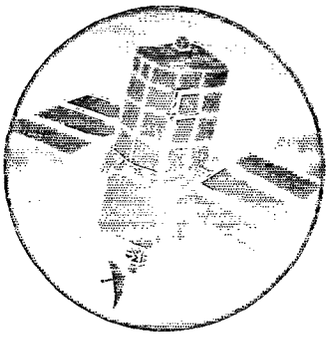
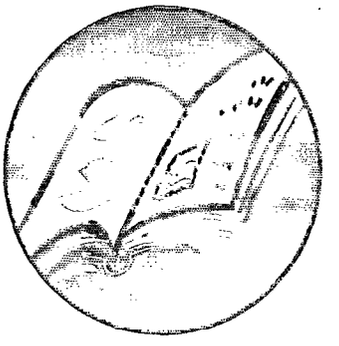
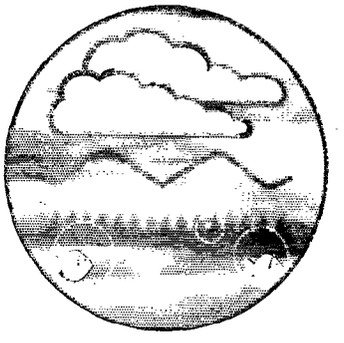
# Species Management in Aquatic Habitats

## Compendium of project outputs -Species Action Plans and Management Guidelines

**Research and Development**

**Project Record**

**W1/i640/3/M**

ENVIRONMENT AGENCY

# Species Management in Aquatic Habitats

Compendium of Project Outputs - Species Action Plans and Management Guidelines

Project Record W1/i640/3/M

C P Mainstone (Editor)

Research Contractor:
WRc plc

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**Dissemination status**
Internal: Released to Regions
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**Statement of use**
This report contains information to guide the operational and promotional works of the Agency by identifying potential impacts upon, and enhancements for, species of conservation concern. It includes Species Action Plans and Management Guidelines for a range of aquatic animals and plants with which the Agency comes into contact as a result of its activities. In drawing attention to the needs of these species, this helps top fulfil certain of the Agency's biodiversity obligations. All of the documents contained within this report are of a temporary nature - some SAPs are being taken forward by BAP Steering Groups, whilst all management guidelines have been subsumed into the Agency's new manaual on habitat and species management. This report should therefore not be considered as the primary reference source for most of the information contained herein.

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R&D Project Record W1/i640/3/M

**Amendments**

Any corrections or proposed amendments to this manual should be made through the regional Agency representative on the Water Resources National Abstraction Licensing Group.

# CONTENTS

# EXECUTIVE SUMMARY

R&D Project i640 was initiated three years ago to provide information on species of conservation value of particular relevance to the Environment Agency (then the National Rivers Authority), in relation to its activities affecting aquatic environments. A total of 52 stand-alone outputs has been produced by 22 different contributing organisations or experts, many funded in collaboration with English Nature and/or the Countryside Council for Wales.

Outputs comprise Species Action Plans (SAPs), practical management guidelines for Agency staff and third parties, and various research and survey outputs to improve the knowledge base on the status and ecological requirements of priority species. An overview of the work undertaken is provided in R&D Technical Report W161, whilst three Project Records contain all outputs produced during the course of the project (except for two special cases). Project Records W1/i640/1/M and W1/i640/2/M group together all research and survey reports produced with Project i640 involvement: Project W1/i640/1/M contains reports on priority mollusc species, whilst W1/i640/2/M contains reports on all other species addressed by Project i640. Project Record W1/i640/3/M (this document) contains all SAPs and management guidelines.

It should be noted that the SAPs and management guidelines presented in this volume are not permanent documents, in that they are updated as new information comes to light. Many of the SAPs have already been modified by BAP Steering Groups, whilst all management guidelines have been subsumed into the Agency's new manual on habitat and species management. *This report should therefore not be considered as the primary reference source for most of the information contained herein.*

# KEY WORDS

Priority species, conservation, management, aquatic habitats.

## Full list of outputs produced with Project i640 involvement

| Species | | Output type |
|---|---|---|
| Water shrew | *Neomys fodiens* | SAP/MG |
| | | Research report |
| Daubenton's bat | *Myotis daubentonii* | SAP/MG |
| | | Research report |
| Bats | | Research report |
| Kingfisher | *Alcedo atthis* | MG |
| Yellow wagtail | *Motacilla flava* | MG |
| Grey wagtail | *Motacilla cinerea* | MG |
| Sand martin | *Riparia riparia* | MG |
| Reed bunting | *Emberiza schoeniclus* | MG |
| Dipper | *Cinclus cinclus* | MG |
| Marsh warbler | *Acrocephalus palustris* | MG |
| Grass snake | *Natrix natrix* | SAP/MG |
| Common amphibians | | SAP/MG |
| Great crested newt | *Triturus cristatus* | MG |
| Spined loach | *Cobitis taenia* | SAP |
| | | Research report 1 |
| | | MG |
| | | Research report 2 |
| Brook lamprey | *Lampetra planeri* | SAP |
| River lamprey | *Lampetra fluviatilis* | SAP |
| Sea lamprey | *Petromyzon marinus* | SAP |
| Pearl mussel | *Margaritifera margaritifera* | Survey report - England |
| | | Research report |
| | | Survey report - Wales |
| Shining rams-horn snail | *Segmentina nitida* | {Survey report |
| Little whirlpool rams-horn snail | *Anisus vorticulus* | {Survey report |
| | | Research report |
| Fine-lined pea mussel | *Pisidium tenuilineatum* | SAP |
| | | Survey report |
| Compressed river mussel | *Pseudanodonta complanata* | SAP |
| Glutinous snail | *Myxas glutinosa* | Survey report |
| Norfolk hawker dragonfly | *Anaciaeshna isosceles* | MG |
| | | Research |
| Downy emerald dragonfly | *Cordulia aenea* | MG |
| Scarce chaser dragonfly | *Libellula fulva* | MG |
| Southern damselfly | *Coenagrion mercuriale* | MG |
| | | Research report |
| Scarce blue-tailed damselfly | *Ishnura pumilio* | MG |
| Scarce emerald damselfly | *Lestes dryas* | MG |
| Native crayfish | *Austropotamobius pallipes* | Strategy report |
| | | Leaflet |
| Medicinal leech | *Hirudo medicinalis* | SAP |
| Triangular club-rush | *Schoenoplectus triqueter* | SAP |
| | | Research report |
| Loddon pondweed | *Potamogeton nodosus* | MG |
| Round-headed club-rush | *Scirpus holoschoenus* | MG |
| Northern spike-rush | *Eleocharis austriaca* | MG |
| Black poplar | *Populus nigra ssp betulifolia* | MG |
| Ribbon-leaved water-plantain | *Alisma gramineum* | Research report |

MG Management guidelines SAP Species Action Plan

# PART 1 MAMMALS

1.1 Species Action Plan for the water shrew in England and Wales

1.2 Management guidelines for the water shrew

1.3 Species Action Plan for Daubenton's bat in England and Wales

1.4 Management guidelines for Daubenton's bat

# ENVIRONMENT AGENCY SPECIES ACTION PLAN FOR ENGLAND AND WALES

## WATER SHREW - *Neomys fodiens*

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University of London

February 1997

**Summary**

The water shrew is the smallest aquatic mammal and is dependent on freshwater habitats. Although no systematic, nationwide surveys have ever been made to investigate possible declines in population numbers, evidence from localised live-trapping studies in prime water shrew habitat suggests that numbers may be in decline as a result of habitat loss and management, particularly through drainage schemes and modifications to river banks, and possibly through the bioaccumulation of pesticide residues. The habitat of this species is frequently encountered by the Agency in the course of fulfilling its statutory duties, particularly in relation to river engineering and water quality management. The Agency therefore feels that it has a special duty towards the conservation of the water shrew.

The recommendations made in the Species Action Plan for the water shrew are limited by the lack of information about its habitat requirements and population trends. These deficiences are addressed in the aims and recommended actions of the Action Plan. A precautionary approach should be adopted until more comprehensive data are available.

## 1. PRIORITY STATEMENT

Under R & D Project 461/640 'Species Management in Aquatic Habitats', the water shrew was identified as a species of concern to the Environment Agency because of its dependence on freshwater habitats, and the threat to its populations and habitats.

## 2. ACTION PLAN OBJECTIVES

*Short-term*: To clarify the status of the water shrew, its habitat requirements and preferences, and the causes of any observed population trends.

To provide written guidance on practical management techniques designed to encourage and enhance water shrew populations which may be used by the Agency in its operational activities, as well as by others.

*Medium-term*: To implement management techniques for water shrews wherever possible and appropriate, and to promote their use by others.

*Long-term*: To demonstrate the enhancement of water shrew populations and occurrence through practical management work and its promotion by the Agency, by means of appropriate monitoring.

## 3. LEGAL STATUS

a) Part 1 and Schedule 6 of the Wildlife and Countryside Act 1981 (amended 1988), provides protection for the water shrew (together with all shrews) against intentional killing or injury.

b) Afforded limited protection against exploitation, together with all shrew species, by the Council of Europe's Convention on the Conservation of European Wildlife and Natural Habitats (No. 104, 1979).

## 4. BIOLOGICAL ASSESSMENT

### 4.1 Status

The water shrew is widely distributed throughout England and Wales (and Scotland), including the Isle of Wight and Anglesey. It is found in both lowland and upland areas, being recorded at 420 m in Wales, but nowhere is it common. It is abundant only very sporadically and locally in its favoured habitats. Unlike the common shrew which occupies and thrives in diverse habitats, the water shrew is more habitat-specific. There is concern that it may be declining in numbers and occurrence, particularly in once-favoured sites, as a result of habitat destruction and modification. Evidence for this comes from casual observers (landowners and workers), examination of field signs and brief live-trapping censuses, and is unconfirmed to date. Actual trends in population density and habitat occurrence have never been studied systematically, either in Britain or elsewhere in its range. Before guidelines on its management can usefully be produced and implemented, the status and habitat requirements of the water shrew need urgent clarification.

### 4.2 Ecology

As a result of its nomadic tendencies and the dispersal activities of juveniles, the water shrew occurs in many habitats, terrestrial as well as aquatic. Although it is encountered in deciduous woodlands, scrub-grasslands and hedgerows, numbers here are generally low and the populations transitory, usually comprising dispersing juveniles or males searching for mates. Only in aquatic habitats is it found in any numbers and here the populations remain relatively stable from year to year. The most frequented habitats are well-vegetated banks bordering swiftly-flowing streams and rivers, water-cress beds, drainage ditches, pond edges and reed beds. These habitats provide terrestrial space for burrows with entrances/exits above the water level, cover for terrestrial foraging, and ready access to the water for aquatic foraging. It feeds extensively (but not exclusively) throughout the year on freshwater invertebrates, principally crustaceans and caddis larvae, and the diet is supplemented with a variety of terrestrial invertebrates. The precise factors influencing its choice of habitat are still unknown, but

requirements are an adequate food supply throughout the year (it is not a hibernating species); easy access to clean, clear (usually flowing) freshwater for foraging; adequate vegetation cover to avoid predators and harbour terrestrial prey; and suitable substratum (soil) for burrows in which to retreat, rest and rear the young.

## 4.3 Distribution and Population

The water shrew is a Palaearctic species with a wide geographical distribution. It is found throughout northern and central Europe, Scandinavia, and eastwards across Russia into Siberia as far as Lake Baikal. There are relict populations in parts of the Russian Far East, bordering the Sea of Japan. It is absent from most of Spain. In Britain, the water shrew is found sporadically throughout England and Wales (including the Isle of Wight and Anglesey, but excluding the Scilly Isles and the Channel Islands) and much of Scotland including the west coast islands of Arran, Islay, Shuna, Garvellachs, Kerrera, Mull, Skye, Pabbay, Raasay, and on Hoy (Orkney). It is absent from Ireland. Although a widespread species, population density is low compared with the common shrew: even in favoured habitats peak densities of only 3-10 per hectare have been recorded while common shrews can reach 100 per ha.

## 4.4 Limiting Factors

*4.4.1 Habitat loss and modification* — *Importance - High*

Drainage and reclamation of marsh and reed bed habitats for agriculture; earth drainage ditches being replaced with brick/concrete/plastic drainage pipes; creation of concrete banks and barrages on river sides; replacement of grass banks with concrete in commercial water-cress beds (a highly favoured habitat) to permit motorised access; vegetation clearance and increase in homogeneity of topography and incline of river/stream banks during waterway maintenance and flood control, together with burrow destruction during mechanised maintenance work.

*4.4.2 Inappropriate habitat management* — *Importance - Medium*

Reduction of vegetation cover during routine bank maintenance, particularly in summer when populations are at their peak and shrew activity on the ground surface is high. Changing flow velocity and water levels in the river system, particularly increases in water level which result in bank flooding and shrews unable to reach the substratum when foraging for benthic invertebrates.

*4.4.3 Pollution and pesticide use* — *Importance - Unknown*

With its position near the top of the food chain, and as a predator of a wide range of invertebrates, including target pest species, the water shrew is vulnerable to insecticides and molluscicides, together with a range of industrial pollutants such as PCBs and heavy metals. With its high metabolic rate and high rate of food consumption, toxins are quickly accumulated and assimilated.

*4.4.4 Persecution and disturbance* *Importance - Low*

Water shrews do not conflict with man's interests and are not regarded as pests, and so are not subject to persecution. Domestic cats may occasionally catch them. Disturbance may occur during routine habitat maintenance (particularly drainage and mowing of banks).

*4.4.5 Prey availability* *Importance - Unknown*

Seasonal or annual declines in prey availability may affect water shrew numbers and occurrence at particular sites.

## 5. CONSERVATION ACTION TO DATE

Although concerns have been expressed about changes in its status, the water shrew has had a low profile and low priority with respect to its conservation. This results largely from lack of information about population trends and habitat occurrence.

## 6. PROPOSED ACTION

### 6.1 Policy and Legislative

Action 1: Greater protection may be required for the water shrew under the Wildlife & Countryside Act 1981 if a downward trend in population numbers is confirmed. Priority: priority low until further information is available about population trends.

*Agency action: none pending further information.*

### 6.2 Site Safeguard, Land Acquisition and Management

Action 2: Identification of important water shrew habitats. Selection of suitable sites to be given SSSI or County Wildlife Status. Inclusion of the presence of thriving water shrew populations in the list of criteria for site acquisition/protection. Priority: high, following elucidation of habitat preferences of water shrews. EN, CCW, Wildlife Trusts to be consulted.

*Agency action: assistance in identification of important sites in liaison with local 'experts' and conservation bodies.*

Action 3: Conservation and maintenance of important sites for water shrews. Priority: high. Liaison and co-operation with county Wildlife Trusts and other conservation bodies.

*Agency action: production of management guidelines for use by Agency staff and third parties; incorporation of appropriate riparian mowing regimes, compatible with habitat requirements for water shrews, into the Agency's Flood Defence Function; assist in maintenance and management of sites, where appropriate.*

Action 4: Creation of new aquatic habitats suitable for water shrews. Priority: medium. The Environment Agency and conservation bodies to liaise, once habitat requirements are better elucidated.

*Agency action: sympathetic habitat management in key areas; creation of suitable habitats based upon management guidelines produced, including use of opportunities for habitat creation arising during the course of routine flood defence operations.*

## 6.3 Species Management, Protection and Licensing

Action 5: Emphasis to be placed on site protection rather than species translocation where developments threaten water shrew habitats. Translocation and introduction/reintroduction of water shrews to selected sites is feasible and practical, provided target areas exceed approximately one hectare (because of their nomadic tendencies). Licensing for live-trapping animals for translocation/introduction administered by English Nature/CCW. Priority: low, pending further information on habitat requirements.

*Agency action: agreement to translocation of water shrews from and to Agency sites, as appropriate.*

## 6.4 Advisory

Action 6: Advice to landowners on appropriate ways to manage and protect suitable sites for water shrews. Priority: medium.

*Agency action: advice to landowners, where appropriate, through the dissemination of management guidelines.*

## 6.5 Future Research and Monitoring

Action 7: Further research on habitat occurrence and precise habitat requirements of the water shrew. Priority: high. The Environment Agency, EN, CCW and local 'experts'.

*Agency action: support for and co-operation with further research, including support for development of survey methods for use by Agency staff and third parties.*

Action 8: Assessment of national status and population trends of the water shrew. Priority: high. Liaison with JNCC.

*Agency action: Agency staff to be encouraged to submit records on sightings and field signs, through the production and dissemination of a Species Awareness Leaflet; support for the development of field recognition and survey procedures.*

Action 9: Monitoring of status and population trends of water shrews at key sites, and assessment of effectiveness of management strategies. Priority: high. Liaison with EN, CCW, local 'experts'.

*Agency action: support for monitoring work.*

Action 10: Investigations into the causes and mechanisms of population declines of water shrews, should these be confirmed during the monitoring of population trends. Priority: high, if evidence of decline is found. Liaison and cooperation with EN, CCW, local 'experts'.

*Agency action: support for research.*

### 6.6 Communication and Publicity

Action 11: Publication of management guidelines for use by landowners and managers, including Agency staff. Public education on the natural history and status of the water shrew, and awareness of its habitat requirements and need for protection. Priority: high.

*Agency action: publication and dissemination of an advisory leaflet.*

### 6.7 International

No action required. Over most of their geographical range water shrews are not under threat.

## 7. ACTION PLAN REVIEW

This plan will be reviewed after 3 years (1999/2000)

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# ENVIRONMENT AGENCY SPECIES MANAGEMENT GUIDELINES

## WATER SHREW - *Neomys fodiens*

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February 1997

## 1. STATEMENT OF USE

*Neomys fodiens* is a widespread but elusive species that is intimately associated with the aquatic environment, and has been selected as a priority species for conservation action by the Environment Agency. These management guidelines have been developed to assist in the targeted implementation of appropriate management and protection measures for the maintenance, enhancement and creation of *Neomys fodiens* populations. They are for use by Agency staff across all Functions and for distribution to third parties who are in a position to implement such measures in suitable areas (i.e. in localities that are known to, or could, support the species).

## 2. DISTRIBUTION AND STATUS

The water shrew is found throughout mainland Britain and many of the offshore islands. It is widely distributed throughout England and Wales (and Scotland), including the Isle of Wight and Anglesey. It is found in both lowland and upland areas, being recorded at 420 m in Wales, but nowhere is it common. It is abundant only very sporadically and locally in its favoured habitats.

Unlike the common shrew which occupies and thrives in diverse habitats, the water shrew is more habitat-specific. There is concern that it may be declining in numbers and occurrence, particularly in once-favoured sites, as a result of habitat destruction and modification. Evidence for this comes from casual observers (landowners and workers), examination of field signs and brief live-trapping censuses, and is unconfirmed to date. Actual trends in population density and habitat occurrence of the water shrew have not been studied systematically and so its present status (declining, increasing or stable) is unknown. The Management Guidelines given here are limited by the lack of detailed information about its habitat requirements and population trends.

## 3. RECOGNITION

The water shrew is distinguishable from all other shrews in Britain by its relatively large size, its dense black fur on the dorsal surface and the fringes of silvery, bristle-like hairs found on the margins of the feet and forming a keel on the underside of the tail. It is the only shrew in Britain which shows a close affiliation to freshwater habitats where it swims and dives for food.

## 4. HABITS

The water shrew is essentially an annual species, and it undergoes a seasonal cycle in numbers and activity. Young are born in summer, they overwinter as immatures and then achieve maturity in the following spring ready for the breeding season (June-September). The adults die off in late summer/autumn, after breeding, leaving the young to carry the population through the winter and into the next breeding season. These shrews rarely live more than 18 months, and few survive a second winter. In summer, population numbers are relatively high and the shrews are very active: adults searching for mates and rearing young, juveniles dispersing and establishing new home ranges. At this time the shrews can occasionally be sighted, or more often heard, as they forage, undergo territorial disputes and courtship. In winter, following the death of old adults and the dispersal of juveniles, population density is lower and activity on the ground surface declines. They do not hibernate and continue to forage underwater, but more time is spent in the warmth and safety of the nest and burrows with only brief, local foraging excursions.

Although essentially solitary and territorial, as are most shrew species, the water shrew often occurs in small groups of 4-6 individuals living in close proximity and sharing burrow systems in favoured sites.

## 5. HABITAT OCCURRENCE AND HABITAT REQUIREMENTS

The water shrew occurs in many habitats, terrestrial as well as aquatic. It is encountered in deciduous woodlands, scrub-grasslands and hedgerows, but numbers here are generally low and the populations transitory, usually comprising dispersing juveniles. Only in aquatic habitats is it found in any numbers.

The most frequented habitats are well-vegetated banks bordering swiftly-flowing streams and rivers, water-cress beds, drainage ditches, pond edges and reed beds. These habitats provide terrestrial space for burrows with entrances/exits generally above the water level, cover for terrestrial foraging, and ready access to the water for aquatic foraging. Burrow entrances are usually sited amongst vegetation on the sharply-inclined sides of river/stream banks, facing the water. Along streams or rivers, home ranges/territories are linear, comprising a length of stream plus the adjacent bank, amounting to some 60-80 $m^2$ per shrew and overlapping with neighbouring shrews at the periphery. Most of the shrews' activities are concentrated on the river/stream and its banks, although occasional forays may be made into the terrestrial hinterland beyond the banks. In favoured habitats, population density peaks in summer at about 3-10 individuals per hectare, although there may be small patches of habitat where local density is greater.

Water shrews feed extensively (but not exclusively) throughout the year on freshwater invertebrates. Most freshwater invertebrates are eaten, together with some vertebrates (frogs, newts and small fish), but the major dietary items are crustaceans and caddis larvae. The diet is supplemented with a variety of terrestrial invertebrates, including beetles, spiders and earthworms. Between 50-80% of the food is taken from the water in aquatic habitats, although water shrews can survive on land invertebrates alone in terrestrial habitats (and in captivity).

Although captive water shrews are able to dive to several metres in still water, wild shrews have been observed to dive only to 200 cm depth in streams, mostly to around 30 cm. Their foraging strategy comprises frequent shallow dives of short duration (3-10 secs) to collect prey which are then eaten on land. Swiftly-flowing streams and rivers with a substratum of stones and gravel harbour the greatest density of invertebrate prey, and studies in Britain and elsewhere suggest that these appear to be the most favoured habitats for water shrews, although they are also reported to reach relatively high densities in reed beds.

The precise factors influencing the choice of habitat are still unknown, but water depth and velocity probably influence habitat selection by water shrews, together with prey availability and accessibility, and suitable cover. The requirements of a population of water shrews are an adequate food supply throughout the year (it is not a hibernating species); easy access to clean, clear (usually flowing) freshwater for foraging; adequate vegetation cover to avoid predators and harbour terrestrial prey; and suitable substratum (soil) for burrows in which to retreat, rest and rear the young.

More information is required about habitat selection by water shrews, and their precise requirements, before detailed recommendations can be made.

## 6. MANAGEMENT FOR WATER SHREWS

Within the limits of our knowledge of their habitat requirements, the following guidelines for habitat management are suggested for encouraging and enhancing populations of water shrews.

### a. Bank structure and vegetation

The structure of stream/river banks is important. It should be of earth and stones to provide a firm but workable substratum for burrowing. Water shrews create their own burrows, or take over and modify those of other small mammals (principally bank voles). They use burrows for nesting (both in and out of the breeding season) and as runways to other parts of their home range. They also create surface burrows within the litter layer to aid safe passage and provide a retreat for consumption of prey. Burrow entrances are usually sited above water level, in the sides of banks rather than on the tops. They are found in places where the incline ranges from approximately 40° to 90°. A heterogeneous topography of the banks is favoured, providing abundant retreats during exploration and foraging. Banks should be high enough to avoid flooding of the burrows, and the general bank incline should be low enough to avoid erosion and provide stability for vegetation. Clearance and redistribution of earth during mechanised drainage works, creating homogeneously-inclined banks which slope steeply to the water and which are temporarily devoid of vegetation, should be avoided.

Water shrews require vegetation cover for their terrestrial explorations and to support land invertebrates for their terrestrial foraging, and from which they have ready access to the water for aquatic foraging. Ideally, on stream/river banks and drainage ditches, this should be low, dense riparian vegetation with a high proportion of grasses and a well-developed litter/root layer. Periodic mowing through the growing season does not discourage them, provided the litter layer is left intact, and cut vegetation can be left *in situ* to boost the litter layer. Vegetation should be allowed to build up in autumn to provide cover in winter. Shrub clearance should be encouraged, as this will arrest the plant succession and promote and maintain an appropriate riparian vegetation. The Environment Agency's Flood Defence Function has a major role in adopting suitable management schemes, including drainage, bank maintenance and mowing regimes, in areas that support water shrews.

Bank and vegetation management for water shrews is similar to, and compatible with, that for water voles although they do not require such an abundance of marginal vegetation.

**b. Channel structure and characteristics**

With their limited diving abilities and their requirements for abundant and accessible freshwater invertebrates, water shrews are found mainly in stream/river sites where water depth does not exceed approximately 1 m, commonly at water depths less than 30 cm. Although they do occur in reed beds and ponds with a substratum of mud, they are found mostly where there is a substratum of small stones. Invertebrate prey are located amongst the stony substratum, and so water shrews are precluded from foraging in sites with deep, swiftly-flowing water which is beyond their diving capability. More information is required about this before detailed management guidelines on channel depth and width can be provided.

**c. Water quality**

Good water shrew sites have proved to be those with clear, fast-flowing water maintained at approximately 30 cm depth, with a substratum of small stones which support a wealth of aquatic invertebrates. They use sites which contain emergent vegetation (such as water-cress and reeds) but management should be undertaken to maintain water flow and counteract silting-up. Water shrews appear to vacate sites choked by silt and vegetation, where water depth and velocity have fallen.

High water quality is needed to maintain the water shrew's fur in good, water-proof condition, and maintain its body heat during and after diving. The protective water-proofing is lost if the fur is contaminated by mud and slime which mats the hair, causing it to lose its air-trapping property and the body to chill. Shrews groom the fur vigorously following diving, involving licking. Contaminants in water or substrate have a direct route into the digestive system by this means. Water quality needs to be sufficient to support an abundant and diverse invertebrate prey fauna. For these reasons, areas subject to high inputs of contaminants from intensive agriculture or industry may not be suitable for water shrews. Similarly, herbicide and insecticide use in bank management should be avoided.

### d. Size, shape and siting of suitable habitats

Being essentially solitary, water shrews do not attain high population densities. They also have nomadic tendencies. In order to encourage a stable population, the suitable site must be large enough to support a viable number of shrews and permit movement and redistribution of individuals around it. The recommendation is for sites to be at least one hectare in area which, experience shows, is large enough to support a permanent population in prime habitat. The shape of the suitable site should take account of the linear structure of the home ranges which are usually centred upon a stream/river with adjacent banks. Ideally, suitable sites should also be part of a more continuous habitat which provides a dispersal route for immigrants from nearby areas. This will boost the population and permit interchange of individuals, particularly in autumn/winter when populations are low, and in spring when terrestrial movements increase in the search for mates. Sympathetic and appropriate habitat management in favour of water shrews (as outlined above) along small stretches of a more continuous waterway will do much to encourage and enhance the population.

### e. Disturbance

Water shrews are active mostly at night. Studies on commercial water-cress farms show that they will tolerate a high level of human activity/disturbance in the habitat during the day. Hence, regular habitat management should not affect them unduly. Frequent disturbance by walkers with dogs which dig the burrows may affect them more seriously.

## 7. FIELD SIGNS AND MONITORING

Being small, and rarely active in open areas devoid of cover, water shrews are rarely seen and they leave little evidence of their activity. This makes them difficult to monitor in a systematic manner. However, there are several key field signs to assist a monitoring scheme. They are best looked for in summer months when population numbers are relatively high, and when they are most active on the ground surface.

They can be detected by the presence of distinctive burrow entrances in grassy banks bordering streams, small rivers, water-cress beds or drainage ditches. Burrows (and their entrances) are well above water level. Unlike the burrow entrance of bank voles (which often share the same habitats), where the vegetation is chewed short, exposing scuffed, bare soil, the vegetation around the burrow entrance of water shrews remains intact and the shrews squeeze through it, creating a perfectly round hole of about 2 cm in diameter.

They can also be detected by the presence of prey remains of invertebrates, particularly the stone/twig larval cases of caddis flies, broken mollusc shells, and small twigs and stones which are left following aquatic foraging at habitual feeding sites at the water's edge. These sites usually comprise a small area of earth/gravel or a flat stone under an overhang or in a secluded crevice on the stream bank. The faeces of these shrews, though small, are also quite distinctive: they are cylindrical, approximately 7 mm x 3 mm, black and granular in texture (because of the undigested, chitinous prey remains). They are often deposited in middens in surface runs close to burrow entrances, and near feeding sites on the stream bank, particularly on flat stones.

Footprints are distinguishable from other small mammals, including shrews, but are rarely, if ever, found *in situ.* Smoked paper trays placed in suitable habitat can be used to record and identify footprints. Although laborious to examine, the hairs of water shrews are also distinguishable microscopically, and can be collected in sticky 'hair tubes' placed in the habitat. Use of 'bait stations' which encourage shrews to enter, feed and defaecate may provide an easier way of detecting the presence of water shrews, identified by their distinctive scats. Suitable protocols for these techniques are currently being devised to assist in a monitoring scheme.

Water shrews produce loud, high-pitched but audible squeaks in a rapid, continuous, repetitive sequence, plus a characteristic rolling 'churr-churr' of lower frequency used as threat or warning signals in intraspecific interactions. These can be heard most frequently in summer.

The most reliable and effective census method at present is live-trapping in selected sites following preliminary evaluation using the field signs described above. The shrews will readily enter Longworth live-traps placed on firm ground above the water level and close to burrow entrances. This techniques requires a licence from English Nature/CCW and an undertaking to use suitable food baits and trap-checking routines to aid survival of captives.

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# ENVIRONMENT AGENCY SPECIES ACTION PLAN FOR ENGLAND AND WALES

## DAUBENTON'S BAT - *Myotis daubentonii*

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May 1997

**Summary**

Daubenton's bat is widespread in England and Wales, but it is vulnerable for several reasons. It has a very strong dependence on water, making it critically dependant on water quality and quantity and riparian habitat structure. Major roosts are often in vulnerable locations, e.g. in the stonework of bridges. Relatively few maternity roosts are known. Action is needed to protect and enhance foraging and roosting sites, and identify key requirements of maternity roosts.

## 1. PRIORITY STATEMENT

a) Under Research and Development Project 461 "Species Management in Aquatic habitats - Phase 1", Daubenton's bat was identified as a high priority species for the Agency, owing to its dependence on river corridors and associated wetland habitats and its vulnerability to Agency activities.

b) Daubenton's bat is listed in the UK Biodiversity Steering Group Report (1995) as a key species, included in the "Long list" because of full protection afforded under the Wildlife and Countryside Act (1981) Schedule 5 and unfavourable status in Europe.

*c)* In England, Daubenton's bat has been given a medium priority for conservation action, particularly for status surveys as inadequate data are available (Mitchell-Jones, 1996).

d) This SAP addresses many of the points raised in the Bat Conservation Trust Action Plan for the conservation of bats in the United Kingdom (Hutson 1993).

## 2. ACTION PLAN OBJECTIVES

*Short term*: To provide written guidance on practical management techniques designed to maintain and enhance Daubenton's bat populations, which may be utilised by the Agency in its operational activities, as well as by others.

*Medium term*: To implement management techniques for Daubenton's bat wherever possible and appropriate, and to promote their use by others. To promote survey work which would clarify the species' status.

*Long term*: To demonstrate the enhancement of Daubenton's bat populations by means of appropriate monitoring. Monitoring can be carried out using ultrasound detectors, counting bat passes/unit time in predetermined areas. As roost sites are difficult to locate, counts of bats as they emerge in the evening are unlikely to be as useful as standardised bat pass counts in predetermined aquatic habitats (Warren *et al.*, 1997).

## 3. LEGAL STATUS

a) Listed in Schedule 5b of the Wildlife and Countryside Act, 1981, Daubenton's bat, in common with all other UK bats, is protected against intentional killing, injuring or taking, and its roosts are protected against damage, destruction or obstruction. It is also an offence to disturb any bat species whether in a roost or hibernating.

b) Additional protection (notably of feeding habitat) is provided by the (Bern) Convention on the Conservation of European Wildlife and Natural Habitats, 1982. All species of European bats except the pipistrelle are listed in Appendix II, which requires they are given special protection; the Agreement on the Conservation of Bats in Europe (Bonn Convention on the Conservation of Migratory Species of Wild Animals, 1992, Appendix II), and the European Communities Directive on the Conservation of Natural and Semi-natural Habitats and of Wild Fauna and Flora, 1992 (Annex Iva).

## 4. BIOLOGICAL ASSESSMENT

### 4.1 Status

Daubenton's bat is widespread throughout England and Wales, but is largely restricted to riparian habitats. The little information available on population trends in the UK is conflicting. Increases have been reported in continental Europe, which may be a result of

pollution causing eutrophication of water bodies and increasing availability of prey such as chironomids, or an artefact of increased numbers at a shrinking number of good foraging sites (see Harris *et al.*, 1995).

## 4.2 Ecology

Rarely found away from riparian habitats, Daubenton's bat forages over open water, taking insects in flight from the water surface, or the 1 m of airspace above the water. It preys primarily on Diptera and Trichoptera (reviewed by Vaughan, 1997). On rivers it shows a strong preference for smooth flowing water with tree cover on both banks (Warren *et al.*, 1997). It typically forages over a short stretch of river, but can be found up to 5 km from the roost, and can travel much further. It also forages over canals, lakes and even quite small ponds. Roosts are found in tree holes, the stonework of bridges, and in buildings, rarely far from open water. Few maternity roosts are known (c. 60 nationally, A.L. Walsh, pers. comm.), and in summer there is evidence for sexual segregation, with males found further upstream than females (Warren *et al.*, 1997). Known hibernation sites are primarily in caves, mines, tunnels and the stonework of bridges. Adopting a precautionary principle we should assume that some individuals hibernate in trees.

## 4.3 Distribution and Population

Widespread in Europe and southern Siberia east to the Pacific. The England and Wales population is an estimated 110,000 (Harris *et al.*, 1995), but this is based on very limited information. Stebbings and Griffith (1986) classify it as "not threatened?".

## 4.4 Limiting factors

*4.4.1 Fragmentation and isolation of preferred foraging habitat.*

*Importance - Medium/High*

The discontinuity of riparian woodland probably limits the foraging time available to Daubenton's bat. Continuous riparian woodland is probably most important in the vicinity of roosts. Distribution and density, particularly of maternity roosts, may be limited by the area of suitable water over which to forage.

*4.4.2 Roost site availability.* *Importance - Medium/High*

Loss of roost sites in trees and buildings (such as chimneys, bridges) close to suitable foraging sites is probably an important limiting factor.

Inappropriate management of bank side trees and trees in nearby woodland would reduce the number of potential roost sites, primarily by the removal or excessive surgery of old trees. Inappropriate bridge maintenance has the potential for catastrophic destruction of roost sites and resident bats.

*4.4.3 Loss of hibernation sites* *Importance - Medium/High*

Loss of hibernation sites in caves, mines, tunnels, and probably trees, due to restoration works, mine capping, disturbance.

*4.4.4 Habitat loss and modification* *Importance - Medium*

Agricultural run-off (nutrients, herbicides and pesticides, etc.) into rivers, canals and lakes, and loss of bankside vegetation will lead to habitat loss and degradation, and reduced prey availability. Inappropriate water management, such as excessive abstraction, will lead to loss of key foraging areas.

The *Phytophthora* infection of native alder which is spreading through England and parts of Wales is of some concern, as many riparian woodlands in the preferred habitats of Daubenton's bat have a high proportion of this species. Measures to control the disease, and contingency plans for replanting (perhaps with disease resistant natives) need to be developed.

*4.4.5 Fluctuations in the quality and quantity of water.* *Importance - Medium*

In the short to medium term Daubenton's bat may be limited by pollution incidents that reduce prey availability, and by fluctuations in water levels. In the longer term, climate change may reduce water levels in some catchments to such low levels in summer that foraging habitat for Daubenton's bat is lost. On a national scale this may cause population declines, particularly in the southern half of England.

## 5. CONSERVATION ACTION TO DATE

All UK bat species and their roosts are protected by the Wildlife and Countryside Act, (1981). The Bat Conservation Trust and the county Bat Groups assist EN and CCW in the enforcement of the Act by answering public enquiries and visiting roosts under potential threat, in addition to carrying out a wide range of practical conservation measures, including survey and monitoring. Most Bat Groups/County Wildlife Trusts keep detailed records, and the BCT is working to standardise these. EN and CCW also hold records of roost sites.

The BCT has published an "Action Plan for the Conservation of Bats in the UK" (Hutson, 1993), reviewing progress, and suggesting where future effort might be best directed. The recent National Bat Habitat Survey (Walsh and Harris, 1996a,b) is the first to look at the abundance of bats on a national and a local scale and determine habitat preferences in a major survey. This is being followed up by a DOE funded project to the BCT to establish methods for the monitoring of bats in roosts, foraging areas and hibernacula. There is a specific programme for monitoring Daubenton's bat in 1997.

## 6. PROPOSED ACTION

### 6.1 Policy and Legislative

Action 1: Promote Action Plan for national endorsement by JNCC/DOE as a contribution to the Biodiversity Steering Group Report Action Plans. Priority - high.

*Agency action: organise promotional training day/launch of Action Plan.*

### 6.2 Site safeguard, land acquisition and management

Action 2: Major breeding and non breeding roosts (containing > 50 adults) to be considered for county wildlife / SSSI status and for all roosts, the associated riparian habitat identified and appropriately managed. Trees containing roosts may be protected under Tree Preservation Orders. Priority - medium.

*Agency action: utilise results of River Corridor and River Habitat Surveys to identify riparian habitat.*

Action 3: Roosts in bridges given special consideration. Local authorities notified and bat friendly restoration/repair guidelines to be followed. Implement management guidelines to maintain and improve foraging and roosting sites. Priority - medium. Agency, farming community, conservation bodies.

*Agency action: help identify, protect and enhance roost sites and associated riparian and aquatic habitats in liaison with NGOs, landowners and statutory agencies. Assist in management of sites where appropriate.*

## 6.3 Species management, protection and licensing

Action 4: Training for bridge repairers and tree surgeons in the recognition of sites as potential bat roosts and the implementation of bat friendly restoration. The application of the precautionary principle to tree surgery. Priority - high.

*Agency action: participate and contribute to training days.*

## 6.4 Advisory

Action 5: Advice to landowners on appropriate ways to manage water courses/bodies and their catchments, bank side vegetation and woodland. Advice to authorities responsible for bridge maintenance. Priority - high. Agency, conservation bodies, farming advisory groups, other landowners, local authorities, Highways Agency.

*Agency action: advice to landowners/agencies where appropriate.*

## 6.5 International

Action 6: Monitor Daubenton's bat at the edges of its range (to document any contractions). Priority - medium

*Agency action: liaison about monitoring sites with BCT/County Bat Groups*

## 6.6 Future Research and Monitoring

Action 7: Further research to establish location, population densities and habitat requirements of maternity roosts. Priority - high. Agency, EN, CCW.

*Agency action: support for further research.*

## 6.7 Communications and Publicity

Action 8: Publication of management guidelines, for use by landowners and managers. Priority - high. Agency, EN, CCW, conservation bodies.

*Agency action: publication of advisory leaflet.*

## 7. ACTION PLAN REVIEW

This plan will be reviewed after 3 years (2000).

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# ENVIRONMENT AGENCY SPECIES MANAGEMENT GUIDELINES

## DAUBENTON'S BAT - *Myotis daubentonii*

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May 1997

## 1. STATEMENT OF USE

Daubenton's bat is a native mammal that is intimately associated with aquatic and riparian habitats. It has been selected as a priority species for conservation action by the Environment Agency, and these management guidelines have been developed to assist in the targeted implementation of appropriate management and protection measures for the maintenance, enhancement and creation of breeding populations. They are for use by Agency staff and for distribution to third parties who are in a position to implement such measures in suitable areas (i.e. in localities that are known to, or could, support the species).

## 2. DISTRIBUTION AND STATUS

Daubenton's bat is widely distributed in Britain and Ireland. Harris *et al.* (1995) estimated the English and Welsh population to be 110,000, with 40,000 in Scotland, although the reliability of this estimate is very poor. A decline in numbers has been reported in the north of Scotland where Daubenton's bat is the least common species. There is no evidence of decline in the rest of Britain, and it may have increased, as appears to have been the case in continental Europe. Roost sites for this species are notoriously difficult to find. In Britain only about 60 maternity roost sites are known (A.L. Walsh, pers. comm.).

## 3. HABITAT REQUIREMENTS

Daubenton's bat is the bat most closely associated with riparian and wetland habitats in Britain. It feeds almost exclusively over water (for detailed review and references see Racey, 1996; Warren *et al.*, 1997). The ecology and behaviour of the species is reviewed by Warren *et al.* (1997). It emerges from hibernation in April and May, and will forage throughout the night. The evening emergence occurs 15-130 min after sunset. Summer roosts are usually in tree holes, buildings or bridges. Maternity roosts are thought to be predominantly female and are usually close to water. Daubenton's bat occasionally roosts with other species such as brown long-eared, *Plecotus auritus*, noctule, *Nyctalus noctula*, Natterer's, *Myotis nattereri*, and whiskered bat, *M. mystacinus*. Night roosts (where bats rest for up to several hours) are very close to the main hunting grounds. Daubenton's bats

typically enter hibernacula in October, choosing to overwinter in caves and crevices, and man-made tunnels and mines (probably also tree holes, rosk piles etc.), and preferring a hibernation temperature of 3-8°C (Speakman, 1991). Bats may emerge to feed, drink or move site during the winter. Other sites, such as trees and bridges may also be used.

The species prefers to forage over pools or areas of smooth, calm, moving water bounded by trees and other riparian vegetation. Main feeding areas are associated with overhanging vegetation and emerging water weed (Richardson, 1985). It typically forages for insects less than 1 m above the water and often takes prey from the water surface. The species has been reported to forage in woodland early in the season and move to riparian habitats in late spring. It regularly forages up to 2 km from its roost (Richardson, 1985).

The diet of Daubenton's bat consists of insects, in particular nematoceran Diptera and Trichoptera (reviewed by Vaughan, 1997). Water quality requirements are not known, but presumably the quality must be good enough to support a sufficient biomass of emergent insects throughout the foraging year, and be sufficient in volume to form areas of smooth water over which bats can forage.

Daubenton's bats have been recorded avoiding crossing open areas: they commute along linear landscape elements such as vegetation or hedgerows to reach their hunting areas.

## 4. MANAGEMENT FOR DAUBENTON'S BAT

Sexual segregation of roosting and foraging bats occurs in at least some catchments (Warren *et al.*, 1997). Adopting a precautionary principle, it would be appropriate to manage for Daubenton's bat at the catchment level, to ensure protection of a viable, reproducing population. Habitat management at this scale would also benefit other long-lived and mobile species, such as otters.

### a. Woodland and vegetation

Riparian woodland corridors and other vegetation should be created or maintained to encourage a diversity of insect species. Trees should be maintained or planted on both banks of rivers and static water bodies. To avoid excessive shading, tree density should be low and variable, with frequent small gaps. A mixture of species of different heights and structure should be present. Native species and/or those historically appropriate to the locality should be present or planted whenever possible. The judicious planting of willows as part of erosion control measures is also appropriate. Linear landscape elements along which the bats can commute from roost sites to rivers and other water bodies are also important. Hedgerows should therefore be encouraged as field boundaries, and trees maintained and/or planted on small feeder streams.

The key is to provide continuity of riparian woodland between roosting and prime feeding sites. This woodland should contain trees which can be used as day/night roosts. Veteran trees should be retained, and these may have to be managed to prevent them from breaking up or from falling into the river (e.g. by pollarding or other tree surgery). Woodland close to water offers potential foraging sites, especially early in the year.

There is an inverse relationship between breeding success and the distance between roost and foraging sites in many bats. Typical commuting distances are about 2 km for Daubenton's bat, so management plans should take this into account.

Foraging activity and feeding success over large water bodies are probably greatest in the marginal lentic zone: in the absence of contrary evidence, management for Daubenton's bat is probably best confined to water within 25 m of the water's edge.

Designation of tranquil areas of riverbanks or the sides of canals and lakes could provide havens for otters, roost sites for bats and feeding and resting areas for a range of other wildlife. These areas should not be grazed by livestock, and there should be a general policy of nonintervention, to include tree surgery. Maintaining, and where possible enhancing, riparian woodland would serve to buffer water bodies from the effects of agrochemical spray drifts and other pollutants such as manure, slurry and effluent.

**b. Foraging sites**

The density and distribution of Daubenton's bat, particularly of maternity roosts, may be limited by the area of suitable water over which bats can forage. Smooth pools should be encouraged on stretches of river with surrounding riparian vegetation, particularly where trees are present on both sides of the river, since these are primary foraging sites. In lakes (and large ponds) sheltered bays in shallow areas, in which bats can feed, can be created by treeplanting. South facing locations would be best as they are warmer and more productive. The creation or recreation of water bodies (e.g. restoration of large ponds and canal systems) with appropriate riparian vegetation, should be encouraged.

Areas of riparian marginal (woody) vegetation should be retained during river engineering works in order to maintain continuity of foraging habitat, particularly if the engineering work covers long stretches of river channel.

**c. Roost sites**

Woodland areas close to rivers and other water bodies should be maintained or created, and old trees preserved for potential roost sites. Renovation of bridges and buildings close to rivers should be undertaken carefully to prevent the exclusion or trapping of bats, through blocking of the roost site entrances and destruction of roosts. Potential hibernacula such as caves, mines and tunnels should be left undisturbed where possible. Entrances to such sites may be restricted through the use of grilles through which bats can pass.

Roost site creation in bridges and trees may be useful in situations where they may be a limiting factor. Specially designed roosts may be attached to bridges: the Bat Conservation Trust may be able to offer advice.The use of cordite and other explosives by the National Trust has shown potential in reducing top heaviness of trees and encouraging fungal entry and the formation of holes which may serve as roosts.

At all times, the possibility of conflicting requirements for the conservation of different animal and plant species should be considered in drawing up plans. For example, management prescriptions for the water vole would include the provision of sunlit banks, with long grass and herbs to provide food and cover. Ideal solutions are likely to involve management of a mosaic of habitats along a river catchment.

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# PART 2 BIRDS

2.1 Management guidelines for the kingfisher

2.2 Management guidelines for the yellow wagtail

2.3 Management guidelines for the grey wagtail

2.4 Management guidelines for the sand martin

2.5 Management guidelines for the reed bunting

2.6 Management guidelines for the dipper

2.7 Management guidelines for the marsh warbler

# ENVIRONMENT AGENCY SPECIES MANAGEMENT GUIDELINES

## KINGFISHER *Alcedo atthis*

Stephanie Tyler

May 1997

## 1. STATEMENT OF USE

The kingfisher is intimately associated with riverine habitats and has been selected as a priority species for conservation action by the Environment Agency. These management guidelines have been developed to assist in the targeted implementation of appropriate management and protection measures for the maintenance, enhancement and creation of kingfisher habitat. They are for use by Agency staff and for distribution to third parties who are in a position to implement such measures in suitable areas (i.e. in localities that are known to, or could, support the species).

## 2. DISTRIBUTION

a. Worldwide. The kingfisher (river kingfisher) is one of the most widely distributed kingfishers in the world, breeding from Britain and Ireland to North Africa and across Europe to the Indian subcontinent, Japan, Sri Lanka, the Philippines and Solomon Islands (Cramp 1985). The nominate race occurs in NW Africa, Italy and Bulgaria whereas the race occurring in Britain and Ireland, *A. a. ispida*, breeds also in southern Norway down to Spain.

b. Kingfishers breed on rivers throughout much of Britain and Ireland although are scarce in Scotland, other than in the south, and in upland areas of Wales and northern England.

## 3. STATUS

Kingfishers are severely affected by hard winters in Britain although some do migrate south in the autumn into France and possibly into Spain. They suffered a catastrophic decline after the 1961/62 and 1962/63 winters, being the worst hit species in these winters (Sharrock 1976). Some local populations were entirely lost and numbers fell to 15% in Wales and 5% in England from previous levels; Irish birds were less badly affected. Populations suffered further set-backs in the hard winters of the 1970s, notably 1978/79, and the early 1980s (Marchant *et al.* 1990). Populations recover quickly though (birds lay large clutches and may have two to three clutches in a season) and the recent relatively mild winters have speeded the recovery. The most recent breeding estimate is 3,300 to 5,500 pairs in Britain with a further 1,300 to 2,100 pairs in Ireland (Gibbons *et al.* 1993). Lack (1986) put the wintering population as 9,000 to 15,000 individual birds.

The kingfisher was included in the list of candidate Red Data bird species by Batten *et al.* (1990) and is on the 'amber' list (i.e. some cause for concern) in the revised 'Birds of Conservation Concern' listing (RSPB 1996). Populations have fallen in ten European countries, leading Tucker and Heath (1994) to give the species an unfavourable conservation status (SPEC 3 category) in Europe.

Kingfishers are fully protected under the Wildlife and Countryside Act and as they are on Schedule 1, they receive special protection with penalties of up to £2,000 for killing or injuring adults or for disturbing, damaging or destroying occupied nests or nests under construction.

