Monitoring the Southern Damselfly

Coenagrion mercuriale

Conserving Natura 2000 Rivers

Monitoring Series No. 8

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Conserving Natura 2000 Rivers

This protocol for monitoring the southern damselfly (*Coenagrion mercuriale*) has been produced as part of **Life in UK Rivers** – a project to develop methods for conserving the wildlife and habitats of rivers within the Natura 2000 network of protected European sites. The project's focus has been the conservation of rivers identified as Special Areas of Conservation (SACs) and of relevant habitats and species listed in annexes I and II of the European Union Directive on the Conservation of Natural Habitats and of Wild Fauna and Flora (92/43/EEC) (the Habitats Directive).

One of the main products is a set of methods for monitoring species and habitats, which complements reports containing the best available information on their ecological requirements. Each report has been compiled by ecologists who are studying these species and habitats in the UK, and has been subject to peer review, including scrutiny by a Technical Advisory Group established by the project partners. In the case of the monitoring techniques, further refinement has been accomplished by field-testing and by workshops involving experts and conservation practitioners.

Conservation strategies have also been produced for seven different SAC rivers in the UK. In these, you can see how the statutory conservation and environment agencies have developed objectives for the conservation of the habitats and species, and drawn up action plans with their local partners for achieving 'favourable conservation status'.

Life in UK Rivers is a demonstration project and, although the reports have no official status in the implementation of the directive, they are intended as a helpful source of information for organisations trying to set conservation objectives and to monitor for 'favourable conservation status' for these habitats and species. They can also be used to help assess plans and projects affecting Natura 2000 sites, as required by Article 6.3 of the directive.

Favourable conservation status

The purpose of designating and managing SACs is to maintain at, or restore to, 'favourable conservation status' the habitats and species listed on annexes I and II of the directive.

The conservation status of a natural habitat can be taken as favourable when:

- Its natural range and areas it covers within that range are stable or increasing.
- The specific structure and functions necessary for its long-term maintenance exist and are likely to exist for the foreseeable future.
- The conservation status of its typical species is favourable.

The conservation status of a species may be taken as favourable when:

- Population data indicate that the species is maintaining itself on a long-term basis as a viable component of its natural habitats.
- The species' natural range is neither being reduced nor is likely to be reduced for the foreseeable future.
- There is, and will probably continue to be, a sufficiently large habitat to maintain its populations on a long-term basis.

The conservation status of a species or habitat has thus to be assessed across its entire natural range within the European Union, in both protected sites and the wider countryside, and over the long term.

Monitoring techniques

The Habitats Directive requires the condition of the habitats and species for which an SAC has been designated to be monitored, so that an evaluation can be made of the conservation status of these features and the effectiveness of management plans. An assessment of conservation status must, therefore, be applied at both site and network level.

Standard monitoring methods and a coherent assessment and reporting framework are essential to allow results to be both compared and aggregated within and across EU member states.

While the directive outlines the data reporting required from member states at a national level, it did not set out detailed assessment techniques for data collection at habitat and species level.

The Conserving Natura 2000 Rivers series of monitoring protocols seeks to identify monitoring methods and sampling strategies for riverine species and the *Ranunculus* habitat type that are field-tested, cost-effective, and founded on best scientific knowledge.

Titles in the monitoring and ecology series are listed inside the back cover of this report, and copies of these, together with other project publications, are available on the project website: www.riverlife.org.uk.

Contents

1 Introduction

The southern damselfly (*Coenagrion mercuriale*) is one of five members of the genus *Coenagrion* currently found in the British Isles. This genus, together with the common blue damselfly (*Enallagma cyathigerum*) and the white-legged damselfly (*Platycnemis pennipes*), constitutes the 'blue damselflies', which are all blue and black in colouration, and of which the southern damselfly is the smallest. It enjoys individual species protection within Europe as a whole, and several European countries (including Britain) have taken complementary legislative measures for protection at a national or regional level (van Tol & Verdonk 1988, Grand 1996). It is the only species of Odonata currently given priority status in the UK Biodiversity Action Plan (HMSO 1995).

