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THE NATIONAL POND SURVEY: 1989-1993

Interim Report to the World Wide Fund for Nature

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THE NATIONAL POND SURVEY: 1989-1993

SUMMARY

This report outlines the interim results of the National Pond Survey, initiated by Pond Action in 1989, and core funded by the World Wide Fund for Nature (WWF-UK).

The National Pond Survey (NPS) data set is the largest and most comprehensive body of information about ponds in Britain and involves analysis of 181 ponds selected in order to produce a database of essentially unpolluted and undamaged ponds.

The aim of the NPS has been to describe the physical, chemical and biological characteristics of ponds in Britain and to provide information which can be used to facilitate pond conservation. In particular it provides:

- (i) a baseline for monitoring long-term trends
- (ii) information about the location of high conservation value ponds
- (iii) data about the distribution of individual freshwater species
- (iv) quantitative information on the importance of ponds for wildlife
- (iv) data which can be used to improve pond management techniques
- (v) a means of prioritising ponds for protection

RESULTS

Freshwater plants

A total of 215 wetland plant species are recorded in the interim data base. Overall, this represented 65% of the British wetland flora (55% of the aquatic species and 70% of the emergent species).

The number of plant species recorded from individual ponds ranged from one to 59, with an average per pond of 17. This was much higher than the average from other surveys (often two to three times greater) almost certainly reflecting the fact that a very high proportion of sites were located in areas of semi-natural land use. This adds to the body of evidence from the Oxfordshire Pond Survey which suggests that relatively unpolluted ponds located in natural surrounds are richer in species (and more likely to support uncommon species) than ponds in the wider countryside.

A considerable number of uncommon wetland plant species were recorded during the NPS and most ponds supported at least one species which could be considered to be nationally local. Eight of the species recorded had Nationally Notable status and one, slender marsh bedstraw (*Galium debile*), was RDB3.

Classification of the plant communities using the computer ordination techniques DECORANA and TWINSPAN suggests that the main environmental factors affecting community composition at the ponds were pH and geographical location, with neutral or alkaline sites in lowland England at one end of the classification and ordination figures, and acid upland sites in Wales and Scotland at the other.

Aquatic macroinvertebrates

A total of 407 aquatic macroinvertebrate species have been recorded from the National Pond survey ponds to date. This represents approximately 55% of the British freshwater fauna as a whole (within the groups which were identified to species level) and approximately 65% of those species which are likely to be found in still freshwater (ie excluding obligate brackish and running water species). This included 75% of all the British freshwater snail species and 86% of all the water bugs.

That such a high percentage of the British list was recorded from a relatively limited number of ponds again indicates how important ponds are as a nature conservation resource.

Over one third (38%) of the invertebrate species recorded from the 34 ponds were uncommon, and of these 11 species were RDB3 (Rare), four were RDB2 (vulnerable) and three were RDB1(endangered).

Classification and ordination analysis of the macroinvertebrate communities suggests that, as with plants, the main environmental factor affecting community composition was pH and geographical location.

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THE NATIONAL POND SURVEY: 1989-1993

Interim Report to the World Wide Fund for Nature

1. INTRODUCTION

1.1 Content of the report

This report outlines the interim results of the National Pond Survey (NPS), initiated by Pond Action in 1989, and core funded by the World Wide Fund for Nature (WWF-UK).

1.2 Scope of the National Pond Survey

The aim of the NPS has been to describe the physical, chemical and biological characteristics of ponds in Britain and to use this information both to classify ponds and to improve our current understanding of pond conservation techniques.

The survey has involved analysis of 181 ponds located in areas of semi-natural habitat. These ponds have been particularly targeted in order to produce a database of essentially unpolluted and undamaged ponds.

1.3 What the data provides

The NPS data set is the largest and most comprehensive body of information about ponds in Britain. It is of high quality having been gathered systematically by full-time professional staff. Collection and analysis of the data currently represents 5.5 person/years work and, by the time the project is completed, will represent approximately 7 person/years work (see Summary Report "Pond Action 1990-1993").

The NPS provides information which is fundamental to many aspects of pond conservation. In particular it provides:

(i) a baseline for monitoring long-term trends

Understanding long-term trends is an important aspect of environmental protection. The data-set consists of ponds which are relatively unpolluted and undamaged and can therefore tell us how ponds vary naturally with time. This is necessary if we are to understand the effect of pollution by nutrients, pesticides or atmospheric contaminants such as acid rain.

(ii) information about the location of high quality ponds

The NPS provides information about the location of ponds of high conservation interest. One of the most important steps towards protecting valuable ponds from damage is knowing (or being able to predict) where they are.

(iii) information on the distribution of individual species

The NPS provides data on the distribution of individual wetland species which will increase knowledge of their status and habitat requirements.

(iv) quantitative information on the importance of ponds

The NPS gives, for the first time, quantitative data on the importance of ponds for wildlife. The provision of statistics describing the importance of ponds can be used to encourage pond protection, creation and management.

(iv) the NPS provides a wealth of information about pond management

The results of the NPS are shedding new light on many long-established beliefs about pond management. For example:

- analysis of correlations between pond conservation value and environmental factors can help us to understand how to manage and create ponds of high conservation value.
- classification of ponds can help us understand their similarities and differences, and explain which features or pond types we need to protect.

This information can be used to give better management advice for ponds. For example, surveys of natural ponds provide important insights into how to manage ponds which dry out or become shaded (see 'New approaches to pond management', which is enclosed with this report).

(v) prioritising ponds for protection

Classification of pond types can, together with an understanding of what influences conservation value, provide information which enables ponds to be prioritised for protection.

1.4 What's been done so far, and what's left to do

1.4.1 Work completed

The following work on the NPS has been completed:

- (ii) Methods development and testing.
- (ii) Collection and sorting of invertebrate samples from all ponds.
- (iii) Field survey and identification of plants from 90% of ponds.
- (iv) Collection of environmental data from 90% of ponds.
- (v) Identification of 60% of sorted invertebrate samples.
- (vi) Provisional analysis of plant data.
- (vii) Provisional analysis of invertebrate data.
- (viii) Chemical analysis of water from all ponds.

1.4.2 Work in progress

The work to be completed is:

- (i) Identification of the remaining 40% of invertebrate samples.
- (ii) Entering of all data onto central data base, and checking the data.
- (iii) Checking of plant data information in database.
- (iv) Collection of desk study data e.g. grid reference, geology.
- (v) Final calculations from field data (eg pond size, areas of vegetation stands).
- (vi) Entering of field and map information into the data base.
- (vii) Analysis of biological data and correlation against physical and environmental variables.
- (viii) Assessment of conservation value and influences.

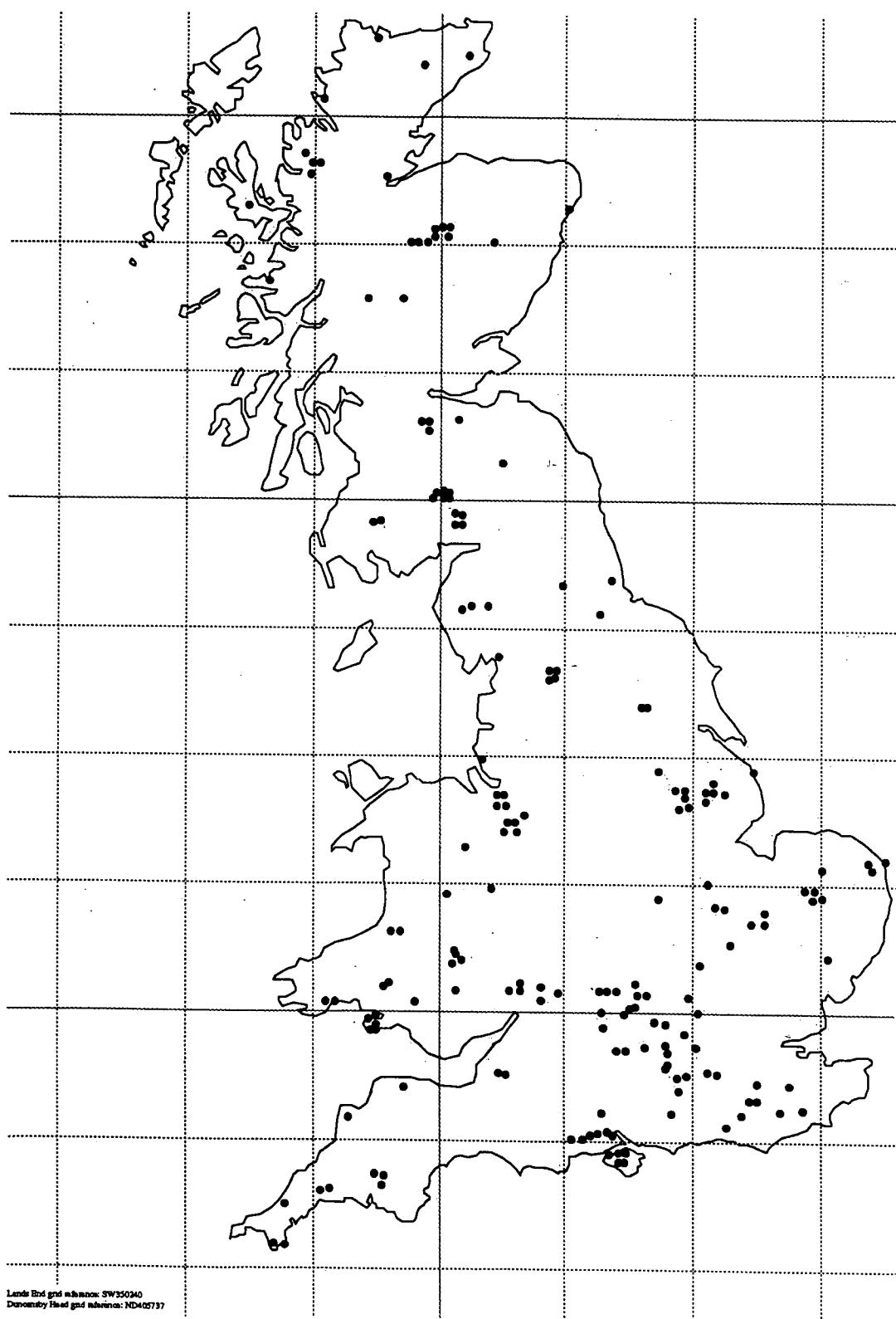
This work will continue to be funded by Pond Action by cross-subsidising from other areas of the group's work.

1.5 Content of the report

The report has three sections:

- (i) a description of the richness of the flora of the ponds surveyed, together with a preliminary classification of the plant communities.
- (ii) a description of the richness of the fauna of the ponds surveyed, together with a preliminary classification of the invertebrate communities.
- (iii) conclusions from the survey to date.

Figure 1. Distribution of ponds surveyed during the National Pond Survey (1989-1993): 181 sites.



