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Conservation and management of great crested newts: Proceedings of a symposium held on 11 January 1994 at Kew Gardens, Richmond, Surrey

ENGLISH NATURE

BRITISH COAL OPENCAST

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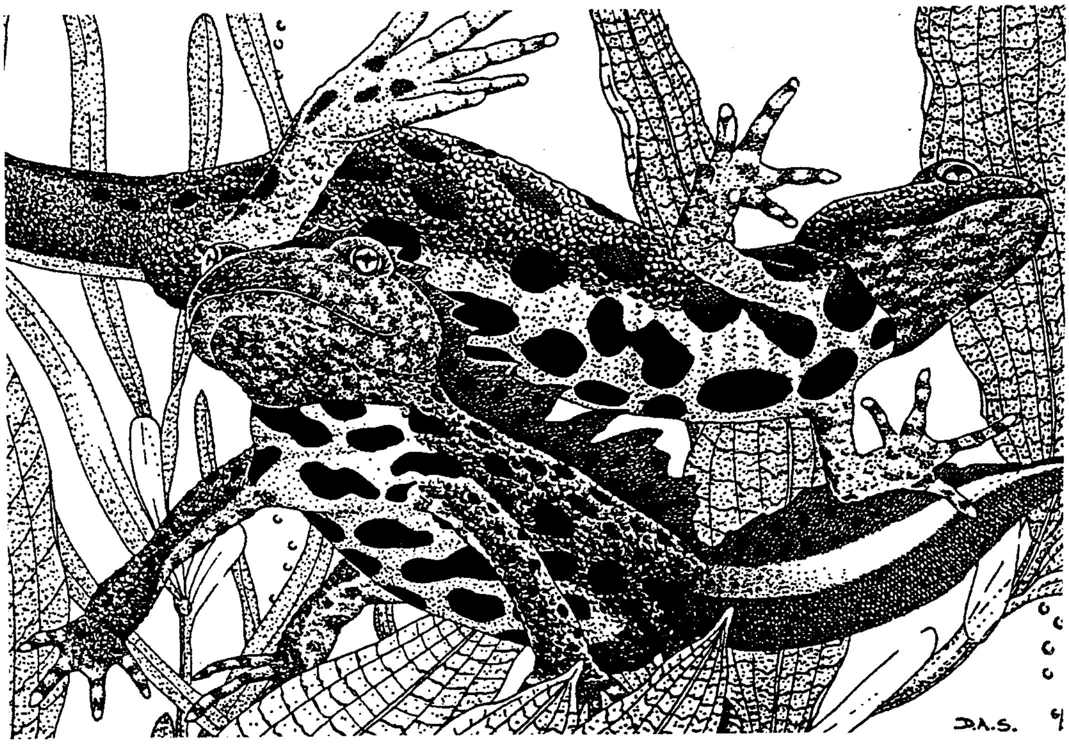
Assisted by British Coal Opencast

Edited by Tony Gent, English Nature and Robert Bray, Landscape Architect



Great crested newts by David Showler; courtesy of Herpetofauna Consultants International

ISBN 1 85716 154 8

CONSERVATION AND MANAGEMENT OF
GREAT CRESTED NEWTS *TRITURUS CRISTATUS* :

Proceedings of a symposium held on 11 January 1994 at Kew Gardens, Richmond, Surrey.

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Acknowledgements

It would not have been possible to have held the seminar without the financial support of British Coal Opencast, and in particular the help of Alan Stopher of BCO Central Region. Thanks are owed to the staff and students at Kew Gardens, notably Sarah Corser and Alan Hulme who helped ensure the day ran smoothly and the catering staff for providing the necessary refreshments. Thanks also to Mary Roberts who typed the Proceedings.

Particular thanks go to all the speakers whose contributions gave accounts of a diversity of topics relating to the conservation and management of this species and to those who chaired the sessions. Finally thanks are due to all those who attended the seminar for their contributions in providing interesting discussion on the day and for their greater involvement in the conservation of the species outside the seminar hall.

TG and RB
November 1994

Conservation and management of great crested newts *Triturus cristatus* : Proceedings of a symposium held on 11 January 1994

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Introduction

Great crested newts are a threatened species. Although they are widely distributed in Britain they have experienced an enormous decline in both range and abundance over the last 50 years. This decline is primarily the result of the loss and deterioration of both aquatic and terrestrial habitats. Concern for the conservation of this species, together with the protection provided for the species through the Wildlife and Countryside Act 1981, has meant that greater attention is now being paid towards the plight of this amphibian.

Information needed to understand the animals' requirements and conservation needs can be difficult to obtain by practitioners. There are many separate and isolated studies, the majority of which are not published or made widely available; new ideas and understandings do not get readily passed on and often experiences are having to be re-discovered. This has led to a divergence of standards and inconsistency in approach which is detrimental to the conservation of the species.

Clearly a greater exchange of ideas and information is needed. It was with this intention that, with the financial assistance of British Coal Opencast (BCO), a number of scientists, conservationists and practitioners involved with the conservation of the species were invited to a seminar to provide a forum for such an interchange of views. The seminar was designed to develop a greater collective understanding of the issues concerning the conservation of the great crested newt with a view to promoting the development of best practice and providing a basis for this to be formalised if appropriate.

British Coal Opencast have been very much involved with the conservation of the great crested newt; the species has been found on BCO land in several coalfields and on land adjacent to them or where there are proposals for working sites. As a responsible landowner and developer BCO have undertaken a number of projects relating to this species. These include survey and on-site mitigation proposals but also include studies of the habitats use, effects of translocation and captive rearing great crested newts for introduction to new and restored sites and have produced a leaflet about the species.

The seminar fits nicely with an ongoing commitment between English Nature and British Coal Opencast to cooperate together over a wide range of conservation ideas and initiatives.

Distribution and status of great crested newts in Britain

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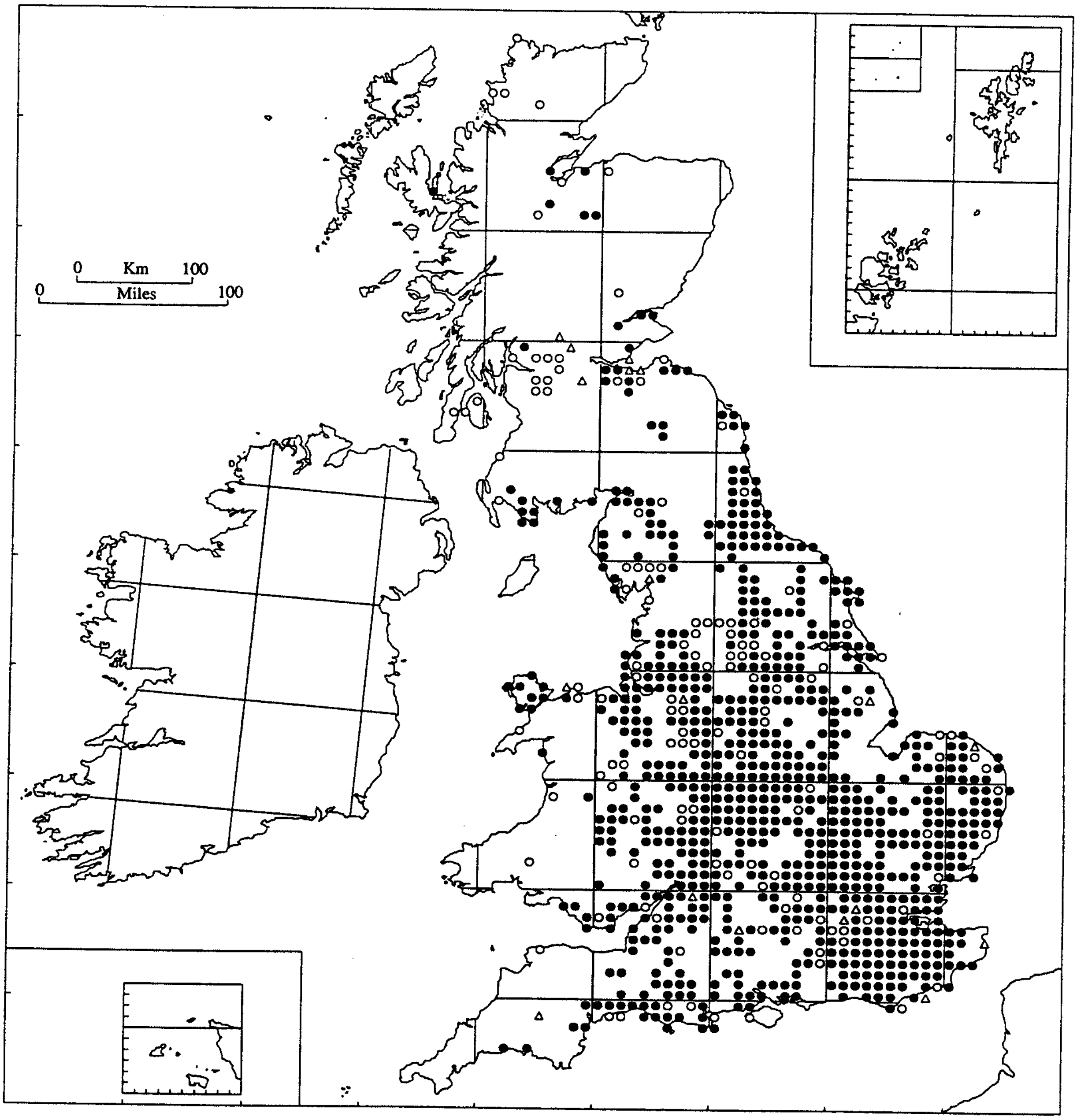
The earliest attempts to map the distribution of the British herpetofauna, including the great crested newt, were made by Colonel R.H.R. Taylor and the first of these was published nearly fifty years ago in the British Journal of Herpetology (1948). Taylor's second effort was published in 1963; the Biological Records Centre produced distribution maps in 1973 and 1983 (Arnold 1973, 1983), and most recently the intensive investigation of crested newt distribution by Rob Oldham's group at Leicester was reported from the mid 1980s (Oldham & Nicholson 1986; Swan & Oldham 1989, 1993). All of these studies confirmed, in increasing detail, the pattern originally demonstrated in 1948; the crested newt is a lowland animal in Britain, widespread over most of England but much rarer in the south-west, Scotland and Wales and absent from Ireland (Figure 1). There is no evidence to suggest any significant contraction or other change in this general pattern over the past half century. Outside the British Isles, crested newts range widely over northern, central and south-east Europe. The taxonomy of the crested newt complex was revised in the early 1980s, to the effect that what were previously considered to be four sub-species (*T. cristatus cristatus, T.c. carnifex, T.c. dobrogicus and T.c. karelini*) became widely recognised as four distinct species (eg Rafinski & Arntzen 1987; see Corbett *this volume*). The global distribution of the type found in Britain and northern/central Europe, *T. cristatus*, was thus reduced by about 50% virtually overnight.

Concern that the crested newt might be declining faster in Britain than the other eight widespread species of native amphibians and reptiles was first expressed by the British Herpetological Society (BHS) Conservation Committee in the early 1970s. A questionnaire-based survey, the results of which were published in 1975, gave some support to these fears (Beebee 1975). The data indicated, for example, that crested newts had indeed declined and done so more rapidly than the other newt species over the preceding ten years in much of eastern, central and southern England. The more intensive study at Leicester during the 1980s resulted in a much improved database for crested newt sites (= breeding ponds) as well as further insights into the autecology of the species. More than 2,000 specific breeding ponds have now been identified, and some 18,000 such sites are extrapolated to exist; site loss during the early 1980s was estimated to run at about 2% over six years, and many causes of site loss (urban development, agricultural changes and pond neglect in particular) were identified (Swan & Oldham 1989).

The question arises as to whether enough is now known about crested newt biology to prescribe effective conservation measures that might halt or reverse recent declines. Although most of the requisite information is probably at hand, some is certainly not. For example, crested newts share a similar distribution in Britain to that of the much commoner smooth newts, *Triturus vulgaris.* This is true at both coarse and fine-scale resoltion, and it is relatively rare to find crested newts in the absence of the smaller species (but not vice-versa, because crested newts have additional, more demanding habitat requirements). Nevertheless, on the basis of British information it would look as if anywhere smooth newts occur might be suitable, or capable of being made suitable, for crested newts. However, the distributions of these two species are much less similar just across the North Sea in the Netherlands. In that notoriously lowland country smooth newts are ubiquitous, but crested newts occur only in the (relatively) high inland areas. Why this is so is not known, but it clearly implies that there can be substantial differences in habitat requirements between these two species that sometimes operate over large geographical areas. The same might well be true, on a finer scale, in Britain.



● 1970 onwards (GB - 780, Ir - 0, Ch.Is. - 0)

○ 1901 - 1969 (GB - 130, Ir - 0, Ch.Is. - 0)

△ nineteenth century (GB - 18, Ir - 0, Ch.Is. - 0)

Figure 1: **Distribution of great crested newt in Britain; reproduced with permission of Biological Records Centre, Monks Wood (July 1994)**

Finally, then, we need to consider what the main issues facing crested newt conservation are. In my estimation there are four main concerns:

1. **Identification of priority sites for conservation.** With only 10-15% of the estimated total number of crested newt sites specifically identified, it is very likely that some of the biggest populations remain undiscovered. How do we obtain the right balance between making efforts to conserve what we do know, and finding the best of the rest?

2. **Estimating population sizes.** The basic task of identifying the largest populations is not always straightforward. We need a method for comparative scaling of the various methods currently used to this end.

3. **Autecological information.** What else do we need to know about crested newt biology to ensure that conservation efforts are successful? How relevant is the meta-population concept to crested newts? What are the critical landscape, geological or other features which predispose areas to support, or not support, crested newts? More information on these issues is particularly important in the context of translocations.

4. **Site protection.** What is the most appropriate method for a widespread species inhabiting multiple, generally small patches of habitat? When sites are lost to development, what trade-off should conservationists insist upon?

No doubt there will be other ideas about what the most important problems are, but it is clearly desirable that a consensus on the best way forward is reached as quickly as possible.

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European perspective and status

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Herpetological Conservation Trust

Taxonomic changes to elevate the four sub-species *Triturus cristatus cristatus, T.c. carnifex, T.c. dobrogicus* and *T.c. karelini* to full species level are widely accepted (eg Bucci-Innocenti *et al* 1983; Rafinski & Arntzen 1987; Macgregor *et al* 1990). Coincidentally these also served to further accentuate the conservation status of *Triturus cristatus*, by effectively reducing its range. The distribution of these species are shown in Figure 1.

The field status of the Danubian Crested Newt *T. dobrogicus* is as yet poorly understood, but ecologically it is suspected as facing conservation problems. The Balkan Crested Newt *T. karelini* is considered to be Threatened in at least five of the eight countries of its range, ie Romania, Russia, Ukraine, Georgia and Azerbaijan. The Italian crested newt *T. carnifex* occurs in central southern Europe including Italy, the former Yugoslavia, Albania and northern Greece.

Our great crested newt *T. cristatus* has declined across much of its western European range to the extent where it is now recognised as Threatened in no less than 11 countries. The causes of decline centre on a loss of lowland ponds and terrestrial habitats; pollution; fish stocking; and the general lowering of ground water tables in urban, industrial and intensive agricultural areas. The status of the great crested newt in Europe is discussed in a document prepared by the Conservation Committee of Societas Europaea Herpetologica for the Standing Committee of the Berne Convention (Convention on the Conservation of European Wildlife and Natural Habitats) (SEH 1991). The extent of this decline led to the adoption by this Standing Committee in December 1991, within its formal Recommendation No 27 (Council of Europe 1991), of no less than 11 specific elements addressed to relevant national governments for this species; namely:

Austria

1. Ensure, by the most appropriate means, protection and management of the best habitats of *Triturus cristatus* in every 'Land' wherever possible, especially the populations in the old mineral pits around Harmannsdorf.

Belgium

4. Ensure, by the most appropriate means, protection and management of the best sites of *Triturus cristatus* in each Province.

Finland

9. Carry out a survey of *Triturus cristatus* and ensure, by the most appropriate means, protection and management of the few remaining habitats of this species.

France

11. Ensure, by the most appropriate means, protection and management of the habitats of *Triturus cristatus*, especially in the regions around Aisne, Oise, Vosges, Meuthe, Moselle and L'Yvonne and in its overlapping zone with *Triturus marmoratus*.

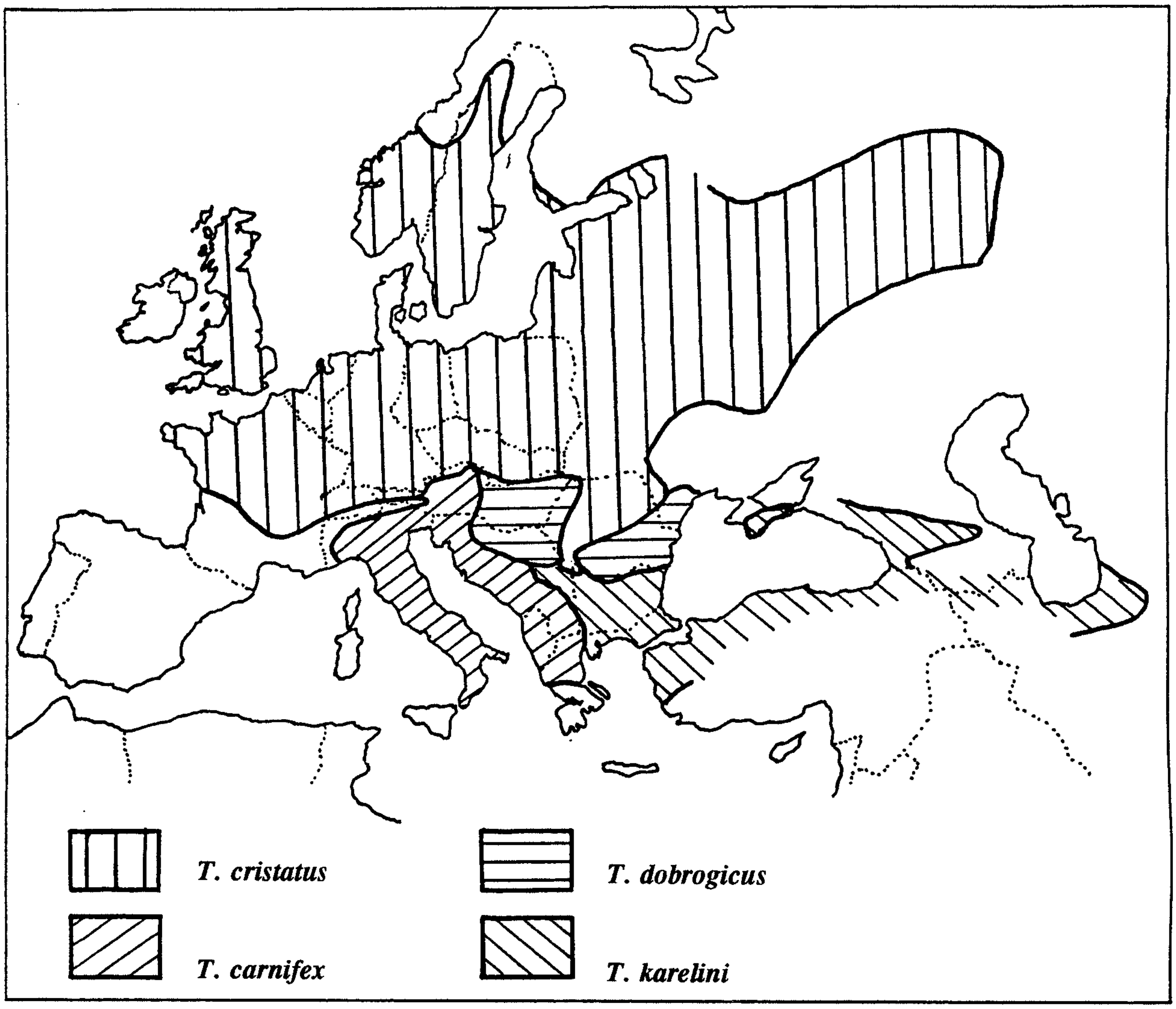

Figure 1 The distribution of *Triturus cristatus*, *T. dobrogicus*, *T. karelini* and *T. carnifex*. Redrawn from maps and data from Macgregor *et al* (1990) and Steward (1969)

Germany

15. Take appropriate steps to ensure protection and management of the most important habitats of *Triturus cristatus* at the Länder level.

