Otter Breeding Sites

Conservation and management

Conserving Natura 2000 Rivers

Conservation Techniques Series No. 5

Otter Breeding Sites

Conservation and Management

Conserving Natura 2000 Rivers Conservation Techniques Series No. 5

Geoff Liles

For more information on this document, contact:
English Nature
Northminster House
Peterborough
PE1 1UA
Email: enquiries@english-nature.org.uk
Tel: +44 (0) 1733 455100
Fax: +44 (0) 1733 455103

This document was produced with the support of the European Commission's LIFE Nature Programme. It was published by **Life in UK Rivers**, a joint venture involving English Nature (EN), the Countryside Council for Wales (CCW), the Environment Agency (EA), the Scottish Environment Protection Agency (SEPA), Scottish Natural Heritage (SNH), and the Scotland and Northern Ireland Forum for Environmental Research (SNIFFER).

ISBN 1 85716 753 8

A full range of **Life in UK Rivers** publications can be ordered from:
The Enquiry Service
English Nature
Northminster House
Peterborough
PE1 1UA
Email: enquiries@english-nature.org.uk
Tel: +44 (0) 1733 455100
Fax: +44 (0) 1733 455103

This document should be cited as: Liles G (2003). *Otter Breeding Sites. Conservation and Management.* Conserving Natura 2000 Rivers Conservation Techniques Series No. 5. English Nature, Peterborough.

Technical Editor: Lynn Parr
Series Ecological Coordinator: Ann Skinner

Cover design: Coral Design Management, Peterborough.
Printed by Astron Document Services, Norwich, on Revive, 75% recycled post-consumer waste paper, Elemental Chlorine Free. 1M.

Conserving Natura 2000 Rivers

This report on conservation and management of breeding sites for the otter (*Lutra lutra*) 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, while a complementary series contains 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.

This report on identifying, creating and managing otter breeding sites is part of the project's series of publications on conservation techniques. The series also deals with reintroduction methods for the white-clawed crayfish (*Austropotamobius pallipes*), siltation assessment and management, geomorphological surveying for river conservation, and captive breeding of the freshwater pearl mussel (*Margaritifera margaritifera*).

Life in UK Rivers is very much 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.

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 **5**
1.1 Outline 5
1.2 Background 5
1.3 Scope 5
1.4 Sources of information 6
1.5 Limitations 6

2. The timing of otter breeding in Wales and England **7**

3. Otter breeding requirements **8**
3.1 Introduction 8
3.2 Breeding sites 9
3.3 Natal dens 12
3.4 Food availability 14

4. Locating likely and potential breeding sites **15**
4.1 Introduction 15
4.2 Aim 15
4.3 Identifying breeding sites 15
4.4 Identifying natal dens 19

5. A strategic approach to breeding-site conservation **20**
5.1 Introduction 20
5.2 Breeding-site conservation at the catchment and sub-catchment level 21

6. Management guidelines for protecting and creating otter breeding sites **21**
6.1 Introduction 21
6.2 Existing breeding sites – protection and management 22
6.3 Creating new breeding sites 22

7. Recommendations for future work **24**

Acknowledgements **25**

References **26**

Appendix A: Otter breeding sites in Wales **28**

Appendix B: Otter breeding sites in England **34**

1 Introduction

1.1 Outline

This report provides information on identifying the physical and ecological requirements of the otter (*Lutra lutra*) during breeding.

The main aims are to:

- Establish the ecological requirements for otter breeding sites.
- Develop a methodology to locate and identify breeding sites.
- Develop management guidelines for creating or enhancing breeding sites.

1.2 Background

Conservation work for otters in the UK has been carried out since the mid-1970s, and has involved many organisations. This work has included otter and habitat surveys (for example, Jenkins 1982), changes to legislation to protect otters, and practical habitat management schemes. Research into otter ecology in the UK started in the mid-1950s with the publication of the Otter Report (Stephens 1957).

Much of the practical habitat management conservation work carried out for otters has concentrated on the protection or enhancement of riparian habitats (for example, Vincent Wildlife Trust 1985), often in conjunction with the Environment Agency. A particular focus for work in England and Wales has been the protection of otter resting sites, and the creation of suitable habitats or sites in areas not yet colonised by otters (RSNC 2001). Very little work has been directed specifically towards identifying and protecting, or creating, otter breeding sites, due mainly to a lack of information on local otter breeding activity.

The protection of otter breeding sites has often received only passing comment in many of the publications that discuss otter conservation issues (for example, Mason & Macdonald 1986; Foster-Turley *et al.* 1990; Chanin 1993; Kruuk 1995). This lack of emphasis by conservationists on the protection of breeding sites is likely to be due to a number of factors, including a lack of knowledge about such sites and difficulty locating them, and the fact that for much of the last 20 years, otter populations have been absent or restricted in many parts of England and Wales (Andrews & Crawford 1986; Andrews *et al.* 1993; Strachan *et al.* 1990). The significance to otter conservation of protecting breeding sites has been identified in research by Taylor & Kruuk (1990) and Durbin (1996), and is acknowledged in Article 12 of the European Commission Habitats Directive (1992) and in a UK context (JNCC1996).

1.3 Scope

This report focuses on otter breeding in freshwater environments within Special Areas of Conservation (SACs). It is essentially a data collation exercise, with some fieldwork undertaken to collect data on variables to develop a methodology for identifying breeding sites from field signs. Much of the fieldwork focused on three SAC rivers in Wales: the River Teifi, the Western Cleddau, and the River Wye in the Welsh Marches – areas where the author has worked on otters for the last 20 years, and where information on otter breeding activity and sites already exists (G. Liles, unpub.).

1.4 Sources of information

Primary information sources on otter breeding activity and sites were:

- Published research on the otter – for example Green *et al.* (1984), Durbin (1996) and Elmeros & Madsen (1999).
- Other publications, such as Mason & Macdonald (1986) and Kruuk (1995).
- Otter road casualty records, collated by Bradshaw & Slater (1999) and Simpson (1998), and other records held by the author.
- Otter breeding site descriptions (G. Liles, unpub.).
- Unpublished records for otter breeding (for example, K. O'Hara pers. comm., D. Glenn, pers comm., N. Mott, pers comm., G. Woodroffe pers comm.).
- Otter sightings records (G. Liles, unpub. data).

Information on food availability for otters is taken from published research and from data provided by fisheries and conservation staff in the Environment Agency Wales.

1.5 Limitations

The wide variety of sites used by otters as daytime resting places is well documented (Green *et al.* 1984, Mason & Macdonald 1986) and includes underground sites such as tree root systems and rock cavities, and above-ground sites, such as couches (Hewson 1969) in scrub thickets and timber piles. A couch is a mat or platform of vegetation created by otters that can be 1m or more in diameter. Some resting sites are in relatively exposed locations (Green *et al.* 1984, G. Liles, pers. obs.), and appear to offer little protection from disturbance.

In contrast, information on otter breeding and breeding sites (particularly in freshwater habitats) is rare (Durbin 1996) with most of the published research carried out in Scotland. Much of the research into otter breeding ecology carried out in the rest of Europe (for example in Norway) has concentrated on marine environments. Examples of breeding sites used in this report are mainly in freshwater locations, with marine examples used if they can help to shed light on aspects of breeding ecology in freshwater systems.

A major difficulty exists, therefore, when attempting to draw firm conclusions about habitat requirements for otter breeding sites. Despite the amount of effort put into otter surveys, conservation and research in the last 40 years, remarkably few breeding sites have been found and described. In published research, for example, only five papers refer to breeding sites or natal dens (Macdonald & Mason 1980; Harper 1981; Green *et al.* 1984; Taylor & Kruuk 1990; Durbin 1996). A request for information from colleagues working throughout Europe was published in the *Otter Bulletin* (*IUCN Otter Spec. Group Bull.* 18 (1)/2001) but no responses were received.

In order to reach even tentative conclusions about sites on which conservation action can be based, it has been necessary to include information on sites where field signs or direct observations of animals strongly suggest that otter breeding has occurred (for example, Hewson 1969). The obvious problems with using such information are acknowledged. For example, as Taylor & Kruuk (1990) point out, female otters are known to move cubs from the natal den so that evidence of cubs in a holt does not necessarily mean that they were born there.

The unpublished information on specific sites used in this report is described in Appendix A. Every effort has been made to use only information from reputable sources.

Although the broad conclusions of the project are intended to be relevant to a wide range of SAC river catchments, it should be noted that most of the data is derived from south-west, mid- and northern England, and Wales. Some conclusions may not be relevant to lowland catchments in eastern England.

2 The timing of otter breeding in Wales and England

A better understanding of the timing of cub births in Wales and England is important for conservation as it may help to identify a particularly important seasonal food resource and inform site protection and management decisions.

Although otters apparently have no specific breeding season, and cub births have been recorded in every month in different parts of their range, several studies have identified seasonal peaks in births. In Shetland, for example, Kruuk *et al.* (1987) found that otters have a definite breeding season around June. On the coast of Norway, the main birth peak is in late summer and autumn (Heggberget & Christensen 1994). In freshwater habitats in Denmark, most births were also recorded during summer and autumn (Elmeros & Madsen 1999), with the highest frequency of births from July to September.

In Britain, it is generally accepted that there is no birth peak, and that cub births are distributed evenly throughout the year (Stephens 1957, Mason & Macdonald 1986). However, data collected for this project suggest that there may be a bias towards autumn and winter births, at least in Wales.

Data from three sources were used to estimate birth months or seasons:

- Otter road casualties and other mortalities.
- Orphaned otters.
- Reported otter sightings.

Records of otter road casualties and other otter mortality incidents have been kept systematically in Wales (Liles & Colley 2000) and parts of England since 1980, with many carcasses collected for autopsy (Bradshaw & Slater 1999, Simpson 1998). From 1980 to 2000 a total of 261 otter road deaths were recorded in the Environment Agency Wales region, and of these 39 were pregnant or lactating females and cubs. In addition, nine cubs died from other causes.

Birth months can be calculated with some accuracy from pregnant females and cubs of known weight (Stephens 1957). Estimating birth months from lactating females is more problematic, because the period of lactation in otters is unknown and may continue for up to eight months (Kruuk *et al.* 1991).

Seventeen orphaned otter cubs have been retrieved in Wales, usually by the Otters and Rivers Project (G. Liles, pers. obs) or the RSPCA (A. Grogan, pers. comm.), and 11 in England (A. Grogan, pers comm). An estimate of birth months for these animals was based on weight and size, and on whether they were weaned.

