope (although most list members are usually Europeans or North Americans). Most are orientated towards the international scientific community or keen amateur naturalists. Examples of typical lists are given below.

- E-mail directory of dragonfly workers
- Directory of chironomid workers
- Directory of mayfly workers

Table 4. Organisations and initiatives undertaking work which may overlap with the current project

Major projects and organisations are also described in more detail in Appendix 3.

Checklists

- A coded checklist of animals occurring in fresh water in the British Isles (on the IFE website): http://www.ife.ac.uk/ife/coded_list/Invert_List.htm.
- Coded list of freshwater algae (on the CEH website): http://www.nwl.ac.uk/~loissys/algal_coded_list.htm.
- European Information System (EUNIS): http://www.mnhn.fr/ctn/eunis.html.
- Expert Center for Taxonomic Identification (ETI) World Biodiversity Database: http://www.eti.uva.nl/database/database.html.
- Swedish checklist of beetles (including water beetles): http://www.nrm.se/en/catalogus.html.se#COL.
- Catalogue of French Chironomidae: http://www.sci.ouc.bc.ca/fwsc/iwalker/intpanis/chirolis_france.html.
- Checklists of the Iberian fauna: http://www.fauna-iberica.mncn.csic.es/faunai/fauna.html.
- European Register of Marine Species: http://erms.biol.soton.ac.uk/.
- Stoneflies of the United States: http://www.npwrc.usgs.gov/resource/2000/sfly/sflyusa.htm.
- Bird checklists of the United States: http://www.npwrc.usgs.gov/resource/2000/sfly/sflyusa.htm.
- Mayflies of the south-eastern United States: http://www.famu.org/mayfly/sespecies_list.html.
- Aquatic molluscs of North Dakota: http://www.npwrc.usgs.gov/resource/distr/invert/mollusks/mollusks.htm.

Conservation data (status, distribution)

- Internationally threatened species on the World Conservation Monitoring Centre (WCMC) database: http://www.wcmc.org.uk/species/data/.
- Threatened plants in the UK on the Joint Nature Conservation Committee (JNCC) web-site: http://www.jncc.gov.uk/species/.
- National Biodiversity Network data gateway NBN Gateway: http://www.jncc.gov.uk/gateway/.
- Habitats Directive: http://europa.eu.int/eur-lex/en/lif/dat/1992/en_392L0043.html.
- Birds Directive: http://europa.eu.int/eur-lex/en/lif/dat/1979/en_379L0409.html.
- Berne Convention list of European protected species: http://www.nature.coe.int/english/cadres/berne.htm.
- National Red Lists of threatened amphibians in Germany: http://www.amphibienschutz.de/rotlist.htm.
- Threatened birds in Luxembourg: http://www.luxnatur.lu/luxnatur/lnv005.htm.
- US Fish and Wildlife Service list of Endangered Species: http://endangered.fws.gov/wildlife.html.

Life history databases

- FishBase: http://www.fishbase.org/.
- LarvalBase: http://www.ifm.uni-kiel.de/fi/bu/larvalbase/Homepage_1.htm.
- *MarLIN* Biology and Sensitivity Key Information Sub-programme: http://www.marlin.ac.uk.
- NatureServe: Online Encyclopedia of Species and Ecological Communities on the web-site of the Association for Biodiversity Information: http://www.abi.org/NatureServe.cfm.
- IUCN Species Under Threat: http://www.wcmc.org.uk/species/data/species_sheets/.
- Pond FX: http://www.ent.orst.edu/PondFX/.

Keys

- Key for the Swedish damselflies: http://home9.swipnet.se/~w-90582/dragonfly/key.html.
- A key to the anuran tadpoles of the United States and Canada: http://www.pwrc.usgs.gov/tadpole/.
- A key to the aquatic and wetland vascular plants of the Northern Great Plains: http://www.npwrc.usgs.gov/resource/1999/vascplnt/vascplnt.htm#contents.
- A field guide to the freshwater snails of Florida: http://www.flmnh.ufl.edu/natsci/malacology/fl-snail/snails1.htm.