2. WILDLIFE OF THE PONDS

2.1 Introduction

This section describes the provisional results of the National Pond Survey with analysis of the plants from 137 ponds and the invertebrates from 110 ponds. A list of the ponds surveyed is given in Appendix 1.

2.2 Wetland plants

2.2.1 Recording wetland plant species

The wetland plant species present at each pond were recorded during summer 1990-93. At each site a list was compiled of all wetland plant species growing within the outer edge of the pond. Plant abundance was recorded by plotting the distribution of major stands of wetland vegetation on to a base map. A detailed description of the methods used for plant surveys is given in the NPS Methods Booklet (Pond Action, 1994a). Raw data from the plant survey is given in Appendix 2.

Uncommon plant species (ie species which have relatively restricted distribution in Britain) recorded from the ponds have been divided into six groups. With increasing degree of rarity these are: local, nationally notable B(NNB), nationally notable A (NNA), Red Data Book 3 (RDB3), Red Data Book 2 (RDB2) and Red Data Book 1 (RDB1). Descriptions of the terminology are given in Pond Action (1994b).

2.2.2 Number of wetland plant species

A total of 215 wetland plant species were recorded from the 137 ponds. This represents 65% of the British wetland flora (55% of the aquatic species and 70% of the emergent species).

The number of wetland species recorded from individual ponds ranged from one to 59, with an average per pond of 17 (see Table 1). The richest ponds were generally larger sites with extensive shallow marginal drawdown areas. However, size was not the only influence on species number: the richest 10% of sites included a number of small Cheshire marl pits which were less than 0.3ha in area.

The average number of emergent species recorded per pond was 17.5. The smallest number recorded from any pond was one - from a tiny bare tree-fall pond in floodplain woodland in the New Forest which supported only the grass Creeping Bent (*Agrostis stolonifera*). The maximum number of emergents recorded was 43 - from an old Hampshire gravel pit.

Aquatic species (including both submerged plants and those with floating leaves) were much less common than the emergent herbs and grasses. The average number of species per pond was only 5 and 5% of sites supported one or no aquatic species. The largest number of aquatics recorded at any pond was 16 - again from a Hampshire gravel pit.

Table 1. Numbers of plant species recorded during the NPS.

	Aquatic plants	Emergent plants	Total
Number of species			
Total no. of spp recorded	55	157	215
Percentage of the British flora	55%	70%	65%
Mean no. of spp per pond	5.1	17.5	22.6
Range of spp. per pond	0-16	1-44	1-59
Uncommon species			
Total no. of local spp.	27	37	64
Total no. of NNB spp.	4	4	8
Total no. of NNA spp.	1	3	4
Total no. of RDB3 spp.	1	0	1
Total no. of RDB2 spp.	0	0	0
Total no. of RDB1 spp.	0	0	0

2.2.3 Uncommon wetland plant species

A considerable number of uncommon wetland plant species were recorded during the NPS (see Table 1) and most ponds supported at least one species which could be considered to be nationally local. Overall, 19.5% of the emergent plant species recorded fell into 'uncommon species' category. Amongst the aquatics the total was considerably higher (60%). This very high proportion is likely to reflect the current paucity of unpolluted freshwater habitats in Britain.

Eight of the plant species recorded had Nationally Notable status (see Table 2) and one, slender marsh bedstraw (*Galium debile*), was RDB3.

Table 2. List of uncommon wetland plants recorded during the NPS.

Species	Rarity status
Elatine hexandra	Six-stamened Waterweed
Potamogeton coloratus	Fen Pondweed
Cladium mariscus	Great Fen-sedge
Pilularia globulifera	Pillwort
Nuphar pumila	Least water-lily
Cicuta virosa	Cowbane
Lathyrus palustris	Marsh Pea
Peucedanum palustre	Milk Parsley
Galium debile	Slender marsh bedstraw
	RDB3

2.2.4 Comparison with other studies

A number of other regional studies are available for comparison with the NPS data. The most comprehensive of these studies have been reviewed and, where necessary, modified so that species lists are directly comparable with the NPS recording list.

The results, presented in Tables 3 and 4, show that the total number of species recorded from the NPS was consistently higher than most regional studies. In part, this is because the NPS covers a much wider geographical range than any of the regional surveys. However the very high average number of species per pond (two to three times that of some other surveys) almost certainly reflects the fact that a very high proportion of sites were located in areas of semi-natural land use. This adds to the body of evidence from the Oxfordshire Pond Survey (Pond Action, 1994) which suggests that relatively unpolluted ponds located in natural surrounds are richer in species (and more likely to support uncommon species) than ponds in the wider countryside.

Table 3. Number of plant species recorded from the NPS and other pond surveys.

	No. of ponds	All species		Aquatic species		Marginal species	
		average	range	average	range	average	range
National Pond Survey	137	22.6	1-59	5.1	0-16	17.5	1-44
Oxfordshire Pond Survey	36	17.7	1-44	4.4	0-11	13.3	1-33
Dorset (Friday 1988)	16	8	2-15	3	1-7	5	1-9
Cheshire (Brian et al. (1987)	153	9	0-23	2	-	7	-
Clwyd (Day 1981)	406	14	0-30	2.5	-	11.5	-
Milton Keynes (Ridge and Furniss 1985)	117	7.5	-	1.5	-	6	-

Table 4. Number of uncommon plant species recorded from ponds the NPS and other regions.

	Number of ponds	Number of spp.	No. of local spp.	No. of NNB spp.	No. of NNA spp.
National Pond Survey	137	215	64	8	5
Oxfordshire Pond Survey	36	118	36	2	0
Dorset (Friday 1988)	16	31	4	0	0
Cheshire (Brian et al. (1987)	153	79	15	0	1
Clwyd (Day 1981)	406	114	26	1	2
Milton Keynes (Ridge and Furniss 1985)	117	89	11	1	0

2.3 TWINSPAN and DECORANA analysis of plant communities

2.3.1 Methods

The plant species lists recorded from the ponds were analysed using the computer programmes TWINSPAN and DECORANA. Both work by arranging samples in an order of similarity of community composition. TWINSPAN (Two Way INdicator SPecies ANalysis) is a means of classification which produces a dendrogram showing the relationship between sites. It also lists the indicator species (in this case plants) which are important in determining the classification.

2.3.2 TWINSPAN classification of plant communities

Classification of the pond's plant communities using TWINSPAN resulted in eight end groups (see Figure 2).

Overall ponds on the left of the TWINSPAN plot (Groups 1-4) are relatively neutral or alkaline ponds of lowland England and Wales. Ponds to the right of the plot (Groups 5-8) are predominantly acid ponds, unusually supporting *Sphagnum* and cotton grass. They often occur in moorland, and become progressively more northerly in location to the right of the plot. The distinguishing features of individual TWINSPAN groups are described below.

Group 1

A small distinctive group of ponds, all located on fen peat in East Anglia (the Norfolk Broads and Wicken Fen).

Group 2

A large group of sites, all essentially neutral, lowland ponds of central and southern England. If the sites are split further by another division of TWINSPAN they divide more-or-less in half into (i) small to medium clay based ponds and (ii) larger sand or gravel based ponds.

Groups 3 and 4

Two groups with a high degree of overlap on the DECORANA plot (see Figure 3). Most are small ponds of lowland Scotland and Wales but they also include small ponds located on acid substrates (sand and gravel) in Hampshire and Sussex and one pond in the Norfolk coastal dunes.

Group 5

Group 5 comprises mostly small shallow ponds on unimproved moorland grassland in England and Wales.

Group 6

These ponds are generally more northerly - occurring either in Yorkshire (Malham Tarn) or in Scotland. Often located in areas of bog or heather moorland.

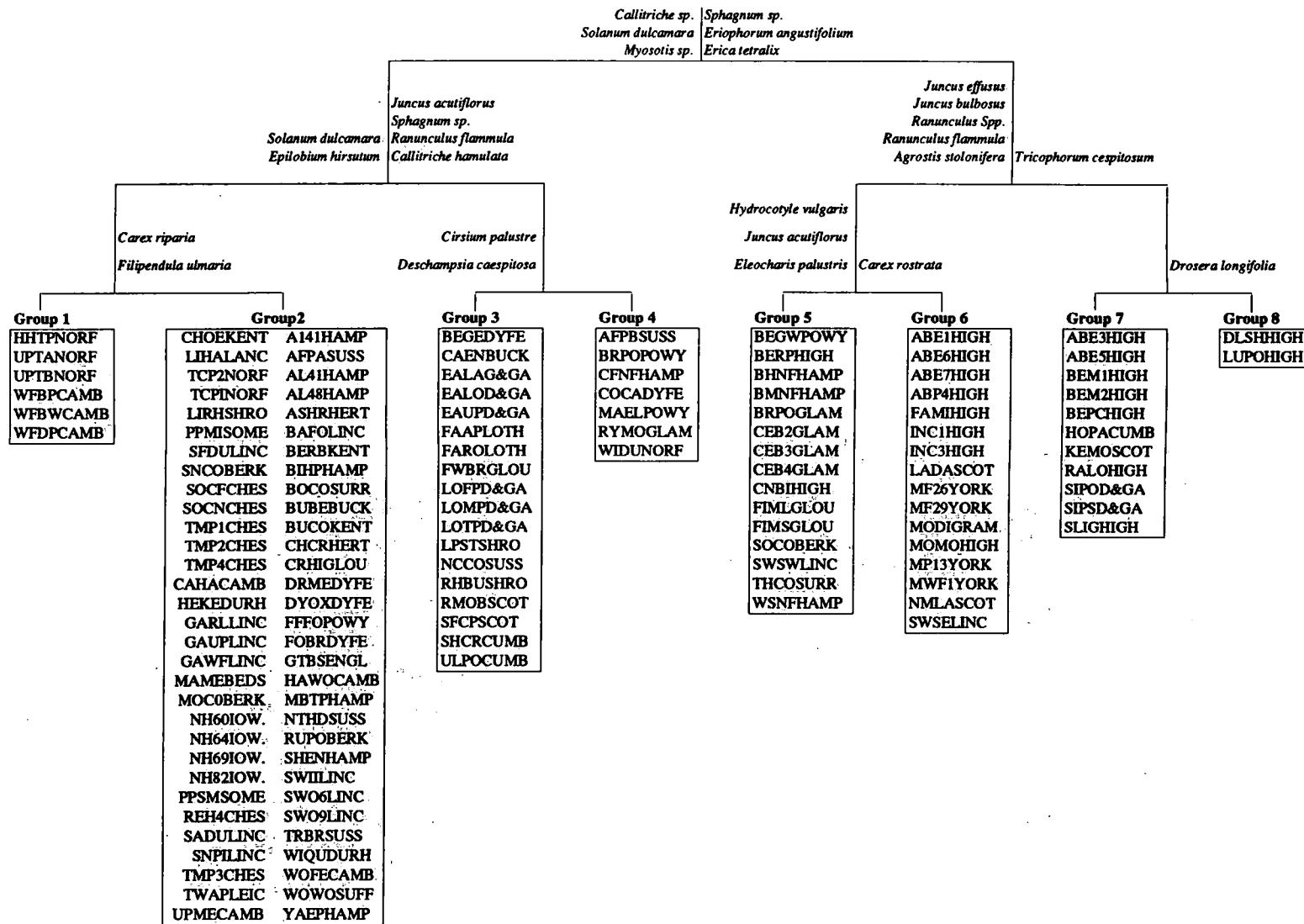
Group 7

This group of ponds are all located in mountainous areas of Scotland or the Lake District - again typically in areas of bog or heather moorland.