The southern damselfly is restricted in distribution at both a global and national level. It is limited to the south and west of Europe and has populations of unknown status in northern Africa. Populations in Italy and northern Africa consist of different sub-species to other European populations (*C. m. castellani* and *C. m. hermeticum* respectively) (Askew 1988). It has disappeared from, or is on the edge of extinction in, seven European countries along the northern boundaries of its distribution (Austria, Belgium, Luxembourg, Netherlands, Poland, Romania and Slovenia) and is declining in three others (Britain, Germany and Switzerland) (Grand 1996).

The southern damselfly has a discontinuous distribution in Britain, restricted mainly to the south and west of the country. Major strongholds of populations are found on heathlands in the New Forest in Hampshire and the Preseli hills in Pembrokeshire, with scattered populations in Devon, Dorset and the Gower Peninsula, in Wales, and single populations in Anglesey and Oxfordshire. There are also large centres of population in water meadow ditch systems surrounding the River Itchen and, to a lesser extent, the River Test. It has disappeared from Cornwall, has declined in Devon and Dorset, and has been lost from St. David's Peninsula in Pembrokeshire. It occurs in two principal habitat types in Britain, heathland streams/valley mires and water meadow ditch systems surrounding chalk streams. It is likely that all of the British sites are now known largely due to surveys that have been undertaken since the production of the UK Biodiversity Action Plan (BAP).

The aim of this protocol is to provide a basis for comparing trends in the relative abundance of adult southern damselflies over time, and to draw attention to features indicative of favourable condition in British sites. It can be read in conjunction with Thompson *et al. (*2003).

2 Background and rationale

To assess the condition of a site it is possible to monitor the species directly by counting individuals, or indirectly by looking at the habitat. Within both these approaches, there are a variety of techniques available requiring varying degrees of time, effort and skill.

2.1 Which stage in the life cycle should be monitored?

It would be possible to monitor the southern damselfly at any one of the stages of its life history – egg, larva, exuvia, and immature and mature adult. The best time in the life cycle to assess the population density of an odonate is a debatable point, although most population ecologists would argue that the number of adults emerging from a site is most appropriate. This can best be obtained by counting exuviae, but is extremely labour-intensive and so not cost-effective.

Monitoring of larval population sizes would have the advantage of being possible at any time of the year, thus freeing up time in the summer for monitoring other species. However, larvae are extremely difficult to sample quantitatively, and time-consuming to identify in comparison to adults. It is also only possible to sample a relatively small section of a stream, and so small populations can be missed completely. Work is currently underway to determine the ecology and habitat preferences of the

larvae (Purse & Thompson 2002, 2003; J. Rouquette, unpublished), but routine monitoring of this life stage is not recommended.

The usual way to estimate the population size of odonates is by counting the number of mature adults, and that is the recommended approach here. Estimating adult numbers has the disadvantage that it can only be done during a narrow time window in the middle of the summer (see below) but can be achieved relatively quickly and easily compared to the other life stages. Therefore, the mature adult population should be monitored.

2.2 How should adults be monitored?

Monitoring of odonate numbers is usually accomplished by using a modified 'Pollard walk' (Brooks 1993, Pollard & Yates 1993). A fixed transect is walked through a site, sometimes within a fixed amount of time, and individuals observed within an estimated 5 m of the observer are counted.

However, the type of monitoring protocol adopted depends on the resources available and what is required from the procedure. If the aim were to generate accurate population estimates of the southern damselfly on a particular site, then mark-release-recapture methods would need to be employed over a large part of the flying season. However, this is too time- and labour-intensive for monitoring on a national scale.

At the other end of the scale, if all that was required was to know if southern damselfly were present on a site, a quick check leading to presence or absence data would be sufficient. Closer to this minimalist end of the monitoring strategy spectrum is a transect that stops when a particular threshold count has been passed. Such a monitoring policy is the quickest and cheapest, and does fit closely with the notion of simply checking to see whether a site is in favourable condition. It also has the advantage that there could be some relaxation of the rather strict environmental conditions in which the recommended monitoring strategy can be carried out. However, this strategy would seem to be missing the opportunity to gather useful population data that would be lost if a transect were to be abandoned once a threshold count had been reached.