## 4. RECOGNITION

Unmistakeable if seen at close range but, despite its bright colours, easily overlooked when it is perched in a tree. The loud ringing call alerts you to its approach and you may then see it flash by, showing its conspicuous blue rump. The best clue to the presence of breeding kingfishers is a nest hole in a vertical bank. Large nestlings may be very noisy, calling from the nest hole, and droppings at the entrance are a further clue to an occupied nest burrow.

## 5. HABITAT REQUIREMENTS

In the breeding season kingfishers occur most commonly on unpolluted rivers, and on those with a good supply of small fish. They require stretches with shallow, clear water. Relatively slow-moving, non-turbulent water and partly shaded stretches of river are most favoured. Some reedy or woody cover at the river edge is desirable for perching sites. Vertical banks of a fairly soft sand or clay material are needed for nesting. Banks at least 1-2 m in height are favoured so that nest burrows can be excavated well above water levels, often within 0.5 m of the top of a bank. Occasionally kingfishers nest in holes in upturned tree roots. River width is immaterial; they nest on rivers 50 m wide as well as on small streams of only 1-2 m width. A pair of kingfishers may have a territory of over 4 or 5 km.

Food consists of minnows, sticklebacks, bullhead, stone loach and young trout, dace, chub, perch, pike and other fish up to 125 mm in length. Aquatic invertebrates, especially dragonfly nymphs, and amphibian larvae are also eaten. Where pollution depresses fish numbers, kingfisher density is low.

In the autumn and winter a wider range of aquatic habitats are used. These include garden ponds, lakes, canals, reedbeds and estuaries.

## 6. CURRENT THREATS

a) Severe winters which cause a freezing over of ponds, lakes, canals and even watercourses. In such winters kingfishers cannot readily otain prey, and they suffer a high mortality.

b) Any deterioration in water quality that reduces the density of juvenile fish or the ability of kingfishers to locate and catch their prey. Fish densities can be reduced by a wide variety of contaminants from a range of sources, some of which are obvious ( such as organic pollution of watercourses from farms or from

domestic or industrial effluents) and others which are not readily apparent from the appearance of the water (such as acidification or heavy metal contamination). Any activity that increases the turbidity of the water will impair the kingfisher's ability to catch prey.

c) Physical damage to the channel and banks (for example removal of bankside or instream cover, grading or destroying steep banks and overgrazing of the riparian fringe). Such habitat damage may directly destroy nest sites and perches from which birds feed. It may also indirectly have an adverse effect on fish prey and hence on kingfishers. Infilling of old oxbows and ponds will reduce feeding opportunities.

d) Physical disturbance near or of rivers during the breeding season. Instream work at this time will cause turbidity/ high suspended solids and thereby reduce feeding efficiency (see 5 (a) above). Disturbance at or close to the nest site from flood defence or agricultural work, anglers, walkers etc. may cause nest desertion or chilling of eggs and small young.

e) Overabstraction of water leading to low flows which exacerbate pollution and cause stress to fish when temperatures are high, or which result in sections of river drying up.

f) Sudden large releases of water from impounded bodies could cause high flows (making feeding difficult) or flood nests.

g) infilling of oxbows or ponds which provide good feeding areas at times of high flow and damage to ditch systems that are used in high flows.

h) human persecution for the feather trade and to allegedly protect fish fry is fortunately, largely a historical problem.

## 7. MANAGEMENT SUGGESTIONS

a) Careful vetting of land drainage consents and proposed flood defence work, especially during the breeding season, so that nest sites are not destroyed inadvertently.

b) Retain all cliff banks used by breeding kingfishers. Also retain eroding cliffs which offer potential nest sites unless bank protection is necessary because of buildings, roads or other important assets being at risk.

c) Retain any riverside upturned tree roots which may be used for breeding, and ensure some low overhanging branches are retained as perches.

d) Through River Habitat surveys and strategic River Corridor Surveys, prior to Flood Defence works, identify degraded sections and make recommendations for improving habitat diversity. This could include :

* Fencing off riparian strips above riverside cliffs which offer existing or potential nest sites. This will prevent disturbance or damage to the nest burrow, such as by trampling stock. Fences should be sited at least 1 m back from the river edge.

* Excavating old oxbows and in-channel loops and/or create new shallow pools within the floodplain.

* creating areas of shallow water through placing rocks or gravel on outer bends or on wider stretches. Kingfishers often feed in the shallows at the edge of shoals in water only 3-4 cm in depth.

* where natural nest sites are absent, artificial cliff nest sites can be created. See also Andrews and Kinsman (1990).

Some of these habitat improvement suggestions could be achieved with grants available to farmers and landowners through for example, long-term Set-aside and Habitat Enhancement Schemes on river edges, SSSI management agreements as on the Rivers Teme, Lugg and Wye, Countryside Stewardship and, in Wales, Tir Cymen. More information is available through the Agricultural Development Advisory Service (ADAS) and through English Nature or the Countryside Council for Wales. EA conservation or flood defence budgets could also be used to achieve habitat enhancement.

Other practices which improve river habitats are fully described in the RSPB/RSNC Rivers and Wildlife Handbook by Lewis and Williams (1984) and in the revised RSPB/NRA/Wildlife Trusts Handbook by Ward, Holmes and Jose (1994).

e) Ensure that water quality is maintained or improved so that there is a plentiful supply of young fish and other prey, and ensure the water is sufficiently clear to allow kingfishers to locate and catch their prey.

## 8. MONITORING

All kingfishers seen on rivers by all EA field staff (RHS, RCS, biologists, fisheries staff etc.), by farmers, landowners or the general public should be noted and all records submitted every year to the County Bird Recorder of the local bird club or society or to the local British Trust for Ornithology (BTO) Representative (a list of recorders and BTO reps and their addresses is printed in the Birdwatchers Yearbook).

The Waterways Birds Survey (WBS) organised by the BTO entails walking a selected (usually three to four miles) stretch of river on six or more occasions during the breeding season from late March to July, mapping the position of all river birds encountered on each visit and submitting maps at the end of the season to the BTO for analysis. The results from WBS plots in England and Wales provide an annual population index for each species against which changes can be measured.

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# ENVIRONMENT AGENCY SPECIES MANAGEMENT GUIDELINES

# YELLOW WAGTAIL *Motacilla flava flavissima*

Stephanie Tyler

May 1997

## 1. STATEMENT OF USE

The yellow wagtail is intimately associated with riverine habitats and riparian meadows and has been selected as a priority species for conservation action by the Environment Agency. These management guidelines have been developed to assist in the targeted implementation of appropriate management and protection measures for the maintenance, enhancement and creation of yellow wagtail habitat. They are for use by Agency staff and for distribution to third parties who are in a position to implement such measures in suitable areas (i.e. in localities that are known to, or could, support the species).

## 2. DISTRIBUTION

a. Worldwide Various races of the yellow wagtail *M. flava* breed in Scandinavia down to North Africa and across Eurasia to Japan. The race *flavissima* formerly bred only in Britain but now breeds too in south west Norway, northern France and the Netherlands alongside the blue-headed race *flava*. 'Our' race of yellow wagtail winters in West Africa, here overlapping with other races which winter also elsewhere in Africa, mainly south of the equator, in India and south east Asia. Some Mediterranean populations are resident.

b. In Britain yellow wagtails are most frequent in southeast England, in areas around the Wash and in northern England; they are patchily and sparsely distributed in southern Scotland, southwest England and Wales. No yellow wagtails now breed in Ireland. Occasionally the blue-headed race breeds in England or Wales.

## 3. STATUS

There was a contraction in range in Scotland earlier this century and since 1970 there have been range contractions in southern England and South Wales (Gibbons *et al.* 1993). Populations fluctuate markedly, with peaks noted in 1968 and the mid 1970s since when a decline has been evident (Marchant *et al.* 1990). BTO Common Birds Census (CBC) data showed a 11% decline in numbers between 1969 and 1991 in England and Wales. This decline continued through the early 1990s although there was a slight increase in 1995 on CBC plots. Sharrock (1976) gave a population estimate for the UK of 100,000 to 175,000 pairs but in 1988-91 this was thought to be reduced to 50,000 pairs (Gibbons *et al.* 1993). The Welsh population probably now numbers fewer than 300-400 pairs.

## 4. RECOGNITION

This is the most pipit-like of the three species of wagtail found in Britain, spending much time walking on the ground. Its olive green back and yellow underparts are diagnostic although females and young birds show much less yellow. When breeding it makes high-pitched calls when flying around an intruder or from vegetation.

Yellow wagtails are only present in England and Wales from mid April to September.

## 5. HABITAT REQUIREMENTS

Yellow wagtails are mainly lowland birds of broad valleys or floodplains, usually found along the lower reaches of rivers from the end of April. They prefer moist grassy areas in the vicinity of water and cover, especially lush herbage which provides a good invertebrate food supply. Favoured haunts are water meadows, damp, preferably cattle-grazed pastures by fresh or saltwater, marshes, bogs, edges of lakes and old sewage farms with settling lagoons. Birds will also nest in cereal and potato crops in river valleys. Nests are always on the ground in crops, grass or other vegetation or on river shoals.

Birds feed in vegetation in fields in the floodplain, on river banks, river shoals and around cattle and cow dung. A wide variety of both terrestrial and aquatic invertebrate prey is eaten. Flies and spiders made up 80% of the food items in one study area in southern England but damseflies and beetles contributed 50% of the prey biomass. As there is a greater diversity of aquatic insects in rivers with a high water quality, it is clearly desirable to maintain or enhance such water quality.

## 6. CURRENT THREATS

a) Intensive agriculture - reseeded pastures, heavy use of fertilisers and pesticides and high stocking rates (especially of sheep) create a uniform close-cropped sward which has no cover for nests and which has few insects associated with it as prey. High stocking rates also cause nest trampling

b) Loss of wetlands on floodplains and associated waterside vegetation

d) Grazing or cultivation right up to the river edge removes cover for nest sites and reduces invertebrate prey

e) Heavy grazing pressure on saltmarshes on estuaries will deter yellow wagtails or cause nest losses.

f) River engineering works which prevent dynamic processes such as formation of new oxbows and new shoals will reduce nesting and feeding opportunities for yellow wagtails

## 7. MANAGEMENT SUGGESTIONS FOR YELLOW WAGTAILS

### a. Vegetation and other management

Lush vegetation near the water's edge with associated insects is beneficial to yellow wagtails. This could be achieved by :

* fencing off areas of river bank from grazing stock in regular breeding areas. This would also reduce trampling of nests on banks and shoals. Some management of the fringe may then be neccessary to prevent dense scrub invasion; alternatively stock could be allowed access during the autumn and winter.

* extensification of cattle grazing. A take-up by farmers of the Agri-environment Habitat Schemes could achieve less intensive grassland management on riverside pastures.

* creation of a buffer strip of grassland to arable crops. If left unsprayed with herbicides or pesticides these strips could provide good feeding areas for yellow wagtails. Such buffer strips could be achieved through take-up by farmers and landowners of agri-environment schemes. Relevant schemes include long-term Set-Aside, Habitat Enhancement Schemes, Tir Cymen and Countryside Stewardship as well as SSSI management agreements on a few rivers such as the Wye and Teme.

* avoidance of any flood defence work on rivers and embankments between May and July, or of river engineering work which results in loss of river shoals, in areas where yellow wagtails are known to occur. This will help reduce nest losses and help retain a good food supply for the birds. The granting of land drainage consents should only be given, or decisions on any flood defence work only be made if the diversity of wetland and wetland edge habitats for yellow wagtails will not be destroyed or degraded. Vegetated shoals should be retained and opportunities sought to create more of this habitat.

### b. Wetland creation

The creation of shallow pools and scrapes on riverside farmland of low existing conservation interest will provide good feeding areas. Existing old ox-bows and pools could be enlarged or dredged in the autumn months. Limiting access by stock to these wetlands will improve the emergent vegetation and hence the invertebrate supply for the wagtails. The conversion of arable fields or formerly agriculturally improved and drained grassland to wet grassland will also increase the amount of good foraging habitat for yellow wagtails.

## 8. MONITORING

Yellow wagtails should be noted on rivers by all EA field staff (RHS, RCS, biologists, fisheries staff etc.). All records should be submitted every year to the County Bird Recorder or the local British Trust for Ornithology (BTO) Representative (a list of recorders and BTO reps and their addresses is printed in the Birdwatchers Yearbook) .

The Waterways Birds Survey (WBS) organised by the BTO entails walking a selected (usually three to four miles) stretch of river on six or more occasions during the breeding season from late March to July, mapping the position of all river birds encountered on each visit and submitting maps at the end of the season to the BTO for analysis. The results from WBS plots in England and Wales provide an annual population index for each species against which changes can be measured.

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# ENVIRONMENT AGENCY SPECIES MANAGEMENT GUIDELINES

# GREY WAGTAIL *Motacilla cinerea*

Stephanie Tyler

May 1997

## 1. STATEMENT OF USE

The grey wagtail is intimately associated with riverine habitats and has been selected as a priority species for conservation action by the Environment Agency. These management guidelines have been developed to assist in the targeted implementation of appropriate management and protection measures for the maintenance, enhancement and creation of grey wagtail habitat. They are for use by Agency staff and for distribution to third parties who are in a position to implement such measures in suitable areas (i.e. in localities that are known to, or could, support the species).

## 2. DISTRIBUTION

a. Worldwide. Grey wagtails occur throughout much of the Old World from Britain and Ireland, Scandinavia and north Africa across Europe and Asia to Japan (Cramp 1988). Northern populations are migratory, moving south to the Mediterranean, into Africa south of the Sahara, India and Malaysia.

b. In Britain and Ireland grey wagtails are widely distributed although are scarce or absent in parts of central and eastern England as well as in the Outer Hebrides, the Orkneys and Shetland Isles. They are most abundant in the upland areas of the north and west. This century has seen an expansion of breeding range into southern and eastern England especially since 1950, with regular breeding now recorded in London, Essex and Lincolnshire.

During the winter some British grey wagtails move south into France; others move from Scotland and northern England to the south and west of England and Wales (Tyler 1979). Our wintering population also includes some Continental birds.

## 3. STATUS

Current populations are high. Gibbons *et al.* (1993) estimated a breeding population of 34,000 pairs in Britain (and a further 22,000 in Ireland).

Numbers fluctuate markedly, declining after severe winters, with lowland populations then contracting back towards the strongholds in the north and west (Marchant *et al.* 1990). Populations suffered setbacks after the harsh winters of 1961/62 and 1962/63, increased again up to the mid 1970s with further declines after 1978/79, 1981/82 and 1984/85 since when numbers have recovered.

In central Europe grey wagtails have expanded their range since the 1850s and have spread north. They now breed throughout most of Europe except in very flat lowland areas.

## 4. RECOGNITION

Of the three species of wagtail likely to be seen in England and Wales, the grey wagtail is most restricted to rivers, especially fast-flowing rivers. It is easily recognised by its blue-grey upperparts, yellow underparts and rump, and by its long wide-edged tail. In the breeding season the male has a black throat.

Often seen sitting on shoals or rocks or walking along the river bank, constantly wagging its tail, it is also a skilled aerial flycatcher.

Any 'yellow' wagtail seen in the winter months will be a grey wagtail as the true yellow wagtail migrates to Africa at this time.

## 5. HABITAT REQUIREMENTS

### 5.1 Physical requirements

In the breeding season grey wagtails prefer fast-flowing streams and rivers but may occur on lowland watercourses especially if weirs or mill races provide stretches of faster running water. Densities are higher on upland streams bordered by broadleaved trees than on open moorland streams or on those flowing through dense conifer plantations. grey wagtails also favour streams with extensive shoals (Tyler and Ormerod 1991), or where there are numerous exposed rocks and instream boulders. These are commonly used for perching and as a base for flycatching sorties over the water; the wagtails also pick prey from around the wetted edge of these rocks and boulders.

Suitable nest sites include rock cliffs, bouldery steep banks, tree roots in banks and even old Sand Martin burrows (Tyler 1972). Many pairs nest in crevices or on ledges in the stonework of bridges or riverside walls, in drainpipes in such structures or on girder ledges under bridges. Where suitable sites are not present close to the river, birds may fly half a kilometre or more to nest in a stone barn, shed or other such site.

The breeding season starts at the end of March and continues through until August or early September. Two or even three broods may be reared.

Birds usually roost in branches of trees overhanging streams and rivers, occasionally in scrub such as bramble by streams. In the winter flocks of grey wagtails have occasionally been recorded roosting in reedbeds.

## 5.2 Water Quality

There is no requirement for clean water because unlike dippers, grey wagtails take a very wide variety of invertebrate prey and are not dependent on pollution-sensitive mayfly nymphs and caddis larvae (Ormerod and Tyler 1991). Hence they may breed by acidic, enriched or otherwise polluted watercourses. However, a more plentiful supply of aquatic insects will be available on rivers with a higher water quality where grey wagtails may breed in higher abundances.

## 5.3 Food and foraging

In the breeding season grey wagtails forage mainly along the river corridor, picking prey from the ground or from low vegetation and flycatching. They forage both in the riparian zone and from instream rocks and boulders, especially at their wetted edge or from their surface just below the water, and on gravel shoals in or by the river. In warm weather when insects are on the wing, flycatching over the river is more commonly seen. Sometimes they feed on pastures, tracks or woodland clearings away from the river. During the winter months they frequently forage away from rivers, for example around farmyards and manure or silage heaps or at sewage works.

They are very catholic in their diet. Adult and larval flies (Diptera) are important prey for adult and nestling grey wagtails. They especially favour chironomids (midges) and simuliids (blackflies), as well as cranefly larvae, the maggots of blowflies and other flies. Prey also includes mayflies, stoneflies and caddis (aquatic and emerged stages), beetle larvae and adults, moth caterpillars (Lepidoptera), damsel- and dragonfly nymphs and adults (Odonata) and even frog tadpoles or small fish.

## 5.4 Summary of requirements

There is a preference for upland watercourses with some broadleaved trees along the banks, with areas of shoal or exposed rocks and shallow water. Riverside cliffs, stony banks and tree roots are usual nest sites. On lowland streams artificial features such as weirs and mill streams are favoured, with bridges and walls being used for nesting. On good streams and rivers in the heart of its range grey wagtail territories are as little as 400m to 500m long. On such watercourses there can be up to 20 pairs per 10 km, although a pair per km would be more usual.

Outside the breeding season grey wagtails forage wherever there is a good supply of invertebrates, for example at sewage works with filter beds and at slurry pits and manure heaps at farms, as well as along the edges of rivers.

## 6. CURRENT THREATS

a) Severe winters pose the greatest threat through reducing prey availability.

b) Loss of nest sites, notably bridges, on more lowland streams and rivers where there are no cliffs or steep banks, may deter birds from breeding. As old bridges are repointed or strengthened, crevices in stonework are destroyed. New concrete bridges may lack suitable nest niches.

c) Removal of bankside trees or overgrazing up to the river edge, which prevents regeneration or new growth, reduces insect prey available for grey wagtails. Trees also provide nest and roost sites; they provide cover too where wagtails can avoid aerial predators, notably Sparrowhawks.

d) Removal of shoals especially during the breeding season will reduce foraging opportunities as well as available food. Many beetle larvae for example, live in shoals, and the wet edge of shoals provides a very rich feeding area for wagtails.

e) Disturbance to nest sites is a localised minor problem, for example at favoured bridge picnic sites. Keeping adults off eggs or small chicks will quickly result in chilling of the clutch or brood and death.

f) Overabstraction leading to drying up of sections of watercourse, will reduce the available food for grey wagtails.

g) Removal or loss of weirs on lowland rivers will remove important feeding/breeding areas. So too would loss of mill streams and lake outflows.

## 7. MANAGEMENT RECOMMENDATIONS

Whilst grey wagtails are common and widespread birds on upland rivers, the highest densities often occurring on headwater streams, there are some opportunities to attract birds on more degraded sections or increase their numbers on more lowland watercourses. Riparian management, channel maintenance for land drainage and adjacent landuse are amongst the factors which may influence the distribution and abundance of grey wagtails.

a) On lowland rivers breeding grey wagtails often depend on weirs, cascades or waterfalls as at lake outflows and mill streams for suitable feeding habitat in the breeding season. Construction of such artificial features, where possible, may attract grey wagtails to breed. Retention of/repair to such features is important.

b) On all rivers where there are breeding grey wagtails ensure that flood defence schemes avoid bank protection works, channel re-alignment or other engineering works which will reduce new gravel shoal formation or destroy all areas of existing gravel shoals. Clearly some shoal removal will be necessary to prevent flooding of roads or properties, for example in the vicinity of bridges, but work should be avoided during the breeding season. In the late summer, shoals are used extensively for feeding by small flocks of grey wagtails migrating south.

c) Ensure that flood defence work avoids the clearance of riparian broadleaved trees especially during the breeding season on good grey wagtail watercourses. Pollard or coppice where trees need to be cut back. Retain upturned tree roots close to rivers as these provide nest sites.

d) Fence off sections of river bank to encourage natural regeneration of trees where this does not conflict with requirements of species such as sand martin or little ringed plover which favour open areas.

e) The provision of nest ledges, drainpipes or bird boxes in/on walls under new bridges, or where old stone bridges are repointed or in riverside retaining walls will help offset loss of nest sites. Such niches may also provide good roost sites. Liaison with highways departments of local authorities is strongly recommended so that opportunities to provide nest sites are not lost. All responses from the Agency to a Highways Authority over any new road scheme which involves river crossings or over any new bridge, should include a reminder about the requirements of grey wagtails (and other river birds and bats) and the need to provide artificial ledges, recesses or drainpipes as nest sites.

The diameter of a drainpipe should be greater than 8 cm. Any ledge or recess in a wall should have a base of 10-12 cm or more, a height of at least 8 cm and a depth of at least 10 cm, preferably 15 cm or more as the greater the depth the less obvious the nest will be to predators.

A standard open-fronted 'robin' nestbox with a ledge across the front is ideal for grey wagtails (and Pied Wagtails). It should be sited under or on the sides of a bridge well above flood levels. Ideally it should be sited at a height of over 2 m above the river or over deep water to avoid human intereference. Boxes sited as high as 10m or more above the water are regularly used by wagtails.

Suggested dimensions for a nestbox are : Base 12 cm (width) x 15 cm (depth); Sides 15 cm (width) x 25 cm (height); ledge across front 4-5 cm in height. If the box is to be sited under a bridge it can have a flat roof extending beyond the edges of the box. Where rain or snow can fall on the box it should have a sloping roof, again exending beyond the sides of the box. The box should be securely attached to a long back (45 cm in length) which can then be nailed or otherwise secured to the bridge wall. Grey wagtails however, readily use much larger boxes such as those designed for dippers, so the dimensions are not critical.

## 8. MONITORING

Grey wagtails should be noted during River Habitat Surveys and on casual visits to rivers. All records should be submitted every year to the County Bird Recorder or the local BTO Representative (a list of recorders and BTO reps and their addresses is printed in the Birdwatchers Yearbook) .

The British Trust for Ornithology runs the Waterways Birds Survey (WBS). The results from WBS plots in England and Wales provide an annual population index for many species of river bird against which changes can be measured. The WBS entails walking a selected (usually three to four miles) stretch of river on six or more occasions during the breeding season from late March to July, mapping the position of all river birds encountered on each visit and submitting maps at the end of the season to the BTO for analysis.

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# ENVIRONMENT AGENCY SPECIES MANAGEMENT GUIDELINES

## SAND MARTIN *Riparia riparia*

Stephanie Tyler

May 1997

## 1. STATEMENT OF USE

The sand martin is intimately associated with riverine and other wetland habitats. It has been selected as a priority species for conservation action by the Environment Agency, and these management guidelines have been developed to assist in the targeted implementation of appropriate management and protection measures for the maintenance, enhancement and creation of breeding populations. They are for use by Agency staff and for distribution to third parties who are in a position to implement such measures in suitable areas (i.e. in localities that are known to, or could, support the species).

## 2. DISTRIBUTION

a) Worldwide. The sand martin ranges extensively throughout North America, Europe and Asia to north India and south east China and northern islands in the Pacific (Cramp 1988). It is a migratory species with Palearctic birds wintering in the Sahel zone of Africa and in East Africa.

b) In Britain sand martins are widely distributed but localised, occurring on lowland rivers and at sand and gravel pits, as well as on the lower and middle reaches of more upland rivers. They are scarce in parts of Wales such as Pembrokeshire, the Vale of Glamorgan and the South Wales valleys.

## 3. STATUS

In Britain the population has fluctuated widely over the last 50 years. It increased, to perhaps a million pairs, during the 1950s and 1960s, possibly due to the provision of new nest sites by the expanding gravel and sand extraction industry. However, the sand martin population crashed to about 40,000 pairs after the 1968/69 winter when there was a severe drought in the Sahel region (Sharrock 1976). It remained low in the early 1970s, increased thereafter but dropped again in 1985. Since then there has been a partial recovery linked to better rainfall in the Sahel zone (Marchant *et al.* 1990). Gibbons *et al.* (1993) suggested a population size of 77,500-250,000 pairs in Britain (plus 49,500-150,000 pairs in Ireland) between 1988 and 1991. The number of occupied 10km squares declined by 25 % between the two Atlases (of 1968-72 and 1988-91).

The sand martin was listed as a candidate Red Data bird species by Batten *et al.* (1990) and is included in the 'Amber' list of the revised 'Birds of Conservation Concern' (RSPB 1996). Declines in sand martin populations have been noted in western Europe (Tucker and Heath 1994) where the species is considered to have an unfavourable conservation status (SPEC 3 category).

## 4. RECOGNITION

Unlike swallows, sand martins do not have long tail streamers and are brown above, white below with a brown breast band. They are usually seen or heard in small flocks over water. They are colonial nesters with their nests made at the end of long tunnels in sandy banks. Colony size can be fewer than ten to over 200 nest holes.

## 5. HABITAT REQUIREMENTS

The prime requirement is availability of a good nest site, such as an actively eroding sandy river bank, within 10-15 km of feeding areas. Natural sites are high vertical river banks, at least 1-2 m above the water, and sandy cliffs by lakes or the coast. Artificial sites include freshly worked cliffs at sand and gravel quarries, sometimes 25 m or more in height, vertical roadside banks and drainage pipes in riverside walls. An estimated 84 % of nests in Britain and Ireland is thought to be in quarries.

Lakes, rivers and marshes are important feeding areas because of the rich insect life associated with wetlands. High water quality will ensure a good supply of aquatic winged insects such as mayflies and caddis flies, whilst ponds, oxbows and other wetlands in or near the river corridor will also contribute to an adequate supply of insect prey for sand martins.

Outside the breeding season when sand martins are migrating south in the late summer and early autumn they stop off to roost in unoccupied nest burrows at colonies. The protection of colonies is therefore important outside the main breeding season.

## 6. CURRENT THREATS

a) Drought in the wintering quarters has the largest influence on populations. Unfortunately this is an uncontrollable factor from the British perspective (unless our lifestyles through causing 'Global Warming' exacerbate drought in the Sahel zone).

b) Loss of suitable cliff banks due to grading of eroding river banks, toe revetments and the use of boulderstone or gabions to protect eroding banks, river straightening schemes etc. can affect populations locally.

c) Modern intensive farming practices, notably a heavy use of pesticides and the intensification of grassland management, reduces the numbers of insects available as prey. Drainage or infilling of wetlands likewise reduces insect prey.

d) Disturbance to colonies in the breeding season may have local impacts. This may include physical and noise disturbance. sand martins are however, remarkably tolerant of the presence of humans close to their nesting burrows.

e) Trampling by cattle and other stock up to the edge of the river can damage or destroy colonies through exacerbating slumping of river bank and causing collapse of nest burrows.

f) Predation by mink can decimate colonies. Badgers are occasionally reported as digging into nest burrows.

## 7. MANAGEMENT RECOMMENDATIONS

### a. Protection of existing colonies and potential new nest sites by :

* Retaining existing and developing vertical banks during flood defence or any river works. Even short, 3-4 m stretches of vertical bank may be used by a few pairs. Extensive stretches of 20-30 m or more are favoured by large colonies. Height of the bank is not especially important although banks 3- 4 m above water level offer greater protection from flooding than lower ones.

  Applications for land drainage consent by farmers and landowners for works in the vicinity of breeding colonies should be very carefully considered, and approved only where important assets (and not farm-land) are at risk.

* avoiding any work at or close to colonies during the breeding season and in the early autumn when nest burrows are used as roosts by migrating sand martins.

* not destroying cliff banks outside the breeding season unless there are other adjacent or nearby suitable banks or unless alternative sites have been created. If destruction of all or part of a cliff bank outside the breeding season is absolutely unavoidable, then alternative or artificial nest sites should first be provided.

* allowing rivers to meander in their flood plains so that new eroding cliffs can form.

* erecting livestock-proof fencing alongside existing or potential colonies to avoid trampling of nest tunnels Fencing should be at least 1 m back from the river edge. Open fencing or strands of barbed wire could allow stock to reach through to graze. However, a mesh fence which prevented all grazing along the river edge would allow the development of a buffer strip of riparian vegetation. This would increases the available invertebrate prey.

Grants are available through various agri-environment schemes for fencing off of the riverside edge and the creation of buffer strips along rivers, for example the Welsh Office Agriculture Department (WOAD) Habitat Enhancement Scheme applies to all rivers although MAFF schemes in England are more limited; Countryside Stewardship and Tir Cymen schemes are also both relevant.

### b) Habitat enhancement

In habitat-poor areas or where existing colonies are at risk, encourage the development of new vertical banks through sympathetic channel engineering. These banks should be at least 1-2 m above spring/summer flood levels and ideally, 10 m or more in width. Reinstatement of meanders or removal of gabions or boulderstone on some banks may help achieve this.

### c) Provision of artificial nest sites

Where riverside walls are necessary for flood protection, as in some urban situtions, artificial drainpipes should be incorporated in the walls to provide nest sites for sand martins. Successful schemes have been carried out in several areas, for example by the former NRA Welsh Region (South East Area) by the R. Monnow in Monmouth. A suggested design is given in the Rivers and Wildlife Handbook by Lewis and Williams (1984). Drainpipes should be about 8-10 cm in diameter. A series of such open pipes should be placed through the new wall, either horizontally or sloping very slightly forwards to improve drainage. The pipes should be long enough to pass through the wall, opening out into loose earth or sand behind the wall, where the birds can excavate a nest chamber.

Create artificial vertical banks, as described by Andrews and Kinsman (1990), du Feu (1993) and Smith (1994), where opportunities permit by lakes and reservoirs, by roadsides, at existing sand and gravel quarries or on other private land. The ideal material is compacted fine sand. New riverside banks should be 1-2 m above spring/summer flood levels; if away from water the banks should be 4-5 m in height to minimise predation problems. Any material slumping at the toe of the new banks should be cleared each year in February or early March, again to reduce access by predators.

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# ENVIRONMENT AGENCY SPECIES MANAGEMENT GUIDELINES

## REED BUNTING *Emberiza schoeniclus*

Stephanie Tyler

May 1997

## 1. STATEMENT OF USE

The reed bunting is intimately associated with upland riverine habitats and has been selected as a priority species for conservation action by the Environment Agency. These management guidelines have been developed to assist in the targeted implementation of appropriate management and protection measures for the maintenance, enhancement and creation of reed bunting habitat. They are for use by Agency staff and for distribution to third parties who are in a position to implement such measures in suitable areas (i.e. in localities that are known to, or could, support the species).

## 2. DISTRIBUTION

a. Worldwide. Races of reed buntings occur from Britain and northern and western Europe south to central France, north Switzerland, north west Austria across to Russia and east to China and West Mongolia.

b. In Britain and Ireland, reed buntings are widespread although absent from some higher upland areas, notably in Scotland. They are more numerous in lowland areas from coastal Lancashire south east to The Wash and Essex. They occur in higher densities in Ireland than in Britain (Gibbons *et al.* 1993). Although birds are mainly sedentary in Britain they do desert upland areas during the winter and flock on lower ground (Lack 1986). About 80 % of males and 40 % of females move less than 5 km between their breeding and wintering haunts. Of those dispersing further fewer than 20 % move more than 100 km from their breeding area, moving mainly to the milder south west. Some winter visitors from Scandinavia and north west Europe also occur in Britain.

## 3. STATUS

The current population in Britain is estimated to be 220,000 pairs with a further 130,000 in Ireland (Gibbons *et al.* 1993). It has been generally stable since the early 1980s but numbers are lower than in the late 1960s to mid 1970s.

There was no significant change in the status of reed buntings prior to 1950 although there was colonisation of some Scottish islands at the edge of the species' range. During the 1950s following a run of mild winters there was a marked population increase in parts of England and southern Scotland, with a resulting

overspill into suboptimal drier habitats including farmland more typical of Yellowhammers (eg Kent 1964, Gordon 1972). There was a crash in numbers after the severe winters of 1961/62 and 1962/63 and then a steady recovery with high population levels to the mid 1970s. A decline started in 1976 or 1977 and was more marked in the late 1970s and early 1980s, partly due to severe winters of 78/79 and 81/82 but believed to be exacerbated by farmland changes, notably an increased use of herbicides (Marchant *et al.* 1990). Since 1983 populations have been generally low, comparable to that in the mid 1960s, but stable.

There has been a marked increase in birds reported coming into gardens in the winter for seed, suggesting a scarcity of food in the wider countryside. An increase in the use of herbicides and loss of weedy areas for nesting and of weed seeds for winter food has been suggested as a reason (Thompson 1988).

In Ireland Hutchinson (1989) reported reed buntings as increasing and expanding into drier habitats.

## 4. RECOGNITION

The black head and white collar of the male reed bunting during the breeding season is striking. Males often perch on the tops of shrubs or long vegetation in or by wetlands. Females and wintering birds are drabber, streaked brown birds but white outer tail feathers in both sexes are a useful feature.

## 5. HABITAT REQUIREMENTS

### 5.1 Physical requirements

Reed buntings favour wetland edges where there is a good growth of aquatic emergent vegetation such as reeds *Phragmites australis* or reed-mace *Typha latifolia* in which to nest. They also like to perch on low shrubs or willows *Salix* spp. In the breeding season they occur along ditches, by lakes, pools and ox-bows, in reedbeds, fens and marshes, by rivers and at upland pools wherever such a vegetation mix occurs. In the winter, birds often flock and roam more widely away from wetlands and into farmland habitats (Lack 1986).

In the 1970s birds bred also in more drier farmland habitats as in hedgerows but in Britain have now contracted back into wetland habitats.

### 5.2 Food

In the breeding season a wide variety of insects and other invertebrates are taken as well as seeds and other plant material (Cramp and Perrins 1994). Birds forage on the ground and among reeds, sedges, rushes and other vegetation, in damp pastures and low in waterside bushes and trees. Outside the breeding season reed buntings forage on the ground for seeds in open countryside, in arable fields and pastures, any weedy areas and even in woodland clearings as well as near wetlands. Then they often occur in flocks with other seedeaters. An increase in the winter use of gardens has been noted (Thompson 1988).

## 5.3 Nest site

Nests are well hidden on the ground usually in sedge tussocks, dead rushes or other material or in reeds. Sometimes they may be built up to 4 m above the ground in willows or other trees.

## 5.4 Summary of main habitat requirements

Any wetland with dense and prolific low vegetation and with a good supply of small invertebrates may be used for breeding. Access to weed seeds is essential outside the breeding season.

# 6. CURRENT THREATS

a) Severe winter weather especially prolonged snow cover, prevents reed buntings from finding food (Prys-Jones 1984).

b) Intensive agriculture with a heavy use of herbicides destroy weeds and hence reduce the seed available for buntings (see O'Connor and Shrubb 1986).

c) Autumn ploughing of wheat and barley stubble and autumn sowing removes grain and weed seeds as winter food.

d) Grazing by stock up to edges of rivers, streams and ditches destroys or damages emergent aquatic vegetation where birds nest, feed, shelter and roost.

e) Drainage of wetlands and infilling of ponds, old oxbows and channels removes breeding/feeding habitat.

f) River straightening and bank protection (concrete/boulderstone/gabions) destroys or reduces bankside vegetation and aquatic emergent vegetation.

g) Dredging of ditches in the breeding season removes cover for nest sites and destroys nests, whilst dredging of long sections of ditches outside the breeding season slows down the vegetation recolonisation process, thereby reducing the value of these sections for reed buntings.

# 7. MANAGEMENT SUGGESTIONS

There is nothing that can be done to influence winter weather, but sympathetic management of watercourses and floodplains can improve habitat for reed buntings in the breeding season and improve survival over the winter period. The aim should be to provide an increase in marginal emergent vegetation for both breeding and feeding and to provide a greater supply of weed seeds during the winter.

a) Reduce grazing pressure in riparian zones especially in lowland floodplains, either through extensification of the grazing regime or by riparian fencing. Fencing should be at least 1 m back from the river bank.

Within the fence there should be no spraying of fertilisers or pesticides so that grasses and wildflowers can thrive and provide seeds as a food source for reed buntings and other birds.

b) Establish riparian buffer zones in arable areas as a seed and insect source for birds

c) Carry out any ditch dredging outside the breeding season and in a sympathetic way (rotational dredging) so that there is always sufficient vegetative cover at the water's edge for nesting birds and for recolonisation

d) Retain or establish riparian scrub or low trees for perching and foraging.

e) Carry out any river engineering sensitively so that sections of marginal vegetation are retained.

f) Retain stubble fields with weeds over the winter as feeding areas.

g) Create small wetlands, fenced off from stock, within the flood plain where aquatic emergents can develop.

Agri-environment schemes and, on a few rivers, SSSI management agreements can provide grants for fencing off river banks and for the creation of riparian buffer zones. Such mechanisms as the Habitat Enhancement Scheme, long-term Set-aside, and Countryside Stewardship in England and Tir Cymen in Wales can help achieve the management noted above and thereby improve habitat and increase the sources of food for breeding and wintering reed buntings.

## 8. MONITORING

The Common Birds Census and Waterway Birds Survey Schemes organised by the BTO provide an annual population index for the reed bunting in farmland and along rivers. These schemes involve walking over farmland or along a stretch of river (minimum length 3-4 km) on eight to twelve occasions during the spring and summer. All birds seen or heard during these surveys are recorded on maps. Local ornithological societies publish records of reed buntings and other species in their annual reports, conduct occasional surveys and some provide detailed distribution maps (on a 2km x 2 km or tetrad basis).

The EA should urge all its staff involved in work along rivers to report sightings of breeding reed buntings (and other river birds) and of wintering flocks to the relevant County Bird Recorder/Ornithological Society.

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# ENVIRONMENT AGENCY SPECIES MANAGEMENT GUIDELINES

## (WHITE-THROATED) DIPPER *Cinclus cinclus*

Stephanie Tyler

May 1997

## 1. STATEMENT OF USE

The white-throated dipper is intimately associated with upland riverine habitats and has been selected as a priority species for conservation action by the Environment Agency. These management guidelines have been developed to assist in the targeted implementation of appropriate management and protection measures for the maintenance, enhancement and creation of dipper habitat. They are for use by Agency staff and for distribution to third parties who are in a position to implement such measures in suitable areas (i.e. in localities that are known to, or could, support the species).

## 2. DISTRIBUTION

a) Worldwide The white-throated dipper has the most extensive range of the world's five species of dipper. It breeds from Britain and Ireland to Scandinavia and North Africa across Europe in mountainous areas to the Himalaya range (Cramp 1988, Tyler & Ormerod 1994).

b) In Britain dippers are widespread on rivers in upland areas of the north and west, with strongholds in Wales, parts of northern England and south west England. They extend out into the adjacent lowlands of Shropshire, Worcestershire, Herefordshire, Gloucestershire, Wiltshire, Somerset and Hampshire (Gibbons *et al.* 1993). They will breed down to sea-level wherever suitable watercourses occur.

Scandinavian migrants occasionally winter on lowland sluggish streams or ditches in eastern England but in the breeding season dippers are confined to faster-flowing streams and rivers of the uplands and adjacent areas.

## 3. STATUS

The latest breeding population estimate for Britain and Ireland is a minimum of 26,000 pairs (Gibbons *et al.* 1993). Dippers are rather little affected by severe winters and their population has been stable or increasing since 1983 (Marchant *et al.* 1990). A comparison of the 1968-72 Atlas (Sharrock 1976) and the New Atlas (Gibbons *et al.* 1993) shows little major change in distribution in England and Wales although birds have apparently disappeared from parts of west Wales, south west and northern England. These losses may be due to poorer observer coverage for the recent Atlas but most of the areas with gaps in distribution coincide with those parts of Britain which are adversely affected by surface water acidification.

Acidification of rivers is known to cause declines in dipper populations (Tyler & Ormerod 1994). Dippers are an excellent 'indicator species' on upland watercourses, their presence and breeding abundance showing the 'health' of a river.

Good dipper rivers may have up to 20 pairs per 10km with neighbouring territories abutting. Poor rivers within the dipper's area of distribution may have only 2-3 pairs per 10km with gaps between territories.

## 4. RECOGNITION

Dippers are unmistakeable, dark brown dumpy birds with a short often cocked tail and a white breast. They frequently perch on rocks and boulders in a stream and characteristically bob or dip. White droppings or small regurgitated pellets resembling mouse droppings on a rock in mid-stream are evidence of their presence. dippers fly fast and direct low over the water, only rarely leaving the river.

## 5. HABITAT REQUIREMENTS

Dippers require unpolluted, well-oxygenated watercourses with rocky or stony beds. They favour watercourses with a pool and riffle sequence; such watercourses generally occur in upland areas where the gradient provides physiographically suitable stretches. These upland streams and rivers contain abundant and accessible invertebrate prey, notably caddis larvae and both stonefly and mayfly nymphs (Tyler & Ormerod 1994). Such important prey is generally more numerous in streams and rivers with a pH of 6 or 7; in very acidic or soft water streams caddis and mayflies are scarce.

Although dippers frequently dive to 1-2m, it is more cost-effective (energetically) for them to obtain food from riffles and shallow water. A preferred prey in the breeding season for older chicks and for the adults are web-spinning hydrosychid caddis larvae which often occur at high abundances in riffles. Mayfly and stonefly nymphs, blackfly *(Simulium)* larvae, freshwater shrimps (*Gammarus*) and small fish such as bullheads are also taken as prey.

Dippers occur on broad rocky rivers and on minor watercourses only 1-2 m wide. Breeding abundances are generally higher on streams and small rivers (< 15 m wide) where the water depth is less than a metre, where there are abundant riffles and exposed rocks and where there is unpolluted, neutral or alkaline water. Typically territories are about 500 m in length on such watercourses.

Whilst an abundance and availability of food is necessary, so too are suitable nest and roost sites. Natural sites are ledges and recesses in rocky cliffs, in stony banks and tree roots and occasionally holes in trees. Old stone walls and bridges provide excellent alternative sites. Bridges with girder ledges and drainpipes are also readily used. Whilst on true upland streams there will usually be a plethora of suitable nest and roost sites, on lowland streams as in Herefordshire, Worcestershire or Gloucestershire, artificial sites, especially bridges, are vital to retain breeding populations.

In the winter many dippers remain on their breeding territories but those at higher altitudes or on small steep watercourses may move down onto more lowland rivers within the breeding range, or to the edges of lakes and even onto rocky sea-shores.

## 6. CURRENT THREATS

a) Pollution of watercourses which reduces the abundance of sensitive prey (caddis larvae and mayfly nymphs) is the main threat to dippers. Acidification, caused by the burning of fossil fuels, of the upper reaches of rivers flowing over base-poor rocks has affected some populations in Wales and northern England (and Scotland eg Galloway). Excessive run-off of nitrogenous fertilisers from nearby farm-land, causing nutrient enrichment and algal growth, may reduce invertebrate prey. Chronic and episodic farm (slurry, silage etc.) pollution or industrial pollution will also affect prey abundance and availability and hence reduce dipper populations. Conversely, in the South Wales valleys dipper populations have expanded as coal and industrial rivers have been cleaned up.

b) The planting of conifers close to the edge of a stream exacerbates acidification in areas of the north and west with base-poor soils and rocks. It also causes dense shade and low stream temperatures which adversely affect aquatic plants, invertebrates and fish and hence dippers. It is however, now Forestery Commission policy to clear conifers back from stream edges and to stop new planting close to watercourses. Extensive new conifer-planting in acid-sensitive areas should be avoided.

c) Ploughing on steep slopes in upland catchments may result in soil erosion. The run-off of soil into streams after heavy rain can smother benthic (bottom-living) aquatic invertebrates, the food for dippers and fish. Suspended solids in the water can impair feeding by dippers which rely on sight to find prey.

d) Disturbance at nest and roost sites is a minor problem. Fishermen and picnickers cause some nest losses through keeping adults off eggs or small chicks but most first broods are on the wing by early May before there is too much people pressure. Some second broods are reared from May to July but these are generally much smaller than the first.

e) Loss of old bridges and consequent loss of available nest and roost sites on more 'lowland' stretches is potentially a problem. On the Welsh borders many bridges have been replaced with concrete bridges to take modern traffic. Unless niches are provided in these, they offer little for river birds.

f) River works, for example the removal of debris dams and fallen trees or removal of shoals during the period March to early July, may destroy nests, disturb breeding birds or through causing turbidity, making feeding difficult for adult dippers.

g) Overabstraction at times of low flow may adversely affect dippers through reducing the wetted area in the stream and hence reducing their food supply, through concentrating pollutants or through making nests more vulnerable to ground predators such as feral mink. Drying up of sections of stream will clearly be deleterious.

h) Overgrazing by stock which prevents regeneration of a riparian fringe of broadleaved trees, will in time adversely affect dippers. The leaf input into watercourses provides food for grazing and browsing invertebrates, themselves food for fish and dippers. Insects, especially caterpillars, that fall from trees into rivers also provide a food source for aquatic animals.

## 7. MANAGEMENT SUGGESTIONS

Highest dipper abundances are likely to be on small upland watercourses most of which will be non-main rivers and where no regular river work will be carried out by the Agency. The emphasis in these areas should be to retain riparian broad-leaved trees, avoid the planting of conifers close to the rivers, prevent organic pollution from livestock farms or contamination of watercourses from sheep-dip chemicals, and retain riparian moorland or pasture.

On main rivers, especially at the edges of the dipper's range, the objective should be to safeguard existing populations and to enable the spread of breeding birds onto formerly unsuitable stretches. Improvements to water quality and reinstatement of habitats on degraded rivers will be most beneficial, but on some otherwise physiographically suitable and prey-rich rivers, the provision of secure nest and roost sites might enable the birds to breed.

Through river habitat surveys, and strategic River Corridor Surveys prior to Flood Defence works, degraded sections of river (those without riffles, pools, shoals or exposed rocks) and sections where nest sites may be limiting breeding, can be identified. Recommendations can then be made for habitat enhancement.

a) The creation of artificial riffles or shallow water over a stony substrate, and the provision of large rocks in a watercourse, may improve the feeding habitat for dippers on streams and rivers with a low gradient. On the R. Severn in Newtown such rocks, placed there by the former NRA, provide perching sites for dippers from which they feed, especially in the winter months.

b) Old weirs on lowland streams at the edge of the dipper's range should be retained where possible as these often provide ideal feeding conditions and nest sites.

c) Retain upturned tree roots and old riparian trees where possible as these may provide niches for natural nest sites. In the breeding season (March to early July), ensure that there are no nests on any fallen trees scheduled to be removed from a watercourse. Nests are sometimes built on top of a fallen tree over the water.

d) Ensure provision is made for nest and roost sites in any new structure over or by a suitable dipper watercourse. This will apply to Flood Defence staff but also Highways Departments of local authorities. When the EA is commenting on highways proposals or other relevant land drainage consents, ensure that nesting and roosting provision is not forgotten. Putting in artificial drainpipes (of about 15cm diameter) or creating a recess (maximum 30cm deep, 30cm wide and 30cm high) is easy if account is taken of this need at the design stage for a new bridge or wall.

e) Surveys and liaison with local dipper enthusiasts (through the local ornithological society) will enable an assessment of whether there are any unsuitable bridges on any river. Open-fronted nest-boxes could be erected under such bridges; always site boxes 1-2m up on walls under and near the centre of the bridge and over deep water if possible. Designs are given in the first edition of the RSPB/ RSNC Rivers and Wildlife Handbook ( Lewis & Williams 1984) and in the BTO's latest nestbox guide (Du Feu 1993), but

all that is required is a large open-fronted box with a height, depth and width of 20-22 cm and a ledge 8-10 cm in height across the front.

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# ENVIRONMENT AGENCY SPECIES MANAGEMENT GUIDELINES

## MARSH WARBLER -*Acrocephalus palustris*

John Hodson

Worcestershire Wildlife Trust

April 1997

## 1. STATEMENT OF USE

The marsh warbler is a rare species in England and Wales (actually only occurring in England), associated with rough grassland habitat adjacent to rivers. It has been selected as a priority species for conservation action by the Environment Agency, and these management guidelines have been developed to assist in the targeted implementation of appropriate management and protection measures for the maintenance, enhancement and creation of breeding populations. They are for use by Agency staff and for distribution to third parties who are in a position to implement such measures in suitable areas (i.e. in localities that are known to, or could, support the species).

## 2. DISTRIBUTION AND STATUS

### 2.1 Mainland Europe

The species occurs mainly in central, eastern and south-east Europe, but also increasingly in southern Fennoscandia. Europe accounts for about 75% of the world breeding range. About 50% of this European population is found in Germany, Russia and Romania, which together with the populations in Poland, Latvia, Czech Republic and Belarus account for about 75%. During the years 1970-1990 the majority of this part of the population remained stable with some fluctuation in Germany and decline in the Czech Republic. Elsewhere range expansion took place in Sweden, Finland and Estonia with slower increases taking place in Denmark, Norway, France and the Ukraine.