Group 8

Group 8 only contains two ponds. Both are located in the very north of Scotland.

Figure 2. TWINSPAN dendrogram showing NPS plant communities

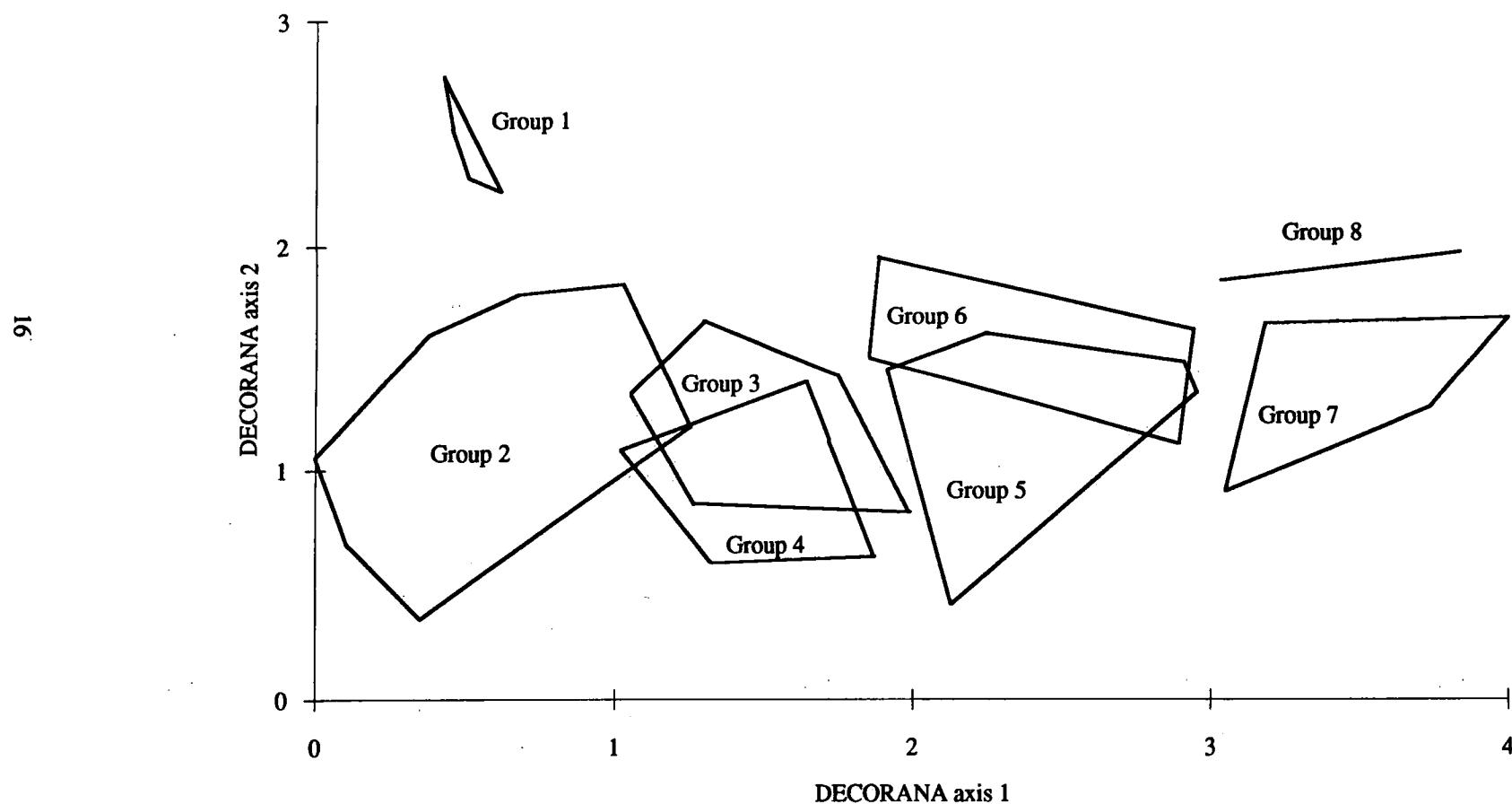


2.3.3 DECORANA analysis of plant communities

DECORANA (DEtrended CORespondance ANAlysis) is a complementary programme which assesses community composition in terms of major variations in community structure. The principal variation in community structure is shown by the first axis, the next major variation by the second axis etc.

Figure 3 shows the axes of the DECORANA plot, with each polygon enclosing the DECORANA co-ordinates in each TWINSPAN end group. As with TWINSPAN the main axis of variation (Axis 1) appears to primarily reflect pH and geographical location, with neutral or alkaline sites to the left of the axis and acid upland sites to the right. The second axis largely separates out the alkaline fen ponds of eastern England (Wicken fen and the Norfolk Broads) from all other sites. This is similar to the results of analysis from the Oxfordshire Pond Survey which also separated-out ponds located in areas of fen (Pond action 1994b).

Figure 3. DECORANA ordination of NPS sites showing differences between plant communities



2.4 Aquatic macroinvertebrates from the NPS

2.4.1 Methods

Aquatic macroinvertebrate samples were collected from each pond using a hand-net. The sampling was time-limited, with a three-minute sampling period allocated to each pond. This time period was split equally between the different microhabitats identified in the pond (e.g. gravel bottom, earth banks, plant communities of different compositions etc.). Typically between three and eight microhabitats were sampled in each pond. Samples were taken to the laboratory where macroinvertebrates were removed for identification and counting. Identification to species level was undertaken for invertebrate groups listed in Table 5. A detailed description of the methods used for invertebrate surveys is given in the NPS Methods Booklet (Pond Action, 1994a). Raw data from the survey is given in Appendix 4.

2.4.2 Results of macroinvertebrate surveys

The following section discusses the result of the main invertebrate data set, for which approximately 60% of samples have been identified to date. It also includes statistical analysis of 111 single-season samples using TWINSPAN and DECORANA.

2.4.3 Number of all aquatic macroinvertebrates

A summary of the numbers of species of invertebrates within the major groups recorded is given in Table 5 together with the percentage of the British fauna which these numbers represent. In addition the number (and %) of species in each of the groups which are likely to be found in still freshwater habitats alone has been estimated from studies of the literature.

A total of 407 aquatic macroinvertebrate species have been recorded from the National Pond survey ponds to date. Within the groups which were identified to species level this represents approximately 55% of the British freshwater fauna as a whole and approximately 65% of those species which are likely to be found in still freshwater (ie excluding obligate brackish and running water species). Species recorded are listed in Appendix 4.

The high percentage of the British list recorded so far indicates how important ponds are as a nature conservation resource.

2.4.4 Description of invertebrate groups

Flatworms and leeches

Eight species of flatworm have been recorded from the NPS ponds. This represented two thirds of the British freshwater fauna and approximately 80% of all the species likely to be recorded from ponds in Britain.

Sixteen species of leech occur in Britain. All are amphibious or aquatic and most (14) are quite likely to occur in ponds at some time. The 10 species recorded during the NPS represent 63% of the total freshwater fauna.

Table 5. Number of species of macroinvertebrates in major groups recorded from the National Pond Survey

Group		Local	NNB	NNA	RDB3	RDB2	RDB1	NPS Total	UK Total	% UK Total	Pond Total	% Pond Total ¹
Flatworms	(Tricladida)	1	1	-	-	-	-	8	12	67%	10	80%
Snails	(Gastropoda ²)	1	1	-	-	2	2	33	44	75%	36	92%
Leeches	(Hirudinea)	2	1	-	-	-	-	10	16	63%	14	71%
Spiders	(Araneae)	-	-	-	-	-	-	1	1	100%	1	100%
Shrimps/slaters	(Malacostraca)	2	1	-	-	-	-	8	41	20%	14	57%
Mayflies	(Ephemeroptera)	3	-	-	-	1	-	20	49	41%	18	111%
Stoneflies	(Plecoptera)	2	-	-	-	-	-	13	34	38%	10	130%
Dragonflies	(Odonata ³)	3	6	1	-	-	-	28	45	62%	35	80%
Bugs	(Hemiptera)	13	2	1	1	-	-	54	63	86%	61	89%
Beetles	(Coleoptera ⁴)	18	56	7	9	1	1	172	273	63%	226	76%
Alderflies	(Megaloptera)	-	-	-	-	-	-	1	3	33%	1	100%
Caddisflies	(Trichoptera ⁵)	14	2	2	1	-	-	59	168	35%	90	65%
TOTAL		59	68	11	11	4	3	407	742	55%	529	77%

Key

*¹ Species possibly found in ponds (e.g. excludes obligate brackish and running water species)

*² Aquatic Gastropoda are as defined in Macan (1975).

*³ The two species *Coenagrion puella* and *Coenagrion pulchellum* are inseparable as larvae.

*⁴ Aquatic Coleoptera are limited to those described in Friday (1988).

*⁵ Excluding the Hydroptilidae which are rarely identifiable as larvae.

Snails

Snails are well represented in the data set, with a total of 33 species recorded. This represents approximately 75% of British aquatic snails and 92% of the British stillwater snail fauna. Of the snail species which are absent, almost all are brackish water, or exclusively riverine, species.

Malacostracan crustaceans (shrimps, slaters and crayfish)

Very few species of shrimps or slaters were found during the NPS, a reflection of the brackish and sometimes subterranean nature of the habitats of many of this group. The eight species recorded represent about 20% of the species likely to be found in freshwater, but 57% of the species which are likely to be found in ponds.

Mayflies and Stoneflies

Mayflies and stoneflies are poorly represented in the NPS database, largely because the majority of species are riverine. Of the 49 British mayflies and 34 stoneflies only 18 and 10 respectively, are typical of still water habitats. In fact the NPS supported more than 100% of the species which were likely to be found in ponds because it included a number of river species.

Dragonflies (dragonflies and damselflies)

Dragonflies and damselflies are well represented in the NPS database, with the 28 species recorded, representing 80% of the British stillwater species.

Bugs

Most of the aquatic bugs are still-water species and they were therefore particularly well represented in the ponds. In total, 86% of the British list (54 species) were recorded.