Therefore, a transect/timed-count method completed across the site is recommended. For the southern damselfly, standardising counts by fixing the time taken may be inappropriate given that the amount of habitat available is likely to vary widely between sites and that the habitat is sometimes difficult to move through. It is recommended that fixed transects (of measured distance) be walked along watercourses (or mire where streams are more diffuse) and include areas of both high and low concentrations of individuals. This does not allow for absolute population size to be estimated but provides an index of abundance that can be used to assess changes in abundance over time. It is relatively quick and easy to perform and can be standardised across sites.

Only males are counted on transects because they spend longer on site in any given day than females. Females are only present during the time it takes them to lay a clutch of eggs. In addition, males spend almost every day of their mature adult lives at breeding sites, missing only days when weather is unsuitable for reproductive activity. Females only come to breeding sites when they have a clutch of eggs to lay, the frequency of which is not known with any great certainty. Thus the presence of males is a better indicator of population size.

2.3 How does the Index of Abundance relate to the population size?

There is only anecdotal evidence of how sporadic maximum adult counts correspond to annual population sizes. In Aylesbeare Common, Devon, in 1998, 217 adults were observed over the 1998 field season, but the maximum daily count was 75 and the average daily count was 10 (Purse 2001). At

Upper Crockford in 1997, the maximum daily count was 269 (62 on average) but 3,000 adults were marked through the season (Purse 2001). Thus, annual population sizes could be at least 10 times larger than maximum adult counts, and many British populations could contain hundreds of individuals in relatively short stretches of stream or mire.

2.4 How do counts vary over a number of years?

The most exhaustive examples of successive transect counts published to date are those of Jenkins (1991) and Kerry (2001) on two quite contrasting sites. Kerry's study was of a population (Aylesbeare Common, Devon) whose size increased at an extremely high rate following a new management regime that began in 1990. The peak count on this transect rose steadily from single figures to more than 300 between 1991 and 2001.

Jenkins (1991) summarises transect counts over five years (1985–1989) from Britain's most well known and arguably best southern damselfly site, the Crockford Stream in the New Forest. There is remarkable consistency in these counts within each of the four sub-sections recorded by Jenkins (1991). Although the lengths of the transects are not given, from our own knowledge of this site, his figures correspond to peak counts of between 30 and 100 per 100 m. It must be borne in mind that the Crockford Stream is a prolific site and actual population targets for other sites still in favourable condition will be considerably lower than those described here.

2.5 How does this relate to conservation action?

As count data at a particular site build up over an increasing number of years it will be possible to assess changes in population over time. Aylesbeare provides a good example of a site that was in unfavourable condition, but following positive management has recovered well, and this is borne out in the count data. Crockford is in favourable condition, and count data has confirmed that this has been maintained over time.

Conservation action at a site will be triggered if a large drop occurs in the count over subsequent years, or if a small decline is recorded consistently over a longer period.

2.6 Does presence or abundance of damselflies correlate with habitat features?

Counts of individuals provide the most useful information about the status of a population at a given site. However, more data can be obtained on site visits than simple population counts and some of these data can be informative in aiding conservation goals. If, during the surveying period, some assessment can be made of whether the habitat is in a condition favourable to the long-term persistence of the population, then a change in habitat condition at a site may be an early warning that the population is likely to decline.

The southern damselfly requires certain habitat features that have been detailed in Thompson *et al.* (2003). Table 1 shows key and subsidiary habitat attributes (with suggested upper and lower limits) that indicate favourable condition on chalk stream sites in Britain (see Thompson *et al.* 2003 for a similar table for heathland sites). The attributes shown in this table are relatively simple to assess and can form the basis of a monitoring strategy.

Ongoing research (J. Rouquette, unpublished) is taking a detailed look at the habitat requirements of the species in chalk stream habitats, with the aim of producing a model to investigate the strength of associations between southern damselfly abundance and habitat features. It is hoped that this will highlight a few key features that will indicate favourable condition, which can then be used to fine-tune the monitoring strategy.

2.7 How should habitat be monitored?

There are a wide variety of different approaches to habitat monitoring, which require varying degrees of time, effort and skill. Current research in the Test and Itchen Valleys (J. Rouquette, unpublished) has involved the measurement of a large number of physical, chemical and biological characteristics at over 100 known southern damselfly sites. Parameters measured included width, depth, flow, channel morphology, substrate, bank profile, riparian land use, the species and percentage cover of submerged and emergent vegetation, bankside vegetation, and associated macroinvertebrates. A suite of chemical parameters has also been measured, including dissolved oxygen, pH, nitrate, phosphate, suspended solids and so on. However, measuring all of these parameters would be too time-consuming for routine monitoring, and many of the features recorded will prove irrelevant.