Luxembourg

26. Ensure, by the most appropriate means, protection and management of the best habitats of *Triturus cristatus*, combined with a pond restoration programme.

Netherlands

29. Take appropriate steps to ensure protection and management of the best habitats of *Triturus cristatus* in every province.

Norway

32. Ensure, by the most appropriate means, protection and management of the remaining habitats of *Triturus cristatus*, especially in the very important locality for the species near Fusa (Iddal), in the western part of Norway, combined with field surveys of the species.

Sweden

35. Take appropriate steps to ensure protection and management of the best habitats of *Triturus cristatus.*

Switzerland

49. Promote, by the most appropriate means, protection and management of the most important populations of *Triturus cristatus*, combined with more regional field surveys.

Progress with the implementation of Recommendation 27 is due for review at the next Standing Committee. Subsequent positive measures are known to have been taken in The Netherlands, Norway, Sweden, Switzerland, and probably France. This is, of course, beyond the necessary pond surveys for such amphibians already completed with government funding in Denmark, Netherlands, Sweden, Switzerland, and many German Ländes.

If the measures required under Recommendation 27 reflect specific national situations for this species, there remain the various and pre-existing conservation obligations under Berne for such Annex II listed species.

Article 6 requires that each Contracting Party shall take appropriate and necessary legislative and administrative measures to ensure the special protection of the wild fauna so specified. The following shall be prohibited for these species: . . . . . .

b. the deliberate damage to or destruction of breeding or resting sites; . . . . . .

Article 4 is also significant in that it relates to the need to protect species habitats as well as endangered natural habitats, and further requires that planning and development policies avoid or minimise as far as possible any deterioration of such areas.

Because Article 4 was considered central to the proper functioning of the Berne Convention, a further Resolution and 3 associated Recommendations were adopted. Relevant to the great crested newt and its habitat are the following:

Res.1.2c. defining 'conservation' as the maintenance and, where appropriate, the restoration and improvement of the abiotic and biotic features which form the habitat of a species . . . . and includes, where appropriate, the control of activities which may indirectly result in the deterioration of such habitats.

Res.1.3a. defined within the 'deliberate' damage to or destruction of breeding or resting sites, any act committed without the intention to cause damage or destruction but in the knowledge that such would probably be the consequences of the act.

Rec.16.

1. take steps to designate areas of special conservation interest to ensure that necessary and appropriate conservation measures are taken for each area . . . . where that area fits one or several of the following conditions:

    a. it contributes substantially to the survival of threatened species, endemic species, or any species listed in Annexes I or II of the Convention . . . . . .

3. take such steps, either by legislation or otherwise, to ensure wherever possible that:

    a. areas referred to above are the subject of an appropriate regime, designed to achieve the conservation of the factors set out in para 1. above.

    b. the agencies responsible . . . . have sufficient resources to enable them properly to manage, conserve, and survey the areas.

    d. activities taking place adjacent to such areas or within their vicinity do not adversely affect the factors giving rise to the designation and conservation of those sites.

4. a/b . . . . . . produce and implement appropriate management plans . . . . . .

    d. advise the competent authorities and landowners of the extent of the areas and their characteristics.

5. Determine those areas which remain inadequately provided for under existing mechanisms and improve the conservation status of such areas using whatever mechanisms are appropriate in order to meet the requirements of the Convention.

The only exceptions allowed are those under Article 9:

1. Each Contracting Party may make exceptions from the provisions of Article 4. & 6 . . . . provided that there is no other satisfactory solution and that the exception will not be detrimental to the survival of the population concerned:

    - for the protection of flora and fauna;
    - to prevent serious damage to crops, livestock, forests, fisheries, water, and other forms of property;
    - in the interests of public health and safety, air safety, or other overriding public interests:

- for the purposes of research and education, of repopulation, of reintroduction and for the necessary breeding . . . . . .

Our 1981 Wildlife & Countryside Act is the instrument of the UK ratification of Berne and thus the conservation of the great crested newt. It seems increasingly improbable that either this Act, or perhaps more importantly its implementation, does comply with the excellent requirements of Berne. Requirements which have become more answerable by their incorporation in the EC's Habitat and Species Directive, and the listing of this species under its Annex II and IVa.

We attach as an Appendix an extract of a herptile paper submitted to Berne which gives one interpretation of the situation of *Triturus cristatus* conservation in the UK and we leave the reader to judge whether the cited examples (chosen from many) are exceptions or representative, and whether such a situation is satisfactory from a UK or European conservation standpoint?

One last but important question remains; as the species is still comparatively widespread in the UK, should we be expending conservation resources in lessening its known decline? While it is true that we, and perhaps Germany, hold the highest populations in western Europe, as it is declining and threatened in most other countries we have a better practical and moral opportunity to take efficient action now.

The species predominant use of lowland ponds has an 'indicator' value for a habitat type not covered under UK legislation (cf. Denmark and Germany) yet one equally declining and now obsolete in farming terms.

It is arguably not in the interest of the UK's tattered environmental image to continue to neglect its increasing European obligations for this species.

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Appendix

Extract from: DHKD, WWF & SEH. 1992. Update on some issues of importance for herpetile conservation. Paper for the Standing Committee of the Convention on the Conservation of European Wildlife and Natural Habitats for the 12th meeting 30 November-4 December 1992. Strasbourg: Council of Europe. Reference: T-PVS(92)76, dated 21 October 1992, pp 10-15.

Conservation of *Triturus cristatus* habitats in the UK - A paper submitted jointly by Societas Europaea Herpetologica and World Wide Fund for Nature (International)

This Berne Convention Annex II species is known to be declining across much of its European (world) range to an extent whereby its current status is considered as endangered in Norway, Finland, Belgium, Netherlands, Luxembourg, Switzerland and Austria; and as vulnerable in Sweden, Germany, NE France, and the UK.

Whilst this species is still considered as widespread in the UK it and its habitats have continued to decline unchecked since 1982 when the Bene Convention was ratified. The exact rate of decline remains unknown and estimates vary (up to 0.5% per annum); however, as this species is so reliant on ponds for breeding, its decline seems certain to be a reflection of UK pond loss. Here, a number of pond surveys in different regions all conclude a total loss rate during *c*.20 years of 25%, with a further 25-30% rendered unsuitable for newts. Although the UK has arguably the largest European reservoir for the species, it can equally be said to be doing amongst the least in efforts to conserve it or its habitat. For example, in contrast to the situation in Germany, Denmark and Sweden, where ponds are protected as an important habitat type, the UK system of SSSI, designation does not readily embrace small habitat units such as the lowland ponds required for *Triturus cristatus* breeding. Also, unless a site is designated within the SSSI system it has no international importance in terms of planning constraints, eg 'call-in' for determination by the Minister of the Environment, or consideration for buffer zones to offset the adverse effects of adjacent developments.

Apart from the development pressures to ponds and their surrounding and essential terrestrial habitat, UK ponds are now a redundant feature of the countryside and are thus prone to losses due to infill, pollution, and simple neglect of management to offset the processes of natural succession back to dry land. Sites are further lost to newt species by their stocking with wildfowl or predatory fish.

We believe that this dismal scenario is in direct opposition with the obligations to conserve this species and its habitat implicit within Articles 4 and 6, and more specifically within the appropriate definitions detailed within Resolution 1(89); Recommendation 14(89) 1.d.; Recommendation 16(89) - elements 1.a), b), and c), 3.b) and d), 4.c) and d) and 5; and Recommendation 27(91) - element 47.

The Wildlife and Countryside Act (1981) is considered to be the legal instrument meeting the UK's obligations to the Berne Convention and it would be fair to say that not excepting problems, its SSSI provisions (Part 2) go some way in conserving habitat types. This is not, however, the case for its protection of species habitats (Part 1) and which as yet remain in a largely *ad hoc* and unsatisfactory state, and do not meet the carefully defined and adopted obligations to Article 4. In practice in the UK neither owners nor most planning authorities are being informed in advance of the presence of *T.c* but rather its occurrence is announced (or not) as the reactive consequence of a planning application for development or for road construction. The usual outcome is at best that a degree of mitigation is proposed instead of any site conservation or protection. To date too many token rescues have been sanctioned with a low percentage of any population caught and with subsequent relocation to receptor sites inadequately assessed and too often quite unsuitable to the species. There have been comparatively few exceptions of case-work where adequate replacement ponds and terrestrial habitats have been provided, and very few where the existing site has been defended and saved.

The Appendix illustrates recent examples from all corners of the UK and where regional nature conservation administration is generally unaware, or unable to defend the species. Only recently have there been any regional staff in England with a direct species remit, and whilst this was at first seen as a welcome improvement, it soon became too apparent that they (1) were required to be virtually preoccupied with badger (*Meles meles*) and bats (*Chiroptera*); (2) were inadequately trained in dealing with other protected fauna such as *T.c*; (3) represented the lowest ranked level of the Regional scientific staff structure. The situation in Wales and Scotland has worsened since the splitting (or devolution) of the Nature Conservancy Council, and where there are even fewer species posts and inadequate scientific guidance. Whilst these problems may be seen as purely administrative matters for the UK authorities to resolve, the situation necessarily questions the underlying ability or commitment to conserve this species.

Previous and positive UK guidelines (NCC) had recommended that all owners and planning authorities should be informed of the presence and the legal constraints of all significant sites supporting *T.c* At the same time there was supposed to be consideration for designating the top status sites both nationally and regionally as proposed SSSI candidates. The former consultations have not been pursued because of a preoccupation towards habitat type SSSI and other related initiatives, while pitifully few species SSSIs have been realised over the past 11 years. Research reported in 1991 some 2200 known *T.c.* sites of which 28 had met SSSI criteria but only nine were or had been made SSSI, ie 0.4%. This report also cites 60 significant UK sites for the species of which only 13 appear yet to be SSSI. There is some confusion over the accuracy of how poor has been the progress, and it is our belief that even the monitoring methods are insufficient to correlate this (and other) species' occurrence and status within the UK SSSI register.

One potential way forward could have been within the UK Species Recovery Programme, now in its second year. However, this as yet only includes one herpetofaunal species and only five Berne Annex I or II species amongst its 20 targets, again hardly reflecting recognised European need and priorities, and not therefore complying with Article 4. It is noted that the Experts Meeting on the Conservation of Amphibians and Reptiles (T-PVS(92)27) invited the UK to pursue implementation of Recommendation 27 by protecting as SSSIs more habitats of populations considered important.

The pressing needs are therefore:

1. To inform owners and planners of the presence of the species - without such a basic step the legal constraints within Part 1 of the UK Wildlife and Countryside Act are essentially meaningless.

2. To have a more positive site conservation policy against damaging or destructive threat, and to resist token rescue and inappropriate relocation.

3. To progress protection of high status *T.c.* populations and their habitats, terrestrial as well as aquatic.

4. To incorporate adequate species protection measures and strategies to complement SSSI input, and to train conservation staff to this end.

5. To better define distribution data by an increased input toward field survey.

In short, to adopt and implement a UK conservation strategy for this species AS A MATTER OF PRIORITY. The Standing Committee is asked to consider this situation and to urge the UK to take appropriate action to improve the protected status of *Triturus cristatus* and its habitat.

Appendix: Recent examples of threats, damage and loss of great crested newt sites in the UK

The underlying trend has clearly been to rely at best on 'mitigation measures' and very rarely to defend the site in question. This list of necessity only cites a few of the many cases brought to our attention. There would also have been many more that we would not have known about and very many more whose loss has gone unheralded.

Sites marked with an asterisk are those already registered by the Nature Conservancy Council during 1986-1991.

Wales

Burntwood (Standard Clay Pit), Buckley, Clwyd (SJ 291 651)

A large quarry pond with five amphibian species present was drained to form part of a landfill site. Alyn and Deeside District Council gave planning permission to its own waste disposal department in August 1988. Volunteers were asked to spend a few weeks rescuing an estimated 5,000-10,000 great crested newts. Many of the almost mature great crested newt larvae caught died during transportation. Many of the adult newts were not caught as they had already left the water. The Nature Conservancy Council were notified and helped with the 'rescue'. Officially a reported 2,000 adult crested newts were removed although it is unclear exactly how they have survived in the variety of sites where they were translocated. Some were dispersed as far east as Preston in England. A reserve area at the site was proposed but this was not created although newts have been seen in settling ponds around the site that may not be suitable in the long term.

Top-y-Lloc, Clwyd (SJ 145 764)

Delyn Borough Council had identified an area of terrestrial habitat next to a great crested newt breeding pond as suitable for a housing development. The site had been subject to consultation with the Countryside Council for Wales, but in 1990 the already eutrophic pond had a new septic tank discharge pipe added to it, and in addition, new piping was laid bringing main road run-off into the pond, killing aquatic vegetation. Both actions were taken without consultation with CCW.

Scotland

National Field Survey data is sorely lacking and very few *Triturus cristatus* sites are yet known.

***Dalmeny Pond, Lothians (NT 141 771)**

Two great crested newt ponds were affected by draining in 1991, when the owner decided to alter the water flow by digging a trench between the ponds and redirecting the outflow. It appears that he was unaware of the newts being present in the ponds as he had not been so informed by NCC and had not therefore consulted them over his proposed actions. Although the effect of this work on the great crested newts has not been assessed none have been seen for the last two years.

England (South east)

Bamber Pit, Swanscombe, Kent (TQ 598 748)

A pond in a chalk quarry with an existing planning permission for waste disposal was infilled in 1988. The site held a very large colony of great crested newts in a pond at one end of the quarry. Limited rescue of newts was carried out by volunteers. Newts were dispersed at a variety of sites by volunteers both locally in Kent and at other sites in Surrey and Essex. The breeding pool was then needlessly destroyed although this area of the site has to date had no after use.

***Lemham Heath, Kent (TQ 909 495)**

A Department of Transport extension to a road system (M20) required a link road. The pond had hundreds of great crested newts and smooth newts removed from it and these were taken to local ponds of variable quality. A planned substitute pond at the site was not constructed after the existing pond was destroyed in 1988.

An orchard pond in the same area was also destroyed in 1988 for a hotel extension at Ashford, even though it was known to support *Triturus Cristatus*. A rescue removed 818 adults (as well as 1200 smooth and palmate newts) which were released into other local ponds, including one which had by chance been recently excavated by a local farmer. No monitoring of the fate of these releases has occurred.

England (South west)

Isleport Business Park, Somerset (ST 475 327)

A Sedgemoor District Council promoted Business Park on a greenfield site. Two nature reserve areas had been agreed as part of a development 'package' for the site. These areas held two ponds that were breeding sites for great crested newts. The nature areas were overlooked during granting of detailed planning permission. In 1991 almost all of the terrestrial habitat around the main newt breeding site was bulldozed. Following complaints by locals, English Nature used consultants to negotiate mitigation including saving one pond.

Osehill Green, Holnest, Dorset (ST 665 095)

Terrestrial habitat supporting *Triturus cristatus* and adjacent to the largest known breeding site in the country was proposed as an above ground waste disposal site. Despite the previously identified species interest, planning permission was granted in 1992 without any form of statutory planning operating conditions relating to *Triturus cristatus.* After prolonged public protests, further research is now underway to see if any belated mitigation measures are practicable.

England (East)

Hethersett, Norfolk (TG 156 034)

A pond with a good number of great crested newts was destroyed in 1986 as a result of improvements to the A11 road. The Nature Conservancy Council had been consulted and visited the site, but a drop in the water table occurred when the edge of the pond was breached and deep culverts installed at the side of the pond. A diesel bowser then leaked into the pond and the pond owners and building contractors infilled the pond without any form of translocation or substitute pond construction.

Kirby Bedon, Norfolk (TG 284 057)

Planning permission was granted for the building of bungalows in woodland next to 'Bramerton Pond. This was reported to the Nature Conservancy Council by locals, but despite the great crested newt population present, no attempt was made to request the developer to take steps to protect the newts. The pond water level has been permanently lowered as a direct result of the development. During construction in 1988 some newts were rescued from the foundations of the new buildings, but the large *Triturus cristatus* population that had been known there is now reported to be barely in existence.

Seething, Norfolk (TM 318 977)

A small clay pit on a parkland estate was known by local naturalists as the only stronghold for great crested newts in the parish. In 1989 the owner said that he would only infill one edge of the pond but instead completely filled in the pond claiming it was a safety hazard. Nature Conservancy Council deferred any action fearing that the pond might now possibly be defined as being a garden pond even though the adjacent housing had been built but recently.

England (North east)

*Beverley Barracks Quarry, Humberside (TA 024 375)

This was a very large great crested newt population with a daytime county of 60 adults. The site was a chalk quarry filled with water each year by an aquifer. Owned by a private waste disposal company, permission to tip had been given with conditions that it be completed in 10 years. Despite a visit by Nature Conservancy Council representatives before infilling had reached the pond, no measures were taken to retain a breeding pond on the site, or even to rescue and translocate the amphibians and in 1991 the site was destroyed.

England (North west)

Wimslow Park, Cheshire (SJ 855 818)

One of the best great crested newt sites in the county, nevertheless over half of the available terrestrial habitat was bulldozed for house building over a period of several weeks in late summer 1992. We understand that English Nature officials were informed, but that no mitigation measures were taken or proved possible. Now the breeding pond itself has been found to be under severe threat from the effects of major road construction.

Legislation

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History

The great crested newt is protected in Great Britain by its inclusion on Sch 5 of the Wildlife and Countryside Act 1981. The species protection provisions of this Act came fully into force on 28 September 1982. The Wildlife and Countryside Act is the statutory mechanism by which The Convention on the Conservation of European Wildlife and Natural Habitats ('the Bern Convention'), that the United Kingdom signed in 1979 and ratified in 1983, is brought into effect in England, Scotland and Wales. The European Union Directive on Conservation of Natural Habitats and of Wild Fauna and Flora (Habitats and Species Directive) was published in 1992. This will require implementation by legislation in the UK during 1994 (see Addendum).

What does the law say?

The Wildlife and Countryside Act

a. Species Protection (Part I)

At a simple level, the inclusion of *Triturus cristatus* on Schedule 5 means that it is *fully protected* in Great Britain. This prohibits killing, injuring, taking (ie. capture), possession and sale; disturbance and destruction of habitat are also forbidden.

However, the text of the legislation needs to be referred to determine exactly what is prohibited and what is allowed. Thereafter, the legislation may needs some further interpretation to determine whether the wording applies to any given situation.

The Wildlife and Countryside Act 1981 is divided into four parts; Part I relates to Species Protection, Part II to the protection of the countryside including the designation of protected areas, Part III is concerned with access to the countryside and Part IV with miscellaneous provisions. Protection for the great crested newt arises primarily from Part I, although protected sites (eg Sites of Special Scientific Interest) can be established under Part II for the conservation of the species.

Part I of the Act divides into 27 sections; of these Sections 9 and 10 are of most significance to the conservation of great crested newts; however, to a lesser extent Section 11 (which prohibits certain methods of capturing and killing all wild animals) does relate to the species. Sections 18 and 19 are connected with offences and enforcement, Section 20 to prosecutions and Section 21 to penalties. Sections 22, 23 and 24 describe the roles of the Secretary of State and advisory bodies and to variations of Schedules. Section 25 relates to the role of Local Authorities and Section 26 to the mechanisms by which Orders and Regulations should be produced. Section 27 provides interpretation and definitions of terms used in Part I.

I set out a condensed version of the text of Section 9 of the Act; this uses the exact words of the legislation (included within quotation marks, with deletions indicated by an ellipsis). The numbers in brackets are the numbers of the sub-section. The full text of Sections 9 and 10 are included in the appendix to this chapter.

Section 9 :

Subject to the provisions of this Part, if any person . . .