Beetles

Water beetles are a very diverse group, and ponds can provide an important habitat for them - over 80% of the aquatic species are likely to occur in still freshwater habitats. It is therefore not surprising that water beetles represented by far the most diverse group in the NPS data set. A total of 172 species were recorded from the 111 ponds, which was approximately 42% of all the invertebrate species recorded during the survey.

Alderflies

There are only three species of alderfly in Britain and two of these are exclusively riverine. The remaining species (*Sialis lutaria*) is more of a generalist which can live in both still and running waters and was widespread in the ponds surveyed.

Caddisflies

In total, 59 species of caddisfly were recorded during the NPS - approximately 35% of the British fauna and 65% of the species likely to be found in still freshwater. The relatively low percentage of the fauna recorded is likely to partly reflect the restriction of many caddisflies to riverine habitats. In addition some are mainly found in temporary waters and often emerge very early in the year (at the beginning of March in many cases). This means that the NPS surveys will inevitably have missed some of the species which emerge at this time.

2.4.5 Uncommon macroinvertebrate species

Over one third (38%) of the invertebrate species recorded from the 34 ponds were uncommon (ie local, notable or Red Data Book). The national distribution status of the most uncommon (ie Red data book species) are given in Appendix 5.

2.5 TWINSPAN and DECORANA analysis of macro-invertebrate communities

2.5.1 Methods

Invertebrate communities were analysed using the computer programmes TWINSPAN and DECORANA (see section 2.3 above).

2.5.2 TWINSPAN classification of macroinvertebrate communities

Classification of the pond's invertebrate communities using TWINSPAN resulted in 16 end groups (See Figure 4).

Overall ponds on the left of the TWINSPAN plot (Groups 1-10) are relatively neutral or alkaline ponds of lowland England and Wales. Ponds to the right of the plot (Groups 11-16) are increasingly acid in chemistry (on heath or moorland) and more northerly in location to the right of the plot.

Groups 1 and 2

These are large gravel pits in lowland southern Britain

Groups 3 and 4

Sites at Wicken Fen and small sand or gravel pits in lowland southern Britain.

Group 5

Most are medium sized ponds with rapid water turnover: either gravel pits fed by groundwater, or spring fed ponds in areas of chalk or limestone lithologies. All lie in lowland England.

Group 6

A heterogeneous group of small or medium sized ponds from Lowland England.

Group 7 and 8

These groups are composed mainly of small, shallow sites with a significant inflow and sites on river floodplains.

Groups 9 and 10

These groups are shallow sites which are prone to drying out, almost all are in neutral sites in lowland southern England.

Groups 11 and 12

These groups also include small shallow sites which are prone to drying out, however, unlike Groups 9 and 10 most are more acidic in character and from Wales.

Groups 13 and 14

These are mainly small acidic sites located in moorland, heathland or upland grassland.

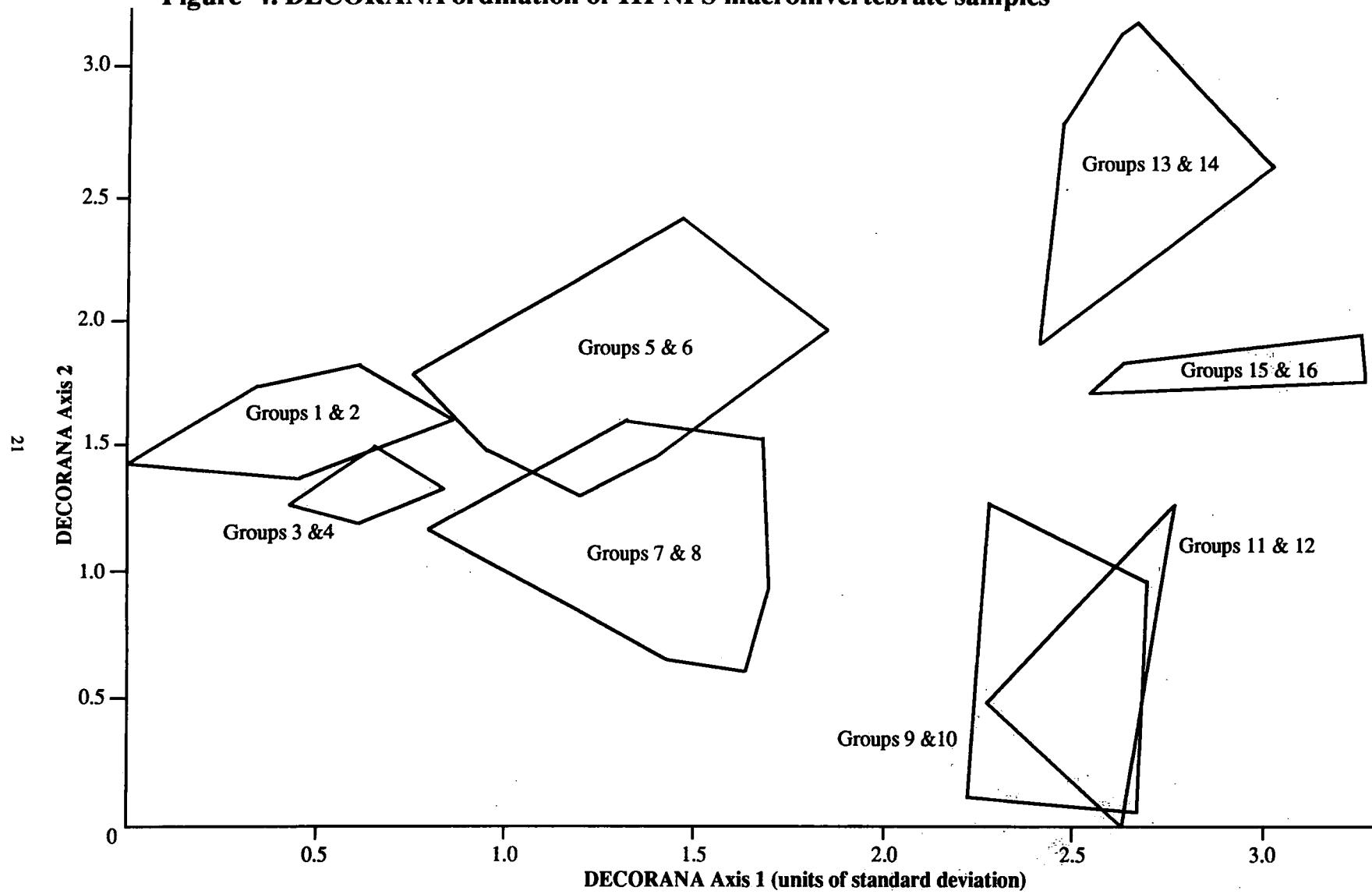
Groups 15 and 16

Upland moorland or mountain sites in Scotland.

2.5.3 DECORANA analysis of invertebrate communities

The main axis of variation in the DECORANA analysis (Axis 1) seems to mainly reflect acidity, with neutral or alkaline ponds to the left of the axis and acid ponds to the right. Axis 2 seems to be partly an axis of permanence, with temporary ponds at the bottom of axis 2 and more permanent ponds towards the top (see Figure 4).

Figure 4. DECORANA ordination of 111 NPS macroinvertebrate samples



3. REFERENCES

Pond Action (1994a) National Pond Survey Methods Booklet. Pond Action.

Pond Action (1994b) Oxfordshire Pond Survey. Pond Action.

APPENDICES

Appendix 1. Ponds surveyed during the National Pond Survey

County	Grid ref.	Site code	Site Name
Bedfordshire	TL059383	MAME	Maulden Meadow
Berkshire	SU636740	MOCO	Moor Copse SSSI
Berkshire	SU798765	RUP0	Ruscombe Pond
Berkshire	SU460710	SNCO	Snelsmore Common SSSI
Berkshire	SU413707	SOCO	Sole Common SSSI
Buckinghamshire	SU949845	BUBE	Burnham Beeches Upper Pond
Buckinghamshire	SU794927	CAEN	Cadmore End Common
Buckinghamshire	SU749938	IBCO	Ibstone Common
Cambridgeshire	TF119015	CAHA	Castor Hanglands Main Pond
Cambridgeshire	TL299532	HAWO	Hayley Wood
Cambridgeshire	TL253825	UPME	Upwood Meadow
Cambridgeshire	TL561706	WFBW	Wicken Fen Boardwalk Pond 77B
Cambridgeshire	TL560707	WFBP	Wicken Fen Brick Pit 76A
Cambridgeshire	TL560707	WFDB	Wicken Fen Ditch Pond 78E
Cambridgeshire	TL225838	WOFE	Woodwalton Fen Experimental Pond
Cheshire	SJ634542	REH4	Rease Heath Pond 4
Cheshire	SJ619480	SOCF	Sound Common Main Pond
Cheshire	SJ624482	SOCN	Sound Common North Pond
Cheshire	SJ624481	SOSP	Sound Common South Pond
Cheshire	SJ639479	SOFP	Sound French Lane Field Pond
Cheshire	SJ538616	TMP1	Tiverton Marl Pit 1
Cheshire	SJ538617	TMP2	Tiverton Marl Pit 2
Cheshire	SJ534616	TMP3	Tiverton Marl Pit 3
Cheshire	SJ535616	TMP4	Tiverton Marl Pit 4
Cornwall	SW726182	BRCO	Brays Cott
Cornwall	SX056611	BRSH	Breney Shallow
Cornwall	SX072623	REDM	Redmoor
Cornwall	SW696158	RUP0	Ruan Pool
Cornwall	SW781512	VEMO	Ventongimps Moor
Cumbria	NY231147	HOPA	Honister Pass Pool
Cumbria	NY258181	SHCR	Shepherds Crag Cut-Off Pond
Cumbria	NY397179	ULPO	Ullswater Pool
Devon	SX552652	CABR	Cadover Bridge NE Pond
Devon	SX566735	FQMP	Foggintor Quarry Main Pond
Devon	SX566734	FQSP	Foggintor Quarry Small Pool
Devon	SS280180	MEGR	Meddon Green
Devon	SS725425	PIPO	Pinkerley Pond
Durham	NZ281109	HEKE	Hell Kettles
Durham	NY990330	SIBP	Stanhope Bog Pool
Durham	NZ374374	WIQU	Wingate Quarry
Gloucestershire	SO91	CRHI	Crickley Hill
Gloucestershire	SO658164	FIML	Micheldean Fairplay Iron Mine Main
Gloucestershire	SO658165	FMIS	Micheldean Fairplay Iron Mine Small
Gloucestershire	SO658168	FWBR	Micheldean Fairplay Westbury Brook Res.
Gloucestershire	SO820193	OVNP	Over North Pond (Azolla)

Appendix 1. Ponds surveyed during the National Pond Survey
 (cont.)