Section 5

Project strategy and organisational framework

5.1 Approach - Where and how to start?

Development of the site is a long-term project that, it is anticipated, will take in the order of seven years to complete. It is proposed that project development should be undertaken in four main project phases:

Phase 1: Put down a marker for the site and establish funding sources.

Phase 2: Lay out the framework for the site. Establish (i) skeleton data/information in all areas of the site and (ii) detailed, completed datasets for demonstration sections and/or taxa.

Phase 3: Complete the site, including detailed data (such as the life history database) in all main areas of the site.

Phase 4: Maintain and update the site in the long term.

These phases are described in more detail below. Note, however, that in practice, phasing is unlikely to be this simple. Developing funding sources may, for example, continue through at least phases one and two, and each development phase will probably be staggered depending on the geographic area included (see below).

5.2 Phase 1: Put down a marker for the site and establish funding sources

1. Putting down a marker

An initial, and relatively urgent, first step is to set down a marker for the project as a whole. This will be achieved in three main ways:

(i) *Web site establishment*. A project web site will be established. This will initially comprise simply a home page with a description that includes all the project elements and targets, together with a time-frame for site construction. This information will be available in English, French, Spanish and German. The web site will be hosted initially on the Oxford Brookes University site.

(ii) *Discuss the project with potential funding bodies*. Since there is a need for project fund raising, this will be an effective means of both setting down a marker and beginning to seek financial support for the main elements of the site (see also below).

(iii) *Discuss the project with potential partners and competitors*. Beginning to discuss the project more widely will, in itself, set down a marker. Care will need to be taken to ensure that the project is inclusive and developed in partnership with other ecological organisations wherever possible.

It may also be appropriate, at some point, to include one or more major UK, European or US organisations into the core project group in order to strengthen the consortium.

2. Establish funding sources

The detailed strategy that should be adopted in approaching funding bodies has yet to be agreed and depends partly on whether the project is developed as a UK initiative which becomes European/International or has international objectives from the outset.

Whatever the approach, it is clearly vital that major funders are brought on board as partners from the beginning. It may be appropriate to do this through high level meetings with our existing contacts in these organisations.

A list of possible funding sources for the project are given below, focusing on funding bodies relevant to the UK and Europe.

- Research Councils (NERC, BBSRC)
- Chemical and manufacturing companies (agrochemical, biochemical, pharmaceutical, manufacturing e.g. Esotoc, IVA, CPA).
- Statutory bodies (Environment Agency, MAFF, DETR, English Nature)
- European Community programmes associated with the environment and data (e.g. LIFE, Framework 5, Environment)
- Trusts and other grant giving bodies
- Contractors and suppliers
- Water industry (water companies).

3. Design the site layout and scope out next phases

The components of the site and its design need to be scoped out in detail at a fairly early stage so as to avoid redundancy or unnecessary complexity as the site is developed in future years.

4. Time/funding that will potentially be required in Phase 1

The Phase 1 project will include (i) contacting people/organisations (ii) meetings with potential funding partners (iii) preparing funding bids for phases 2-4 (iv) setting up the new web site (v) putting project information on the web site, and (vi) scoping the detailed design and lay-out of the web site.

5.3 Phase 2: Create the site's framework

The initial development of the site will be undertaken along both horizontal and vertical lines. This is, coincidentally, also the approach that MarLIN has taken.

Although the project will continue to develop in phases 3 and 4, each of the Phase 2 development stages will produce a stand-alone output of value in its own right.

Horizontal development: All major sectors of the site are established, focusing on the most popular and easily accessible information. This will be the quickest to achieve and will be appropriate for the largest audience. In practice this could include listing:

- The freshwater species which the site will include (and associated information, i.e. common names, authority).
- Species conservation status (BAP, Red Book, IUCN etc.).
- Habitat and waterbody type information for species, particularly species of widespread interest.
- General description of family or genera.
- List of methods.
- List of existing taxonomic keys (European?).
- Links to other sites, or web searches.