(1) ". . . intentionally kills, injures or takes any wild animal on Sch 5 . . ."

(2) ". . . has in his possession or control any live or dead wild animal included in Sch 5 or any part of, or anything derived from, such an animal . . ."

(4) "... intentionally -

(a) damages or destroys, or obstructs access to, any structure or place which any wild animal included in Sch. 5 uses for shelter or protection ; or

(b) disturbs any such animal whilst it is occupying a structure or place which it uses for that purpose . . ."

(5) ". . . (a) sells, offers or exposes for sale, or has in his possession or transports for the purpose of sale, any live or dead wild animal included in Sch. 5, or any part of, or anything derived from, such an animal ; or

(b) publishes or causes to be published any advertisement likely to be understood as conveying that he buys or sell, or intends to buy or sell, any of those things . . ."

. . . he shall be guilty of an offence.

There are defences offered by the Act in both sections 9 and 10. Unless included in quotation marks, these are paraphrased here and do not represent exact wording from the legislation (the numbering indicates section and sub-section numbers) :

A person shall **not be guilty** of an offence under Section 9 :

9 (3) regarding S. 9 (2) only, if

(a) the animal had not been killed or taken or had been acquired legally; or

(b) had been sold legally;

10 (1) if done as

(a) a requirement of MAFF or the Secretary of State in connection with s. 98 of the Agriculture Act 1947 or Agriculture (Scotland) Act 1948 ; or

(b) a requirement of an order under the Animal Health Act 1981

10 (2) regarding S. 9(4) only, if done in a dwelling house

10 (3) if

(a) the animal was injured and was taken for the purposes of tending it and releasing it when no longer disabled;

(b) the killing was for humane reasons when there is no reasonable chance of recovery; or

"(c) . . . he shows that the act was an incidental result of a lawful operation and could not reasonably have been avoided."

10 (4) if the action was necessary to protect livestock, foodstuffs or other form of property or fisheries.

16 (3) and (4)(b) if licensed by the appropriate authority.

b. Site protection (Part II)

Section 28 of the 1981 Act places a duty on the Nature Conservancy Council (amended to refer to English Nature, Countryside Council for Wales and Scottish Natural Heritage as a result of the Environmental Protection Act 1990 *et seq*) to notify sites that, in their opinion, are of special interest by reason of its flora, fauna or physiographical features to the local planning authority, the owner(s) and the Secretary of State. This notification is the process of designating Sites of Special Scientific Interest (SSSI). This legislation superseded a similar mechanism in S. 23 of the National Parks and Access to the Countryside Act 1949 which required notification of special sites to the Local Authority, but offered a much more limited scope for site protection than the more recent Act (though the 1949 Act is still in force, the majority of sites notified under this legislation have been renotified under the 1981 Act). In 1989 the Nature Conservancy Council published the guidelines by which sites could be evaluated on the basis of biological criteria; these include criteria for the assessment of great crested newt sites.

The designation of these sites means that a certain list of activities (termed Potentially Damaging Operations) is produced; these activities which are deemed likely to threaten the interest of a site and are prohibited. There is a requirement for Local Authorities to consult the Statutory Nature Conservation Organisations where a planning application is made on or, since 1991, that will affect the land on a SSSI. Details of these requirements can be found in the following DoE Planning Circulars : 'Planning Controls over sites of Special Scientific Interest' (no. 1/92) and 'Nature Conservation' (No. 27/87).

Other legislation

Other legislation may be appropriate when considering great crested newt conservation and welfare.

Planning legislation (see above) governs the role of Local Authorities in considering great crested newts in relation to development.

Animal welfare issues, relating to domestic or captive animals, are covered by the Protection of Animals Act 1911. This prohibits ill-treatment, etc. Captive animals are those that are in captivity or confinement or which is 'maimed or pinioned or subjected to any appliance or contrivance for the purpose of hindering or preventing its escape from captivity or confinement'. Consequently there is some additional protection for great crested newts that are held in captivity or that are captive bred (and hence beyond the control of the Wildlife and Countryside Act). A subsidiary act (the Abandonment of Animals Act 1960) prohibits the abandonment of captive or domestic animals 'in circumstances likely to cause the animal any unnecessary suffering'. This may have some application in preventing releases of animals in unsuitable habitat; due to licensing controls over wild animals it is only likely to be applicable to captive bred newts.

The Animals (Scientific Procedures) Act 1986 defines certain actions as being 'regulated procedures' which are prohibited unless a licence from the Home Office is obtained. These apply to all vertebrate species (other than man). In essence these are any scientific or experimental procedure likely to cause pain, suffering, distress or lasting harm; these include use of anaesthetics. Whilst certain marking and tagging methods are excluded, toe clipping is considered to be a regulated procedure in that it is regarded as causing more than 'momentary pain or distress and ... lasting harm'. It is wise to consult this legislation (and a Home Office inspector) to determine whether any proposed scientific procedures require licensing.

What does the law mean?

Wildlife and Countryside Act

Interpretation of the wording of the legislation is the role of the courts. Test cases on the Wildlife and Countryside Act are rare; prosecutions, which are not common, are tried at Magistrates Court - only if there is an appeal will the case be heard by Crown Court such that the decision can be considered a test case. However practical guidance is needed to assist the application of this legislation to identify what can and cannot be done and when licences are required. This guidance can be given by the Statutory Nature Conservation Organisations (ie English Nature, Scottish Natural Heritage, Countryside Council for Wales), Local Authorities and by consultancies.

I outline the approach adopted by English Nature when advising on the application of the Wildlife and Countryside Act. I shall look at a series of key words in the legislation and try to illustrate the application of these via some examples.

As a first observation the legislation is about PROTECTION of animals and is not CONSERVATION of the species. The difference is subtle, and one born of necessity (it would considerably more difficult to draft legislation based around conservation objectives); however it can mean that the legislation does not provide the most appropriate means of conserving wildlife. It can prove quite onerous (for example, every single animal in a population is protected) but at the same time does not provide scope to require conservation action against, for example, 'passive' neglect of a site (ie where a pond is allowed to silt up or become too shaded).

Wild animals : the legislation relates only to wild animals; these are defined in Sub-section 27 (1) as 'any animal (other than a bird) which is or (before it was killed or taken) was living wild'. Consequently this legislation does not apply to captive bred animals living in captivity; however it does cover animals that are in captivity but taken from the wild, regardless of how long ago that happened (Sub-section 9 (3) permits the keeping of animals taken before the passing of the legislation). There is an interesting twist, captive bred animals released to the wild can become wild animals (however the legal arguments as to exactly when the owner loses control over the animal, and hence it becomes truly wild as opposed to a short term escapee could become quite complex).

Intentionally : Sub-sections 9 (1) and 9 (4) require that acts of killing, injuring and taking or of disturbance and habitat damage must be intentional before they can be an offence. This wording is valuable to prevent accidental actions becoming an offence, for example squashing a newt on the road whilst driving at night. This wording is very significant in making the application of the legislation difficult.

It can be argued that an intentional act which results, for example, in the death of a protected species or destruction of their habitat would be an offence if the death/destruction was a likely and predictable outcome. I advise that if it is known that great crested newts occur in an area then any action which results in the death or destruction of habitat of these animals, for example development, may well constitute an offence if it could be considered a likely or a predictable outcome. I recommend that it is always safer (plus more beneficial for conservation) to follow this interpretation of the legislation. The Bern Convention gives some support to this interpretation. Resolution 1 to this Convention (of 1989) defines 'deliberate damage or destruction of breeding or resting sites' (the wording in the Convention is 'deliberate' not 'intentional') as "any act committed with the intention of destroying or causing harm to the breeding or resting sites ... and any act committed without the intention to cause damage or destruction but in the knowledge that such would probably be the consequences of the act". Although the Wildlife and Countryside Act should reflect this International obligation it is the wording of British law that is used in any proceedings.

However, 'intentional' may be considered to imply a degree of premeditated thought and that the intention of the act was to, for example, kill or injure an animal. Thus the intention, ie. what is in the mind of the perpetrator, needs to be considered along-side the act itself.

A case in which a roofer caused the destruction of a bat roost (in July 1991) which resulted in the death of some bats highlights the difficulties of interpretation. At the hearing in May and July 1992, a Magistrates Court accepted the Prosecution's argument that the destruction of the roost and the corresponding disturbance to the animals had been intentional. However, although the death of the bats could be directly attributed to his action, the court was not satisfied that the roofer had intended to kill the bats. The defendant appealed and this was heard at Dorchester Crown Court in June 1993. The judge and two magistrates took the view that because the builder was not aware of the presence of bats before any work was undertaken, then the subsequent damage to the roost and disturbance to the bats was accidental and not intentional. Whilst it was accepted that the defendant's actions might have been reckless they were not considered intentional and the case was dismissed.

For an act to be 'intentional' this ruling indicates that it needs to be carried out deliberately and consciously and the Court needs to be satisfied that what was in the mind of the defendant was the intent to carry out a criminal act.

There are no such rulings that relate to great crested newts. Other circumstances may lead to a court taking a different interpretation.

Damages or destroys : damage should be considered to have occurred when a thing is of less value than it was originally. Given that this offence relates to structures or places used for shelter or protection, the test would be to determine that an action actually rendered the habitat less suitable for these purposes. The damage or destruction needs to be intentional.

Destruction of a habitat for the purpose of development is, in my view, intentional (albeit unavoidable) damage and destruction.

Disturbs : It is hard to define disturbance, but presumably it is manifested by a change in behaviour of the animal. The disturbance has to occur in a place used for shelter and protection before an offence is committed (under the Wildlife and Countryside Act disturbing a newt whilst crossing a road is probably not an offence !).

Structure or place used for shelter or protection : this is difficult to define for great crested newts. However, given that the animal is an ectotherm, and is susceptible to dehydration, much of the habitat use will be determined by a need to select micro-habitat that offer physical or physiological protection. Wild animals are susceptible to disturbance; these structures may be used as shelter to avoid disturbance. As such, with the exception of areas traversed during migration, nearly all habitat used by newts constitutes such 'a place'. It is debatable whether a breeding pond really offers shelter and protection to adults. For example, open water is used for courtship and not 'shelter or protection'. Disturbance whilst courting is therefore probably legal. However damage to this feature (eg by draining the pond) will damage the other features (eg weed, etc) used for protection by adult, larvae and eggs alike - the water itself will also act to provide a degree of protection (and thus give scope for hours of legal debate).

" . . . an incidental result of a lawful operation and could not reasonably have been avoided": Sub-section 10 (3) (c) of the Wildlife and Countryside Act is one of the subjective defences relating to great crested newt conservation. It is considered by many as a universal 'let out clause' and has been the reason why people have said that Planning Permissions, etc, over-ride the Wildlife and Countryside Act. The defence is given that an action (eg killing or habitat destruction) is not an offence if it is incidental AND if it could not have been reasonably have been avoided. This latter clause relates to the reasonableness of avoidance and not the reasonableness of the otherwise 'lawful activity'. For example it is perfectly reasonable for a developer to develop land with planning permission; habitat destruction is an inevitable, unavoidable consequence and hence is not an offence. However killing or injuring animals is likely to be avoidable in which case it would not be covered by this clause.

This clause provides the justification for conservation actions as well. For example clearing weeds from ponds could be considered damage to places used for shelter and protection, even though it is essential for conservation. The act is intentional and thus potentially an offence. Clearing ponds during winter minimises the risk of disturbing animals (and conversely disturbance during the spring/ summer is usually avoidable). Consequently, since the pond clearing is lawful and the 'damage' resulting from the conservation action is unavoidable, this clause will permit such action.

The combination of Sub-section 10 (3) (c) and the need to prove 'Intention' of action though does seriously undermine the provisions of the Act as far as habitat loss in connection with development, etc, is concerned.

Planning guidance

Local Authorities receive guidance on planning via Circulars issued by the Department of Environment. Two circulars gave guidance about the Wildlife and Countryside Act ('Wildlife and Countryside Act 1981' (No. 32/81) and 'Wildlife and Countryside Act 1981, Commencement of Part 1' (No. 24/82)). These mainly outlined the nature of the provisions of the legislation and advised when it was coming into force.

In 1987 a circular entitled 'Nature Conservation' (No. 27/87) was published and this replaced the circular on 'Nature Conservation and Planning' (No. 108/77) produced ten years earlier. Circular 27/87 're-affirms the Government's commitment to the conservation of the natural heritage and amplifies previous advice and guidance intended to assist the achievement of this objective'. The thrust of the protection it delivers though is through statutory site protection, namely through SSSI and NNR designation and policies relating to safeguarding sites so designated. However it does emphasise the international obligations resulting from the Bern Convention and does highlight the need to conserve protected species that occur outside of protected sites.

The Circular 'Planning Controls over Sites of Special Scientific Interest' (No. 1/92) advised over the further protection afforded to SSSIs and to the need for control over activities which may affect SSSIs.
Government guidance to Planning Authorities in connection with species protection has, to date, not been explicit. A draft circular has been produced by DoE that clearly identifies protected species as a material planning consideration. This document has been due for publication for some while but is being delayed by the need to include advice relating to the EU 'Habitats and Species' Directive'. The production of such clear advice is needed to control development on areas that are important for great crested newts and to facilitate the use of conditions associated with Planning Applications that would greatly clarify the implementation of the species conservation legislation.

Licensing

Section 16 of the Wildlife and Countryside Act 1981 permits licences to be issued to allow actions that would otherwise be prohibited by the Act. Licences are issued for specific purposes, and the purpose of issue defines the Authority responsible for licensing. I shall describe the situation relating to great crested newts.

English Nature, CCW and SNH are responsible for licensing actions for the purposes of science, education, marking, conservation, translocation and photography. The Ministry of Agriculture licences activities relating to the protection of public health and safety, preventing the spread of disease and protecting livestock, foodstuffs, crops, etc, or other property. The Department of Environment license sale, etc. MAFF and DoE are required to consult the Statutory Nature Conservation Organisations (or other appointed advisory body) before granting such licences.

Licences can not be granted under the Wildlife and Countryside Act 1981 for other purposes, eg to allow development; there is no legislative means for doing so. When a translocation is required to enable development to go ahead the licence is issued for the purpose of conservation. We therefore need to be happy that there is a conservation benefit in allowing the activity. Habitat destruction is permitted only if it satisfies the defences provided under the Act (eg Section 10 (3) (c)).

European Union dimension

The great crested newt is listed on two Annexes of the EU's Council Directive No. 92/43/EEC on the Conservation of Natural Habitats and of Wild Fauna and Flora (the 'Habitats and Species Directive'). Annex IIa is the list of animal species for which Special Areas of Conservation need to be established; the great crested newt is the only British amphibian species to be listed on this Annex. SACs are areas that form part of the Europe-wide *Natura 2000* series and are to receive additional protection. It is not yet clear how many sites will be designated as SACs for great crested newts. The list of sites must be prepared within six years of the notification of the Directive (ie by May 1998) and once adopted the site should be designated as soon as possible (and within six years).

Article 12 of the Directive outlines protection measures for species listed in Annex IVa (which includes the great crested newt). The wording closely follows that of the Bern Convention. It is doubtful whether the Wildlife and Countryside Act fully implements the requirements of the Directive as it stands. The Directive uses the term 'deliberate' when referring to capture, killing, habitat destruction, etc. It is likely that the word 'intentionally' will need to amended in the Wildlife and Countryside Act to implement the different emphasis (and to remove the weaknesses of the 1981 Act mentioned above). Sub-section 1 (d) of Article 12 prohibits 'deterioration or destruction of breeding sites or resting places'. It is likely that the term 'deterioration' will be considered to relate to an active process rather than the passive reduction in quality of habitat through natural causes such as weed encroachment, shading or silting up. Legislation to implement the Directive must be in place in the Member States within two years (ie by May 1994).

Changes around the corner?

The EC 'Habitats and Species Directive' is likely to result in some amendment to the legislation regarding species protection. This is likely to be by the publication of Regulations during 1994. Additional protection for the species is likely to be imminent. Certainly areas need to be designated as SACs for conservation of some of the best great crested newt sites in the United Kingdom.

New planning guidance should provide clearer direction about the need to consider protected species when determining planning applications and this should see further site safeguard on the basis of species present and more effective use of planning conditions where development is permitted.

Penalties and enforcement

The penalties for offences listed in Section 21 of the Wildlife and Countryside Act have been updated. A combination of the Magistrates Court Act 1980 and Criminal Justice Act 1982 established a 'standard scale' of fines. Maximum fines for offences under Section 9 of the Wildlife and Countryside Act were set as Level 5. Level 5 fines were increased with effect from 1 October 1992 to £5,000 per offence (following an Order being passed under the Criminal Justice Act 1991). Where more than one animal is involved, each can be treated as a separate offence and consequently it is possible that very large fines can be generated if offences involving many animals can be proven.

The Magistrates Court Act 1952 requires that any offence can only be tried of proceedings are instigated within six months of the offence occurring. Section 20 of the Wildlife and Countryside Act extended this period for offences under section 9 (1) involving the killing or taking of protected wild animals to within six months of sufficient evidence of the offence coming to light to enable prosecution, provided that it is within two years of the offence taking place.

The combination of the difficulty of establishing cases (eg proving intent) and the short time period to bring the prosecution has meant that few cases have been brought under Section 9 of the Wildlife and Countryside Act.

However there is an increasing pressure to test the legislation in Courts. Only by doing this will the strengths or weaknesses be evaluated and cases made for requesting amendments.

English Nature are not usually involved with taking prosecutions under Part I of the Wildlife and Countryside Act 1981. This is considered to be the role of the police. Often actions will be taken by other organisations, such as Planning Authorities or the RSPCA; English Nature aim to offer assistance where possible in these cases. However, English Nature is an enforcement agency for offences under Part II of the Wildlife and Countryside Act (eg relating to SSSIs).

References

Primary legislation
Protection of Animals Act 1911
The Magistrates Court Act 1952
Abandonment of Animals Act 1960
Magistrates Court Act 1980
Wildlife and Countryside Act 1981
Criminal Justice Act 1982
The Animals (Scientific Procedures) Act 1986
Environmental Protection Act 1990
Criminal Justice Act 1991
Conventions
The Convention on the Conservation of European Wildlife and Natural Habitats ('the Bern Convention')
European Union Directives
Council Directive No. 92/43/EEC on the Conservation of Natural Habitats and of Wild Fauna and Flora (the 'Habitats and Species Directive')

DoE Circulars
'Nature Conservation and Planning' (No. 108/77)
'Wildlife and Countryside Act 1981' (No. 32/81)
'Wildlife and Countryside Act 1981, Commencement of Part 1' (No. 24/82))
'Nature Conservation' (No. 27/87).
'Planning Controls over sites of Special Scientific Interest' (No. 1/92)

Addendum

Since the Symposium Regulations have been put into place to implement the additional requirements of the EU Habitats and Species Directive (No 92/43/EEC). These are published as a Statutory Instrument called *The Conservation (Natural Habitats, & c.) Regulations 1994* (SI. 1994 No. 2716). The Regulations came into effect on 30 October 1994.

The Regulations will provide an additional layer of protection for Great Crested Newts; and do not repeal the protection afforded by the Wildlife and Countryside Act 1981. There are differences between S38 of the Regulations and S9 of the Wildlife and Countryside Act. Notably the word 'intentionally' is replaced by 'deliberately'; protection covers disturbance without restricting it to 'whilst occupying a place used for shelter and protection'; damage/destruction of 'a breeding site or resting place' is prohibited. The implications of these and other changes, and their application *vis-a-vis* the Wildlife and Countryside Act, need further investigation.

Planning guidance for England has also been updated. Planning and Policy Guidance note PPG9 was published in October 1994. The presence of a protected species is now explicitly stated as a material planning consideration. Local Authorities are directed to consult English Nature where a development threatens the species on its habitat. The PPG also gives guidance on Special Areas of Conservation etc. Since this will now govern planning guidance relating to crested newts, reference should be made to this document. PPG9 cancels previous DoE Circulars numbers 32/81, 24/82, 27/87 and 1/92.