Gloucestershire	SO820193	OVSP	Over South Pond (Lemma)
Hampshire & IOW	SU889514	AL41	Aldershot Site 41 (Proposal)
Hampshire & IOW	SU885515	AL48	Aldershot Site 48
Hampshire & IOW	SU146026	BLHP	Blashford Pond 102
Hampshire & IOW	SU380056	BHNF	Buck Hill Pond
Hampshire & IOW	SU211047	BMNF	Burley Moor East
Hampshire & IOW	SU199021	CFNF	Chubbs Farm Pond, Burley
Hampshire & IOW	SU808617	EV02	Eversley Site 2
Hampshire & IOW	SU813620	EV2A	Eversley Site 2a
Hampshire & IOW	SU336075	MBTP	Matley Bog Tree Pool
Hampshire & IOW	SZ438912	NH60	Newtown Harbour Pond 60
Hampshire & IOW	SZ348916	NH64	Newtown Harbour Pond 64
Hampshire & IOW	SZ432918	NH69	Newtown Harbour Pond 69
Hampshire & IOW	SZ430921	NH70	Newtown Harbour Pond 70
Hampshire & IOW	SZ442908	NH82	Newtown Harbour Pond 82
Hampshire & IOW	SU293221	SHEN	Sherfield English
Hampshire & IOW	SU272062	WSNF	Warwickslade
Hampshire & IOW	SU873574	YA24	Yateley Site 24
Hertfordshire	SP982126	ASHR	Ashridge
Hertfordshire	TL047013	CHCR	Chipperfield Common Roadside
Kent	TQ861254	BERB	Beckley Raised Bog'
Kent	TQ679247	BUCO	Burwash Field Pond
Kent	TQ510469	CHOE	Chiddingstone
Kent	TQ762445	MAME	Marden Meadow
Lancashire	SD480770	LIHA	Little Haweswater
Leicestershire	SP742897	GRBO	Great Bowden
Leicestershire	SK742897	TWAP	Twenty Acre Piece
Lincolnshire	TF153736	BAFO	Bardney Forest Pond
Lincolnshire	TF165733	GARL	Gaultby Red Lane Pond
Lincolnshire	TF175723	GAVP	Gaultby Viners Pond
Lincolnshire	TF166736	GAWF	Gaultby Wood Farm Pond
Lincolnshire	TF482895	SADU	Saltfleetby Dunes NNR
Lincolnshire	TF116716	SNPI	Snakeholme Pit
Lincolnshire	SK945685	SW06	Swanholme Lakes Site 6
Lincolnshire	SK946686	SW09	Swanholme Lakes Site 9
Lincolnshire	SK939685	SW11	Swanholme Lakes Site 11
Lincolnshire	SK945687	SWSE	Swanholme Lakes Sphagnum East
Lincolnshire	SK946687	SWSW	Swanholme Lakes Sphagnum West
Norfolk	TL993894	HOPO	Horworts Pond
Norfolk	TG366190	HHTP	How Hill Turf Pond
Norfolk	TM010911	SAFP	Snetterton Arable Field Pond
Norfolk	TL938961	TCP1	Thompson Common Pingo 1
Norfolk	TL939964	TCP2	Thompson Common Pingo 2
Norfolk	TG392133	UPTP	Upton Tree Pool
Norfolk	TG497201	WIDU	Winterton Dunes
Norfolk	TG005125	WYGP	Wymondham Gravel Pit

Appendix 1. Ponds surveyed during the National Pond Survey
 (cont.)

Oxfordshire	SP595135	ASME	Asham Meads
Oxfordshire	SP559055	BRWP	Brasenose Wood Newt Pond
Oxfordshire	SP569145	CEPO	Central Pond, Otmoor
Oxfordshire	SU468996	DSMP	Dry Sandford Pit Main Pond
Oxfordshire	SP572141	FOPI	Fowl's Pill, Otmoor
Oxfordshire	SP289001	FCLR	Friars Court Farm Little Rudge
Oxfordshire	SP518033	KEPO	Kennington Pit
Oxfordshire	SU306893	UFVP	Uffington Village Pond
Oxfordshire	SP339169	WYC1	Wychwood Forest New Hill 1
Oxfordshire	SP338169	WYC2	Wychwood Forest New Hill 2
Oxfordshire	SP338170	WYC3	Wychwood Forest New Hill 3
Shropshire	SJ223287	LLFR	Llyn Rhuddwyn (Trefonen)
Shropshire	SJ355977	LPST	Long Pool, Stiperstones
Shropshire	SO425965	RHBU	Robin Hood's Butts (Wildmoor Pool)
Somerset	ST545518	PPM1	Priddy Pool 1
Somerset	ST528537	PRP2	Priddy Pool 2
Suffolk	TM055442	WOWO	Wolves Wood
Surrey	TQ124558	BOCO	Bookham Common
Surrey	TQ204541	HEHE	Headley Heath (Heath End House)
Surrey	TQ030736	STMB	Staines Moor Butts Pond
Surrey	SU903406	THCO	Thursley Common
Sussex	TQ446328	AFPA	Ashdown Forest Pond A
Sussex	TQ447329	AFPB	Ashdown Forest Pond B
Sussex	TQ272124	NTHD	Newtimber Hill Dew Pond
Sussex	TQ384206	NCCO	North Chailey Common
Sussex	SZ837224	TRBR	Trotton Bridge
Yorkshire	SD886671	MF26	Malham Tarn Mid Fen Pond 26
Yorkshire	SD886672	MF29	Malham Tarn Mid Fen Pond 29
Yorkshire	SD882668	MP13	Malham Tarn Pinewood Pond 3
Yorkshire	SD883671	MWF1	Malham Tarn West Fen Pond 1
Yorkshire	SE649391	SKPI	Skipwith Piliwort Pond
Yorkshire	SE650390	SKWD	Skipwith Wash Dyke Pond

Appendix 1. Ponds surveyed during the National Pond Survey

Scotland	ND230470	DLSH	Dubh Loch of Shielton
Scotland	NM655705	KEMO	Kentra Moss
Scotland	NN718573	LADA	Lochan An Daime
Scotland	NC510600	LNML	Lochan Nam Muir Lath
Scotland	NC880400	Lupo	Lucy Pool
Scotland	NT161637	RMOB	Red Moss of Balerno
Scotland	NK032277	SFCP	Sands of Forvie Coastgaurd Pool
Scotland	NT506286	WHRP	Whitlaw Retting Pool
Scotland: Dumfries & Galloway	NY122890	LOFP	Lockerbie Auchenroddan Flight Pond
Scotland: Dumfries & Galloway	NY126886	LOLP	Lockerbie Auchenroddan Lower Pond
Scotland: Dumfries & Galloway	NY126886	LOMP	Lockerbie Auchenroddan Middle Pond
Scotland: Dumfries & Galloway	NY126886	LOTP	Lockerbie Auchenroddan Top Pond
Scotland: Dumfries & Galloway	NT050017	EALA	Moffat Earshaig 'Earshaig Lake'
Scotland: Dumfries & Galloway	NT047027	EALP	Moffat Earshaig Lower Pond
Scotland: Dumfries & Galloway	NT045029	EAUP	Moffat Earshaig Upper Pond
Scotland: Dumfries & Galloway	NT040013	MKF1	Moffat Kinnelhead Forest Pond 1
Scotland: Dumfries & Galloway	NT040014	MKF2	Moffat Kinnelhead Forest Pond 2
Scotland: Dumfries & Galloway	NT040015	MKF3	Moffat Kinnelhead Forest Pond 3
Scotland: Dumfries & Galloway	NX474827	SIPO	Silver Pond
Scotland: Dumfries & Galloway	NX476833	SIPS	Silver Pool System
Scotland: Grampian	NJ434012	MODI	Muir of Dinnet Lochan
Scotland: Highland	NJ029118	ABP1	Abernethy Pond 1
Scotland: Highland	NJ029129	ABP3	Abernethy Pond 3
Scotland: Highland	NJ028130	ABP4	Abernethy Pond 4
Scotland: Highland	NJ029117	ABP5	Abernethy Pond 5
Scotland: Highland	NJ031117	ABP6	Abernethy Pond 6
Scotland: Highland	NG990636	BEM2	Bienn Eighe Mountain No. 2
Scotland: Highland	NG932711	BEPC	Bienn Eighe Peat Cuts
Scotland: Highland	NG995634	BEM1	Bienn Eighe Pool 1
Scotland: Highland	NG974678	BERP	Bienn Eighe Roadside Pond
Scotland: Highland	NC072128	CNBI	Creag na Braiste, Inverpolly NNR
Scotland: Highland	NH836022	INS1	Inshriach (Uath Lochan) 1
Scotland: Highland	NH838020	INS2	Inshriach (Uath Lochan) 2
Scotland: Highland	NH834021	INS3	Inshriach (Uath Lochan) 3
Scotland: Highland	TQ577534	MOMO	Monadh Mor Lochan
Scotland: Highland	NN430580	RALO	Rannoch Lochan
Scotland: Highland	NG488289	SLIG	Sligachan
Scotland: Lothian	NS923610	FAAP	Fauldhouse Acid Pond
Scotland: Lothian	NS910621	FAMI	Fauldhouse Mineshaft
Scotland: Lothian	NS928610	FARO	Fauldhouse Roadside 1

Appendix 1. Ponds surveyed during the National Pond Survey

Wales: Dyfed	SN105075	BEGE	Begelly
Wales: Dyfed	SN685627	COCA	Cors Caron
Wales: Dyfed	SN573203	DRME	Dryslwyn Meadows
Wales: Dyfed	SN820077	FOBR	Ford Bridge
Wales: Dyfed	SN606223	DYOX	Pen y Banc Dynefwr Oxbow
Wales: Dyfed	SN106085	THCH	Thomas Chapel
Wales: Dyfed	SN692627	TYLL	Tyn-y-Llyn (Nr. Cors Caron)
Wales: Powys	SO065922	ABER	Aberhafesp (Severn Ox)
Wales: Powys	SO141448	BEGW	Begwns
Wales: Powys	SO116376	BRPO	Brechfa Pool
Wales: Powys	SO187400	FFFA	Fford-fawr
Wales: Powys	SO132485	LLCO	Llandeilo Common (Painscastle)
Wales: Powys	SO138174	MAEL	Maelienydd
Wales: West Glamorgan	SS509910	BRPO	Broad Pool, Gower (Pond 1)
Wales: West Glamorgan	SS508909	CEB2	Cefn Bryn Pond 2 (N of pair)
Wales: West Glamorgan	SS509912	CEB3	Cefn Bryn Pond 3
Wales: West Glamorgan	SS511914	CEB4	Cefn Bryn Pond 4 (W of pair)
Wales: West Glamorgan	SS450922	RYMO	Ryer's Moor Pond

Appendix 2. Wetland plant species lists for the NPS ponds.

Appendix 2. Wetland plants species lists for NPS ponds

Appendix 3. The status of uncommon plants recorded during the NPS

***Galium debile* (Slender Marsh-bedstraw)**

Status: Red Data Book 3

Found at pond margins and pools in areas which dry out in summer. Devon, New Forest and Humberside.