### 2.2 United Kingdom

Historically the main population has always been found in the Midland counties with the Lower Avon Valley of Worcestershire being at the centre. Since the mid 1970's this population has been in decline with the loss of the species as a breeding bird occurring in Gloucestershire in 1984 and in Worcestershire in 1994. However, male marsh warblers continue to arrive in Worcestershire each year and hold territory despite the absence of females. Marsh warblers breeding in the British Isles are at the westernmost limit of their range and are therefore susceptible to any climatic changes that may

occur. There is no evidence that any change has taken place, though several cold, late springs may have had an adverse effect on such a small, localised population.

The isolation of the Midland population is thought to have been a factor in the decline and final extinction of the species as a breeding bird, producing a population loss through the natural process of emigration that was uncompensated for by immigration. In common with many bird species, female marsh warblers rarely return to their natal areas whereas a large percentage of males do. In Europe this movement away from the natal area may involve a distance of only a few kilometres and, due to a more widespread population, the locating of an unpaired male is almost assured. A movement of similar distance by the Worcestershire birds would put them beyond the populations range and lead inevitably to a population dominated by males. Research carried out in the mid 1980's has shown that breeding success and productivity was not the reason for decline, though past habitat loss may have contributed to the problem by restricting the size of the population, making it unable to withstand the natural losses that occur each year. Almost mirroring the decline of this population, a new population has slowly become established in Kent, with an unconfirmed report of at least 80 singing males in 1995. Irregular breeding or territory holding by unpaired males has also taken place in at least 19 other, mainly southern, counties.

### 2.3 Legal status

The species is protected under Schedule 1 of The Wildlife and Countryside Act 1981, the EC Birds Directive and Appendix II of the Berne Convention.

## 3. HABITAT REQUIREMENTS

### 3.1 The Worcestershire sites

The sites with the longest history of continuous use as breeding sites by marsh warblers are situated alongside the River Avon and one of its tributaries, the Bow Brook. All are roughly rectangular in shape and lie within the narrow strips of alluvial flood plain between the water courses and the gravel-based river terraces. The terraces are free-draining with spring lines at the base on the edge of the flood plain. During past river management work (channel deepening), levees were constructed with the dredged material. The effect of both the spring line and the levees is to produce a soil moisture gradient across the width of the flood plain. The spring lines, together with run-off from horticultural irrigation of fields situated above most of the sites, have the effect of buffering the sites against summer drought. The average area of the main Worcestershire sites is just under 1.5ha, some of which contained up to 7 pairs when the population was at its peak. Much smaller areas of habitat were also colonised by single pairs, with areas of $100m^2$ being recorded.

Vegetation within the sites can be broadly described as rank herbaceous, with common nettle (*Urtica dioica*), great willowherb (*Epilobium hirsutum*) and meadowsweet (*Filipendula ulmaria*) dominating. Some sites contain varying amounts of reed sweet-grass (*Glyceria maxima*), greater pond-sedge (*Carex riparia*), common reed (*Phragmites australis*) and hemlock (*Conium maculatum*). Most sites are bordered by tall mixed hedges, some containing larger trees within both the hedgerows and the sites themselves. The hedges consist mainly of hawthorn (*Crataegus monogyna*), blackthorn (*Prunus spinosa*) and elder (*Sambucus racemosa*) and tend to border the northern boundaries of most sites, giving shelter from winds in that sector. The trees are mainly crack willow (*Salix fragilis*) and white

willow (*Salix alba*), with smaller numbers of pedunculate oak (*Quercus robur*), ash (*Fraxinus excelsior*) and field maple (*Acer campestre*). Shrubs within the sites are predominantly hawthorn, blackthorn and elder with some wild plum (*Prunus domestica*).

The main feature of all marsh warbler sites appears to be the structure of the vegetation. This is, as stated, a tall herbaceous community capable of providing the rigid supports necessary for nest building and to act as song posts. The average nest is built about 1m above ground level in vegetation that could be 2m tall or more. The plant most suited to this on the Worcestershire sites is great willowherb. Although both common nettle and meadowsweet are used for nest building, nettle in pure stands is very prone to being flattened by wind and rain and, on drier sites, infestation by goosegrass (*Galium aparine*) has the same effect. The other main structural component of the sites is the presence of willow trees. These can provide song posts but are mainly used for foraging, willows coming second to oak for the range of insect species to be found on them (mainly moth larvae). Most food items taken by the adults prior to hatching of the eggs are found within the vicinity of the nest, with excursions of up to 150m being made once the eggs have hatched. Areas with high food abundance may be shared by several birds. The list of prey items recorded as being taken by marsh warblers is extensive, with the adult diet consisting of almost any invertebrate that occurs within the bird's territory. Beetles provide up to 50% of the intake, with spiders, flies, aphids, damselflies and lepidoptera larvae making up a large part of the remainder. Nestlings are fed on the smaller and softer items such as spiders, aphids and the larvae of several orders.

## 3.2 Summary of habitat requirements in Worcestershire

The sites can be identified by their proximity to waterways, ideally within the flood plain. They are covered with tall herbaceous vegetation, Great willowherb being the key species with common nettle as a strong secondary component. They are fairly well sheltered, normally by surrounding overgrown hedgerows with scattered trees. The trees are predominantly willows and there may also be small scattered shrubs within the plots.

## 3.3 Habitat requirements in Kent

Most sites occupied by marsh warblers in Kent are situated in river valleys and low-lying ground much as they are in Worcestershire; however, several birds have been found occupying drier sites. These sites, despite being drier, have one strong similarity to the more traditional Worcestershire sites, and this lies in their vegetational structure. On many sites the dominant plant species are rosebay willowherb (*Chamerion angustifolium*) and goldenrod (*Solidago virgaurea*), different species but plants with a similar structure in that they tend to grow tall and upright and often form dense stands. One other similarity that these plants have with the more usual great willowherb and common nettle is the tendency for dead stems to remain over winter into the following season. These stems are important to the birds as supports for nest building and also as song posts; they may also indicate to returning birds the growth potential of the vegetation within the site.

## 3.4 Summary of habitat requirements in Kent

As in Worcestershire, low-lying ground in river valleys is the norm, but with an expanding population there is a tendency for some birds to occupy drier sites away from river valleys and watercourses.

These sites, however, are visually similar with large stands of sturdy, upright plants of single species composition in sheltered situations.

## 4. MANAGEMENT FOR MARSH WARBLERS

### 4.1 Water table and drainage

The reasons for the existence of the plant communities found on these sites are directly related to the water table and poor drainage. The ground tends to remain wet throughout the year and is not suited to modern farming practices with its associated heavy machinery. It has therefore been removed from agricultural production, and the conditions that then prevailed led to the tall, rank vegetation that we see today. Lowering of the water table and attempts to make the sites more free draining would lead to some of them becoming suitable for a return to agriculture. Even without a change of use the effect would be to alter the vegetation in such a way as to render them unsuitable for both marsh warblers and other plant and animal communities found there. It is therefore important that the hydrology of existing or potential sites is considered when both maintenance and major works are planned.

### 4.2 Maintenance of herbaceous vegetation

No management of the herbaceous vegetation is carried out on the marsh warbler reserves in Worcestershire. It appears that the dense nature of the vegetation together with a deep litter layer prevents colonisation by tree and shrub species. The build up of litter also leads to enrichment of the soil which benefits the nettles and also presumably the great willowherb. Cutting of the vegetation, even on a long rotation, would lead to a more grassy habitat as rabbits within the sites exploit any open areas by grazing the new growth, altering the species composition in the long term. Rabbits have caused concern in the past, having been observed 'felling' large areas of nettle stems to reach the more palatable tops. They can also gain access to nettle tops by climbing the dense mats of goosegrass that occur in some years. Control of rabbits has been attempted in the past, mainly to placate neighbouring farmers. Goosegrass control was also attempted in the past, but with no success. With more suitable habitat available than there are marsh warblers, goosegrass is no longer perceived as the problem that it once was. Fortunately it does not occur in abundance every year but remains a difficult plant to control.

### 4.3 Maintenance of trees and shrubs

It is important that riverside trees, together with trees within suitable breeding habitat, receive regular maintenance in the form of pollarding and coppicing. Ideally bankside willows should be pollarded every 5 years dependent upon regrowth. This eliminates both the risk of casting too much shade upon the site and the risk of overgrown trees falling apart. The shorter periods between pollarding would eliminate the need for heavy machinery to be taken into the sites, as the smaller material should not require winching. Compaction of the soil surface within sites suppresses regrowth of vegetation in following years. Vehicular activity also flattens dead stems from the previous years growth and so should be avoided.

### 4.4 Habitat creation

The creation of habitat for marsh warblers is fairly straightforward and fits in well with the concept of buffer zones along watercourses. Sites chosen should have similar physical features to existing occupied sites and ideally should be showing signs of reverting to suitable habitat. Damp meadows and former agricultural land along river valleys would respond to a policy of non-intervention and develop a suitable habitat within a few years. Planting of species such as great willowherb and meadowsweet in damper areas could speed up the process. Drier areas of sites could be left to develop naturally or be planted with trees and shrubs to create shelter and feeding areas for the birds. Land with previous arable use could be rotavated in late summer when willowherb seed is being wind-dispersed - germination rate is usually quite high, especially on damper soils. Manipulation of the hydrology may not be necessary but where needed would require no more than diverting drainage ditches, blocking land drains and the possible creation of wetter areas by the means of excavation work. Aftercare would probably follow the same lines as management on existing reserves, in that tree and shrub growth would be restricted to the perimeter of the site with a cycle of pollarding being established to avoid shading of the site by larger trees. (See 4.2 & 4.3).

Grants may be available through the Countryside Stewardship Scheme, in particular the Waterside Land option (in Worcestershire wet grasslands are a regional priority). For more details contact the local Farming and Wildlife Advisory Group.

## 5. MONITORING AND RECORDING

Marsh warblers return to their breeding territories in Great Britain from the middle of May, with arrivals still taking place until late June. Monitoring the arrival and presence of the birds can only be achieved by listening for the song of the male marsh warbler. Although the song is diagnostic and quite unlike that of any other species of bird, even experienced birdwatchers can have trouble with identification, especially if they have not had recent contact with the species. This is due to the unfortunate fact that the rare marsh warbler is almost identical in appearance to the relatively common reed warbler (*Acrocephalus scirpaceus*). On return the male's song output is almost continuous, with only short periods of time when song cannot be heard. This makes monitoring fairly easy, although confusion can occur in sites of multiple occupancy when trying to ascertain how many singing males are present. The one major problem with monitoring marsh warblers by their song is the fact that song output is greatly reduced once a female has been attracted; it is therefore essential to visit likely sites on a daily basis from very early in the season. When a male is thought to have paired it is necessary to obtain views of both birds together, if the pairing is positive this should not be a problem as the male tends to follow the female during her nest building activities, which cover a period of about four days. Unpaired males will continue in song well into July on occasions. Reports of marsh warblers from unknown recorders should always be treated with caution, especially records based on visual evidence alone. For verification contact should be made with the regional bird recorder.

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# PART 3 HERPETOFAUNA

# ENVIRONMENT AGENCY SPECIES ACTION PLAN FOR ENGLAND AND WALES

## GRASS SNAKE - *Natrix natrix*

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June 1996

**Summary**

This plan recognises that the grass snake, a species dependent upon wetland habitats, has declined in recent years, mainly due to habitat loss. Although not under severe threat, it is a species whose habitat is frequently encountered by the Agency in the course of fulfilling its statutory duties, particularly in relation to river engineering. The Agency therefore feels that it has a special duty towards the conservation of the grass snake.

Owing to the magnitude of the potential impacts of Agency activity (both positive and negative) and the numerous other threats to grass snake populations that exist, action is needed to ensure that:

- existing populations are adequately protected;
- habitats are managed in appropriate ways;
- opportunities are taken to create new habitats where possible.

The Agency has a direct role in habitat management and creation, but can also make an indirect contribution through the encouragement of suitable management activity and protection measures by third parties (particularly landowners) and the commissioning of necessary research.

## 1. PRIORITY STATEMENT

a) Under R & D Project 461 "Species Management in Aquatic Habitats", the grass snake was identified as a High Priority species of concern to the Agency because of its dependence upon wetland habitats, and the threat to its populations.

b) This Species Action Plan addresses several of the points made in the Joint Nature Conservation Committee's "Framework for the Conservation of Amphibians and Reptiles in the UK: 1994-1999".

## 2. ACTION PLAN OBJECTIVES

*Short-Term*: To provide written guidance on practical management techniques designed to enhance grass snake populations, which may be utilised by the Agency in its operational activities, as well as by others.

*Medium Term:* To implement management techniques for grass snakes wherever possible and appropriate, and to promote their use by others.

*Long Term:* To demonstrate the enhancement of grass snake populations through practical management work by the Agency, by means of appropriate monitoring.

## 3. LEGAL STATUS

a) Under Schedule 5 of the Wildlife and Countryside Act 1981, the grass snake is protected from intentional killing or injury, and from sale of any live or dead specimens.

b) The Berne Convention lists the grass snake under Appendix III as a species requiring management/regulation of exploitation.

## 4. BIOLOGICAL ASSESSMENT

### 4.1 Status

The grass snake is widely distributed throughout England and Wales, mainly in lowland areas, being rare in the north but locally common in other parts of England. Like all reptiles, grass snake populations have not done well in recent years; Hilton-Brown and Oldham (1991) reported significant declines in the West Midlands, South-West and North-West England. Detecting real trends in status is hampered by the secretive behaviour of grass snakes, and the true situation may in fact be worse than this report suggests.

### 4.2 Ecology

The grass snake is found in a variety of habitats, including grassland and woodland, but is most numerous in wetlands, where it feeds on amphibians and fish. As well as an adequate food supply, its habitat requirements include basking sites, piles of rotting vegetation as egg-laying sites and underground hibernation sites. It is a wide-ranging species which does best in large areas of suitable habitat; this requirement can be met by linear corridors (eg along river systems), intact blocks (eg grazing marsh) or linked patches (eg remnants of scrub, ponds and hedgerows in arable farmland).

## 4.3 Distribution and Population

Grass snakes are found throughout most of Europe, being absent only from Scotland (apart from a few records), Ireland and northern Scandinavia; they also occur in north-west Africa and through Asia east to Lake Baikal. Within Britain, grass snakes are rare in northern England, locally common in south-central England and widespread but not common through the rest of England and Wales. The UK population size is estimated at 320,000 in 5,365 populations.

## 4.4 Limiting Factors

*4.4.1 Habitat loss and modification* *Importance - High*

Urbanisation, agricultural intensification, road construction and increasing disturbance have led to loss of grass snake habitat and fragmentation of populations.

*4.4.2 Loss of egg-laying sites* *Importance - High*

Changes in land use and agricultural practices mean that piles of rotting vegetation are less frequently present in the countryside. Changes in aquatic vegetation management (use of herbicides, removal of cut vegetation off-site) will have similar effects.

*4.4.3 Inappropriate habitat management* *Importance - Medium*

Overmanagement, leading to uniformity of vegetation structure, or neglect, leading to scrub development, degrades grass snake habitat. Some management techniques eg mowing can lead to direct mortality if carried out inappropriately.

*4.4.4 Persecution and disturbance* *Importance - Unknown*

Despite legal protection, snakes are still killed on occasions. The significance of human disturbance interfering with hunting/basking is not known.

*4.4.5 Prey availability* *Importance - Low*

Declines in amphibian populations may have affected grass snakes, though their diet is fairly catholic.

## 5. CONSERVATION ACTION TO DATE

As a relatively common species, the grass snake has not been subject to the kind of conservation programmes undertaken for the rare reptiles. The National Common Reptile Survey and the new Amphibian and Reptile Recording Scheme provide the background information on distribution, habitat and status required for conservation action. A nationwide campaign undertaken in 1995 by Herpetofauna Conservation International Ltd aimed to encourage sympathetic management, promote environmental education and investigate local status. On a local scale, Wildlife Trusts, local Amphibian and Reptile Groups and other conservation bodies have managed sites for grass snakes.

## 6. PROPOSED ACTION

### 6.1 Policy and legislative

Action 1: Full protection for the grass snake under the Wildlife & Countryside Act 1981. Priority: medium. JNCC.

*Agency action: put proposal to JNCC.*

### 6.2 Site Safeguard, land acquisition and management

Action 2: Most important sites for grass snakes to be given SSSI or County Wildlife status. Priority: high. EN, CCW, Wildlife Trusts.

*Agency action: help identify important sites in liaison with conservation bodies.*

Action 3: Conservation bodies to acquire, and manage appropriately, sites important for grass snakes. Priority: high. Wildlife Trusts etc.

*Agency action: assist management of sites where appropriate.*

Action 4: Creation of new wetland habitats suitable for grass snakes. Priority: medium. Agency, conservation bodies.

*Agency action: wetland creation through enhancement/mitigation works.*

### 6.3 Species Management, Protection and Licensing

Action 5: More emphasis to be placed on site protection rather than translocation where developments threaten grass snake habitats. Priority: Medium. EN, CCW.

*Agency action: acceptance of translocated populations on Agency sites as a last resort.*

### 6.4 Advisory

Action 6: Advice to landowners on appropriate ways to manage suitable sites for grass snakes. Priority - Medium. FWAG, Agency, etc.

*Agency action: advice to landowners where appropriate.*

## 6.5 International

No action.

## 6.6 Future Research and Monitoring

Action 7: Further research on precise habitat requirements of grass snakes, particularly overwintering sites. Priority - low. Agency, EN, CCW.

*Agency action: support for further research.*

Action 8: Assessment of national grass snake population trends. Priority - medium. JNCC.

*Agency action: Agency staff to be encouraged to submit records to appropriate bodies.*

Action 9: Monitoring of grass snake populations at key sites, and to assess the effects of management work. Priority - high. EN, CCW etc.

*Agency action: support for monitoring work.*

## 6.7 Communications and Publicity

Action 10: Publication of management guidelines, for use by landowners and managers. Public education on the natural history, status and legal protection of grass snakes. Priority: high. Agency, conservation bodies.

*Agency action: publication of advisory leaflet.*

## 7. ACTION PLAN REVIEW

This plan will be reviewed after 3 years (1998).

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# ENVIRONMENT AGENCY SPECIES MANAGEMENT GUIDELINES

# GRASS SNAKE - Natrix natrix

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February 1998

## 1. STATEMENT OF USE

The grass snake is highly dependent upon wetland habitats and has declined in recent years in association with habitat loss. Although not under severe threat, it is a species whose habitat is frequently influenced by the Agency in the course of fulfilling its statutory duties, particularly in relation to river engineering and maintenance. These management guidelines have been developed to assist in the targeted implementation of appropriate management and protection measures for the maintenance, enhancement and creation of grass snake populations. They are for use by Agency staff across all Functions and for distribution to third parties who are in a position to implement such measures in suitable areas (i.e. in localities that are known to, or could, support the species).

## 2. DISTRIBUTION AND STATUS

The National Common Reptile Survey, co-ordinated by De Montfort University between 1989 and 1992, found the grass snake recorded in 46% of 10 km squares surveyed. Its distribution has a lowland bias; it is found across England and Wales, but is rare in North-West and Northumbria/Yorkshire Regions, and is more limited than might be expected in South-Western. The grass snake is not native to Scotland.

The Nature Conservancy Council status report (Hilton-Brown and Oldham, 1991) reported that the grass snake was widespread and locally common in England except the North where it had a patchy distribution and was rare. Declines were reported through the 1980s for the West Midlands, South-West and North-West England. In Wales, the grass snake was widespread but not common, and no change in status was detectable. Loss, modification and fragmentation of suitable habitat is thought to be the major reason for decline in populations; agricultural improvement and loss of egg-laying sites are particular problems for grass snakes.

## 3. HABITAT REQUIREMENTS

The importance of the grass snake for the Agency is that, of the British reptiles, it is the one most closely associated with wetland habitats. The National Common Reptile Survey found 29% of grass snake records in wetlands, with 28% on grasslands and 26% in woodlands. The other reptiles only recorded about 5% of sightings in wetland habitats.

Grass snakes, as excellent swimmers, are to be found in river valleys (local distribution of grass snakes often coincides fairly closely with river systems), marshes, damp meadows and drainage ditches, and around stillwater bodies such as ponds, lakes, reservoirs, gravel pits and canals. Within such areas, grass snakes require a mosaic of tall vegetation for foraging and cover, short vegetation for basking, and sites for egg-laying and hibernating.

The diet of grass snakes consists principally of amphibians - frogs, newts and, in some areas at least, especially toads will be taken, both in and out of the water. Fish, as well as lesser numbers of young birds, small mammals and large insects, will also be eaten. Young grass snakes feed upon tadpoles, juvenile amphibians and small fish.

Water quality requirements, when utilising wetland habitats, are not known, but presumably the water quality must be good enough to allow a diversity of prey items to thrive.

Grass snakes emerge from hibernation in late March when temperatures are appropriate. They are predominantly diurnal, but have been observed to forage in ponds after dark. Mating occurs in April and May, and clutches of 10-40 eggs are laid in late June or early July. As Britain's only egg-laying snake, the grass snake requires suitable sites consisting of heaps of rotting plant material within which the heat generated by decomposition provides the optimum temperature for egg development. Such egg-laying sites may be provided in river corridors by trash-line vegetation left after the highest floods, piles of soft vegetation cleared during maintenance work on rivers and wetlands, and cut reed and reed waste in reedbeds. Elsewhere, suitable conditions are provided by compost, manure heaps, sawdust mounds, piles of rotting logs, seaweed, hay/litter on rough grassland, and less often amongst moss, piles of dead leaves or tree roots.

The young snakes emerge from late August to late September. When temperatures start to drop below the level required to support activity (usually by mid-October), grass snakes retreat into hibernation quarters. Hibernation (which is sometimes communal) takes place underground, in rubble piles, the burrows of mammals, thickly-vegetated banks, tangled tree roots or occasionally stone walls. Hibernation sites must provide protection from frost, flooding and predation.

## 4. MANAGEMENT FOR GRASS SNAKES

### a. Vegetation and other management

Areas currently supporting, or suitable for colonisation by, grass snakes should be managed so as to maintain structural diversity of the vegetation. The aim should be to create blocks of tall vegetation, for feeding and shelter, and short grass for basking. Selective mowing, to produce areas of shorter grass, should be undertaken in a predictable way so that individuals are given an opportunity to take evasive action to avoid injury. If grazing is utilised, this should be

managed so that the result is not a uniform sward. Tree and shrub growth should be controlled to prevent too much shading of the habitat. Over-zealous scrub clearance should, however, be avoided as it reduces the amount of cover available (for both grass snakes and their prey).

Gassing of burrows to control rabbits will also kill any reptiles present. In areas known to support grass snakes, such vermin control should only be undertaken after serious consideration.

**b. Basking sites**

Grass snakes require sunny places in which to bask and raise their body temperature. These should be sheltered areas of low vegetation which act as a sun-trap, close to their wetland feeding areas. Banks and mounds with south to south-west facing slopes can be created as basking sites.

**c. Wetland creation**

The creation of ponds and other wetland sites, particularly if designed for amphibians, will provide feeding areas for grass snakes. The NRA "Ponds and Conservation" booklet and the British Herpetological Society's "Garden Ponds as Amphibian Sanctuaries" provide details. The stocking of fish should normally be avoided as this will limit the growth of amphibian populations.

**d. Egg-laying sites**

Grass snake egg-laying sites can be constructed from vegetation cleared as a result of river maintenance operations (grass and reed cuttings, dredged aquatic plants, tree prunings), ditch and pond dredgings, or by making use of trash. Grass snakes will travel several hundred metres from preferred habitat to egg-laying sites, but they are best sited as near to the wetlands as possible, though above river flood levels. They should be in sunshine for at least part of the day, and in an area with as little disturbance as possible. Siting of heaps should avoid damage to swards of conservation value.

The heap should be well aerated, but with a good moisture content. The base of the heap should be a criss-crossed layer of coarse material - branches or logs - to create a good air supply. The main part of the heap is then made up of soft vegetation mixed with some more rigid matter (twigs, prunings) to create gaps. Finally the heap should be covered with a layer of dry plant material such as long grass, to keep in the moisture.

The minimum size for an egg-laying heap is 1.6 m long by 1.2 m wide by 1 m high after initial settling. Large heaps are generally better than small ones. A heap should be topped up each spring with fresh material; if not replenished, a heap will be of little use after two years. If a new heap is to replace an existing one, it should be as close as possible to the original, due to the snakes' site fidelity. Heaps should not be disturbed from June to September, when they may contain eggs, nor from late October to mid-April, when they may also function as a hibernation site.

The above guidelines may describe an ideal, but grass snakes will often lay eggs in heaps of much simpler construction, such as piles of horse or pig manure. Construction of such simpler heaps should be encouraged where land use permits.

### e. Hibernation sites

Potential hibernation sites, such as old tree stumps, should be highlighted in management plans and retained. Hibernation sites can also be created by burying, or constructing mounds out of, brick rubble, broken paving slabs, crushed concrete, railway sleepers, old pallets or logs. They should be packed loosely with topsoil to create a matrix of 2-3 cm diameter gaps. Overwintering sites need to be sited so as to avoid river flood levels, normal high water table or frost pockets. Grass snakes tend to remain near their hibernation sites for a while after emergence in spring, so they need to be close to suitable feeding areas.

## 5. MONITORING

Grass snakes are best looked for on warm, sunny mornings during the active season, especially late spring. Likely basking sites - banks, edges of bushes and hedgerows, gaps in tussocky vegetation - should be scanned, though grass snakes may also be seen swimming. A means of increasing the chances of finding reptiles is to lay small sheets of tin (corrugated iron) on the ground, under which snakes will lie to be warmed by the sun. The sheets are best checked when the temperature beneath them is around 20°C. It is suggested that a good site for grass snakes should yield 5+ sightings per day, with tins set at a density of 10/ha.

Section HERPS 3.1 of the English Nature Species Conservation Handbook gives further details on monitoring reptiles.

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# ENVIRONMENT AGENCY SPECIES MANAGEMENT GUIDELINES

# GREAT CRESTED NEWT *(Triturus cristatus)*

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February 1998

## 1. STATEMENT OF USE

The great crested newt is a species of high conservation priority and there is great potential for the Environment Agency to influence favoured habitats in the course of fulfilling its statutory duties. These management guidelines have been developed to assist in the targeted implementation of appropriate management and protection measures for the maintenance, enhancement and creation of great crested newt populations. They are for use by Agency staff across all Functions and for distribution to third parties who are in a position to implement such measures in suitable areas (i.e. in localities that are known to, or could, support the species).

## 2. INTRODUCTION

The great crested newt *(Triturus cristatus)* is a fully protected species, appearing on Schedule 5 of the Wildlife and Countryside Act 1981. It is illegal to deliberately injure, capture or disturb great crested newts (at any stage of their life cycle), or obstruct their access to areas where they live and breed (which are also protected against damage or destruction).

The great crested newt is also given protection through being listed on Annexes II and IV of the European Union Directive on Natural Habitats and Wild Fauna and Flora, and on Appendix II of the Conservation of European Wildlife and Natural Habitats (the "Bern Convention"). A species action plan has been prepared by the UK Biodiversity Steering Group (1995), the great crested newt appearing on its "Short List", and this has been developed into an action plan programme 1998-2002 by the Great Crested Newt Species Action Plan Forum.

Britain has particular responsibility for conservation of the great crested newt, since it holds the strongest populations of a species which is threatened in continental Europe. Given the strict legal protection, and its dependence upon aquatic habitats, the great crested newt is obviously a species which the Environment Agency has obligations to protect in its own operations, in relation to its authorisations, and through the planning liaison process. There is much advisory literature available on conservation of the species (see, for example, Gent and Bray 1994; English Nature 1996).

## 3. DISTRIBUTION AND STATUS

Great crested newts are widespread in Britain (as shown in Arnold 1995) and are particularly well distributed in lowland England. They are uncommon in most parts of Wales (though numerous in the north-east), Devon and Cornwall, the Fens, the Pennines and Scotland. Even in areas where they are widespread, populations are generally said to be local.

There have been concerns that the great crested newt has declined faster in Britain than the other widespread amphibians and reptiles. A survey in 1990 (Hilton-Brown and Oldham 1991) suggested that during the 1980s there had been a decline in all parts of England and Wales, other than East Anglia, South-West and South-East England, where no change in populations was detected.

The National Amphibian Survey undertaken by Leicester Polytechnic (Swan and Oldham 1989) suggested a total in Britain of 18,000 great crested newt breeding sites. The species was found in 53% of surveyed 10km squares. It was estimated that site loss in the early 1980s ran at about 2% over six years, the principal causes being urban development and changes in agricultural practices. Neglect of pond management, leading to pond senescence, may be an even more significant threat, though difficult to quantify.

## 4. HABITAT REQUIREMENTS

Evidence from the National Amphibian Survey (reported in Swan and Oldham 1993) indicated that the great crested newt has more exacting habitat requirements than other British amphibians. Ponds with an area of 500 to 750$m^2$ are most frequently occupied. The optimum depth is between 0.5 and 2 metres. There are preferences for macrophyte growth: great crested newts are most numerous when emergent vegetation cover is between 25 and 50%, and submerged vegetation between 50 and 75%. Newt numbers decline when shade affects more than 75% of the pond circumference, but a certain amount of shade (up to 60%) is beneficial, as courting pairs appear to congregate in poorly vegetated areas under overhanging branches.

Hard water, with a high calcium carbonate content and pH values above 6.0, is usually preferred (McDouall 1996). Slightly eutrophic water is acceptable, and water quality is usually only significant in extreme circumstances when organic pollution leads to deoxygenation and change in pH. Great crested newts cannot tolerate large numbers of waterfowl nor the presence of fish, with sticklebacks, perch and pike being a particular problem (though the newts may survive in suppressed numbers). They have a preference for ponds which dry out occasionally in late summer (as this will prevent establishment of fish populations), but it should not happen every year. Great crested newts rarely use garden ponds. They will infrequently breed in slow-flowing water.

Owing to the limitations of newt dispersal, the proximity of suitable breeding ponds one to another is important. Low pond density will diminish colonisation even if good terrestrial habitat is present between. The minimum pool density threshold is about 0.7 suitable ponds $km^{-2}$ for good great crested newt populations. 100% occupancy is only recorded at a much higher pond density of 3 ponds $km^{-2}$. Buildings are the most obvious barriers to newt dispersal, but rivers have a similar effect and roads also pose a threat.

As adult newts spend over half the year on land, appropriate terrestrial habitat is critical. The lower critical limit of "newt friendly" habitat needed to sustain a viable great crested newt population is 4000 $m^2$ within 500 metres of the breeding site. The preference is for a landscape in which a variety of land-uses are present within 500 metres of the pond and which specifically contain areas of permanent cover (marsh or woodland or scrub/long grass) within 100 metres.

Great crested newts prefer rough grassland habitat to woodland edge or improved grassland, and they avoid extensive arable areas or dense woodland. Sub-optimal habitats can be enhanced by the presence of features such as ditches and hedges. However, flowing water within 100 metres of the breeding sites has an adverse effect on crested newt presence (either as a barrier or a source of fish colonisation).

Great crested newts usually hibernate from October to February. In spring they return to their ponds to breed, laying eggs from late February to July. The eggs are laid singly on leaves of submerged plants, the leaves being individually folded over and sealed to protect the eggs. From hatching, the young take about three months until they are ready to leave the water. Most great crested newts spend their lives within 200-500 metres of their breeding pond, although some, mainly the young newts, will disperse further.

Great crested newts feed both on land (on a variety of small invertebrates) and in water, where they will take whatever is most available - water fleas, water hoglice, freshwater shrimps, insect larvae, other amphibian tadpoles, and even adult smooth and palmate newts.

The availability of hibernation sites is generally not a limiting factor in determining newt population size. Suitable sites are sheltered, damp and protected from frost, such as crevices below ground, or in piles of rubble or rocks, compost heaps or log piles,. Hibernation sites can be colonial.

## 5. MANAGEMENT FOR GREAT CRESTED NEWTS

### a. Protection of existing sites

The first priority for conservation of the great crested newt must be the protection of existing breeding ponds and associated terrestrial habitat. The Agency's main management influence is through river maintenance works. Insensitive management of watercourses will have detrimental effects: though rarely breeding in rivers and streams, riparian habitats likely to support amphibian populations include small meandering streams with shallow well-vegetated edges, drainage ditches and river valley ponds. Breeding ponds must be retained wherever possible, and depressions which may be used for breeding should not be filled with dredgings, for example.

Through liaison with English Nature, CCW and Wildlife Trusts, Agency conservation staff should be aware of great crested newt breeding sites, and can provide protection through appropriate assessment of Agency authorisation applications. In particular, discharge consents to still waters, abstraction licences and fish stocking consents may all have implications for great crested newt populations. There is also the opportunity to press for conservation of great crested newt sites through the planning liaison process (see (e) below).

## b. Management of existing breeding ponds

Management of breeding ponds can help to sustain great crested newt populations by maintaining the appropriate conditions (see Section 4), such as vegetation cover (25-50% emergents, 50-75% submerged) and shade (<60%). However, management of breeding sites needs careful timing - removal of submerged weed in which newt eggs may be laid must be avoided. Work should be carried out on ponds in winter, when the newts are not present. A licence will be needed from English Nature/CCW for disturbance to a known great crested newt site. Pressures on ponds (such as unrestricted livestock access and adjacent pesticide/herbicide applications) should be discouraged through liaison with landowners. Terrestrial habitat should be maintained along with the breeding pond, as amphibians require both habitats to complete their life cycle (see (d) below).

## c. Creation of new breeding ponds

The creation of new ponds provides potential breeding sites which may be utilised by great crested newts if appropriately sited in relation to existing colonies. The general principles of pond creation have been well documented - see, for example, the NRA booklet on ponds and conservation (Sansom 1993). The main points to take into account are:

- size and depth should be appropriate for the species (500-750$m^2$, 0.5-2m deep);
- ponds should have shallow margins, preferably sloping gently to reach the greatest depth at a distance of 5 m from the edge;
- a cluster of three or four small ponds is likely to be more successful than one large one;
- occasional drying-out of a pond is not generally a problem (i.e. not more than once in every three or four years);
- stocking with fish should be avoided; waterfowl are also a problem and artificial enhancement of populations should be discouraged;
- a variety of emergent and submergent plants can be established, avoiding invasive species such as reedmace;
- avoid too much tree planting near the water's edge - in particular, the south and east aspects should be left exposed, to achieve the warmest conditions possible.

## d. Management of terrestrial habitat

As noted in (a) above, the first priority is to ensure that there is suitable terrestrial habitat associated with existing or newly created breeding ponds, but this may also require management. Terrestrial habitat should be managed to retain diversity, with some scrub and tree

growth for shelter, foraging areas and hibernation. Essentially, a mosaic of habitats is preferred, with different cutting regimes or grazing with a low stocking density.

Timing of cutting, mowing, and scrub removal is important. Adults and juveniles can be above ground during the night at any time of the year outside the winter hibernation season, but are unlikely to be active by day, so management operations should be carried out in full daylight. However, during the day they may take refuge in tussocky grassland; a high cut, leaving tussock bases intact, is best. If some areas are to be kept as a short sward, they should be cut regularly through the year, as newts avoid these exposed areas during daylight. The preferred time for cutting and scrub removal is from mid-October to mid-February.

During the daytime (outside the breeding season), amphibians may be found hiding under logs, stones or man-made objects such as corrugated iron sheets or slabs of concrete, and the provision of such features will enhance the habitat. Rock and log piles can be constructed and should be positioned within 200m of the edge of the pond. Compost heaps and piles of leaves will serve a similar function.

In general, amphibians will readily find places to hibernate. However, in immature habitat, a newt hibernaculum can be constructed from an excavation 45 cm deep with a minimum of about 2 square metres. This should be filled with brick rubble, mixed with some leaf litter to give humidity. Since hibernating newts are often found in association with bits of wood, these should also be included. There should be plenty of spaces amongst the brick rubble and so the rubble itself should be mainly of large pieces - whole and half bricks. Flagstones, concrete slabs or other flat heavy covering should be placed over the edge bricks, ensuring there are entry gaps leading under the flags. This should be covered with a layer of soil over the flags, making sure the entry gaps remain clear, and topped with some brash. Vertical pipes filled with medium-sized stones, providing ready access to the base of the hibernaculum, may be inserted.

It is essential that the whole structure is free-draining, so a straight-sided pit dug into clay is not suitable. If the site is poorly drained, the hibernaculum can be constructed as a low mound rather than a pit. Newts of all kinds, as well as toads, will use such hibernacula. The use of gabions as hibernation sites has also been suggested. Smaller scale hibernacula can be built from log piles covered with soil to a depth of 30 m. Known or potential hibernation sites should not be disturbed during the winter.

## e. Effects of development on great crested newts

The Agency needs to be aware of existing great crested newt sites, through liaison with English Nature/CCW, wildlife trusts and local records centres. In responding (through the Planning Liaison function) to development proposals which may affect great crested newt populations in riparian habitats, there are several issues that the Agency can raise to assist conservation of these populations.

- Protection of existing amphibian habitat must be a priority wherever possible, both breeding ponds and terrestrial habitat (see (a) above).

- New roads which cross dispersal routes can be a problem, with numbers being killed every spring. Pre-formed "toad tunnels" are also used by newts and can be installed readily during road construction (see Langton 1989).

- Another problem which has been identified recently is that of amphibians (and other animals) falling into and being unable to escape from roadside drainage gullies. This can be alleviated by laying sloping, rather than vertical, kerbstones behind the gullies, so that the animals are not directed into the hazard, and by providing escape ladders. Escape ramps should also be fitted in cattle grids, another hazard for amphibians.

- Mitigation measures, including the construction of new breeding ponds and re-creation of terrestrial habitat, should always be considered where developments are going to affect amphibian populations.

- Developers should be reminded of the need to obtain an English Nature/CCW licence if interfering with great crested newts or their habitat. A leaflet published by English Nature (1996) gives details.

**f. Translocation**

As a last resort, where an amphibian population is going to be disrupted by river management or new development and no other mitigation measures are possible, consideration may be given to translocation of that population to another secure site, if there is no satisfactory alternative.

However, there is a dilemma here, in that any potential host site will either be unsuitable, or if suitable, will already contain an established population, probably of maximal size. This can only be overcome by management to increase the carrying capacity, or by the unlikely instance of finding a site which is suitable but devoid of amphibians because of their failure to colonise.

It may also be thought worthwhile to assist the colonisation of a new pond by introductions if there is no obvious nearby source of animals. Whatever the reason for moving great crested newts, as a result of their protected status, a licence will be required from English Nature/CCW. Guidance is given in English Nature (1996).

If the intention is an emergency rescue to remove animals from a site that is to be destroyed, catching of adults (perimeter fencing is the most efficient method - see Arntzen, Oldham and Latham 1995) or netting for tadpoles, depending upon the time of year, would be the options. If it is a planned introduction to a new site, the most effective method of translocation is probably transfer of eggs, and Bray (in Gent and Bray 1994) describes the use of plastic strips (black bin liner, 1 cm wide and 45 cm long) as artificial egg-laying substrates. However, adult newts can be transferred from an existing pond in April, ensuring that there is a mix of both sexes. A high proportion should settle down and breed in a new site if conditions are suitable (though barriers may be required to prevent others attempting to return home).

## 6. RECORDING AND MONITORING AMPHIBIAN POPULATIONS

Methods for surveying and monitoring amphibian populations are detailed in a British Herpetological Society booklet, and in the New Rivers and Wildlife Handbook. Newts can be counted during the spawning period (principally April - May) by netting during the day or by searching the pond with a torch during the night. Torchlight counts of more than 10 in a 100 metre stretch indicate a good population, whilst more than 100 would be exceptional (BHSCC, undated). Suspected new sites for great crested newts should be notified to the appropriate English Nature/CCW office.

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# ENVIRONMENT AGENCY SPECIES ACTION PLAN FOR ENGLAND AND WALES

# COMMON AMPHIBIANS

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June 1996

**Summary**

As a group, the amphibians have seen a general decline in recent years, due largely to the loss or inappropriate management of their wetland breeding sites. These are species whose habitat is heavily influenced by the Agency in the course of fulfilling its statutory duties, particularly in relation to water quality protection and river engineering. The Agency therefore feels that it has a special duty towards their conservation. Action is needed to maintain existing populations, and create new sites for the establishment of further populations. This plan addresses that need in relation to the four common amphibian species: common frog, common toad, smooth newt and palmate newt.

The Agency has a direct role in habitat management and creation, but can also make an indirect contribution through the encouragement of suitable management activity and protection measures by third parties (particularly landowners).

## 1. PRIORITY STATEMENT

a) Under R&D Project 461 "Species Management in Aquatic Habitats", the amphibians were recognised as a group of concern to the Agency because of their critical dependence upon aquatic sites for breeding, and the declines shown in recent years (though of Low Priority in relation to the other rare species identified as needing work).

b) This Species Action Plan addresses several of the points made in the Joint Nature Conservation Committee's "Framework for the Conservation of Amphibians and Reptiles in the UK: 1994 - 1999".

## 2. ACTION PLAN OBJECTIVES

*Short Term:* To provide written guidance on practical management techniques designed to enhance amphibian populations, which may be utilised by the Agency in its operational activities, as well as by others.

*Medium Term:* To implement management techniques for amphibians wherever possible and appropriate, and to promote their use by others.

*Long Term:* To demonstrate the enhancement of amphibian populations through practical management work by the Agency, by means of appropriate monitoring.

## 3. LEGAL STATUS

All four of the common amphibians are given protection under Section 9 (5) of the Wildlife and Countryside Act 1981 with regard to sale of the species.

## 4. BIOLOGICAL ASSESSMENT

### 4.1 Status, Distribution and Population

The common frog is widespread throughout England and Wales, common particularly in urban areas, and has actually seen increases in the Midlands, South-West and Southern England and Wales. The common toad, widespread and common in mainland England and Wales, has seen declines in the West Midlands, South and South-West England. The smooth newt is mainly a species of lowland England, with populations less common in Wales, Northern and South-West England; it has seen little change in its status recently. The palmate newt is found mainly in upland, Western areas, as well as acidic heathlands in lowland England, where it is fairly widespread and common, though there has been a decline in Wales. Estimated populations of these species in the UK are: common frog - 13,000,000 in 1,222,800 populations; common toad - 5,000,000 in 323,500 populations; smooth newt - 10,000,000 in 441,465 populations; palmate newt - 1,800,000 in 44,300 populations.

### 4.2 Ecology

The amphibians are dependent upon ponds and small lakes as breeding sites. Whilst such sites can vary greatly in size, they are not generally very shallow and they avoid extremes of vegetation cover; occasional desiccation can be tolerated. For much of their life cycle (up to 50 weeks each year for toads and frogs), amphibians are away from the water, their preferred terrestrial habitats being those such as woodland and rough grassland which show a diversity of habitat features.

### 4.3 Limiting Factors

*4.3.1 Habitat loss and modification* *Importance - High*

Loss of ponds due to urban development, agricultural intensification and pollution has led to decreased breeding opportunities. Terrestrial habitats have been affected similarly.

*4.3.2 Inappropriate management of habitats* *Importance - High*

Neglect of ponds, leading to silting up and scrubbing over, or inappropriate use, such as for disposal of polluting wastes or introduction of fish, have led to losses of breeding sites.

*4.3.3 Disease* *Importance - Unknown*

Frogs, in particular, have suffered a number of instances of mass mortality in recent years, the causes of which are unknown.

## 5. CONSERVATION ACTION TO DATE

Restoration of neglected ponds, or creation of new ponds, has been undertaken quite extensively by the NRA (now the Environment Agency), Wildlife Trusts, local Amphibian and Reptile Groups and other conservation bodies. The creation of garden ponds has benefited the common frog in particular. There are a number of examples of attempted translocations of amphibian populations, through long-term success still needs to be documented. A number of educational projects, such as Frogwatch, have been undertaken. The National Amphibian Survey and the new Amphibian and Reptile Recording Scheme provide the background information on distribution, habitat and status required for conservation action.

## 6. PROPOSED ACTION

### 6.1 Policy and Legislative

No action required.

### 6.2 Site safeguard, land acquisition and management

Action 1: Most important sites for amphibians to be given SSSI or County Wildlife status. Priority: high. EN, CCW, Wildlife Trusts.

*Agency action: help identify important sites in liaison with conservation bodies.*

Action 2: Conservation bodies to acquire, and manage appropriately, sites important for amphibians. Priority: high. Wildlife Trusts, etc.

*Agency action: assist management of sites where appropriate.*

Action 3: Creation of new wetland habitats suitable for amphibians. Priority: high. Agency, conservation bodies.

*Agency action: wetland creation through enhancement/mitigation works.*

## 6.3 Species Management, Protection and Licensing

Action 4: More emphasis to be placed on site protection rather than translocation where developments threaten amphibian habitats. Priority: medium. EN, CCW.

*Agency action: acceptance of translocated populations on Agency sites as a last resort.*

## 6.4 Advisory

Action 5: Advice to landowners on appropriate ways to manage suitable sites for amphibians. Priority: medium. FWAG, Agency, etc.

*Agency action: advice to landowners where appropriate.*

## 6.5 International

No action required.

## 6.6 Future Research and Monitoring

Action 6: Assessment of national amphibian population trends. Priority: medium. JNCC.

*Agency action: Agency staff to be encouraged to submit records to appropriate bodies.*

Action 7: Monitoring of amphibian populations at key sites, and to assess the effects of management work. Priority: medium. EN, CCW, etc.

*Agency action: support for monitoring work.*

## 6.7 Communications and Publicity

Action 8: Publication of management guidelines, for use by landowners and managers. Priority: medium. Agency, conservation bodies.

*Agency action: publication of advisory literature.*

# 7. ACTION PLAN REVIEW

This plan will be reviewed after three years (1999).

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# ENVIRONMENT AGENCY SPECIES MANAGEMENT GUIDELINES

# COMMON AMPHIBIANS

## Common frog, common toad, smooth newt, palmate newt

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June 1996

## 1. STATEMENT OF USE

Amphibian populations are under threat in England and Wales from a variety of sources. Whilst particularly endangered species (such as the natterjack toad) are given a great deal of conservation attention, the more common species are given less consideration. The Agency has great scope to affect the status of amphibian populations in the course of fulfilling its statutory duties, and therehas a special responsibility towards them. These management guidelines have been developed to assist in the implementation of appropriate management and protection measures for the maintenance, enhancement and creation of amphibian populations. They are for use by Agency staff across all Functions and for distribution to third parties who are in a position to implement such measures in suitable areas.

## 2. INTRODUCTION

Five amphibian species can be regarded as widespread and common in England and Wales: the common frog, common toad, smooth (or common) newt, palmate newt and great crested (or warty) newt. The last of these is given special protection under British legislation, and thus needs to be considered in a slightly different way. This review, therefore concentrates upon the frog, toad, and the smaller two newts. As, in general, the habitat requirements of these four are fairly similar, it is acceptable to treat them as a group, whilst recognising that management can allow for their slightly different needs.

As species which are critically dependent upon wetland habitats for their survival, with their need to breed in open water sites, these four amphibians are obviously of concern to the Agency. They are not generally associated with rivers as such, for several reasons: the warm shallow conditions needed for spawning are better provided by stillwaters than rivers; spawn and tadpoles are readily washed downstream; and predatory fish, numerous in rivers, can have a devastating effect on tadpoles. However, amphibians are frequently found in river corridors, in slow-flowing backwaters

and riparian ponds, and the creation of new habitat for amphibians can readily be seen as a part of river floodplain management.

## 3. DISTRIBUTION AND STATUS

Amphibian communities are ubiquitous: the National Amphibian Survey (Swan and Oldham 1993) found that, across Britain, 98% of surveyed 10 km squares contained amphibians. Records tended to be a little sparse only in the uplands (probably due to a lack of recorders) and the Fens (due to lack of habitat).

Table 1 shows the distribution and status of each species in England and Wales. Data on distribution and coverage came from Swan and Oldham (1993), and on status and trends from Hilton-Brown and Oldham (1991).

## 4. HABITAT REQUIREMENTS

Although each of the four common amphibian species occurs in distinct habitats (see Tables 2 and 3), the National Amphibian Survey did recognise a number of general principles that apply to amphibian communities in Britain.

Regarding the breeding sites, amphibians are found in a variety of water bodies of sizes ranging from 0.5 $m^2$ to 2,000,000 $m^2$. They are less frequent in ponds which are shallower than 0.5 m, and they avoid extremes of vegetation cover: generally they are less frequent if there is no submerged or emergent vegetation, or if the emergents cover more than 75% of the surface. There is a low occurrence of amphibians in ponds which are desiccated annually, but (if garden ponds are disregarded) fish apparently have little effect on amphibian presence.

In terms of the individual species, frogs are catholic in their choice of ponds, breeding in a wide range of sizes and successional stages; sites devoid of emergent or submerged vegetation are avoided, as are those with more than a quarter of the surface shaded. For toads, large pond size and permanence is important; aquatic vegetation cover, and pond-edge cover, is necessary but ponds should not be excessively overgrown. Toads show higher than expected frequencies in sites containing fish. Smooth newts occupy a range of pond sizes including sites which occasionally dry out, and are able to utilise smaller sites in gardens; aquatic and pond-edge vegetation cover is required, but excessive shading or aquatic plant growth is detrimental. Palmate newts also inhabit a wide range of pond sizes, including garden ponds, but they are more frequent if the ponds never dry out; relatively unshaded ponds are preferred, with some submerged vegetation, but emergent vegetation little influences their presence (as it tends to be sparse in the oligotrophic ponds they use).