Reported otter sightings in Wales have been recorded by the author since 1980. From a total of almost 300 otter sighting records, 36 records involve cubs or families. An estimate of birth month or season has been calculated based on:

- An assumption that cubs that are seen out of the natal den will be at least 2+ months old (Kruuk *et al.* 1991, Durbin 1996).
- The size and description of cubs in relation to adults and from the behaviour of cubs.

Sightings were reported by naturalists (for example, Mathew 1992), people who live next to rivers and lakes, and by walkers and anglers. Everyone reporting cub sightings was interviewed to verify the record, and to gain maximum information.

Based solely on the more reliable data derived from mortality and orphan otter records, results show a clear peak in cub births during autumn and winter (as shown in Figure 1), with 37% of the total birth records in each of these two seasons (G adj. = 9.37, df = 3, $p>0.05$), and only 14% and 12% for spring and summer respectively. The sightings data (Figure 2), also shows a peak, but for the winter months only (58% of the total birth records).

Very little recent information on otter birth dates in England is available, although dates of cub sightings and tracks were collected in Yorkshire between 1991 and 2002 following otter releases in the early 1990s (G. Woodroffe, pers comm.). *Post mortem* studies by Simpson (1998) in the southwest of England appear to show evidence of breeding during the winter although the author points out that the sample

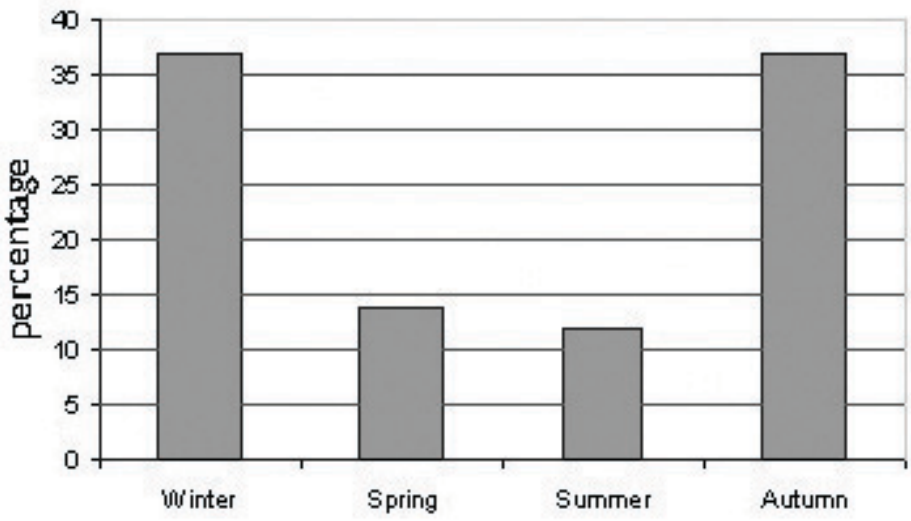

Fig 1. Seasonal distribution of cub births in Wales, based on RTA and orphan cub records (n = 57).

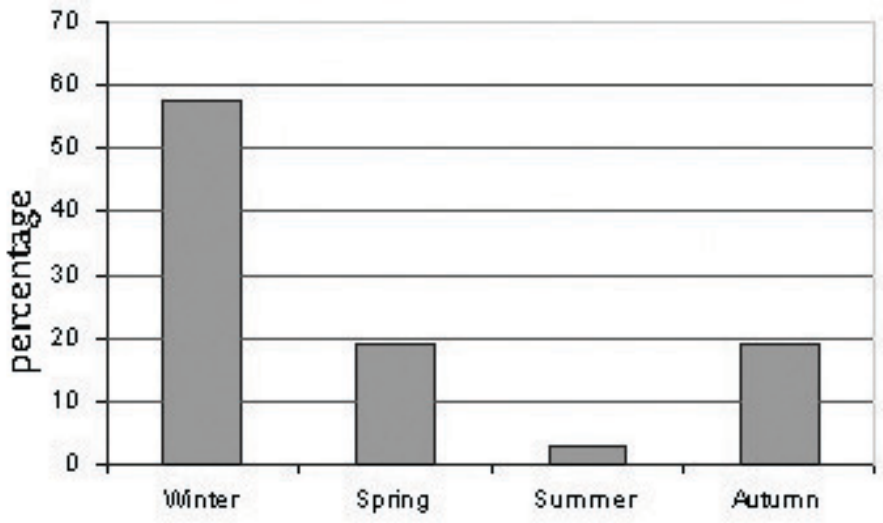

Fig 2. Seasonal distribution of cub births in Wales based on sightings (n=36).

size (six females) is very small. Eleven orphaned otter cubs collected in England by the RSPCA since January 1999 were from Cumbria, Yorkshire, Norfolk, Somerset, Devon, and Cornwall, and numbers per month are spread evenly from July to January (A. Grogan pers comm.)

The existence of a clearly defined breeding season for otters in some parts of their range has been linked to food availability during the period of highest energetic demands on the female (Kruuk *et al.* 1987). Studies in Sweden by Heggerberget & Christensen (1994) and in Denmark by Elmeros & Madsen (1999) support this theory. The apparent autumn/winter peak in births in Wales may also be related to food availability, and this is discussed in Section 3.4.

3 Otter breeding requirements

3.1 Introduction

It is generally assumed that a female chooses a breeding site within her home range that is undisturbed, away from flooding and close to a good food supply (Mason & Macdonald 1986, Chanin 1993, 2003). The following discussion and initial conclusions on habitat requirements are drawn from published

descriptions of otter breeding sites and unpublished descriptions of sites from colleagues, and the author's own experience while studying otters in Wales.

It is important to note that a distinction is made between the breeding site and the natal den. The term breeding site is used to describe an area of land, whereas the natal den is taken to be the small space occupied by the female when she gives birth and where the cubs stay for up to three months.

In terms of conservation the identification and protection of the breeding site should be treated as a priority. Natal dens are obviously important but their existence and security will often depend on the integrity of the wider breeding site in which they are found.

3.2 Breeding sites

The term breeding site is used here to describe an area of land, or open water and land, large enough to provide a breeding otter with:

- Security from disturbance.
- One or more potential natal den sites.
- Play areas for cubs.
- No risk of flooding.
- Access to a good food supply.

Where several discrete areas of suitable cover exist within a few kilometres of a river, it is possible that two or more breeding sites may be available within the home range of a single breeding female.

Although a few descriptions of natal dens are found in the literature, there are no details given of the area, or larger block of cover (the breeding site) in which they were found, although breeding sites can sometimes be inferred from descriptions of natal dens.

For the purposes of conservation, a distinction is made between breeding sites that are **optimal** and those that are **sub-optimal**.

Optimal breeding sites

Experience of otter breeding activity in Wales suggests that optimal breeding sites providing all the conditions described above can be used by otters over a period of many years. At Site 1 (Appendix A) for example, evidence from sightings, surveys and a cub mortality record suggests that the site has been used for breeding for at least 30 years. At the lakes in Pembrokeshire (Appendix A, Site 5) a bitch with very young cubs was first recorded in 1987, and since then sightings of young cubs have been recorded frequently in most years. Evidence for breeding over a number of years has also been recorded at Sites 3 and 4 (Appendix A).

Sub-optimal breeding sites

Although there is little information available on otters breeding at sites that do not provide all the ideal conditions, it is likely that some females (particularly sub-dominant or inexperienced individuals) may give birth at sites that are sub-optimal. At Site 2 (Appendix B), for example, a seemingly suitable natal den site in a hollow tree in which cubs had been born was flooded during the time when the very young cubs would have been inside.

The location of breeding sites within catchments and factors likely to influence the quality of sites are discussed below.

3.2.1 Location within river catchments

Otter breeding sites in freshwater situations described in the literature (inferred from the discovery of natal dens) are generally located on tributary streams (widths 0.7 m to 4 m). With the exception of the lowland lake and dense conifer scrub site situated in the upper section of the River Earn described by

Green *et al.* (1984), there is no reference to their location within the river system.

In Wales breeding sites have been found in all parts of river catchments. For example:

- The upper reaches of a 3 m wide stream (Appendix A, Site 1), and a watershed marsh (J. Higgins, pers comm.).
- The middle reaches (Appendix A, Site 3).
- The lower part of the catchment on the main river (Appendix A, Site 4).
- Close to the coast, on an estuary (Appendix 1, Site 2), and on lakes immediately behind a coastal bay (Appendix A, Site 5).

The two sites in England are in the lower middle reaches of the catchment (Appendix B, Site 2), and on a flood relief channel within 1 km of the coast (Appendix B, Site 1).

It seems that otter breeding sites can be located anywhere within river systems from estuaries to the upper reaches, and on large rivers as well as small streams. They are not restricted to small streams as suggested by Jenkins (1980).

3.2.2 Size

The extent of habitat required to provide optimal conditions for breeding is likely to vary from site to site, and to be influenced by a range of factors including the type(s) and quality of habitat available and the level of disturbance.
Information on site size from both the literature and the two sites in England can only be inferred from brief descriptions. For example, Durbin (1996) describes the block of cover holding the natal den as a narrow (20 m wide) strip of deciduous woodland, and no more than a broad hedgerow (Durbin, pers comm.) but no length of woodland strip is given. The natal dens described by Harper (1981) are in woodland and willow carr, but again the size of the woodland is not given. Similarly, no area is given for the marsh and reedbed in which Taylor & Kruuk (1990) carried out their investigation of the natal den couch.

In Wales, the areas of land considered by the author to constitute discrete breeding sites vary greatly in size, and range from 2 ha to 50 ha. The sites are:

- 4 ha of neglected agricultural land (Appendix A, Site 1).
- 50 ha of wetland dominated by *Phragmites* spp. reed beds (Appendix A, Site 2).
- A 2.1 ha lake (Appendix A, Site 3).
- 3.7 ha of woodland and scrub (Appendix A, Site 4).
- A 30 ha lake system (Appendix A, Site 5).

Although very different in size, all these are discrete blocks of cover or areas of habitat that can be identified as being separate from and different to adjacent or surrounding habitats.

The 4 ha area of scrub and rough grassland at Site 1 (Appendix A) for example, is part of a very much larger area of cover that extends upstream from the site. However, while most of the habitat upstream is dominated by *Molinia* spp., the 4 ha breeding site is a patchwork of dense blackthorn (*Prunus spinosa*), bramble (*Rubus fruticosus*) and gorse (*Ulex* spp). Surveys indicate that natal dens and intensive otter activity (sprainting, pathways through vegetation) are confined to the 4 ha block.