Vertical development: Early development of the web site will also include a small number of case studies which provide examples of the future development of more complex areas of the site. For example:

- *Life history data-base*: examples of life history information, photos etc. for a small number of species or taxonomic groups.
- *Methods database*: Example information of sample collection and preservation methods for one plant or animal group (or habitat?).
- *Taxonomic keys*: One or two on-line keys developed. Preferably a general key (e.g. to invertebrate families) or a popular group (e.g. wetland plants, dragonflies, or snails).

  It is provisionally suggested that an appropriate key might be the FBA's key to riffle beetles i.e. FBA Scientific Publication No. 26 "*A key to the larvae, pupae and adults of the British Species of Elminthidae*" by David Holland. The advantages of using this key are: a) it covers all stages of the life cycle (and so fits in with the life history theme of the web-site); b) it is relatively short; c) it is out of print. The FBA would hope to commission an up-date of the key at the same time. The suggestion is that a simple on-line version of the existing key would first be placed on the web-site as a trial, with a feedback facility for comments, followed by the definitive version in c. 3 years.

Alpha and beta testing will be carried out to ensure full functioning of the website and database.

Funding required for Phase 2: The development of Phase 2 is likely to require a team of approximately five people including: a data manager, chief editor, and 3 staff working on specific projects (e.g. collecting data for the pilot areas of the site, developing taxonomic keys etc. This suggests that the whole project would be a 2-3 year initiative with moderately large funding requirements.

5.4 Phase 3: Complete the site.

Development of all major sectors of the project to appropriate levels:

- *Life history database*: including life history information, photos etc. for all wetland taxonomic groups. It may also be appropriate to produce this database as a CD-ROM.
- *Methods database*: Information on sample collection and preservation methods for all taxonomic groups (and habitats?).
- *Taxonomic keys*: A range of on-line keys developed. Preferably at Pan-European or Pan-US level.

Alpha and beta testing to ensure full functioning of the website and database.

Major funding sources will be required for this work.

5.5 Phase 4: Maintain and update the site.

The site will need to be regularly maintained to ensure that it remains useful and viable. Wherever possible, the need to update standard information (such as changes to species nomenclature and rarity/conservation status) will be minimised through incorporation of seamless links to other authorised web sites rather than through direct updating of the site. There will, however, remain sectors of the web site that will need regular maintenance. These include:

- The life history database: searching new papers, articles, books across a wide range of taxonomic groups for life history data that can be added to the database.
- Lists of keys and to the details of on-line keys as more information becomes available.
- Improving site design and links to other sites
- Investigating use of the site and looking for areas of improvement.

Funding options for maintaining the database include:

1. Long term grant aid or sponsorship
2. Advertising on the website
3. Top slicing of consultancy work or premium phone lines associated with the site.

5.6 Handling the geographic spread of the project

The current aim is that the development of the site will follow three tracks that run in parallel but which have a staggered start:

Track A: UK +1 or 2 other EU countries.

Track B: Europe.

Track C: US.

Completing any or all phases will be quickest and easiest in the UK. Extending the work to Europe will inevitably take longer because of (i) language / translation requirements (ii) taxonomic and nomenclature harmonisation (iii) the greater number of countries and species. It may be best to use nationals from each country to undertake collation work for their own EU State, or to identify European or US centres of excellence in each taxon/habitat.

One approach could be, therefore, to stagger the development of project i.e. (i) take the UK plus one or two other EU countries (e.g. Holland, Denmark, Germany, Spain) as a case study and begin to develop the site in full for species present in these countries, (ii) extend the site to become Pan-European as EU funding became available, (iii) develop the US site in tandem, perhaps from a linked US base.