Further references

DEPARTMENT OF THE ENVIRONMENT. 1994. Planning Policy Guidance: Nature Conservation (PPG), October 1994.

Statutory Instrument. 1994, No. 2716. Wildlife, Countryside: The Conservation (Natural Habitats, & c.) Regulation 1994.

Appendix

Text of sections 9 and 10 of the Wildlife and Countryside Act 1981: other sections should be consulted for definitions, etc

The great crested newt is listed in Schedule 5 to the Act

Wildlife and Countryside Act 1981 — c.69

Protection of other animals — Part I

9. (1) Subject to the provisions of this Part, if any person intentionally kills, injures or takes any wild animal included in Schedule 5, he shall be guilty of an offence. — Protection of certain wild animals.

(2) Subject to the provisions of this Part, if any person has in his possession or control any live or dead wild animal included in Schedule 5 or any part of, or anything derived from, such an animal, he shall be guilty of an offence.

(3) A person shall not be guilty of an offence under sub-section (2) if he shows that -

(a) the animal had not been killed or taken, or had been killed or taken otherwise than in contravention of the relevant provisions; or

(b) the animal or other thing in his possession or control had been sold (whether to him or any other person) otherwise than in contravention of those provisions;

and this subsection 'the relevant provisions' means the provisions of this Part and of the Conservation of Wild Creatures and Wild Plants Act 1975. — 1975 c.48.

(4) Subject to the provisions of this Part, if any person intentionally -

(a) damages or destroys, or obstructs access to, any structure or place which any wild animal included in Schedule 5 uses for shelter or protection; or

(b) disturbs any such animal while it is occupying a structure or place which it uses for that purpose,

he shall be guilty of an offence.

(5) Subject to the provisions of this Part, if any person -

(a) sells, offers or exposes for sale, or has in his possession or transports for the purpose of sale, any live or dead wild animal included in Schedule 5, or any part of, or anything derived from, such an animal; or

(b) publishes or causes to be published any advertisement likely to be understood as conveying that he buys or sells, or intends to buy or sell, any of those things,

he shall be guilty of an offence.

(6) In any proceedings for an offence under subsection (1), (2) or (5)(a), the animal in question shall be presumed to have been a wild animal unless the contrary is shown.

10. (1) Nothing in section 9 shall make unlawful -

(a) anything done in pursuance of a requirement by the Minister of Agriculture, Fisheries and Food or the Secretary of State under section 98 of the Agriculture Act 1947, or by the Secretary of State under section 39 of the Agriculture (Scotland) Act 1948; or — Exceptions to S.9; 1947 c.48.; 1948 c. 45.

(b) anything done under, or in pursuance of an order made under, the Animal Health Act 1981. — 1981 c. 22.

(2) Nothing in subsection (4) of section 9 shall make unlawful anything done within a dwelling-house.

(3) Notwithstanding anything in section 9, a person shall not be guilty of an offence by reason of -

(a) the taking of any such animal if he shows that the animal had been disabled otherwise than by his unlawful act and was taken solely for the purpose of tending it and releasing it when no longer disabled;

(b) the killing of any such animal if he shows that the animal had been so seriously disabled otherwise than by his unlawful act that there was no reasonable change of its recovering; or

(c) any act made unlawful by that section if he shows that the act was the incidental result of a lawful operation and could not reasonably have been avoided.

(4) Notwithstanding anything in section 9, an authorised person shall not be guilty of an offence by reason of the killing or injuring of a wild animal included in Schedule 5 if he shows that his action was necessary for the purpose of preventing serious damage to livestock, foodstuffs for livestock, crops, vegetables, fruit, growing timber or any other form of property or to fisheries.

(5) A person shall not be entitled to rely on the defence provided by subsection (2) or (3)(c) as respects anything done in relation to a bat otherwise than in the living area of a dwelling house unless he had notified the Nature Conservancy Council of the proposed action or operation and allowed them a reasonable time to advise him as to whether it should be carried out and, if so, the method to be used.

(6) An authorised person shall not be entitled to rely on the defence provided by subsection (4) as respects any action taken at any time if it had become apparent, before that time, that that action would prove necessary for the purpose mentioned in that subsection and either:

(a) a licence under section 16 authorising that action had not been applied for as soon as reasonably practicable after that fact had become apparent; or

(b) an application for such a licence had been determined.

Surveying and monitoring great crested newts

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Introduction

This paper is based upon work conducted over a number of years by specialists in North-west England, mainly members of the Lancashire Wildlife Trust Newt Group.

The great crested newt *Triturus cristatus* is the UK's most pond-dependent species of amphibian, borne out by the latest findings of the National Amphibian Survey (Swan & Oldham 1993). The GCN dislikes larger water bodies such as lakes and reservoirs and is only occasionally successful in canals and ditch systems. At the other extreme, GCN is far less able to colonise garden ponds than other amphibians, and is not as opportunistic as the common frog with temporary shallow ponds. Flooded cart ruts might suit the common frog but not the great crested newt!

Ponds are crucial to the conservation of the great crested newt and the mapping of ponds is central both to understanding the distribution of the species and for planning surveys.

There is a difficulty. The sheer number of ponds renders it difficult to conduct a blanket survey for the whole of England and Wales, given the limited number of volunteers, seasonal constraints and the lack of substantial funding to engage paid surveyors. Where funding has been applied, such as in Clwyd, then the survey results are impressive. In Wigan Metropolitan Borough, a combination of Lancashire Wildlife Trust Newt Group volunteers and deployment of a local authority funded MSC team has enabled a rational basis for Unitary Plan land allocation and more objective consideration of planning applications.

To date, it has been estimated that only 10-15% of the estimated total number of 18,000 GCN sites (Whitten 1990) in the UK have been identified even after years of effort (T. Beebee, this volume). Not only does this leave unprotected the unsurveyed sites, it greatly increases the land use planning conflict and consumes large sums of public and private money in last-minute confrontation and drawn-out public inquiries. Furthermore it creates paralysis in the mechanism for the selection of key GCN sites as SSSIs, there being a desire to designate the most appropriate sites only in the context of a detailed regional survey.

It seems unlikely that most of the ponds in England and Wales will have been surveyed for great crested newt by the turn of the century. Interim measures must be taken to ensure protection of sites and increase the discovery rate of sites. This paper suggests a way forward based upon four elements:

- how to target survey effort;
- how to improve survey speed;
- how to improve survey effectiveness;
- how to present and interpret survey results.

The starting point for this account is the chapter on 'Survey and Monitoring of Amphibians' in English Nature's *Species Conservation Handbook* (Gent 1994).

The need to target GCN survey effort

The challenge is considerable, ponds being so numerous. How many ponds exist in England and Wales is a matter of speculation. Rackham (1986) estimated that some 340,000 'ponds, lakes and wet pits' are shown on the Ordnance Survey 1:25,000 maps of the 1920s. This was based on analysis of sample maps and appears to be an underestimate judging from further sampling (Grayson 1994). While pond losses in England and Wales have been severe and are continuing, substantial numbers remain in certain regions. For example, some 56,423 are shown on Pathfinder 1:25,000 maps of Lancashire, Merseyside, Greater Manchester, Cheshire, eastern Clwyd and northern Staffordshire (Grayson 1994). True, many of these ponds are now destroyed by development or agricultural improvement and many are SODs (shaded-out/dead) due to withdrawal of livestock and consequent uninterrupted tree growth. Yet, from a GCN surveyor's point of view, all 56,423 ponds need to be considered, if only to delete them from the exercise. Using this figure and extrapolating nationwide from Rackham's work after allowance for pond losses, suggests some 250,000 ponds are depicted on Pathfinder 1:25,000 maps of England and Wales. The work of Grayson (1994) suggests that the estimate of about 170,000 farmland ponds derived from a sample survey in 1985 by the Ministry of Agriculture and Fisheries in England and Wales, is too low and, in any case, the large number of ponds in forests, golf courses, parks etc needs to be added. Entirely in Cheshire, admittedly the most pond-rich county in England, a detailed survey by Boothby, Hull, Jeffreys and Small (1993) showed that an estimated 16,946 ponds existed in 1985.

The size of the challenge is therefore to survey some 250,000 sites, to determine if a pond still exists, and to determine presence or absence of great crested newt. In addition, the survey must also deal with water bodies which are inadequately shown on Pathfinder maps, notably disused canals, brick pit ponds, sand pit ponds, dune slacks and dew ponds.

How to target GCN survey effort

To target survey effort, it is necessary to know where the ponds are.

The distribution of ponds is poorly known nationally, the map by Rackham (1986) being schematic and refers to the 1920s. Satellite photos, air photos and field surveys are time-consuming and expensive. Yet co-ordinated voluntary effort could produce a National Pond Map plotted on the 1 km squares of the National Grid both quickly and cheaply, based upon inspection of Pathfinder 1:25,000 maps and Grayson (1994) describes a standard clerical method. The finished result would be amenable to computer manipulation and integration with GIS land use studies and species distribution maps and valuable for both landscape ecology and nature conservation purposes, as well as helping to target GCN survey work. This is in spite of the National Pond Map being an amalgam of mapping by different workers across a range of dates, and heavy pond losses having occurred since. The first portion of such a Pathfinder-derived National Pond Map is shown as Figure 1 and covers Lancashire, Cheshire, Merseyside, Greater Manchester, eastern Clwyd and adjacent areas. It took six man-weeks to produce by members of Lancashire Wildlife Trust (Grayson 1994).

To describe where the ponds are, some terminology is useful, and completion of the National Pond Map will permit whole tracts of ponds to be described in terms of landscape ecology and wildlife corridors. Grayson (1994) suggests the following terminology:

Pondscape: Landscape with six or more ponds shown on Pathfinder maps in each adjacent 1 km square of the National Grid, and therefore capable of being visually affected by the presence of either ponds or associated features such as trees and swamps. The term 'core pondscape' is valuable to draw attention to areas where the mapped pond density is 15 or more ponds per 1 km square, a situation where the landscape is likely to be dominated by ponds or associated features.

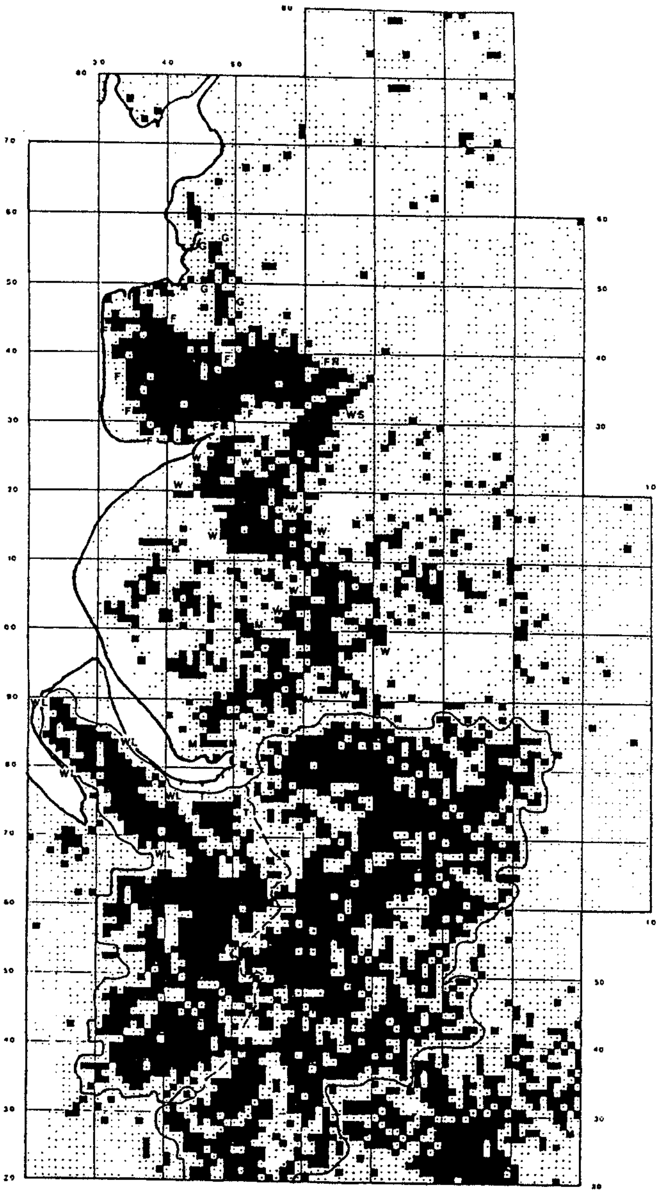

Figure 1: **Pondways, Superclusters and Isolated Pond Clusters shown on 1:25000 Pathfinder maps of North-West England.**

Black squares = 1 km OS squares with 6 or more ponds mapped
Dots = 1 km OS squares with 1 to 5 ponds mapped
Blank areas = 1 km OS squares with no ponds mapped

G = Garstang Pondway
F = Fylde Supercluster
FN = North Ribble Pondway
WS = South Ribble Pondway
W = Wigan Pondway
M = North Mersey Pondway
WL = Wirral Pondway
T = Thornton Pond Cluster

continuous black line = perimeter of Cheshire-Shropshire Supercluster
dashed black line = partial division of Cheshire-Shropshire Supercluster

'Degraded pondscape' is a useful term if fieldwork shows that pond losses have reduced the number of ponds to below six per 1 km square.

Pond Supercluster: A large tract of pondscape, typically covering 100s sq km. The term 'pond cluster' should not be used except as in the informal current usage - just three ponds can be a pond cluster! Examples shown on Figure 1 include the massive Cheshire-Shropshire Supercluster (indicated by a continuous line), and the Fylde Supercluster (F) of Lancashire. Pond superclusters can be a major ecological resource, even in a degraded landscape.

Pondway: A linear tract of pondscape, typically 10 or more km in length. Examples shown on Figure 1 include the Wigan Pondway (W), South Ribble Pondway (WS), North Ribble Pondway (WN), Garstang Pondway (G), North Mersey Pondway (M) and the Wirral Pondway (WL). Pondways can be a major ecological resource and may operate as wildlife corridors.

To target GCN survey effort, areas of high pond density should be priorities

On a regional basis, pond density is neither random nor regular but highly clustered. It follows that the maximum number of ponds per day can be surveyed for GCN by concentrating upon the superclusters, pondways and prominent clusters. With 250,000 sites to survey this makes sense! There are two other good reasons for concentrating GCN survey effort in this manner.

Firstly, this will detect any major population supported by a cluster of ponds, and identify any tracts of open countryside which sustain a semi-continuous population. This will be at the price of missing isolated GCN populations.

Secondly, the probability of a pond supporting GCN seems to be greater if the pond is near to other ponds, preferably as part of a cluster, supercluster or pondway. The National Amphibian Survey (Swan & Oldham 1993) demonstrated that for pond densities of below 0.7 ponds per sq km the probability of GCN occupying a pond is less than expected, and above 0.7 ponds per sq km it is greater than expected. In Greater Manchester County, unpublished work by Grayson, Parker and Mullaney demonstrates that where the pond density shown on Pathfinder maps exceeds approximately eight ponds per 1 km square, then the probability of GCN being found in a pond is greater than squares with a lower value for mapped pond density. From a surveying standpoint, searching 10 isolated ponds is likely to be less rewarding in terms of the number which yield GCN than if the 10 ponds are in a pond-rich area. From an ecological standpoint, the determining factor may be a relationship between pond density and land use, or the inability of a GCN population to recolonise an isolated pond following elimination due to a catastrophe such as fish ingress, shading out for 10 years, or eutrophication for several seasons. Conversely a pond in a cluster of ponds would be expected to be re-colonised swiftly by GCN.

In practice, the situation is more complicated. There are large tracts of pondways and superclusters in which the GCN is either rare or absent. This is the case for large parts of the Cheshire-Shropshire Supercluster the and the Fylde Supercluster where the terrestrial habitat is unsuitable due to ponds becoming shaded out by trees consequent upon removal of livestock and the intensification of agriculture. Sample GCN surveys, either random or transect, should quickly determine the situation. Where terrestrial conditions are favourable, pondways, superclusters and clusters can yield numerous GCN sites as in the Wigan Pondway, and the NE rim of the Cheshire-Shropshire Supercluster. This is demonstrated by comparison of Figure 2 (an enlargement of a portion of Figure 1) and Figure 3 which shows GCN-occupied 1 km squares in Greater Manchester and selected parts of Lancashire (Chorley) and Cheshire (Rixton, Rostherne, Manchester Airport).

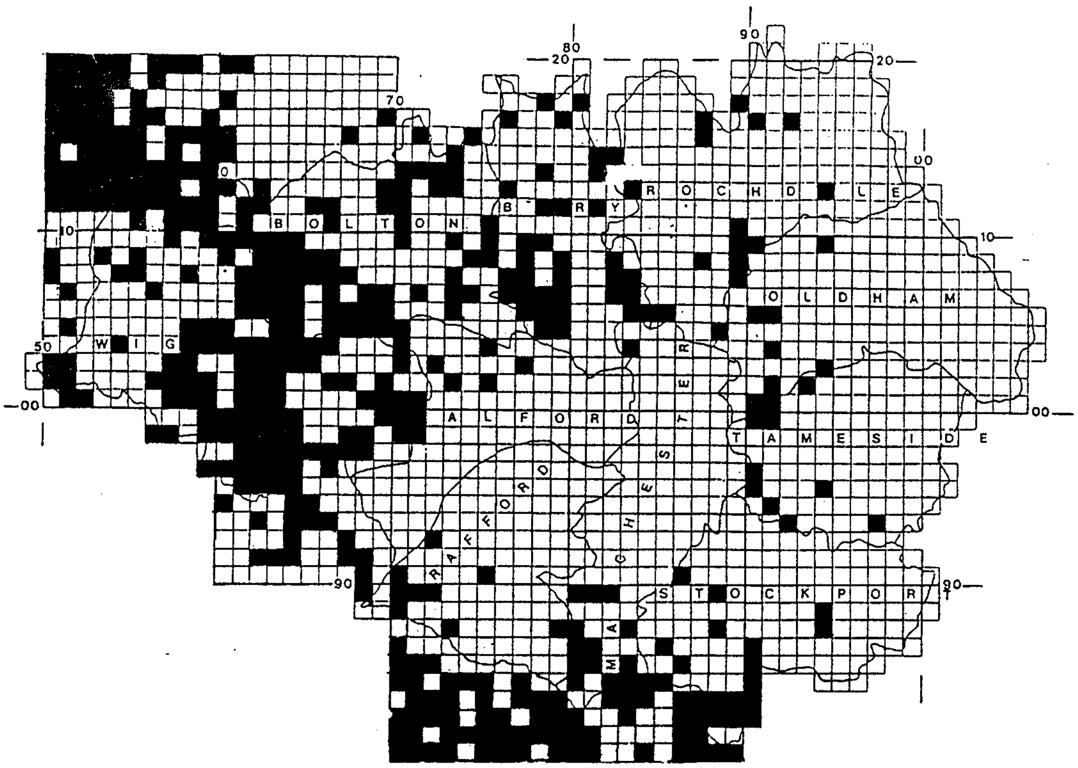

Figure 2: Distribution of high pond density in the 10 metropolitan districts of Greater Manchester County and adjacent parts of Lancashire and Cheshire.

Black squares = 1 km OS squares with six or more ponds shown on Pathfinder maps.