***Cicuta virosa* (Cowbane)**

Status: Nationally Notable A

Found in shallow water, ditches and marshes. Found scattered throughout Great Britain, though local and mainly occurring in East Anglia, Shropshire, Cheshire and SE Scotland.

***Lathyrus palustris* (Marsh Pea)**

Status: Nationally Notable A

In fens and damp grassy and bushy places. Recorded in eastern England from Cambridge to SE Yorkshire and North Somerset.

***Peucedanum palustre* (Milk Parsley)**

Status: Nationally Notable A

Typically found in fens and marshes. Mainly in East Anglia, though present in a few scattered localities elsewhere in the southern half of England.

***Elatine hexandra* (Six-stamened Waterweed)**

Status: Nationally Notable B

Associated with ponds and on wet mud, very local. Found scattered throughout the British Isles. Mainly in the south and west.

***Potamogeton coloratus* (Fen Pondweed)**

Status: Nationally Notable B

Shallow ponds and pools in fen peat, especially in calcareous water. Local throughout the British Isles, northwards to Argyll.

***Cladium mariscus* (Great Fen-sedge)**

Status: Nationally Notable B

Forms dense pure stands in reed-swamp and in fens, usually on neutral or alkaline soils, locally abundant. Recorded thinly scattered over the British Isles north to W Sunderland but frequent only in Norfolk.

***Pilularia globulifera* (Pillwort)**

Status: Nationally Notable B

Typically found at the edges of ponds and lakes often submerged, on acid soils. Recorded from the Outer Hebrides southwards, but absent from many counties including most of the English Midlands.

**Appendix 4
(cont.)**

**Invertebrates recorded during the NPS: status
of the species recorded.**

Species Name	NCI	Common Name	Local	Nat. Cons. Value	Nationally Notable species		Red Data Book species			New Red Data Book species site records		
				B	A	3	2	1	3	2	1	
Libellulidae	8											
<i>Orthetrum cancellatum</i>	2					1						
<i>Orthetrum coerulescens</i>	2					1						
<i>Libellula depressa</i>	1		1									
<i>Libellula quadrimaculata</i>	1		1									
<i>Sympetrum nigrescens</i>	1		1									
<i>Sympetrum sanguineum</i>	4						1					
<i>Sympetrum scoticum</i>	1		1									
<i>Sympetrum striolatum</i>	1		1									
HEMIPTERA												
Mesovelidae	5											
<i>Mesovelia furcata</i>	2					1						
Hebridae	0											
<i>Hebrus pusillus</i>	8						1					
<i>Hebrus ruficeps</i>	2					1						
Hydrometridae	5											
<i>Hydrometa stagnorum</i>	1		1									
Veliidae	0											
<i>Velia caprai</i>	1		1									
<i>Velia saulii</i>	1		1									
<i>Microvelia pygmaea</i>	8						1					
<i>Microvelia reticulata</i>	1		1									
<i>Microvelia umbricola</i>	16							1				
Gerridae	5											
<i>Gerris argentatus</i>	2					1						
<i>Gerris costai</i>	1		1									
<i>Gerris gibbifer</i>	2					1						
<i>Gerris lacustris</i>	1		1									
<i>Gerris lateralis</i>	2					1						
<i>Gerris odontogaster</i>	1		1									
<i>Gerris thoracicus</i>	1		1									
<i>Gerris paludum</i>	8					1						
Nepidae	5						1					
<i>Nepa cinerea</i>	1		1									
<i>Ranatra linearis</i>	2					1						
Naucoridae	5											
<i>Ilyocoris cimicoides</i>	1		1									
Notonectidae	5											
<i>Notonecta glauca</i>	1		1									
<i>Notonecta maculata</i>	1		1									
<i>Notonecta obliqua</i>	1		1									
<i>Notonecta marmorea</i>	1		1									
Pleidae	5											
<i>Plea leachi</i>	1		1									

**Appendix 4
(cont.)****Invertebrates recorded during the NPS: status
of the species recorded.**

Species Name	Nat Cons Value			Nationally Notable species	Red Data Book species			New Red Data Book species site records				
	NCI	Comm n	Local		B	A	3	2	1	3	2	1
Corixidae	5											
<i>Micronecta scholtzi</i>	2											
<i>Micronecta poweri</i>	1	1										
<i>Cymatia bondonorffii</i>	2											
<i>Cymatia coleoptrata</i>	2		1									
<i>Glaenocorisa propinqua</i>	1	1										
<i>Callicorixa praestuta</i>	1	1										
<i>Callicorixa wollastoni</i>	1	1										
<i>Corixa affinis</i>	2		1									
<i>Corixa dentipes</i>	2		1									
<i>Corixa panzeri</i>	2		1									
<i>Corixa punctata</i>	1	1										
<i>Hesperocorixa castanea</i>	1	1										
<i>Hesperocorixa linnei</i>	1	1										
<i>Hesperocorixa moesta</i>	1	1										
<i>Hesperocorixa sahlbergi</i>	1	1										
<i>Arctocorixa carinata</i>	1	1										
<i>Arctocorixa germari</i>	1	1										
<i>Sigara dorsalis</i>	1	1										
<i>Sigara distincta</i>	1	1										
<i>Sigara falleni</i>	1	1										
<i>Sigara fossarum</i>	1	1										
<i>Sigara scotti</i>	1	1										
<i>Sigara lateralis</i>	1	1										
<i>Sigara nigrolineata</i>	1	1										
<i>Sigara concinna</i>	2		1									
<i>Sigara limitata</i>	1	1										
<i>Sigara semistriata</i>	1	1										
<i>Sigara venusta</i>	1	1										
<i>Sigara stagnalis</i>	1	1										
COLEOPTERA												
Haliplidae	5											
<i>Brychius elevatus</i>	1	1										
<i>Peltodytes caesus</i>	4						1					
<i>Haliplus confinis</i>	1	1										
<i>Haliplus flavicollis</i>	1	1										
<i>Haliplus fluviatilis</i>	1	1										
<i>Haliplus fulvus</i>	1	1										
<i>Haliplus heydeni</i>	4						1					
<i>Haliplus immaculatus</i>	1	1										
<i>Haliplus laminatus</i>	4						1					
<i>Haliplus lineatocollis</i>	1	1										
<i>Haliplus lineolatus</i>	1	1										
<i>Haliplus obliquus</i>	2		1									
<i>Haliplus ruficollis</i>	1	1										
<i>Haliplus variegatus</i>	16								1			1
<i>Haliplus wehnckeii</i>	1	1										
Hygrobiidae	5											
<i>Hygrobia hermanni</i>	1	1										
Dytiscidae & Noteridae	5											
<i>Noterus clavicornis</i>	1	1										
<i>Noterus crassicornis</i>	4						1					

Appendix 4 (cont.)

Invertebrates recorded during the NPS: status of the species recorded.

Species Name	NCI	Comm n	Local	Nat. Cons. Value		Nationally Notable species			Red Data Book species			New Red Data Book species site records		
				B	A	3	2	1	3	2	1	3	2	1
Dytiscidae & Noteridae	5													
<i>Laccophilus hyalinus</i>	1	1												
<i>Laccophilus minutus</i>	1	1												
<i>Hydrovatus clypealis</i>	8													
<i>Hyphydrus ovatus</i>	1	1												1
<i>Hydroglyphus pusillus</i>	4													1
<i>Hygrotus decoratus</i>	4													1
<i>Hygrotus inaequalis</i>	1	1												
<i>Hygrotus quinquelineatus</i>	4													1
<i>Hygrotus versicolor</i>	2													1
<i>Coelambus confluens</i>	1	1												
<i>Coelambus impressopunctatus</i>	1	1												
<i>Coelambus novemlineatus</i>	4													1
<i>Coelambus parallelogrammus</i>	4													1
<i>Hydroporus angustatus</i>	1	1												
<i>Hydroporus discretus</i>	1	1												
<i>Hydroporus erythrocephalus</i>	1	1												
<i>Hydroporus gyllenhalii</i>	1	1												
<i>Hydroporus incognitus</i>	1	1												
<i>Hydroporus longulus</i>	4													1
<i>Hydroporus marginatus</i>	4													1
<i>Hydroporus melanarius</i>	2													1
<i>Hydroporus memnonius</i>	2													1
<i>Hydroporus morio</i>	2													1
<i>Hydroporus neglectus</i>	4													1
<i>Hydroporus nigrita</i>	1	1												
<i>Hydroporus obscurus</i>	1	1												
<i>Hydroporus palustris</i>	1	1												
<i>Hydroporus planus</i>	1	1												
<i>Hydroporus pubescens</i>	1	1												
<i>Hydroporus striola</i>	1	1												
<i>Hydroporus tessellatus</i>	1	1												
<i>Hydroporus tristis</i>	1	1												
<i>Hydroporus umbrosus</i>	1	1												
<i>Stictonectes lepidus</i>	4													1
<i>Graptodytes flavipes</i>	32													1
<i>Graptodytes granularis</i>	4													1
<i>Graptodytes pictus</i>	1	1												
<i>Porhydrus lineatus</i>	2													1
<i>Potamonectes assimilis</i>	2													
<i>Potamonectes depressus</i>	1	1												
<i>Potamonectes griseostriatus</i>	4													1
<i>Stictotarsus duodecimpustulatus</i>	1	1												
<i>Oreodytes sanmarkii</i>	1	1												
<i>Oreodytes septentrionalis</i>	1	1												
<i>Scarodytes halensis</i>	4													1
<i>Laccornis oblongus</i>	16													1
<i>Copelatus haemorrhoidalis</i>	2													
<i>Platambus maculatus</i>	1	1												
<i>Agabus affinis</i>	1	1												
<i>Agabus arcticus</i>	2													
<i>Agabus bipustulatus</i>	1	1												
<i>Agabus chalconatus</i>	4													1
<i>Agabus congener</i>	2													1
<i>Agabus conspersus</i>	4													1
<i>Agabus didymus</i>	1	1												