For a significant part of their life cycle, amphibians leave their breeding ponds and make use of a terrestrial environment, toads being adapted to drier habitats, whilst frogs and newts need moist surroundings. A diversity of terrestrial habitats is important in determining the suitability of landscapes for supporting amphibians. Habitats which are naturally diverse at ground level (woodland, rough grassland) provide all the requirements of amphibians, whilst in less diverse

**Table 1. Distribution and status of the common amphibians.**

| Species | Distribution* | Coverage** | Status* | Trends (1980 - 90)* |
|---|---|---|---|---|
| Common Frog | Throughout England and Wales. | 71% | Widespread and common/abundant, though slightly less so in SW England and East Anglia. Common in urban areas, often patchy distribution in countryside. | Has increased in Midlands, SW and S England, Wales. |
| Common Toad | Throughout mainland England and Wales. | 57% | Generally widespread and common, though unevenly distributed in East Midlands and SW England. | Little change; declines in West Midlands, S and SE England. |
| Smooth Newt | Devon to southern and eastern England, Midlands, East Anglia, much of Wales and northern England; predominantly lowland. | 51% | Fairly widespread and common, but scarce in SW England. | Generally no change; slight decrease in Wales and increase in East Anglia. |
| Palmate Newt | Fragmented distribution, mainly upland and western, including where smooth newt absent (Cornwall, West Wales, pockets of upland elsewhere such as Pennines, Dartmoor, Charnwood), also acidic lowlands - heathland in SE England. | 33% | Fairly widespread and common in upland areas, much less common in lowlands; scarce in West Midlands, NW England; absent/rare in East Midlands, East Anglia. | Little change, but decline in Wales. |

* England and Wales

** % of squares surveyed in National Amphibian Survey (UK) in which the species occurs

habitats (arable, improved grassland), the presence of other features such as ditches and hedges becomes more important.

Frogs are now found more frequently in garden ponds than in field ponds in the countryside. Arable land is inimical to the presence of frogs, even as a minor feature in a landscape dominated by other land uses (this may be due to the effects of agrochemicals). Grassland habitats are enhanced for frogs by the presence of ditches within 100 metres of the breeding pond, and rough grassland is improved by woodland within 500 metres. Toads prefer woodland habitats, and in general their environment is enhanced by landscape features which increase the amount of cover and provide a high biomass of invertebrate prey; in grassland, a relatively high pond density is required to support toads.

Adult newts can feed in water and so they are less dependent than frogs and toads upon their terrestrial habitat for food, though they still require a landscape suitable for their breeding migration/juvenile dispersal, as well as frost-free hibernation sites. Smooth newts avoid extensive woodland, though woodland buffer strips up to 10 metres wide around their breeding ponds are acceptable; in open agricultural landscapes, they need some permanent cover at the edge of the breeding site. Conversely, for palmate newts, both upland and coastal woodlands can provide good habitat.

Tables 2 and 3 summarise, for each species, the required characteristics of the breeding pond and the terrestrial environment respectively. The information is taken largely from Swan and Oldham (1993).

The diet of all four common amphibians is similar, though frogs and toads feed only on land. Both frogs and toads will take any moving invertebrate of suitable size, especially insects and slugs, whilst frogs also feed on spiders, woodlice, centipedes, harvestmen and snails, and toads will prey upon young amphibians, slow-worms and grass snakes. Smooth and common newts also feed on slugs, snails, insects and worms whilst on land, and in the water they prey upon aquatic invertebrates of various kinds, frogspawn, and frog and newt tadpoles. See Frazer (1983) for further details.

All the common amphibians follow a similar life-cycle of hibernation, return to the breeding pond, dispersal away from the breeding site, and return to hibernation. The timing of this sequence varies with each species; details are summarised in Table 4.

Hibernation sites for newts need to be damp, though not wet, frost-free, relatively warm because of the decomposition of plant material and with a supply of invertebrate food. Several newts may hibernate together in close contact, and aggregations of large numbers are sometimes found. Newts hibernating under stones move down into the earth as temperatures drop, to a depth of 10 cm in humus. Smooth newts have been found hibernating in tree stumps, under bark and logs, in piles of leaves, cellars, mineshafts and on seaweed-covered walls beside the sea. Young newts, particularly, may hibernate underwater in the breeding pond, as do frogs. Toads require similar conditions for terrestrial hibernacula as do newts.

## 5. MANAGEMENT FOR THE COMMON AMPHIBIANS

### a. Protection of existing sites

The first priority for conservation of the common amphibians must be the protection of existing breeding ponds and associated terrestrial habitat. Though rarely breeding in rivers and streams, riparian habitats most likely to support amphibian populations include small meandering streams with shallow well-vegetated edges, drainage ditches and river valley ponds. Insensitive management of watercourses - straightening, steepening sides, uniform cross-sections and removal of vegetation - will have detrimental effects. Breeding ponds must be retained wherever possible. Management of breeding sites needs careful timing; removal of submerged weed on which newt eggs may be laid, or dredging when frogs may be hibernating in the mud, must be avoided. Early autumn is probably the best time. Terrestrial habitat must be maintained along with the breeding sites, as amphibians require both aspects to complete their life-cycle. The terrestrial habitat should also be managed appropriately - see c) below.

### b. Creation of breeding ponds

The creation of new ponds provides potential breeding sites which will be readily utilised by the common amphibians. The general principles of pond creation have been well documented - see, for example, the NRA "Ponds and Conservation" booklet and the British Herpetological Society's leaflet on "Garden Ponds as Amphibian Sanctuaries". If the aim is to attract particular species, then the preferences set out in Table 2 will need to be taken into consideration. In general, the points to take into account are:

- size and depth should be appropriate for the species
- ponds should have shallow margins, preferably sloping gently to reach the greatest depth at a distance of 5 m from the edge
- a cluster of three or four small ponds is likely to be more successful than one large one
- occasional drying-out of a pond is not generally a problem (ie not more than once in every three or four years).
- stocking with fish should be avoided; waterfowl will also eat amphibian spawn
- a variety of emergent and submerged plants can be established, avoiding invasive species such as reedmace
- avoid tree planting near the water's edge; in particular, the south and east aspects should be left exposed, to achieve the warmest conditions possible.

**Table 2. Breeding water body requirements of the common amphibians**

| Species | Optimum Size | Size Preferences | Depth | Shading | Emergent Vegetation | Submerged Vegetation | Desiccation | Water Quality |
|---|---|---|---|---|---|---|---|---|
| Common Frog | 75-1,000 $m^2$ | Catholic in choice of pond sizes (5$m^2$ - 1 $km^2$) | Shallow margins (15 - 70 cm) for spawning | Prefer completely unshaded; occupancy reduced if > 25% surface shading | Occurrence reduced if completely absent | Occurrence reduced if completely absent | Ponds desiccating early every year avoided | High potassium, phosphate high in January, falling to low at spawning time, pH > 5.0 |
| Common Toad | 1,000 $m^2$ | Less frequent in sites < 500 $m^2$ | Less frequent if < 0.5 m deep | Less frequent if completely unshaded or if > 75% surface shading | Less frequent if completely absent, or if > 50% of water surface | Less frequent if completely absent | Occurrence reduced in ponds drying out every year or in severe drought only | Tolerate acidic conditions (to pH 4.2), brackish water (up to 10% seawater) |
| Smooth Newt | 90 - 400 $m^2$ | More frequent if < 750 $m^2$ | Less frequent if < 0.5 m deep | Less frequent if no shading, or if > 75% surface shading | Less frequent if completely absent, or if > 75% cover | Less frequent if completely absent, or if > 75% cover | More frequent if permanent, or only desiccate in severe drought | Hard water (high calcium carbonate) |
| Palmate Newt | 90 - 400 $m^2$ | More frequent if < 750 $m^2$ | Less frequent if < 0.5 m deep | Relatively unshaded ponds preferred | Little effect on occurrence | Less frequent if completely absent | Rarely use ponds desiccating annually | Soft water, low calcium carbonate, low potassium, acidic (to pH 3.9) |

**Table 3. Terrestrial habitat requirements of the common amphibians.**

| Species | Preferred Habitats | Features Enhancing the Habitat | Use of Garden Ponds |
|---|---|---|---|
| Common Frog | moorland > woodland, rough grassland > improved grassland » arable | Flowing water within 500 m of breeding site. | Adapts well; occurs in 82% of garden ponds. |
| Common Toad | woodland > rough grassland > arable, woodland > improved grassland | Extensive woodland or scrub within 100 m; flowing water or other small water bodies within 100 m. | Little used. |
| Smooth Newt | rough grassland > arable > improved grassland > woodland | Gardens, mineral extraction sites within 500 m; rough grassland within 100 m. | Breed successfully in greater percentage of garden than non-garden ponds. |
| Palmate Newt | moorland/heathland > woodland, dune slack » rough grassland, improved grassland and arable | Flowing water within 100 m; woodland within 100 m. | Will use garden ponds. |

**Table 4. Life-cycles of the common amphibians**

| Species | Hibernation Sites | Emergence* | Main spawning* Period | Spawn | Dispersal to Terrestrial Habitat | Return to Hibernation |
|---|---|---|---|---|---|---|
| Common Frog | Mud at bottom of pond, in ditch, compost heap, underground in drier sites | External temperature around 4°C (may be January) | February - April | Eggs in clumps, in shallow water (15 - 70 cm) | Female as soon as spawned, male week or two after last female | Late September/ October |
| Common Toad | Often in woodland, under old timber or leaf litter, in self-dug holes, or in small mammal burrows | When temperature minimum 5 - 6°C (February) | March - April | Eggs in long string of jelly, entangled around vegetation at 30 - 40 cm depth | Female after spawning, male some days after last eggs; juveniles by mid-June | September/ October |
| Smooth Newt | Buried in earth, occasionally in mud and crevices at bottom of ponds | February | March - June | Eggs laid singly on leaves of submerged vegetation, leaf often folded over egg | July | November |
| Palmate Newt | Usually on land, though small proportion in water | February/March | March - June | Eggs laid singly on leaves of submerged vegetation, leaf often folded over egg | June - July (in montane areas, may spend entire year in water) | October/November |

*Varies across the country - earlier in south-west, later in north-east.

## c. Management of terrestrial habitat

As noted in a) above, the first priority is to ensure that there is suitable terrestrial habitat associated with existing or newly created breeding ponds. To support a population of great crested newts, a minimum area of terrestrial habitat of 4000m$^3$ within 500m of the pond has been identified as being necessary, and this area would probably be appropriate for the more common species too. The preferred habitats for the different species are indicated in Table 3.

Terrestrial habitat should be managed to retain diversity, with some scrub and tree growth for shelter, foraging areas and hibernation. During the daytime (outside the breeding season), amphibians may be found hiding under logs, stones or manmade objects such as corrugated iron sheets or slabs of concrete, and the provision of such features will enhance the habitat: rock and log piles can be constructed (compost heaps and piles of leaves will serve a similar function), and should be positioned within 200 m of the edge of the pond.

In general, amphibians will readily find places to hibernate. However, in immature habitat, a newt hibernaculum can be constructed from an excavation 45 cm deep with a minimum of about 2 square metres. This should be filled with brick rubble, mixed with some leaf litter to give humidity. Since hibernating newts are often found in association with bits of wood, these should also be included. There should be plenty of spaces amongst the brick rubble and so the rubble itself should be mainly of large pieces - whole and half bricks. Flagstones, concrete slabs or other flat heavy covering should be placed over the edge bricks, ensuring there are entry gaps leading under the flags. This should be covered with a layer of soil over the flags, making sure the entry gaps remain clear, and topped with some brash.

It is essential that the whole structure is free-draining, so a straight-sided pit dug into clay is not suitable. If the site is poorly drained, the hibernaculum can be constructed as a low mound rather than a pit. Newts of all kinds and toads will use such hibernacula. The use of gabions as hibernation sites has also been suggested.

## d. Effects of development on amphibians

In responding, through the Planning Liaison function, to development proposals which may affect amphibian populations in riparian habitats, there are several issues that the Agency can raise to assist conservation of these populations.

- Protection of existing amphibian habitat must be a priority wherever possible, both breeding ponds and terrestrial habitat (including links between the two as migration routes, for toads especially) - see a) above.

- New roads which cross toad migration routes can be a particular problem, with large numbers being killed every spring. Pre-formed toad tunnels have been developed and can be installed readily during road construction. See Langton 1989.

- Another problem which has been identified recently is that of amphibians (and other animals) falling into and being unable to escape from roadside drainage gullies. This can be alleviated by laying sloping, rather than vertical kerbstones behind the gullies, so that

the animals are not directed into the hazard. Escape ramps should be fitted in cattle grids, another hazard for amphibians.

- Mitigation measures, including the construction of new breeding ponds and re-creation of terrestrial habitat, should always be considered where developments are going to affect amphibian populations.

### e. Translocations

As a last resort where an amphibian population is going to be disrupted by river management or new development, and no other mitigation measures are possible, consideration may be given to translocation of that population to another secure site.

However, there is a dilemma here, in that any potential host site will either be unsuitable, or if suitable, will already contain an established population, probably of maximal size. This can only be overcome by management to increase the carrying capacity, or by the unlikely instance of finding a site which is suitable but devoid of amphibians because of their failure to colonise.

It may also be thought worthwhile to assist the colonisation of a new pond by introductions if there is no obvious nearby source of animals. As the four common amphibians are not given full protection under the Wildlife and Countryside Act 1981 (protection only relating to trade in the species), no licence would be required to catch them and move them from one site to another.

If the intention is an emergency rescue to remove animals from a site that is to be destroyed, catching of adults or netting for tadpoles, depending upon the time of year, would be the options. If it is a planned introduction to a new site, the approach will depend upon the species concerned. Frogs are best introduced as clumps of spawn, stockings preferably taking place over two consecutive years. Similarly, toads, though harder to establish, can be introduced as spawn, over three consecutive years, the strings being wound around submerged plants at an appropriate depth (around 30 cm). Introductions of adult toads to establish a new population is thought to be relatively unsuccessful (Cooke and Oldham 1995). In contrast, newts are best transferred from an existing pond as adults in April, ensuring that there is a mix of both sexes; they will readily settle down and breed in a new site if the conditions are suitable.

## 5. MONITORING AMPHIBIAN POPULATIONS

Methods for surveying and monitoring amphibian populations are detailed in a British Herpetological Society booklet, and in the New Rivers and Wildlife Handbook. For frogs, the best method of assessing a population is to count clumps of spawn just after they have been laid, which gives an indication of the number of females coming to the pond. Toad spawn is more difficult to count, so the best method is a head count of adults on a mild wet evening at spawning time. The newts can be counted during the spawning period by netting during the day or by searching the pond with a torch during the night. Note that none of these methods will give a truly accurate population size, but consistently obtained annual comparisons are valid.

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# PART 4 FISH

## 4.1 Species Action Plan for the spined loach

## 4.2 Management guidelines for the spined loach

## 4.3 Species Action Plan for the native lampreys

- sea lamprey
- river lamprey
- brook lamprey

# SPECIES ACTION PLAN

# SPINED LOACH - *Cobitis taenia*

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Produced for English Nature in association with the Environment Agency

June 1996

# SPECIES ACTION PLAN

# SPINED LOACH - *Cobitis taenia*


## Summary

The spined loach has a localised distribution in the River Trent and River Great Ouse catchments and in some of the smaller rivers and drains in Cambridgeshire and Lincolnshire. It has recently (1995) been recorded from the River Nene in Northamptonshire. The precise nature of this distribution is uncertain because the small size of this benthic species means that it is rarely caught in fish surveys and almost never in anglers' catches. It is likely to be more widespread than current records indicate, but a survey is needed to establish its limits. Such information would be valuable in future assessment of its status by providing a baseline from which to note any changes in distribution. Future conservation action should be preceded by a survey of known populations in order to identify the spined loach's precise habitat requirements. In particular, information is needed on its spawning requirements and on the optimum microhabitat conditions for the vulnerable, newly-hatched fish. In view of the EN proposal for the Ouse Washes to be a Special Area of Conservation (SAC), a survey of that region is urgently needed. At present, the spined loach does not appear to be in serious danger, but its apparently fragmented distribution in highly regulated rivers and drains means that it is potentially vulnerable to changes in river/land use.


## 1. PRIORITY STATEMENT

The spined loach has a fragmented distribution in rivers and drainage channels in the Midlands and eastern England, but recorded details of this distribution are incomplete. Current information suggests that, though the habitats in which it lives are potentially vulnerable to anthropogenic disturbance and some local populations may disappear, the species is not in immediate danger throughout its range. Conservation action, other than management of Special Areas of Conservations (SACs) and that related to the general improvement and maintenance of river habitats by the Environment Agency, is therefore of ***medium priority***.

## 2. ACTION PLAN OBJECTIVES

*Objective 1:* *In the short term to confirm the presence of the spined loach at previously identified locations and to determine the limits of its distribution. To use this information to identify the species' spawning habitat requirements and the microhabitat requirements of newly-hatched fish.*

*Objective 2:* *In the short term to establish the distribution and status of the spined loach in the Ouse Washes so as to determine the value of the site as a SAC.*

*Objective 3:* *In the medium term (after ca. 5 years) to repeat the survey of the spined loach's distribution in order to reassess its status, in particular to determine if the limits of its distribution are changing.*

*Objective 4:* *In the long term, to ensure that the habitat conditions needed to provide viable populations of the spined loach are maintained in the Rivers Trent and Great Ouse and in a range of drains and small rivers in Cambridgeshire and Lincolnshire.*

## 3. LEGAL STATUS

The spined loach is not specifically protected under the broad remit of the Salmon and Freshwater Fisheries Act of 1975. However, it is listed in Appendix 3 of the Bern Convention and Annex 2 of 1992 EC Directive (EC, 1992) on the conservation of natural habitats and of wild fauna and flora. The latter lists animal and plant species of community interest whose conservation requires the designation of special areas of conservation. The spined loach is also regarded as a threatened species by the Council of Europe (Lelek, 1980).

## 4. BIOLOGICAL ASSESSMENT

### 4.1 Introduction

The spined loach *Cobitis taenia* L. is a small, bottom-dwelling fish, which is confined to rivers and drainage channels in the Midlands and eastern England. One population has been reported from a small gravel-pit lake, but this population may have been seeded through flooding from the nearby River Great Ouse. Because of its small size (maximum length about 14 cm, but most fish are less than 10cm) the spined loach is often overlooked in fish surveys. In an electrofishing and netting survey during 1981 to 1984, spined loach was recorded at only 4 out of 233 sites (Penczak *et al.*, 1991), although it is known to occur at several locations in the Lincolnshire - South Humberside area. Its ecology has been little studied in England, and most information comes from an investigation of a small population in the River Great Ouse at Newport Pagnell (P.W.J.Robotham, 1976 and subsequent papers). The degree to which these biological data are representative of other English populations is not known.

### 4.2 Ecology

The spined loach is confined to habitats where the substratum consists of a fine, organic rich, sediment. Such areas are intermittent in most rivers and, hence, the spined loach has a patchy distribution. The survival of spined loach in such microhabitats, which are not frequented by many other species of fish, is aided by their relatively high gill surface area, which is caused principally by the presence of large numbers of secondary lamellae (Robotham, 1978a).

In the Great Ouse, the spined loach probably spawns in June and July (Robotham, 1981) although earlier spawning times have been reported from continental Europe (e.g. April-May, Sterba, 1962). It lays its eggs on plants and, possibly on other substrata (see section 4.4.2). At Newport Pagnell, the juveniles achieved a length of 30 mm at age one year, and most adult males rarely lived past

their second birthday (when they were, on average, 52 mm in length), although adult females generally lived for three years and reached a length of 68 mm on average. However, there was very little difference between the growth rates of the males and females. The sexes can be differentiated by the presence of the Organ of Canestrini on the pectoral fins of the male (Vladykov, 1925).

Spined loach have a specialised feeding mechanism, by which fine substratum material is sucked into the buccal cavity and food particles removed with mucus. This feeding habit may explain the preference for areas of fine sediment because the species cannot feed effectively if the substratum is compacted (Robotham, 1982).

The dietary preferences of newly-hatched spined loach are not known (Robotham was unable to catch any loach at this stage of their life-cycle). However, studies of other fish species indicate that the transition from reliance on yolk-sac food reserves to feeding on exogenous food is a critical stage. The lack of sufficient food particles of an appropriate size at this time can decrease survival rates. The preferred diet of older spined loach in the Great Ouse (Newport Pagnell) population comprised small animal prey, principally Chydoridae (Cladocera), Chironomidae larvae (Diptera), cyclopoid Copepoda, and Rhizopoda (Protozoa). All these taxa were small in size, and were closely associated with surface layers of mud and weed. The desmid *Closterium*, which can be found on the surface areas of mud also, was an important food component. Peak feeding activity was at dawn (Robotham, 1977).

## 4.3 Distribution and population

The spined loach is found across the whole of Europe and central Asia, from Spain and North Africa to China, Siberia and Japan, south to Italy and Turkey except the northern regions (Lelek, 1980; Phillips & Rix, 1985). It is absent from southern and northern England, Wales, Scotland and Ireland. In Sweden it is recognized as a locally endangered species (Larje, 1990).

In England, spined loach have been recorded only in the lower parts of the Trent and Great Ouse catchments, and in some of the small rivers and drains in Lincolnshire and East Anglia. There is a report (Phillips & Rix, 1985) of its presence in some tributaries of the River Thames, but this could not be confirmed by the NRA Thames Region (as was) and Wheeler (1977) states that the species is not indigenous to the Thames.

Little is known of the population densities of spined loach in any of the waters in which it occurs. Most records are based on the capture of a few specimens, often during sampling operations for other purposes. Nevertheless, it would appear that spined loach are present in sufficiently large numbers to maintain breeding populations at a number of sites (see Appendix I).

## 4.4 Limiting factors

### 4.4.1 *Microhabitat* — *Importance: high*

At one site in the Great Ouse, spined loach was closely associated with areas of fine organic substratum. Experimental studies revealed its preference for substratum comprising particles sizes between 0.15 and 0.34 mm (Robotham, 1978b). In addition, the Great Ouse fish were confined to

areas where water velocities ranged from 5.9 to 27.4 cm $s^{-1}$ (mean 14.8). Adjacent areas that did not contain spined loach had current speeds ranging from 18.9 to 48.4 cm $s^{-1}$ (mean 29.3). However, these water velocities were measured 6 inches (ca. 15 cm) above the river bed (to avoid fouling the propeller of the velocity meter) and are probably much higher than those experienced by the fish in the sediment. This close association of the spined loach with areas of fine sediment meant that their microdistribution changed seasonally as these substrata were deposited or became eroded.

These data on microhabitat relate only to the Newport Pagnell site on the Great Ouse and it is not known if the spined loach has become established in other conditions. This possibility cannot be discounted because many other fish species show some degree of variation in their habitat requirements in different river systems.

### 4.4.2 *Spawning substrata and the microhabitats of newly-hatched fish* *Importance: high*

Most descriptions in general books on fish state that spined loach spawn on aquatic plants in flowing water. The source of this information is unclear and it seems likely from the occurrence of spined loach in some of the Lincolnshire drains, that spawning can take place on other substrata, probably under conditions of low current velocities.

More information on spawning requirements is needed, as is information concerning the ecology of newly-hatched fish. Most studies of the ecology of other fish species show that mortality rates during this phase of the life cycle can be very high and can vary between years and between different habitats. The optimum conditions for juvenile spined loach to grow and survive are not known.

Weed-cutting and dredging operations are carried out in many rivers and drains by the Environment Agency in relation to flood control and navigation requirements. These operations may have locally detrimental effects on spined loach populations, although the presence of spined loach in a number of waters that have been subject to such management for many years suggests that it can survive such disruptions.

### 4.4.3 *Food availability* *Importance: low*

The dietary requirements of spined loach do not differ markedly from those of many other small fishes. Most of the food organisms described by Robotham (1977) are readily available in most slow-flowing rivers. However, the period when the first external food sources are ingested has been little studied. As indicated in section 4.4.2, factors affecting this early stage in the life cycle can have important implications for spined loach survival and, consequently, the number of subsequent spawners.

### 4.4.4 *Water quality* *Importance: medium*

There are few data on the water quality requirements of spined loach. Robotham (1979) observed that spined loach had a slightly higher tolerance to lowered oxygen concentrations than the closely-related stone loach *Barbatula barbatula* (L.) (previously *Noemacheilus barbatulus* (L.)). In water

with 8% oxygen saturation, spined loach became disturbed and, at 6% saturation, small specimens commenced air-breathing.

Information on lethal concentrations of heavy metals and other pollutants to the spined loach is not available, although there are a few data relating to the more common stone loach. For example, the disappearance of stone loach from a tributary of the River Nene, Northamptonshire was attributed to a rise in zinc concentrations from 1 to 5 mg $l^{-1}$. However, it would be unwise to assume that *Cobitis taenia* has the same response as stone loach to the concentrations of zinc and other pollutants (Solbé & Flook, 1975). There is a general concern about the effects of sub-lethal concentrations of pollutants on all species of freshwater fish, but there are few data available and none for spined loach.

## 5. RESUME OF CONSERVATION ACTION TO DATE

The Government department that controls inland fisheries is the Ministry of Agriculture, Fisheries and Food. The Environment Agency has the principal responsibility for the well being of fish stocks in fresh water and enforces the relevant legislation at the Regional level. Under the terms of the Salmon and Freshwater Fisheries Act of 1975 the NRA (now part of the Environment Agency) has a statutory duty to maintain, improve and develop fisheries. Part of this remit is promulgated by the control of the quality of industrial and sewage effluent; this and other measures to improve water quality must be generally beneficial to spined loach. However, there have been no conservation actions directed specifically at spined loach.

## 6. PROPOSED ACTION

### 6.1 Policy and legislation

No action required

### 6.2 Site safeguard, land acquisition and management

*Action 1:* *EN/EA to commission work on the status, distribution and habitat requirements of the species in the Ouse Washes.*

*Priority: high*

EN have currently (1995) proposed the Ouse Washes as a SAC for spined loach, although the distribution and status of the species in this area is not known. Consequently a survey of the drainage channels is needed to determine the conservation value of the area for the species. No action is required at this time for populations in other waters. However, this position should be reviewed after a survey to identify the precise distribution of the species and the value of the Ouse Washes as a SAC.

## 6.3 Species management, protection and licensing

*Action 2:* *EA to maintain the physical habitat of important populations in its current state in the absence of detailed knowledge of habitat requirements.*

*Priority: high*

*Action 3:* *EA/EN to work together on the establishment of management guidelines once research on ecological requirements has been undertaken.*

*Priority: high*

Important local stocks should be known to the appropriate Region of the Environment Agency in order that their habitats are protected from disturbances caused by river management procedures. However, insufficient detailed information exists on the species' habitat needs to define what river management procedures are acceptable. In particular, data are needed on spawning habitats and the habitats utilised by juvenile and older fish. Ideally the data collected should be suitable for the construction of habitat suitability curves so that the habitat preferences of spined loach is known for its various life history stages.

## 6.4 Advisory

*Action 4:* *EA to draw up an information leaflet for staff and angling clubs in relevant areas.*

*Priority: medium*

Many people with fishing interests are ignorant of the whereabouts and ecology of the spined loach. Information should be targeted particularly at Environment Agency staff and angling clubs that have spined loach in their waters. This should emphasise the potential vulnerability of the species to habitat disturbance, particularly through dredging and removal of aquatic vegetation.

## 6.5 International

*Action 5:* *EA/EN to take into consideration relevant on-going work abroad when commissioning future research..*

*Priority: medium*

The spined loach is widely distributed in Europe and central Asia, although there have been relatively few studies of its ecology and status. Only in the north temperate regions is it recorded as being scarce (Larje, 1990), although Lelek (1980) includes it in a list of threatened European species. Any future study of the English populations of spined loach should include contact with overseas scientists involved in investigations of the Cobitidae (loach family).

## 6.6 Future research and monitoring

*Action 6:* *EA fisheries staff to pay particular attention to the occurrence of spined loach during fishery surveys in areas likely to support the species, and to improve the flow of information on species occurrence to the Biological Records Centre.*

*Priority: high*

*Action 7:* *EN/EA to commission work to identify habitat requirements during the different stages of its life cycle.*

*Priority: high*

The Agency conducts numerous fishery surveys across England and Wales each year, and there is therefore plenty of opportunity to improve our knowledge of the distribution of the species. However, more attention needs to be paid to the recording of minor species and the transferal of this information to relevant parties. In parallel with this initiative, more focused surveying is required to elucidate habitat requirements, covering the full range of habitats known to support the species. Information collected during such a survey could be used readily to increase information on the age, growth and diets of spined loach in different waters. Such research would sensibly link with baseline work on the proposed Ouse Washes SAC (see Section 6.2).

## 6.7 Communications and publicity

*Action 8:* *EN/EA to promote the publication and dissemination of information on spined loach distribution and ecology, particularly to Agency staff.*

*Priority:medium*

Survey data plus further information on spined loach ecology would be best presented as a scientific publication (more than one, if necessary). In addition, a popular article on the species status and ecology would be of value; this could be produced in assocation with publicity regarding the establishment of the Ouse Washes as a SAC.

# 7. ACTION PLAN REVIEW

A revision of the Action Plan will be needed after the survey of spined loach distribution in England is completed, in order that priority areas containing the most important populations can be identified and, if necessary, given some protection. If the value of the Ouse Washes as a SAC for spined loach is confirmed, then the status of the populations therein will need to monitored. Surveys at approximately five year intervals will enable EN and the Agency to monitor any change in the distribution and status of the spined loach. The vulnerability of all of the major spined loach habitats to damage will also need to be assessed.

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## APPENDIX I. SPINED LOACH RECORDS FROM ENGLAND

National Grid References in parentheses are approximate locations only.

### A. River Trent catchment (data provided by NRA Severn-Trent Region)

| | | Map Ref. | Date of last record |
|---|---|---|---|
| Trent | Stoke Bardolph | SK 650405 | May1995 |
| Trent | Thrumpton | SK 513317 | October 1994 |
| Trent | South Muskham | SK 803565 | Nov.1994 |
| Trent | Swarkestone | SK 375283 | May 1993 |
| Trent | Ladybay Bridge | SK 585387 | May 1993 |
| Trent | Shardlow | SK 447299 | Sept.1994 |
| Trent | Kings Mills | SK 417274 | Sept.1994 |
| Trent | Winthorpe Bridge | SK 805567 | March 1995 |
| Trent | Yoxall Bridge | SK 131177 | June 1992 |
| Soar | Whetstone | SP 552985 | October 1993 |
| Soar | Narborough | SP 541973 | March 1994 |
| Soar | Aylestone | SK 570001 | May 1995 |
| Sow | Eccleshall | SJ 831296 | March 1993 |
| Sow | St Thomas Bridge | SJ 946228 | May 1995 |
| Sow | Broad Eye Bridge | SJ 918233 | March 1993 |
| Derwent | Wilne | SK 452314 | Dec.1994 |
| Hilton Brook | Hilton | SK 242306 | June 1992 |
| Anker | Atherstone Ratcliffe Bridge | SP 317985 | June 1993 |
| Penk | Penkridge-Cuttlestone Bridge | SJ 915137 | October 1993 |
| Penk | Stafford-Radford Bridge | SJ 938216 | May 1995 |

## B. Great Ouse catchment

### I. Survey of River Great Ouse, August 1989 (Copp, 1990a); present at 12 out of 44 sites.

| | | |
|---|---|---|
| Great Ouse | Passenham | SP 782393 |
| | Sherington Bridge | SP 884454 |
| | Sherington: side channel | SP 883455 |
| | Ravenstone mill stream | SP 854486 |
| | Ravenstone: side channel | SP 855485 |
| | Radwell Bridge | TL 005573 |
| | Bromham Hall | TL 012510 |
| | Bedford: Barns Drain | TL 072486 |
| | Hillgrounds Park: side channel (Kempston) | TL 021476 |
| | Mill Farm: side channel | TL 080480 |
| | Great Barford mill stream | TL 134517 |
| | Godmanchester (u/s Cookes backwater) | TL 243710 |

### II. Survey of River Great Ouse & major tributaries, August 1990 (Copp, 1990b).

a) Cam, Granta, Rhee, Mel, Snail, New River, various lodes; present at 1 of 23 sites.

| | | |
|---|---|---|
| | Swaffham Bulbeck Lode | (TL 550640) |

b) Padbury, Claydon, Tove, Ouzel, Ektow, Ivel, Flit, Hiz, Kym, Alconbury; present at 6 of 27 sites.

| | | |
|---|---|---|
| Padbury | Thornborough | SP 729332 |
| Tove | Bozenham | SP 776483 |
| Ouzel | Stoke Hammond | (SP 885364) |
| Ouzel | Caldecote: channels | (SP 885424) |
| Elstowe Brook | | (TL 051474) |
| Kym | Hail Weston | (TL 170623) |

c) Great Ouse & side channels: Turweston (Bucks) to Welney (Cambs); present at 6 of 50 sites.

| | | |
|---|---|---|
| Ouse | Passenham | SP 782393 |
| Ouse | Whitings stretch | (SP 805714) |
| Ouse | Sherrington: side channel | SP 883455 |
| Ouse | Radwell Bridge | TL 005573 |
| Ouse | Kempstone: side channel | (TL 021476) |
| Ouse | Hall Green Brook | (TL 303680) |

### III. Other records from the Great Ouse.

| | | | |
|---|---|---|---|
| Newport Pagnell | 1972-1974 | See various papers by P.W.J.Robotham | |
| Sharnbrook | ca. 1984 | Unpublished IFE data | SP 990579 |

## IV. Cambridgeshire and Lincolnshire rivers and drains (data from Penczak *et al.*, 1991 & NRA Anglian Region, Fish Survey Reports).

| | | | |
|---|---|---|---|
| Ancholme | Pease Holme | TF 023936 | 1993 |
| | Brandy Wharf | TF 015970 | 1979 |
| | North Kelsey Carrs | TA 006006 | 1979 |
| | Brigg Sports Centre | -- | 1979 |
| French Drove | | TF 331089 | 1995 |
| West Fen Drain | Dovecote | TF 281528 | 1990 |
| | Medlam drain | TF 322539 | 1993 |
| | Newham drain | TF 292500 | 1993 |
| Hobhole Drain | Hemholme Bridge | TF 403586 | 1993 |
| | Kelsey Bridge | TF 346465 | 1993 |
| R. Lym | Mill Bridge | TF 430641 | 1993 |
| R. Steeping | Firsby | TF 457621 | 1993 |
| | Relief channel | TF 488602 | 1993 |
| | Tasco's Bridge | TF 508599 | 1993 |
| Sibsey Trader System | | TF 339597 | 1990 |
| R. Witham | 5 Mile House | TF 059715 | 1978 |
| | Greetwell Hall | -- | 1978 |
| | Cherry Willingham | -- | 1978 |
| | Anton's Gowt | -- | 1981 |
| | Dogdyke | -- | 1981 |
| | Tattershall Bridge | -- | 1981 |
| | Thorpe Tilney | -- | 1981 |
| | Kirkstead Bridge | TF 175621 | 1981 |
| | Stixwold station | -- | 1981 |
| | Southrey | TF 139663 | 1981 |
| | Bardney | TF 112691 | 1981 |
| | Lincoln Power station | -- | 1981 |
| | u/s Bardney Bridge | TF 110614 | 1994 |
| R. Till | Broxholme | SK 903768 | 1978 |
| | Till Bridge | SK 907797 | 1994 |
| | Squires Bridge | SK 903824 | 1994 |
| Fossdyke | Pyewipe Inn | -- | 1978 |
| Sincil Dyke | d/s 5 Mile House | -- | 1982 |
| | Bardney Locks | -- | 1982 |
| Barling's Eau | Newball Wood | TF 082758 | 1982 |

| | | | |
|---|---|---|---|
| Burton Catchwater Drain | Bishops Bridge | -- | 1982 |
| South 40 Foot Drain | Dowsby Road | TF 167324 | 1990 |
| | Bicker Fen | TF 185395 | 1995 |
| 16 Foot Drain | Boots Bridge | TL 446912 | 1983 |
| | Sparrow Hall | (TL 465943) | 1983 |
| | Poplar Farm Bridge | -- | 1983 |
| | Crown Drove Bridge | -- | 1983 |
| Rippingdale Running Dyke | Dunsby Fen | -- | 1984 |
| Skellingthorpe Main Drain | Kews Holt | SK 945740 | 1994 |
| Farroway Drain | Praie Grounds | TF 136523 | 1994 |
| River Brant | Navenby Road Bridge | SK 940580 | 1994 |
| Bellwater Drain | Bellwater Farm | TF 423592 | 1993 |
| Cowbridge Drain | d/s Kelsey Bridge | TF 346465 | 1995 |
| Head Dyke | Pump Station | TF 186467 | 1995 |
| East Fen Catchwater | Holmes Road, Stickney | TF 350566 | 1993 |

## V. Other records from NRA Anglian Region

The spined loach is also reported from:

Grand Union Canal (Northampton)
River Nene (Oundle area and u/s Northampton)
Mortons Leam
North Level System

The record (October 1995) for the River Nene u/s Northamton is the first one for that river.

# ENVIRONMENT AGENCY SPECIES MANAGEMENT GUIDELINES

## SPINED LOACH (*Cobitis taenia*)

Chris Mainstone

WRc

April 1998

## 1. STATEMENT OF USE

The spined loach is a local and threatened species of streams, rivers and drainage ditches, and its status is heavily influenced by the activities of the Environment Agency. These management guidelines have been developed to assist in the targeted implementation of appropriate management and protection measures for the maintenance, enhancement and creation of spined loach populations. They are for use by Agency staff across all Functions and for distribution to third parties who are in a position to implement such measures in suitable areas (i.e. in localities that are known to, or could, support the species).

The spined loach has been little studied until recently and understanding of its ecological requirements is limited. The guidance given in this document draws upon the work of Perrow and Jowitt (1997, 1998) and should be considered as provisional pending further research.

## 2. DISTRIBUTION AND STATUS

In England and Wales, the spined loach is naturally restricted to the Great Ouse, Witham and Trent catchments (although it appears to have recently entered the Essex Stour through a water transfer scheme). It occurs widely in this restricted area and is found in streams, rivers, drains and gravel pits. The current UK distribution of the species is a result of colonisation from Europe along historical river connections prior to the severence of the land bridge at the end of the last Ice Age. This distribution has been maintained by a lack of angler interest in the species and consequent lack of artificial spread by Man. Worldwide, the species occurs across Europe and central Asia, from Spain and North Africa to China, Siberia and Japan. However, the long period of isolation from the continent means that British spined loach may well have developed into endemic races, sub-species or even species.

There is insufficient information on which to base an assessment of status, since the species is not routinely monitored by the Environment Agency or any other organisation, and it is an inconspicuous species that is easily overlooked.

## 3. RECOGNITION

The spined loach can be distinguished from the more common stone loach by the bifid spine situated in a pocket beneath each eye. The pectoral fins also have fewer rays and the pattern of barbels around the mouth differs. More detailed information is available in Maitland and Campbell (1992).

## 4. HABITAT PREFERENCES

The spined loach has a specialised feeding mechanism by which it pumps fine material through its buccal cavity and extracts food particles with mucous. It therefore requires the ample presence of finer substrates. Whilst it can tolerate mud and silt, it appears to have a preference for sandy substrates that has not been properly recognised in this country until recently. This may be linked to the presence of appropriately sized (0.2-0.75 mm) prey species and plant/detrital material in sands. In addition, it is likely to provide a better spawning substrate than finer sediments, which generally have a greater oxygen demand with minimal interstitial water flow and may lead to enhanced egg mortalities. However, the existence of different races of spined loach, some of which are more adapted to the silty organic sediments more typical of lakes and drains, should not be ruled out.

Abundant submerged vegetation appears to be a highly important habitat feature, which acts as a refuge from predators (including fish and even invertebrates) and may provide extra feeding opportunities. Taken in conjunction with substrate preferences, optimal habitat for the species seems to be a mosaic of macrophyte beds and bare sand, providing ample opportunity for feeding, refuge (adults and juveniles) and spawning. Water depth does not appear to be a major constraint, since the species occurs in lakes as well as rivers and streams. However, the species may fare better in shallower waterbodies where plants can root and the occurrence of predatory fish species is limited, or at least in waterbodies with good depth variation that includes shallow areas.

Overall, optimal habitat is likely to be more abundant in rivers and streams than in static waterbodies, particularly considering the low hydraulic energy of lakes and drains and the tendency towards finer substrates. Heavily modified streams have been found to be less likely to support spined loach populations than more natural river channels, probably due to loss of habitat diversity (including flow refugia) and enhancement of peak current velocities (leading to wash-out of fish). *Lowland drains have superficial similarities to channelised rivers in terms of channel structure, but they do not suffer from the same high current velocities during flood events. This is likely to be a key factor in the presence of spined loach populations in lowland drains.*

The spined loach has a short life cycle and is consequently highly dependent upon good recruitment into the adult population each year. Any large-scale transient disturbance to the spawning process or juvenile development, either physical or chemical, will therefore have a disproportionate effect on spined loach populations compared to longer-lived fish species. Continuity of optimal spawning and juvenile habitat is therefore essential.

It follows from the discussion above that any activities that impact upon the health of submerged macrophytes or create a move away from sandy substrates towards finer materials

is likely to have a detrimental effect on spined loach populations. Large-scale engineering or maintenance works in waterbodies containing spined loach is likely to critically interupt recruitment and subsequent spawning. The excessive favouring of fish species that may prey upon juveniles and adults, through stocking or habitat enhancement, is also likely to have adverse consequences.

## 5. MANAGEMENT FOR SPINED LOACH

### a. Sympathetic river engineering and channel maintenance

Engineering and maintenance activities should seek to maintain or create a mosaic of submerged vegetation and bare sandy substrate, with a good range of water depths and active growth of marginal vegetation. Since these habitats must be available continually to spined loach populations, it is crucial that any such activity at sites where the species occurs (or is to be encouraged) is undertaken in a patchy manner on a rotational basis, always leaving frequent suitable habitat for egg development, juveniles and adults.

Any further destruction of habitat diversity through channelisation should be avoided, whilst channels badly affected by historical works should be restored using sympathetic engineering techniques. Dredging should largely be restricted to mid-channel, with a return frequency of 4 years or more to any dredged area, or 2 to 3 years in the case of a large stretch where small areas are being dredged rotationally. Weed-cutting should be undertaken to retain around one third of submerged macrophyte beds at any one time, in a patchy distribution that encourages natural flow diversity. Longer term management of submerged growth should be considered so that weed-cutting is less needed; selective planting of riparian trees and reduced phosphorus loads to the system are two possibilities.

### b. Prevention of nutrient enrichment

Elevated loads of phosphorus will ultimately lead to algal domination and elimination of submerged macrophytes through shading. Water column and sediment concentrations must therefore be maintained at, or reduced to, reasonable levels. A water column concentration of 0.1 mg $l^{-1}$ Soluble Reactive Phosphorus (SRP) is a sensible target at which to aim, although it should be noted that SRP will not be a good indicator of nutrient status in some lowland drains and rivers within the natural range of the spined loach (due to high plant uptake in the growing season). Consideration of sediment phosphorus concentrations is more difficult as little work has been undertaken on critical concentrations. The minimum action should be that no further increases in sediment phosphorus concentrations should be permitted at sites with spined loach populations.

Where required, steps should be taken to reduce phosphorus loads from point and diffuse sources. Although the relative contributions from different sources will vary from site to site, sewage treatment works are usually major sources and are relatively easy to control, whilst other point sources (such as industrial plants) may also be individually important. Considering the intensive nature of agriculture across much of the natural range of the spined loach, loads from agricultural run-off (particularly from large applications of inorganic fertiliser) are also likely to be highly important. Nutrient budgeting and soil

conservation measures should therefore be encouraged, and the establishment of buffer strips should be considered.

### c. Prevention of organic enrichment

The loading of bed sediments with degradeable material will lead to reduced oxygen availability in the substrate itself and in the water column near the sediment/water interface. This is likely to lead to reduced egg and juvenile survival and should be avoided. Improved treatment of sewage effluents and other organic discharges to reduce BOD concentrations may be required in some instances. Livestock farms can also be a key source, from both the farmyard and from landspreading of slurry and dirty water. Application of best agricultural practice and effective enforcement of the Slurry, Silage and Agricultural Fuel Oil Regulations will alleviate problems. Organic enrichment is also caused by enhanced plant growth and subsequent decay as a result of elevated phosphorus loads to the system (see (b)).

### d. Prevention of siltation

Siltation of bed sediments is a complex problem that is dictated by particulate inputs to the system and the flushing capacity of the waterbody. Any activities that increase the particulate load or reduce the ability of the waterbody to transport the load out of the system will exacerbate siltation problems. Primary treatment will remove the majority of solids from point sources, whilst adoption of soil conservation measures and the establishment of buffer zones of permanent vegetation alongside water margins and across key run-off pathways will reduce diffuse loads. In riparian areas that are particularly prone to overland flow or overbank flooding, establishment of permanent pasture should be encouraged with stocking densities that maintain good sward integrity. Water resource management should consider the effect of any alterations to flow regime on the flushing capacity of the system. In rivers and streams, reasonable bed velocities should be maintained through the summer to keep as much as possible of the particulate load in suspension, whilst winter flushing events should be protected to maximise resuspension and subsequent export. In terms of river engineering, narrowing of overwide channels will increase bed velocities and thereby help the self-cleaning process.

### e. Sympathetic fishery management

The stocking of various species of fish of high angling interest is likely to lead to adverse consequences for the spined loach. Bottom-feeding fish, such as carp and tench, will disturb sediments and create turbid waters that will impact upon submerged macrophyte communities. A range of omnivorous and carnivorous species will prey upon the eggs, juveniles and adults of spined loach. In waterbodies with spined loach populations, stocking should therefore be restricted to repopulating following pollution incidents or water quality improvements, and even in these cases the scope for natural recovery should be evaluated and given an opportunity to work wherever possible. All stocking exercises should consider the likely carrying capacity of the water and stocking should not be undertaken at rates above this (*not even to allow for possible mortalities immediately following stocking*). Bottom-feeding species should be avoided.

With the increased awareness of fishery staff to the needs of small fish species, there is a small but discernible trend for such species to be stocked into waters where they are absent (or thought to be absent) or felt to be faring poorly. Whilst this increased concern is to be welcomed, it is important to consider that populations of species such as the spined loach remain largely unaffected by direct stocking and there is a strong possibility of genetic (perhaps adaptive) differences between populations, particularly between major catchments. *It would be preferable for genetic studies of possible differences to be investigated prior to any further stocking activity that may compromise the gene pool.* At the very least, stocking should only be undertaken from populations that are likely to have reasonable historical links to the site being stocked.

## 6. SURVEYING AND MONITORING

There is great scope within the Agency for improved recording of the species in streams, rivers and drains. There is a strong move within Fisheries Departments to improve the recording of small species of no angling interest, which will be encouraged by the establishment of a new fisheries database system (being trialled in Midlands Region), the increased use of the National Fisheries Classification System, and the distribution of a new Species Awareness Leaflet on priority fish species. Spined loach can be caught in routine fishery surveying, but is possibly even more likely to turn up in fry surveys that are sometimes undertaken in cyprinid-dominated areas. It is also sometimes picked up by routine macroinvertebrate surveys. Targeted surveys of distribution and status, using point abundance sampling or simple hand trawls in likely habitats, should be encouraged within relevant Agency Fisheries Departments.

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# SPECIES ACTION PLANS FOR LAMPREYS IN ENGLAND

Peter S Maitland


Report to English Nature

January, 1997

# SPECIES ACTION PLANS FOR LAMPREYS IN ENGLAND

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January, 1997

# SPECIES ACTION PLANS FOR LAMPREYS IN ENGLAND

CONTENTS PAGE

# SPECIES ACTION PLANS FOR LAMPREYS IN ENGLAND

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## INTRODUCTION

This report includes three Species Action Plans each dealing with one of the three species of lamprey which occur in England - the Sea Lamprey *Petromyzon marinus*, the River Lamprey *Lampetra fluviatilis* and the Brook Lamprey *Lampetra planeri*. All three Action Plans are very similar to each other. This is because these lampreys are very alike in many ways - especially in their life histories in fresh water, where they occupy similar (often the same) habitats for most of their lives (Maitland 1980). Thus, factors which have affected one species are likely to have affected both others. Similarly, conservation requirements to enhance and restore populations are very similar for all three species. The larvae of *Lampetra fluviatilis* and *Lampetra planeri* are indistinguishable from one another and it may be that this is just one species with two different life forms.

The new conservation obligations to these three lampreys have arisen from the 'Habitats Directive' (1992) which lists all three species in Annex II and thus obliges member states to (a) designate sites to form part of the 'Natura 2000' network comprising Special Areas of Conservation (SACs), (b) protect such sites from deterioration or disturbance with a significant effect on the nature conservation interest (and take steps to conserve that interest), and (c) protect the species of Community interest listed in the Annexes to the Directive.