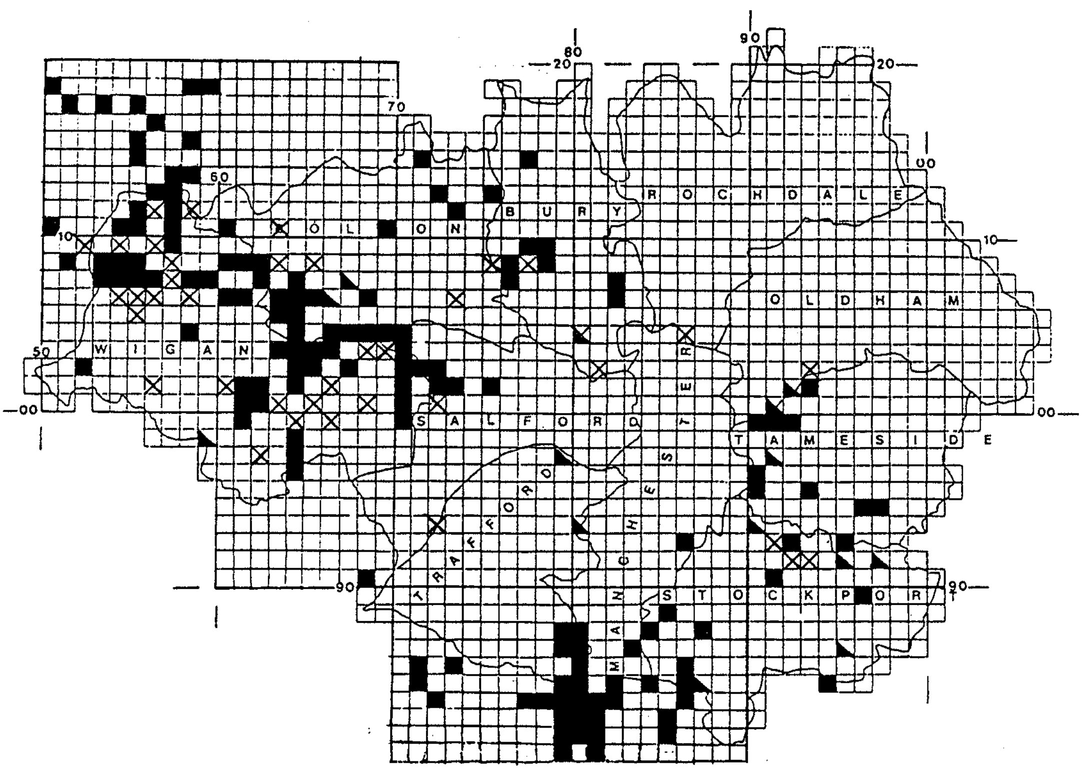

Figure 3: Distribution of great crested newt in the 10 metropolitan districts of Greater Manchester County and adjacent parts of Lancashire and Cheshire

How to improve GCN survey speed

With 250,000 ponds to survey, the speed of GCN surveying is important. Table 1 indicates how the choice of survey method can greatly influence the number of ponds capable of being surveyed in a field season. Other methods such as bottle trapping and pitfall traps are relatively slow but can yield important information about population size. While the figures in Table 1 are notional, they show that the egg search method enables a significantly faster survey than any other method. It should be borne in mind that the egg search method does not work on all sites, is possible only in part of the survey season and usually cannot yield information about population size. Nevertheless the egg search method seems the only method capable of quickly achieving a baseline survey of pondways and superclusters in terms of simple presence or absence. The use of the egg search method in blanket surveys was developed by Dr Ray Gemmell in NW England and used widely by the Lancashire Wildlife Trust Newt Group in preference to other methods. Its value for detecting simple presence of GCN is noted by Beebee (1990) and it is now widely accepted as a field technique.

Table 1 Relative speed of GCN survey methods. Assume one hour to site, six hours on site, one hour from site; five day week; average weather; no access problems; ponds clustered.

	time at pond	pond to pond	in a day
Egg search	5 min	5 min	36 ponds
Terrestrial search	15 min	5 min	18 ponds
Net adults	20 min	7 min	12 ponds
Net larvae	15 min	7 min	17 ponds
Torch night	15 min	12 min	6 ponds
To do 1,000 ponds			
Egg search	28 days	6 weeks	
Terrestrial search	56 days	12 weeks	
Net adults	83 days	17 weeks	
Net larvae	59 days	12 weeks	
Torch night	166 nights	33 weeks	

How to improve GCN survey effectiveness

To improve the effectiveness of GCN surveys, the method should be chosen with care

Table 2 shows the performance of six different survey methods in detecting GCN at 36 GCN ponds in a part of the Wigan Pondway in and around the proposed Lomax Opencast Site in Greater Manchester County. In this instance the egg-search method performed better (86.1%) than all other methods combined (75%). This was largely due to the ponds being weedy, muddy, ringed with marsh and therefore unsuitable for either night counts or ease of netting of adults. By night or day, adult GCN had usually crash-dived to the safety and obscurity of the muddy pond bottom while the observer was getting in position in the marginal marsh. Most of the farmland ponds of NW England present the same intractable difficulty with night counts.

Table 2 Comparison of effectiveness of six GCN survey methods in Lomax Study Area in Greater Manchester.

	GCN ponds detected	GCN ponds missed	Method impossible	Success rate
Pooled results	36	0	0	100%
Egg search	31	3	2	86.1%
EX egg search	27	7	2	75.0%
Torch night	13	10	13	36.1%
Larvae netting	10	24	2	27.7%
Terrestrial search	9	19	8	25.0%
Adult netting	7	27	2	19.4%
Adult sighting	5	19	12	13.9%

There are exceptions. Eggs can be hard to find if a pond has vague margins, for the female GCN may then lay her eggs in less obvious parts of the pond. Furthermore, ponds with few or unsuitable pond plants may make the egg search method impossible. Stands of reedmace defeat the novice but with practice GCN eggs can be quickly found. Scarcity of suitable pond plants may make eggs impossible to find. At one pond in Bolton ('Crystal'), GCN adults are easily observed at night but eggs are rarely found due to the scarcity of available pond plants. At other ponds, too much vegetation makes detection of eggs very difficult to impossible yet netting later is the season for larvae generally succeeds. Where water plants are scarce, placing of artificial egg substrate (strips of black plastic bin bags bundled together) usually succeeds but where vegetation is abundant it is a pointless exercise.

The egg search method also detects eggs laid by other smaller species of newt, so helping to establish the presence of an amphibian assemblage. However, as the smooth newt *Triturus vulgaris* occurs in the great majority of GCN ponds, the crucial species therefore tends to be the palmate newt *Triturus helveticus*, but the egg search method fails to separate palmate from smooth. Given that the egg-search method is becoming more widely adopted it would be opportune to devise a method for identifying palmate eggs. Species' determination by electrophoresis upon eggs brought back and stored in a domestic refrigerator until enough samples for a batch run have accumulated would be a major step forward and merits experimentation.

The value of GCN pond clusters

Many, indeed most, of the ponds of NW England are unsuitable for night counts and often difficult to net for adults. It seems likely that this applies to the majority of the farmland ponds of England and Wales. The recognition of GCN sites as potential SSSIs is therefore artificially skewed in favour of those ponds which have clear water, pale floors, only limited amounts of aquatic vegetation and minimal marginal marsh. Major GCN sites with ponds which do not meet this prescription will remain undetected unless the egg search method, or perhaps larval netting, become more widely used. Even once detected, they will still fail to qualify as potential SSSIs because their GCN population size will remain unknown until too late when the pond is the subject of an emergency rescue or a controlled translocation. Not only isolated GCN ponds, but also whole clusters of GCN ponds will fail to qualify as potential SSSIs.

There are scientific and pragmatic reasons for designating substantial clusters of GCN ponds as potential SSSIs:

a. A cluster of GCN ponds is far less vulnerable to permanent damage from natural succession, pollution or ingress of fish than a single GCN pond - even if the single pond supported the same size of population.

b. A cluster of GCN ponds will probably show a wider autecology for the species than possible with a single pond, even perhaps if the single pond is of substantial size. More likely the ponds will offer a greater range of, for instance, marginal vegetation, stage of succession, shade, food supply, temperature etc. Furthermore, the cluster of GCN ponds should, on a statistical basis, tend to be associated with some additional ponds which currently are unsuitable for GCN due to eutrophication, succession, fish, shading out etc, but may be part of a long term cycle of change in which GCN recolonises. In favourable years, the probing of such ponds by GCN would add to the interest of the potential SSSI.

c. A cluster of GCN ponds may be associated with derelict land, underutilized land or low-intensity farming, often supporting a wide range of night-time feeding areas, day-time shelters, hibernation sites and corridors.

d. A single pond with high GCN night counts may indicate a shortage of waterbodies in the area suitable for breeding, rather like the impact of a water hole in the African savannah upon herds of game and flocks of birds. The single pond, while an undeniably important GCN site, may sometimes be a source of overcrowding and stress.

e. A cluster of GCN ponds is more likely to support a substantial GCN population. This may be uniformly distributed amongst the ponds, but more likely will be concentrated in a few, some only achieving breeding in good years. Some may be more in the nature of 'probing ponds', not achieving breeding due to fish, regular desiccation etc. However, a cluster of GCN ponds may be sufficient to ensure that in all but the most extreme conditions, some recruitment is successful in some of the ponds every season, although perhaps different ponds each time. Against such a background it would seem unwise to exclude ponds from the SSSI perimeter on the grounds that in the particular year of survey GCN did not breed in that pond.

f. A cluster of GCN ponds is more likely to be in a pondway or supercluster and therefore may be a relic of a former single continuous regional population. In contrast, an isolated GCN pond may be more difficult to account for and may be more likely to be an introduction, deliberate or accidental (eg via eggs on water plants) or else be derived from relatively few individuals and therefore more prone to inbreeding. A cluster of 10 GCN ponds may therefore support a more representative population more able to sustain a viable gene stock unaided indefinitely. This assumption requires verification.

g. The concept of GCN pond clusters can be speedily applied to many sites under threat, and appears to be robust enough to be defendable at Public Inquiry.

Definition of GCN pond clusters

Determining which GCN breeding ponds belong to a GCN pond cluster

To determine if GCN breeding ponds should be regarded as belonging to the same GCN pond cluster, a consistent method is necessary. It is recommended that a circle of 250 metre radius should be drawn upon a map around each GCN breeding pond, then delete any portion of the encompassed area which is considered to be seriously impeded by major obstacles to GCN movement. If the residual portion of the circle touches or overlaps a circle drawn for a neighbouring GCN breeding pond, then both should be considered to belong to the same GCN pond cluster. As an approximation, with small ponds, the centre of the pond can be used as the centre of the 250 m circle, but for large ponds the for linear ponds (eg ditches and ox-bows) corrections should be made. Even so, use of the '250 m radii rule' is quick and consistent.

This procedure accords with estimates that GCN juveniles can move up to 500 metres away from their 'birth pond' and therefore ponds which are less than this distance apart (ie with circles of

250 m radii in contact) can be considered to be part of the same meta-population and therefore likely to have regular genetic interchange of genetic material (Gent 1994).

Drawing SBI boundaries around a GCN pond cluster

In deciding where to draw the perimeter of a SBI on a map in order to embrace a GCN meta-population, the '250 m radii rule' provides quickly a provisional boundary. Closer study permits refinement by addition of peripheral areas of nature conservation value or essential to protect the integrity of the site, or by deletion of areas of little or no potential value to GCN.

Drawing of SBI boundaries in this manner provides a simple 'tripwire' inside which GCN is a material consideration in an EIA, planning application, temporary site works, management plan or in land allocation for a local plan. The onus is put upon a developer, planner or engineer to demonstrate to the satisfaction of both English Nature and the local planning authority, by means of a detailed survey, that the SBI boundary can be infringed without undue detriment to the GCN meta-population or with the impact adequately mitigated.

Deciding which GCN breeding ponds constitute a single population

When GCN breeding ponds are closer together, sufficient for the 250 m radius circle centred upon a GCN pond to encompass or touch the next GCN pond, then genetic interchange can be expected to be so substantial that they can be regarded as constituting a single population. It should be remembered that, while juvenile GCN may move 500 m away from their birthpond, adult GCN seem to be more pond-loyal and are more likely to move within 250 m of their spawning pond. For this reason, English Nature's *Species Conservation Handbook* (Gent 1994) states that for GCN: "counts in ponds within 250 m of each other should be summed provided that there are no obvious barriers to dispersion; those that bit further away may be important to the long term viability of each other.

Mapping, evaluation and ranking of GCN sites

Three levels for mapping and evaluation of GCN sites

In presenting survey results there are three valid levels at which counts can be calculated and presented, each level being of value in site evaluation:

Level A: *To determine the importance of a GCN breeding pond,*
leave the counts unsummed, as raw data on a pond-by-pond basis;

Level B: *To determine the importance of a GCN population,*
sum counts for GCN ponds within 250 m radius of each other;

Level C: *To determine the importance of a GCN meta-population,*
sum counts for GCN ponds with 250 m radii touching or overlapping.

Unfortunately consultants have too often interpreted large proposed development sites, which may cut across major GCN pond clusters, solely on a pond-by-pond basis (level A). This approach has merit in the appraisal of individual ponds, and in helping to rank them on a pond-by-pond basis, but in isolation contributes little to the overall evaluation of a whole GCN population or a whole GCN site. For an EIA of a GCN population, it is essential to conduct level B mapping and evaluation, and this also permits the EIA to become more focused upon evaluation of the terrestrial habitats. On a pond-by-pond basis, GCN night counts might be low, but if level B is determined then a population with a night count of potential SSSI quality may be proven (ie 100+ adults seen). For an EIA of a GCN meta-population, it is essential to conduct level C mapping and evaluation. Level C is crucial in conserving the continuity of the local geographical range of the species - a strategic dimension to species protection and species recovery.

Three levels for mapping and evaluation of GCN in amphibian assemblages

Many surveyors present records solely on a pond-by-pond basis (level A) in Environmental Statements. In this manner, each pond can be claimed to have a 'low population' of GCN using the scoring system set out in the NCC *Guidelines for the selection of Biological SSSIs* reproduced here (Table 3). Yet if level B mapping and evaluation is conducted, day time net counts (or night time torchlight counts) are summed to reveal the status of the GCN population, then the pond in question may be part of a 'good population' or even an 'exceptional population'. Similarly, level C mapping and evaluation can be conducted to reveal the presence of a 'good meta-population' or an 'exceptional meta-population'.

Table 3 **NCC Scoring System for the selection sites with assemblages of amphibians (based on Table 29 of NCC *Guidelines for the selection of Biological SSSIs***

		Low population Score 1	**Good population Score 2**	**Exceptional population Score 3**
GCN adults	Seen or netted in day	<5	5-50	>50
	Counted at night	<10	10-100	>100
Smooth newt adults	Netted in day	<10	10-100	>100
	Counted at night	<10	10-100	>100
Palmate newt adults	Netted in day	<10	10-100	>100
	Counted at night	<10	10-100	>100
Common toad adults	Estimated	<500	500-5,000	>5,000
	Counted	<100	100-1,000	>1,000
Common frog spawn	Spawn clumps counted	<50	50-500	>500

Notes:

- Scores have to be for breeding sites observed during the breeding season.
- Day time netting should be made during a 15-minute period for sites with less than 50 m of water's edge, for 30 minutes for sites with 50-100 m etc.
- To compute the total score for a site, add the scores obtained for individual species.
- Add one point if four of these species are present and two points for five species.
- Add two more points if natterjack toads are present.
- At a site where several breeding ponds are utilised by amphibians, number of individuals should be summed to derive a total for the site.
- A score of 10 or more indicates a site to be 'of SSSI quality' (see Gent 1994).

Three levels for mapping and evaluation of amphibian assemblages

A simple approach is desirable. For any GCN pond cluster, as well as assessment in terms of GCN at levels A, B and C, it should also be assessed in terms of its amphibian assemblage as follows:

Level A mapping and evaluation of amphibian assemblages: Scores should be calculated on a pond-by-pond basis. In addition, ponds used for breeding by all three native species of newt

(GCN, smooth and palmate) should be highlighted, and even higher emphasis put upon ponds used for breeding by four or even all five of the more widespread species (GCN, smooth, palmate, common frog and common toad). Any pond used by the natterjack toad is of such special importance in the UK as to merit particularly high conservation status. Level A evaluation should also be presented in map form, to demonstrate pond-by-pond variations across the GCN-defined site, to show whether breeding ponds are shared by different species, and whether the non-GCN species are confined to the GCN-defined site or continue beyond it.

Level B mapping and evaluation of amphibian assemblages: Scores should be calculated by summing amphibian counts for all ponds found within the tract of land encompassed by 125 m radii around each GCN breeding pond, ie within the land equated with the extent of the GCN population. At level B, the assemblage score is expected to equal or exceed the score for any single pond (level A).

Level C mapping and evaluation of amphibian assemblages: Scores should be calculated afresh by summing amphibian counts for all ponds found within the tract of land encompassed by 250 m radii around each GCN breeding pond, ie within the land equated with the extent of the GCN meta-population. Again, at level C the assemblage score is expected to equal or exceed that for level B by virtue of the chosen radii being larger. Many more ponds are likely to contribute to the score at level C.

With amphibian assemblages, surveyors calculate scores usually only on at level A, eg 'pond 1 have a low score of 3, pond 2 had a slightly better score of 5'. Ideal for consideration on a pond-by-pond basis, this may reveal little about the overall importance of the amphibian assemblage of a multi-pond site. Level B assessment would better reveal the importance of the amphibian assemblage, perhaps an overall score of 10 or more, qualifying as an 'outstanding assemblage' and therefore 'of SSSI quality' according to Gent (1994). Level C mapping and evaluation would indicate the importance of the amphibian assemblage coincident with the GCN meta-population.

It should be noted that caution is required in using the amphibian assemblage scoring chart published in the BHS booklet *Surveying for Amphibians* (BHS undated) because the legend incorrectly states: 'where several ponds lie close together use the highest counts for each species to produce a score for the site'.

A difficulty arises in applying the amphibian assemblage scoring scheme to pond clusters. Each species should, in theory, have bespoke rules regarding to what extent it is reasonable to consider it as being a population or meta-population. What size of radius is appropriate around a breeding site for common toad, or palmate newt etc? More confusing still, formidable obstacles isolating one species may be no deterrent to another species.

There is a second difficulty. While it is self-evident that in the case of an isolated pond, the 'scoring unit' is the single pond itself, there is no such clarity with a multi-pond site. For example, a cluster of, say, 15 ponds might have a high score warranting description as an outstanding amphibian assemblage, perhaps even with the maximum score possible (ie 17 points) - yet no one pond actually having more than one species of amphibian present! A more plausible, and perhaps quite common, phenomenon would be a group of ponds with (say) common toad breeding only in ponds at one end of the site whereas (say) palmate newt breed only in ponds at the opposite end of the site. A high amphibian assemblage score might be calculated but its significance needs to be interpreted with caution.

It is evident that the evaluation procedure recommended above is GCN-dominated. This is considered appropriate because national legislation and international treaties and conventions confer 'strict protection' upon the GCN, whereas the smooth newt, palmate newt, common frog and common toad are given lesser protection. SSSI and SBI designation procedures should recognise and incorporate this hierarchy, as indeed do EIA procedures and the planning procedures. This still leaves the desirable aim of protecting by SSSI or SBI designation all 'exceptional populations' of smooth newt, palmate new, common frog and common toad and all populations of natterjack toad. In addition, 'outstanding assemblages' which happen to lack GCN also merit protection.

Ranking of GCN pond clusters by numbers of GCN breeding ponds

A supplement to the criteria for the selection of potential SSSIs should be made, so that GCN pond clusters can be used as a parallel scheme, without disturbing the existing criteria, as follows:

clusters of 10 or more GCN ponds	potential SSSI and SSSI quality	Grade A SBI
clusters of 4 to 9 GCN ponds	SBI quality	Grade A SBI
clusters of 2 to 3 GCN ponds	SBI quality	Grade B SBI
isolated GCN pond	SBI quality	Grade C SBI

It is suggested that a threshold value of 10 GCN breeding ponds in a GCN pond cluster is appropriate nationally in order for the site to qualify as a potential SSSI. However, the ranking Sites of Biological Importance (SBIs), as used by local planning authorities, will be subject to revision county by county. Furthermore the administrative practicality of designating every site with a GCN pond as an SBI may be questionable in counties with numerous sites. Yet failure to designate will jeopardise all such sites by necessitating fallback to species' protection legislation which has proved to be far less effective at defending the wildlife interest of parcels of land. The opportunity should be taken in a future Government Circular (eg Planning Guidance Note) to local planning authorities to encourage or direct them in this matter.