**Appendix 4
(cont.)**

**Invertebrates recorded during the NPS: status
of the species recorded.**

Species Name	NCI	Comm n	Local	B	A	Nationally Notable species			Red Data Book species			New Red Data Book species site records		
						3	2	1	3	2	1	3	2	1
<i>Agabus guttatus</i>	1	1												
<i>Agabus labiatus</i>	4							1						
<i>Agabus melanocornis</i>	1	1												
<i>Agabus nebulosus</i>	1	1												
<i>Agabus paludosus</i>	1	1												
<i>Agabus striolatus</i>	32										1			1
<i>Agabus sturmii</i>	1	1												
<i>Agabus uliginosus</i>	4							1						
<i>Ilybius aenescens</i>	4							1						
<i>Ilybius ater</i>	1	1												
<i>Ilybius fenestratus</i>	4							1						
<i>Ilybius fuliginosus</i>	1	1												
<i>Ilybius guttiger</i>	4							1						
<i>Ilybius quadriguttatus</i>	1	1												
<i>Ilybius subaeneus</i>	4							1						
<i>Rhantus exsoletus</i>	1	1												
<i>Rhantus grapii</i>	4							1						
<i>Rhantus suturalis</i>	4							1						
<i>Rhantus suturellus</i>	2					1								
<i>Colymbetes fuscus</i>	1	1												
<i>Hydaticus seminiger</i>	4							1						
<i>Acilius canaliculatus</i>	16										1			1
<i>Acilius sulcatus</i>	1	1												
<i>Dytiscus circumcinctus</i>	8										1			
<i>Dytiscus circumflexus</i>	4							1						
<i>Dytiscus lapponicus</i>	4							1						
<i>Dytiscus marginalis</i>	1	1												
<i>Dytiscus semisulcatus</i>	1	1												
<i>Suphrodytes dorsalis</i>	1	1												
<i>Gyrinidae</i>	5													
<i>Gyrinus bicolor</i>	8									1				
<i>Gyrinus caspius</i>	2					1								
<i>Gyrinus marinus</i>	1	1												
<i>Gyrinus minutus</i>	8									1				
<i>Gyrinus opacus</i>	8									1				
<i>Gyrinus substriatus</i>	1	1												
<i>Gyrinus suffriani</i>	16										1			
<i>Hydrophilidae & Hydraenidae</i>	5													
<i>Hydrochus angustatus</i>	4							1						
<i>Hydrochus elongatus</i>	16										1			1
<i>Helophorus aequalis</i>	1	1												
<i>Helophorus grandis</i>	1	1												
<i>Helophorus brevipalpis</i>	1	1												
<i>Helophorus dorsalis</i>	8										1			
<i>Helophorus flavipes</i>	1	1												
<i>Helophorus granularis</i>	2					1								
<i>Helophorus griseus</i>	4							1						
<i>Helophorus minutus</i>	1	1								1				
<i>Helophorus nanus</i>	4									1				
<i>Helophorus obscurus</i>	1	1												
<i>Coelostoma orbiculare</i>	1	1												
<i>Paracymus scutellaris</i>	1	1												
<i>Hydrobius fuscipes</i>	1	1												
<i>Limnoxenus niger</i>	4							1						

**Appendix 4
(cont.)**

**Invertebrates recorded during the NPS: status
of the species recorded.**

Species Name	NCI	Common	Local	B	A	Nationally Notable species			Red Data Book species			New Red Data Book species site records		
						3	2	1	3	2	1	3	2	1
<i>Anacaena bipustulata</i>	4					1								
<i>Anacaena globulus</i>	1	1												
<i>Anacaena limbata</i>	1	1												
<i>Anacaena lutescens</i>	1	1												
<i>Laccobius biguttatus</i>	2			1										
<i>Laccobius minutus</i>	1	1												
<i>Laccobius atratus</i>	4					1								
<i>Laccobius sinuatus</i>	4						1							
<i>Laccobius striatulus</i>	1	1												
<i>Helochares lividus</i>	4					1								
<i>Helochares punctatus</i>	4						1							
<i>Enochrus affinis</i>	4						1							
<i>Enochrus coarctatus</i>	4						1							
<i>Enochrus fuscipennis</i>	2			1										
<i>Enochrus isotae</i>	16	1							1			1		
<i>Enochrus melanocephalus</i>	4					1								
<i>Enochrus ochropterus</i>	4						1							
<i>Enochrus testaceus</i>	2			1										
<i>Cymbiodyta marginella</i>	2		1											
<i>Chaetarthria seminulum</i>	4					1								
<i>Hydrochara caraboides</i>	64										1			1
<i>Berosus affinis</i>	4					1								
<i>Berosus luridus</i>	4						1							
<i>Berosus signaticollis</i>	4						1							
<i>Cercyon convexiusculus</i>	4					1								
<i>Cercyon marinus</i>	2			1										
<i>Cercyon tristis</i>	4					1								
<i>Cercyon ustulatus</i>	4						1							
Hydrophilidae & Hydraenidae	5													
<i>Ochthebius bicolor</i>	4					1								
<i>Ochthebius dilatatus</i>	1	1												
<i>Ochthebius minimus</i>	1	1												
<i>Ochthebius viridis</i>	4					1								
<i>Hydraena riparia</i>	1	1												
<i>Hydraena testacea</i>	4					1								
<i>Limnebius nitidus</i>	4						1							
<i>Limnebius papposus</i>	4						1							
<i>Limnebius truncatellus</i>	1	1												
Dryopidae	5													
<i>Helichus substriatus</i>	8							1						
<i>Dryops anglicanus</i>	16								1			1		
<i>Dryops luridus</i>	1	1												
<i>Drops similis</i>	16									1			1	
<i>Dryops striatellus</i>	16										1			
Elmidae	5													
<i>Elmis aenea</i>	1	1												
<i>Esolus parallelepipedus</i>	1	1												
<i>Limnius volckmari</i>	1	1												
<i>Oulimnius tuberculatus</i>	1	1												
<i>Riolus cupreus</i>	4					1								
<i>Riolus subviolaceus</i>	4						1							
MEGALOPTERA														
Sialidae	4					1								
<i>Sialis lutaria</i>	1	1												

**Appendix 4
(cont.)**

**Invertebrates recorded during the NPS: status
of the species recorded.**

Species Name	NCI	Comm n	Local	Nat Cons Value		Nationally Notable species		Red Data Book species			New Red Data Book species site records			
				B	A	3	2	1	3	2	1	3	2	1
TRICHOPTERA														
Rhyacophilidae/Glossosomatidae	7													
Rhyacophila dorsalis	1	1												
Rhyacophila oblitterata	1	1												
Hydroptilidae	6													
Agraylea multipunctata	1	1												
Agraylea sexmaculata	2					1								
Tricholeiochiton fagesii	8										1			
Philopotamidae	8													
Psychomyiidae & Ecnomidae	8													
Lype phaeopa	1	1												
Lype reducta	1	1												
Tinodes wáeneri	1	1												
Psychomyiidae & Ecnomidae	8													
Ecnomus tenellus	2				1									
Polycentropodidae	7													
Cyrnus flavidus	1	1												
Cyrnus trimaculatus	1	1												
Holocentropus dubius	1	1												
Holocentropus picicornis	1	1												
Holocentropus stagnalis	1	1												
Plectrocnemia conspersa	1	1												
Plectrocnemia geniculata	1	1												
Polycentropus flavomaculatus	1	1												
Polycentropus irroratus	2	1												
Polycentropus kingi	2	1												
Hydropsychidae	5													
Hydropsyche siltalai	1	1												
Phryganeidae	10													
Agrypnia obsoleta	1	1												
Agrypnia pagetana	2				1									
Agrypnia varia	1	1												
Oligotricha striata	2				1									
Phryganea bipunctata	1	1												
Phryganea grandis	2				1									
Trichostegia minor	1	1												
Brachycentridae	10													
Brachycentrus subnubilus	2				1									
Lepidostomatidae	10													
Crinoecia irrorata	1	1												
Lepidostoma hirtum	1	1												
Limnephilidae	7													
Halesus digitatus	1	1												
Halesus radiatus	1	1												
Melampophylax mucoreus	2				1									
Micropterna sequax	1	1												
Potamophylax cingulatus	1	1												
Potamophylax latipennis	1	1												
Chætopteryx villosa	1	1												
Anabolia nervosa	1	1												
Glyphotaelius pellucidus	1	1												
Grammotaulius nigropunctatus	1	1												

**Appendix 4
(cont.)**

**Invertebrates recorded during the NPS: status
of the species recorded.**

Species Name	NCI	Comm n	Local	B	A	Nationally Notable species			Red Data Book species			New Red Data Book species site records		
						3	2	1	3	2	1	3	2	1
<i>Limnephilus affinis</i>	1	1												
<i>Limnephilus auricula</i>	1	1												
<i>Limnephilus bipunctatus</i>	2		1											
<i>Limnephilus borealis</i>	4				1									
<i>Limnephilus centralis</i>	1	1												
<i>Limnephilus decipiens</i>	2		1											
<i>Limnephilus extricatus</i>	1	1												
<i>Limnephilus flavicornis</i>	1	1												
<i>Limnephilus griseus</i>	1	1												
<i>Limnephilus ignavus</i>	2		1											
<i>Limnephilus lunatus</i>	1	1												
<i>Limnephilus luridus</i>	1	1												
<i>Limnephilus marmoratus</i>	1	1												
<i>Limnephilus rhombicus</i>	1	1												
<i>Limnephilus sparsus</i>	1	1												
<i>Limnephilus stigma</i>	1	1												
<i>Limnephilus subcentralis</i>	8							1						
<i>Limnephilus vittatus</i>	1	1												
<i>Nemotaulius punctatolineatus</i>	16								1				1	
Goeridae	10													
<i>Goera pilosa</i>	1	1												
Beraeidae	10													
<i>Beraea pullata</i>	1	1												
<i>Beraeodes minutus</i>	2		1											
Sericostomatidae	10													
<i>Sericostoma personatum</i>	1	1												
Odontoceridae	10													
<i>Odontocerum albicorne</i>	1	1												
Molannidae	10													
<i>Molanna angustata</i>	1	1												
<i>Molanna palpata</i>	2		1											
Leptoceridae	10													
<i>Atripsodes aterrimus</i>	1	1												
<i>Atripsodes bilineatus</i>	1	1												
<i>Atripsodes cinereus</i>	1	1												
<i>Ceraclea dissimilis</i>	1	1												
<i>Ceraclea senilis</i>	4							1						
<i>Leptocerus tineiformis</i>	1	1												
<i>Mystacides azurea</i>	1	1												
<i>Mystacides longicornis</i>	1	1												
<i>Mystacides nigra</i>	2		1											
<i>Triaenodes bicolor</i>	1	1												
<i>Oecetis lacustris</i>	1	1												
<i>Oecetis ochracea</i>	1	1												
<i>Oecetis testacea</i>	2		1											

Appendix 5

Notes on Red Data Book (Rare, Vulnerable And Endangered) species recorded by Pond Action during the National Pond Survey

GASTROPODA

Segmentina nitida (GASTROPODA: Planorbidae). The Shiny Ramshorn.

RDB1. Considered endangered in Britain, this snail was "locally but widely distributed" northwards as far as Yorkshire in the 19th and early 20th centuries, but has declined dramatically over the past century and since 1965 has been found in "only a handful of places in the Norfolk and Suffolk Broads east of Norwich; ...East Kent; and ...East Sussex"; this decline is still continuing and the species appears now to be "extinct over most of England, even in areas where it was once common". The species requires clean, hard water with plenty of vegetation, occurring in drainage ditches in levels. (In the past it was recorded from lakes and ponds, usually on former floodplains or reclaimed marshland.) The reasons for its decline are not yet fully understood, but are thought to include overfrequent marsh drain dredging, lowering of water levels and eutrophication. (Kerney, in *British Red Data Book 3*, 1991.)