River Habitat Survey (RHS) (Environment Agency 2003) could provide much useful information, but is recorded over 500 m. Damselfly sites are often smaller than this and so unsuitable areas will be included. In such surveys, RHS merely collects presence/absence data on channel vegetation types, so important information of relevance to the southern damselfly would be lost. However, it would be useful to carry out an RHS on the larger sites, perhaps only once every six years.

The most appropriate way to monitor habitat for the southern damselfly would be, therefore, to record just a few key habitat attributes annually. This would be quick and easy to achieve and should highlight the most important features of the habitat for the species. It is also desirable to be able to carry out the monitoring from the bankside, as this would reduce the amount of equipment necessary and simplify health and safety issues related to the survey. The features chosen are linked to the favourable condition table (Table 1) but will need to be reviewed in the light of ongoing research.

3 Preparation

3.1 Licensing

The southern damselfly is fully protected under Schedule 5 of the Wildlife and Countryside Act 1981. It is essential, therefore, that all surveyors be licensed by the relevant statutory conservation agency, either English Nature or the Countryside Council for Wales, before any work begins that involves disturbance to the species or its habitat. Processing of licence applications can take from two weeks to four months, depending on pressure of work in the relevant office and whether the application has to be circulated around regional offices.

The licence holder or his/her accredited agent must carry out the surveys. It is, for example, insufficient to supervise surveys from an office by mobile telephone. All licence conditions must be complied with. The surveyor (or accredited agent) should carry a copy of the licence at all times during the survey.

3.2 Access

Permission for access must be sought from the landowner(s) in advance of any survey.

3.3 Health and safety

All field survey work must adhere to health and safety procedures. In surveying adult southern damselflies it should not be necessary to touch water with the skin, but if this does happen, it is important that the surveyors be aware of Weil's disease. In New Forest sites there is also the risk of contracting Lyme disease through contact with ticks, so it is inadvisable to wear shorts. The other main risk near heathland streams is the presence of adders.

Table 1. Key habitat attributes (with suggested upper and lower limits) that indicate favourable condition on chalk stream sites in Britain.

Key habitat attributes	Definition of upper and lower limits for favourable condition
1. Open, unshaded lengths of ditch with slow water velocity or only moderate velocity in the central channel and shallow, slow-flowing areas at the edges.	*Upper limit of extent on site*: 100% of ditch/stream. *Lower limit of extent on site*: Same % of ditch/stream covered by such habitat in last survey or 50% of ditch/stream.
2. Ditch edges with broad fringes of herbaceous emergent and submerged macrophytes, typically including some cover of reed sweet-grass (*Glyceria maxima*), water mint (*Mentha aquatica*), fool's watercress (*Apium nodiflorum*), watercress (*Rorippa nasturtium-aquaticum*) and brooklime/ water speedwell (*Veronica* spp.).	*Lower and upper limit of cover*: 20–80% for both emergent and submergent portions. *Upper limit of extent on site*: 100% of ditch/stream. *Lower limit of extent on site*: Same % of ditch/stream covered by such habitat in last survey or 50% of ditch/stream.
3. Areas of adjacent bankside vegetation with medium-height tussocks.	*Lower and upper limit of height*: 0.2–0.6 m. *Upper limit of extent on site*: 100% of bankside. *Lower limit of extent on site*: Same % of watercourse/mire covered by such habitat in last survey or at least 30% of bankside.
4. Ditch largely unshaded by bankside shrubs and trees.	*Lower and upper limit of scrub or trees shading ditch*: 0–40% cover.
5. Unpolluted conditions indicated by absence of encroaching algae and bacterial film. No invasive tall emergents such as reed canary-grass (*Phalaris arundinacea*).	*Upper limit of extent on site*: 25% of watercourse. *Lower limit of extent on site*: 0% of watercourse.
6. Some cover of silt or other organic substrate in ditch/stream.	*Upper limit of extent of encroachment on site*: 100% of ditch/stream *Lower limit of extent on site*: Same % of mire or watercourse covered by such habitat in last survey or at least 50% of ditch/stream.