Ranking of GCN pond clusters by areal extent

Part of the value of GCN pond clusters is the areal extent. For example, three GCN breeding ponds may be very close together and therefore the local range of the species might be little more than that expected with a single GCN breeding pond. On the other hand, the three GCN breeding ponds may be so spaced as to maximise the hectares accessible to the GCN population (level B), ie at 250 m apart, producing a local range for the population some 750 m across. Alternatively the three GCN ponds may be 500 m apart and so maximise the local range of the meta-population at 1,000 m across. Furthermore the meta-population is likely to include several populations and therefore cover several times more hectares than any one population alone.

Broadly speaking, the larger the range of a population, the more important it may be. The larger the range of a meta-population, the more important it is, in that it represents the local range of the species in which populations are nucleated. Any contraction or obstruction of the range of a meta-population (level C) is a matter of strategic concern, and EIA surveyors should not confine assessment to either the range of a population (level B) or to a pond-by-pond basis (level A).

Mapping and evaluation of GCN sites at regional and national level

As with other biological records, GCN survey results can be, and are, stored in a wide range of systems. Experience in Greater Manchester has highlighted problems in storing GCN survey records primarily by means of grid references. Clerical errors with grid references do occur and in areas of high pond density (eg Wigan Pondway) a six-figure grid reference may refer to more than one pond. 'Grid reference-led' data has caused problems in protected GCN breeding ponds under threat from development.

In terms of speed of data entry, speed of data retrieval, accuracy, accessibility and expense, the Lancashire Wildlife Trust Newt Group mark GCN ponds on a set of Pathfinder 1:25,000 maps, plus a simple word processor database (WordPerfect 5.1) which is split into units of OS 1 km squares. Within each unit, each GCN pond is logged in using a six-figure grid reference.

Use of the 1 km OS grid facilitates higher levels of achieving mapping and evaluation of the species:

Level D: To determine the regional GCN distribution

Mapping of GCN survey results at regional level is best presented on a 1 km OS grid (Figure 3). This is much superior to the use of tetrads (2 km x 2 km OS squares), in helping pinpoint GCN breeding points with four times the accuracy.

Level D mapping of GCN survey results displays the approximate continuity and discontinuity of GCN within its range, drawing attention to the largest areas which should support the most extensive GCN meta-populations (level C) each composed of one or more GCN population (level B) perhaps with numerous (or at least strategically spaced) GCN breeding ponds (level A). An example of level D is shown as Figure 3 which draws attention to a remarkable 22 adjacent 1 km squares. 77 GCN breeding ponds known so far (level A), considered to consist of 18 discrete GCN populations (level B) with between 1 and 8 breeding ponds each, organised into 13 discrete GCN meta-populations (level C). At level C, one of the meta-populations is known to consist of a remarkable 45 GCN breeding ponds in 400 hectares of open agricultural land. This is centred upon the land-take of Manchester Airport's proposed second runway, the subject of a Public Inquiry. In this example, mapping and evaluation at levels D and C are as relevant as levels B and A.

Level E: To determine the national GCN distribution

Level E mapping of GCN survey results in invaluable for understanding the national distribution of the species and for comparison with other mapping schemes using this manageable and familiar 10 km OS grid. Caution is required, for the 10 km OS grid produces an illusion that the species is common or abundant in NW England. Level D (Figure 3) shows GCN to be only locally common or abundant, and its range to be vulnerable to severe contraction.

Conclusions

1. It appears that the key to undertaking a national survey of the great crested newt and in documenting its national status is in targeting areas with a high density of ponds. This requires a National Pond Map to be quickly and cheaply produced along the lines of the 'pilot' map for NW England.

2. The main survey effort should be refocussed on the egg-search method by virtue of its superior speed and effectiveness, in most, but by no means all, situations, in determining simple presence of breeding GCN. The egg-search method merits 'training days' by the county wildlife trusts and British Herpetological Society to raise awareness and to disseminate know-how on all methods.

3. Electrophoresis may prove successful in discriminating between smooth an palmate eggs encountered while searching for GCN eggs, so helping identify important amphibian assemblage sites.

4. The value of GCN pond clusters merits special recognition and all clusters of 10 or more GCN ponds deserve consideration as potential SSSIs. Even isolated GCN ponds should be declared

Sites of Biological Importance (SBIs) by local planning authorities, and this should be a topic for Government circulars to local councils, species' protection legislation being insufficient and inappropriate for parcels of land.

5. Presentation and evaluation of GCN survey results is unduly focused on a pond-by-pond basis. Mapping and evaluation should be on a hierarchy of five levels:

   Level A: pond-by-pond
   Level B: populations
   Level C: meta-populations
   Level D: regional mapping of range @ 1 km OS grid
   Level E: national mapping of range @ 10 km OS grid

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Questions and discussion - Session one

Charles Gibson: I have a question for Tony Gent. A consultation paper on the Habitats and Species Directive went out from DoE last autumn: you didn't mention this at all. It actually goes some way in intention, if it gets there, towards meeting some of the things that Keith Corbett and you were discussing. Do you have any comments?

Tony Gent: I don't deal in any great detail with the Habitats and Species Directive and could only offer very peripheral comments.

Charles Gibson: Has anyone else here seen it and thought about it from the point of view of great crested newts; has Keith Corbett seen it?

Keith Corbett: I can only bring to mind one aspect of it namely the 'deterioration clause' which we are supposed to meet. My understanding is that the Government, through their consultation paper and since, is only interpreting it to apply to SSSIs. They have said that they will resurrect the option of compulsory purchase if landowners allow deterioration and if they cannot stop it any other way. However, that will only apply to SSSIs. As such, it won't apply to other important species sites that are not within an SSSI.

Charles Gibson: What about the reference in the consultation paper which indicated that something that is the incidental result of lawful action would no longer be legal?

Keith Corbett: Although the paper referred to certain aspects of the planning system, it did not by any means cover all. For example, it did not address the problem of very old mineral planning applications that are still extant.

Charles Gibson: I thought it did. In the consultation paper there was also the suggestion that extant planning permissions would no longer be a valid excuse. Elsewhere in it, it was indicated that this would apply to all sorts of planning permission, whether it was given under the Town & Country Planning or Electricity Acts etc.

Keith Corbett: This will be for SAC sites and SSSIs but not for species habitats *per se* as we are required to, not only under Annex 2 but also under Annex 4.a of the Habitats Directive and the obligations of the Berne Convention.

Charles Gibson: I wasn't totally clear about that. The way the wording referred to different parts of the Wildlife & Countryside Act led me to hope that it might be referring to the species listed in the Annexes as well.

Philip Horton: Having read the document as well, I think there is some ambiguity in the text as to whether the provisions of the Habitats Directive will refer to all SSSIs or only to SACs, which will become the 'super SSSIs'. As such it is possible that even SSSIs will not receive further protection through the Habitats Directive. I wonder if anyone from JNCC or English Nature can comment.

Tom Tew: I think that the pessimistic interpretation from a conservationist's point of view would be the correct one. I think it will apply just to SACs.

Philip Horton: A further issue about deterioration that the legislation will have to deal with is whether it will be part of the Town & Country Planning legislation or an amendment of the Wildlife & Countryside Act. It would, therefore, have the implication that local authorities may have the responsibility to deal with deterioration on SSSIs rather than the statutory conservation bodies. There are a lot of questions to be answered.

Tom Tew: A further point for concern is whether this deterioration is active or passive.

Arnold Cooke: If I can make a comment on what Robin was saying about pond clusters. Certainly in the past we have viewed a site with many ponds on it as a single site, such as a brick pit site. Where the ponds have been more widely spread we have generally looked to see whether the nearest neighbours were within *x* metres of each other; here we use the magic figure of 250 metres. Certainly in the past we have always tried to make it quantitative so we have tried to base it on night counts or some equivalent. I think there is some mileage in the future in trying to develop a system based on presence and absence of newts within pond clusters. We could, I suppose, assume that there is a minimum number of newts in each pond in order to get some quantification of population size. Even if you can't take it as far as SSSI notification, it is possible to give it some clout regionally, if not nationally, by, for example, saying this is the best cluster in the region.

Simon Pickering: Since the consultation, do we actually know what has happened to the Habitats Directive? As I understand it, the way it is going to be implemented is going to be an Affirmative Motion to a Government Committee with an in built Government majority and that there is going to be no opportunity for amendments. So I was wondering, having had everyone comment on the consultation, what's actually happened to it?

Tom Tew: I think you are understanding will again be correct, unfortunately. We are very much DoE advisers on this one and DoE are running the shop. In terms of our direct involvement at the moment, we are just pushing for SAC sites because we see Annex 2 designation as being the most powerful. The current situation is that the proposed list of SAC sites is about to go to DoE over the next couple of months and they will provide reasons why particular sites should or shouldn't be on it. In terms of primary legislation, there is still quite a way to go on that before anything is decided finally.

Habitat assessment and population ecology

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1. Introduction

This paper provides the text of the presentation at Kew Gardens and will be concerned with the following aspects of the ecology of the great crested newt:

a. Aquatic and terrestrial habitat preferences, particularly the key factors of use in assessing habitats. An expert system based upon the key factors is introduced.

b. Annual pattern of activity revealed using a variety of monitoring techniques.

c. Characteristics of the survivorship curve and age profile.

d. Patterns of population dispersion and density in sites with contrasted habitat characteristics.

In line with the request of the conference organisers, the paper will be concerned principally with summarising original work based at De Montfort University and will not attempt to review material reported in the literature, except where this is essential.

The paper is a brief review of work performed in collaboration with **Mary Swan** and **Mark Nicholson** (National Amphibian Survey), **Herbert Macgregor**, **Pim Arntzen**, **David Bullock**, **Dorian Latham** and **Anne Smithson** (Joint Agriculture and Environment Programme), **Mark Cain**, **Mark Jeffcote** and **Derek Teather** (expert system development), **Robert Duff** and **Paul Franklin** (ecology of the newt at Little Wittenham Nature Reserve).

2. Great crested newt habitat

A bewildering array of habitat features is of potential importance in underpinning great crested newt ecology, some of which are shown in Figure 1. For convenience these have been subdivided into three categories: geographic and climatic, aquatic, and terrestrial. Although all are of potential significance to great crested newt populations, some can be isolated as of particular **diagnostic** importance in determining the occurrence and status of the species. These key features (Figure 2) were identified as part of our work to develop a computer-based expert system aimed at helping the user to identify the potential of a site as a great crested newt habitat (Cain, 1993). The evidence for the selection is based upon the findings of the National Amphibian Survey (**NAS**; Swan and Oldham 1993) undertaken between 1983 and 1992, those of the Joint Agriculture and Environment Programme (**JAEP**), undertaken between 1989 and 1993 and last, but not least, upon our herpetological experience accumulated over several decades.

2.1 Identification of key factors

To illustrate the process of selection the geographic and climatic category will be considered (Figure 3). Latitude and altitude are features of significance in deciding whether newts are likely to occur at any given site and also in determining their likely status if they do occur. They are significant partly because of their climatic consequences, in particular temperature, light and rainfall. In the British Isles the normal annual variations of light and rainfall encompass the requirements of the newts, in other words

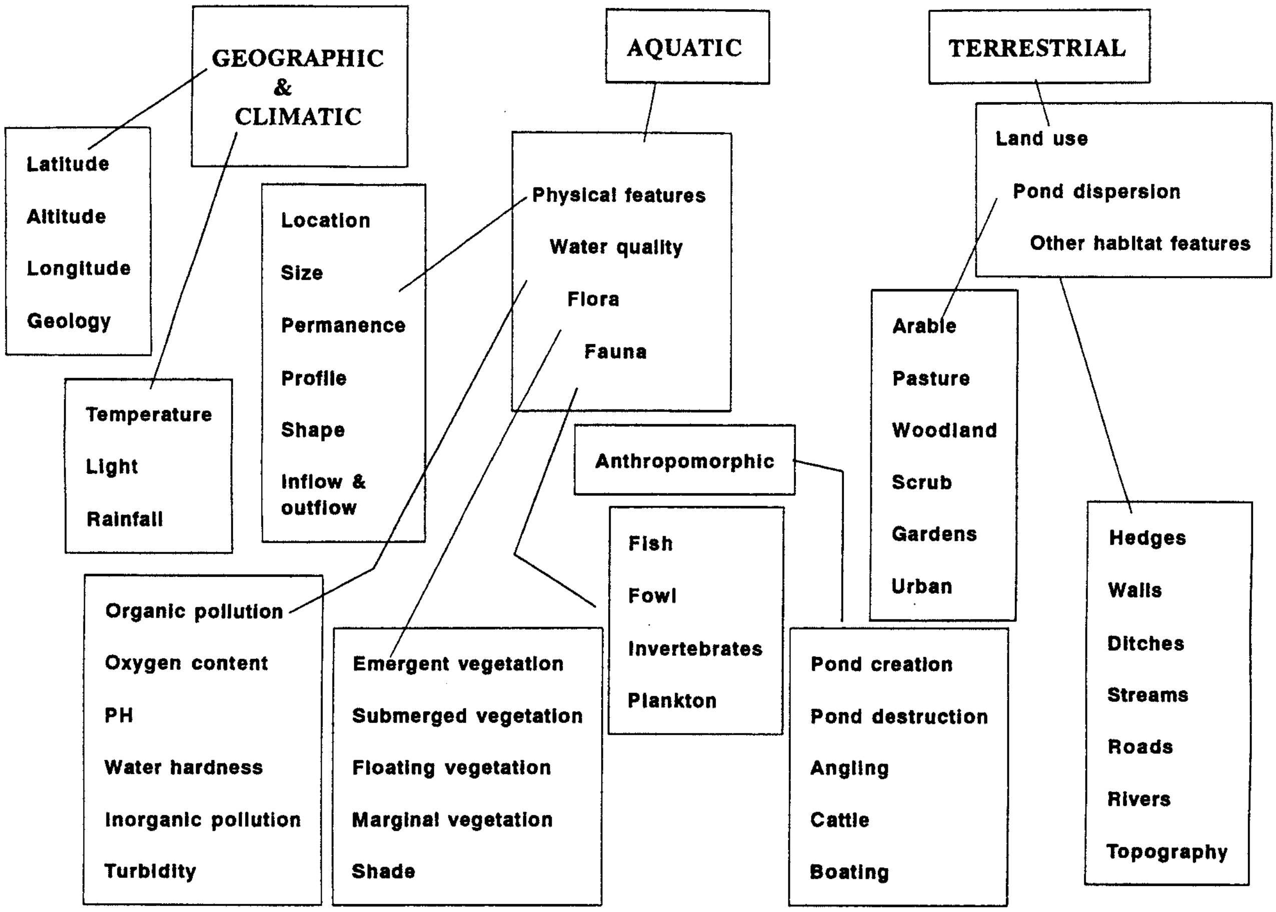


Figure 1: Habitat features of potential importance to the great crested newt

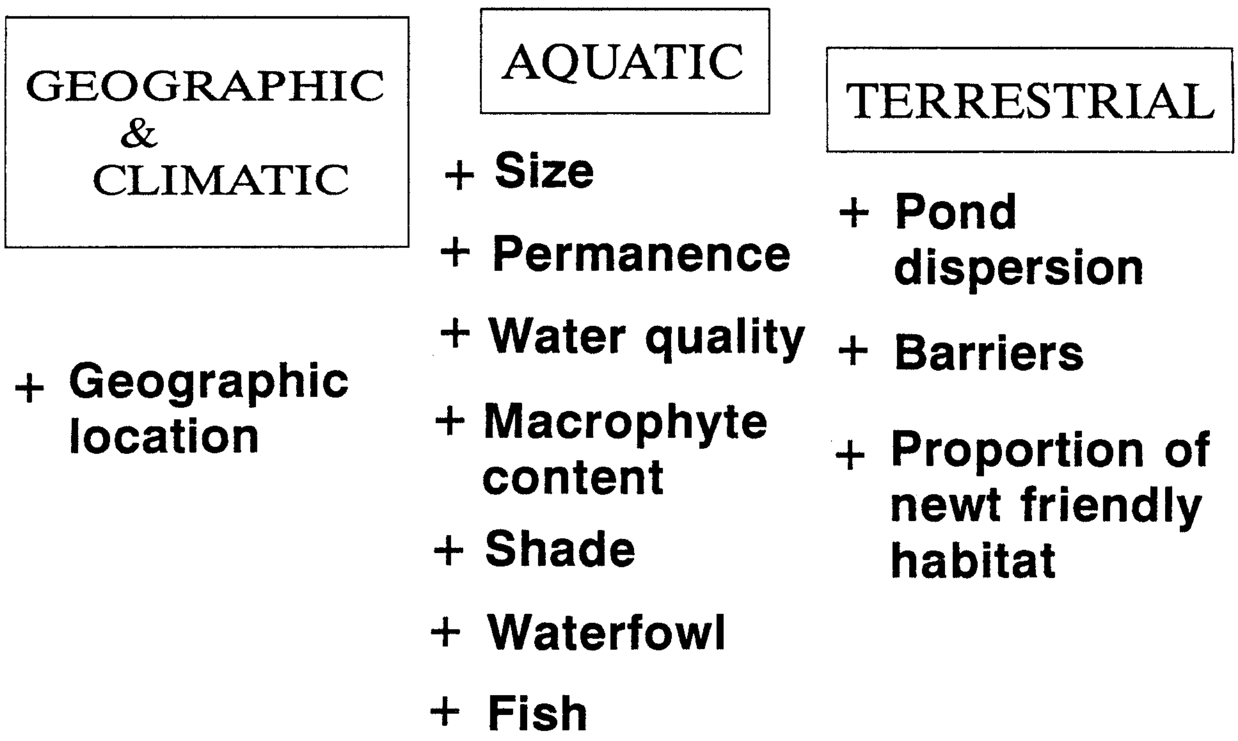
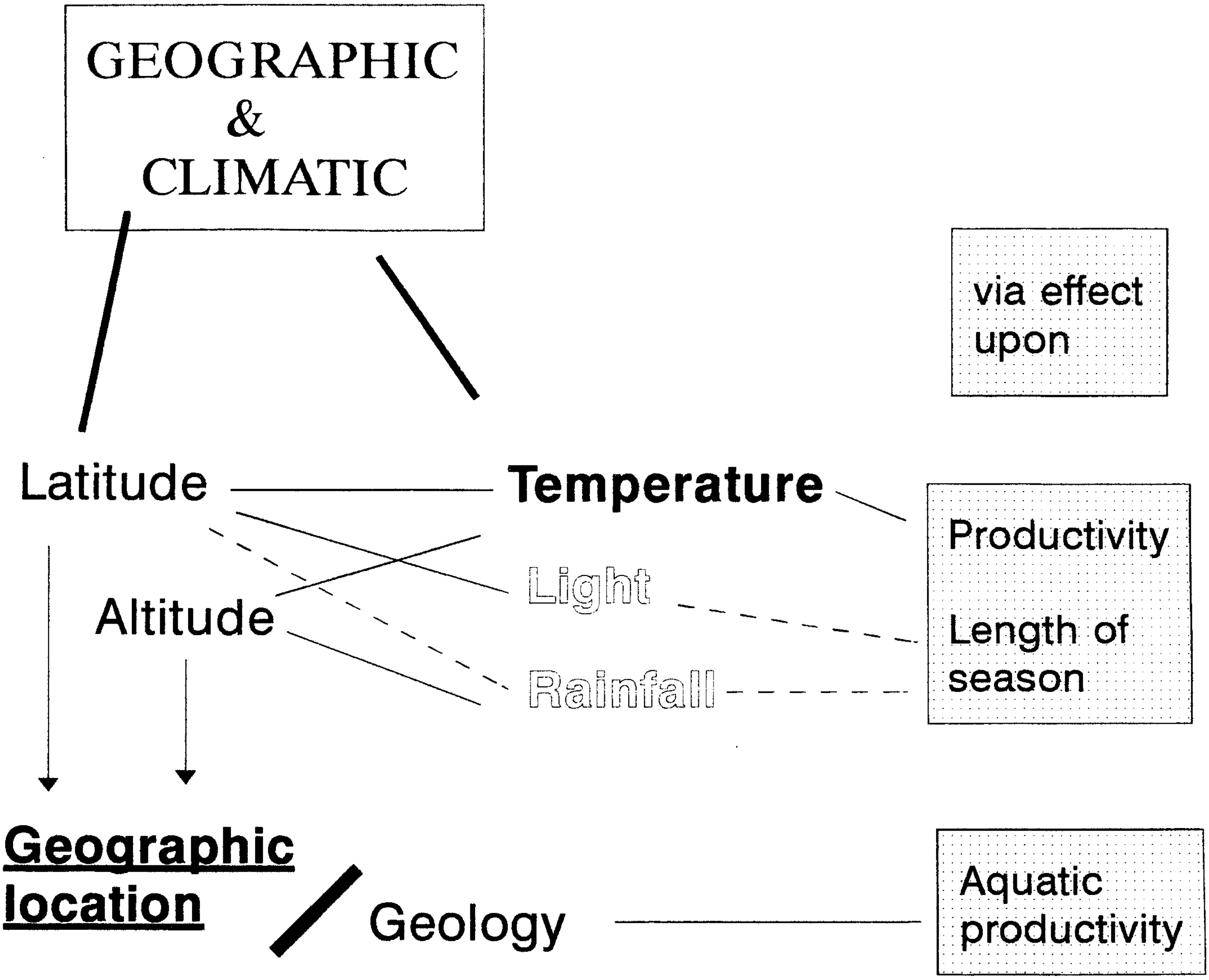


Figure 2: Key features for the identification of sites suitable to support great crested newts



Legend:

Key factors to be determined

Important variables with a direct effect, but determined indirectly

Components of a key factor

Factors with an indirect or non limiting effect in the UK

Figure 3: Isolation of key geographic and climatic features

they are not limiting factors, although local variations may be responsible for determining the timing and length of the active season. Temperature is much more deterministic, since, to a large extent, it controls the biological productivity of the site. Below a certain temperature threshold, in highland regions for instance, the productivity of required food organisms is apparently too low to support populations of this relatively large newt. We are spared the need to define the threshold because we can observe its effects on the distribution of the newt (Figure 4). The impact of latitude and altitude are integrated into one simple feature, the "geographic location" and this can be specified in terms of a grid reference.