Lymnaea glabra (GASTROPODA: Lymnaeidae). The Mud Snail.

RDB 2. A rare species found in soft water in small muddy ponds and ditches, especially those which dry out periodically. Sites tend to be "on ancient uncultivated land with acid sandy or gravelly soils, such as heaths and commons". *Lymnaea glabra* continues to show a decline, having now become extinct over much of lowland Britain, and is presently threatened both by drainage of boggy areas and by the deepening of seasonal pools in order to convert them to permanent ponds, "such as is frequently carried out on nature reserves for the benefit if Odonata". (Kerney, in *British Red Data Book 3*, 1991.)

Myxas glutinosa (GASTROPODA: Lymnaeidae). The Glutinous Snail.

RDB 1. Feared extinct in Britain until recorded in Kennington Pit during this survey, this snail has been said to "occur in spacious bodies of quiet, very clean water in slow rivers, canals, drainage ditches and lakes, usually in hard water". It is also said to "avoid turbid or weed-choked places", and to "show a preference for firm substrates rather than vegetation". Much of the available evidence about the actual preferences of *Myxas* in this country, however, is contradictory at present and does not always appear to conform with these assumptions. Research is therefore continuing. The species does appear to be unusually sensitive to physical disturbance and to chemical pollution. It is protected under Schedule 5 of the Wildlife and Countryside Act 1981. (Kerney, in *British Red Data Book 3*, 1991; Pond Action, 1992 and 1993.)

Valvata macrostoma (GASTROPODA: Valvatidae). An operculate snail.

RDB2. Although now very rare, being restricted to a few scattered populations in (roughly) the southern half of Britain, this species is still abundant at a few of the sites where it persists; it is, however, feared to be "losing ground". (Its range is, however, somewhat unclear due to recording error: juvenile forms of the common species *Valvata piscinalis* are often mistaken for *macrostoma*, so that "some literature records are consequently unreliable".) It is restricted to still or slowly-moving, well-vegetated, lowland waters, mainly drainage ditches in marshland levels. Causes of the species' decline are still unclear, but probably include habitat damage/destruction by excessive disturbance, such as dredging, and by eutrophication. (Kerney, in *British Red Data Book 3*, 1991.)

EPHEMEROPTERA

Potamanthus luteus (EPHEMEROPTERA: Potamanthidae). A mayfly.

RDB2. This species, "one of the rarest British mayflies", has been reliably recorded at only a few locations, all of these being in the vicinities of the Thames, the Usk, or the Wye. The nymphs have been found in large rivers, sometimes in "small pools almost cut off from the main river but inundated at times of flood (which) were flooded by stones and fine silt", and in other locations "from riffles with substrata of stones and gravel or from deeper slow-flowing stretches with consolidated gravel beds". The main threats to *Potamanthus* are thought to be (i) industrial development along major rivers, increasing both "the chronic pollution load and the risk of a catastrophic pollution accident"; (ii) river bed disturbance, e.g. caused by river engineering work, which may temporarily increase the silt load of the water; (iii) the removal of marginal vegetation, thus depriving the species both of the stems upon which emergence sometimes occurs, and shelter for adults; and even (iv) the siting of road and other lights close enough to the water to lure away the adults, causing the breeding population to slump. (Bratton, in *Research and survey in nature conservation* 29, 1990.)

ODONATA

Coenagrion hastulatum (ODONATA: Coenagrionidae). The Northern Damselfly or Northern Coenagrion.

RDB2. The distribution of this species is confined to only fifteen sites in Scotland (all in Highland, Tayside and Grampian), where it is not uncommon, the population appearing at present "fairly stable". Its status is, however, considered highly vulnerable to adverse environmental changes, the main threat to it being "drainage for the purpose of reafforestation". *C. hastulatum* favours the marshy margins of shallow reedy lochs, especially those sheltered by nearby woodland, and also frequents sheltered bogs with little open water. (Merritt, in *Red Data Book 2*, 1987.)

HEMIPTERA

Microvelia buenoi umbricola (HEMIPTERA: Veliidae). A water cricket.

RDB3. A very local surface-dwelling species which appears fairly widespread in the fens of East Anglia, but seems to be restricted in distribution to this one area, where it has been recorded from Wicken Fen in Cambridgeshire and several broads and marshes in Norfolk. It is confined to still, usually shallow, water with dense vegetation overhanging the edges (commonly, but not exclusively, from the margins of smaller ditches away from the main broads). "Both lack of management, and unsympathetic management, of ditches and water margins may be threatening" to this species: if ditches become so choked with vegetation as to lose all open water, or, conversely, if long stretches of ditch are completely cleared of all vegetation in a single operation, *M. umbricola* populations may be deprived of all suitable habitat. The lowering of water tables as a result of drainage, water abstraction, etc. is also cited as a possible threat, as is any manipulation of bank profiles (e.g. steepening) which inhibits the establishment of marginal vegetation. (Kirby, 1992.)

COLEOPTERA

Acilius canaliculatus (COLEOPTERA: Dytiscidae). A diving beetle.

RDB3. This species, confined since 1970 to the north-east of England and Scotland, shows evidence of decline or extinction throughout its range except "in the Border Counties and north of the Cairngorms": formerly designated Nationally Notable B, its status was revised in 1992. It is mainly associated with small pools (such as tree-holes) in acid fen, but is also found in fen drains and wind-eroded pools above 600 metres. (Foster, 1985; Hyman and Parsons, 1992.)

***Agabus striolatus* (COLEOPTERA: Dytiscidae). A diving beetle.**

RDB2. "Exclusively from the Broadland of east Norfolk." The species was recorded in this area up until around the mid-19th century, but was then not recorded at all for over 100 years before being rediscovered in the same locality in 1978. It is rare, being found in extremely small numbers in pits (such as tree-holes) which dry out in the summer, in relict fen carr and wet woodland. "The habitat is fragile, being subject to total drying-out on the one hand or loss in swamp woodland on the other, and also being easily disturbed or polluted." (Foster, in *Red Data Book 2*, 1987.)

***Dryops anglicanus*, *D. similaris*, *D. striatellus* (COLEOPTERA: Dryopidae). Dryopid water beetles.**

All RDB3. The Dryopidae are a family of "furry" water beetles which occur at the edge of water bodies in the mud, or occasionally in the water clinging to stones; the larvae burrow into the banks or bottom sediments of shallow margins. The British distributions of these three species of *Dryops* (among others) are not at present fully known, but all are presently designated Rare (two of them having recently been "promoted" in status: *D. similaris* and *D. striatellus* were both formerly Nationally Notable A). *Dryops anglicanus* is said by Foster and Eyre to be a relict species of deep mesotrophic fen. (Hyman and Parsons, 1992; Foster and Eyre, 1992; Fitter and Manuel, 1986; Pond Action, unpublished data.)

***Enochrus isotae* (COLEOPTERA: Hydrophilidae). A water scavenger beetle.**

RDB3. This species was recorded for the first time in Britain in 1984 (Foster); its range at present appears to be limited to the south of England, where its typical habitat seems to be fens. The species is rare. (Friday, 1988.)

***Graptodytes flavipes* (COLEOPTERA: Dytiscidae). A diving beetle.**

RDB2. Known to have breeding centres in west Cornwall, Dorset and the New Forest, where it inhabits pools (in particular temporary ponds) and slow-running waters on heathland. Numbers of *G. flavipes* have declined greatly in recent years, its few known remaining refuges being in the above-named areas. Immediate threats to its continuing survival include tourism, urbanisation, nuclear power stations and agricultural intensification. (Foster, in *British Red Data Book 2*, 1987.)

***Gyrinus suffriani* (COLEOPTERA: Gyrinidae). A whirligig beetle.**

RDB3. Found at the edges of pools, in a very few locations in south-eastern England, with one site in Anglesey. According to Foster, "apart from *Gyrinus natator*..., (this) is our rarest (*Gyrinus*) species, probably by a margin greatly in excess of what might be construed from the maps." *G. suffriani* was recently (1992) "promoted" to RDB3 from Nationally Notable A, and is therefore now officially designated Rare. (Foster, 1985; Hyman and Parsons, 1992.)

***Halipus variegatus* (COLEOPTERA: Haliplidae). A haliplid water beetle.**

RDB3. Rare and declining; recently recorded from Somerset, Norfolk, East Sussex and East Kent, although there are pre-1950 records for Devon and Cornwall. Mainly associated with shallow temporary habitats in relict sites. (Foster, 1981; Foster and Eyre, 1992.)

***Hydrochara caraboides* (COLEOPTERA: Hydrophilidae). The Lesser Silver Water Beetle.**

RDB1. There have been scattered records for this species as far north as Northern Yorkshire; but only in the London Marshes, Somerset Levels and Cambridgeshire Fens have there been "authenticated records in sufficient numbers to indicate breeding", and populations of *Hydrochara* now appear to be confined to the peat areas of Somerset. Many of the other records are assumed to be errors; however, small numbers, or lone specimens, of adults do appear occasionally at other locations: the (authenticated) Cheshire record was one such. Whether these are vagrants from Somerset or small undetected populations is unknown. *Hydrochara* favours lowland fens in dykes with diverse emergent population. Intensification of drain management, and the resulting disturbance, is cited as the main cause of the almost complete disappearance of this species from all but one small area of fenland. (Foster, in *Red Data Book 2*, 1987; Pond Action, 1992.)

***Hydrochus elongatus* (COLEOPTERA: Hydrophilidae). A water scavenger beetle.**

RDB3. Very sparse distribution in the south of England, and absent from the rest of mainland Britain. (This species, however, was only split from *H. ignicollis* - also RDB3 - in 1977, necessitating the abandonment of most of the records previous to that date.) Found in ponds and drains, often among reeds. (Foster, 1987; Friday, 1988.)

***Laccornis oblongus* (COLEOPTERA: Dytiscidae). A diving beetle.**

RDB3. This is a relict species which is "an important indicator of undisturbed fens". (*Laccornis* may be declining: it was recently "promoted" from Nationally Notable A.) It has been recorded from Scotland, East Anglia, Wales and Herefordshire, Westmorland and Durham, and Devon, but distribution is sparse and the species is considered rare. It is sometimes found in mossy pools. (Foster, 1983; Friday, 1988; Hyman and Parsons, 1992.)

TRICHOPTERA

***Nemotaulius punctatolineatus* (TRICHOPTERA: Limnephilidae). A limnephilid caddis fly.**

RDB2. This species was designated RDB3 in Red Data Book 2 (1987), but subsequently redesignated Vulnerable in status because of "the current threats to the Caithness bogs", where it is found in small dubh lochs on the blanket bog. Adults have been recorded at Aviemore, but the breeding site for these is unknown: all known breeding sites, with the exception of one on Speyside, are in Caithness. To all appearances to date, the species is exceedingly rare. (Wallace, 1991.)