Modified from Purse (2001)

3.4 Equipment

- Ordnance Survey base map 1:2500
- Kite net with extending handle
- Recording form
- Digital camera
- Global Positioning System (GPS)
- Clipboard
- Close-focusing binoculars
- Tally counters
- Identification guide (we recommend Brooks & Lewington 2002)
- Suitable clothing reflecting local site and daily weather conditions.

Table 2. Key and subsidiary habitat attributes (with suggested upper and lower limits) that indicate favourable condition for *C. mercuriale* on heathland sites in Britain.

Key habitat attributes	**Definition of upper and lower limits for favourable condition**
1. Open, unshaded, shallow lengths of watercourse/mire with permanent discernible flow (approx. 10 cm s^{-1}).	*Upper limit of extent on site*: 100% of watercourse/mire. *Lower limit of extent on site*: Same % of watercourse/mire covered by such habitat in last survey or at least 50% of watercourse/mire.
2. Stream lengths with cover of submerged and semi-emergent, herbaceous macrophytes including some cover of *Hypericum elodes*, *Potamogeton polygonifolius*, or *Ranunculus flammula*, with some *Carex* spp. or *Juncus* spp.	*Lower and upper limit of cover*: 20–80%. *Upper limit of extent on site*: 100% of watercourse/mire. *Lower limit of extent on site*: Same % of watercourse/mire covered by such habitat in last survey or at least 50% of watercourse/mire.
3. Areas of adjacent bankside vegetation with medium heights of tussocks and/or medium height of emergents in stream.	*Lower and upper limit of height*: 0.2–0.6 m. *Upper limit of extent on site*: 100% of bankside, 50% of ditch. *Lower limit of extent on site*: Same % of watercourse/mire covered by such habitat in last survey or at least 30% of bankside. *Lower and upper limit of scrub or trees shading watercourse*: 0-40% cover.
4. Dystrophic to mesotrophic conditions indicated by a lack of areas of watercourse with encroachment of algae (except brown flocculent algae), bacterial film or invasive tall emergents such as *Juncus effusus*, *J. acutiflorus* and *Phragmites* spp.	*Upper limit of extent on site*: 25% of watercourse. *Lower limit of extent on site*: 0% of watercourse. *Lower and upper limit of scrub or trees shading watercourse*: 0–40% cover.
5. Some cover of peat or other organic substrate in watercourse/mire.	*Upper limit of extent on site*: 100% of mire or watercourse. *Lower limit of extent on site*: Same % of watercourse/mire covered by such habitat in last survey or at least 50% of watercourse/mire.
Subsidiary habitat attributes	**Definition of upper and lower limits**
6. Small areas of tall scrub or trees within 20 m of watercourse or mire but not on intervening habitat between two areas of population.	*Lower and upper limit of scrub or trees shading watercourse*: 0–40% cover.

4 Key monitoring targets

4.1 Population targets

There are at present relatively few published studies of population counts of southern damselfly. Purse (2001) reviewed maximum daily counts of adults at 61 sites and found that maximum counts of less

than 50 adults were recorded in 51% of British sites. Jenkins (1991) recorded transect counts that relate to peak counts of between 30 and 100 per 100 m on the Crockford Stream in the New Forest. In the Itchen Valley Country Park, peak counts of between 20 and 100 per 100 m were recorded between 1999 and 2002 (unpublished data). These are both good sites in favourable condition, and so other sites still in favourable condition may be considerably lower than those described here.

Three targets are recommended:

- Peak number recorded per 100 m in a given time. Population would indicate unfavourable condition if it was less than 'x' per 100 m.
- No drop from one year to the next of greater than 'y' %.
- No drop over three years or longer of greater that 'z' % (where z is less than y).

However, there are a number of difficulties with this approach. It would be almost impossible to provide a number above which a site is said to be in favourable condition and below which it is not. Some sites are inherently going to have a stronger population than others.