Section 6

Risks and how to avoid them

A list of potential risks for the project is outlined briefly below:

- The plan is too large and unmanageable - leading to inertia in starting the project, an inability to complete it, or the product becoming outdated.

  Strategy to minimise risk - develop the site as a series of phases, with each section a complete and valuable stand-alone product in its own right.

- The staged development of the site means that it does not co-ordinate well as a whole, or that earlier work needs to be redone.

  Strategy to minimise risk - good planning plus partial development of all parts of the site in the initial stages to ensure that the full scope of the project is understood.

- There are too few data available for many species to make the site worthwhile.

  Strategy to minimise risk - ensure that database can also collate life history data at higher taxonomic levels e.g. family.

- The project management and co-ordination becomes unweildy.

  Strategy to minimise risk – In the short term one organisation will act as a focus for the secretariat.

- Information on the site becomes out of date or it is superseded

  Strategy to minimise risk - the site will require long term maintenance.

- The site overlaps with that of other interest groups e.g. many organisations are developing web sites of their own.

  Strategy to minimise risk - develop partnerships and share information wherever possible.

- The project fails to secure funding for one or more of its stages

  Strategy to minimise risk – All sections of the project will be completed t as a series of stand-alone products and out puts will be developed so that they can be produced using alternative media e.g. as a CD-ROM.

Section 7

Timeframes

The major sections of the project are outlined below followed by an estimate of costs for each section, with most detail given for the initial stages. Additional discussion of the computing options for the project is given in Appendix 2. A more detailed breakdown of costings is given in Appendix 4.

7.1 Phase 1: Establish a market presence and develop funding sources

Set-up web-site

- Preparation and design of home page including a short text description of the project and the design of a logo for the site. Translation into French, German and Spanish.
- Establish the website on the server of an existing partner

The website names: *freshwaterlife.org.uk* and *freshwaterlife.org* have been registered for the project by the FBA.

Conduct market research

Use the website pilot to help examine the market place for the project in terms of potential users and their requirements.

Determine scope of web-site and technical approach

- Determine the content, design and layout of the web-site for Phases 2, 3 and 4 in consultation with website designers.
- Determine the technical approach to the web-site development. This to include identification of key IPR and data protection rights issues, likely problems and solutions, particularly with respect to the forthcoming EU Directive on Copyright.

Establish international partner network

- Hold high-level discussions with potential funders/funding partners e.g. NERC, DETR, EU, industrial partners and others.
- Develop collaborations with European and US partners.
- Develop promotional materials to support collaboration and funding bids.

Plan next phases of project

- Prepare a detailed, strategic approach for Phases 2, 3 and 4 including consideration of alternative options.
- Prepare funding strategy for Phase 2

- Identify potential means of financing Phase 3 (full development of database).
- Identify potential means of financing Phase 4 (long term maintenance), including through advertising revenue.

Explore funding options for Phases 2& 3

Prepare funding bids to NERC and/or EU or others.

Management & administration

Identify and recruit approximately two new committee members who can actively assist the project.

Produce a Phase 1 report

Prepare a report giving the scope of the web-site, a detailed project plan and a financial strategy.

7.2 Phase 2: Initial development of the site

Core web-site and database development

Create and structure web-site, purchase Oracle server and construct template relational database (see Appendix 2), create links to other sites, finalise data management issues, including IPR, use of experts etc.

Finalise intellectual property right issues. Identify experts to quality control grey literature.

Trial horizontal development of the site

Gather the following data:

- *List of species*: (i) collate list of freshwater species for UK and 1-2 other European countries (excluding protozoa, fungi and bacteria) (ii) list other European checklists.
- *Conservation/rarity status for species*: list international and national rarity statuses for these species.
- *Life history summaries*: summarise species and habitat information for species.
- *Species distribution*: text description of distribution and/or link to other sites with distribution data.
- *Taxonomic keys*: list of European and US taxonomic keys
- *Information on survey methods*. list of references to survey methods
- *Network of contacts/experts*: European network established.