Conveniently the geographic location can also be used to define suitable geological features (Figure 3). Geology may influence the status of the great crested newt through its effect on the aquatic habitat. The softer rocks of lowland Britain increase the mineral content of pools which promote eutrophic conditions, probably indirectly favouring larval growth, whilst the harder rocks of upland regions are associated with more acidic, nutrient-poor conditions. It happens that most of the hard rocks are also associated with low temperature and high rainfall, so that the relative contributions of each of these variables is difficult to disentangle. Once again, however, we can dispense with the need to define the causative factors, because they act in the broad scale, relatively easily designated using the grid reference.

Limiting factors which vary on a local basis are the ones requiring more careful determination. For example Figure 5 lists some of the physical features of the breeding site, of which size and permanence are particularly important. Pond size, that is area coupled with depth, together with site permanence help to determine the temperature regime, the length of the growing season of the larvae, the diversity of the aquatic community, and the extent of predation, particularly by fish. Other physical features such as pond depth profile and shape exert their effects mainly via the two key features of size and permanence. Stream inflow and outflow can be important, but their impact can be expressed through other key features, particularly water quality. NAS data on the great crested newt show that it occurred in a wide range of pond sizes, but a higher proportion of ponds with an area between 500 and 750m^2 was occupied than for any other area (from a sample of 1,322 non-garden ponds; Swan and Oldham, 1993). The corresponding value for pond depth was between 0.5 and 2m. The permanence of a site is important since permanent ponds are more likely to contain predators, especially fish, whilst those drying annually may not permit larval development to metamorphosis. The NAS indicated that ponds which occasionally dried out were occupied more frequently than those which never dried or those which dried every year.

2.2 Comments on the key factors

Each of the features represented in Figure 1 was considered in a similar manner and the conclusions summarised in Figure 2. Some of these, **geographic location, pond size and permanence**, have been discussed above, the remainder are listed below:

2.2.1 **Water quality** can be significant although usually only in extreme circumstances. Organic pollution with associated deoxygenation and change in pH, for instance, may result from agricultural dumping, large waterfowl populations or leaf fall in heavily shaded ponds.

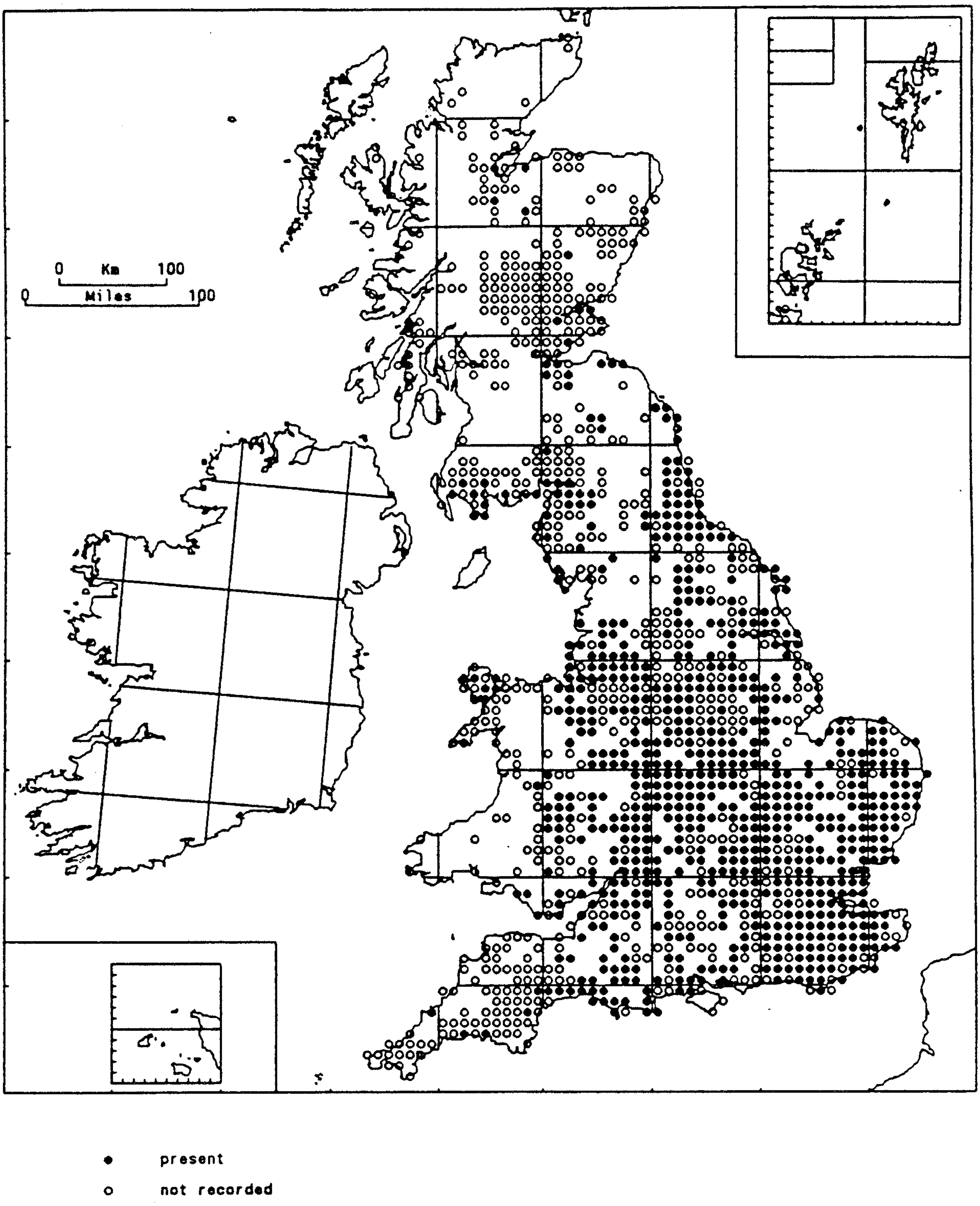


Figure 4: Distribution of the great crested newt by 10 km square (from Swan & Oldham 1993)

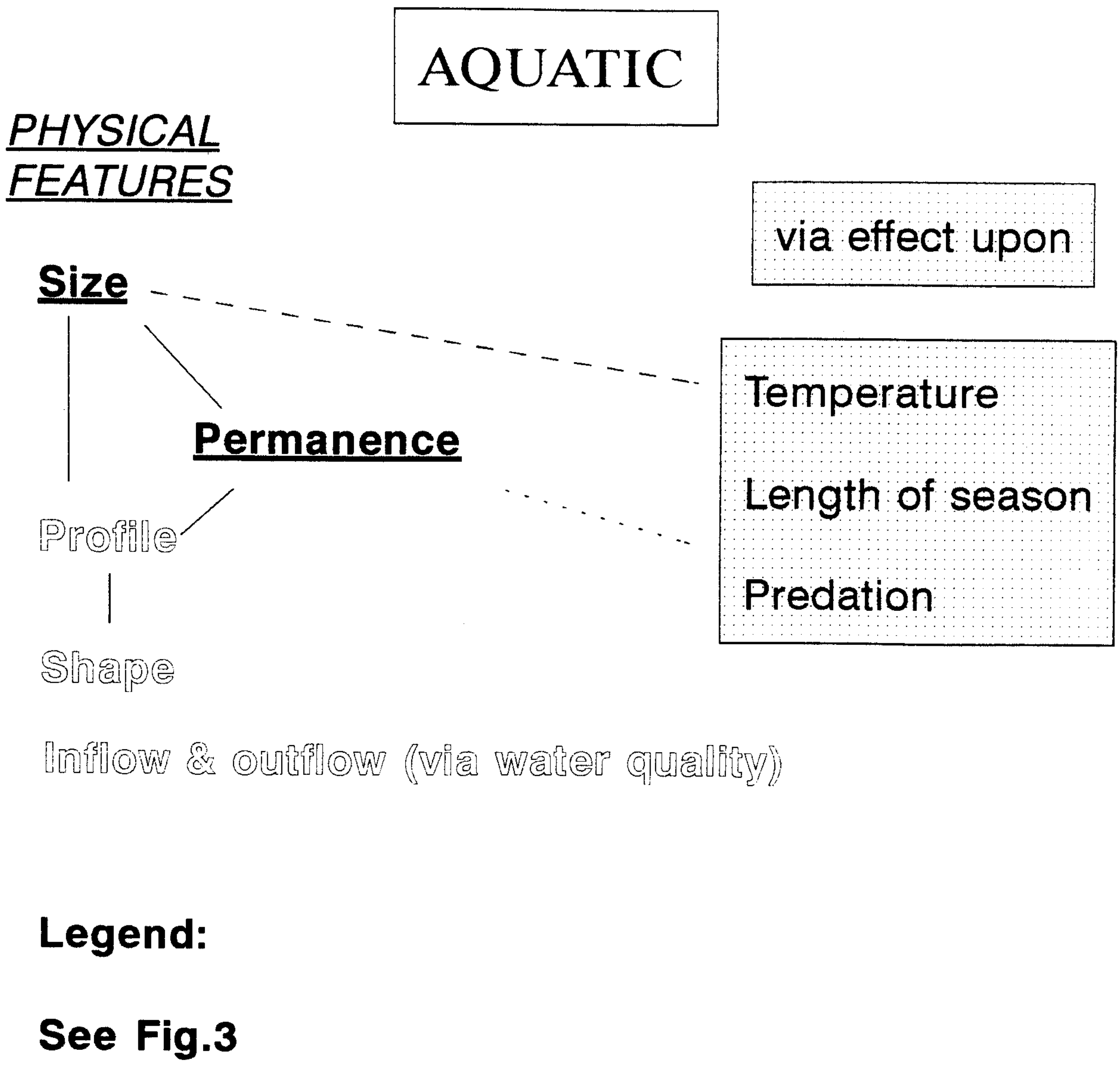


Figure 5 Isolation of key physical features of the aquatic habitat

2.2.2 There is an optimum **macrophyte content**. If the pond is in a late stage of succession, especially when dominated by emergent vegetation, there may be insufficient aquatic space for newts, but at the other extreme a paucity of plant life is normally associated with low pond productivity. NAS data showed the highest occurrence of great crested newts in ponds with emergent vegetation cover between 25 and 50% and submerged vegetation between 50 and 75%. Natural succession is the most commonly perceived threat to great crested newt populations (Oldham and Swan, 1991).

2.2.3 **Shade**, by reducing biological productivity and, indirectly, by reducing water quality through leaf fall, appears to be detrimental, but only in extreme circumstances. NAS data showed a reduction in newt occurrence only when the shade affected over 75% of the pond circumference. Interestingly there was also low occupancy of ponds in which no shade was recorded, perhaps a reflection of a lack of terrestrial habitat diversity in the vicinity of the pond.

2.2.4 **Waterfowl**, usually ducks, can have a dramatic effect if present in large numbers (more than about two per 1,000 m^2 of pond surface), as a result of organic pollution (Section 2.2.1) and general habitat disturbance.

2.2.5 **Fish** are well known as predators of newt larvae. They probably also compete for food with the adults. Nevertheless, there are many records in the NAS of great crested newt populations surviving, probably in suppressed numbers, in the presence of fish.

2.2.6 **Pond dispersion**, the proximity of suitable breeding sites, one to another, is important in terms of newt dispersal. Low pond density, with ponds separated by more than the range of dispersal, will diminish genetic heterogeneity and inhibit colonisation and recolonisation, even if there is good terrestrial habitat.

Using the NAS blanket surveys, Swan and Oldham (1993) suggested a minimum pond density threshold of about 0.7 ponds km^{-2} for great crested newts (Figure 6). Only 31% of areas where pond densities were below this level supported the species, by comparison with 58% above it. The occupancy value rose to 100% only at the much higher pond density of 3 ponds km^{-2}.

The recorded median density of ponds in mainland Britain was 1.4 km^{-2} (NAS data) but in those blanket survey areas where the species is known to occur the median density of occupied ponds was only 0.4 km^{-2}.

At a pond density of 3 km^{-2} the average distance to the next pond, the required dispersal distance to permit colonisation of adjacent sites, is 0.6 km (Table 1) whilst at pond density 0.7 km^{-2} it rises to 1.2 km and at 0.4 ponds km^{-2} to 1.6 km.

Table 1: Pond densities and required dispersal ranges

	Pond density (ponds/sq.km)	Range of dispersal (km)
Suggested great crested newt threshold	0.7	1.2
Observed pond density in much of central Britain	0.1 to 2.0	3.0 to 0.7
Median density of ponds occupied by crested newts within distributional range	0.4	1.6
Observed threshold for 100% occupancy	3.0	0.6

Dispersal is commonly observed up to 500m (Franklin 1993, Oldham and Nicholson 1986, Oldham unpublished) and in the unlikely event that this represents the upper limit of dispersal, the required pond density would need to be 4 km^{-2}. However, there is evidence from France (Arntzen & Wallis, 1991), based upon the range extension of *T. cristatus*, of a dispersal rate of up to 1km per annum over a 30 year period, at which rate the required density would be 1 km^{-2}. In either event the required pond density is much higher than the observed median density of 0.4 km^{-2} and since the median loss rate recorded by the NAS was 0.2 ponds km^{-2} during the last 20 to 30 years, there is increasing cause for concern. The lowering density of suitable ponds is likely to contribute to the perceived reduction in great crested newt status during the last two decades (Cooke & Scorgie, 1983, Hilton-Brown & Oldham, 1991).

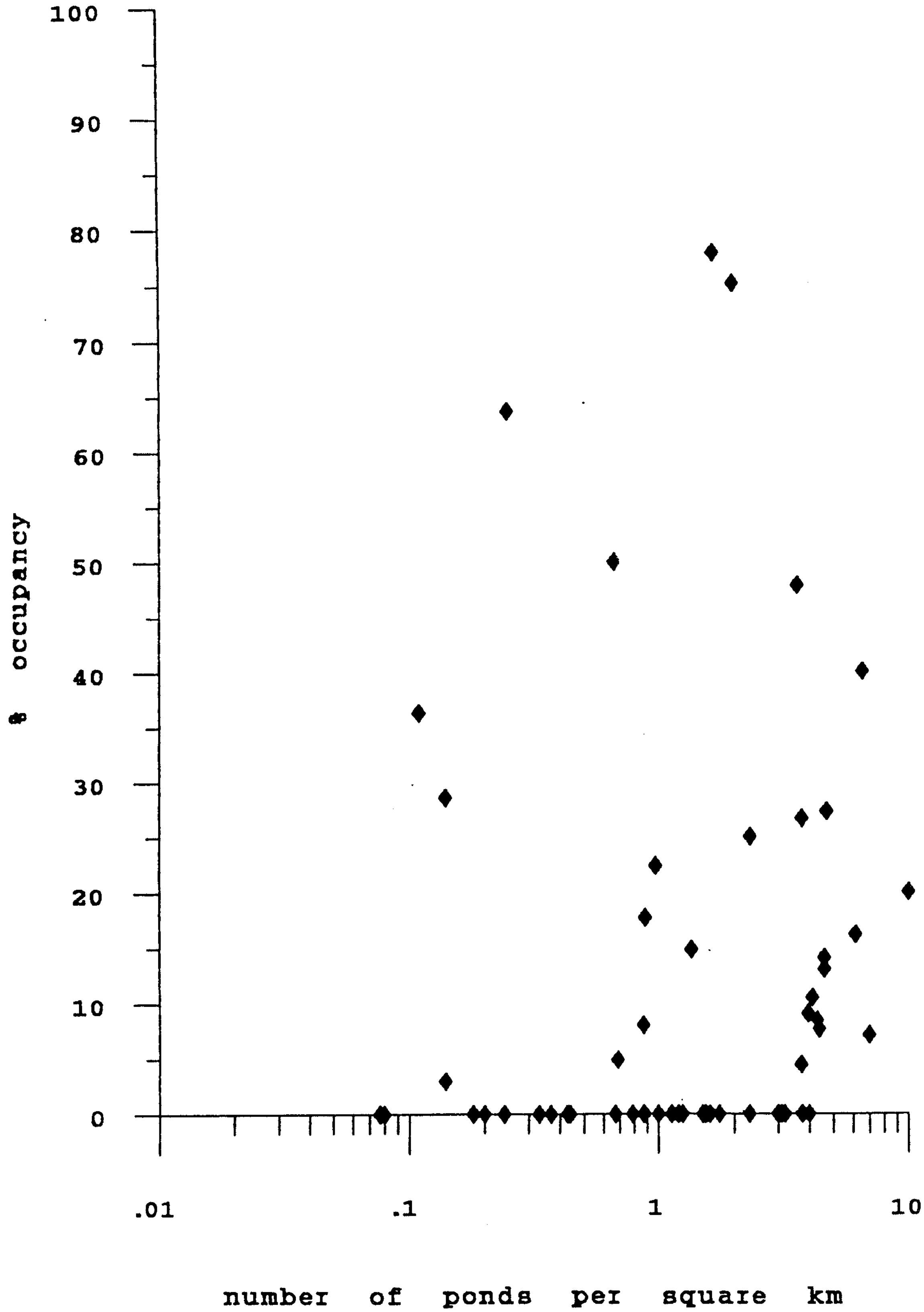


Figure 6: **Percentage of water-bodies occupied by great crested newts at different levels of pond density (from Swan & Oldham 1993)**

2.2.7 The most obvious **barriers** to newt dispersal are probably man-made, especially roads and buildings. In a regression analysis comparing the characteristics of 260 Leicestershire ponds, and their surroundings, with the occurrence of great crested newts (Arntzen *et al.* in prep.) the proximity of the pond to a river proved to be the most important negative correlate. Similarly, discriminant analysis based upon the NAS data emphasised the importance of flowing water as a negative feature in the great crested newt landscape.