Time-series data are much better as trends can be assessed at each particular site over time, but setting targets is still difficult. Insect populations are well known to fluctuate heavily from year to year, and although the southern damselfly does this less than some other species, it does still vary. Presumably, the smaller or more isolated populations will be more prone to large fluctuations. For example, in Anglesey, the peak count recorded on transects fluctuated from 31 in 1997 to 11 the following year, but recovered to 80 in 2002 (Colley & Howe 1999, J. Rouquette, unpublished). A further complication is the two-year life cycle of the species. There is evidence at some sites that the population may be stronger in even years than in odd years, or *vice versa*.

Thus, in the first instance, population targets must be set individually for particular sites and consideration should be given to the maximum count of individuals normally supported on a site (or part of site), based on any available count data. If the number of individuals on a site falls drastically below this target, then action can be triggered. Estimates of population targets can then be improved as successive transect counts over several years, conforming to this standardised method, are made at a site.

In the UK, it is important that the transect data in the possession of various individuals and organisations is collated and added to the BAP Steering Group database. This will aid the production of realistic population targets for individual sites.

4.2 Habitat targets

Key habitat targets are shown in tables 1 and 2. We have tried to provide an indication of the upper and lower limits indicative of favourable condition for each key habitat attribute. However, this is somewhat speculative at this stage and should be reviewed in the light of ongoing research, and as the monitoring programme progresses. Any substantial change from one year to the next should trigger conservation action, unless the result of conservation management work.

5 Timing and frequency

The emergence period for the southern damselfly varies according to latitude and altitude, productivity of the site, and seasonal weather conditions. In the UK, emergence begins at Peaked Hill, in the New Forest in mid-May but not until three weeks later at two sites on the edge of Dartmoor. The flight period is over at some sites by the end of July, but in others it can go on until near the end of August. At the Dartmoor site there were still emerging adults in the last week in July in 2002. Thus the timing of surveys depends to some extent on knowledge of the site being surveyed. In general on UK sites, peak counts are likely to be obtained between 20 June and 18 July, a four-week period.

Activity of southern damselflies peaks between 12:00 and 13:00, British Summer Time (BST), and is highly dependent on weather conditions. It is therefore difficult to plan in advance when monitoring should be carried out. The following conditions should be met and are based on those recommended by Brooks (1993) and Smallshire (2000):

- Counts should take place between 11:00 and 14:00 BST.
- The air temperature in the shade should be above 17°C.
- There should be at least 50% sunshine.
- Wind should not exceed force 4 on the Beaufort scale (no more than leaves and branches moving).

Counts should be made weekly during the four-week sampling window, though the vagaries of the British summer may make this impossible if many sites need to be monitored with limited resources, particularly experienced personnel.

Habitat monitoring only needs to be carried out once per year and should be carried out in the same four-week period. It could be carried out immediately before or after one of the adult monitoring transects.

6 Monitoring strategy

6.1 Identification

The only blue damselflies with which the southern damselfly co-occurs in the UK are the azure damselfly (*Coenagrion puella*) and the common blue damselfly (*Enallagma cyathigerum*). Both of these species are longer and the males are paler blue. Although the 'mercury' mark on the second abdominal segment of males of the southern damselfly is variable, it can never be confused with the characteristic U-shaped mark on the same segment of the azure damselfly or the 'mushroom cloud' mark of the common blue damselfly. Experienced surveyors would not need to catch males to identify them. The use of close-focusing binoculars is recommended to further minimise disturbance.

Females of the southern damselfly can be identified by the shape of the posterior margin of the pronotum, especially by the median lobe (see Brooks & Lewington 2002), but only males will be counted on transects.

6.2 How much to survey

The most appropriate survey unit for comparison is the number of mature adults counted per 100 m of stream/mire length (and time taken to survey). The smallest sites for the southern damselfly (<200m in length) should have a comprehensive survey of the whole site, as these are likely to be in the most immediate danger. Beyond the small sites it is recommended that 100 m be surveyed for each 500 m of suitable watercourse. Exactly which 100 m sections should be surveyed in the larger sites would depend on discussion with local experts and interrogation of the BAP Steering Group database. Boyce (2002) gives estimates of the length of suitable habitat at each site, though his figures need to be reconciled with experience of those who have visited the sites during the flying season. In 2002 GPS data were obtained on the locations in which adults were actually seen (DJ Thompson, unpublished) and these data will be available in the BAP Steering Group database.