Trial Vertical development of the site

- Completion of life history data base for a small range of common species in representative taxonomic groups,
- Full description of a small number of survey methods,
- A trial key made available on the web site in full. It is provisionally suggested that this might be the FBA's key to riffle beetles i.e. FBA Scientific Publication No. 26 "*A key to the larvae, pupae and adults of the British Species of Elminthidae*" by David Holland.

Project and funding management

Continue to identify funding sources for site development and long term maintenance, including through advertising books and equipment.

Prepare detailed scoping of Phase 3 and write report.

Continue to develop and foster links with other organisations, including within the context of seeking information to fill knowledge gaps.

7.3 Phase 3 Full web site development

Full development of web-site, extending the horizontal development to all of Europe and the US and extending vertical site development to all the life history of all species and standard methods, available keys in Europe and the US.

Continued development of partnerships and funding sources, and preparation of project plan for Phase 4.

7.4 Phase 4: Long term maintenance of the site

Long term maintenance will be required for all major sectors of the site and particularly the following:

- Life history database: searching new papers, articles, books across a wide range of taxonomic groups for life history data that can be added to the database.
- Changes in species nomenclature and rarity/conservation status.
- List of keys and to the details of on-line keys as more information becomes available.
- Improving site design and links to other sites, including investigating use of the site and looking for areas of improvement.

Appendix 1

Group members' aims for the project

FBA

The Freshwater Biological Association was founded in 1929 and is an independent organisation which conducts research into all aspects of freshwater science and technology.

The Mission of the FBA is to promote freshwater science:

- through an innovative research programme
- an active membership organisation
- by providing sound, independent scientific opinion.

Within the Freshwater Life consortium the FBA are represented by Roger Sweeting and Karen Rouen.

Aim for the current project

1. To extend the resource currently provided by the freshwater keys.

2. To raise the profile of the FBA..

3. To fulfil the FBA's remit to provide education and information about freshwater ecosystems.

Key items on wish list

- Life history database - providing information to supplement the keys.
- List of taxonomic keys.
- Survey and preservation methods.
- Conservation status information.

Zeneca

Zeneca Agrochemicals is a world-leading supplier of crop solutions based on chemical and biotechnology products designed to improve crop yield and food quality. The business has a global marketing reach and a broad portfolio of crop protection products for the control of the principal weeds, pests and diseases affecting major crops.

Within the Freshwater life consortium Zeneca are represented by Steve Maund.

Aim for the project

- To provide ecological information that will feed into strategic risk assessment and other ecotoxicological work.

Key items on wish list

- Provision of information about freshwater species, particularly life history, distribution, and habitat preferences.
- Taxonomic keys, especially for training purposes.
- List of taxonomic authorities/referees.

Ponds Conservation Trust

The Ponds Conservation Trust is a charitable organisation whose membership comprises of 23 conservation organisations and individuals. These are:

British Dragonfly Society
British Herpetological Society
British Trust for Conservation Volunteers
British Waterfowl Association
De Montfort University
English Nature
Environment Agency
Farming and Wildlife Advisory Group
Freshwater Biological Association
Froglife
Ian Benton Ponds
Institute of Terrestrial Ecology
National Federation of Women's Institutes
Oxfordshire Nature Conservation Forum
PCT: Policy & Research
Pond Life Project Liverpool John Moores University
Surrey Amphibian and Reptile Group.
The Wildlife Trusts
The Association of Local Government Archaeologists
University of Bournemouth
University of Sussex
Wildfowl & Wetlands Trust
WWF UK

The Trust objectives are to raise awareness and provide a national focus for pond conservation.

In the current project the PCT is represented by Anne Powell.