## CHARACTERISTICS OF LAMPREYS

The lampreys (family Petromyzonidae) belong to a small but important group known as Agnatha - literally 'jawless' fishes, the most primitive of all living vertebrate animals. Thus they are quite distinct from all the other fish in the British Isles which have their upper jaws fixed closely to the skull and hinged lower jaws which oppose them. The lampreys, in contrast, have no lower jaws and the mouth is surrounded by a round sucker-like disc within which, in the adults, are strong, horny, rasping teeth. These vary in shape, size, position and number among the species, and are an important aid to identification. Lampreys occur in the temperate

zones of both the northern and southern hemispheres. Fossils are available from the late Silurian and Devonian periods, some 450 million years ago.

Lampreys have several other very characteristic features. They are always eel-like in shape, but have neither paired fins nor scales. They have no bones - all the skeletal structures being made up of strong, but flexible, cartilage. There is only one nostril, situated on top of the head, just in front of the eyes - the latter rarely being functional or even visible in the young. The gills open directly to each side of the head (i.e. there is no gill cover or operculum) forming a row of seven gill pores behind each eye. Adult lampreys have two dorsal fins which are often continuous with the elongate tail fin.

Most species of lamprey have a similar life cycle, which involves the migration of adults upstream into rivers to reach the spawning areas - normally stony or gravelly stretches of running water. There they spawn in pairs or groups, laying eggs in crude nests - shallow depressions previously created by lifting away small stones with their suckers. These stones surround and sometimes cover and protect the eggs, while the nest itself may often be under a large stone, log or clump of vegetation. Frequently, however, the nest is in the open in shallow water and the spawning adults are very vulnerable to predators. After hatching, the young elongate larvae, known as ammocoetes, swim or are washed downstream by the current to areas of sandy silt in still water where they burrow and spend the next few years in tunnels. They are blind, the sucker is incomplete and the teeth are undeveloped. These ammocoetes feed by creating a current which draws organic particles (coated with bacteria) and minute plants (such as diatoms) into the pharynx. There they become entwined in a slimy mucus string which is swallowed by the larva.

The metamorphosis from larva to adult is a dramatic change which takes place in a relatively short time - usually a few weeks - after several years of larval development. The rim of the mouth (previously in the form of an oral hood) develops into a full sucker inside which are rasping teeth; the skin becomes much more silvery and opaque except over the eyes where it clears to give the lamprey proper vision. The lampreys then migrate, usually downstream away from the nursery areas.

Some species of lamprey, such as the Brook Lamprey, never feed as adults - after metamorphosing they spawn and then die - but most are parasitic

on various other fish which they attack, either in large freshwater lakes and rivers or in the sea, where most of the adult life is spent. They attach to the sides of fish and rasp away the skin, eating it and the body fluids and muscle underneath. The prey may never recover from such an attack (especially if the body cavity is penetrated) and in some waters, to which they have recently gained access, lampreys are serious pests of commercial fish stocks. The most famous example of this is in the Great Lakes of North America, where canalisation gave the Sea Lamprey access, for the first time, to the upper lakes (Hardisty & Potter 1971). Various commercial fish stocks there became seriously depleted, particularly the American Lake Charr (*Salvelinus namaycush*), whose populations collapsed in a dramatic way. On reaching sexual maturity, the adult lampreys migrate back to their spawning streams. All species seem to die after spawning.

## DISCUSSION

As noted above, the EC 'Habitats Directive' gives rise to clear obligations on the part of member states in relation to all three lamprey species and the production of Species Action Plans is a first step in indicating how English Nature intends to go about meeting these obligations.

None of the three species of lamprey in England is rare or seriously threatened overall. Nevertheless, all three have undergone decline over the last century and have disappeared from river systems which they previously occupied. There is no comprehensive information on their distribution (Maitland 1972). Thus action is needed, not only to fulfil legal requirements, but also to take account of those populations that still exist and review situations from which they have disappeared. Conservation measures are needed, not only to fulfil requirements in relation to European legislation, but also to restore their status and the biodiversity of those riverine systems in which they formerly occurred (Maitland & Lyle 1991).

In order to fulfil these conservation needs, the general conservation requirements of all three species in England are the same:

(a) Detailed information is needed on their status and distribution. The recent review of the biology, threats to and conservation of lampreys in Switzerland (Kirchhofer 1996) is exactly the type of detailed review that is needed for England before full conservation measures can be instigated.

(b) Where conditions have deteriorated from those occurring naturally, there must be improvements in water quality and habitat, both in those rivers where the species still occur and in those previously occupied.

(c) Artificial barriers (chemical and physical) to the upstream spawning migrations of all three species should be removed or means of access around them provided.

(d) Restoration by translocation of extinct populations should be carried out in selected rivers where habitat conditions have been restored.

(e) In order to maintain awareness of the conservation status of each species of lamprey, there is a need for an ongoing programme of monitoring at key sites. This could be based on a five year rolling programme (similar to that undertaken for salmonids) and should involve counts of relative numbers of adults in standard traps (on a CPUE basis) and on their spawning grounds, as well as absolute counts of larvae in nursery silts. The role of SACs is important here, since these sites will require a detailed definition of conservation status and detailed monitoring to ascertain whether this is being met or not. Among the proposed SAC rivers in England are several which contain all three lamprey species (e.g. the Rivers Avon, Derwent, Eden, Tweed and Wye) and thus within the SAC system alone several important populations will be given considerable protection.

(f) Much of the lack of information and of action in the past has been due to lack of awareness, and thus a programme of publicity and education concerning the ecology and conservation of lampreys is important.

Although the Action Plans for the three species of lampreys are essentially similar to one another, they do involve a wide range of activities with varying input. For example, the identification and monitoring of spawning grounds is something which can be carried out on a voluntary basis by local school, naturalists or anglers. In good weather, at the right times of year the location of spawning grounds, the number of redds, the number of lampreys actually spawning and the species involved can all be observed from the river bank, without even entering the water. Thus the Species Action Plans can be used to identify just what contributions individuals or organisations can make to help in securing the long term conservation of lampreys.

(g) Finally, the conservation management of river systems for lampreys (and for other native wildlife) should not be solely a matter of attaining standardised measurements of chemical or other attributes, but much more an attempt to instigate long term plans which will retain and restore the natural features and attributes of each river. Some rivers will naturally have extensive spawning and nursery habitat for lampreys and, consequently, large populations of all three species. Others, for example many highland systems, may have extensive spawning gravels but virtually no nursery silts and only Brook Lampreys, or even no lampreys at all, would occur here. There should be no attempt in such natural systems to 'improve' lamprey habitat by creating silts, thereby reducing naturalness (Boon *et al.* 1996), affecting other native species and habitats and reducing the natural diversity among river systems. The present move towards river management specifically for salmonid fish has dangers for other native wildlife (e.g. lampreys, where the provision of salmonid spawning gravels destroys ammocoete nursery silts) and natural habitats, and must be clearly seen as 'fishery' as opposed to 'conservation' management.

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# Species Action Plan - Sea Lamprey

*Petromyzon marinus*


## Summary

Great Britain is one of the strongholds of the Sea Lamprey *Petromyzon marinus* Linnaeus 1758, which, though rare and threatened in some European countries and extinct in others, is fairly widespread in England and other parts of the United Kingdom and occurs in dozens of rivers there. Its main habitat requirements are, on the one hand, clean areas of gravel in running water in which to spawn and, on the other, deposits of sandy silt within which the larvae can burrow and spend most of their lives. Many populations have been lost because of pollution and river engineering works and, because it is anadromous, it (and the River Lamprey) has suffered more than the Brook Lamprey, which lives only in fresh water. Conservation action for the Sea Lamprey requires (a) further detailed knowledge of its distribution, (b) improvement of water quality and other habitat requirements in those rivers from which it has disappeared, (c) the removal of any artificial barriers to its spawning migrations, (d) translocation back to previously occupied rivers to which there is no natural access from existing populations, (e) regular monitoring of priority populations, (f) raising public awareness through education and publicity, and (g) a long-term programme of habitat management to restore as many rivers as far as possible back to their original, natural, 'wild' condition.


## 1. PRIORITY STATEMENT

The Sea Lamprey *Petromyzon marinus*, though it has declined in some parts of its European range and in parts of the British Isles, is still common in parts of England. It is listed in the Bern Convention (Appendix III) and in Annex II of the EC Directive on the Conservation of Natural and Semi-natural Habitats and Wild Fauna and Flora. English Nature attaches medium priority to conservation action for the Sea Lamprey.

## 2. ACTION PLAN OBJECTIVES

*Objective 1: To obtain further detailed knowledge of the status and distribution of the Sea Lamprey throughout England.*

*Objective 2: To support the improvement of water quality and other habitat requirements of the Sea Lamprey in all rivers, including those from which it has disappeared, in order to achieve a situation as close as possible to that which would have occurred there naturally.*

*Objective 3: To support the removal of artificial barriers to the spawning migration of the Sea Lamprey in English rivers.*

*Objective 4: To consider re-establishing populations of Sea Lamprey, using suitable translocation methods, in selected rivers in which it formerly occurred and to which there is no natural access from existing populations.*

*Objective 5: To establish a national monitoring programme for the Sea Lamprey.*

## 3. LEGAL STATUS

*Petromyzon marinus* is listed in Annex II of the EC Directive on the Conservation of Natural and Semi-natural Habitats and of Wild Fauna and Flora as a species of Community interest, whose conservation requires the designation of Special Areas of Conservation. The Bern Convention on the Conservation on the Conservation of European Wildlife and Natural Habitats lists *Petromyzon marinus* in Appendix III, which permits some exploitation of its population. However, this species is not listed in the 1981 Wildlife and Countryside Act, nor is it considered by Maitland & Lyle (1991) to be in need of special legal conservation measures in Great Britain, except in the case of certain populations which may have some individuality (Maitland & Lyle 1992). It is, however, considered as threatened in Ireland and listed in the Irish Red Data Book (Whilde 1993).

## 4. BIOLOGICAL ASSESSMENT

### 4.1 Introduction

The Sea Lamprey is the largest of the British lampreys and may reach a length of 100 cm and a weight of 2.5 kg. The normal adult length is around 50 cm. It is an anadromous species which grows to maturity in the seas around Britain and then migrates into fresh water to spawn. It spawns there in clean rivers and streams and the larvae send several

years in silt beds before metamorphosing and migrating downstream to the sea. The Sea Lamprey has declined in Britain over the last hundred years and, though not yet distinctly threatened, is in need of conservation measures to restore populations to their former status.

### 4.2 Ecology

The ammocoete larvae are usually found in silty sands in running water. Where suitable substrates are present they occur in streams and rivers upstream as far as the adults are able to migrate; they are stopped by high waterfalls or weirs, dams and severe pollution. The habitat occupied by the larvae of all lamprey species seems to be very similar and larval Brook, River and Sea Lampreys may often be found together at the same sites (Maitland 1980a).

The optimum particle size of the beds of sediment in which lamprey occur is 0.18-0.38 mm, and to include clay, silt and sand fractions. Moderate shade (which appears to be related to the types of micro-organisms on the surface) and water velocity (appropriate to allow the settlement of the above particle sizes) appear to be important factors connected to the suitability of sites. Normally, suitable sites are found only in some parts of each river system and in some rivers there may be none at all. In British streams, most populations occur where the average stream gradients are 1.9-5.7 m/km. Lampreys are rarely found where gradients exceed 7.8 m/km. Within the stretches of suitable gradient, adequate sites are often found in conditions of slowing current, where deposition of sand and silt occurs (e.g. in eddies, backwaters, behind obstructions or at the edges of streams).

Relatively little is known about the precise habitats occupied by adult Sea Lampreys. Most adults found in fresh water are either migrating upstream to spawn or dying after spawning (Larsen 1980). Habitat seems only to be important in relation to their ability to get to the spawning beds. Just before spawning they may be found in calmer water above the spawning areas or below protecting obstructions, etc. The nests are normally built in areas of flowing shallow water among sand and gravel of varying particle size.

The Sea Lamprey usually spawns in late May or June in British rivers, when the water temperature reaches at least 15°C. Normally, males appear

on the nesting sites first and are apparently highly attractive to females, possibly by the secretion of an olfactory sex attractant. The numbers of eggs produced by the females in some populations averages about 172,000 per female. The eggs are small (0.80-1.25 mm in diameter) and an opaque white colour when laid.

After hatching, larvae leave the nest and drift downstream, distributing themselves among suitable silt beds (Hardisty 1969). The duration of larval life varies but averages about five years. Metamorphosis to the adult form takes place between July and September and the process usually takes a few weeks. The time of the main migration downstream varies from river to river and relatively little is known about them after they reach the sea, where they have been found in both shallow coastal and deep off-shore waters. The spawning migration in Great Britain takes place in May and June when the adults start to migrate back into fresh water.

There is little evidence for any differences in the food or feeding habits of the ammocoete stage of the three British species of lamprey. All appear to feed from within their burrows on fine particulate matter, mainly micro-organisms, desmids and diatoms in particular. In addition, various unicellular animals including ciliates, euglenoids and rhizopods have been found in ammocoete guts in some numbers. The role of detritus as food is uncertain, but large amounts appear to be eaten during the summer months. Most of the food taken in by the larvae comes from the superficial sediments in the vicinity of the larval burrows. The system of ciliated tracts in the pharynx, used as a means of transporting food on strands of mucus towards the intestine, is complex.

After metamorphosis and the downstream migration to the sea, the adults feed on fish there, but detailed evidence on their feeding habits is fragmentary (except in the specialised case of the purely freshwater populations in North America which have been intensively studied [Lennon 1954]). They seem to feed on a wide variety of marine and anadromous fishes, including Sturgeon, Herring, Salmon, Cod and Haddock. Salmon and Sea Trout entering rivers often bear fresh scars attributable to attacks by this species.

The mortality rates in ammocoete populations are probably rather low and consistent throughout the larval period. Apart from the effect of fluctuating physical factors, especially during the embryonic period, it is

known that the larvae are eaten by Eels, sticklebacks and other fish as well as several different birds (e.g. Herons). Losses may be particularly high during the dispersal from the nest to the ammocoete silt beds and a high mortality probably occurs at metamorphosis. Only a few parasites have been recorded from lampreys and nothing is known about their effect on the host.

There are a number of records of birds and mammals attacking adult Sea Lampreys, especially at spawning time. The species, though considered a pest in North America, is commercially important in a number of countries in Europe (e.g. Spain and Poland). In these countries, humans must be considered as the most serious threat to the species in view of these fisheries, but elsewhere pollution and barriers to upstream migration are the main problems.

### 4.3 Distribution and populations

The Sea Lamprey is a native anadromous species occurring over much of the Atlantic coastal area of western and northern Europe (from northern Norway to the western Mediterranean) and eastern North America, and in estuaries and easily accessible rivers in these regions. In the British Isles it is absent from northern rivers (i.e. it does not appear to occur north of the Great Glen of Scotland) and has become extinct in a number of southern ones due to pollution and engineering barriers. There are several landlocked populations in North America but in the British Isles the only site where the species is known to feed in fresh water is Loch Lomond.

In England, there are still many populations of Sea Lampreys in the larger cleaner rivers, though a number of stocks have become extinct in the past because of pollution and river engineering. However, apart from a study in 1996 (commissioned by English Nature) of lamprey distribution in a number of priority river systems, there has been no recent survey for this (or other) lamprey species and detailed distribution information on all lampreys is urgently required.

### 4.4 Limiting factors

The following limiting factors are regarded as the most important in relation to the success of this species in England.

### 4.4.1 Pollution *Importance: locally high*

Because most polluting effluents are directed into running waters , many rivers in England became grossly polluted in the past and lost their populations of lampreys, which are almost entirely riverine animals. In addition to direct toxic effects, pollution has a major impact on lamprey populations by smothering both spawning gravels and nursery silts.

The migrations of Sea Lampreys are affected by pollution barriers in such systems which may prevent migrations to the spawning grounds. One extreme belt of pollution between the sea and the spawning grounds can have a major effect on lamprey populations in that system.

### 4.4.2 River engineering *Importance: locally high*

In a similar way to pollution barriers, engineering works of various kinds (dams, weirs, etc.) can be obstacles to upstream migration and affect the success of local populations of lampreys (Applegate 1950).

Channelisation can also be very damaging to lampreys, mainly through destruction of their habitat. The removal of areas of riffle and associated spawning gravels on the one hand, and the dredging of essential nursery silt beds on the other, may entirely eliminate lampreys from a river.

### 4.4.3 Other factors *Importance: locally high*

Both water abstraction and land drainage (Maitland *et al.* 1990) have similar negative effects on lamprey populations leading to unstable habitats with variable water levels which flood and disturb both spawning gravels and nursery silts at some times but leave them high and dry at others. Natural low and high flows can have similar damaging effects.

Eutrophication acts in a similar way to some other forms of pollution (Maitland 1984): the algal and bacterial production resulting from increased nutrients smothers both the spawning substrate (preventing spawning or killing eggs) and the nursery substrate, creating anoxic conditions there.

Fishery management for one particular group may adversely affect other fish and wildlife and their habitat. For example, action aimed at improving conditions for salmonids (e.g. dredging of ammocoete silts or the provision

of fish passes only surmountable by salmonids) may be detrimental to lampreys.

## 5. RESUME OF CONSERVATION ACTION TO DATE

### 5.1 General

There has been little conservation action aimed specifically at the Sea Lamprey in England other than general attempts to raise the profile of the conservation of all fish in the British Isles (Maitland 1974, 1979, 1989, 1991, Maitland & Lyle 1991, 1992) and recent reports to JNCC identifying important sites for the Sea Lamprey in Great Britain (Maitland 1993, 1995).

### 5.2 Priority sites

Because there is inadequate information on the status of the Sea Lamprey in some areas of the British Isles, it is not possible to be categoric about the identification of all important sites for this species. However, based on existing information, the following rivers in England, which are known to have populations of Sea Lamprey, have already been proposed as SACs: R Avon (Hants.), R Derwent (Cumbria), R Eden (Cumbria), R Tweed and R Wye. In addition to these, Maitland (1993) proposed several other waters as being of importance for this large anadromous species (e.g. R Burry, The Flits NNR, R Loughor, R Severn, R Tyne, R Wnion, R Dee, R Wye, Aber Geich, R Usk, R Burry, R Dyfi, R Loughor, R Rheidol, R Taf, R Taw, R Teme, R Tywi, R Usk, R Wnion).

## 6. PROPOSED ACTION BY ENGLISH NATURE

### 6.1 Policy and legislation

*Action 1: Work with the Environment Agency to sustain or improve natural water and habitat quality in both those rivers which have populations of Sea Lamprey and those which formerly possessed populations.*

*Priority: high*

It is believed that river pollution and habitat destruction through engineering works are the main reasons for the loss of lamprey

populations in England. Action: English Nature, Environment Agency, landowners, Department of the Environment.

*Action 2: Work with the Environment Agency to remove all artificial barriers to lamprey migration in both those rivers which have populations of Sea Lamprey and those which formerly possessed populations.*

*Priority: high*

It is probable that artificial barriers in rivers are the main obstacle in preventing the spread of lampreys into all areas which they formerly occupied. Such barriers require to be identified and may be chemical (severe pollution) or physical (weirs, etc.). The former will disappear with improved water quality, the latter may be overcome by complete (or partial) removal, or the installation of suitable fish passes. Clearly if both types of barrier are present in one river, the removal of one is of little use without the removal also of the other. Action: English Nature, Environment Agency, landowners, Department of the Environment.

### 6.2 Site safeguard, river acquisition and management

*Action 3: Protect, by SSSI and SAC designation, an adequate range of the river systems in which Sea Lampreys still occur, in the context of English Nature's designation policy.*

*Priority: high*

Some of the sites in which Sea Lampreys occur already have some protection (Maitland 1993). As previously recommended by Lyle & Maitland (1992), a review of all SSSI sites is needed in order to make sure that an adequate range of sites for the Sea Lamprey is given protection within the existing series. Selection criteria should include consideration of both altitude (Maitland 1991) and latitude. Action: English Nature.

*Action 4: English Nature and appropriate NGOs should object to any development proposals (engineering, agricultural, fisheries, etc.) that may adversely affect a site which is important for Sea Lampreys.*

*Priority: medium*

Given that a large proportion of the life cycle of lampreys is spent in burrows in silt beds, special attention must be paid to these (not normally considered as important fish habitat), and to spawning gravels, in any consideration of the impact of a development proposal affecting a river. Action: English Nature, NGOs.

### 6.3 Species management, protection and licensing

*Action 5: English Nature should ensure that, as far as possible, lamprey stocks are fully protected in priority rivers.*

*Priority: high*

Lampreys are rarely given consideration in the plans drawn up for fishery management but important sites (Maitland 1985) and habitats (Maitland 1992) both need protection. There is thus a need to develop and incorporate management guidelines for lampreys in such plans. Action: English Nature, Environment Agency.

*Action 6: Consideration should be given to restocking those river systems where Sea Lampreys are known to have occurred previously and where conditions are again deemed to be suitable.*

*Priority: medium*

If it is clear that the causes of extinction of previous populations have now been removed and that it is unlikely that populations could be restored naturally from elsewhere in the river network, then it may be sensible to consider restoring populations of Sea Lampreys. Action: English Nature, Environment Agency.

### 6.4 Advisory

*Action 7: Promote a better understanding of Sea Lampreys and their requirements among the public, especially anglers.*

*Priority: medium*

Although the Sea Lamprey is a parasitic species, there is no evidence of any significant damage to native fish stocks in Europe. Moreover, it is

beneficial to the ecology of rivers, both in helping to stabilise and aerate silt beds and in providing food for a range of other wildlife. Action: English Nature, Environment Agency, NGOs.

### 6.5 International

*Action 8: Promote European cooperation on research, survey and conservation of the Sea Lamprey.*

*Priority: high*

Britain has an important role to play in the conservation of the Sea Lamprey in Europe and it is essential that a coordinated approach is taken across its area of distribution. Action: English Nature, JNCC.

### 6.6 Future research and monitoring

*Action 9: Give support to survey work to establish in detail the current status and distribution of the Sea lamprey in England.*

*Priority: high*

It is some time since the detailed distribution of this species was studied in the British Isles (Maitland 1972). It is of obvious importance to understand the present status as a basis for any future conservation strategy. Action: English Nature, Environment Agency, JNCC, NERC.

*Action 10: Give support to research on the ecology of this species, especially factors affecting larval and adult migration.*

*Priority: high*

There have been relatively few studies of this species in Great Britain (e.g. Hardisty 1969, Hardisty & Potter 1971) and further work is needed, especially on larval habitat and factors affecting both juvenile and adult migrations. Action: English Nature, Environment Agency, NERC.

*Action 11: A long-term monitoring programme should be implemented.*

*Priority: high*

It is essential to establish baseline data in a number of key river systems so that the status of this species in England can be followed in a scientific manner, using a 5-year rolling programme. Standard techniques for this species are available (Maitland 1980b, Schoonoord & Maitland 1983, Morris & Maitland 1987) and these differ from those of normal fish surveys. Action: English Nature, Environment Agency.

### 6.7 Communications and publicity

*Action 12: Promote an understanding of lampreys and their conservation requirements among the general public - especially anglers.*

*Priority: medium*

There is a general lack of understanding of lampreys among the general public, perhaps especially among anglers and landowners, many of whom regard all lampreys as pest species. Action: English Nature, Environment Agency, NGOs.

## 7. ACTION PLAN REVIEW

This Action Plan should be reviewed and revised every five years from its inception.

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# Species Action Plan - River Lamprey

## *Lampetra fluviatilis*


Summary

Great Britain is one of the strongholds of the European River Lamprey *Lampetra fluviatilis* (Linnaeus 1758), which, though rare and threatened in some European countries, is fairly widespread in England and other parts of the United Kingdom and occurs in dozens of streams there. Its main habitat requirements are, on the one hand, clean areas of gravel in running water in which to spawn and, on the other, deposits of sandy silt within which the larvae can burrow and spend most of their lives. Many populations have been lost because of pollution and river engineering works, and, since it is anadromous, because of barriers on their migration routes. Conservation action for the River Lamprey requires (a) further detailed knowledge of its distribution, (b) improvement of water quality and other habitat requirements in those rivers from which it has disappeared, (c) the removal of any artificial barriers to its spawning migrations, (d) translocation back to previously occupied rivers to which there is no natural access from existing populations, (e) regular monitoring of priority populations, (f) raising public awareness through education and publicity, and (g) a long-term programme of habitat management to restore as many rivers as far as possible back to their original, natural, 'wild' condition.


## 1. PRIORITY STATEMENT

The River Lamprey *Lampetra fluviatilis*, though it has declined in some parts of its European range (Maitland 1980a) and in parts of the British Isles, is still common in many places in England. It is listed in the Bern Convention (Appendix III) and in Annexes II and V of the EC Directive on the Conservation of Natural and Semi-natural Habitats and Wild Fauna and Flora. English Nature attaches medium priority to conservation action for the River Lamprey.

## 2. ACTION PLAN OBJECTIVES

*Objective 1: To obtain further detailed knowledge of the status and distribution of the River Lamprey throughout England.*

*Objective 2: To support the improvement of water quality and other habitat requirements of the River Lamprey in all rivers, including those from which it has disappeared, in order to achieve a situation as close as possible to that which would have occurred there naturally.*

*Objective 3: To support the removal of artificial barriers to the spawning migration of the River Lamprey in English rivers.*

*Objective 4: To re-establish populations of River Lamprey, using suitable translocation methods, in those rivers in which it formerly occurred and to which there is no natural access from existing populations.*

*Objective 5: To establish a national monitoring programme for the River Lamprey.*

## 3. LEGAL STATUS

*Lampetra fluviatilis* is listed in Annexes II and V of the EC Directive on the Conservation of Natural and Semi-natural Habitats and of Wild Fauna and Flora as a species of Community interest, whose conservation requires the designation of Special Areas of Conservation. The Bern Convention on the Conservation on the Conservation of European Wildlife and Natural Habitats lists *Lampetra fluviatilis* in Appendix III, which permits some exploitation of its population. However, this species is not listed in the 1981 Wildlife and Countryside Act, nor is it considered by Maitland & Lyle (1991) to be in need of special conservation measures in Great Britain, except in the case of one unique population in Loch Lomond (Maitland & Lyle 1991, Maitland *et al.* 1994). It is, however, considered as threatened in Ireland and listed in the Irish Red Data Book (Whilde 1993).

## 4. BIOLOGICAL ASSESSMENT

### 4.1 Introduction

Of the three British lampreys, the River Lamprey is intermediate in size between the large Sea Lamprey and the small Brook Lamprey. The average adult length is around 30 cm with a corresponding weight of some 60 gm, but specimens over 40 cm can be found and the unusual race in Loch Lomond (see below) is often less than 20 cm. It is an anadromous species which grows to maturity in estuaries around Britain and then migrates into

fresh water to spawn. It spawns there in clean rivers and streams and the larvae send several years in silt beds before metamorphosing and migrating downstream to estuaries. The River Lamprey has declined in Britain over the last hundred years and, though not yet distinctly threatened, is in need of conservation measures to restore populations to their former status. The population in Loch Lomond (Maitland 1980b) appears to be unique in the United Kingdom in terms of both its morphology and life history (adults do not go to the estuary but feed entirely in fresh water) and warrants conservation status because of this.

### 4.2 Ecology

Spawning in British rivers starts when the water temperature reaches 10-11°C, usually in March and April (Hardisty & Potter 1971). The spawning grounds are areas of small stones and gravel in flowing water where current is present but not too strong. Very characteristically they spawn at the lower ends of pools just where the water is starting to break up into a riffle. Nesting and spawning behaviour have been described in some detail (e.g. Hagelin 1959) and is usually a communal affair, sometimes along with *Lampetra planeri* in the same nest (Huggins & Thompson 1970). The nest, which may be constructed by up to a dozen or more adults, is normally an oval depression about 30-70 cm across and 2-10 cm deep. The females are very fecund with an average of 16,000 eggs per individual (Hardisty 1964).

After hatching, young larvae move out of the nest and redistribute themselves by drifting downstream and burrowing in suitable silt beds. The optimum particle size of the beds of sediment in which lamprey occur is 0.18-0.38 mm, and includes clay, silt and sand fractions. Moderate shade (which appears to be related to the types of micro-organisms on the surface) and water velocity (appropriate to allow the settlement of the above particle sizes) appear to be important factors connected to the suitability of sites. Normally, suitable sites are found only in some parts of each river system and in some rivers there may be none at all. In British streams, most populations occur where the average stream gradients are 1.9-5.7 m/km. Lampreys are rarely found where gradients exceed 7.8 m/km. Within the stretches of suitable gradient, adequate sites are often found in conditions of slowing current, where deposition of sand and silt occurs (e.g. in eddies, backwaters, behind obstructions or at the edges of streams).

There is little evidence for any differences in the food or feeding habits of the ammocoete stage of the three British species of lamprey. All appear to feed from within their burrows on fine particulate matter, mainly micro-organisms, desmids and diatoms in particular. In addition, various unicellular animals including ciliates, euglenoids and rhizopods have been found in ammocoete guts in some numbers. The role of detritus as food is uncertain, but large amounts appear to be eaten during the summer months. Most of the food taken in by the larvae comes from the superficial sediments in the vicinity of the larval burrows. The system of ciliated tracts in the pharynx, used as a means of transporting food on strands of mucus towards the intestine, is complex.

The mortality rates in ammocoete populations are probably rather low and consistent throughout the larval period. Apart from the effect of fluctuating physical factors, especially during the embryonic period, it is known that the larvae are eaten by Eels, sticklebacks and other fish as well as several different birds (e.g. Herons). Losses may be particularly high during the dispersal from the nest to the ammocoete silt beds and a high mortality probably occurs at metamorphosis. Only a few parasites have been recorded from lampreys and nothing is known about their effect on the host.

The length of larval life has been estimated as 3-5 years, but usually 4 years (Hardisty & Huggins 1970). Differences are probably due to variations in local temperatures and other site factors. Metamorphosis takes place between July and September (Hardisty 1961) after which the young River Lampreys can still burrow but their main purpose seems to be to descend downstream to the sea, The downstream migration appears to occur during darkness and its timing is highly variable, usually between March and June, but may be as late as October (Potter & Huggins 1973, Bird & Potter 1979). *Lampetra fluviatilis* does not feed during this migration.

As in other lampreys, the main food of the larvae is fine particulate matter, mainly micro-organisms such as desmids and diatoms. The ciliary mechanism and the mucus threads involved in the collection of this food form a complex, but very efficient feeding mechanism. Most of the food taken in by larvae seems to come from the superficial sediments in the vicinity of their burrows. In the estuaries of major rivers they can be found in some numbers and they spend 1-2 years here feeding on a

variety of estuarine fish, but particularly Herring, Sprat and Flounders. They often inflict extensive damage on these hosts by rasping away large amounts of flesh from the back. The lampreys themselves have a very bloated appearance due to the entire gut being full of blood and fish flesh. In purely freshwater populations, the main prey species are Powan, Vendace and Salmon.

The spawning migration back into fresh water takes place between August and October, but its timing appears to vary widely from river to river and may take place over a long period in any one system.

### 4.3 Distribution and populations

River Lampreys are found only in western Europe where they range from southern Norway to the western Mediterranean in coastal waters and estuaries and in accessible rivers. The species is mainly anadromous but there are a few land-locked non-migratory populations isolated from the sea in Finland, Russia and in Scotland.

The ammocoetes of River Lampreys occur in silt beds in many rivers in the British Isles from the Great Glen southwards. They are absent from a number of rivers because of pollution or obstacles which the adults cannot surmount during the spawning migration - these may be natural waterfalls or artificial dams, etc. River Lampreys often occur in association with the other two British lampreys but occasionally (e.g. as in one small stream in the English Lake District) they may, for reasons unknown, occur as pure populations.

In England little recent detailed information on its distribution has been recorded since the 1970s (Maitland 1969; 1972), apart from a study in 1996 (commissioned by English Nature) of lamprey distribution in a number of priority river systems. This is one of several fish species which warrants national survey.

### 4.4 Limiting factors

The following limiting factors are regarded as the most important in relation to the success of this species in England.

### 4.4.1 Pollution *Importance: locally high*

Because most polluting effluents are directed into running waters (and so to the sea), many rivers became grossly polluted in the past and lost their populations of lampreys, which are almost entirely riverine animals. In addition to direct toxic effects, pollution can have a major impact on lamprey populations by smothering both spawning gravels and nursery silts.

The migrations of anadromous species such as River Lampreys are especially affected by pollution barriers in such systems considerable migrations are often necessary from the estuary to the spawning grounds. One extreme belt of pollution between these two habitats in a river can have a major effect on lamprey populations in that system.

### 4.4.2 River engineering *Importance: locally high*

In a similar way to pollution barriers, engineering works of various kinds (dams, weirs, etc.) can be obstacles to upstream migration and affect the success of local populations of lampreys.

Channelisation can also be very damaging to lampreys, mainly through destruction of their habitat. The removal of areas of riffle and associated spawning gravels on the one hand, and the dredging of essential nursery silt beds on the other, may entirely eliminate lampreys from a river system.

### 4.4.3 Other factors *Importance: locally high*

Both water abstraction and land drainage (Maitland *et al.* 1990) are likely to have similar negative effects on lamprey populations leading to unstable habitats with variable water levels which flood and disturb both spawning gravels and nursery silts at some times but leave them high and dry at others. Very high or low natural flows will, of course, create the same problems.

Eutrophication acts in a similar way to some other forms of pollution (Maitland 1984): the algal and bacterial production resulting from increased nutrients smothers both the spawning substrate (preventing spawning or killing eggs) and the nursery substrate, creating anoxic conditions there.

Fishery management for one particular group may adversely affect other fish and wildlife and their habitat. For example, action aimed at improving conditions for salmonids (e.g. dredging of ammocoete silts or the provision of fish passes only surmountable by salmonids) may be detrimental to lampreys.

## 5. RESUME OF CONSERVATION ACTION TO DATE

### 5.1 General

It appears that there has been no conservation action aimed specifically at the River Lamprey in England other than the general attempts to raise the profile of the conservation of all fish species in the British Isles (Maitland 1974, 1979, 1989, 1991a, Maitland & Lyle 1991, 1992) and the recent report to JNCC identifying important sites for this species in Great Britain (Maitland 1993, 1995).

### 5.2 Priority sites

Because there is inadequate information on the status of the River Lamprey in some areas, it is not possible to be categoric about the identification of all important sites for this species. However, based on existing information, the following rivers in England, which have populations of River Lamprey, have already been proposed as SACs: R Avon (Hants.), R Derwent (Cumbria), R Eden (Cumbria), R Tweed and R Wye. In addition to these, Maitland (1993) proposed several other waters as important for this species (e.g. R Beela, R Coquet, R Chew, R Derwent (Trent), R Eden, Great Eau, Gualin NNR, R Idle, R Lune, R Severn, R Teme, R Test, R Thames, R Wharfe, R Windrush, Cors Geirch NNR, Craig Cerig Gleisiad NNR, R Dyfi, Gualin NNR, R Rheidol, R Tywi, R Usk).

## 6. PROPOSED ACTION BY ENGLISH NATURE

### 6.1 Policy and legislation

*Action 1: Work with the Environment Agency to sustain or improve natural water and habitat quality in both those rivers which have populations of River Lamprey and those which formerly possessed populations.*

*Priority: high*

It is believed that river pollution and habitat destruction through engineering works are the main reasons for the loss of lamprey populations in England. Action: English Nature, Environment Agency, landowners, Department of the Environment.

*Action 2: Work with the Environment Agency to remove all artificial barriers to lamprey migration in both those rivers which have populations of River Lamprey and those which formerly possessed populations.*

*Priority: high*

It is probable that artificial barriers in rivers are the main obstacle in preventing the spread of lampreys into all areas which they formerly occupied. Such barriers require to be identified and may be chemical (severe pollution) or physical (weirs, etc.). The former will disappear with improved water quality, the latter may be overcome by complete (or partial) removal, or the installation of suitable fish passes. Clearly if both types of barrier are present in one river, the removal of one is of little use without the removal also of the other. Action: English Nature, Environment Agency, landowners, Department of the Environment.

### 6.2 Site safeguard, river acquisition and management

*Action 3: Protect, by SSSI and SAC designation, an adequate range of the river systems in which River Lampreys still occur, in the context of English Nature's designation policy.*

*Priority: high*

Some sites in which River Lampreys occur already have protection (Maitland 1993). As recommended by Lyle & Maitland (1992), a review of all SSSIs is needed in order to make sure that an adequate range is given protection within the existing series. Selection criteria should include both altitude (Maitland 1991b) and latitude. Action: English Nature.

*Action 4: English Nature should object to any development proposals (engineering, agricultural, fisheries, etc.) that may adversely affect a site which is important for River Lampreys.*

*Priority: medium*

Given that a large proportion of the life cycle of lampreys is spend in burrows in silt beds, special attention must be paid to these (not normally considered as important fish habitat), and to spawning gravels, in any consideration of the impact of a development proposal affecting a river. Action: English Nature, NGOs.

### 6.3 Species management, protection and licensing

*Action 5: English Nature should ensure that, as far as possible, lamprey stocks are fully protected in priority rivers.*

*Priority: high*

Lampreys are rarely given consideration in the plans drawn up for fishery management but important sites (Maitland 1985) and habitats (Maitland 1992) both need protection. There is thus a need to develop and incorporate management guidelines for lampreys in such plans. Action: English Nature, Environment Agency.

*Action 6: Consideration should be given to restocking selected river systems where River Lampreys are known to have occurred previously and where conditions are again deemed to be suitable.*

*Priority: medium*

If it is clear that the causes of extinction of previous populations have now been removed and that it is unlikely that populations could be restored naturally from elsewhere in the river network, then it may be sensible to consider restoring populations of River Lampreys. Action: English Nature, Environment Agency.

### 6.4 Advisory

*Action 7: Promote a better understanding of River Lampreys and their requirements among the public, especially anglers.*

*Priority: medium*

It is worth emphasising here that, although the River Lamprey is a parasitic species, there is no indication that it is a threat to any fishery.

It is beneficial to the ecology or rivers, both in helping to stabilise and aerate silt beds and in providing food for a range of other wildlife, especially various riverine birds and mammals. Action: English Nature, Environment Agency, NGOs.

### 6.5 International

*Action 8: Promote European cooperation on research, survey and conservation of the River Lamprey.*

*Priority: high*

Britain has an important role to play in the conservation of River Lamprey in Europe and it is essential that a coordinated approach is taken across its area of distribution. Action: English Nature, JNCC.

### 6.6 Future research and monitoring

*Action 9: Give support to survey work to establish in detail the current status and distribution of the River lamprey in England.*

*Priority: high*

There is little recent detailed information on its distribution and this is one of several species which warrants national survey. It is of obvious importance to understand fully the present status of this species as a basis for any future conservation management strategy. Action: English Nature, Environment Agency, JNCC, NERC.

*Action 10: Give support to research on the ecology of this species, especially factors affecting larval and adult migration.*

*Priority: high*

There have been relatively few studies of the ecology of this species in Great Britain (e.g. Huggins & Thompson 1970, Maitland 1980a, 1980b, Maitland *et al.* 1984) and valuable work remains to be carried out, especially on larval habitat and factors affecting juvenile and adult migration. Action: English Nature, Environment Agency, NERC.

*Action 11: A long-term monitoring programme should be planned and implemented.*

*Priority: high*

There is no current provision for survey and monitoring of this species. Ideally, several of the most important populations should be monitored using standard trapping and electrofishing methods. It is essential to establish baseline data in a number of key river systems so that the status of this species in England can be followed in a scientific manner, using a 5-year rolling programme. Standard techniques for this species are available (Maitland 1980c, Schoonoord & Maitland 1983, Morris & Maitland 1987) and these differ from those of normal fish surveys. Action: English Nature, Environment Agency.

### 6.7 Communications and publicity

*Action 12: Promote an understanding of lampreys and their conservation requirements among the general public - especially anglers.*

*Priority: medium*

There is a general lack of understanding of lampreys among the general public, perhaps especially among anglers and landowners, many of whom regard all lampreys as pest species. Action: English Nature, Environment Agency, NGOs.

## 7. ACTION PLAN REVIEW

This Action Plan should be reviewed and revised every five years from its inception.

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# Species Action Plan - Brook Lamprey

## *Lampetra planeri*


### Summary

Great Britain is one of the strongholds of the European Brook Lamprey *Lampetra planeri* (Bloch 1784), which, though rare and threatened in some European countries, is fairly widespread in England and other parts of the United Kingdom and occurs in hundreds of streams there. Its main habitat requirements are, on the one hand, clean areas of gravel in running water in which to spawn and, on the other, deposits of sandy silt within which the larvae can burrow and spend most of their lives. Although many populations have been lost because of pollution and river engineering works, because it is a purely freshwater species, it has suffered less in the past than either of the other two native lampreys, both of which require access to and from the sea. Conservation action for the Brook Lamprey requires (a) further detailed knowledge of its distribution, (b) improvement of water quality and other habitat requirements in those rivers from which it has disappeared, (c) the removal of any artificial barriers to its spawning migrations, (d) translocation back to previously occupied rivers to which there is no natural access from existing populations, (e) regular monitoring of priority populations, (f) raising public awareness through education and publicity, and (g) a long-term programme of habitat management to restore as many rivers as far as possible back to their original, natural, 'wild' condition.


### 1. PRIORITY STATEMENT

The Brook Lamprey *Lampetra planeri*, though it has declined in some parts of its European range and in parts of the British Isles, is still common in many parts of England. It is listed in the Bern Convention (Appendix III) and in Annex II of the EC Directive on the Conservation of Natural and Semi-natural Habitats and Wild Fauna and Flora. English Nature attaches medium priority to conservation action for the Brook Lamprey.

### 2. ACTION PLAN OBJECTIVES

*Objective 1: To obtain further detailed knowledge of the status and distribution of the Brook Lamprey throughout England.*

*Objective 2: To support the improvement of water quality and other habitat requirements of the Brook Lamprey in all rivers, including those from which it has disappeared, in order to achieve a situation as close as possible to that which would have occurred there naturally.*

*Objective 3: To support the removal of artificial barriers to the spawning migration of the Brook Lamprey in English rivers.*

*Objective 4: To re-establish populations of Brook Lamprey, using suitable translocation methods, in those rivers in which it formerly occurred and to which there is no natural access from existing populations.*

*Objective 5: To establish a national monitoring programme for the Sea Lamprey.*

## 3. LEGAL STATUS

*Lampetra planeri* is listed in Annex II of the EC Directive on the Conservation of Natural and Semi-natural Habitats and of Wild Fauna and Flora as a species of Community interest, whose conservation requires the designation of Special Areas of Conservation. The Bern Convention on the Conservation on the Conservation of European Wildlife and Natural Habitats lists *Lampetra planeri* in Appendix III, which permits some exploitation of its population. However, this species is not listed in the 1981 Wildlife and Countryside Act, nor is it considered by Maitland & Lyle (1991) to be in need of special legal conservation measures in Great Britain, except in the case of certain isolated populations which may have some individuality (Maitland & Lyle 1992). It is, however, considered as threatened in Ireland and listed in the Irish Red Data Book (Whilde 1993).

## 4. BIOLOGICAL ASSESSMENT

### 4.1 Introduction

The Brook Lamprey is the smallest of the British lampreys and matures at a length of some 13-15 cm. Some populations are known where the adults may be much smaller than this, e.g. on Skye adults spawning in the small burns there may be less than 10 cm, and at some sites they may be larger. For instance in the River Endrick which flows into Loch Lomond adults may reach 16 cm and occasionally even 17 cm in length. It is a

purely freshwater species which grows to maturity in silt beds and then metamorphoses and migrates upstream to its spawning grounds. The Brook Lamprey has declined in Britain over the last hundred years and, though not yet distinctly threatened, is in need of conservation measures to restore populations to their former status.

The larvae of this species are virtually indistinguishable from those of the River Lamprey except when nearing metamorphosis. Indeed these two lampreys form a very close pair (Hardisty & Potter 1971, Bird & Potter 1979, Morris 1989) and are considered by some to be a single species with two life forms.

### 4.2 Ecology

The ammocoete larvae of *Lampetra planeri*, like those of other lampreys, occur in suitable silt beds, mainly in running water but sometimes in large numbers in silt banks in large lakes (Maitland 1980a). Large larvae can be found in considerable numbers in Loch Ness for instance. The Brook Lamprey is the most abundant and widespread of the British lampreys and is often found in the absence of the other two species, for example above a pollution or physical barrier which prevents the anadromous species reaching that part of the river.

The optimum particle size of the beds of sediment in which lamprey occur is 0.18-0.38 mm, and to include clay, silt and sand fractions. Moderate shade (which appears to be related to the types of micro-organisms on the surface) and water velocity (appropriate to allow the settlement of the above particle sizes) appear to be important factors connected to the suitability of sites. Normally, suitable sites are found only in some parts of each river system and in some rivers there may be none at all. In British streams, most populations occur where the average stream gradients are 1.9-5.7 m/km. Lampreys are rarely found where gradients exceed 7.8 m/km. Within the stretches of suitable gradient, adequate sites are often found in conditions of slowing current, where deposition of sand and silt occurs (e.g. in eddies, backwaters, behind obstructions or at the edges of streams).

This species does not feed as an adult and most of its life is spent in silt beds as the larval stage. The larvae have light sensitive cells in the skin and are negatively phototactic, for the most part remaining sedentary

within their burrows. However, if disturbed they will swim around rapidly until they find suitable silt into which to burrow. They are capable of completely disappearing into sand in just a few seconds. As spawning time approaches the metamorphosed adults move out from the silts and start to migrate upstream (often in large numbers) till they reach suitable spawning grounds (Malmqvist 1980). These are areas of small stones and gravel in flowing water where current is present but not too strong. Very characteristically they spawn at the lower ends of pools just where the water is starting to break up into a riffle.

The spawning season of this species in British rivers starts when the water temperatures reach 10-11°C (Hardisty 1944, 1961a). There is a clear relationship between water temperature and the number of animals at spawning sites, numbers declining as the temperature drops. The nest, which may be constructed by up to a dozen or more adults, is normally an oval depression about 20-40 cm across and 2-10 cm deep. The actual spawning act is similar to that of other lampreys though the Brook Lamprey on account of its small size is less fecund, producing only about 1,500 eggs per female. After hatching the young larvae leave the nest and distribute themselves by drifting downstream and burrowing in suitable areas of silty sand. By this time all the adults are dead for none seem to survive long after spawning.

*Lampetra planeri* and *Lampetra fluviatilis* are known to spawn communally (Huggins & Thompson 1970).

Larval life seems to vary considerably in different parts of Europe but in the British Isles is about 6.5 years (Hardisty 1961a, 1961b). The larvae are some 3-5 mm on hatching and about 12-15 cm at metamorphosis which takes place between July and September, usually simultaneously (i.e. within 3-4 weeks) in any one population. The adults usually migrate upstream after metamorphosis but continue to burrow like ammocoetes or hide under stones during the day. Since they no longer feed, they lose weight (and length) up to spawning time, when the females suddenly become heavier as the eggs take up water prior to spawning.

The larvae feed, like those of other lampreys, by filtering fine organic particles, especially diatoms and other algae as well as protozoans and detritus, from the surface of the silt around the mouths of the burrows in which they spend virtually all their larval years. The ciliary mechanism

and the mucus threads involved in the collection of this food form a complex, but very efficient feeding mechanism.

The mortality rates in ammocoete populations are probably rather low and consistent throughout the larval period. Apart from the effect of fluctuating physical factors, especially during the embryonic period, it is known that the larvae are eaten by Eels, sticklebacks and other fish as well as several different birds (e.g. Herons). Losses may be particularly high during the dispersal from the nest to the ammocoete silt beds and a high mortality probably occurs at metamorphosis. Only a few parasites have been recorded from lampreys and nothing is known about their effect on the host.

### 4.3 Distribution and populations

*Lampetra planeri* is a purely freshwater species occurring in streams and occasionally in lakes in north-west Europe, especially in basins associated with the North and Baltic Seas. It occurs over much of the British Isles, but is absent from most of Scotland north of the Great Glen, including the northern and all but a few of the Western Isles. The species has declined in several countries in Europe, where it is now regarded as threatened (e.g. Switzerland) and where it is given protection.

In England little recent detailed information on its distribution has been recorded since the 1970s (Maitland 1969, 1972), apart from a study in 1996 (commissioned by English Nature) of lamprey distribution in a number of priority river systems. This is one of several fish species which warrants national survey. There is no current provision for survey and monitoring of this species. Ideally several of the most important populations should be monitored using standard trapping and electrofishing methods.

### 4.4 Limiting factors

The following limiting factors are regarded as the most important in relation to the success of this species in England.

#### 4.4.1 Pollution *Importance: locally high*

Because most polluting effluents are directed into running waters (and so to the sea), many rivers became grossly polluted in the past and lost their

populations of lampreys, which are almost entirely riverine animals. In addition to direct toxic effects, pollution can have a major impact on lamprey populations by smothering both spawning gravels and nursery silts.

Although the migrations of anadromous species are especially affected by pollution barriers in such systems, purely freshwater species can also be influenced. In the Brook Lamprey, considerable migrations may be necessary from the nursery areas to the spawning grounds. One extreme belt of pollution between these two habitats in a river can have a major effect on lamprey populations in that system.

### 4.4.2 River engineering *Importance: locally high*

In a similar way to pollution barriers, engineering works of various kinds (dams, weirs, etc.) can be obstacles to upstream migration and affect the success of local populations of lampreys.

Channelisation can also be very damaging to lampreys, mainly through destruction of their habitat. The removal of areas of riffle and associated spawning gravels on the one hand, and the dredging of essential nursery silt beds on the other, may entirely eliminate lampreys from a river system.