3.2.3 Habitat

The major habitat types associated with otter breeding sites (based on present information) are:

- Extensive reed beds (for example, Appendix A, Site 2, & Taylor and Kruuk 1990).
- Ponds and lakes (for example, Appendix A, Site 3, and the lowland lake in Green *et al* 1984).
- Deciduous woodlands (ranging in size from a 20 m wide strip to several hectares).

- Young conifer plantations (for example, Green *et al.* 1984).
- Extensive areas of scrub (for example, Appendix A, Site1).

None of the breeding sites in the published papers referred to, or known in Wales and England, is in an area of cover separate to and distant from a watercourse. Natal dens have been found some distance from water (Green *et al.* 1984), but the site furthest away (100 m or more) appears to be in habitat that extends down to water and would provide the female with unbroken cover.

3.2.4 Disturbance

A lack of disturbance at breeding sites is an important feature commonly referred to by authors (Mason & Macdonald 1986; Chanin 1993). Most of the known breeding sites in Wales are similarly free from disturbance. However, there are sites described in the literature where a level of disturbance has been noted, but where females appear to be tolerant to it. Durbin (1996) recorded potential disturbance near to a boulder-pile natal den, from a wood-cutting shed, main road, and driveway at distances of 80 m, 120 m and 15 m.

Apart from disturbance by people, the most likely threat is the presence of dogs, especially at breeding sites where natal dens are in above-ground cover such as scrub and reed beds.

Sites 2 and 5 (Appendix A) are open to the public, with well-defined footpaths, and walkers and dogs are often in close proximity to swimming otters (G. Liles, pers obs.; B. Haycock, pers.comm.; Henshilwood 1981). It may be significant that both sites are very large (approximately 70 ha and 40 ha respectively) and both have extensive areas of undisturbed dense cover.

The situation at the lake at Site 3 (Appendix A) would appear to present a high level of disturbance to the breeding female. The house is, in effect, in the middle of the lake, and the natal den is immediately adjacent to the garage. From the many sightings of bitch and cubs reported by the owners, and the length of time that the otter family spend on the lake, it is evident that this level of disturbance does not cause a problem. It is noticeable, however, that the couple living at the house had a relatively quiet lifestyle and were keen not to disturb the otters.

One of the factors that may need to be considered when assessing levels of disturbance that can be accepted by a breeding female is the type of natal dens available to her, and the level of security that they provide. For example, the breeding female at Site 3 (Appendix A) may have been able to tolerate some disturbance because the natal den is underground in the root system of a felled elm. Where otters are giving birth above ground in wetland areas, or in scrub such as at Site 1 (Appendix A) and underground enclosed sites are not available, even low levels of disturbance may prevent breeding at the site.

Few descriptions exist of incidents involving disturbance to breeding females. However, Jefferies (1987) recounts an incident that he witnessed on the Scottish island of South Uist, when a female otter reacted to his presence close to a 'breeding holt' by returning to the 'secure rock holt, some 130 m away', and removing 'a single, very young cub'.

3.2.5 Flooding

The requirement for breeding sites to be away from flood risk is a very important factor identified by most authors. All the sites in the literature at which breeding has taken place, and the optimal breeding sites known to the author in Wales, are above flood levels.

3.2.6 Natal dens

Investigations carried out over a period of three years or more at breeding sites in Wales suggest that:

- At sites where only above-ground cover is available (for example scrub and reed beds) a different natal den may be used each year. At Site 1 (Appendix A) for example, a natal den was found in 1983 under a thicket of gorse (*Ulex europaeus*) and bramble (*Rubus fruticosus*). In subsequent years, field signs suggested that natal dens were located within dense blackthorn

thickets. In 1990, another natal den was found in a sparse bramble clump, approximately 30 m downstream from the natal den found in 1983.

- Underground or enclosed natal dens (for example tree root systems and boulder caves) can be used repeatedly (although not necessarily over consecutive years). At Site 3 (Appendix A), for example, the natal den is in the roots of a very large felled elm stump surrounded by dense rhododendron. A female with young cubs was seen by the resident owner of the site to emerge from the natal den in each of the five years between 1995 and 1999. No records are available before or after this period.
- Because breeding sites vary in size and in the range and quality of habitats, some will provide many potential natal den sites whilst at others only one suitable site will be available.

Natal dens are discussed in more detail in Section 3.3.

3.2.7 Other factors

Cub predation

It is not known whether predation of young otters in the natal den occurs, particularly by foxes (*Vulpes vulpes*), badgers (*Meles meles*), or American mink (*Mustela vison*).

Otter cubs in above-ground natal dens, when left unattended, could be susceptible to predation. There are many instances of adult badgers killing fox cubs (Neal & Cheeseman 1996), but no records of them killing otters (C. Cheeseman, pers comm.). Interestingly, in work on badgers in County Kerry, Ireland, Sleeman *et al.*. (2001) have suggested that otters may be killing badger cubs, although this hypothesis needs to be tested. As reported in the description of Site 1 (Appendix A) the appearance of badger activity within the breeding site has coincided with the abandonment of otter breeding, and this too requires further investigation.

Domestic dogs could also take unattended cubs, especially those left in above-ground natal dens and in enclosed, underground dens with large entrances. Terriers are known to go into occupied badger setts and remove very young badger cubs (G. Liles, pers. obs).

3.3 Natal dens

The natal den is the small space used by the female to give birth and where the young cubs will remain for up to three months. Although relatively few natal dens have been described, some tentative conclusions can be presented on the range of cover and features used; use of bedding; proximity to water; field signs present; and their use over the long term.

3.3.1 Types and location of natal dens

The four types of natal den found during radio-telemetry studies on otters (mainly in freshwater systems) and the natal den exposed during tree management (Site 2, Appendix B) are very different and include enclosed and above-ground sites.

The natal den found by Durbin (1996) in a large pile of boulders (60 m^2 and 2.5 m high) had six entrances into crevices, and the boulder pile was in 'scrub-like' vegetation of nettles, etc. (Durbin, pers comm.). A boulder pile natal den (located as a result of many sightings and field signs) is also known on the main Afon Tywi in Wales (Mathew 1992; G. Liles, pers obs.).

In contrast, a reed couch den was described by Taylor & Kruuk (1990) as being 0.95 m long, 0.75 m wide and 0.4 m high, with a wad of reeds forming a roof. A covered couch similar to that described by Taylor & Kruuk was found recently in a *Molinia*-dominated wetland in Wales (J. Higgins, pers comm.). Green *et al.*. (1984) discovered a natal den with several entrances in an exposed rock face.

Another type of den is represented by Site 2 (Appendix B) where cubs were found in the hollow trunk of a large elm (*Ulmus* spp.) growing on the bank edge of a stream. Otter access to the den was through

a 30 cm hole in the root plate. A natal den has also been located in peat tunnels (Moorhouse 1988) in a coastal situation.

In Wales, 10 natal dens have been located, based on evidence from field signs and comparisons with confirmed natal dens in the literature, and reliable anecdotal information. At two sites (sites 1 and 5) it was possible to describe the shape and dimensions of the natal dens. For the other sites, dimensions were not measured because of on-going studies, or where enclosed situations prevent such reporting.

Four of these natal dens are above ground in scrub thickets and one in a stand of greater tussock sedge (*Carex paniculata*). Each of the natal dens found in scrub had a structure similar to that of the two natal dens found at Site 1 (Appendix A). For example, the den at Site 1 has an overall size of 1.2 m long, 0.68 m wide and 0.37 m high (similar in dimensions to the reed couch den described by Taylor & Kruuk 1990), with a short (0.30 m long) latrine tunnel off the main chamber area. A hollow trunk was used as a natal den at Site 5 (Appendix A) for at least two years, though not consecutively. The natal den was inside the 5 m long trunk, and there were at least three entrances into it.

3.3.2 Bedding

Bedding material has been recorded in most of the natal dens where it could be described, and consists of grass (Durbin 1996); grass and sedge (Appendix B, Site 2); dry fragments of fern (Appendix A, Site 1); and *Phragmites* reeds (Taylor & Kruuk 1990), although in this latter case, the bedding itself formed the natal den. Bedding, in the form of a couch built in a cavity in peaty soil (on an island in a lake), was also used for a litter of three small young otters found by Hewson (1969). At one of the two natal dens discovered at Site 1 (Appendix A) no evidence of bedding was found, and the den floor was compacted earth.

Bedding has also been recorded in daytime otter resting sites (Green *et al.* 1984, Moorhouse 1988), so its use is not unique to natal dens.

3.3.3 Proximity to water

With the exception of the two natal dens referred to by Green *et al.* (1984), natal dens described in the literature, those recorded in Wales and reported here from England are either at the water's edge (Appendix A, Site 3, and Appendix B, Site 2) or are within 3.5 m of water (for example, Appendix A, sites 1 and 5, and Durbin 1996). The den sites described by Green *et al.* (1984) were 40 m from a lake edge, and the other was assumed to be at least 100 m from the nearest stream in a young conifer plantation. The reedbed couch natal den reported by Taylor & Kruuk (1990) is described as being 'close to an open-water ditch', although no distance is given. A couch is a mat or platform of vegetation created by otters that can be 1m or more in diameter.

3.3.4 Field signs associated with natal dens

Spraint

Available information on the presence of spraint close to natal dens (from radio-telemetry studies, and investigations at a known natal den in Scotland and sites in Wales) appears to be contradictory.

In two radio-telemetry studies of breeding females, sprainting activity decreased greatly during the period when the bitch and cubs were resident in the natal den (Green *et al.* 1984, Durbin 1996). In the first study referred to, only one spraint was found beside the breeding holt, and seven within 100 m of it. Taylor & Kruuk (1990), however, found a heavily used sprainting station 1m away from a natal den. Similar heavily used 'sprainting stations' have been found by the author at presumed natal den sites in Wales (see Appendix A), and two of these were in short 'latrine tunnels' that led from the natal den itself.

Pathways

Well-used and very obvious pathways, usually from water to the natal den, have been recorded at most of the natal den sites in Wales (Appendix A, sites 1, 2, 4, and 5), and through a reedbed to a natal den, by Taylor & Kruuk (1990). Again, this is in contrast to the radio-telemetry studies referred to above.