6.3 Monitoring adult damselflies

At each monitoring site a transect should start or end at an identifiable permanent point such as a bridge or confluence point. If no suitable points are available then permanent markers should be

installed. The start and end points should be located using a GPS and marked on detailed maps. The transect should include areas of previously recorded high and low concentrations of individuals. Where streams are less than 5 m wide, one transect up the stream should be walked, but where the stream or mire is wider, two or more transects should be walked on different parts of the site. If there is a change in land use or stream characteristics within the transect, the transect should be divided into sections.

When time and weather conditions are suitable, the observer should walk slowly along the route counting all male individuals seen within 5 m. If identification is uncertain, the observer should attempt to catch the damselfly with a net. The time taken to walk transects should be recorded in order to ensure that similar amounts of time are taken on each visit. The order of magnitude of time per unit distance that has been used on past transects is around 10–15 minutes per 50 m of stream. Weather conditions (temperature, wind speed and direction, and amount of sunshine) should also be recorded.

6.4 Monitoring habitat

6.4.1 Annual monitoring of key attributes

Once a year a few key habitat features should be measured. A 10 m strip across the stream should be assessed for every 50 m of transect. The location of each 10 m strip should be recorded with a GPS and marked on detailed maps. Within this 10 m strip the following information should be recorded (the key habitat attribute from Table 1 is shown in italics):

- % cover of emergent broad-leaved herbs – *key habitat attribute 2 (& 1)*.
- % cover of emergent reeds / sedges / rushes – *key habitat attribute 2 (& 1)*.
- % cover of submerged vegetation – *key habitat attribute 2 (& 1)*.
- Bankside vegetation height – mean of 5 random measurements on both banks taken directly with a rule or tape measure – *key habitat attribute 3*.
- Presence or absence of livestock grazing on left and right banks – *key habitat attribute 3*.
- % of channel in shade from bankside shrubs and trees (do not include shading caused by bankside reeds or emergent vegetation) – *key habitat attribute 4 (& 1)*.
- % cover of filamentous algae – *key habitat attribute 5*.
- Channel substrate – % of boulders, pebbles, gravel, sand, silt (including detritus and peat) – *key habitat attribute 6*.

All percentage covers should be estimated by eye to the nearest 1% if less than 10%, or to the nearest 5% if greater than 10%. Always face downstream to determine which are the left and right banks.

Fixed-point photography

A photograph should be taken using a digital camera once a year for each transect/spot check from a fixed point.

6.4.2 Longer-term monitoring

It it recommended that a River Habitat Survey be performed once every six years to provide more comprehensive information. This would be particularly relevant in larger sites. RHS should only be undertaken by an accredited surveyor.

Aerial photography can be used to assess longer-term changes across complete sites. This would be particularly useful to monitor changes in bankside tree and scrub cover. It could also be used to monitor changes in the amount of open water within a ditch system, but care should be taken to ensure that photos were taken at exactly the same time of year and should be interpreted with caution.

7 External data requirements

Site management is likely to have the greatest impact on abundance of the southern damselfly. Information should be gathered from the landowner(s) or statutory bodies regarding any changes to ditch profiles (including dredging, clearing and bank work), changes to flow regime (caused by installing sluices, or siltation), changes to livestock numbers, fencing and so on. Information should also be sought on whether the area is managed under an agri-environment scheme such as Countryside Stewardship in the UK.

Weather conditions can have a major affect on the number of adult damselflies observed, and periods of bad weather are known to increase mortality. Therefore, it would be useful to collect monthly weather data from nearby weather stations, particularly for June and July. Extra care should be taken when interpreting results, particularly following unusual weather events.

The southern damselfly is known to require good water quality, and any pollution incident is likely to have a deleterious effect. The Environment Agency collects routine water quality data and would have information on any incidents likely to have damaged southern damselfly sites.

8 Data analysis and reporting

For the type of survey proposed in this protocol, no sophisticated analysis is required. The data that will be produced are indices of abundance (rather than absolute population estimates) and are thus only comparable with estimates undertaken on the same site in similar conditions. This type of estimate should be good enough to ensure that the status of the southern damselfly is being monitored adequately.

It would be possible to combine the index of abundance from each transect with the habitat information to investigate whether there were any correlations.