### 4.4.3 Other factors *Importance: locally high*

Both water abstraction and land drainage (Maitland *et al.* 1990) are likely to have similar negative effects on lamprey populations leading to unstable habitats with variable water levels which flood and disturb both spawning gravels and nursery silts at some times but leave them high and dry at others. Very high or low natural flows will, of course, create the same problems.

Eutrophication acts in a similar way to some other forms of pollution (Maitland 1984): the algal and bacterial production resulting from increased nutrients smothers both the spawning substrate (preventing spawning or killing eggs) and the nursery substrate, creating anoxic conditions there.

Fishery management for one particular group may adversely affect other fish and wildlife and their habitat. For example, action aimed at improving

conditions for salmonids (e.g. dredging of ammocoete silts or the provision of fish passes only surmountable by salmonids) may be detrimental to lampreys.

## 5. RESUME OF CONSERVATION ACTION TO DATE

### 5.1 General

It appears that there has been no conservation action aimed specifically at the Brook Lamprey in England other than the general attempts to raise the profile of the conservation of all fish species in the British Isles (Maitland 1974, 1979, 1989, 1991, Maitland & Lyle 1991, 1992) and the recent report to JNCC identifying important sites for this species in Great Britain (Maitland 1993, 1995).

### 5.2 Priority sites

Because there is inadequate information on the status of the Brook Lamprey in some areas, it is not possible to be categoric about the identification of all important sites for this species. However, based on existing information, the following rivers in England, which have populations of Brook Lamprey, have already been proposed as SACs: R Avon (Hants.), R Derwent (Cumbria), R Eden (Cumbria), R Tweed and R Wye. In addition to these, Maitland (1993) listed many other waters as important for this relatively common species (e.g. R Alham, R Aln, R Alun, R Blyth, R Brathay, R Brede, R Brue, R Cam, R Cherwell, R Chess, R Coquet, R Crake, R Cuckmere, Day Brook, R Derwent (Trent), R Evenlode, R Frome, Highland R, R Hodder, R Lea, R Loughor, R Lymington, R Never, R Ouse (Sussex), Parkmill Stream, Rhymney Stream, R Ribble, Wansbeck, R Wey, R Windrush, Wray Beck, R Wye, R Wylye, R Wyre, R Yeo).

## 6. PROPOSED ACTION BY ENGLISH NATURE

### 6.1 Policy and legislation

*Action 1: Work with the Environment Agency to sustain or improve natural water and habitat quality in both those rivers which have populations of Brook Lamprey and those which formerly possessed populations.*

*Priority: high*

It is believed that river pollution and habitat destruction through engineering works are the main reasons for the loss of lamprey populations in England. Action: English Nature, Environment Agency, landowners, Department of the Environment.

*Action 2: Work with the Environment Agency to remove all artificial barriers to lamprey migration in both those rivers which have populations of Brook Lamprey and those which formerly possessed populations.*

*Priority: high*

It is probable that artificial barriers in rivers are the main obstacle in preventing the spread of lampreys into areas which they formerly occupied. Such barriers require to be identified and may be chemical (severe pollution) or physical (weirs, etc.). The former will disappear with improved water quality, the latter may be overcome by complete (or partial) removal, or the installation of suitable fish passes. Clearly if both types of barrier are present, removal of one is of little use without removal of the other. Action: English Nature, Environment Agency, landowners, Department of the Environment.

### 6.2 Site safeguard, river acquisition and management

*Action 3: Protect, by SSSI and SAC designation, an adequate range of the river systems in which Brook Lampreys still occur, in the context of English Nature's designation policy.*

*Priority: high*

Some of the sites in which Brook Lampreys occur already have protection (Maitland 1993). As previously recommended by Lyle & Maitland (1992), a review of all SSSIs is needed in order to make sure that an adequate range is given protection. Selection criteria should include consideration of both altitude (Maitland 1991) and latitude. Action: English Nature.

*Action 4: English Nature should object to any development proposals (engineering, agricultural, etc.) that may adversely affect a site which is important for Brook Lampreys.*

*Priority: medium*

Given that a large proportion of the life cycle of lampreys is spend in burrows in silt beds, special attention must be paid to these (not normally considered as important fish habitat), and to spawning gravels, in any consideration of the impact of a development proposal affecting a river. Action: English Nature, NGOs.

### 6.3 Species management, protection and licensing

*Action 5: English Nature should ensure that, as far as possible, lamprey stocks are fully protected in priority rivers.*

*Priority: high*

Lampreys are rarely given consideration in the plans drawn up for fishery management but important sites (Maitland 1985) and habitats (Maitland 1992) both need protection. There is thus a need to develop and incorporate management guidelines for lampreys in such plans. Action: English Nature, Environment Agency.

*Action 6: Consideration should be given to restocking selected river systems where Brook Lampreys are known to have occurred previously and where conditions are again deemed to be suitable.*

*Priority: medium*

If it is clear that the causes of extinction of previous populations have now been removed and that it is unlikely that populations could be restored naturally from elsewhere in the river network, then it may be sensible to consider restoring populations of Brook Lampreys. Action: English Nature, Environment Agency.

### 6.4 Advisory

*Action 7: Promote a better understanding of Brook Lampreys and their requirements among the public, especially anglers.*

*Priority: medium*

It is worth emphasising that the Brook Lamprey is a non-parasitic species which is beneficial to the ecology of rivers, both in helping to stabilise

and aerate silt beds and providing food for other wildlife, including birds and mammals. Action: English Nature, Environment Agency, NGOs.

### 6.5 International

*Action 8: Promote European cooperation on research, survey and conservation of the Brook Lamprey.*

*Priority: high*

Britain has an important role to play in the conservation of Brook Lamprey in Europe and it is essential that a coordinated approach is taken across its area of distribution. Action: English Nature, JNCC.

### 6.6 Future research and monitoring

*Action 9: Give support to survey work to establish in detail the current status and distribution of the Brook lamprey in England.*

*Priority: high*

It is of obvious importance to understand fully the present status of this species as a basis for any future conservation management strategy. Action: English Nature, Environment Agency, JNCC, NERC.

*Action 10: Give support to research on the ecology of this species, especially factors affecting larval and adult migration.*

*Priority: high*

Though this species has been studied more often than the previous two and a number of publications is available (e.g. Hardisty 1944, 1961a, 1961b, Huggins & Thompson 1970) further research is needed, especially on larval habitat and factors affecting adult migration. Action: English Nature, Environment Agency, NERC.

*Action 11: A long-term monitoring programme should be planned and implemented.*

*Priority: high*

It is essential to establish baseline data in a number of key river systems so that the status of this species in England can be followed in a scientific manner, using a 5-year rolling programme. Standard techniques for this species are available (Maitland 1980, Schoonoord & Maitland 1983, Morris & Maitland 1987) and these differ from those of normal fish surveys. Action: English Nature, Environment Agency.

### 6.7 Communications and publicity

*Action 12: Promote an understanding of lampreys and their conservation requirements among the general public - especially anglers.*

*Priority: medium*

There is a general lack of understanding of lampreys among the general public, perhaps especially among anglers, most of whom regard all lampreys as pest species. Action: English Nature, Environment Agency, NGOs.

## 7. ACTION PLAN REVIEW

This Action Plan should be reviewed and revised every five years from its inception.

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# PART 5 INSECTS

5.1 Management guidelines for the Norfolk hawker dragonfly

5.2 Management guidelines for the downy emerald dragonfly

5.3 Management guidelines for the scarce chaser dragonfly

5.4 Management guidelines for the southern damselfly

5.5 Management guidelines for the scarce blue-tailed damselfly

5.6 Management guidelines for the scarce emerald damselfly

# ENVIRONMENT AGENCY SPECIES MANAGEMENT GUIDELINES

## NORFOLK HAWKER - *Anaciaeshna isosceles* (Müller 1767)

Dr Pamela Taylor
Dr Norman W. Moore
Mrs Jill Silsby

British Dragonfly Society
June 1996

## 1. STATEMENT OF USE

*Anaciaeshna isosceles* is a rare species intimately associated with the aquatic environment, and has been selected as a priority species for conservation action by the Environment Agency. These management guidelines have been developed to assist in the targeted implementation of appropriate management and protection measures for the maintenance, enhancement and creation of *A. isosceles* populations. They are for use by Agency staff across all Functions and for distribution to third parties who are in a position to implement such measures in suitable areas (i.e. in localities that are known to, or could, support the species).

## 2. DISTRIBUTION

**a.** Worldwide. The Norfolk hawker is basically a Mediterranean species, widely distributed in lowland areas of North Africa and southern and central Europe. It is absent from Scandinavia, apart from Gotland.

**b.** In Britain it is confined to the Fens and grazing marshes of the Broadlands of Norfolk and north-east Suffolk. It breeds regularly at Castle Marshes (TM 47 91) on the southern edge of its range; Mendel (1992) believes that it breeds regularly on many other River Waveney grazing marshes. Formerly it occurred in the Cambridgeshire fens including Whittlesey Mere before it was drained in 1850. (Lucas 1900, Longfield 1937).

## 3. STATUS

*A. isosceles* is listed under category 1 (endangered) in the British Red Data Books on Insects and is legally protected under Schedule 5 of the Wildlife and Countryside Act, 1981. The species has never been common in Britain although in the early 1900s it was found to be locally plentiful in parts of the Norfolk Broads; the number of colonies then declined during the middle part of the century. Changes in agricultural practice and increasing pollutant inputs from both domestic sources and agriculture were almost certainly the cause of its decline. Partly due to protection of grazing marshes by governmental measures, the species appears to be recolonising some of its old broadland haunts and, since many of these are already protected in nature reserves, it is hoped they will provide suitable habitats for the hawker's continuing survival.

A survey of Norfolk dragonflies by Irwin and Milford in 1990 (reported in the Transactions of the Norfolk and Norwich Naturalists' Society) found a general decline in the quality of the vegetation in dykes, indicating a movement towards eutrophication, which must give cause for concern. Since this occurred in dykes mainly within the Norfolk Broads Environmentally Sensitive Area (ESA) where traditional management and water levels have to be maintained, the suggestion is that poorer quality water is flowing into such dykes from intensively farmed non-ESA land outside (Driscoll, 1995).

At Ludham Marshes NNR (TG 3917), a survey of *A. isosceles* for English Nature has been carried out at two-yearly intervals since 1989. Counts of adults totalled 74 in 1989, 76 in 1991, 86 in 1993 but only 40 in July 1995. This fall in numbers is attributed to saline water overflowing from the adjoining tidal river during the winter of 1993/94. At that time most of the reserve was apparently flooded and, in the 1995 survey, the western part of the area contained only 10% of its usual population. These findings emphasise the vulnerability of the Norfolk Hawker even at sites where it is protected.

## 4. RECOGNITION

The Norfolk hawker is one of Britain's two brown hawker dragonflies. It can be separated from the commoner brown hawker (*A. grandis*) by its clear, untinted wings and green eyes (NB the wings of some specimens at Upton Broad do have a pale gingery tint). Larvae are typically aeshnid, with large eyes. Separation from other members of the family requires close examination.

C.O.Hammond (1983) provides a useful guide to the identification of adult and larval stages.

## 5. HABITAT REQUIREMENTS

### 5.1 Physical requirements

The Norfolk hawker is characteristically a species of fen and grazing marsh dyke systems in broadland. Water bodies (mainly dykes but, in a few instances, small turf ponds) should contain water soldier (*Stratiotes aloides*) among the floating vegetation. The reason for the importance of Water soldier in England is not understood. In many breeding sites outside Britain, the plant is not present. (Leyshon and Moore 1993). It is not known whether both water soldier and *A. isosceles* merely require the same physico-chemical habitat or whether in England *A. isosceles* depends upon water soldier in some way.

Both the Norfolk hawker and *S. aloides* appear to prefer dykes that branch off the main system or those that have dead ends so that the flow rate within them is reduced. Female Norfolk hawkers are known to oviposit into water soldier leaves, but they also do so into floating plant debris. The eggs hatch in about three to four weeks and the larvae take two years to develop. It is thought that larvae survive best in association with water soldier. Adults generally emerge on water soldier leaves (Leyshon and Moore, 1993) but other emergent vegetation (such as rushes) may also be used.

Trees and bushes are needed in the vicinity of breeding dykes so that the species has sheltered hunting routes and resting places during bad weather and during the night hours. Water bodies should have rushes or flags at their edges to provide shelter and for daytime resting places. *A. isosceles* hawks less and settles more frequently than other hawkers (Askew, 1988), and

consequently territorial males have a higher population density than other aeshnids (Merritt *et al.* 1996).

## 5.2 Water quality requirements

Water of high quality appears to be of vital importance to *S. aloides* and to *A. isosceles*: as a general rule, if *S. aloides* is present so is *A. isosceles*. The eutrophication of rivers and broads from agricultural run-off and sewage effluent has degraded much of Broadland. *A. isosceles* does not seem to tolerate eutrophic water in Britain but the mechanism of effect is unclear. Given the association of the species with *S. Aloides*, any effect of enrichment on the competitive ability of the plant may have consequences for the Norfolk hawker. Water quality problems are confounded by: (a) the conversion of pasture to arable farming and the consequent loss of traditional benign dyke management techniques; and (b) the lowering of the water table (Merritt *et al*, 1996), such that it is difficult to disentangle the effects of any one factor.

## 5.3 Summary of main habitat requirements

Unspoilt dyke systems in grazing marsh, with high quality (not enriched), non-saline water, rushy margins and an abundance of water soldier, often accompanied by other aquatic species, appear to provide the essential conditions for breeding.

# 6. CURRENT THREATS

a) Conversion of grazing marsh to arable farming.

b) Inappropriate ditch management.

c) Excessive nutrient enrichment of breeding habitat from agricultural run-off and domestic sources.

d) Toxic inputs from agriculture (pesticides), industry and road-run-off.

e) Penetration of saltwater into grazing marshes.

# 7. MANAGEMENT

a) The dykes and similar water bodies containing breeding Norfolk hawkers will have to be cleared periodically, but it is important to undertake this on a rotational basis so that there are always undisturbed areas with suitable vegetation for refuge. In addition, care must be taken to avoid restriction of water flow; if practicable, alternate banks should be cleared in different years, so leaving a reservoir of larvae and, at the same time, maintaining the water flow. *S. aloides* is a dominant plant when conditions are right and, under these circumstances, it will prevent further succession occurring in the dykes where it reaches dominance. Too frequent dyke clearance (every 3 or 4 years) does not allow *S. aloides* to reach dominance. A longer term management regime could therefore help, but not so long as to allow the dyke to become choked. In all cases emergent vegetation encroaching from the dyke banks may have to be controlled. If feasible,

cleared out material should be allowed to drain on the bank before total removal from the site, in order to allow evicted larvae to make their way back to the water.

b) Although trees and hedges are required in the vicinity, judicious lopping of overhanging branches is recommended when most of the dyke is shaded for at least part of the day.

c) Conversion of neighbouring land from grazing marsh to arable use may be detrimental to existing populations and the chances of establishing new populations. Every effort should therefore be made to maintain land under a system of extensive grazing in areas where the species is present or suspected, or adjacent to such areas.

*d)* The introduction of *S. aloides* to dykes in the vicinity of those already hosting the Norfolk Hawker could well increase the number of colonies. This should only be done in dykes shown to be suitable for the plant, since *S. aloides* is itself a rare species and protected by law. *Permission will be required from English Nature to do such work.*

e) ANY action that minimises the seepage of saline water into dykes where the Norfolk hawker is known to breed is to be encouraged although, in years of severe flooding, successful action is likely to be very limited.

f) Steps should be taken to ensure that nutrient enrichment of any dyke systems supporting, or otherwise capable of supporting, *A. isosceles* does not occur.

g) Translocation is not appropriate within the Broadlands area, as the species has good powers of dispersal and is likely to colonise suitable habitat unaided. However, if it were decided to re-introduce the species into the Cambridgeshire Fens, translocation could be considered after consultation with English Nature. *S. aloides* is now extinct in the fens and it would probably be necessary to get it established there before the re-introduction of *A. isosceles* was attempted.

## 8. RECORDING AND MONITORING

It is vital to try and confirm whether the species is breeding at known sites and to keep watchful eyes on similar sites in the area. Exuviae searches (during June) in grazing and fen dyke systems within and adjacent to the current known distribution are an effective way of surveying and gaining proof of breeding. Almost all current Norfolk records lie within the broadland region to the south of Stalham and to the east of Wroxham; Suffolk sites are known from the grazing marshes in the north-east of the county.

Details of confirmed sightings should be sent to the Biological Records Centre through the Odonata Recording Scheme (ORS), particularly if the site is likely to be previously unknown. The minimum information required is the date of observation, name of location, grid reference, and any proof of breeding (oviposition, pairs mating or flying in tandem, or the presence of larvae or exuviae). Targeted searching for larvae is not recommended for this species due to its status under the Wildlife and Countryside Act; where it is necessary to study larvae English Nature should be contacted. Records should be sent to the ORS coordinator at BRC, ITE Monkswood.

Advice on the monitoring of dragonfly populations, for assessing changes in population size, has been given by Moore and Corbet (1990) and Brooks (1993).

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# ENVIRONMENT AGENCY SPECIES MANAGEMENT GUIDELINES

## DOWNY EMERALD - *Cordulia aenea* L. 1758

Stephen J. Brooks
Dr Norman W. Moore
Mrs Jill Silsby

British Dragonfly Society
June 1996

## 1. STATEMENT OF USE

*Cordulia aenea* is a scarce species intimately associated with the aquatic environment, and has been selected as a priority species for conservation action by the Environment Agency. These management guidelines have been developed to assist in the targeted implementation of appropriate management and protection measures for the maintenance, enhancement and creation of *C. aenea* populations. They are for use by Agency staff across all Functions and for distribution to third parties who are in a position to implement such measures in suitable areas (i.e. in localities that are known to, or could, support the species).

## 2. DISTRIBUTION

**a.** Worldwide. The range of the downy emerald extends over northern and central Europe, east through Russia to Japan where the nominate species is replaced by the sub-species *C.a.amurensis* Selys, 1887. In southern Europe it is restricted to montane areas but is absent from the Iberian peninsula, most of the Mediterranean and much of northern Scandinavia.

**b.** In Britain the species is locally common in south-east England, especially on the wooded heaths of Surrey, Berkshire, Essex, Sussex, Hampshire and the New Forest. It also occurs in a few localities in Dorset and south Devon, the area around the Bristol Channel, Cheshire, Norfolk, Cumbria and north-west Scotland (Merritt *et al*, 1996).

## 3. STATUS

This species is "nationally scarce" according to the British Red Data Book on Insects. It is locally common and apparently holding its own in most regions, though it was once more widespread in East Anglia. There are pre-1960 records for the species from the Norfolk Broads and from Suffolk but the only current East Anglian record is from a site in Norfolk. There is further evidence for decline from the Shropshire/Cheshire meres and the Hertfordshire/Essex border. *Adults are apparently poor at dispersing so the species will not readily re-colonise sites from which it has been lost or sites which become suitable for the species.*

## 4. RECOGNITION

The downy emerald has a shiny copper-coloured body and very noticeable bright green eyes. It patrols the edges of water bodies with a characteristic rapid flight, interspersed with fairly prolonged periods of hovering. In flight, the tip of the abdomen is held slightly higher than the thorax which gives them a unique appearance. Larvae can be distinguished by their rounded abdomens and long, striped, cream and dark brown legs.

C.O. Hammond provides a good guide to the identification of both adult and larval stages.

## 5. HABITAT REQUIREMENTS

### 5.1 Physical requirements

Ancient, deciduous woodland (not coniferous woodland) is extremely important for this species. The downy emerald shows a distinct preference for still-water habitat (particularly ponds and, to a lesser extent, canals). All records relating to this species from flowing water sites are non-breeding casuals. (Cham, *et al*, 1995). Water bodies containing breeding colonies of downy emerald are almost invariably in or close to areas of deciduous woodland. Females oviposit in flight, by repeatedly dipping the tip of the abdomen into the water. They avoid shady sites, preferring sunny or dappled shade areas. About ten eggs are released with each dip: these are gelatinous and stick to submerged vegetation. They soon hatch and the larvae, which live amongst leaf-litter on the pond bed, take two to three years to develop. They probably feed on water hog-lice (*Asellus*), alderfly larvae (*Sialis*) and oligochaete and chironomid larvae which are all common in this type of habitat. Bankside plants and trees are necessary as emergence supports and to provide the all-important carpet of leaf litter.

Males patrol small sunny bays at the pond margin and avoid heavy tree shade or dense emergent vegetation. Adults feed, roost and mate in the tree canopy and in woodland clearings away from the pond.

### 5.2 Water quality requirements

Larvae are known to occur in water ranging from pH 4.5 to 7.5. The species appears to be restricted to fairly oligotrophic waters but this requirement has not been extensively studied throughout its British range. Eutrophication of sites in the Norfolk Broads could be the reason for its decline in that region.

### 5.3 Summary of main habitat requirements

A pond within deciduous woodland, or in close proximity to such, with scattered bankside trees, sparse stands of emergent vegetation and with a carpet of leaf litter on the pond floor will offer the best conditions for breeding.

## 6. CURRENT THREATS

a) Loss of woodland ponds, together with loss and fragmentation of deciduous woodland are probably the major threats.

b) Stickleback are predatory and feed by pecking amongst the substrate, therefore early instar larvae are at risk in ponds with high densities of stickleback.

c) Ponds with large populations of wildfowl are likely to be unsuitable due to eutrophication of the water.

d) Since the species is largely restricted to woodland, grazing is unlikely to be influential. However, if present, nutrient enrichment of the water body from livestock may be a problem.

e) Acidification is unlikely to be a threat unless very low pH prevails. The species is able to tolerate fairly acidic waters.

f) The species has a 2-3 year development period, so seasonal drying of the water body will exterminate the population. Over-abstraction may thus be a problem.

g) Dense beds of emergent plants will deter the species, but sparse stands are desirable as oviposition sites and for delimiting male patrol areas.

h) Dense tree shade will deter the species, but scattered bankside trees, at least some of large size to provide plenty of leaf litter throughout the pond, are essential.

i) Dredging the pond will eliminate the larval habitat and is known to have exterminated the species from a number of sites.

## 7. MANAGEMENT

1. Over-management (i.e. excessive removal of aquatic and bankside plants or dredging an entire pond) is likely to be detrimental: see particularly (i) above. Since the Downy Emerald is poor at dispersing, a site is unlikely to be recolonised, in the short term, following the elimination of a population through poor management practices.

2. Provision of leaf litter, bankside trees and emergent plants should be ensured at all times. Submerged aquatics seem to play no part in any stage of the life history. In fact some of the Epping Forest ponds are apparently unsuitable because they have too many submerged plants.

3. If clearance is essential, no more than a third of the pond bed containing leaf litter should be dredged at one time. Areas of bare substrate or areas under heavy shade are less likely to contain larvae so could be cleared without a negative impact.

4. Any activity that results in reduced water levels in the pond, such as abstraction, diversion or drainage, should be avoided.

5. Where shading by bankside trees is becoming too intense, pruning of over-hanging boughs should be considered so that patches of sun can reach the water's surface.

6. Thinning of dense beds of emergent vegetation may be necessary to improve oviposition sites.

7. Feeding of wildfowl by the general public should be discouraged in order to avoid nutrient enrichment.

8. Stickleback can be controlled by introducing predatory fish such as pike or perch.

9. Translocation could be a sensible option in some instances, considering the poor dispersive abilities of adults. It is probably unnecessary in most places but could be considered for East Anglia where it was once more widespread, provided suitable oligotrophic sites were still available.

## 8. RECORDING AND MONITORING

It is vital to try and confirm whether the species is breeding at a known site and to keep watchful eyes on similar sites in the area. Presence of males is no indication of breeding: a few hopeful males are usually present at satellite ponds away from the main breeding site. Larvae can be very difficult to find, so their apparent absence should not be taken as an indication of absence of the species. *Presence of exuviae is the only sure indication of a breeding site* and, for the downy emerald, these are best looked for from the first to third week in May. Details of confirmed sightings should be sent to the Biological Records Centre through the Odonata Recording Scheme (ORS), particularly if the site is likely to be previously unknown. The minimum information required is the date of observation, name of location, grid reference, and any proof of breeding (oviposition, pairs mating or flying in tandem, or the presence of larvae or exuviae). Records should be sent to the ORS coordinator at BRC, ITE Monkswood.

Advice on the monitoring of dragonfly populations, for assessing changes in population size, has been given by Moore and Corbet (1990) and Brooks (1993). Population estimates of *C.aenea* however can only be done satisfactorily by exuvial counts. A census of adults or even mark/recapture will produce drastic underestimates because of the habit of each adult spending only a short period at a particular pond. When carrying out an exuvial count, it is important to remove the exuviae after each day's counting.

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# ENVIRONMENT AGENCY SPECIES MANAGEMENT GUIDELINES

## SCARCE CHASER- *Libellula fulva* Müller, 1764

David C. Winsland
Dr Norman W. Moore
Mrs Jill Silsby

British Dragonfly Society
June 1996

## 1. STATEMENT OF USE

*Libellula fulva* is a scarce species intimately associated with the aquatic environment, and has been selected as a priority species for conservation action by the Environment Agency. These management guidelines have been developed to assist in the targeted implementation of appropriate management and protection measures for the maintenance, enhancement and creation of *L. fulva* populations. They are for use by Agency staff across all Functions and for distribution to third parties who are in a position to implement such measures in suitable areas (i.e. in localities that are known to, or could, support the species).

## 2. DISTRIBUTION

**a.** Worldwide. The scarce chaser is a European species, recorded from southern France to northern Germany and across central Europe to Russia. Throughout its range it has a somewhat discontinuous distribution and, in all places, it can be considered rare to scarce.

**b.** In Britain, it is restricted to a few localities within six broad areas: the Bristol Avon (three 10km squares); the River Arun in Sussex (four 10km sq.); the Great Ouse and Nene and associated dykes in Cambridgeshire (seven 10km sq.); the Rivers Yare/Waveney in Norfolk and Waveney in Suffolk (six 10km sq.); the Rivers Frome, Stour, Moors and the Hampshire Avon in Dorset (eight 10km sq.) and the North Stream and associated ditches in Kent. (Merritt *et al*, 1996)

## 3. STATUS

*L. fulva* is listed under category 3 (scarce) in the British Red Data Books on Insects. It is a local species which can be abundant in preferred localities. Subjective evidence indicates the following:

**Bristol Avon** - it may be extending its range southerly.

**Arun** - stable.

**Great Ouse** - stable on river and extending onto disused gravel workings as they become habitable. It is also stable on some large dykes in the Cambridgeshire Fens.

**Norfolk/Suffolk** - in Norfolk it is no longer found on the R. Ant where it occurred in two 10km sq. prior to 1980. Elsewhere stable.

**Dorset** - stable with the possible exception of the Moors River where a current decline is indicated. On the Hampshire Avon the species is restricted, in the main, to backwaters although a few males may be seen on the main river.

## 4. RECOGNITION

The scarce chaser is one of Britain's four libellulids in which mature males exhibit a blue pruinescence on the abdomen: in this species only segments 3-7 become blue, the base and tip of the abdomen being black. In addition, at the base of the hind-wings there is a dark triangular patch. The combination of these dark areas helps to separate the male scarce chaser from the other three species. The yellowish females differ from the other three in that they bear small smoky patches at the tips of all wings.

*L.fulva* larvae cannot be confused with any other species frequenting its known habitat. Prominent dorsal spines are clearly visible to the naked eye even when the larva is wet, whereas those on closely related species are not.

C.O. Hammond provides a useful guide to the identification of both adult and larval stages.

## 5. HABITAT REQUIREMENTS

### 5.1 Physical requirements

The scarce chaser inhabits lowland rivers (and their backwaters), streams, dykes and some gravel pits in flood plain localities. Their preferred habitat is for meandering waters of low velocity, mesotrophic to eutrophic in nature with a high density of emergent bankside vegetation. In addition, some shrub-type vegetation is generally present nearby - the species appears to be rather intolerant of exposure to wind. Adjacent woodland is also used for maturation, roosting and feeding.

Larvae tend to congregate amongst the detritus in areas of low water velocity, in the lee of bends and amongst the roots of aquatic plants. They usually take two years to develop before emerging during the latter part of May, on sturdy bankside emergent vegetation such as *Phragmites communis, Typha spp., Sparganium erectum, Schoenoplectus lacustris* and, to a lesser extent, *Iris pseudacorus*. They climb between 0.5 - 1m, seldom moving far into the bankside vegetation. Plants such as these are an essential habitat component for all life stages, with the root systems providing niches to harbour the developing larvae while the plants themselves provide shelter and emerging/basking/vantage points for the adults. *Sagittaria, Potamogeton, Mentha* etc. are more of an indirect benefit in providing suitable breeding and development habitats for prey species (Winsland, 1996).

After the maiden flight, some hours may be spent basking upon tall vegetation such as umbellifers and nettles which are close to the emergence site. After this initial period, they fly up into the

tree/shrub canopy where they may spend the bulk of their maturation period; some do not appear to stray far from their emergence sites, others move considerable distances.

Copulation between adults can be prolonged, and culminates in the female egg-laying alone. She chooses areas of clear water into which she dips the end of her abdomen, washing off the eggs which, being sticky, then adhere to the substrate.

It should be stressed that the balance between adequate shrub/tree cover and its shading effect upon the water is extremely delicate.

## 5.2 Water Quality requirements

Larvae are known to occupy sluggish water with a pH range of between 7.0 and 8.0 and with a high base status. It is more tolerant of pollution than some other species such as *Platycnemis pennipes* which breeds in similar habitats. At one site in the 1980s, a population survived a high level of lindane contamination.

## 5.3 Summary of main habitat requirements

Large dykes and sluggish, meandering, deep rivers; adequate emergent vegetation; some aquatic vegetation (submerged and floating species) and a certain amount of shrub or tree shelter.

## 6. CURRENT THREATS

a) Major river works which fundamentally alter the hydrological nature of the river. This may lead to excessive scouring of the bed, a loss of bankside vegetation and subsequently to a single habitat type bereft of additional ecological niches.

b) Over-abstraction of water by water companies and other licensed users for industrial, domestic or agricultural purposes may result in a lower dilution of harmful effluents and also lower oxygen levels.

c) Polluting inputs from domestic sources and industry, in the form of organic pollution and toxic chemicals.

d) Contamination from agricultural sources in the form of nutrients and pesticides, which may lead to excessive higher plant growth, algal problems or direct toxicity.

e) Excessive boat traffic (in areas where boating occurs), causing turbulence and sediment resuspension which have consequences for the growth of both emergent and submerged vegetation.

f) Over shading of breeding areas by trees. This has been observed in one site in Dorset.

## 7. MANAGEMENT SUGGESTIONS

It is difficult to explain the patchy distribution of *L. fulva* on the basis of current knowledge, and therefore guidance on appropriate management is inevitably limited. However, it is known that the species has need of lowland rivers and dykes with good water quality, open areas of water with low current velocities, sufficient emergent and aquatic vegetation, and adjacent areas of scrub or trees which do not unduly shade the water. In localities where the species occurs and thrives, it is of vital importance that conditions do not deteriorate from their current levels in relation to the threats listed above. If conditions could be improved with respect to these threats, the species should return to sites from which it has been exterminated.

a) River engineering operations should provide for areas of low current velocity in the channel, within which there should be emergent bankside vegetation and patches of open water for oviposition. Continuity of the preferred habitat is required in all localities where the species occurs or may occur.

b) Scrub and trees should be managed as discreet clumps and at no time should shading exceed 50% of water between 11.00 - 16.00 hours during the period from May to July.

c) Where dredging or weed-cutting is a management requirement in rivers, this should be undertaken selectively to avoid extensive disruption to long stretches of watercourse. Ideally, no more than a third of the area of a given habitat should be covered in any one year.

d) In dykes where the species occurs or may occur, rotational management will be required in order to provide areas of open water for oviposition and emergent vegetation for larval refuge and emergence supports. Again, no more than a third of the available habitat should be cleared in any one year.

e) Water quality (in terms of nutrient enrichment, organic pollution and toxicity) should not be allowed to deteriorate from its presence state in habitats supporting the species.

f) Wherever possible, boating activity should be controlled in terms of intensity and speed in order to avoid extensive disruption to larval habitats.

g) The scarce chaser disperses widely in the immature stage and is not yet sufficiently endangered to require translocation. Provided that its current localities are adequately safeguarded in the future, it is expected to maintain its local abundance. Better water management could enable it to return to sites from which it has disappeared.

## 8. RECORDING AND MONITORING

It is vital to try and confirm whether the species is breeding at a known site and to keep watchful eyes on similar sites in the area. The accepted method of obtaining proof of breeding is inappropriate for the scarce chaser, since exuviae are difficult to find. Following mass emergences, the counting of immature adults (whose abdomens of bright orange with black markings are very conspicuous) is a simple task. A careful lookout, during the latter part of May and early June of all areas where the suggested typical habitat occurs could lead to the discovery of new localities.

Details of confirmed sightings should be sent to the Biological Records Centre through the Odonata Recording Scheme (ORS), particularly if the site is likely to be previously unknown. The minimum information required is the date of observation, name of location, grid reference, and any proof of breeding (oviposition, pairs mating or flying in tandem, or the presence of larvae or exuviae). Records should be sent to the ORS coordinator at BRC, ITE Monkswood.

Advice on the monitoring of dragonfly populations, for assessing changes in population size, has been given by Moore and Corbet (1990) and Brooks (1993).

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# ENVIRONMENT AGENCY SPECIES MANAGEMENT GUIDELINES

## SOUTHERN DAMSELFLY - *Coenagrion mercuriale* (Charpentier) 1840

Dr Derek K. Jenkins
Prof Michael J. Parr
Dr Norman W. Moore
Mrs Jill Silsby

British Dragonfly Society
June 1996

## 1. STATEMENT OF USE

*Coenagrion mercuriale* is an internationally threatened species that is intimately associated with the aquatic environment, and has been selected as a priority species for conservation action by the Environment Agency. These management guidelines have been developed to assist in the targeted implementation of appropriate management and protection measures for the maintenance, enhancement and creation of *C. mercuriale* populations. They are for use by Agency staff across all Functions and for distribution to third parties who are in a position to implement such measures in suitable areas (i.e. in localities that are known to, or could, support the species).

## 2. DISTRIBUTION

**a.** Worldwide. Threatened throughout most of its range, this small blue and black damselfly is centred on south-west Europe (Italy, southern France, the Iberian peninsula) and North Africa and it becomes increasingly rare the further north it penetrates.

**b.** In Britain, where it is confined to a few sites in southern and western counties of England and Wales, *C. mercuriale* is at the extreme northern limit of its range. (Merritt *et al*, 1996)

## 3. STATUS

*C. mercuriale* is listed in the EC 'Habitats and Species' Directive, the Appendices to the Berne Convention and the 'short' list of the UK Biodiversity Steering Group report. It is also listed under category 3 (scarce) in the British Red Data Book on Insects. It has disappeared from several localities and is probably still decreasing in numbers. Although, according to Corbet *et al.* (1960), the species once spread as far afield as Cornwall and possibly Norfolk, evidence indicates that it is now confined to the following areas:

**New Forest.** Numbers have declined this century, particularly since the 1950s. It has disappeared from the Ober Water and from Blackwell Common and has suffered a sharp decline at Holmsley, but detailed studies by D.K. Jenkins indicated stable populations during the latter half of the 1980s in the Crockford area and the Forest is still one of its strongholds.

**Itchen and Test Valley.** Some recently discovered colonies on these Hampshire floodplains appear to be thriving.

**Wales.** It appears locally common at a few sites in the Gower Peninsula, Dyfed and Pembrokeshire, particularly at Mynydd Preseli.

**East Devon.** Of several small colonies present on the Pebblebed commons in the 1950s, only two now remain and these have both declined (Colaton Raleigh and Aylesbeare Common). Currently the area is being surveyed by L. Kerry on behalf of English Nature with a view to either reintroduction or management for recovery.

**East Dorset.** Most localities are very small and vulnerable (e.g. Corfe Common, Middlebere, Norden and Creech Heaths) but from none of them has the species actually disappeared. The most important known site in East Dorset (Povington Heath) is probably new or else much enlarged. It is thriving, thanks to sensitive management.

## 4. RECOGNITION

This is the smallest of our blue and black damselflies and it gives a definite appearance of fragility. The black `mercury' mark on the male's second abdominal segment can be useful for identification although its shape does vary; the elongated `spearheads' on segments 3 and 4 are probably more reliable. Female *Coenagrion* species are very similar and difficult to identify. Larvae can be identified by a combination of the unspotted head and short boat-shaped caudal appendages.

C.O. Hammond (1983) provides a useful guide to the identification of both adult and larval stages.

## 5. HABITAT REQUIREMENTS

### 5.1 Physical requirements

These seem to vary in detail from area to area but there are common factors: although *C. mercuriale* is quoted as most numerous on calcareous substrates, particularly on the continent (lime-stone areas of France, Spain), in Britain only the Itchen/Test Valley sites really come into this category. All other British sites are on heathland bogs or valley mires where stream pH varies from just below 6 to around neutral. However, in most cases, the

water is known to arise from deep-lying calcareous formations (e.g. Headon Beds in the south of the New Forest) to give flushes which are less acidic than the general trend for the surrounding area.

Such areas tend to have slightly higher water temperatures in winter and this factor may also be linked to its distribution which indicates a preference for areas of the country with higher winter temperatures.

The southern damselfly is a species of slow-flowing water, generally inhabiting narrow, shallow, well-vegetated runnels on open, flat or gently sloping ground. Larvae are frequently found in seepages and runnels of less than 6cm depth which may be at a little distance from where adults are normally seen.

Low shrubs (particularly *Myrica gale*) and *Juncus* spp. are used for perching and feeding forays. *Potamogeton polygonifolium., Hypericum elodes, Mentha aquatica* and decaying *Juncus* stems are favoured for oviposition. The presence of *Schoenus nigricans* in particular, is a good indicator of the more basic conditions in which the species occurs.

Stream bottoms are mainly silt layers over gravel, gravel alone or, very rarely, deeper mud. *C. mercuriale* does not thrive where even one bank is shaded by tall vegetation but it manages well in exposed and windy situations and is often observed at water under weather conditions dull enough to deter all other Odonata.

## 5.2 Water quality

The water quality requirements of the *C. mercuriale* are poorly understood, although most extant sites appear to have water of good quality. The species is able to breed in relatively acidic water with low nutrient status, but seems to require some calcareous influence and also inhabitats ditches adjacent to chalk streams that are of a higher (natural) trophic status. Given the apparent high quality of known sites and the lack of knowledge concerning the tolerance to nutrient enrichment, organic pollution, heavy metals and synthetic chemicals, it must be assumed that there is a risk to existing populations from any deterioration in water quality.

## 5.3 Summary of main habitat requirements

Water at breeding sites is usually shallow and slow-flowing, over a gravel or marl bed overlaid in places with organic detritus. In those heathland sites where the species is breeding, the water flowing through has been found to be richer in calcareous bases than is the case with most water found on heaths. Watercourses in some old water meadows may also provide suitable habitats.

## 6. CURRENT THREATS

a) Suitable habitats for this species are small and few and far between; populations of *C. mercuriale* in them are often small too and they may have difficulty in colonising new sites, or recolonising old ones, if they are far from the sites where the species still occurs.

b) A few small colonies have been lost in unusually dry summers but, in most sites, there are sufficient reserves of water in the bogs and mires in which the species occurs.

c) Predation by birds (stonechats) has been reported as a major problem at one East Devon site and may possibly occur elsewhere.

d) Problems have occurred where streams have been altered, e.g. by ditching or straightening to improve drainage, thus destroying the habitats on which the species depends.

e) According to a study by Evans (1989), the biggest threat is often the cessation or reduction of grazing/trampling by stock animals, which has had two consequences: it has resulted in some of the smaller runnels and streams becoming totally over-grown with rank vegetation; and on others it has allowed scrub (*Myrica, Salix, etc*) to shade out the water.

f) Poor quality run-off from adjacent agricultural land, particularly with respect to nutrients, poses a potential risk.

g) Drainage due to pressures from agriculture and forestry and, in watermeadows, over-abstraction by water companies have resulted in lowering of the water table and drying out of the sites, which can be disastrous for the species.

## 7. MANAGEMENT

a) As with other vulnerable species, the poor colonising ability of *C. mercuriale* may not be due to a lack of dispersal ability (there are conflicts of opinion on this) but to the fact that its habitat range is very narrow. Immature individuals are known to disperse downwind for over ¼ mile but such journeys only rarely end at a suitable site. It is important that any habitat creation that is considered (see (d)) is done in close proximity to existing populations, in order to maximise the chances of natural colonisation.

b) In the lamentably few sites where colonies are still present, it is important, whenever possible, to avoid the ditching, straightening or dredging of streams. It is vital that the locations of existing sites are known to both the Flood Defence Function of the Agency and relevant Internal Drainage Boards, so that they can avoid detrimental activities. Where feasible, opportunities should also be taken to naturalise/restore some of the headwater channels that have been reprofiled in the past. Any rehabilitation measures should aim to produce shallow, slow-flowing and unshaded water with the streambed at

its original (pre-engineering) height in a state suitable for rapid colonisation by aquatic vegetation.

c) Surrounding scrub must not be allowed to shade out the water in sites where *C. mercuriale* occurs. Moderate grazing and trampling by cattle should be encouraged. In some cases (in parts of Wales for example), regular heathland burning can be used to maintain the required open ground. However, areas of coarse vegetation (long meadow grasses) are required for newly-emerged adults to 'harden off' in safety. Management of sites should ensure that such areas are available in close proximity to emergence sites without shading the water surface.

d) The maintenance of stream flows in existing and potential sites is crucial to the sustainability of populations and the scope for future colonisation. Any planned land drainage operations or abstractions in the vicinity of known sites should be appraised for potential effects on *C. mercuriale* habitat.

e) Opportunities to make new habitats for the Southern Damselfly should be considered. For example, where seepages develop in newly made mineral workings in heathland areas, some of them could be managed to provide suitable habitats. Similarly, quite small changes in the management of watercourses in old water meadows in southern England could provide habitats identical to those which already support the species in the area.

*f)* If the species is found to be a poor disperser, translocation should be considered. Captive breeding and release is the most sensible mechanism if new sites or rehabilitated old ones are not colonised naturally. It should be noted, however, that captive breeding is not likely to be a simple exercise and that some work will be needed to develop effective procedures. This is illustrated by the work of Corbet (1955) who bred larvae from one batch of eggs from the Ober Water in order to study details of final instars. Only one larva from an undisclosed number of ova survived to the adult stage. *Sites with only small populations should never be robbed of larvae for translocation purposes as it would impoverish the existing colony*

## 8. RECORDING AND MONITORING

It is vital to try and confirm whether the species is breeding at a known site and to keep watchful eyes on similar sites in the area. Details of confirmed sightings should be sent to the Biological Records Centre through the Odonata Recording Scheme (ORS), particularly if the site is likely to be previously unknown. The minimum information required is the date of observation, name of location, grid reference, and any proof of breeding (oviposition, pairs mating or flying in tandem, or the presence of larvae or exuviae). Records should be sent to the ORS coordinator at BRC, ITE Monkswood.

Advice on the monitoring of dragonfly populations, for assessing changes in population size, has been given by Moore and Corbet (1990) and Brooks (1993).

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# ENVIRONMENT AGENCY SPECIES MANAGEMENT GUIDELINES

# SCARCE BLUE-TAILED DAMSELFLY - *Ischnura pumilio* (Charp.) 1825

Stephen A. Cham
Dr Norman W. Moore
Mrs Jill Silsby

British Dragonfly Society
June 1996

## 1. STATEMENT OF USE

*Ischnura pumilio* is a rare species intimately associated with the aquatic environment, and has been selected as a priority species for conservation action by the Environment Agency. These management guidelines have been developed to assist in the targeted implementation of appropriate management and protection measures for the maintenance, enhancement and creation of *I. pumilio* populations. They are for use by Agency staff across all Functions and for distribution to third parties who are in a position to implement such measures in suitable areas (i.e. in localities that are known to, or could, support the species).

## 2. DISTRIBUTION

**a.** Worldwide. The scarce blue-tailed damselfly is basically a Mediterranean species: it is found from western North Africa, through Europe and the Middle East across to west and central Siberia. In Europe, it is widespread in scattered colonies but most numerous in the south, especially around the Mediterranean.

**b.** In Britain it has a curious distribution. It is most numerous in south-western areas from Hampshire (especially the New Forest) westwards to Cornwall, through Wales as far north as Anglesey. In recent years an increasing number of isolated colonies have been found in Gloucestershire, Wiltshire, Oxfordshire, Berkshire, Buckinghamshire and Bedfordshire, east of the core range. (Merritt *et al.* 1996) Older records from eastern counties such as Norfolk, Cambridgeshire and Essex (where the species is currently unknown) suggest that range expansion occurred in the past and it is probable that unrecorded colonies have come and gone, as habitat conditions fluctuated.

## 3. STATUS

The species is classed as nationally scarce in the British Red Data Book on Insects. At the turn of the century, *I. pumilio* was considered almost extinct in Britain (Lucas, 1900). Current information suggests that it is more widespread now than it has ever been (Fox and Cham, 1994). The reasons for this recent expansion appear largely due to increased mineral extraction, producing the transient

habitats which the species is well adapted to exploit. Despite this increase, it still remains a threatened insect and a clear understanding of its natural history is essential for its conservation.

## 4. RECOGNITION

*I. pumilio* is one of our two black-abdomened damselflies whose bodies are embellished with a small patch of blue near the tip. The males of the more common *I. elegans* are larger and the blue patch covers the top of segment 8, whereas the blue is on segments 8 and 9 in *I. pumilio*. Females are either greeny brown on the thorax or bright orange in the immature *aurantiaca* phase; they do not have blue at the tip of the abdomen.

C.O. Hammond provides a useful guide to the identification of both adult and larval stages.

## 5. HABITAT REQUIREMENTS

### 5.1 Physical requirements

The southern distribution in Britain (which lies towards the northern limit of its range) suggests that *I. pumilio*'s range may be limited by temperature. Wherever it occurs, it favours small areas of shallow water that are often susceptible to drying out. Where it occurs in flowing water, it is only slow-moving and associated with seepages and flushes. These shallow water conditions warm up rapidly during summer and the spring-fed seepages remain ice-free in all but the coldest winters. The openness of vegetation at these sites offers the minimum of shade which may further contribute to warming. Depressions which retain water throughout the summer, such as tractor ruts and culverts amongst gravel workings, offer similar conditions and may also be colonised.

Habitat requirements are not easy to pinpoint. Across its range *I .pumilio* is now known from both 'natural' and 'artificial' habitats. In western Britain where the species is well established, it occurs in natural wetlands such as shallow bog pools and seepages in valley mires. It seems likely that these natural sites have provided the nucleus for dispersal to artificial sites, each with similar micro habitat conditions, in new areas.

In recent decades the scarce blue-tailed damselfly has been reported increasingly from artificial wetlands such as those created by mineral extraction of one kind or another, by quarrying activities for chalk, sand, gravel and limestone and from newly created ponds and ditches. The creation of these man-made sites has provided an opportunity for colonisation of sites previously unavailable. Colonies at some of the new sites tend to be more transient and are more likely to be associated with the early stages of plant succession. Despite the apparent differences between most of these habitat types, the favoured micro-habitat conditions are remarkably common to each site.

*I. pumilio* requires at least some emergent vegetation at breeding sites. Ovipositing females are most often encountered laying eggs into emergent soft-stemmed aquatic plants in shallow water. According to Fox and Cham (1994) the most favoured plants are soft grasses (such as *Glyceria* or *Alopecurus* spp), rushes (especially *Juncus inflexus and J.articulatus*) and spike-rushes (such as *Eleocharis palustris)*. The larvae of *I. pumilio* are generally found in or on silty, muddy sub-strates, either colonised by lower plants or in the early stages of colonisation by higher plants. Various forms of disturbance which perpetuate bare substrates and openness of vegetation appear to sustain the

species. During maturation, adults tend to utilise sheltered areas of vegetation in close proximity to the breeding site.

Since there are pronounced differences in selected habitats between different parts of Britain, they are considered separately below.

In the **New Forest** the shallow, slow-moving flushes that drain the main bogs appear to be the most natural habitat for the species. Flushes and seepages flowing into streams on the Forest's grazed lawns and heaths, kept open by grazing and ditching, are the most favoured habitat. Sporadic ditching activities have in the past resulted in the creation of suitable micro-habitat conditions which have been reflected by increased abundance of *I. pumilio*. Similar micro-habitat is also found around the shallow periphery of ponds kept open by repeated grazing and trampling from livestock.

In **Dorset** the species has been known from the valley mires for many years, yet the creation of quarries, clay and gravel pits, bomb craters and cress beds in the county has enabled it to colonise new habitats. A similar situation is found in **Cornwall**, where it has spread from natural populations in the moorland valleys of Bodmin Moor to colonise man-made sites in the tin-mining and china-clay areas. It is now widely recorded from marshy seepages associated with tin-streaming sites of old mine workings. This is mirrored in **South Wales** where it is most abundant in flushes and seepages arising in the coalfield areas, most likely having been colonised from the nearby upland sites. In **Devon** the clay extraction areas of western Dartmoor harbour the strongest colonies, with smaller ones in the ball clay quarries of the Bovey Basin. These areas have probably been colonised from natural habitat on Dartmoor.