The absence of obvious pathways to some natal dens may be explained by differences in the substrate across or through which the female has to travel.

Play areas

Except for the three cub play areas at natal dens in Scotland described by Green *et al.* (1984), and the three play areas described by the author from breeding sites in Wales (Appendix A), descriptions of cub playgrounds are absent from published research. All the playgrounds described are characterised by a large area of flattened vegetation (for example, 20 m^2 at one site in Scotland) with tunnels and paths centred around either a fallen or standing tree.

3.3.5 Year-to-year use of natal dens

Surveys at Site 1 (Appendix A) over a period of five consecutive years in the 1980s and in two further years in the early 1990s suggest that a different natal den site may be used each year at some breeding sites. The breeding site at Site 1 (Appendix A) covers about 4 ha of neglected agricultural land, and is a patchwork of scrub and tussock grass habitats providing several potential natal den sites. By contrast, Leon Durbin (pers comm.) considers that the boulder pile within the narrow woodland breeding site was the only obvious place for a natal den. However, it is not known whether this site was used in subsequent years.

Anecdotal evidence from Site 3 (Appendix A) suggests that a suitable natal den site can be used in subsequent years (R. & J. Johnston, pers comm.). At this particular breeding site, the tree root natal den beneath the rhododendron is the only available site.

3.4 Food availability

Authors working in different parts of the otter's range, and in both freshwater and marine environments, have demonstrated that seasonal peaks in cub births coincide with the availability of maximum fish biomass at the time when energetic demands on the mother (during lactation when cubs start to receive solid food) are greatest (Kruuk *et al.* 1987; Heggberget & Christensen 1994; Elmeros & Madsen 1999). The abundance and availability of food at that time is not only likely to dictate the nutritional status of the cubs, but also the mother's periods of absence from the natal den (Durbin 1996) and her own nutritional status. A poor nutritional status may result in the female deliberately abandoning a cub to reduce litter size (Kruuk *et al.* 1991).

The apparent peak in otter births in Wales in the autumn and winter months (see Section 2.2) would mean that the greatest energetic demand on breeding females is between January and May. These five months coincide with three events that could provide otters with potentially abundant and readily available prey.

The common frog (*Rana rana*) is widespread throughout Wales and is known to gather in large numbers in suitable habitats to breed from January to March. The appearance of amphibians in the otter's diet, and particularly in the winter and spring, is well documented (Mason & Macdonald 1986). A study on the seasonal exploitation of amphibians by otters (Weber 1990) estimates frog populations during spawning in marshy areas within north-east Scotland to be in the region of 114 individuals per hectare, with 60 individuals per hectare in grassy areas. For one particular marsh, where otters were known to feed on amphibians during the winter and spring, an estimate of 480 frogs per hectare was calculated. Very heavy predation of frogs has been observed over a period of weeks at a spawning pond in south Wales (G. Liles, pers obs).

The presence of large numbers of frogs in a relatively small area could provide female otters with abundant and easily caught prey. In addition, the types of habitat that support significant frog populations (marshes, ponds and lakes) may also provide ideal otter breeding sites.

A second event is the movement of large salmon and sea trout as they continue their migration upriver during autumn and winter floods. During this time, very large fish get into tributaries less than 2 m

wide (D. Scranney, Environment Agency Wales, pers comm.). In January, salmon finish spawning and many die as kelts.

A third event occurs from April to May in Wales, when the main smolt migration for salmon and sea trout starts. These fish are between 12 and 16 cm and accumulate in pools ready for mass migration down to the sea during the night. Otter predation on smolts during the day in May has been reported by Environment Agency Wales staff (D. Scranney, pers comm.).

4. Locating likely and potential breeding sites

4.1 Introduction

The ability to locate and protect otter breeding sites and key feeding resources associated with them is likely to play an increasingly important role in maintaining or restoring otter populations on SAC rivers at favourable conservation status, as required in the EC Habitats Directive (43/93/EEC).

However, locating and confirming that a site is used for breeding is not straightforward. A few breeding sites have been found during radio-telemetry studies on otters (Section 3.2 above) but very few sites have been located and confirmed by colleagues carrying out routine otter surveys on rivers that support widespread otter populations. Following a request for information on breeding sites to colleagues in the Wildlife Trusts Otter Project, only two (N. Mott & K. O'Hara) were able to document suspected or known otter breeding sites. The failure to confirm breeding at sites during surveys is likely to be due mainly to the fact that otters often breed in secure, well-hidden sites (see Section 3.2.4). It is also possible that field signs associated with breeding are overlooked.

It may be possible to confirm otter breeding by carrying out surveys to identify natal dens from field signs, and a methodology for this is suggested below. However, because the methodology is still being developed and is time-consuming, it is not included in the procedure for locating otter breeding sites.

4.2 Aim

The aim of the procedure is to identify sites that are:

- The likely breeding site(s) associated with a known otter breeding event.
- Potential breeding sites where no otter breeding records exist.

The procedure is based on the author's experience of surveying otters in Wales and, in particular, on surveys carried out over several years at sites where otter breeding was suspected or confirmed.

The information collected on likely and potential breeding sites should be sufficient to carry out conservation action (protecting, enhancing and creating breeding sites). If time and resources are available the methodology to identify natal dens can be used at selected sites.

4.3 Identifying breeding sites

The main actions in the procedure are:

- Locate an otter breeding activity site.
- Identify potential otter breeding sites likely to be associated with the breeding activity.
- Identify likely major food resource(s) associated with the breeding site.

If time and resources are available the methodology to identify natal dens can be used at likely breeding sites (see Section 4.4).

Action 1: Locate an otter breeding activity site

The first task is to establish where in the catchment otter breeding has taken place.

Step 1. Interrogate otter records from relevant organisations for evidence of pregnant and lactating females, and cubs

Several organisations in the UK are likely to hold otter breeding activity records, including the Wildlife Trusts; the Environment Agency; English Nature; Countryside Council for Wales; the Royal Society for the Prevention of Cruelty to Animals (RSPCA); and Scottish Natural Heritage.

Other types of otter record can provide information that indicates where in a catchment breeding has occurred:

- Otter road casualty records. Otter road casualty data for Wales are collated by the Environment Agency Wales for the Roads and Otters Steering Group. In England the data are collected within Environment Agency regions.
- Records of young orphan otters (approximately < 4 months). Information on the location of orphaned otters should be treated with some caution. Although some cubs will be found close to where they were abandoned or near where the female has been killed, there may be instances (for example, when rivers are in spate), where cubs may be found several kilometres from where they originated.
- Otter sightings reports.

Information from these records usually provides a precise location (for example, a six-figure grid reference) for otter breeding activity. For some cSAC rivers supporting widespread otter populations, a mechanism for collecting and recording this information may already exist.

Where records are scarce or absent a procedure to gather data on otter road mortalities and sightings should be established (Step 2).

Step 2. Set up procedures to gather data on otter road mortalities and sightings

A mechanism to collect and collate otter road mortality information should already exist (Note Step 1). For collecting recent historical and contemporary information on sightings of cubs and orphans three approaches can be used:

- A general approach to the public through media publicity.
- A targeted campaign aimed at people living near cSAC rivers. Many people see otters but do not report the sighting to conservation organisations unless they are requested to do so. In a well-publicised campaign to record otter sightings in Wales (called *Have you seen an otter?*) over 250 otter sightings were reported between 1985 and 1998, and many of these were corroborated sightings of cubs (G. Liles, unpub. data). As part of this project, farms and houses close to the middle and upper reaches of the main Afon Teifi were visited to ask owners for information on otter sightings. Out of 27 farms and houses visited, 23 (85%) reported seeing otters, and seven of those (30%) were cub sightings.
- A request for information from anglers through local angling clubs.
- A request for information from the RSPCA.

Action 2. Identify potential breeding sites

Steps 1 and 2 above should provide a point location for otter breeding at a particular place within the river catchment. For most of these records it is assumed that the location of the animal found or seen is relatively close to the breeding site, or at the very least, is within the breeding female's home range.

The aim of the next three steps is to locate blocks or areas of cover that lie within the likely home range of a breeding female that can provide potential habitat for a breeding site. The three steps are:

- Step 3. Establish a search area.

- Step 4. Identify likely or potential breeding site(s).
- Step 5. Confirm potential breeding sites through field surveys.

Steps 3 and 4 are accomplished through a desk study. Step 5 requires field surveys to determine the potential of habitats as breeding sites based on factors such as habitat quality and levels of disturbance.

Step 3. Establish a search area (desk study)

The precise location of known otter breeding activity provides a point around which an approximate home range for a breeding female can be calculated. It is within this geographical area that a search is made for potential breeding sites.

Establish the boundary of the search area on a 1:25000-scale map by selecting the stretches of watercourse and areas of wetland likely to be used by the breeding female associated with the otter breeding activity site. The amount of waterway encompassed within the search area is based on either the total length of waterway (15 km) or the area of water (20 ha) thought to constitute a female home range. Calculating 20ha of water may be possible using GIS mapping software such as MapInfo.

Although the location of the known otter breeding activity provides a point around which the search area can be calculated, it does not necessarily form the centre point of the search area. For ease of reference, boundaries of the polygon are drawn to coincide with 10 km national grid lines.

Step 4. Identify likely or potential breeding sites (desk study)

Habitats likely to provide suitable cover for breeding include:

- Extensive reed beds.
- Lakes and ponds.
- Deciduous woodland.
- Young conifer plantations.
- Extensive areas of scrub.
- Features such as large areas of blockstone or boulders, and buildings/structures immediately adjacent to watercourses.

Based on present knowledge, it is likely that most otter breeding sites will be adjacent and linked to a watercourse, wetland or waterbody (even if natal dens are some distance from the water's edge). However, in view of the paucity of information on breeding sites available, potential sites that are not directly connected to water should be considered. Locate areas of cover within the search area likely to provide breeding habitat, using:

- OS Explorer or other large-scale maps.
- Phase 1 habitat maps. These are available for much of England and Wales, and are held by English Nature and the Countryside Council for Wales. The maps, at a large scale, show the type of habitat in each parcel of land identified using a standard colour and symbol code.
- Aerial photograph. Digital aerial photographs are usually available at 1:10000 scale, and can be used either in conjunction with Phase 1 maps (to ensure that areas of suitable cover are not overlooked), or instead of them, where Phase 1 maps are not available. Organisations that old copies of aerial photographs include English Nature; the Countryside Council for Wales; county councils and national parks.
- UK Environment Agency River Corridor Surveys.
- Information from local Otter Projects. Detailed assessments of habitat availability and potential refuge sites for otters exist for some catchments, such as the Thames (G. Scholey, pers comm.).