Once a time series of data has been collected, the percentage change from one year to the next should be calculated. This could then be used to trigger conservation action or further investigation (see Section 4). If an unexplained decline is observed, requiring further investigation, then a mark-release-recapture investigation and further habitat work could be carried out during the following season.

A short report should be prepared at the end of each season to include a site map, results tables (Excel spreadsheet), a comparison with all previous records, and any site management information. Ideally, the maps and results would also be available on Geophysical Information System (GIS) software. In the UK, surveyors will need to send their results to the relevant statutory bodies (the Environment Agency, English Nature or the Countryside Council for Wales) and also to the BAP Steering Group database manager. At the time of publication (2003) no such individual exists, so the statutory bodies need to find funding for this position.

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Appendix 1. Recording forms for monitoring

Weekly transect

Site	Date	
Recorder		
Start time	Finish time	
Shade temperature °C	Wind direction and speed	% sunshine

Transect section	Tally of male southern damselflies seen	Total
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		

Notes for transect walkers

- Transects should be walked weekly between 20 June and 18 July (generally).
- Counts should take place between 11:00 and 14:00 BST.
- Weather conditions should meet the following minimum requirements:
  - The air temperature in the shade should be above 17°C.
  - There should be at least 50% sunshine.
  - Wind should not exceed force 4 on the Beaufort scale (no more than leaves and branches moving).

Annual habitat survey

Site_____ Date_____

Recorder_____

		% cover at each 10 m spot check							
		A	B	C	D	E	F	G	H
Emergent broad-leaved herbs									
Emergent reeds/sedges/rushes									
Submerged vegetation									
Filamentous algae									
% of channel in shade from bankside shrubs and trees									
Channel substrate:									
	Pebbles								
	Gravel								
	Sand								
	Silt/mud								
Bankside vegetation height									
Left bank:	1								
	2								
	3								
	4								
	5								
	Mean								
Is left bank grazed by livestock?									
Right bank:	1								
	2								
	3								
	4								
	5								
	Mean								
Is right bank grazed by livestock?									

Conserving Natura 2000 Rivers

Ecology Series

1 Ecology of the White-clawed Crayfish, *Austropotamobius pallipes*
2 Ecology of the Freshwater Pearl Mussel, *Margaritifera margaritifera*
3 Ecology of the Allis and Twaite Shad, *Alosa alosa* and *A. fallax*
4 Ecology of the Bullhead, *Cottus gobio*
5 Ecology of the River, Brook and Sea Lamprey, *Lampetra fluviatilis*, *L. planeri* and *Petromyzon marinus*
6 Ecology of Desmoulin's Whorl Snail, *Vertigo moulinsiana*
7 Ecology of the Atlantic Salmon, *Salmo salar*
8 Ecology of the Southern Damselfly, *Coenagrion mercuriale*
9 Ecology of the Floating Water-plantain, *Luronium natans*
10 Ecology of the European Otter, *Lutra lutra*
11 Ecology of Watercourses Characterised by *Ranunculion fluitantis* and *Callitricho-Batrachion* Vegetation

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These publications can be obtained from:

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English Nature
Northminster House
Peterborough
PE1 1UA
Email: enquiries@english-nature.org.uk
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They can also be downloaded from the project website: www.riverlife.org.uk

The Life in UK Rivers project was established to develop methods for conserving the wildlife and habitats of rivers within the Natura 2000 network of protected European sites.

Set up by the UK statutory conservation bodies and the European Commission's LIFE Nature programme, the project has sought to identify the ecological requirements of key plants and animals supported by river Special Areas of Conservation.

In addition, monitoring techniques and conservation strategies have been developed as practical tools for assessing and maintaining these internationally important species and habitats.

The southern damselfly is the smallest member of the blue damselflies, and one of the least common. Once found across much of southwest Europe, it now has a restricted distribution at a global and national level.

The southern damselfly is protected all across its European range, and is the only species of Odonata given priority status in the UK Biodiversity Action Plan.

This report suggests monitoring methods that can be used to determine whether southern damselfly populations are in favourable condition, and what conservation action is necessary for their survival.

Information on Conserving Natura 2000 Rivers and the Life in UK Rivers project can be found at **www.riverlife.org.uk**

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