The easterly expansion of its range is almost certainly due to the creation of suitable habitat from quarrying activities. In the **Forest of Dean**, colonies are found in pools, flushes and ditches associated with coal-mining activities. In **Gloucestershire and Wiltshire**, it has been recorded from the Cotswold Water Park in areas of active gravel extraction. Here the habitat conditions are rapidly changing and the species does not persist for more than a few years at any one site. In **Berkshire and Oxfordshire**, it has been found at shallow seepage pools in areas of gravel extraction and a shallow pool in a limestone quarry near Oxford has also been colonised. Further east, in **Buckinghamshire and Bedfordshire**, the species occurs at spring line seepages in chalk quarries.

It should be noted that spring-fed pools and seepages are less likely to dry out in periods of drought and colonies are more likely to persist at such sites.

## 5.2 Water quality

*I. pumilio* generally occurs in waters of high quality over a range of pH values. It can tolerate slightly brackish conditions (Askew 1988). The species favours mineral-enriched water, usually as slow-flowing seepages, runnels and streams, but also as static water in shallow ponds and lakes.

## 5.3 Summary of main habitat requirements

The small-scale nature of the habitat conditions selected by *I. pumilio* are often overlooked even by experienced site managers. Micro-habitat conditions selected are remarkably similar at all sites and a clear understanding of these is important if management is to conserve the species. Shallow, still or slow moving water, muddy, silty substrates and openness of vegetation are the main criteria at *I. pumilio* sites. Habitat disturbance can play a role in maintaining these conditions.

## 6. CURRENT THREATS

a) Drainage operations that divert water away from existing flushes and seepages.

b) Reworking of quarry sites, which threatens several sites, and inappropriate restoration of others will lead to the drying up of seepages and shallow pools.

c) Vegetational succession and the encroachment of invasive plants, if left unmanaged, will lead to loss of colonies.

## 7. MANAGEMENT

a) Habitat disturbance is beneficial to *I. pumilio* and needs to be considered in site management. Grazing of vegetation and trampling in shallow water should be encouraged wherever possible, although not to the extent that fouling of the water with livestock excreta becomes a problem. At quarry sites, the activities of motor vehicles have successfully prevented the encroachment of vegetation and have created water filled wheel tracks for colonisation.

b) Plant succession needs to be suspended at flush and seepage areas, and choking vegetation removed on a regular basis. If grazing is not feasible, cutting is a suitable alternative.

c) The maintenance of soft-stemmed grasses and rushes at an early stage of succession is advantageous for ovipositing females. The conservation of such habitat is also important for a range of other flora and fauna which depend on similar specialised conditions.

d) Drainage operations should not be undertaken that are likely to divert water away from occupied habitats. Similarly, any planned abstractions should be appraised in relation to the likely effects on *I. pumilio* habitat.

e) Patches of coarse, sheltered vegetation (long meadow grasses) should be maintained adjacent to emergence sites in order to provide safe areas in which newly-emerged adults can harden off.

f) The creation of new pools and ponds on bare substrates suitable for colonisation could be attempted. However, because the suitability of new habitat declines, it is important to clear and manage such temporary wetlands on a rotational basis. In particular, it is important to ensure the perpetuation of bare, fine substrates and the restriction of submergent and emergent macrophytes (especially aggressive species such as *Typha latifolia*).

g) Translocation will not normally be applicable since *I. pumilio* is a dispersive species. If new suitable habitats are created it will probably colonise them fairly quickly, especially if they are near existing colonies. However, if it is deemed to be required in special circumstances, it is feasible since S. Cham (unpublished) has shown that small-scale transportation of larvae can result in successful development in a new site.

## 8. RECORDING AND MONITORING

It is vital to try and confirm whether the species is breeding at a known site and to keep watchful eyes on similar sites in the area. Details of confirmed sightings should be sent to the Biological Records Centre through the Odonata Recording Scheme (ORS), particularly if the site is likely to be previously unknown. The minimum information required is the date of observation, name of location, grid reference, and any proof of breeding (oviposition, pairs mating or flying in tandem, or the presence of larvae or exuviae). Records should be sent to the ORS coordinator at BRC, ITE Monkswood.

Advice on the monitoring of dragonfly populations, for assessing changes in population size, has been given by Moore and Corbet (1990) and Brooks (1993). If information on population changes is required, counting males on transects by the water's edge on warm days, within two hours of solar noon, will provide an index that can be useful.

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# ENVIRONMENT AGENCY SPECIES MANAGEMENT GUIDELINES

## SCARCE EMERALD DAMSELFLY - *Lestes dryas* Kirby 1890

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Mrs Jill Silsby

British Dragonfly Society
June 1996

## 1. STATEMENT OF USE

*Lestes dryas* is a rare species intimately associated with the aquatic environment, and has been selected as a priority species for conservation action by the Environment Agency. These management guidelines have been developed to assist in the targeted implementation of appropriate management and protection measures for the maintenance, enhancement and creation of *Lestes dryas* populations. They are for use by Agency staff across all Functions and for distribution to third parties who are in a position to implement such measures in suitable areas (i.e. in localities that are known to, or could, support the species).

## 2. DISTRIBUTION

**a.** Worldwide. The scarce emerald is an holarctic species found in North America and Eurasia. In Europe it is widespread, ranging from Portugal to southern Finland, though it is more local in northern and central parts. It is also present in the Near East and in Japan.

**b.** In Britain it has always been restricted to eastern counties from East Sussex to Yorkshire and it occurs in western and central Ireland. During the 1950s and 1960s, the scarce emerald was lost from many of its known sites in England and, for a period in the 1970s, there were no records at all, although the species was probably overlooked. It was rediscovered in Essex in 1983 (Benton and Payne, 1983) and today there are established populations in the coastal and estuarine marshes of Essex and North Kent, the breckland of Norfolk, and a few scattered colonies elsewhere in East Anglia (Merritt *et al*, 1996).

## 3. STATUS

*L. dryas* is listed under category 2 (vulnerable) in the British Red Data Books on Insects. The "scarce" emerald is well named since it has always been considered a scarce and very local species. In 1980 NCC declared it probably extinct but the spread of records since 1983, when it was rediscovered, is encouraging. It seems likely that colonies will be discovered further afield, within its former range in Kent, E.Sussex and perhaps Cambridgeshire. The species seems out of immediate danger - **but there are no grounds for complacency**. Its recent decline to the point of extinction remains largely unexplained and its present recovery could well be reversed.

## 4. RECOGNITION

*L. dryas* is one of Britain's two clear-winged, metallic green damselflies. Like the much commoner *L.sponsa*, it almost always perches with its wings spread at an angle of 45°. It is not easy to distinguish between the two species: generally speaking, the blue pruinescence of the adult *L. dryas* male extends over the first and part of the second abdominal segment, the metallic green on the abdomen is brighter than on female and the eyes are bright pale blue. The female is more robust than her *sponsa* cousin and the pair of green spots on segment 1 are rectangular (rounded in *L.sponsa*). It is best to examine the anal appendages of males and the ovipositing valves of females to make identification certain.

*Lestes* larvae can be distinguished from those of other damselflies by the structure of the caudal lamellae (appendages at the tip of the abdomen). The secondary `branches' are at right angles to the main `trunk' and do not further branch until close to the edge of the lamella. In other Zygoptera the secondary branches are at an oblique angle to the main trunk and much branched. There is little difference between the two *Lestes* species: caudal lamellae, especially the middle lamella, in *L. dryas* are usually more curved and tapering towards the hind end than in *L. sponsa*. Since distinction is not always obvious and since the two species often fly together, the presence of any *Lestes* larvae in suitable habitats should justify further searches during the flight period of adults.

C.O. Hammond (1983) provides a useful guide to the identification of both adult and larval stages.

## 5. HABITAT REQUIREMENTS

### 5.1 Physical requirements

The species occurs in different habitat types in the two parts of its range. In **Essex and N. Kent**, its strongholds are in coastal and estuarine marshes where it has populations in borrow dykes as well as in ditches and pools in the marshes. A degree of salinity does not have an adverse effect, but the limits of its tolerance in this respect are as yet unknown. These

populations are often extremely localised within a particular site: nearby ditches with apparently suitable requirements are often not colonised, which suggests the species may have quite subtle habitat needs that have so far not been detected by researchers. Typical breeding sites in the marshes are well vegetated, with at least 50% cover of both submerged and emergent plants. Evidence does not suggest a strong dependence on any particular plant, although club-rush and horsetails are often present. **Inland in East Anglia** it sometimes breeds, or bred, in shaded ponds in plantations.

Emergent vegetation is used for shelter by adults, for emergence and for ovipositing. Eggs are inserted into the stems of emergent plants, usually (but not always) above the water level. The species is associated with the later stages of the drying out of water bodies and so is found in very shallow ditches and pools (10-20cm in late May). However, field studies suggest that, though the scarce emerald is unusual among Odonata in being able to survive under such conditions, the larvae are actually more common in deeper ditches. It seems possible that what appear to be habitat requirements for *L. dryas* are actually conditions that eliminate its competitors or predators. Further research is needed to ascertain food-preferences of larvae and also their vulnerability to predation.

What is known of the life history of the species suggests that it is vulnerable to the drying out of its breeding sites between December and June, especially towards the end of the period when the larvae are developing rapidly. However, they are adapted to withstand drying out during summer.

## 5.2 Water quality

*L. dryas* larvae are clearly tolerant of a degree of salinity. In Essex and Kent today, the species appears to be confined to slightly saline sites, but inland in Norfolk it occurs in fresh water. The species also appears to be able to tolerate a wide range of pH.

One area of concern is nutrient and other chemical run-off from agriculture. In North Essex, *L. dryas* seems to be confined to large grazing marshes which have been saved from conversion to arable by their conservation status or alternative (e.g. MoD) use. It would appear (Benton 1988) that the same is true of the Thames estuary populations but systematic research is needed to determine whether the species is able to maintain viable populations alongside marshes after conversion to arable.

## 5.3 Summary of main habitat requirements

Today the species is mainly found in well-vegetated and slightly saline borrow dykes, ditches and ponds near the sea. Inland, it occurs in well-vegetated ponds and, in the past, well vegetated ditches. Some, but not all, inland sites are/were ponds in woods.

# 6. CURRENT THREATS

a) Several sites along the Thames estuary are threatened by development.

b) Lowering of water tables - the contraction of this damselfly's breeding range has been associated with agricultural activity which has resulted in lower water tables during periods of drought and the destruction of marshy habitat (Moore 1980).

c) Lack of ditch management, leading to complete drying out, especially if combined with lowered water levels for reasons given under (b).

d) Coastal flooding - including `managed retreat' for coastal protection purposes.

e) Insensitive management of ditches and surrounding habitat.

f) Conversion of marshes to arable farming.

g) Over-grazing by cattle, with associated fouling of water.

h) Reduction in size and fragmentation of habitat - due to its association with ditches in later stages of drying out, the species requires adjacent suitable habitat which can be colonised.

## 7. MANAGEMENT

a) Owing to its association with ditches in the later stages of drying out and, since natural succession is eventually likely to eliminate many sites, other ponds and ditches in the vicinity should be appropriately managed, or even created, for the species to colonise. Management should maintain a mosaic of habitat types, especially those in the later stages of hydroseral development. Since it is not yet clear exactly what its requirements are, large sites, containing many waterbodies, are more likely to accommodate the diversity needed to provide suitable habitat for recolonisation.

b) Conversion of neighbouring land from grazing marsh to arable use may be detrimental to existing populations and the chances of establishing new populations. Every effort should therefore be made to maintain land under a system of extensive grazing in areas where the species is present or suspected, or adjacent to such areas.

c) In general, where the presence of *L. dryas* is known or suspected, any deepening of ditches or clearance of emergent vegetation should be confined to ditches liable to be completely dry (even in winter and spring).

d) Where the species is present and apparently thriving, the existing management regime should be continued, with minimal disturbance.

e) No invasive management of breeding sites should be carried out until recolonisation has been conclusively established nearby.

f) Since it seems likely that populations of *L. dryas* in borrow dykes benefit from shelter provided by rank grasses and rushes growing between the dykes and the sea walls, such sites should not be subjected to grass cutting before the end of August.

g) Wherever possible, grazing should be restricted where it threatens the growth of tall emergent vegetation in ditches. This can be done by: (a) timing, i.e. excluding grazing animals between the end of May and the end of August; and/or (b) fencing stretches of ditches. Heavy grazing may also threaten water quality through nutrient enrichment.

h) The proximity of the species' preferred habitat to the coast makes the species vulnerable to changes in the nature of coastal flood defences. The presence and habitat requirements of the species should be therefore be taken into consideration when planning new defence measures.

i) Translocation is unlikely to succeed as a conservation measure, given our limited knowledge of its seemingly exacting requirements. There is no substitute for the protection and proper management of existing habitats and, where appropriate, the creation of new ones.

## 8. RECORDING AND MONITORING

*L. dryas* is best observed at potential breeding sites during peak flight periods (in July). Adult *L. dryas* are easily overlooked, due to their habit of flying well down among stems and leaves of emergent marginal vegetation. When the two *Lestes* species fly together, provisional discrimination between them can be made on the basis of the slightly larger size and more sturdy appearance of the Scarce Emerald Damselfly.

It is important that the details of confirmed sightings are sent to the Biological Records Centre through the Odonata Recording Scheme (ORS), particularly if the site is likely to be previously unknown. The minimum information required is the date of observation, name of location, grid reference, and any proof of breeding (oviposition, pairs mating or flying in tandem, or the presence of larvae or exuviae). Records should be sent to the ORS coordinator at BRC, ITE Monkswood.

Advice on the monitoring of dragonfly populations, for assessing changes in population size, has been given by Moore and Corbet (1990) and Brooks (1993).

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# PART 6 OTHER INVERTEBRATES

## 6.1 Species Action Plan for the medicinal leech

## 6.2 Species Action Plan for *Pisidium tenuilineatum*

## 6.3 Species Action Plan for *Pseudanodonta complanata*

# SPECIES ACTION PLAN

# MEDICINAL LEECH - *Hirudo medicinalis*

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Produced for English Nature in association with the Environment Agency
and the Countryside Council for Wales

June 1996

# SPECIES ACTION PLAN

## MEDICINAL LEECH - *Hirudo medicinalis*


### Summary

The medicinal leech has been recorded in England from only 16 sites since 1970 and 13 sites since 1980. It is noteworthy that 7 of these sites are confined to a small area of Kent and another 4 sites are in Cumbria. In Wales, there are currently four known sites. The medicinal leech generally lives in ponds and lakes which have areas with elevated summer water temperatures. In addition, the species can only persist at sites which are visited by suitable vertebrate hosts at times when the leeches are actively searching for bloodmeals. The general decline in availability of wetland habitats throughout much of England may have impacted populations of the medicinal leech and its potential hosts.

The main conservation priorities requiring action include:

1) confirming the current distribution of the medicinal leech in England and Wales;

2) provision of appropriate advice to maintain the remaining populations;

3) initiating studies to test:

a) the desirability of establishing satellite populations close to potentially vulnerable sites where the medicinal leech currently occurs.

b) the appropriateness of reintroduction at other suitable localities, to secure the continuing presence of the medicinal leech in England.


## 1. PRIORITY STATEMENT

Though once common and widespread, since 1980 the medicinal leech *Hirudo medicinalis* has been recorded at only 13 locations in England (7 of which are in close proximity) and 4 locations in Wales, and therefore its continued survival in this country is threatened. The status of the medicinal leech is also precarious and declining throughout Europe. Current information suggests that the predominantly small waterbodies where the medicinal leech occurs are potentially vulnerable to changing conditions and some local populations may disappear.

The medicinal leech is protected by inclusion on Schedule 5 of the Wildlife and Countryside Act (1981), and appears in the CITES Listing in Appendix II (1987) - Convention on International Trade in Endangered Species of wild Fauna and Flora. It is listed in Appendix III of the Berne Convention and appears in Annex Va of the Directive on Conservation of Natural

Habitats and Wild Flora and Fauna [EEC, Council Directive 92/43 (1992)]. The medicinal leech is also listed as a priority species by the UK Biodiversity Steering Group, with the result that a UK Species Action Plan has been drawn up (Biodiversity Steering Group UK (1995) ). It was classed as "Rare" in the British Red Data Books (1991). English Nature, the Countryside Council for Wales and the Environment Agency therefore attach a high priority to the conservation of the medicinal leech.

## 2. ACTION PLAN OBJECTIVES

*Objective 1:* *In the short-term, to confirm the present distribution of the medicinal leech in England and Wales by: surveying specific known sites and waterbodies adjacent to where the medicinal leech has been recorded since 1970; and encouraging wider recording of the species by ecologists and natural historians in the field. Additionally, to collate information on site management relevant to the maintenance of the medicinal leech populations at these locations.*

*Objective 2:* *In the medium-term, to monitor annually certain selected populations of the medicinal leech in England and Wales, initially estimating the population sizes and, over time, determine whether its continued presence is under threat. Utilise information on site characteristics and management (Objective 1) to determine/confirm the habitat requirements. Provide site managers/owners with the appropriate management advice required to successfully conserve medicinal leech populations.*

*Objective 3:* *In the long-term, to identify key sites which can be suitably managed to ensure that viable populations of the medicinal leech are maintained in England and Wales. In addition, to assess whether introduction of the medicinal leech to suitable new sites in England, or reintroduction to previously known sites would be appropriate species management measures.*

## 3. LEGAL STATUS

The medicinal leech is a protected species under the following Acts:

Schedule 5 of the UK Wildlife and Countryside Act (1981) - this makes it an offence to kill, injure, take, possess or sell (alive or dead) medicinal leeches from the wild, and to damage, destroy, or obstruct access to their natural habitat. A special licence from the relevant country agency is required for scientific work on this species in the wild.

Appendix II of CITES (1987) - this permits international trade only where the Scientific Authority of the exporting country is satisfied that the trade will not be detrimental to the survival of the species in the wild. Such material to be accompanied by proscribed export permits.

Annex Va of the EEC Council Directive 92/43, 1992 (Habitats Directive on Conservation of Natural Habitats and Wild Flora and Fauna) - this annex relates to 'animals and plant species

of community interest whose taking in the wild and exploitation may be subject to management measures'.

SSSIs - a few sites in England are already designated under the Wildlife and Countryside Act (1981) and the sites are managed to conserve the medicinal leech.

## 4. BIOLOGICAL ASSESSMENT

### 4.1 Introduction

The medicinal leech is a comparatively large leech; when fully extended the actively swimming, mature individuals are several centimetres in length. It occurs primarily in ponds and lakes with prolific marginal vegetation and high summer water temperatures. Access to suitable vertebrate hosts for bloodmeals is necessary. Despite being recorded as common in the 19th Century, in 1910 the medicinal leech was declared extinct in the UK. This was somewhat presumptive as it has been recorded at about 20 locations in England and Wales since 1970 (Appendix I), 7 of which are in very close proximity in Kent (Elliott & Tullett, 1992 and Elliott, JM., pers. com.). The overgrown habitats preferred, cryptic behaviour and comparatively high temperature ranges required to promote conspicuous host searching activity may have led to small populations of the medicinal leech being overlooked. The species has in past centuries been exploited throughout Europe, with an annual trade running into millions of leeches. Over this period it enjoyed widespread medical use in blood-letting. Generally they were collected from the wild and importation to England and Wales occurred from the continent (Wells, Pyle, & Collins, 1983). More recently, **with continued demand for the species (for biochemical extracts)** and declining populations, collection from the wild has become greatly restricted and commercial leech farming is developing (Elliott & Tullett, 1992).

### 4.2 Ecology

The medicinal leech requires comparatively high water temperatures in summer to initiate breeding and individuals can live for up to four years. It may reach maturity in its second, third or fourth year depending on site conditions. Feeding requires active searching for prey and searching behaviour has been recorded between April to mid-October (Wilkin, 1987). The species shows little inclination to move at temperatures below 12°C, whilst 50% become active at 19°C and 90% swim vigorously at about 23°C, particularly in response to water disturbance (Elliott & Tullett, 1986). Records of host selection are based mainly on a few direct observations. However, at two adjacent sites in Kent, blood-meal analysis revealed that frogs are important hosts, with smaller contributions from birds and fish. The presence at these same sites of large numbers of smooth newt (*Triturus vulgaris* L.) corpses with bite scars indicated that they are also preyed upon (Wilkin & Scofield, 1990). The introduced marsh frog (*Rana ridibunda* Pall.) is common at the two Kent sites and its more marked aquatic lifestyle could provide extended opportunities for feeding for the medicinal leech in this situation (Wilkin & Scofield, 1990). The species displays long periods of inactivity between feeding and searching for hosts. Populations at the Kent sites are generally dominated by small, young individuals and these occur in low numbers at most sites where older leeches usually predominate.

Optimum temperature for breeding activity is within the range 25.5-27.5°C, with mating and cocoon production confined to the summer months (Elliott & Tullett, 1992). Sperm can be stored for several months after mating (Wilkin, 1987). Cocoons collected in the wild have contained from 5-15 eggs, whilst in the laboratory up to 30 eggs may be present. The eggs take 4-10 weeks to hatch depending on temperature (published data reviewed by Elliott & Mann, 1979).

Other features of lakes and ponds regarded as important requirements of the medicinal leech include moderately eutrophic conditions with extensive stands of waterplants in a shallow littoral zone (Whitten, 1990; Bratton & Elliott, 1991) and suitable bankside egg-laying sites (Elliott & Tullett,1992). The medicinal leech cocoons are attached to the undersurface of stones or other objects just above the water level at the shoreline, where short-term stability of soil moisture conditions are maintained (Wilkin,1987; Elliott, J.M. pers. com.).

Young medicinal leeches have been reared in captivity from cocoons, using bovine bloodmeals, but establishing continuous laboratory culture can be difficult (Wilkin, 1987) and the optimal field conditions required by young medicinal leeches remain to be established (Elliott & Tullett, 1992). However, commercial farming has been attempted since the mid-19th Century (Sawyer, 1981) and a leech farm was established in Swansea in 1984 (Elliott & Tullett, 1992).

## 4.3 Distribution and population

Wells and co-authors (1983) provided an extensive review of information on the medicinal leech, attributing its current reduced occurrence to over-collection from the wild, changes in farming methods and general loss of marsh habitat. Elliott and Tullett (1992) suggested a reduction in the availability of suitable hosts may exacerbate the problems cited above. The medicinal leech was formerly found widely in Europe, south to the countries bordering the eastern Mediterranean and east to the Ural Mountains (Elliott and Tullett, 1982; Wells *et al*, 1983). The northern limits of its range in Scandinavia may have been influenced by repeated introductions, this century the practice has probably ceased with the rapid decline in the widespread use of the medicinal leech in blood-letting therapy.

Recorded national declines of the medicinal leech are universal throughout its known range. It has not been recorded from Ireland for over 100 years and was temporarily considered extinct in Britain, Holland and Norway, where a few isolated populations now persist (Wells *et al*, 1983). Most records of occurrence in England and Wales result from repeat visits to known sites and chance encounters. The overgrown habitats preferred, cryptic behaviour and comparatively high temperature ranges required to promote conspicuous host searching activity may have led to small populations of the medicinal leech being overlooked.

The medicinal leech was recorded from 7 sites within England by Elliott & Tullett (1982). More recently a sizable but localised population in Kent has been found and studied intensively (Wilkin, 1987). At most other new English locations, only single individuals, or low densities have been recorded (Wilkin, 1987; Guthrie, 1993; Elliott, J.M. pers com; Appendix I). The continued presence of the medicinal leech at many of these sites remains to be established. In Wales, there are historical records from lowland lakes near Brecon, Carmarthen and Brecon, but in recent years the species has been recorded from only three sites on Anglesey and one in Glamorgan (Appendix I). Within England and Wales, around half of the currently known sites

where the medicinal leech occurs are protected, in some way, and therefore the possibility of successfully conserving this species must be high (Elliott & Tullett, 1992). Notwithstanding this, particularly small and locally isolated populations are at risk of becoming extinct, leading to a contraction in the present scattered geographic distribution of the medicinal leech in England. Only one site in England and Wales (and the UK) is known to support substantial numbers of medicinal leeches (6000-12000; Wilkin,1987).

## 4.4 Limiting factors

### *4.4.1 Habitat* *Importance: high*

In England and Wales the medicinal leech requires comparatively high water temperatures to breed successfully. Above average temperatures are associated with shallow water in sheltered localities of ponds and lakes. Such conditions are provided by a well developed marginal zone of aquatic vegetation. The presence of suitable hosts, at appropriate times, within this marginal zone is necessary for successful blood-feeding to occur, and therefore appropriate management of the surrounding land use is also necessary. Shelter from potential predatory fish and birds may be critical. Factors such as the in-filling of small ponds and changes in pond use (eg development of fisheries and irrigation supply, their reduced level of use by farm stock), may result in the habitats becoming unsuitable for the medicinal leech. The general loss, fragmentation and isolation of suitable wetland habitats throughout much of England and Wales will also have been detrimental in the past to the species.

### 4.4.2 *Egg laying substrata and the microhabitats of newly-hatched leeches*

*Importance: to be established*

Egg cocoons are deposited in damp locations under stones or amongst vegetation above the water level at the pond or lake margin. The cocoons may be susceptible to either drying out, if the water level falls, or the development of anoxic conditions if the water level rises markedly during the incubation period. The availability of suitable stones for sheltering cocoons, at the water's edge, may be important (Elliott, pers com).

More information on breeding requirements and the ecology of newly-hatched medicinal leeches is required. Most autecological studies show that the mortality rate during this early phase of an animal's life cycle can be very high and varies between years and between different habitats. The optimum conditions for young medicinal leeches to grow and survive are not known but studies indicate some young are capable of surviving their first winter without feeding (Wilkin, 1987).

### 4.4.3 *Food availability* *Importance:high*

The medicinal leech requires blood-meals from vertebrates. It depends on the presence of suitable hosts when water temperatures are sufficiently high to trigger an active response to the hosts' movements in the water. The recorded declines in amphibians in England may have impacted the medicinal leech populations and their scope for recovery. The relative importance of waterbirds and fish as hosts remain to be established on a wider scale (Wilkin, 1987). Recent work has indicated that mammalian blood may not be required in order for the

medicinal leech to attain maturity (Wilkin, 1987). Survival of the medicinal leech at each site depends on its access to suitable hosts, many of which are impacted directly or indirectly by human activities.

*4.4.4 Water quality* *Importance: medium*

There are few data on the water quality requirements of the medicinal leech (apart from temperature requirements) but water quality will indirectly impact the medicinal leech through habitat availability, influencing the growth of algae and larger waterplants and also the availability of suitable vertebrate hosts. Direct impacts of water quality on egg survival in cocoons may be important.

## 5. RESUME OF CONSERVATION ACTION TO DATE

Internationally the threats to survival of the medicinal leech were highlighted by Sawyer (1981), who recognised the growing industrial demand for hirudin and other useful biochemical extracts. Sawyer called for urgent protection for the species, referring to data compiled for the IUCN Invertebrate Red Data Book (Wells *et al*, 1983). Subsequently, a range of publications and reports have echoed this concern (eg, Elliott & Tullett, 1984, 1992; Wells & Coombes, 1987; Wilkin, 1987; Whitten, 1990; Bratton & Elliott, 1991). The medicinal leech is fully protected in the UK by listing under Schedule 5 of the Wildlife and Countryside Act 1981. However, in a wider context, it is noteworthy that the EEC Council Directive 92/43, 1992 (Directive on Conservation of Natural Habitats and Wild Flora and Fauna, which identifies priority species within Europe) lists the medicinal leech under Annex V ("Animals and plant species of community interest whose taking in the wild and exploitation may be subject to management measures") rather than Annex IV ("...in need of strict protection") (adopted October 1994). In addition, continuing attempts to control the international trade in medicinal leeches collected from the wild [eg, Turkey (Kasparek, 1995)] highlight the persisting danger from over-exploitation of wild stocks.

Within the UK, several sites where it has been recorded in the past have been designated as SSSIs/NNRs or have local Nature Reserve status (Ball, 1994). Active management at known sites in England is thought to be confined to the sites in Kent. In Wales, periodic dredging is undertaken at one site on Anglesey in order to maintain shallow water, with an additional pool being dug recently.

The NGO publication "Biodiversity Challenge" (2nd Edition) (1995) provides a UK-wide summary species action plan for the medicinal leech, which includes proposals to extend protected status to all known sites in which it occurs, re-establish populations at new sites and undertake future research and monitoring.

The UK Biodiversity Action Plan Steering Group (1995) has broadly similar proposals and highlights current action including the designation of 12 sites as SSSIs and the development of species management guidelines for the medicinal leech funded by Scottish Natural Heritage.

## 6. PROPOSED ACTION

### 6.1 Policy and legislation

No action required at this time, the medicinal leech is given complete protection under current legislation.

### 6.2 Site safeguard, land acquisition and management

*Action 1:* *EN/CCW to review the options for effective future conservation of the medicinal leech in England and Wales after a survey to establish more precisely the distribution of the species in England.*

*Priority: high*

Such options might include further SSSI designations, the establishment of new reserves and site management agreements.

### 6.3 Species management, protection and licensing

*Action 2:* *EN/CCW to notify the appropriate site owners and local wildlife trusts of the presence of the medicinal leech, in order that critical habitats are protected from disturbances caused by inappropriate management procedures or the collection of leeches. The vulnerability of particular populations to collectors should be considered before the locations of specific sites are publicised.*

*Priority: medium*

The maintenance of viable medicinal leech populations may require active management with regards to the availability of vertebrate hosts, bearing in mind the recorded declines in amphibians in England and Wales and changing practices in relation to provision of piped water for farm animals. Where geographically isolated and potentially vulnerable populations are present, the possibility of translocation and establishment of satellite populations in suitable locations nearby should be investigated. Similarly, at previously known sites, where the medicinal leech no longer occurs, reintroductions should be considered where appropriate conditions and site management can be maintained.

*Action 3:* *EA to assist with habitat enhancement and creation in the vicinity of known populations where feasible.*

*Priority: medium*

The Agency undertakes extensive engineering works in river corridors and opportunities may arise for targeted habitat management to benefit local populations of medicinal leech. Such work would need to be decided on a case-by-case basis as opportunities arise, but basic

information on the location of known populations and favourable habitat conditions are pre-requisites.

## 6.4 Advisory

*Action 4:* *Information should be provided by EN/CCW/EA to landowners that have the medicinal leech in their waters. This should emphasise the potential vulnerability of the medicinal leech to habitat degradation, the species reliance on continued access to suitable hosts for blood-feeding, and suitable habitat management to maintain viable populations.*

*Priority: high*

Many people with access to ponds and lakes are unaware of the whereabouts and ecological requirements of the medicinal leech. Information on appropriate habitat management is required in order to help maintain existing populations and encourage the establishment of new ones.

## 6.5 International

*Action 5:* *Any measures taken by EN/CCW/EA to conserve the medicinal leech should be linked as far as possible to work being conducted elsewhere in the UK and abroad.*

*Priority: high*

The medicinal leech was formerly widely distributed in Europe, although there have been relatively few studies confirming its status. In the north temperate regions it is recorded as being scarce (Wells *et al*, 1983). A recent survey of medicinal leech distribution in Scotland, with advice on appropriate conservation action, is nearing completion (Maitland, 1996). Any future study of the English populations of the medicinal leech should include contact with other UK and overseas scientists involved in investigations of the Hirudinea (leech family) and particularly the medicinal leech. The sites in Kent supporting large populations of the medicinal leech are of international importance.

## 6.6 Future research and monitoring

*Action 6:* *EN/CCW/EA should encourage the recording of the species by their own staff and ecologists/natural historians in the field in order to build up a better picture of the geographical distribution.*

*Priority: medium*

Greater use of existing professional and amateur field surveying resources is required if a reliable picture of the species' distribution in England and Wales is to be obtained. Improved recording of the species should be effected by improved communications and publicity both internally and with external bodies (such as the Wildlife Trusts and other conservation-orientated NGOs). Records should be collated and incorporated in national and UK databases (eg Biological Records Centre, Monks Wood).

*Action 7:* *EN/CCW/EA should commission more focused work on and around known sites in order to confirm the known distribution and investigate the species' habitat requirements during the different stages of its life cycle.*

*Priority:high/immediate*

This work should commence with a survey of the 20 sites in England and Wales at which the medicinal leech has been recorded since 1970 (Appendix I). Such a survey could be extended to adjacent, potentially suitable, sites. The work would need to be undertaken by suitably trained persons capable of identifying the medicinal leech in the field. These data would provide additional information on the habitats utilised by the medicinal leech in different localities.

*Action 8:* *EN/CCW should establish a suitable monitoring programme in order to assess the stability of key populations.*

*Priority:High*

Such a monitoring programme would need to be undertaken by suitably trained persons capable of identifying the medicinal leech in the field and quantifying population sizes.

### 6.7 Communications and publicity

*Action 9:* *EN/CCW/EA should promote the publication and dissemination of information on the medicinal leech to their own staff, owners and managers of sites where it occurs, and conservation-orientated NGOs who may be able to assist in recording and/or management.*

*Priority:High*

Information on the ecology of the medicinal leech would best be presented in accessible publications, particularly leaflets, but they should take account of the vulnerability of specific sites to unauthorized collection.

*Action10:* *EN/CCW to promote the development of alternative sources for important biochemical derivatives, currently extracted from medicinal leeches obtained from the wild.*

*Priority:High*

Current international trade in medicinal leeches from the wild poses a continuing threat to the remaining European populations.

## 7. ACTION PLAN REVIEW

A revision of the Action Plan will be needed after the focused survey of the medicinal leech distribution in England and Wales is completed, in order that priority areas containing the

most important populations can be identified and, if necessary, given some protection. The vulnerability of these and other medicinal leech habitats to damage will also need to be assessed. Surveys at approximately five year intervals will enable EN/CCW to monitor any change in the distribution and status of the medicinal leech.

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## CONSULTEES

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## APPENDIX I - POST 1970 RECORDS OF MEDICINAL LEECH IN ENGLAND

Post-1970 records of occurrence for the medicinal leech, Hirudo medicinalis L., in England, were kindly provided by Dr J.M.Elliott. [Note: More recent records for the Kent sites may be available from P.J. Wilkin or the RSPB - owners of Burrowes Pit. An unconfirmed report of occurrence in Devon (Lucy Cordrey, RSPB, Exeter) should be investigated]. Records from Wales were provided by Adrian Fowles of CCW.

National Grid / or site References in parentheses are approximate locations only.

| Site | Recorder | Map Ref. | Date of last record |
|---|---|---|---|
| **England** | | | |
| R.Frome, East Stoke | T.Gledhill | 30/868868 | 1970 |
| Ponteland, Northumberland | G.White | 45/148732 | 1970 |
| Eyeworth, New Forest | J.M.Breeds | 41/228147 | 1978 |
| Stalham, Norfolk | P.R. Hale | (63/37-26-) | 1981 |
| Romney Marsh, Kent | A.M. Scofield | 61/077217 | 1982 |
| Creech, Dorset | J.A.B. Bass | 30/918832 | 1984 |
| Brockenhurst, New Forest | P.J. Wilkin | (41/30-03-) | 1985 |
| Lydd Airport, Kent | P.J. Wilkin | 61/068216 | 1990? |
| Lydd Airport, Kent | P.J. Wilkin | 61/068213 | 1990? |
| Lydd Airport, Kent | P.J. Wilkin | 61/065210 | 1990? |
| Burrowes Pit, Kent | P.J. Wilkin | 61/069185 | 1990? |
| Hamilton Farm Pit, Kent | P.J. Wilkin | 61/058190 | 1990? |
| Mockmill Sewer, Kent | P.J. Wilkin | 61/073214 | 1990? |
| Stonehills Tarn, Cumbria | J.M. Elliott | 34/418943 | 1990? |
| Jenny Dam, Cumbria | J.M. Elliott | 34/462955 | 1990? |
| Minnow Tarn, Cumbria | M. Guthrie | (Ulverston) | 1992 |
| Leech Tarn, Cumbria | M. Guthrie | (Ulverston) | 1992 |
| **Wales** | | | |
| Newborough Forest, Anglesey | J.B. Ratcliffe et al. | 23/392647 | 1995 |
| Newborough Warren NNR, Anglesey | W. Sandison et al. | 23/424647 | 1995 |
| Cors Goch NNR, Anglesey | M.J. Morgan | 23/502813 | 1986 |
| Cors Goch NNR, Anglesey | M.A. Howe | 23/492811 | 1995 |
| Kenfig Pool, Glamorgan | R.T. Sawyer | 21/79-81- | 1985 |

# ENVIRONMENT AGENCY SPECIES ACTION PLAN FOR ENGLAND AND WALES

# THE FINE-LINED PEA MUSSEL - *Pisidium tenuilineatum*

**Dr. M. J. Willing**

**June 1997**

## Summary

This Species Action Plan is one updated from that appearing on the Short List of the UK Biodiversity Action Programme (Plowman, 1995) and provides updated information.

*Pisidium tenuilineatum* is a rare species that appears to have declined in at least part of its British range since the 1950s. Its present British distribution is unclear, the species occurring chiefly in central-southern England and the Welsh borders but not in Wales. The exact status of the species is difficult to assess because it is very small and similar in appearance to the common *Pisidium subtruncatum*. This confusion together with the generally small number of malacolologists able to identify this species, means that *P. tenuilineatum* is almost certainly under-recorded. The main threats to the species in Britain are not well understood, but may include a deterioration in water quality.

The highest priority for this species is to gather more information on its distribution and status so that further action can be properly prioritised. The emphasis of the proposed actions is therefore to ensure greater recording effort in the short-term, through the funding of targeted surveys and the encouragement of *ad hoc* recording. Once this has been achieved, the level of priority that should be given to studies of ecological requirements and thence targeted management can be identified.

## 1. PRIORITY STATEMENT

*P. tenuilineatum* is a very localised species in Britain with populations occurring in a relatively few areas. The apparent decline in the east Midlands (Bratton, 1991) requires further study, as does the current distribution over its likely British range. Implementation of this overall plan is a ***medium priority*** (this priority rating may need to be reviewed in the light of distributional study results).

## 2. ACTION PLAN OBJECTIVES

*Short-term:* To accurately assess the current distribution and status of *P. tenuilineatum* in England and Wales.

*Medium-term*: To initiate autecological research to develop a clearer understanding of the ecological requirements of the species

Following analysis of ecological studies, implement findings to maintain or enhance the species by the establishment of appropriate habitat management strategies.

*Long-term:* To explore the possibility of restoring *P. tenuilineatum* to previously occupied areas in the East Midlands when habitat conditions are considered suitable.

## 3. LEGAL STATUS

The species is not protected in the United Kingdom. However, it has been placed in category 3 (rare) of the relevant British Red Data Book (Bratton, 1991). The species is also included on the Government's Biodiversity Shortlist (Plowman, 1995). Wells and Chatfield (1992) record that the species appears on national 'red data' or 'threat lists' in Austria and Germany.

## 4. BIOLOGICAL ASSESSMENT

### 4.1 Ecology

*Pisidium tenuilineatum* lives in clean, hard water in lowland rivers, canals and occasionally ponds (Kerney, 1970; Wells & Chatfield, 1992; Ellis, 1962). On the continent it is also reported living in limestone springs. Although it has not been found living in this habitat in Britain, it has been recorded as a fossil in several Postglacial tufa deposits that formed as a result of spring action (Preece, 1979). Very little else is known about the ecology of the species and so it is not yet possible to be more specific in describing the optimum environmental conditions for this species. It is of note that in a survey of seven rivers in southern Britain (Ham & Bass, 1982), *P. tenuilineatum* was not found in several clear, unpolluted, hard water rivers such as the Test, Itchen and Lambourn where it might have been expected.

### 4.2 Distribution and population

*P. tenuilineatum* has mainly been recorded from central-southern England although a recent find in north-west Yorkshire (M.P. Kerney, personal communication) suggests that it may be significantly under recorded. The latest national distributional data records the species in 17 ten kilometre grid squares (M.P. Kerney 1976 and personal communication). It has always been noted as a scarce species, Ellis (1962) noting that it was, 'a rare species and easily overlooked'. Work by Ham and Bass (1982) further demonstrate the extreme rarity of *P. tenuilineatum* in rivers throughout southern England. It is also a rare species in mainland Europe, occurring between the Mediterranean and southern Sweden (Wells & Chatfield, 1992).

### 4.3 Limiting factors

In the absence of a detailed appreciation of the ecology of this species, it is not possible to outline reasons for its decline in the east Midlands (Kerney, personal communication); however, a deterioration of water quality is suspected (Wells and Chatfield, 1992),

## 5. CONSERVATION ACTION TO DATE

*P. tenuilineatum* has not been the subject of any species-specific conservation work.

## 6. PROPOSED ACTION

### 6.1 Policy and legislation

Until the precise reasons for the species' regional decline have been ascertained then it is not possible to advance policy suggestions. These should be reconsidered when areas of research advocated in this plan have been undertaken.

*Agency action: Liaise with English Nature (and CCW if relevant) once further information is available.*

### 6.2 Site safeguard and management

When ecological understanding is improved, consider the development of specific site designation to safeguard selected sites where the species is present, or likely to recover or recolonise. Generally the management of water quality over fairly large catchment areas (probably involving different land ownerships) is likely to be required. If efforts to improve water quality are suggested, then actions might be more easily justified by demonstrating mutual advantages to other sensitive or demanding freshwater species such as *Austropotamobius pallipes,* the freshwater White-clawed Crayfish.

*Agency action: Liaise with English Nature (and CCW if relevant) once further information is available.*

### 6.3 Species management, protection and licensing

More information is required before suitable actions can be proposed.

*Agency action: Liaise with English Nature (and CCW if relevant) once further information is available.*

## 6.4 Advisory

a) When ecological understanding is improved, consider the development of a set of management guidelines to be made available to local site managers/land owners and appropriate local authorities.

*Agency action: Fund the development of guidelines if appropriate.*

b) The identification of this species is rather difficult and currently few people can accurately name it. A short identification and background ecological leaflet (possibly incorporating a picture-based *Pisidium* key) would therefore be very useful to field workers and site managers in areas likely to be populated by the bivalve, and would help to improve our knowledge of the species' status and distribution.

*Agency action: Produce a species awareness leaflet for internal and external distribution.*

## 6.5 International

As this species is rare and possibly threatened throughout its European range, exchange research and management information with European partners. If early research suggests that it is required, seek EU species protection funding.

*Agency action: Ensure research funded by the Agency links with European initiatives.*

## 6.6 Research and monitoring

a) Undertake surveys of all historic locations within a single season to discover if *Pisidium tenuilineatum* populations still remain at any of them. Priority - High

*Agency action: Fund surveys in association with English Nature (and CCW if relevant).*

b) Survey new areas in locations where further populations may be present. Such work may be easier to justify economically if coordinated with surveys for other Biodiversity Short List species such as *Myxas glutinosa* (the Glutinous snail) and *Austropotamobius pallipes* (the freshwater White-clawed Crayfish). Priority - High.

*Agency actions: Fund targeted surveys in association with English Nature (and CCW if relevant) and encourage ad hoc recording internally and externally.*

c) Plan and undertake periodic monitoring of populations, adopting standard practices, at selected sites in order identify population trends and potential threats. Priority - Medium, following survey work.

*Agency action: Consider funding of work following further information.*

d) Undertake further ecological research which may be undertaken partly in co-operation with European partners. Such research might investigate such factors as water chemistry, channel dimensions, flow rate, sediments, vegetation and associated fauna. Priority - Medium, following survey work.

*Agency action: Consider funding of work following further information.*

e) Ensure that ecological and monitoring information is passed to a central organisation (e.g. JNCC) to be incorporated in national databases. Priority - High.

*Agency action: Distribute species awareness leaflet in (6.4b) and agree/publicise a pathway for data transfer.*

f) Periodically provide information to the World Conservation and Monitoring Centre to contribute to the maintenance of updated global red lists.

*Agency action: Distribute species awareness leaflet in (6.4b) and agree/publicise a pathway for data transfer.*

### 6.7 Communications and publicity

Consider promoting awareness of the situation regarding this species if early research suggests that a threat exists to the species.

*Agency action: Distribute species awareness leaflet.*

## 7. ACTION PLAN REVIEW

The action plan should be reviewed on a 5-yearly basis and changes agreed between the Agency, English Nature and the Countryside Council for Wales (if appropriate).

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# ENVIRONMENT AGENCY SPECIES ACTION PLAN FOR ENGLAND AND WALES

## COMPRESSED RIVER MUSSEL - *Pseudanodonta complanata*

**Dr. M. J. Willing**

**June 1997**


### Summary

This Species Action Plan builds upon that appearing in the UK Biodiversity Action Programme (Plowman, 1995) and provides updated information. The UK Biodiversity Steering Group gave *Pseudanodonta complanata* the common name of 'Depressed River Mussel', but previously it had been known as the Compressed River Mussel and it is that widely adopted common name which has been used here.

*Pseudanodonta complanata* is a local species that is rather uncommon in many parts of its range and one that is probably overlooked by many field workers. Current opinion suggests (Kerney, 1976 & personal communication) that there is no evidence that this species is declining in Britain. Its present distribution is rather unclear and extends in England from Somerset to south Yorkshire.

Threats to the species in Britain are not well understood, but may include deterioration in water quality from suspended sediments, eutrophication and drought; the physical disturbance of water courses and low numbers of host fish populations.

Considering the lack of apparent threat to the species, the actions contained in this plan are of low priority compared to other priority species. The most important action is research to clarify the ecological requirements of *P. complanata*, in order to properly assess whether human activities are likely to be a significant threat. *Ad hoc* recording also needs to be encouraged in order to accumulate a better picture of distribution and status.


## 1. PRIORITY STATEMENT

*Pseudanodonta complanata* is a local species in Britain, which often has low population numbers in comparison to other species of *Anodonta*. The ecology of the species is incompletely known and further autecological work is probably the most important conservation action for the species. The current distribution over its likely British range requires further study. Any consideration of actions for this species should bare in mind that, as far as can be ascertained on the basis of current evidence, this species is not threatened to the same degree as other sensitive aquatic species. Implementation of this plan is therefore considered to be a low priority.

## 2. ACTION PLAN OBJECTIVES

*Short-term*: To initiate autecological research to develop a clearer understanding of the ecological requirements and life history of the species.

*Medium-term*: To accurately assess the current distribution and status of *Pseudanodonta complanata* in England and Wales.

*Long-term:* Following distributional studies, establish a representative series of monitoring stations across the range of the species to record population changes.

If necessary, maintain the species by the maintenance or establishment of appropriate habitat management strategies.

## 3. LEGAL STATUS

*Pseudanodonta complanata* is not protected in the United Kingdom. However, it is included on the Government's Biodiversity Shortlist (Plowman, 1995). Wells and Chatfield (1992) record that the species appears on national 'red data lists' in Austria, Germany, Sweden and Switzerland.

## 4. BIOLOGICAL ASSESSMENT

### 4.1 Ecology

*Pseudanodonta complanata* lives in fairly clean, hard water in a wide variety of lowland watercourses, at a range of depths and in a variety of sediment types. Thus it occurs in relatively fast flowing rivers such as the Wye (Oliver et al, 1993) and Mole (personal observation) as well as slow flowing rivers and drainage dykes such as the Cam and Wicken Lode (Aldridge, personal communication) and the Great Ouse (Preece & Wilmot, 1979). It has also been found in a variety of water depths and sediment types ranging from silty clay in 3 - 4 metres of water in the Great Ouse (Preece & Wilmot, 1979 & Rands, 1986), whilst elsewhere it may be present in sand and gravel in shallow water and riffle areas of rivers such as the Wye (Oliver *et al.*, 1993) and Mole. In the fine silty sediments of Wicken Lode, which has a maximum depth of about 1.5m, Aldridge has found the species equally commonly in water of all depths. Woodward (personal communication) has noted that in the Wye the species can be found, "embedded in the accumulation of sticks entangled amongst tree roots".

Its wide range over much of lowland England suggests that *P. complanata* is tolerant of a wide range of water conditions and does not require absolutely clean or unpolluted conditions. Baker *et al.* (1996a) describe how the species is present in stretches of the River Waveney subject to sewage and other pollution, where populations of *Anodonta cygnea* had apparently died out. Baker *et al.* (1996b) also describe how this mussel, "seems to have survived the river pollutions of the 1950s -1990s and is currently moving into new sites such as Rockland and Wheatfen as the water quality improves".

*P. complanata* often occurs in lower numbers than *Anodonta cygnea* and *Anodonta anatina,* with which it is frequently associated. Thus recent mussel population work (studying *Unio, Anodonta* and *Pseudanodonta* spp) in the River Cam and Wicken Lode in Cambridgeshire (D. Aldridge, unpublished data) has shown *P. complanata* to be outnumbered by all other species of large mussel. In Wicken Lode *Anodonta cygnea* and *Anodonta anatina* were 40 and 160 times more abundant than *P. complanata* respectively. *P. complanata* usually buries itself deeper in river sediments than other mussels. Aldridge (personal communication) reports finding this species just covered by sediments, whereas Woodward (personal communication) describes how in the River Teme it tends to occur in fine sandy gravel about two or three inches below the surface. It is likely that *P. complanata* buries to different levels at different times of the year, possibly reaching greater depths in winter months.