Check whether any areas have nature reserve or similar status, and gather relevant information on sites, using information from organisations such as the Wildlife Trusts, RSPB, English Nature and the Countryside Council for Wales.

Check whether any sites are subject to flooding using the Environment Agency Geophysical Information System (GIS) Indicative Flood Plain Mapping. Maps are compiled by the Environment Agency to identify areas at risk from flooding (see Plate 5). The likelihood and frequency of flooding at potentially important sites should be checked with local Environment Agency flood defence engineers. Floodplain areas should not automatically be excluded as they may support breeding sites.

Step 5. Confirm potential breeding site through field surveys

The aim of the survey is to determine whether areas of cover selected in Step 4 satisfy the requirements for otter breeding sites.

It may be reasonable to carry out the survey at a time of year when otter breeding at the site has been recorded previously. However, caution should be exercised in adopting this strategy since breeding activity may take place outside this period. In many instances, there will be no previous breeding site records. Landowner permission for surveys is vital.

The following survey methodology is intended to provide a brief assessment of cover and the likelihood of disturbance within the potential breeding site.

Survey methodology

General

- All watercourses within the site should be walked, including very small streams.
- Ideally, surveys should be conducted along river or stream beds (using waders), in order to reduce disturbance and damage to bankside habitats.
- A range of photographs should be taken to show important features.

During the survey the following information should be recorded and mapped (using large-scale maps):

- Habitat types and land use (within and immediately surrounding the site).
- Size and description of watercourses, wetlands and waterbodies.
- Specific habitat features that could provide natal dens, such as very dense scrub, large boulder piles and areas of tussock sedge.
- Disturbance – extent, levels, and type (for example, people, dogs and livestock).

Action 3. Identify major food resource(s) associated with the breeding site

Although the distances from breeding sites to feeding areas travelled by breeding females with dependant young are not known, it is assumed that an abundant food supply will be located within a few kilometres of optimal breeding sites so that time away from cubs, and energy demands on the female are kept to a minimum.

Step 6. Locate likely food resource(s)

Sites most likely to provide an abundant food supply include:

- Watercourses with known good fish populations.
- Estuaries and coastline.
- Amphibian breeding sites (ponds, lakes and wetlands).
- Fish farms and still water fisheries.

Information on fish distribution and population densities in England and Wales is available from the Environment Agency.

Little information is available on the location of amphibian breeding sites, although some sites may be recorded by the Countryside Council for Wales, English Nature and the Wildlife Trusts.
Potential significant amphibian breeding sites may be identified from large-scale maps, Phase 1 maps and River Corridor Surveys.

Fish farms and still-water fisheries can be located through the Environment Agency and are often shown on large-scale maps. Otter predation incidents for some sites may have been recorded by the Environment Agency and the local otter project.

The value to otters of potential amphibian sites and fish farms/still water fisheries can be verified through surveys carried out at the appropriate time of the year.

4.4 Identifying natal dens

Experience of surveying otter breeding sites in Wales (G. Liles, pers. obs) and evidence from some published research (for example, Moorhouse 1988, Taylor & Kruuk 1990) suggests that, where substrate and cover allows, natal dens can be located together with recognisable field signs. Field signs include:

- The sudden appearance of a heavily used path or paths, from the water, usually into dense cover or an enclosed structure, such as a tree root system or a hollow trunk.
- A natal den, usually only visible at above-ground sites such as scrub thickets and reed beds.
- A latrine containing a very large number of spraints at the natal den, and usually within 1 to 2 m of it.
- A cub play area – for example, a well-worn path around a tree or in a circle up and down the bank.

At breeding sites that are used over a period of many years, some features such as cub play areas can be visible throughout the year (see Appendix A, Site 1).

It should be stressed that the methodology outlined below is still being developed. Information from radio-telemetry studies at breeding sites and natal dens provides conflicting evidence regarding the presence or absence of field signs at natal dens (Green *et al.* 1984, Taylor & Kruuk 1990), and further research into this aspect of otter breeding ecology is needed. The methodology is included here in the hope that it can be tested at some sites as a final part of the procedure to locate potential otter breeding sites.

Survey methodology

General

- All watercourses within potential breeding sites should be searched, including small streams.
- Ideally, surveys should be conducted along river or stream beds (using waders) to reduce disturbance and damage to bankside habitats.
- Photographs should be taken to show important features.

Survey timetable

The timing of surveys at potential breeding sites is critical, and should be organised so that the site is not disturbed from the period immediately before assumed breeding all the way through to the time when cubs leave the natal den.

A survey should be carried out in each of the seasons leading up to the assumed month of breeding activity (based on the date of the original breeding activity report), and again three months after breeding is assumed to occur. So, for example, if the assumed breeding month is December, the survey programme (with survey months underlined) would be:

December January February

March April May

June July August

September October November

Information to be recorded and mapped (using large-scale maps), during the survey should include:

- ***Otter activity***
  - Location and description of all sprainting sites, and numbers of spraints (recorded as 'fresh', 'recent' and 'old').
  - Size of otter prints.
  - Otter resting sites, including a detailed description of evidence for past and present use.
  - Evidence of otter play areas, such as paths around trees, 'slides' down banks, and a description of the evidence for past or present use.

- ***Mammal activity***
  - Mammal pathways (and species if known) within 10 m of the water. Particular attention should be given to paths that lead from the water onto the bank. Detailed descriptions of these are needed, including width of path, height of bank, habitat into which path leads, evidence for past or present use.
  - Mammal signs, especially those of badgers, mink and dogs.

- ***Additional information***
  - If signs of breeding activity are found in any of the surveys, additional information is needed – spraints at latrines should be collected for analysis.
  - Natal dens (and otter access paths), should be recorded on sketch maps with dimensions noted.
  - Cub play areas should be recorded and sketched, with dimensions.

5 A stategic approach to breeding-site conservation

5.1 Introduction

One of the main aims for otter conservation in SACs is to ensure that otter populations in the catchment can be sustained at a favourable conservation status. For this to be achieved, suitable breeding sites must be available throughout river catchments from estuaries to headwaters, and including main rivers and small streams.

It is proposed that the conservation of otter breeding sites should be tackled at the river catchment or sub-catchment level.

Three conservation actions are likely to be required in order to ensure that breeding sites are available:

- Protecting existing breeding sites (both actual and potential).
- Creating or enhancing new sites for otter breeding.
- Protecting or creating feeding sites associated with breeding sites.

All three actions are likely to be required in most river catchments, but it will be important to establish priorities for the catchment that identify the type and location of work required. The procedure outlined below is designed to provide an overview of habitats suitable for otter breeding and feeding so that priorities can be established.

5.2 Breeding-site conservation at the catchment and sub-catchment level

The procedure for identifying priorities for otter breeding site conservation described below can be used for all SAC catchments regardless of the present status of otters. Although the procedure as described assumes that otters are present, it can be applied to catchments where otters are absent or in very low numbers by omitting Section 5.2.1 (l).

5.2.1 Identifying priorities

1. Locate and map all likely breeding sites associated with breeding activity records within the catchment or sub-catchment using the procedure described in Section 4.
2. Identify potential breeding sites on parts of the catchment where no breeding activity records exist, using Phase 1 Habitat Surveys, River Corridor Surveys, aerial photographs, and information from otter project surveys.
3. Use information from 1 and 2 above to identify parts of the catchment where cover for breeding sites is scarce or absent.
4. Identify parts of the catchment where fish populations are poor, using Environment Agency fishery data.

5.2.2 Conservation action

Steps 1 to 4 above provide an overview of both the distribution of available breeding sites within the catchment or sub catchment, and parts of the catchment where breeding habitat and feeding sites are scarce or absent.

To ensure that suitable breeding sites are available throughout catchments, it is recommended that:

- All likely and confirmed breeding sites and feeding sites associated with breeding activity records are protected (by extending the boundaries of SACs where necessary).
- A selection of the best potential breeding sites and feeding sites are protected.
- Breeding sites are created in parts of the catchment where likely and potential sites are absent or very scarce to ensure that suitable habitat is available throughout the catchment.

Overall priority for conservation action should be given to the protection and management of likely or confirmed breeding sites and associated feeding sites. It should be noted, however, that some of the habitats that provide breeding cover (for example, the early years of a newly planted conifer plantation) will have a limited lifespan. The long-term protection of these sites may not be appropriate.

Recommendations for practical management work at specific sites are described in Section 6.

6 Management guidelines for protecting and creating otter sites

6.1 Introduction

These guidelines cover:

- The protection and management of existing breeding sites (likely, confirmed and potential).
- The creation of new breeding sites.

6.2 Existing breeding sites – protection and management

6.2.1 General guidance

- Likely, confirmed and potential breeding sites should be protected from destruction, damage and disturbance. The aim should be to protect the entire site.
- Practical management within the breeding site should normally take place outside the breeding period.
- Depending on the range and quality of habitats within the breeding site, some practical habitat management may be necessary to maintain its value as a breeding site – for example at breeding sites where opportunities for otters to establish natal dens are limited, and where existing suitable sites or cover deteriorates, work may be needed to replace or improve habitats.

6.2.2 Practical habitat management options

- A rise in water levels in wetlands may reduce areas of dry land. Water levels can be manipulated to maintain dry 'islands' (although consent may be required).
- Some natal den structures (for example, hollow tree trunks, piles of timber) have a limited lifespan and will eventually collapse. Where alternative opportunities for natal dens are poor, suitable replacements can be created (for example through scrub planting) or constructed, such as logpile holts, which will last for approximately 10 years (G. Liles, unpub. data).
- Livestock trampling can damage and destroy dense cover and open up areas to disturbance. It may be necessary to erect or repair stock-proof fencing.
- Blackthorn and gorse thickets can provide very dense secure cover when young, but become tall and 'leggy' with age. Coppice management can be used to regenerate dense cover at ground level.
- On some river catchments rhododendron and laurel thickets provide the best cover for otters and may constitute vital cover in some breeding sites. The reduction and elimination of these alien species should be carried out in stages, replacing with native scrub to provide cover within breeding sites.
- Natal dens within the root system of large, mature trees growing on the banks of watercourses and waterbodies and leaning over the water may be vulnerable to collapse or tree management. Coppicing or pollarding can help to ensure that the tree will not topple over, and may greatly increase the lifespan of the natal den. Care must be taken to ensure that the den is not in use when management is to be carried out.
- Some areas of land already protected as nature reserves and established to protect habitats and species other than otters, may also provide otter breeding sites. Habitat management of these sites (for example, the removal of scrub from extensive reedbeds to encourage bitterns) can conflict with the interests of otters. It is likely that only relatively small areas within the nature reserve (for example, 10 m x 10 m patches of dense scrub or logpile holts) need to be maintained in order to provide potential natal dens for otters.