Aim for the project

1. To create a resource which will inform and enthuse the general public about freshwater ecology.

2. To provide information that will enhance the scientific under-pinning of good conservation practice.

Key items on wish list

- User-friendly keys that enable the public to appreciate and identify freshwater life.
- *Summary* life history information which will allow individuals and community groups to know more about the habitats and life-cycle of freshwater species (e.g. in ponds and rivers).

PCT: Policy & Research

PCT: Policy & Research was established in 1988 (as Pond Action) and is an independent national centre for applied research on pond ecology and the conservation of freshwater ecosystems. The group is based in Oxford Brookes University and provides technical advice on the ecology of ponds, lakes and rivers to a wide range of governmental and non-governmental organisations.

Within the Freshwater life consortium PCT: Policy & Research is represented by Jeremy Biggs and Penny Williams.

Aim for the project

As the Ponds Trust's aims, plus:

To provide a resource which will promote research into species' habitat requirements.

To improve existing keys for freshwater species identification.

Key items on wish list

As the Ponds Trust's wish list, plus:

- Life history data base - particularly information relevant to habitat preferences.
- Species conservation status.
- High quality, easy to use taxonomic keys (UK and European).

- Information on sampling methods.

Appendix 2

Options for project computing requirements

Hardware

The basic requirement for the project is for a web-server, with the optional extra of an Oracle server.

There are a number of options regarding the web-server, depending on the size and complexity of the web-site and the volume of traffic (number of visits).

1. Use the existing server facility at one of the partner organisations:

   Technically suitable for Phase 1 and probably also for Phase 2, but may not be sufficient for Phases 3 and 4. If either FBA or PCT: Policy & Research were to provide the server facility, this may preclude any commercial component to the site (not allowed for "Janet" users).

2. Purchase a server, to be sited at one of the existing organisations but dedicated to this web-site alone:

   Potentially suitable for all Phases. May be required for Phases 3 and 4 if thousands of visits were anticipated per day and/or if the site was very large/complex.

3. Use an internet service provider (ISP):

   Suitable for Phases 1 and 2. Suitability for Phases 3 and 4 would depend on the service level which the provider could offer (potential problem of slow links).

Different options can be used for different Phases of the project. This should not present a significant problem, even if it involves changing the server used. If the latter is necessary, technical problems can be minimised by ensuring that the server software is the same or compatible (although any problems associated with transferring between different packages can usually be resolved). It is likely that the domain name could be retained. Although the IP address would change, an automatic redirection facility could be incorporated at the old IP address, with a message prompting users to update their links (although redirection may not be possible out of "Janet").

Likely approaches for this project are therefore:

a) use an existing web-server for Phases 1 and 2, then change to a dedicated server for Phases 3 and 4

b) use an existing web-server facility for Phase 1, then change to a dedicated server for Phases 2, 3 and 4

c) use a dedicated web-server for all 4 Phases

d) use an internet service provider for all 4 Phases.

The costings in this scoping study are based on approach (a), with an assumed cost of £10K (excl. VAT) for the web-server, software and licence. Either approach (b) or (d) may be deemed preferable, however, once the full technical scoping has been undertaken in Phase 1. Approach (c) is not recommended due to the associated high financial risk.

If the web-site uses an Oracle database (see below) then an additional server may be required, dedicated to Oracle.

Network link

If the server is based at the site of one the partner organisations, rather than an ISP, then an extra WAN (wide area network) link may need to be leased to allow commercial activity on the web-site and/or to increase the speed of the internet link.

Software

If a new, dedicated web-server is purchased as part of the project, then it will require an operating system and appropriate web-page server software. If an existing facility is used, then the requirement for software may depend on the package used and the existing availability.

In terms of database software, Oracle may be required in preference to Microsoft Access due to the large size of the final database.

Appendix 3

Details of existing web sites

This Appendix gives detailed background information on project/initiatives that (i) overlap with our proposed web site (ii) may provide opportunities for collaboration, or (iii) have similar ideas in a non-freshwater context.

Appendix 4

Detailed breakdown of estimated costs for phases 1 - 4