Unpublished research (D. Aldridge, University of Cambridge) suggests that the parasitic glochidia larva of this species may be relatively inefficient at attaching themselves to fish gills compared to those of related mussel species. It is also suggested that the populations of suitable fish, particularly perch (*Perca fluviatilis*) and possibly stickleback species, are important in maintaining populations of *P. complanata.* This is a point also made by Baker *et al.* (1996a), who suggest that the reason for finding the highest numbers of mussels near to the edges of reed beds was due to the fact that such areas attracted large numbers of breeding fish, thus providing maximum opportunities for glochidia attachment (and subsequent release). There are currently many gaps in the knowledge of the ecology of this species, particularly at the juvenile stages.

## 4.2 Distribution & population

*Pseudanodonta complanata* occurs throughout most of lowland England from Somerset to south Yorkshire including the Welsh Borders (but has not yet been recorded in Wales).The species has been recorded in 66 ten kilometre grid squares, according to the latest data (M.P. Kerney, 1976 and personal communication). It has always been noted as a scarce species (e.g. Killeen, 1992) although it may be locally common as in sections of the rivers Teme, Wye and Yare. It is almost certainly under-recorded for a combination of reasons. These include the frequently deeper burial and lower numbers of this species compared to other large mussels, and identification confusion with other members of the genus. Elsewhere *P. complanata* occurs in Western and Northern Europe from the Elbe in the east to Finland and Sweden in the north (Pfleger & Chatfield, 1988). There are some suggestions that this species is seriously threatened throughout its mainland European range (with the possible exception of Finland) and that Britain may have the healthiest populations in the continent (F. Woodward, personal communication). It is possible that, for reasons similar to those that apply in Britain, *P. complanata* is also under recorded throughout its European range. Although Wells and Chatfield (1992) catalogue possible problems for the species in Austria, Germany, Poland, Sweden and Switzerland, the species is nevertheless placed in the IUCN threat category of 'insufficiently known' as a consequence of a lack of adequate reliable information.

## 4.3 Limiting factors

In the absence of a sound understanding of the ecology of this species it is not possible to state with certainty the reasons for its seemingly low numbers in some areas. It may be affected by low

numbers of fish that act as hosts for the glochidia larva. It has been suggested that the inability of this species to close the ventral valve margins makes the animal virtually unable to withstand periods of drought (where it is present in shallow water situations) and in addition also subjects it to becoming clogged by fine sediment in suspension (F. Woodward, personal communication). The original SAP mentions the collection of specimens for garden ponds and aquaria as a likely threat. There is no firm evidence that this is the case and the relatively small numbers of specimens likely to be collected at most locations compared to the other large mussels makes this an unlikely problem. Baker *et al.* (1996a) suggested that the frequency of river/canal dredging needs to be carefully considered, there being a balance of benefit and risk for the species in such operations. The benefit of clearing sediment is the maintenance of the water flow that they believe to be a critical factor in maintaining viable *P. complanata* populations. Dredging problems include the destruction of mussel populations as a result of their removal from the river channel. Baker *et al.* also point out that dredging frequency should allow the species sufficient time to reach maturity.

## 5. CONSERVATION ACTION TO DATE

*Pseudanodonta complanata* has been the subject of several species-specific studies. The Ted Ellis Trust have undertaken work at a number of locations in Norfolk (Baker *et al.* 1996a & 1996b) and studies of bitterling populations at U.E.A. by J.Reynolds has involved indirect study of mussel populations. As well as further studies on the inter-relationships between bitterling and *P. complanata,* D. Aldridge (Cambridge University) has also undertaken research into the population dynamics and effects of dredging and water weed cutting on *P. complanata* in a number of local rivers and drainage dykes. The Conchological Society has maintained national 10km square distribution records for the species (Kerney, 1976).

## 6. PROPOSED ACTION

### 6.1 Policy and legislation

Until the precise reasons for any possible decline have been ascertained, then it is not possible to advance policy suggestions. These should be reconsidered when outcomes from research advocated in this plan are available for consideration.

*Agency action: Liaise with English Nature (EN)/ Countryside Council for Wales (CCW) once further information is available.*

### 6.2 Site safeguard and management

As the species occurs over such large areas of the country and does not appear to be generally threatened, then protection for specific sites does not seem necessary. Generally the management of water quality and fish stocks over fairly large catchment areas (probably involving different land ownerships) is likely to be beneficial for the species and could be justified in that whole freshwater communities would also benefit as a consequence.

## 6.3 Species management, protection and licensing

Baker *et al.* (1996a) suggest that prior to dredging work at 'good' *Pseudanodonta complanata* sites, mussels be temporarily removed and then returned to the watercourse after dredging operations had been completed. Other than this, further research is required before management guidance can be offered.

*Agency action: Consider mitigation for dredging activities where valuable populations of the mussel are felt to be at risk. Otherwise, liaise with EN/CCW once further information is available.*

## 6.4 Advisory

a) When ecological understanding is improved, consider the development of a set of management guidelines to be made available to local site managers/land owners and appropriate local authorities.

*Agency action: Fund the development of guidelines if appropriate.*

b) The identification of this species is frequently confused with the usually commoner species, *Anodonta cygnea* and *Anodonta anatina*. Therefore the production of a simple identification guide for use by field workers and site managers is proposed. A guide has been produced at Cambridge University (Aldridge, 1996) and its use might be considered.

*Agency action: Produce a species awareness leaflet for internal and external distribution, considering the guidance already in existence.*

## 6.5 International

As this species is rare and possibly threatened throughout its European range, exchange research and management information with European partners. If research suggests that it is required, seek EU species protection funding.

*Agency action: Ensure research funded by the Agency links with European initiatives.*

## 6.6 Future research and monitoring

In view of the apparent lack of threat to this species, the actions listed below can be considered to be low priorities. ***Actions are listed in priority order.***

a) Undertake autecological work in order to more clearly understand: (1) detailed habitat preferences and physical environmental parameters; (2) details of niche differences between this species and the other large freshwater mussels (such work could usefully include comparisons between a few selected rivers to indicate the consistency of results over the species range); (3) details of the life cycle of the species. Research should be undertaken in co-

operation with European partners as the species maybe at more risk on the European mainland than in Britain. Priority - Low.

*Agency action: Fund research in association with EN and possibly CCW.*

b) Undertake surveys at a representative selection of historic locations within a single season to discover if populations of *P. complanata* are still present.

*Agency action: Fund surveys in association with English Nature and possibly CCW.*

c) Plan and undertake periodic monitoring of populations, adopting standard practices at selected sites in order identify population trends and potential threats.

*Agency action: Consider funding of work following further information.*

d) As the species is considered to be under-recorded, survey new areas (particularly beyond the edges of the current known range) in locations where further populations may be present.

*Agency actions: Fund targeted surveys in association with English Nature and possibly CCW and encourage ad hoc recording internally and externally.*

e) Ensure that ecological and monitoring information is passed to a central organisation (e.g. JNCC) to be incorporated in national databases.

*Agency action: Distribute species awareness leaflet in (6.4b) and agree/publicise a pathway for data transfer.*

f) Periodically provide information to the World Conservation and Monitoring Centre to contribute to the maintenance of updated global red lists.

*Agency action: Distribute species awareness leaflet in (6.4b) and agree/publicise a pathway for data transfer.*

### 6.7 Communications and publicity

Consider promoting awareness of the situation regarding the species if research suggests that a threat to the species exists.

## 7. ACTION PLAN REVIEW

The action plan should be reviewed on a 5 yearly basis and changes agreed between the Agency, English Nature and CCW (if appropriate).

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# PART 7 PLANTS

7.1 Species Action Plan for the triangular club-rush

7.2 Management guidelines for the black poplar

7.3 Species Action Plan for the Loddon pondweed

7.4 Species Action Plan for the round-headed club-rush

7.5 Species Action Plan for the northern spike-rush

# ENVIRONMENT AGENCY SPECIES ACTION PLAN FOR ENGLAND AND WALES

# TRIANGULAR CLUB-RUSH - *Schoenoplectus triqueter*

Peter Nicholson

Environment Agency
South West Region

April 1998

## 1. INTRODUCTION

The triangular club-rush, *Schoenoplectus triqueter*, was identified under R&D Project 461 as a species of conservation priority that was worthy of special consideration by the Environment Agency (then the National Rivers Authority), due to its dependence upon riverine habitats and the scope for the Agency to influence its status. This brief SAP has been produced to guide Agency action on the conservation of the species, acting as a focus for discussion and liaison with other relevant bodies (particularly English Nature). The assistance of Charles Pulteney (English Nature) and Lady R Fitzgerald in the formulation of this SAP is gratefully acknowledged.

## 2. DISTRIBUTION AND STATUS

2.1 Only one, very small, population of triangular club-rush is known to survive in the UK. This is located on the Devon side of the upper tidal reaches of the Tamar estuary, where the plant occurs low down on the muddy foreshore. It has shown a marked decline in England over the last 50 years and is now believed to be absent from previously recorded sites in West Sussex (River Arun), Greater London (River Thames) and Kent (Medway).

2.2 The UK represents the northern edge of the species' range, with a scattered distribution in the Republic of Ireland (River Shannon), South and Central Europe, West Asia, North and South Africa and North America. The plant is considered to be critically endangered in the UK and is protected under Schedule 8 of the Wildlife and Countryside Act 1981.

## 3. LIMITING FACTORS

3.1 Reports from the Thames and Medway suggest that the extinction of the species has occurred during the last 50 years as a result of habitat loss caused by flood bank protection and navigational improvements. The loss of populations on the Tamar and the Arun does not fit this pattern, since 'suitable' habitat would appear to be available. In contrast, the Shannon population is stable despite extensive bank modification.

3.2 Competition for suitable habitat by more vigorous emergent plants (including other species of club-rush and hybrid forms) can be detrimental, in addition to shading from bankside trees. However, this does not appear to be a problem at the extant site, with the possible exception of common reed (*Phragmites australis*).

3.3 Climate change may have some effect, since the species exists on the northern limit of its range in the British Isles.

3.4 Hybridisation with other species of club-rush is a problem on the Tamar Estuary, but does not account for recent losses since all species of *Schoenoplectus* seem to be in decline.

3.5 The causes of the recent decline in the surviving Tamar population are not known. Climate change, low flows, increased 'spatiness', increased sedimentation, genetic drift, pollution, collection, and changes in river and bank management since the decline in the mining industry and other commercial activities are all possible factors.

## 4. CURRENT ACTION

4.1 English Nature, the Agency and local naturalists have monitored the Tamar population since 1989.

4.2 Work at the Royal Botanic Gardens Kew has included both vegetative propagation and seed collection, using material from the Tamar population. Germination of seed from the seedbank has not been possible in trials, but seed falling on the ground in the vicinity of the plant has germinated. Material from this population is also being propagated vegetatively by a local licence holder.

4.3 Genetic studies of *Schoenoplectus* species are being undertaken at Kew, with the aim of determining the parents of the hybrids.

4.4 The Tamar site lies within a Site of Special Scientific Interest, part of which is proposed as a Special Protection Area under the EU 'Birds' Directive and a Special Area for Conservation under the EU 'Species and Habitats' Directive.

4.5 The Agency has visited the River Shannon (Irish Republic) to compare and contrast habitat preferences.

## 5. ACTION PLAN OBJECTIVES AND TARGETS

5.1 Safeguard the existing population using the Wildlife and Countryside Act 1981 (as amended) as appropriate, in addition to the Agency's Local Environment Action Plan for the Tamar.

5.2 Maintain 'rescue' population at Kew.

5.3 Investigate the factors responsible for the plant's recent decline and disappearance.

5.4 Identify twelve sites for reintroduction on the Tamar estuary by 2000 and estimate the costs of planting, to be followed by similar exercises on the Thames, Arun and Medway.

## 6. PROPOSED ACTION WITH LEAD AGENCIES

### 6.1 Policy and Legislation

Action 1: Ensure the SSSI legislation and Schedule 8 of the Wildlife and Countryside Act is enforced, and that the Tamar LEAP and Estuary Management Plan contain appropriate policies and actions. *Relevant bodies: Agency, EN.*

### 6.2 Site Safeguard and management

Action 2: Seek to ensure that activities relating to flood defence and water flow regulation protect the Tamar site and surrounding area from influences that would be detrimental to the plant's survival. *Relevant body: Agency.*

Action 3: Ensure that bank vegetation does not develop to the extent that the Tamar population will be influenced by shade. *Relevant body: Agency.*

Action 4: Identify suitable sites for reintroduction to historical rivers (Tamar, Arun, Medway and Thames), with a preliminary target of twelve sites on the Tamar by the year 2000. *Relevant body: Agency.*

### 6.3 Species management and protection

Action 5: Maintain and propagate current collection at Kew as a source of material for future reintroductions. *Relevant bodies: Kew, EN.*

Action 6: Ensure that the present population remains free from excessive competition from other emergent aquatics. *Relevant body: Agency.*

Action 7: Maintain and propagate licensed local collection. *Responsible body: EN.*

Action 8: Reintroduce propagated plants to the selected sites. *Relevant body: Agency.*

### 6.4 Advisory

Action 9: Ensure landowners, managers and local authorities are aware of the presence, legal status and importance of conserving this species, and of appropriate methods of habitat management. *Responsible bodies: EN, Agency.*

### 6.5 Future research and monitoring

Action 10: Survey and record distribution and abundance of all club-rush populations in the Tamar in order to establish whether hybridisation is a factor causing loss or decline. *Responsible body: Agency.*

Action 11:Establish the relationship between club-rush species and their hybrids and habitat preferences, through genetic studies if necessary, in order to ensure that reintroduced plants do not hybridise. *Relevant bodies: Agency, Kew.*

Action 12:Identify optimal environmental conditions for the species, with particular reference to the River Shannon. Continue survey work on the Shannon, especially from boats since properties accessible by land are not necessarily typical. Liaise with Irish National Parks and Wildlife Service, who are supporting postgraduate research work on *S. triqueter. Relevant body: Agency.*

Action 13:Review historic and potential sites on the Tamar, Medway, Arun and Thames. Collate survey information from all rivers to try and develop a model for habitat requirements, behaviour of populations, reasons for loss or decline, changes in river habitat in the last 100 years, and hybridisation. *Relevant bodies: EN, Agency.*

Action 14:Collect voucher specimens of plant material for the Kew herbarium. Initiate further searches in major herbaria, especially hybrids and their various forms. Collate British and continental information on both morphology and autecology. *Relevant body: Agency.*

Action 15:Monitor the population size/extent of club-rush and associated species at the current Tamar site, initially on an annual basis. Monitor populations at future reintroduction sites triannually, at the beginning of the growth season, in midsummer, and in September to look for inflorescences. *Relevant body: Agency.*

Action 16:Initiate research on pictorial and historical sources and privately owned collections, especially in the Tamer mining area, which may substantiate suppositions on changes in river habitats since the nineteenth century (when the species was widespread). *Relevant body: Agency.*

## 6.6 Communications and publicity

Action 17:Ensure local communities are made aware of the presence and importance of this species and the reasons for carrying out management. *Relevant bodies: EN, Agency.*

Action 18:Keep details of remaining site confidential to guard against collecting. *Relevant bodies: EN, Agency.*

# ENVIRONMENT AGENCY SPECIES MANAGEMENT GUIDELINES

## BLACK POPLAR - *Populus nigra ssp. betulifolia*

Marianne Le Ray

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Midlands Region

February 1998

## 1. STATEMENT OF USE

The relict population of the British sub-species of the black poplar is intimately associated with river corridors, being formerly widespread and common in floodplain forests. The maintenance of remaining trees and re-establishment of populations is closely linked to Agency activities. These management guidelines have been developed to assist in the targeted implementation of necessary measures for the conservation of the species. They are primarily for use by Conservation staff within the Agency, but also provide useful information on the species for landowners and the public.

## 2. DISTRIBUTION

The range of the black poplar extends across Europe to the southern fringes of Russia and the Ukraine. The sub-species *betulifolia* is, however, much rarer, being confined to Britain, northern France and parts of western Germany. Though widespread in England and Wales, with concentrations in the West Midlands, East Anglia and the Home Counties, it is far from abundant. It has recently been discovered in Ireland, but is absent from Scotland.

It is not known exactly how many are present in Britain, but the last count suggests there to be between 2,000 and 3,000 mature trees, only 150 of which are female. There are some very significant clusters within its apparent native range where it occurs with some frequency and the trees are locally important, both as features of the historic landscape and as possible relict populations of the native tree.

The distribution of the black poplar is fascinating and has much to teach us of its ancient origin and of historical changes in land management. This imposing tree is often steeped with local legend and folklore and can provide us with a type of living archaeology. It was often used in parish boundaries or for other areas where an important landmark was required. It follows, therefore, that great care must be taken over the choice of new sites for planting as the mysterious nature of the tree could easily be eroded.

## 3. STATUS

The black poplar is the rarest timber tree in Britain. Its status is such that an action plan for the conservation of the species was drawn up by the Black Poplar Working Group in 1994, and it is being considered for English Nature's Species Recovery Programme.

The main areas identified for action in the Species Action Plan are as follows:

- Complete collation of British records to enable an accurate picture of the distribution to be drawn up. These in turn are being studied in relation to the European range of black poplar.

- Carry out DNA testing to determine the extent of genetic diversity remaining within the sub-species.

- Ensure propagation is carried out which collects the full genetic diversity available. New trees to be held both in collections and replaced in their original habitats with respect being paid to their original distribution.

- Ensure greater protection of existing trees through wider education and increased knowledge of whereabouts.

- Promotion and celebration of this magnificent tree.

The Species Action Plan has targeted the following areas of importance for conservation of the Black Poplar: Dorset, Hereford and Worcester, Gloucestershire, Thames and Oxfordshire, Norfolk, Suffolk, Essex and Lower Thames, Huntingdonshire, Cambridgeshire, Vale of Aylesbury, Shropshire, the Dove Valley (Derbyshire), Cheshire and Wales.

There is still much research to be done into the past uses of Black Poplar so that we can rediscover these qualities and give them a value today. As the Species Action Plan explains succinctly:

> 'The nature of the problem then, is that we must address the need to bring the tree back from the brink of biological extinction without compromising the layers of historical and ecological meaning which have accrued around it' (Spencer, 1994).

## 4. DESCRIPTION

### 4.1 Recognition

The native black poplar is a magnificent tree and individual specimens often form a dramatic feature within the landscape. The tree is quite rounded for a poplar, usually reaching 30m in height and 20m in span. The native black poplar tends to have heavy limbs and the lower branches, in particular, are arching and untidy looking. The tips of the twigs are usually ascending. The trunk

often leans over. The bark is rough, often deeply fissured in a zig-zagging pattern and dark grey; there may be characteristic woody swellings or burrs.

The leaves are extremely variable in size and, to a certain degree, shape, although all are broadly deltoid. The leaf margins have clear rounded teeth and the tip is elongated to an acute point.

Leaves collected from the west of the country are often considerably larger than those of the east. Whether or not this is genetic, or merely a phenotypic reaction to the milder, damper climate, remains to be seen. The leaves flutter in a manner that is reminiscent of aspen, although not as obvious.

The petiole is compressed and between 3-7cm long. It usually lacks the glandular swellings that poplars often exhibit at the junction between the leaf and leaf stem.

The young shoots, petioles and midrib may have a thin deciduous pubescence which appears to be retained longest on the underside, even to leaf fall. This is highly variable, though, and it has been known for both glabrous and pubescent shoots to occur on the same tree.

The leaves flush bronze, before quickly opening bright green, usually in April. The leaves become more leathery and are mid green until October when they take on a golden shade before falling.

As has been mentioned, poplars are dioecious so self-fertilisation is not possible. Flowering occurs at the end of March when the female produces lime green pendulous flowers and the male has purple/red pendulous catkins. Pollination is by wind.

### 4.2 Notes on verification of identity

It should be stressed that the points above are given for guidance only. Any tree which seems to fit the description should be verified by an appropriate authority. The following steps should then be taken:-

If you think that you have found a black poplar it is important to firstly check any existing records. It is important to find out if the tree has been verified by the Forestry Commission or the Botanical Society for the British Isles. If it has, then the records will be held with the Institute of Terrestrial Ecology at Monks Wood Research Station. A local record may be held by the vice-county recorder. The records at present are not consistent and it is important that they are synchronised. In addition, initial DNA testing has indicated that the authenticity of some of the trees held on the list is doubtful. This mistake can easily arise when leaf samples are sent without a photograph or sketch of the tree's form. There is a proposal to re-survey the trees nationwide in order to determine the rate of attrition and so hopefully a few simple measures will be put in place to ensure that these other anomalies are ironed out.

If the tree is not on any of the above lists then the following action should be taken: Occasionally the tree will have been verified as a native black poplar but the original record will not show if it is male or female. If this is the case, then only the first step needs to be followed. The findings should then be forwarded to ITE.

1. If possible, visit the tree in March/April and note if the tree bears red catkins (male) or green pendulous flowers (female). A female tree can also be identified by the copious amounts of fluffy seed that are produced in June. Female black poplars are extremely rare (150 in Britain) so presence of seed may often indicate that the specimen is not the sub-species *betulifolia*.

2. Ideally a sample should be collected between the last week in May and the end of June. During this month the leaf glands mentioned above are particularly prominent on other types of poplar, making it easier to distinguish the true *betulifolia*. A whole twig with leaves should be collected.

3. Pack the sample between two pieces of paper, not plastic, and send, by the end of July, to either Desmond Hobson, Manor Farm Cottage, Homington, Salisbury, SP5 4NH, or Marianne Le Ray, Environment Agency, Hafren House, Welshpool Road, Shrewsbury, SY3 8BB, or Fiona Cooper, The Rough, Henley Common, Marshbrook, Church Stretton, SY6 6RS. Relevant information should accompany the sample, including the grid reference of the tree and the date sampled. A photograph or sketch of the tree's branch structure is essential.

## 5. HABITAT REQUIREMENTS

The native black poplar no longer occurs in what could be considered its original natural habitat in Britain - the forested flood plains and river valleys of the lowlands. It still occurs widely in these areas, but usually persists only in hedgerows and along river courses. The floodplain woodlands of Britain were largely cleared in prehistoric and early historic times and increased drainage in more recent history has since exacerbated the problems.

Areas of flood plains forests do remain in Europe. black poplars growing in these conditions are often crowded and drawn. This type of habitat is characterised by quite violent regimes of flooding and the black poplar is adapted to cope with sudden changes in ground level as silt is either deposited or scoured from around the trunk.

In Britain, only a handful of relict populations, where groups of male and female trees grow in close proximity, are known. The problem is compounded by the fact that the seeds have very specific habitat requirements for germination. The windborne seed needs to fall on bare wet ground at the end of June and the soil has to remain bare and wet until October. The small seedling tolerates drought poorly. The seed is extremely short lived and the fluff which distributes it is often responsible for holding it above the surface. Thus, unless it lands on a moist environment, seed will quickly dehydrate and die. Where seedlings do occur, it is highly likely that there will be genetic contamination by pollen from non-native trees. Recent research suggests that poplar pollen will

easily travel 15 km. Thus, unless pollination can take place in a controlled environment, real protection for the future must lie in propagation by vegetative means.

## 6. GUIDELINES FOR PROPAGATION AND NEW PLANTING

### 6.1 Supply

The Species Action Plan suggests that a range of small nurseries across the country should grow on trees collected from the locality. These should be chosen to represent a cross-section of the local provenance. This is beginning to happen in many areas, but this information needs to be accessed and networked amongst the various interested bodies within an area. The Tree Council can provide information on approved suppliers.

When collecting material for propagation, the following guidelines must be followed. Firstly, it is essential that the tree has been positively identified by an appropriate authority as a true *Populus nigra ssp betulifolia*. As mentioned above, the recent DNA analysis carried in the Upper Severn Area suggests that some of the trees have been wrongly identified. It is therefore prudent to double check the identification of trees which are being used to provide nursery stock. Native Black Poplar will hybridise readily with any other poplar that flowers at the same time. Thus crosses with *P. nigra* 'Robusta' and *P. nigra* 'Italica' are common. To complicate matters further, sometimes back crosses have occurred. This reinforces the importance of having a tree properly identified (see Section 4.2).

It is also important that these new trees originate from local genetic stock. Work on the DNA testing began nationally in 1995. Very early results suggest that there may be less diversity within the sub-species than originally thought. The need to continue this testing is essential in order to define the paramaters of the sub-species. There are proposals to test related hybrid trees in order to set up some type of comparative 'genetic yardsticks'.

Any well-funded and systematic collection of black poplars from an area should include DNA testing where possible, as a necessary cost and stage within the programme. Material for genetic sampling must be from young growth, making spring an ideal time for collection. However, this process can be carried through to about August as long as the youngest growth available is chosen. The reason for this is that, during the testing, DNA from bacteria and other organisms that may be present on older growth can confuse readings.

Information on the techniques used to undertake the DNA testing is being updated all the time, and it is essential to ensure we are all using the same means of analysing DNA. At the time of writing the technique considered most appropriate is known as AFLP or Associated Fragment Length Polymorphism (Vos, *et al*, 1995). This is a molecular tool that has the 'capacity to produce reliable and informative multilocus profiles' (Winfield, *et al*, 1998).

By firstly establishing the genetic variability of trees in an area, it may be revealed that it is only necessary to collect cuttings from a certain percentage of trees. Initially it was thought that those with greater diversity could be targeted. However, initial testing has suggested that diverse trees may be a first generation back cross and that diversity may be something to be wary of in a

population that appears to be 98% similar. Thus, whilst the process may initially seem costly and time consuming, it may not be necessary to return to all the trees, thus saving later on. In addition, if carried out in conjunction with the appropriate bodies, this will be a valuable contribution to the overall national picture of the status of the tree.

If funding is available for this level of data collection, then it would be also beneficial to include a short report on the current state of health of each tree visited. This would be carried out by a trained arboriculturalist and would include suggestions for management of the tree (see Section 8).

### 6.2 Propagation

In the past, the main way of creating new plants has been by cutting truncheons (a stem about 75-100mm in diameter and 750-1000mm tall) of selected trees. This helps to explain the lack of female trees - the abundance of fluffy seed produced has made them unpopular with, for example, soft fruit growers. Hence the females have both been deliberately destroyed and not chosen for cuttings. The black poplar will propagate itself from broken off twigs and branches, but unlike other poplars this sub-species rarely suckers.

Very often, the older trees will be lacking in the suitable young growth required for cuttings. A small amount of minor surgery may be introduced in one year to produce more vigorous growth for cuttings to be taken the next year. In some areas there are many pollards and these would form ideal sources of material. The act of repollarding the tree would also add to its longevity.

When collecting material, thought should also be given to the ratio between male and female trees. Everyone wants to plant female trees but this should be resisted or the present distribution will be confused. The need to carry out any such project systematically and in discussion with the Forestry Commission cannot be emphasised enough.

The collection of material for propagation must, of course, be carefully agreed with the landowner and any conservation bodies that are involved in the site - for example, some trees are on SSSIs. Collection must be carried out by someone with a knowledge of arboriculture and/or horticulture.

Poplar will grow from hardwood or softwood cuttings, with the latter requiring more elaborate horticultural technology. Hardwood cuttings are taken in the autumn and winter when the tree is largely dormant, the current year's wood has ripened, but root growth still takes place. Softwood cuttings are best taken between the end of July and end of August. It is possible to carry on into October but success rates are poorest. Since very good results can be obtained from the hardwood cuttings, it is likely that this will be the most common method chosen. Softwood cuttings may be considered in an emergency situation if a tree collapses or has to be felled during the summer months.

Whilst hardwood cuttings can be taken any time over the dormant months, John Evelyn, 1664, tells us to collect cuttings 'after the first full moon in January'. Cuttings taken before Christmas usually start to root and these may then be broken by frost heave in the soil during the later part of winter. Many have reported that cuttings taken in February and March have been extremely successful.

Cuttings should be taken from new growth made in the previous summer. They should be 150-200mm long with at least half their length below ground. The cuttings can be rooted straight into the open ground. Weed control is very important over the first year and this can be reduced by laying a black plastic or felt mulch and making small slits for the cuttings to grow through.

Rooted cuttings can usually be planted out after their first year. In order to relieve pressure on the native trees, save time in collecting material and produce vigorous cutting material, the establishment of stool beds is recommended.

Cuttings must be well labelled during their life in the nursery.

### 6.3 Where to replant

As explained above, in order to maintain the present distribution, the replanting of black poplars should be concentrated within the target areas (see Section 3). The tree must be planted sensitively and usually in small numbers.

On a more practical note, new trees must be planted well away from any structures and underground services. It is estimated that black poplar will affect the ground for a distance with a radius that is at least the height of the tree. (Cutler and Richardson, 1981).

The ability of any poplar to dry out the ground needs to be considered carefully when introducing new black poplars to an area of existing wetland habitat or adjacent to an area of archaeological importance. The project organiser must be satisfied that damage will not be inflicted upon existing features. Likewise, as with any tree planting, the effects of shade and leaf-fall on the existing habitat need to be weighed up. As mentioned earlier, care should be taken in choosing sites for female black poplars since the large amounts of fluffy seed can create problems.

Planting sites will ideally be in full light with good moisture supply and a lowland climate. black poplar is not thought to tolerate a great deal of shade. If appearance is important, then one should note that black poplar planted close to other trees will take on a drawn appearance and will not develop the broad heavy-limbed silhouette that is so characteristic of the older trees.

Black poplars are normally found on alluvial soils although they have been also been found on the lower slopes of upland areas - the Long Mynd in Shropshire being a particular stronghold. Whatever the location, soils must be water retentive or rainfall needs to be high. Water quality in the adjacent watercourse does not seem to be a critical factor and black poplars may benefit from nutrient enrichment.

The re-creation of new floodplain forests is the subject of an ongoing R&D project jointly carried out by the Forestry Commission and the Agency, looking at the possibility of restoring this very valuable 'lost component' of Britain's flora. The benefits that could arise in terms of pollution and flood control, conservation and timber production are being weighed up against the potential problems. Work on a small number of demonstration sites has been started. Should this idea become policy, then native black poplar is likely to become a major component of new floodplain forests.

Thought should also be given to the creation of new pollards. This choice may be made in order to ensure the continuation of a valuable landscape feature, or, from a practical point of view, to save space. John Evelyn tells us 'to pollard a sapling, cut the trunk off at the required height when it is as thick as one's arm'. It is important to gain a management commitment when creating new pollards since repollarding is essential and should be carried out on about a 10 year cycle. During the establishment period this could be reduced to every 3-5 years.

All new plantings of black poplar should be recorded by the Institute of Terrestrial Ecology at Monks Wood; this can be done directly or via the Forestry Commission. In addition, the Botanical Recorder for the county should be involved in the choice of new sites and given a grid reference for the new plantings. Wherever possible, a note of the source of the cutting material could be included.

## 7. CURRENT THREATS

1) Many existing poplars are very old and will need replacing. The old trees are often hollow inside, and this is only evident when blown down. What remains is a heap of pithy looking wood, and one is left wondering how the tree stood for so long.

   With this in mind, it is advisable to cut any ivy growing on a mature black poplar. Whilst it is understood that this cover can provide valuable habitat for other wildlife it may pose a threat to the tree. Since ivy is evergreen, its leaves may offer greater resistance to winter winds and storms and can act as a sail for mature trees.

   The older trees may pre-date the introduction of hybrid trees and therefore will be pure *betulifolia*. Cuttings of these trees should be taken as a matter of course.

2) Many trees require re-pollarding or tree surgery to prevent them from splitting. Some old trees have had to be cut down because they are posing a threat to nearby dwellings or roads.

3) Some trees are damaged by adjacent construction works. The famous Arbor Tree at Aston-on-Clun, which blew down in a gale in 1995, was a prime example. The soil level had been raised by about a metre up the trunk. Locals think that this occurred about 40 years ago but it was evident when it fell that the rot was concentrated in this area. The tree stood in a corner of three roads so it is possible that damage by excavation for underground services intensified the problem.

   If works are planned around any tree, especially an older one, then a protection zone should be allowed for. When planning engineering works, this requirement must be clearly stipulated at the feasibility and design stage. Ideally, with a poplar this area would have a radius the height of the tree. If this is not possible then the area around the drip line or extent of the canopy can be used. This area should be fenced off during construction. Within the zone there must be no changes to the soil level, no compaction of the soil, no storage of materials, no fires and no storage of chemicals. A useful guide for this work is British Standard 5837 - "Trees in relation to construction".

4) In rural areas common threats encountered include:

- Use of trees as fence posts - bark grows around the barbed wire and in other cases pieces of bark have been cut out to make a recess for fencing rails.

- Some trees have been damaged or have collapsed and re-growth is being continually damaged by grazing stock.

- Trees in arable fields may have their roots continually damaged by ploughing, leading to a general weakening.

- In the more upland sites in particular, some fine black poplars have been found being smothered by coniferous plantations.

5) Very few black poplars are actually offered any form of statutory protection. The wider use of Tree Preservation Orders could be usefully explored with local authorities. Statutory designations need to be carefully considered alongside measures for education and physical protection since there are examples of trees which have died due to compaction caused by hoardes of visitors.

English Nature is presently considering the tree as a candidate for its Species Recovery Programme and it is also being considered for the Red Data Book (P. Tabbush, pers comm).

*Populus nigra* is one of three trees to be considered important enough on a European scale to be considered under the European Forest Genetic Resources Programme (EUFORGEN), operating under the auspices of International Plant Genetic Resources Institute (IPGRI).

6) Whilst *Populus nigra ssp betulifolia* is resistant to the bacterial canker *Xanthomonas populi*, it will succumb to other diseases and an aging population with a narrow genetic base offers little resiliance.

7) There is a lack of understanding of the conservation requirements of the black poplar. In particular, the viability of re-creating floodplain forests or wetland conservation areas as places where *Populus nigra ssp betulifolia* can breed successfully needs to be researched.

8) The general lack of clarity regarding the genetic definition of the sub- species is leading to the confusion of its integrity. The full range of genetic diversity needs to be established and compared with that in Europe.

## 8. ROLE OF THE ENVIRONMENT AGENCY

### 8.1 Distribution

- Staff are out and about in a range of wild and watery environments and could, given simple instructions on black poplar recognition, contribute significantly to the collection of data. Many black poplars are on main rivers.

- The Conservation sections of the Agency have, or are working towards, GIS systems holding information on protected areas. The location of all known black poplars could be mapped into this system. This information should be used in relation to planning consultations, authorisations and operational programmes.

- The Agency comments on a wide variety of planning permission applications, extending beyond the obvious river bank boundaries. Potential threats to black poplars should be highlighted by staff and measures made for their protection. Other groups concerned with their protection should be alerted.

- The Agency must check its own work programmes for all capital and revenue works; on the protection side, this will be already occurring in the majority of situations. In addition, the openings for management by pollarding could be very important in some areas and planting of new trees should be increased.

- Local Environment Agency Plans (formerly Catchment Management Plans) are produced to help the Agency balance the competing requirements and interests of all users, internal and external. This format lends itself to the development of local policies aimed at protecting the black poplar, and can also help to reinforce the existing geographical spread of *Populus nigra ssp betulifolia*. A catchment-based map will be produced for the Conservation Directory to enable a consistent approach to be applied in the production of LEAPs. This map will first be agreed with members of the Black Poplar Working Party.

### 8.2 Education/Advice

- Being in frequent contact with riparian landowners and users, staff have the potential to disseminate information on the protection, management and planting of black poplars. An advisory leaflet may be useful to target key areas. Local initiative areas could be agreed nationally to tie up with the Species Action Plan requirements.

- Black poplar promotion projects could be held with local schools and community groups. These should be accompanied by local publicity in order to maximise the benefit. Since the black poplar can be related to such a range of subjects, it is conceivable that history, archaeology, biology, ecology, geography, maths, craft and the arts could be brought into any prospective teaching material. The black poplar, like many trees, is indeed a truly cross-curricular tree.

- National and European funding for promotional projects could be applied for in collaboration with other bodies such as local authorities and conservation bodies. The Black Poplar Working Group must be consulted on such larger scale projects.

### 8.3 Planting

- The Agency should include black poplar where relevant in conservation planting schemes.

- Conservation Officers and Landscape Architects should promote the local supply of black poplars by investigating and co-ordinating the nurseries in their area that can supply true *betulifolia.*

- Planting of black poplars could make a significant contribution to the development of floodplain forests. Demonstration sites are needed.

## 9. MONITORING

It will be necessary for all planting sites to be monitored to ensure that planted individuals are developing correctly, and are protected from stock damage. It is envisaged that landowners and tree wardens could be involved, together with Agency staff who may be in the vicinity.

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# ENVIRONMENT AGENCY SPECIES ACTION PLAN FOR ENGLAND AND WALES

## LODDON PONDWEED - *Potamogeton nodosus* Poir

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April 1998

## 1. INTRODUCTION

Loddon pondweed, *Potamogeton nodosus*, was identified under R&D Project 461 as a species of conservation priority that was worthy of special consideration by the Environment Agency (then the National Rivers Authority), due to its dependence upon riverine habitats and the scope for the Agency to influence its status. This brief SAP has been produced to guide Agency action on the conservation of the species, acting as a focus for discussion and liaison with other relevant bodies (particularly English Nature).

## 2. DISTRIBUTION AND STATUS

2.1 Loddon pondweed is a rhizomatous perennial with elliptical floating leaves and longer and narrower submerged leaves. Flowering occurs in mid-summer but there is no evidence of the plant setting fruit in field conditions within the UK. In England this species is found within the channel of calcareous and moderately eutrophic rivers. It is present at a wide range of water depths but favours gravel substrates with associated moderately fast flows. In other countries it may be found in a much wider variety of aquatic conditions.

2.2 It was first discovered in 1893 in the River Loddon and later found in the Dorset Stour, Bristol Avon, Warwickshire Stour and River Thames. It is now thought to be extinct from the Warwickshire Stour and has been described as rare in the Thames, but sustains healthy populations at the other three sites. Additional sites have been artificially established in the Loddon, Whitewater and Blackwater Rivers within the last ten years (pers. comm Nigel Holmes). The populations are described as vigorous on the historic sites but are known to vary in abundance from year to year.

2.3 The plant has a global distribution, being found in Europe, North and South America, Africa and Asia, and is the most common broad-leaved *Potamogeton* in southern Europe. It extends its European range as far north as England and the Netherlands.

2.4 In Britain the plant is protected under the Wildlife and Countryside Act 1981. It is a Red Data Book species, where it is assigned a rare status, and under the 1994 IUCN review it has been placed on the vulnerable, lower risk category.

## 3. LIMITING FACTORS

3.1 Loddon pondweed is a plant which is believed to be on the northern extreme of its range within England. It is not recorded as setting viable seed in natural conditions but is able to successfully over-winter and spread vegetatively. Within southern Europe it is known to fruit freely.

3.2 Translocation experiments carried out by N. Holmes in 1988 found that the plants were robust and able to cope with a range of environmental conditions. Water quality, substrate type, water depth and flow conditions were all considered to be minor factors affecting plant survival. It was felt as a result of these studies that physical disturbance of the plants and habitat, and/or direct competition from other aquatic plants, were the principal limiting factors.

3.3 The loss of this species from the Thames appears to be associated with river engineering, resulting in loss of suitable habitat, and disturbance caused by boat traffic.

## 4. CURRENT ACTION

As part of its R&D programme, the Environment Agency has undertaken a desk survey of the distribution and abundance of the species. The Agency has been entirely reliant on the information provided freely by others.

## 5. ACTION PLAN OBJECTIVES AND TARGETS

5.1 Conserve viable and dynamic populations of Loddon pondweed at historic sites for this species on English rivers.

5.2 Restore populations of this species to suitable locations within its former range on the River Thames.

5.3 Support the conservation of this species through an *ex-situ* programme of research.

## 6. PROPOSED ACTIONS WITH LEAD AGENCIES

### 6.1 Policy and legislation

No action.

### 6.2 Site safeguard and management

Action 1: As part of its routine consideration of its own direct actions, consenting procedures and through its role as a statutory consultee on external developments, the Agency should work with other relevant bodies to protect the known sites of this species from inappropriate actions. *Relevant bodies: Agency, EN, local authorities.*

Action 2: Assess the potential for creation of undisturbed habitat to allow the reintroduction of the species within the historic range on the River Thames. If suitable conditions can be created at reasonable cost and/or as a by-product of other activities, these works should take place. An appropriate level of appraisal of the scheme and the existing environment should be carried out beforehand. *Relevant bodies: Agency, EN.*

## 6.3 Species management and protection

Action 3: Subject to the findings of Action 2, undertake translocation experiments to sites on the Thames from herbarium stock or healthy populations on the Loddon. *Relevant bodies: EN; Agency.*

## 6.4 Advisory

Action 4: Through the production and future revisions of LEAPs, the public and relevant bodies should be informed of the conservation importance of Loddon pondweed and the actions proposed by the Agency to assure its protection. *Relevant body: Agency.*

## 6.5 Future research and monitoring

Action 5: Undertake a monitoring programme of the distribution and abundance at selected sites on a three year rolling programme. *Relevant bodies: EN, BSBI, Agency.*

Action 6: Establish a herbarium cultivation programme to investigate seed production and investigate the reasons why wild stocks are not producing viable seed. *Relevant body: Kew.*

# ENVIRONMENT AGENCY SPECIES ACTION PLAN FOR ENGLAND AND WALES

## ROUND-HEADED CLUB-RUSH - *Scirpoides holoschoenus* (L.) Sojak (Cyperaceae)

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April 1998

## 1. INTRODUCTION

The round-headed club-rush, *Scirpoides holoschoenus*, was identified under R&D Project 461 as a species of conservation priority that was worthy of special consideration by the Environment Agency (then the National Rivers Authority). The species is dependent upon coastal dune habitat, over which the Agency has considerable influence through its various responsibilities, including coastal flood defence. This brief SAP has been produced to guide Agency action on the conservation of the species, acting as a focus for discussion and liaison with other relevant bodies (particularly English Nature).

## 2. DISTRIBUTION AND STATUS

2.1 *S. holoschoenus* is a densely tufted rhizomatous perennial species which grows to a height of 1.5 m. Flowering occurs in August/September, but it only produces viable seed in exceptionally hot summers. In the UK it favours dune slacks and low dunes with typical associated flora. It also occurs as an accidental introduction on industrial sites near docks.

2.2 There are two populations considered to be native to the UK, one in North Devon the other in North Somerset. Specimens are known in a few sites in South Wales and southern counties of England. The species occurs in most of central and southern European countries and is also present in Northwest Africa, Siberia and the Canaries.

2.3 *S. holoschoenus* is a British Red Data Book species and is protected under the Wildlife and Countryside Act 1981.

## 3. LIMITING FACTORS

3.1 The majority of the UK population is restricted to a single site at Braunton Burrows. The site was managed as a NNR until recently, and the records for the site indicate a stable population with individual clumps exceeding three thousand (pers. comm. John Breeds). The plant has been known to exist on this site for over three hundred years, but concern has been expressed

that scrub encroachment and a perceived lowering of the water table may have long-term implication to its survival.

The second native site, a deep sandy hollow on a coastal golf course in North Somerset, has a much smaller population in a single clump. Here the plant has been recorded for over two hundred years. There is no evidence that this population has declined but attempts to increase the number of plants by spreading seed from Braunton has not met with any success.

Losses at other sites, notably in Kent and West Glamorgan, have been recorded arising from clearance or redevelopment of derelict industrial sites.

3.2 In common with a number of UK rare species, this plant is believed to be on the northern and western extreme of its climatic range. Limitations to population increase are thought to be caused by the plant's inability to set viable seed in the absence of long hot summers. The evidence from its European distribution suggests that the species is able to withstand far colder winters than it currently experiences within its UK range.

## 4. CURRENT ACTION

As part of its R&D programme, the Environment Agency has undertaken a desk survey of the distribution and abundance of the species. The Agency has been entirely reliant on the information provided freely by others.

## 5. ACTION PLAN OBJECTIVES AND TARGETS

5.1 Monitor existing populations at known sites on a five year programme.

5.2 Ensure that a viable and dynamic population of round-headed club-rush persists at the two native historic sites in Devon and Somerset, through direct management of the site to maintain suitable habitat, and by the control of third party actions requiring authorisations from the Agency and EN.

## 6. PROPOSED ACTION WITH LEAD AGENCIES

### 6.1 Policy and legislation

No action.

### 6.2 Site safeguard and management

Action 1: The primary site at Braunton Burrows was formally a NNR. Problems with the development of a site management strategy between EN and the landowners has led to EN descheduling the reserve. The site remains a SSSI and a World Biosphere Reserve. It is clear that appropriate management of this site and species needs to be maintained. *Relevant body: EN.*

Action 2: Consideration needs to be given to formalised protection and propagation at the second site in North Somerset. No information is currently available on this site in relation to the protective measures in place for the species. *Relevant body: EN.*

Action 3: The Agency should look to consider all of its direct actions and consenting procedures to ensure that the current populations are not adversely affected. *Relevant body: Agency.*

## 6.3 Species management and protection

Action 4: The emphasis should be on site safeguard and protection above, but the viability of enhancing the population at the North Somerset site through artificial means should be investigated. *Relevant body: EN.*

## 6.4 Advisory

No action.

## 6.5 Future research and monitoring

No actions identified.

## 6.6 Communication and publicity

Action 5: The value of the species should be recognised in future revisions of the relevant LEAPs. This will act as a notification to landowners and other bodies of the existence of the species and the proposed protective actions. *Relevant body: EA.*

# ENVIRONMENT AGENCY SPECIES ACTION PLAN FOR ENGLAND AND WALES

# NORTHERN SPIKE-RUSH - *Eleocharis austriaca* Hayek (Cyperaceae)

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April 1998

## 1. INTRODUCTION

The northern spike-rush, *Eleocharis austriaca,* was identified under R&D Project 461 as a species of conservation priority that was worthy of special consideration by the Environment Agency (then the National Rivers Authority), due to its dependence upon riverine habitats and the scope for the Agency to influence its status. This brief SAP has been produced to guide Agency action on the conservation of the species, acting as a focus for discussion and liaison with other relevant bodies (particularly English Nature).

## 2. DISTRIBUTION AND STATUS

2.1 *E. austriaca,* is a green-stemmed perennial similar in appearance to the much more common *E. palustris*, but differing in having more fragile stems. It is easily overlooked and was not discovered in Britain until 1960, following the examination of material gathered in 1947 from the River Wharfe in Yorkshire. In the UK it favours the middle reaches of upland rivers and is most frequently found in more sheltered habitats within the watercourse. It is found on gravels with some silt accumulation where conditions are suitable to allow its stem bases to remain permanently submerged. Populations tend to vary within locations over short periods of time and sites have been recorded and subsequently lost fairly frequently.

2.2 The species has been found to have a fairly wide range in Britain since its discovery, extending from Selkirk to Yorkshire. Within this range it is considered to be scattered, although in its most researched area of Yorkshire the plant has been found to be almost frequent (if ephemeral). The species is recorded as widespread on the continent, ranging across northern Europe and extending south through France and eastward through Russia to Siberia.

2.3 Northern spike-rush is a Red Data Book species and is protected under the Wildlife and Countryside Act 1981.

## 3. LIMITING FACTORS

3.1 There is no detailed information available on population declines, although sites have been recorded as lost due to a change of conditions. Losses have occurred as a result of complete habitat change following river spates. Conversely, prolonged stable flow conditions have resulted in accumulation of fine sediments, providing conditions where *E. palustris* appeared to have had a competitive advantage and replaced *E. austriaca.*

3.2 The species is absent from many apparently suitable habitats within its existing range, but the reason for its absence is not known

## 4. CURRENT ACTION

4.1 As part of its R&D programme, the Environment Agency has undertaken a desk survey of the distribution and abundance of the species. The Agency has been entirely reliant on the information provided freely by others.

4.2 There are currently no specific studies or protective action programme in relation to this species.

## 5. ACTION PLAN OBJECTIVES AND TARGETS

5.1 The information upon which this SAP is based has suggested that this species is obscure and its field characteristics make it easy to miss or confuse with similar commoner species. Since its fairly recent discovery in the UK, its range and abundance has only slowly started to become apparent and it would appear to be more frequent than previously thought. Planned botanical surveys, both locally and nationally, should further clarify the status of this species. The evidence to date would not appear to justify the allocation of specific Agency resources to survey potential habitats for the presence of this species, although it would be valuable to increase the awareness of Agency staff in the field so that *ad hoc* records could be generated.

5.2 The conservation objective for this species should be to ensure the continued presence of viable, dynamic, known populations within its current range.

## 6. PROPOSED ACTION WITH LEAD AGENCIES

### 6.1 Policy and Legislation

No action.

### 6.2 Site Safeguard and management

Action 1: As part of its routine consideration of its own direct actions, consenting procedures and through its role as a statutory consultee on external developments, the Agency should work with other relevant bodies to protect the known sites of this species from avoidable disturbance. *Relevant bodies: Agency, EN, local authorities.*

## 6.3 Species management and protection

No specific action. The emphasis should be on site safeguard and protection above.

## 6.4 Advisory

Action 2: Through the production and future revisions of LEAPs, the public and relevant bodies should be made aware of the presence of the species and the extent of the protective measures in place. *Relevant body: Agency.*

## 6.5 Future research and monitoring

Action 3: Clarification of distribution and status should largely be achieved by the planned survey for this species as part of a wider review of the British flora. *Relevant bodies: EN, BSBI.*

Action 4: Agency staff can enhance the information produced by the above survey by *ad hoc* recording of the species when in the field. This can be promoted by the inclusion of northern spike-rush in the series of awareness leaflets being produced by the Agency for priority species. *Relevant body: Agency.*

Action 5: A research project should be initiated into the ecological requirements of this species. This would lend itself to a M Sc. thesis or similar study. *Relevant body: EN.*