6.3 Creating new breeding sites

6.3.1 General guidance

A number of factors should be considered when deciding where to create a new otter breeding site.

- The site must be free from any risk of flooding, and in an undisturbed area (or where the large size of the site means that public and livestock access can be controlled).

- Breeding sites can be created on any part of the river catchment (regardless of the size of the watercourse) but a major consideration must be the proximity of the site to a likely food supply.
- Where possible, preference should be given to enhancing sub-optimal sites. Existing nature reserves and land already managed for wildlife in agri-environment schemes (such as Tir Gofal in Wales) may provide ideal habitat enhancement opportunities.
- Sites should be as large as possible, and contain a range of habitat types and features that can provide potential natal dens.
- Care should be taken to avoid creating breeding sites on watercourses where females and cubs are likely to be vulnerable to road traffic. Typical situations where this may occur are:
    - At bridges and culverts that are impassable to otters at high water.
    - At watersheds that are bisected by a road.
    - Where otters are likely to take a short-cut while travelling, or to reach a feeding site.
- In situations where these threats cannot be avoided, it may be possible to build-in mitigation measures (for example, dry otter culverts or bolt-on ledges, and otter fencing), to reduce the threat. For further information on road mitigation measures see Grogan *et al.* (2001), and Liles & Colley (2000).
- Breeding sites should not be created within 10 km of a fish farm or stocked lake unless the fishery owner has been consulted and agreement reached on the acceptance of likely losses of fish to otters, or the construction of an otter barrier such as fencing. For further details on excluding otters from fisheries, see Liles (1999).

6.3.2 Design and construction

The following suggestions for the design and construction of otter breeding sites are relevant for enhancing sub-optimal sites and creating new breeding sites.

The design aim should be to create a mosaic of habitats (that can be based on one dominant habitat type) to maximise the variety of natal den sites that are available. Examples are:

- **Woodland**. Mature woodlands with sparse ground cover often have little value for otters, partly because there are few natal den sites, and because open woodlands are easily disturbed. The aim should be to create woodlands with a widespread scrub layer, and specific features that can provide potential natal den sites. Two possible features are areas devoid of trees and dominated by dense scrub (using 10 m x 10 m as a minimum area), especially bramble (*Rubus fruticosus*), dog rose (*Rosa canina*), and gorse (*Ulex europaeus*); and logpile holts. Ideally, features should be within a few metres of water (including very small streams and ditches). The woodland scrub layer should be maintained by coppice management to ensure dense cover at ground level.
- **Scrub**. Large areas of scrub, or rank grassland with scrub, are likely to provide good breeding sites because natal den sites are often abundant, and human access is difficult. An advantage of creating a scrub breeding site is that, where water tables are suitable, amphibian ponds can also be established to provide otter feeding sites.
- **Wetlands**. Where wetlands are created, the mosaic of habitats can be achieved by, for example, building up dry islands on which local scrub species can be planted or a logpile holt constructed, and by creating areas of open water. In very big sites it may be possible to create a network of 2 m wide waterways that link areas of open water. Specific features that provide natal dens sites (such as dry islands) can be situated close to open water or a watercourse.

7 Recommendations for future work

Further research is urgently needed into all aspects of otter breeding ecology and behaviour. In particular, far more information is needed on individual breeding sites. Although there are many problems inherent in studying breeding sites, work on the present project has identified two potential opportunities:

- All natal dens and breeding sites previously identified through research, and confirmed through field evidence and sightings, should be investigated for recent evidence of breeding and studied in detail where appropriate.
- Evidence for otter breeding and breeding sites is occasionally discovered by chance by colleagues working on other aspects of otter conservation and research. A mechanism to rapidly provide funding and personnel to take advantage of this opportunity to investigate breeding sites in detail could be established.

Specific topics for investigation are outlined below:

- The differences between optimal and sub-optimal breeding sites.
- The size that breeding sites need to be to offer ideal conditions for otter breeding in relation to levels of disturbance.
- The role that disturbance plays in determining where otters will breed, particularly in relation to proximity to disturbance, type of disturbance, the habitat structure of the breeding site, and the types and location of natal dens.
- Predation of otter cubs by mammals such as badgers, foxes and dogs is not known to occur. However, otter cubs born in above-ground sites could be vulnerable to predation.
- Bedding has been recorded in natal dens but is also found in daytime resting sites. As part of a study to investigate otter use of logpile holts (G. Liles, unpub. data) bedding was removed from several holts and mammal hair was extracted and identified (Cowell *et al.* 2001). Many otter hairs were found in the bedding. However, there appears to be no method for identifying adult from cub hair. The ability to identify very young (<3 months old) cub hair would provide a valuable tool for confirming otter breeding.
- Eels (*Anguilla anguilla*) are an important part of the otter's diet in most habitats, and may be particularly important during breeding. However, very little is known about trends in eel populations.
- The proposed methodology for identifying natal dens should be tested in different types of habitat.
- The provision of otter breeding sites in areas where natural sites are scarce or absent may be especially important for some river catchments. SAC rivers that support good otter populations offer the ideal opportunity to experiment with management techniques to enhance or create breeding sites. Monitoring of results will be essential.

Acknowledgements

I would like to thank the **Life in UK Rivers** Ecological Co-ordinator, Ann Skinner, for all her help, support and patience throughout this work.

Many colleagues very kindly provided information on a range of otter breeding related topics, such as the timing of and evidence for otter breeding. I am especially grateful to Adeline Bradshaw, Jim and Rosie Green, Gordon Woodroffe, Adam Grogan, Jamie Bevan, Rob Colley, Brian Dove, Tom Fairfield, Jonathan Gilpin, Duncan Glenn, Chris Hall, Bob Haycock , Jenny Higgins, Sylvia Jay, Jimmy Jones, Chris Lawrence, Neil Mathew, David Mackinnon-Wood, Nick Mott, Jane O'Dwyer, Kevin O'Hara, Nina Pritchard, Fred Slater, Graeme Smart, Jonathan Stone, Dave Welton, James Williams, Laura Winter, and to Paddy Sleeman for information on badgers and otters.

Thanks also to Ben Wilson, Dan Forman and Adeline Bradshaw for their help with the production of maps and graphs, and to Dave Scranney and Ben for their advice and information on fish distribution and behaviour.

Several landowners kindly gave me permission to survey, but special thanks are due to Ray and Judy Johnstone, Eileen Haddow, Mr Absalom and Mr and Mrs Morgan for their cooperation and information.

Finally my thanks to Graham Scholey and Ruth Warren for their very helpful comments on the report.

References

Andrews EM & Crawford AK (1986). *Otter survey of Wales 1984–85*. The Vincent Wildlife Trust, London.

Andrews E, Howell P & Johnson K (1993). *Otter Survey of Wales 1991*. The Vincent Wildlife Trust, London.

Bradshaw AV & Slater FM (1999). Dead otters: *Post mortems and Tissue Analysis*. R&D Technical Interim Report. Llysdinam Field Centre, Cardiff School of Biosciences, Cardiff.

Chanin PRF (1993). *Otters*. Whittet Books, London.

Chanin, PRF (2003). *Ecology of the European Otter* Lutra lutra. Conserving Natura 2000 Rivers Ecology Series No. 10. English Nature, Peterborough.

Cowell D, Thomas G, Liles G, Bradshaw A., Midgley L, Slater F. (2001). Monitoring the use of artificial log pile otter holts using hair analysis from bedding. *IUCN Otter Specialist Group Bulletin* 18, 1.

Durbin I (1996). Some changes in the habitat use of a free-ranging female otter *Lutra Lutra* during breeding. *J. Zool. Lond*. 240, 761–764.

Elmeros M & Madsen AB (1999). On the reproduction biology of otters (*Lutra lutra*) from Denmark. *Z. Saugetierkunde* 64, 193–299.

Foster-Turley P, Macdonald SM, and Mason CF (1990). *Otters, an action plan for conservation*. International Union for the Conservation of Naure, Gland.

Green J, Green R, and Jefferies DJ (1984). A radio-tracking survey of otters *Lutra lutra* on a Perthshire river system. *Lutra* 27, 85–145.

Harper RJ (1981). Sites of three otter (*Lutra lutra*) breeding holts in freshwater habitats. *J. Zool. Lond*. 195, 554–556.

Heggberget TM & Christensen H (1994). Reproductive timing in Eurasian otters on the coast of Norway. *Ecography* 17, 339–348.

Henshilwood DA (1981). *Status and diet of the otter (*Lutra lutra*) at Bosherston Lakes*, Dyfed. unpublished report, Nature Conservancy Council, Peterborough.

Hewson R (1969). Couch building by otters *Lutra lutra*. *J. Zool. Lond.* 159, 524–527.

Jefferies DJ (1987). The effects of angling interests on otters with particular reference to disturbance. In: Maitland PS & Turner AK (eds). *Angling and Wildlife in Fresh Waters*. Institute of Terrestrial Ecology, Grange-over-Sands, 23–30.

Jenkins AL (1982). *Otter distribution on the Western Cleddau*. Vincent Wildlife Trust/Nature Conservancy Council, Aberystwyth. 91pp.

Jenkins D (1980). Ecology of otters in northern Scotland. 1. Otter (*Lutra lutra*) breeding and dispersion in mid-Deeside, Aberdeenshire, in 1974–79. *J. Anim. Ecol*. 49, 713–735.

Kruuk H (1995). *Wild Otters. Predation and Populations*. Oxford University Press, Oxford.

Kruuk H, Conroy JWH & Moorhouse A (1987). Seasonal reproduction, mortality and food of otters (*Lutra lutra* L.) in Shetland. *Symp. Zool. Soc. Lond.* 58, 263–278.

Kruuk H, Conroy JWH & Moorhouse A (1991). Recruitment to a population of *Lutra lutra* in Shetland, in relation to fish abundance. *J. Applied Ecol.* 28, 95–101.

Liles G. (1999). *Otter (*Lutra lutra*) predation at still water fisheries: Guidance notes for Advisors*. The Wildlife Trusts, Lincoln.

Liles G & Colley R (2000) *Otter* Lutra lutra *road deaths in Wales: Identification of accident blackspots and establishment of mitigation measures*. Environment Agency Wales, Aberystwyth.

Mason CF & Macdonald SM (1986). *Otters: Ecology and Conservation*. Cambridge University Press, Cambridge.

Mathew NR (1992). Some observations of the otter (*Lutra lutra*) on the River Tywi at Llandeilo. *Llanelli Naturalists Newsletter*. Summer 1992, 23–39.

Neal E & Cheeseman C (1996). *Badgers*. T & AD Poyser Natural History, London.

RSNC [Royal Society for Nature Conservation] (2001). Otters Return. A review of the Water UK and The Wildlife Trusts Otters & Rivers Project: 1998–2001. RSNC, Newark).

Simpson VR (1998). A *Post Mortem Study of Otters (*Lutra lutra*) Found Dead in South West England*. R & D Technical Report W148 Environment Agency, Bristol.

Stephen MN (1957). *The Otter Report.* Universities Federation for Animal Welfare, Potters Bar, London.

Strachan R, Birks JDS, Chanin PRF & Jeffries DJ (1990). *Otter Survey of England 1984-1986*. Nature Conservancy Council, Peterborough.

Taylor PS & Kruuk H (1990). A record of an otter (*Lutra lutra*) natal den. *J. Zool. Lond*. 222, 689–692.

Weber J-M (1990). Seasonal exploitation of amphibians by otters (*Lutra lutra*) in north-east Scotland. *J. Zool. Lond.* 220, 641–651.

Vincent Wildlife Trust (1985). The Vincent Wildlife Trust Report, 1985. Vincent Wildlife Trust, London.

Appendix A: Otter breeding sites in Wales

Site 1. Cleddau cSAC

Location

The site lies on the upper reaches of the River Cleddau in the Western Cleddau catchment, and is south of Fishguard in west Wales.

Description

The breeding site is an area of almost 4 ha of neglected agricultural land that is about 520 m long and between 60 m and 100 m wide, bordered on two long sides by the River Cleddau (3 m wide), and the Fishguard to Haverfordwest railway line. The ends are marked by a hedge and grazed field, and a ditch with *Molinia* wetland (see Map 1). A tributary of the River Cleddau, the Nant y Bugail, also flows through part of the site and joins the Cleddau about halfway along the breeding site.

The habitat is a patchwork of dense bramble and gorse thickets, woodland, dense blackthorn thickets, tall rough grassland (mainly *Phalaris*, *Molinia* and *Deschampsia* spp.), and wetland dominated by *Juncus* spp. The site is ungrazed and undisturbed.

The Cleddau is de-silted on a bi-annual basis by the Environment Agency to maintain drainage for agricultural fields on the opposite bank.

Evidence for breeding

The site was first surveyed by the author in 1979, and was surveyed regularly throughout the 1980s and the early 1990s. In August 1983, a dead otter cub (approximate age 4 months), was found in tall emergent vegetation within the stream channel close to a blackthorn thicket. A play tree that was found on the first visit was heavily used during a few months of each of the 12 years when surveys were carried out.

A female with otter cub was seen in the breeding site in the early 1970s (Bernie Davies, pers comm.), and it is therefore possible that this has been a breeding site for at least 30 years.

Further evidence is described below.

Natal den(s)

What is assumed to be the natal den was found on the banks of the Nant y Bugail in 1983. The natal den consisted of an area of bare flattened earth (approximately 1m), under a small gorse and bramble thicket. Leading from the chamber were two short latrine tunnels (each approximately 40 cm long), with very large piles of spraint (all recent, and covering an area of approximately 225 cm^2, in each. Some fresh spraints were found nearby. The natal den was at the top of a 1 m high bank, and was situated about 1 m from the bank edge. A very well-used path led from the water up the bank and into the den.

By September 1983, the natal den and path into it was still recognisable, but there were no signs of recent use. Evidence of regular use was found at the play tree, with many fresh spraints and paths radiating from the tree into surrounding grassland and scrub vegetation.

Monthly surveys continued, and in March 1984, two very well-used paths suddenly appeared, leading from the water into a blackthorn thicket on the Nant y Bugail. Many fresh and recent spraints were found in a pile on the path immediately at the top of the stream bank, and many more old and recent spraints were found on the well-flattened area under the blackthorn adjacent to the paths. The play tree was well-used, with many spraints.

In November 1987, a lactating bitch was killed on the A40 next to the Cleddau, and only 2 km upstream from the Llangwarren breeding site.

During the survey in April 1990, another presumably natal den was found on the Nant y Bugail close to its confluence with the River Cleddau. Measurements and descriptions were taken during a subsequent visit with Stephen Evans (Nature Conservancy Council), and Roger Pratt (National Rivers Authority) in May 1990. The natal den was an oval of compacted earth (120 cm long and 68 cm wide) with a covering of dry fragments of ferns under a small, sparse bramble clump (maximum height of 37 cm), that had a very open canopy. The chamber was situated 2 m from the stream bank edge, and connected to it by a 15 cm wide path (Figure A1). Leading from the side of the chamber furthest away from the stream was a single short latrine tunnel, 30 cm long and 15 cm wide, with a very large pile of old spraints. Much of this spraint was collected for analyses, and showed that amphibians were the dominant prey item.

Other features

Year-to-year use of dens

It was noticeable that a different natal den site was used in each of the years that surveys were carried out. As well as the two natal dens in bramble, and bramble and gorse described above, field signs suggested that, in other years, natal dens had been established in different parts of the extensive blackthorn thickets within the breeding site.

Play area

During the period when breeding was recorded at the site, otters made regular use of an alder as a play area. The alder is on the top and edge of the stream bank, surrounded by tussock grass with bramble and blackthorn thickets beyond. The play area around the tree consisted of slides on each side of the trunk (and about 1.5 m from it), with a broad semi-circle of low, lush grass around the trunk and connecting the two slides. The play area was always clearly visible (because of the contrast between very green low grass and the surrounding tall, brown-stemmed grass), even when not in use. When in use, the greener grass became flattened, with many spraints scattered around, and the slides appeared muddy, with otter prints and scratch marks.

Otter paths

The triangular area of rough grassland between the Cleddau and the Nant y Bugail was well used by otters for travelling between the two watercourses. Many otter paths were visible (usually with spraint at intervals on tussocks), and could be clearly seen from the air.

Possible disturbance from badgers

Surveys in recent years have shown no evidence of breeding at the site. Spraint is still found along the Cleddau and Nant y Bugail, but there are no signs of intensive use, and the flattened area around the play tree and slides are overgrown. If breeding has ceased at this site, the reasons are unclear. The site remains undisturbed; fish populations have not changed; and habitats appear to be suitable. However, a change that may be significant is that badger activity on the site (first recorded in 1998) has increased.

Site 2. River Teifi SAC

Location

This site is located in the lower reaches of the river about 4 km from the mouth of the estuary.

Description

The breeding site is an area of almost 50 ha of wetland, dominated by *Phragmites* reedbeds. Within the wetland are areas of dry land created by slate waste. The marsh lies alongside 1000 m of a tidal stretch of the Afon Teifi, and is fed by a small stream (the Piliau). A tidal flap at the Piliau confluence was re-instated in 2001. The site is owned by the Wildlife Trust West Wales, and is managed as a nature reserve. Areas of open water have been created within the reedbeds.

The site is dominated by reedbeds, with a large area of elevated wooded land close to the upstream

end of the site, and a very small raised area covered in scrub at the downstream end. Although there are footpaths within the reserve, the reedbeds and the wooded, elevated area are not accessible to the public.

Evidence for breeding

Otter cubs are sighted each year by visitors to the reserve (C. Lawrence, pers. comm.). On January 1 2002, two cubs were seen by R. Colley and T. McOwat (pers. comm.) in the Teifi at the upstream end of the marsh. The cubs were described as 'half-size', and noticeably buoyant.

An interesting piece of circumstantial evidence was provided by David Mackinnon-Wood (pers. comm.). From mid-May to mid-July 1992, he walked his dog each evening along the banks of the Teifi immediately downstream (and in view of) the marshes reserve. Based on very regular sightings (about four each week), he discovered that an otter had established a regular pattern of behaviour. The animal emerged from the marshes (from the River Piliau), about 20 minutes before dark, and travelled slowly downstream, hunting in the same deep pools on each trip. On one occasion, Mackinnon-Wood watched the otter make 40 to 50 dives in one pool, eating on the surface after each dive. The otter also usually investigated a raft that was anchored to the river bed, often climbing out onto it and urinating before continuing on its way.

Mackinnon-Wood also watched the otter rolling on the raft after urinating, and witnessed the same behaviour in grass next to the river. This behaviour was also witnessed by the author in July 1992.

As a follow-up to these sightings, investigations were made at a potential natal den site next to the River Piliau and close to its confluence with the River Teifi (found by the author during previous surveys of the marshes). Signs suggested that there was present or very recent heavy use of the site by otters (see below).

Natal den(s)

The possible natal den in use in spring/summer 1992 was a small 'island' of raised, dry ground (approximately 20 m diameter), covered by a dense blackthorn thicket and surrounded by extensive reedbed. A very obvious, well-used path led from a small ditch alongside the island up into the blackthorn thicket . A few spraints were found where the path entered the thicket. To avoid disturbance, no further investigations were carried out.

Site 3. River Wye SAC

Location

The lake is on the Dulais Brook, a small tributary of the River Wye in its middle to upper reaches, 3 km north of the town of Builth Wells.

Description

The lake and its bankside habitats constitute the breeding site. The lake is 400 m long and relatively narrow, with a typical width of 50 to 60 m. At the eastern end of the lake a house is situated on a small peninsula of land. A small stream flows into the lake, and leaves via a small dam.

The long south bank of the lake is managed mainly for access for walking and occasional fishing, and is bordered by areas of reed and mown grass. The north bank slopes up gently to a grazed field, with a narrow strip of woodland (approximately 160 m long) at the western end of the lake.

Brown trout were introduced into the lake in 1989 and are now breeding freely. Eels are also plentiful, and there are enormous shoals of minnows. Bullhead and possibly stone loach are present.

Evidence for breeding

The previous owners have watched bitch and cubs many times, beginning in June 1995, and their

sightings (dates and descriptions) are well documented and held by the author. In 1996, two adults were seen together on the lake from April to May, and on June 6, a female and two cubs emerged from a holt under the garage. The owners watched this family group regularly until the end of June.

In 1997, two otters were seen together on the lake, and in the second week of February, a female emerged from the garage holt with two cubs. The three otters remained on the lake for most of the summer, and were seen playing in the weed on most nights. The owner described them as being "oblivious to us and our dog". The otters left the lake in the first week of September.

On the August 8, 1998, a female with a single, very small cub (8–10 inches long), emerged from the garage holt at midday, and the cub followed the female around the lake, "shrieking". It was also heard shrieking on the following day, after which both animals disappeared.

In 1999, two adults were seen together in early June, and at the end of June a female and two cubs appeared, and stayed on the lake until the end of July, always using the garage holt as the daytime lying-up site. Again, the otters appeared to have little fear of the presence of the owners.

Natal den(s)

The assumed natal den at this site is the beneath the garage. The garage itself is a separate building from the house. Between the back wall of the garage and the lake edge there is a 3 m wide strip of land dominated by a large, dense rhododendron bush. Beneath the rhododendron is the felled stump of a very large tree (possibly elm), with visible entrance holes. The area at the back of the garage is not used by the owners and is consequently undisturbed.

Other features

During the time when bitch and cubs were active on the lake, a small area of the bankside within the strip of low woodland on the north bank became very well trampled, with paths into the water. As this coincided with the presence of bitch and cubs, it is assumed that this site was used as a play area for the cubs.

Site 4. Cleddau SAC

Location

This site is on the banks of the Western Cleddau in its lower reaches about 5 km north of the town of Haverfordwest, in west Wales.

Description

The breeding site covers 3.7 ha of mainly alder and willow woodland (100 m wide), along a 420 m long stretch of the main river (see map below). Most of the woodland is on a 45° slope, with a 20–30 m wide terrace of flat land immediately adjacent to the river. A short (almost 100 m long) backwater near to the mid-point of the site forms an 'island' of dense bramble and *Phalaris* with occasional trees. Land use on the opposite bank of the Western Cleddau is permanent grassland.

The Western Cleddau supports good populations of salmonids and eels, and there are wetlands and ponds within 2 km of the site that support breeding frog populations.

Evidence for breeding

Field signs that provided circumstantial evidence for breeding were found initially in April 1986 during an otter survey carried out by the author (see below).

Further evidence was provided by a local poacher who used cage traps to capture very young otter cubs at the site in the 1960s with the intention of training them to catch salmon (J. Jones, pers comm.). Cubs were caught in the spring, with cage traps set on the island close to holes that were assumed to be the natal den by Mr Jones. Mr Jones showed the author photographs of cubs in the trap, and on his

knee while he fed them. The estimated age of the cubs, based on their size in the photographs, was two months.

Natal den(s)

The assumed natal den that was found during surveys in April 1986 was located on the edge of the backwater (and about 1 m from the water's edge), in a disused badger tunnel under a large, old, fallen alder. There was a very-well-worn path from the water into the tunnel, with many otter prints. Outside the entrance, and under the fallen tree trunk, was an accumulation of recent and fresh spraints.

The possible natal dens at which Mr Jones set his cage traps were about 15 m from the assumed natal den described above, and were in a group of five disused badger setts, all of which were within 2 m of the main riverbank (riverbank height is 1.5 m). The dominant habitat immediately surrounding the dens was bramble with scattered alders, and a line of alders and willows along the river bank edge.

Site 5. A lake SAC

Location

The lakes are situated close to the south Pembrokeshire coast (with their outflow into a bay) southwest of Pembroke town.

Description

The lakes (part of the Stackpole National Nature Reserve) are artificial, and formed by three flooded narrow limestone valleys. The area of water is 30 ha, and there is a very long lake edge of about 9 km. The width of the lakes varies from 200 m down to 60 m, and they are generally uniformly shallow – between 1.5 and 2 m deep. The lakes are fed by two small streams and many subterranean watercourses and springs from the surrounding limestone hills.

The lakes are bordered by deciduous woodland on valley slopes, with extensive *Phragmites* reedbeds at the upper end of one of the arms of the lake.

The lakes support significant populations of coarse fish – mainly eels, roach, pike and perch.

Evidence for breeding

A possible natal den site was found in autumn 1981 by the (then) lakes warden during an otter survey of the lake system, and was shown to the author at that time (see below).

Most of the evidence for otter breeding within the lake system is based on sightings. Since the first recorded sighting of four cubs by the present Countryside Council for Wales warden (Bob Haycock), in June 1987, and of two cubs in January 1988 (H. Garlick, pers comm.), otter families have been recorded in most years to the present (G. Liles, pers. obs., B. Haycock, pers. comm.). Views of otters at the lakes are usually very clear, partly because animals can often be seen close to the shore (at distances of between 5 and 30 m). The earliest estimated age of cubs seen by the author is 2 to 3 months. From the frequency of sightings through the spring and summer, it is possible that females with cubs are resident on the lakes during most of the period of cub rearing.

Another relevant observation is provided by Bob Haycock, who watched an encounter between two otters in which one animal indulged in vigorous tail slapping on the ground. Tail slapping by a male as part of courtship behaviour has been recorded during a radio-telemetry study on otters, and has also been observed in captive males when sexually aroused (Green *et al.* 1984).

Natal den

The possible natal den site, found in 1981, was in a hollow, rotten tree trunk (*Populus* spp.) that had fallen onto a small dry island (about 80 m long and 15 m wide) in the upper section of the lake system,

and separated from the rest of the lake by a stone bridge. The area around the island covers 4 ha, is heavily silted and dominated by dense *Phragmites-Typha* swamp. The island itself supported a range of tree species, including sycamore, holly, beech, holm oak, and horse chestnut, with a moderately dense ground cover of bramble. Access onto the island was difficult due to a dense shrub layer (dogwood) and a deep ditch.

The tree trunk was approximately 5 m long and 40 cm diameter, and was covered with ivy. Part of the trunk lay in shallow water in the dense *Phragmites* and *Sparganium*. At least three entrances were visible, and a chamber at one end of the trunk had been lined with broken pieces of bur reed and hart's tongue fern to form a substantial nest, and with a large depression consistent with an animal lying-up on the vegetation. Well-defined pathways led from the edge of the island to the tree trunk. A latrine was found at the base of an adjoining tree about 3m from the trunk, and this held a solid mass of old spraints that was 3 cm deep and 15 cm in diameter.

The possible natal den was again found to be in use in 1987, when the site was surveyed by B. Haycock and K. Pyke. Similar signs of use were recorded, with pond sedge (*Carex riparia*) used as the bedding material.

Other features

During the visit to the site by the author in 1981, it was noticeable that an alder on the island had an obvious mammal path on the ground around the base of the tree. All vegetation in the area (covering about 8 m^2), had been flattened and several fresh spraints were found on ivy leaves close to the log.

Appendix B. Otter breeding sites in England

Site 1. Yorkshire

Information from Brian Dove and Gordon Woodroffe.

Location

The breeding site is on a flood-relief channel that flows into Scalby Beck (part of the River Derwent system) north of Scarborough. The site is less than 1 km from the sea.

Description

The breeding site is on a high, steeply sloping, wooded valley side, with housing along the top of the valley slope. Little information is available on dimensions of the site.

The relief channel itself is stocked with brown trout each March by the local angling club, and there are many eels. In addition, because the site is less than 1 km from the sea, a variety of marine fish are likely to be available to otters.

Evidence for breeding

Information on breeding is provided by Brian Dove, who watched otter families in two years. In 1993, a female had two cubs that were first seen in May. The female was seen to return to the natal den with an eel to feed the cubs. In spring 1995, a single cub was seen with a female. The cub was very small, and was seen to support its head on its mother's back when in the water.

Natal den

The possible natal den that was used in 1993 and 1995 was in a pile of old timber and garden rubbish, about 20 m up the steep bank. A track leading from the water up the slope to the pile of timber was visible. Although there were houses and gardens at the top of the slope, the woodland itself was inaccessible to people, and was undisturbed (B. Dove, pers. comm.).

Site 2. River Tweed

Natal den destruction incident

Information for this site is available because a natal den, containing two very young male cubs, was discovered during riverside tree management operations. The information is provided by Duncan Glen, with additional details from Jim Green.

Location

The site is on the Bowmont Water, a tributary of the River Tweed in Northumberland, about 350m downstream from a road bridge on the B6351.

Description

The area surrounding the natal den was sparse mature broadleaved woodland on a steep bank, with a few bank-side willow bushes and reed canary-grass (*Phalaris arundinacea*) along the stream margins. The woodland ground flora was mainly butterbur (*Petasites hybridus*) which was about knee-high at the time of the incident.

Evidence for breeding

The two male cubs found in the natal den weighed 210 and 240 g (J. Green, pers. comm.), and so were very young (birth weights of otters are between 135–145 g). There are no records of otters breeding at this site before or after this incident.

Natal den

The natal den was inside a hollow elm tree growing on the riverbank. The tree had fallen into the stream and was angled downstream by floods so that it rested about 45° to the bank. The trunk was lying almost horizontal and about 1 m above normal water level. The root plate was exposed at the bank.

The nest was carefully constructed of grass and sedge, and otter access into the holt was through a 30 cm hole in the root plate.

The cubs were left in the natal den for a night in the hope that the female would return, but had to be rescued the following day. Two days later, the river was in flood, and the natal den was underwater.

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

Monitoring Series

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

These publications can be obtained from:

The Enquiry Service
English Nature
Northminster House
Peterborough
PE1 1UA
Email: enquiries@english-nature.org.uk
Tel: +44 (0) 1733 455100
Fax: +44 (0) 1733 455103

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.

As a top predator, the otter is an important species in European rivers and streams. In many areas, the otter is showing signs of recovery from a dramatic decline in numbers following the introduction of pesticides in the 1950s.

This report provides information on identifying the ecological and physical habitat requirements of the otter during breeding, with the aim of encouraging projects to develop or enhance breeding sites.

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

This document was produced with the support of the European Commission's LIFE Nature Programme and published by the Life in UK Rivers project - a joint venture involving English Nature, the Countryside Council for Wales, the Environment Agency, the Scottish Environment Protection Agency, Scottish Natural Heritage and the Scotland and Northern Ireland Forum for Environmental Research.