2.2.8 The final key feature in Figure 2, **area of "newt friendly" terrestrial habitat**, is at the same time perhaps the most critical and the most difficult to define and assess. The use of a coverall term recognises the fact that any given newt population size can be supported by an infinite number of habitat combinations. Whilst it is possible in a crude way to rank the major types of land use (woodland, pasture etc.) in terms of their presumed relative value to newts, the difficulty, in the context of the British countryside, is to differentiate the relative effects of habitat quality, habitat quantity and distance from the centre of dispersal. For example, a favourable habitat, deciduous woodland, is of less significance at 1,000m than at 100m from the pond, and also less significant if it covers $100m^2$ rather than $1,000m^2$. A mosaic of habitats, as in some gardens, with a relatively stable mix of diverse features yielding good cover and a constant supply of food, may be the most suitable of all.

Despite the difficulties the need for an assessment demands that an attempt should be made. In the expert system (Cain, 1993) we have selected values, informed guesses, based upon our experience with a number of newt populations (for example see section 4.1). Scrub, woodland (both deciduous and coniferous) and gardens are regarded as providing newt friendly habitat, as distinct from pasture, arable and urban land. The lower critical limit of newt friendly habitat needed to sustain a viable great crested newt population within 500m of the breeding site was taken as 0.4 ha. The greater the area of good habitat, the greater the confidence that the site was suitable (provided other key features were satisfactory). Additionally, certain habitat features, notably hedges and ditches, enhance the suitability of a site. They are probably important not only by enhancing habitat diversity and the provision of resources, but also by providing relatively stable havens in a landscape subject to sudden, intermittent and massive change as a result of normal agricultural practices.

An unexpected result form the JAEP analysis was a positive impact indicated for sheep pasture, not normally regarded as good newt habitat. This result may simply reflect the fact that the preponderance of available great crested newt ponds in Leicestershire happen to occur in association with sheep pasture, but that the newts depend upon other components of the habitat.

Any assessment must take into account the biphasic nature of the newts' life history. A judgement made on the basis of the terrestrial phase must be moderated by judgements on the aquatic phase. Deficiencies in the terrestrial habitat can be compensated by strengths in the aquatic habitat. For example the discriminant analysis based upon NAS data (Swan and Oldham, 1993) suggests that submerged vegetation was of special significance when the predominant surrounding landscape was improved pasture, but not when it was scrub or woodland. Again ditches were indicated as beneficial in poor landscapes, pasture and arable land (also in gardens) but not in scrub and woodland, where their relative value would be reduced. Streams were indicated as negative, possibly because they act as a corridor by which fish can gain access.

2.3 The expert system

The expert systems concerned with great crested newt habitat developed at De Montfort University are described elsewhere (Jeffcote, 1991, Cain, 1993). An expert system, based as an interactive package on a computer, attempts to reason from observations, using the same methods that an expert would use. It asks the user questions about the target site, questions based mainly upon the key features described above, and then using an inbuilt knowledge base it infers the likelihood of the site supporting a population of great crested newts. Furthermore it provides the reasons for the inferences it makes, and goes on to provide management suggestions to improve newt status at the site.

The system was validated using 100 sites and gave accurate predictions in 79% of cases; it tended to err on the side of caution.

2.4 Summary of habitat features

In summary, the combination of aquatic and terrestrial habitats required to support viable great crested newt populations are found mainly in lowland Britain. High newt status is favoured by the presence of unpolluted ponds of medium size (500 to 750 m^2) which dry up very occasionally and support a diverse macrophyte community. Populations can tolerate moderate shade (less than 75%) but not fish. Suitable landscapes will include a high density of ponds (at least 0.7 km^{-2}) and an area of at least 0.4 ha covered by woodland, scrub or mature gardens, but will exclude busy roads and rivers. Clearly variations in all these features can be tolerated to a greater or lesser degree. An expert system is available which can be used to predict the likelihood of occurrence and the status of great crested newts under given site conditions.

3. Population dynamics

3.1 Annual temporal pattern

The annual pattern of great crested newt activity is illustrated in Figure 7. From the viewpoint of site management it should be noted that newts at one or more stage of the life cycle are likely to be in the vicinity of the pond throughout the year, although the late autumn and the winter are the preferred times for most management activities.

3.1.1 Site studies in Leicestershire

The annual pattern is demonstrated further using a series of monitoring methods at single sites.

3.1.1.1 Catches at perimeter fences

Figure 8 shows the weekly catches, in 1986, of newts entering and leaving a site in Leicestershire, obtained using a perimeter fence/trap system around the pond. Over 95% of the captured animals were adult and the site is thought to have supported upwards of 750 adult newts.

It will be noted that although the overall pattern of spring influx and summer exodus, in Figure 8, matches the generalised pattern shown in Figure 7, some captures were made in both inner and outer traps throughout the study period. This can be explained partly through fence inefficiency in that some of the immigrants were captured for the first time at the inner traps and some animals known to have been in the pond were

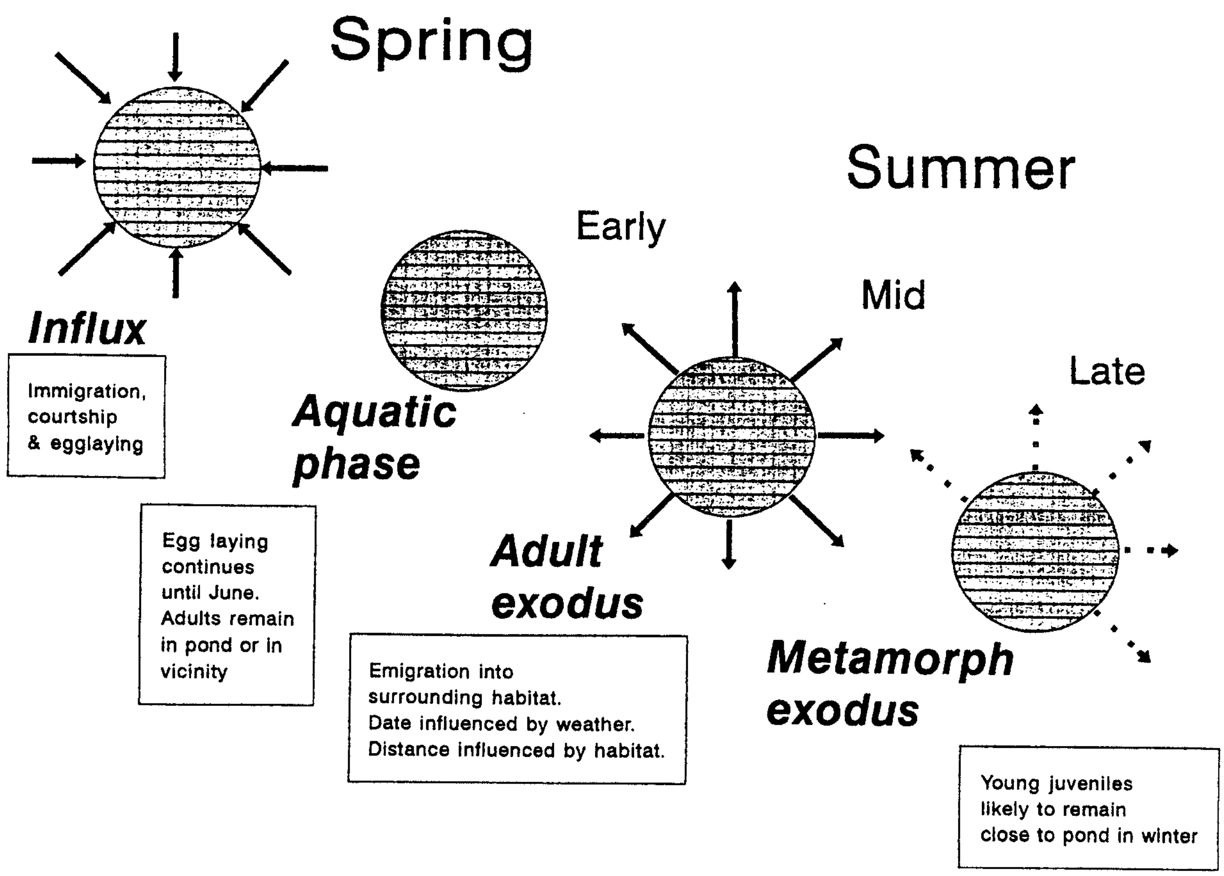


Figure 7: **Generalised annual activity pattern of the great crested newt**

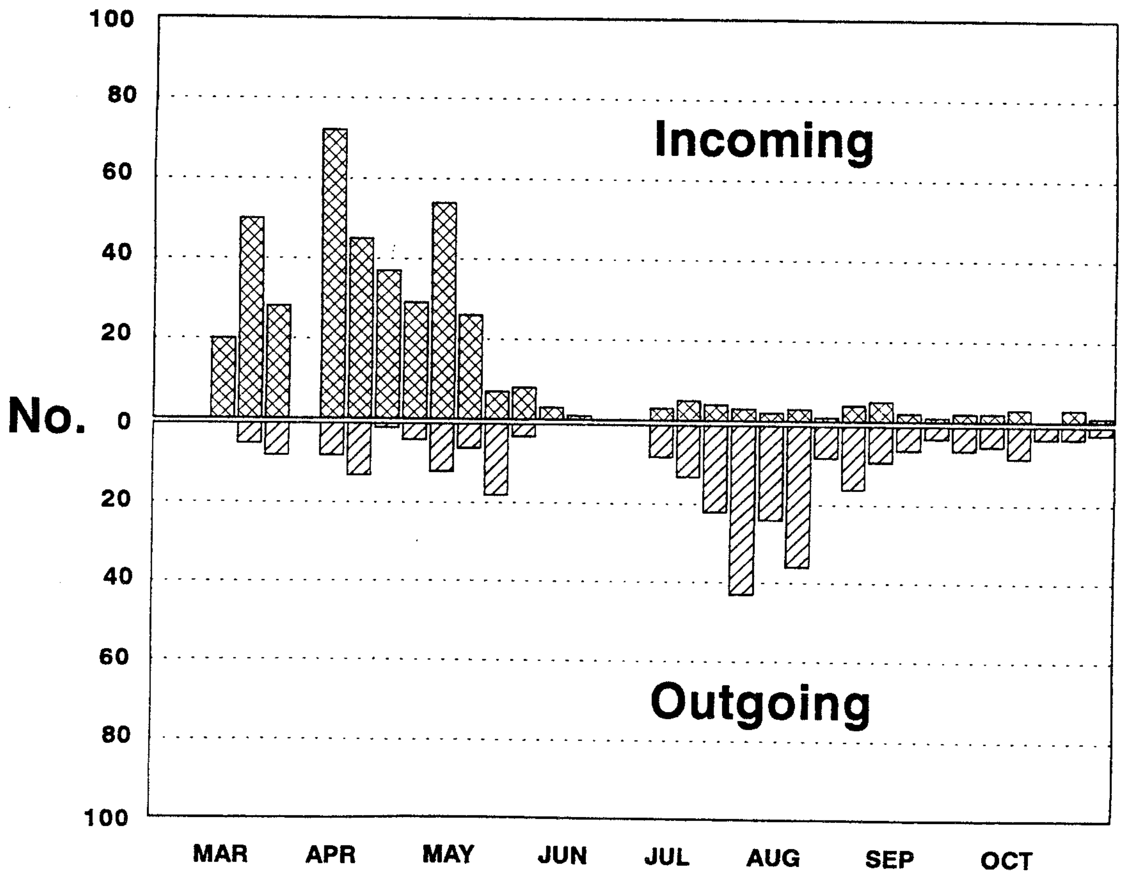


Figure 8: **Weekly captures of great crested newts at pitfall traps on the outer and inner sides of a perimeter fence around a pond in Leicestershire**

captured only in the outer traps. In a study of fence efficiency Arntzen *et al.* (in prep) document a series of cases from our own studies and from the literature in which estimated fence efficiency ranged between 23% and 54% (median 53%) for immigration and between 23% and 56% (median 36%) for emigration. Additionally, however, there is a natural tendency for to and fro movement in the population. In his studies at Little Wittenham, Franklin (1993) documented the observed period of residence of adult newts at the breeding site as varying between 1 day and 210 days, and one third of the population apparently stayed at the pond for less than a week.

3.1.1.2 Bottle trap catches and torch counts

In Figure 9 the total perimeter catch each week in 1987 (outer and inner traps combined) is compared with the catches at bottle traps placed at 6m intervals around the pond and, in Figure 10, with counts obtained using a torch at night. The peak bottle catch occurred immediately after the peak perimeter catch, but subsequently declined, despite the continuing presence of near maximal numbers of adults in the pond. Torch counts showed a marked decline after the end of May, again during a period when newts were probably present in the pond. The two methods gave comparable results; the mean count during an eight week period in April and May was 42 using bottles (95% confidence interval 52 to 32) and 48 by torch (95% interval 58 to 38).

Counting by torchlight was used as the most convenient, widely available method for population size comparisons (peak count) during the NAS; indeed it was the only method available without a licence at the start of the survey in 1983. The count is affected by several variables, especially water clarity, vegetation density and weather. Surveyors were encouraged to visit sites during warm, damp wind-free conditions and to make counts on several occasions.

Bottle catches are also affected by several variables including bottle spacing (Oldham and Nicholson, 1986), the stage of the season (Section 3.1.1.3) and the weather.

3.1.1.3 Egg counts

Figure 11 compares the bottle trap count in the same pond in 1987 with an egg count obtained by counting the eggs laid on strips of plastic placed at 6m intervals around the pond. Up to the end of June there was a strong positive correlation between the bottle catch in any week and the egg count two weeks later ($p<0.001$). Courtship precedes egg laying and it may be that the animals most likely to be caught in the bottles are those actively engaging in breeding behaviour. If so this would help to explain the fall in bottle trap catches as the season progressed despite the evidence (from the perimeter catches) that the newts were still present in the pond.

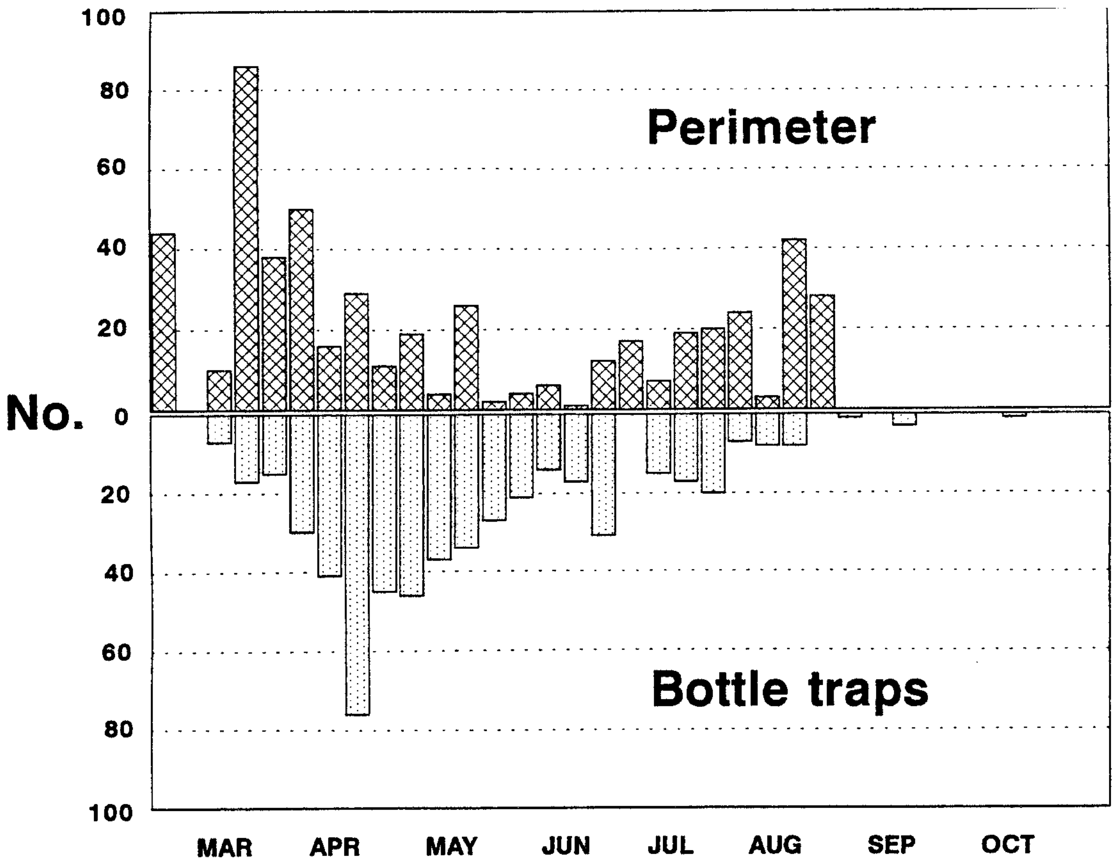


Figure 9: Weekly captures in the perimeter traps (outer and inner combined) compared with captures in bottle traps set at 6 m intervals

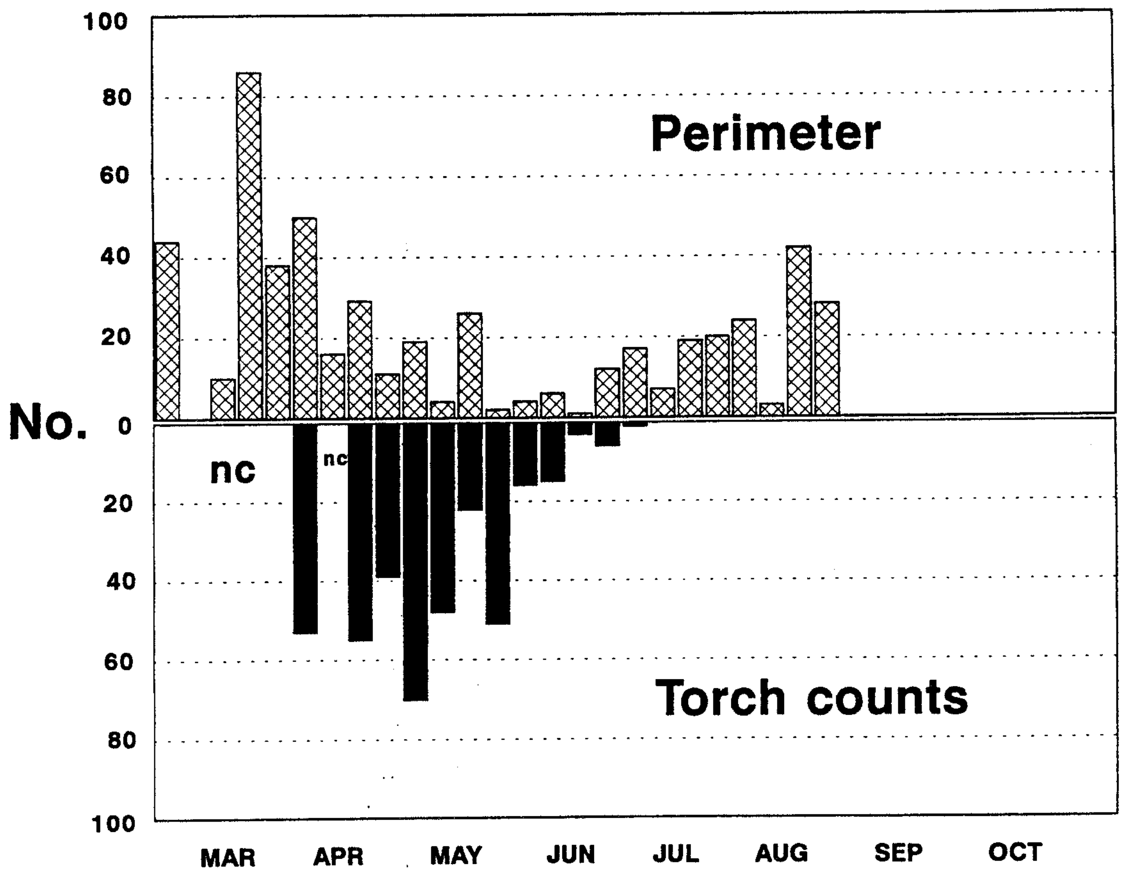


Figure 10: Weekly captures in the perimeter traps compared with counts made by torchlight during a single circuit of the pond (nc = no count)

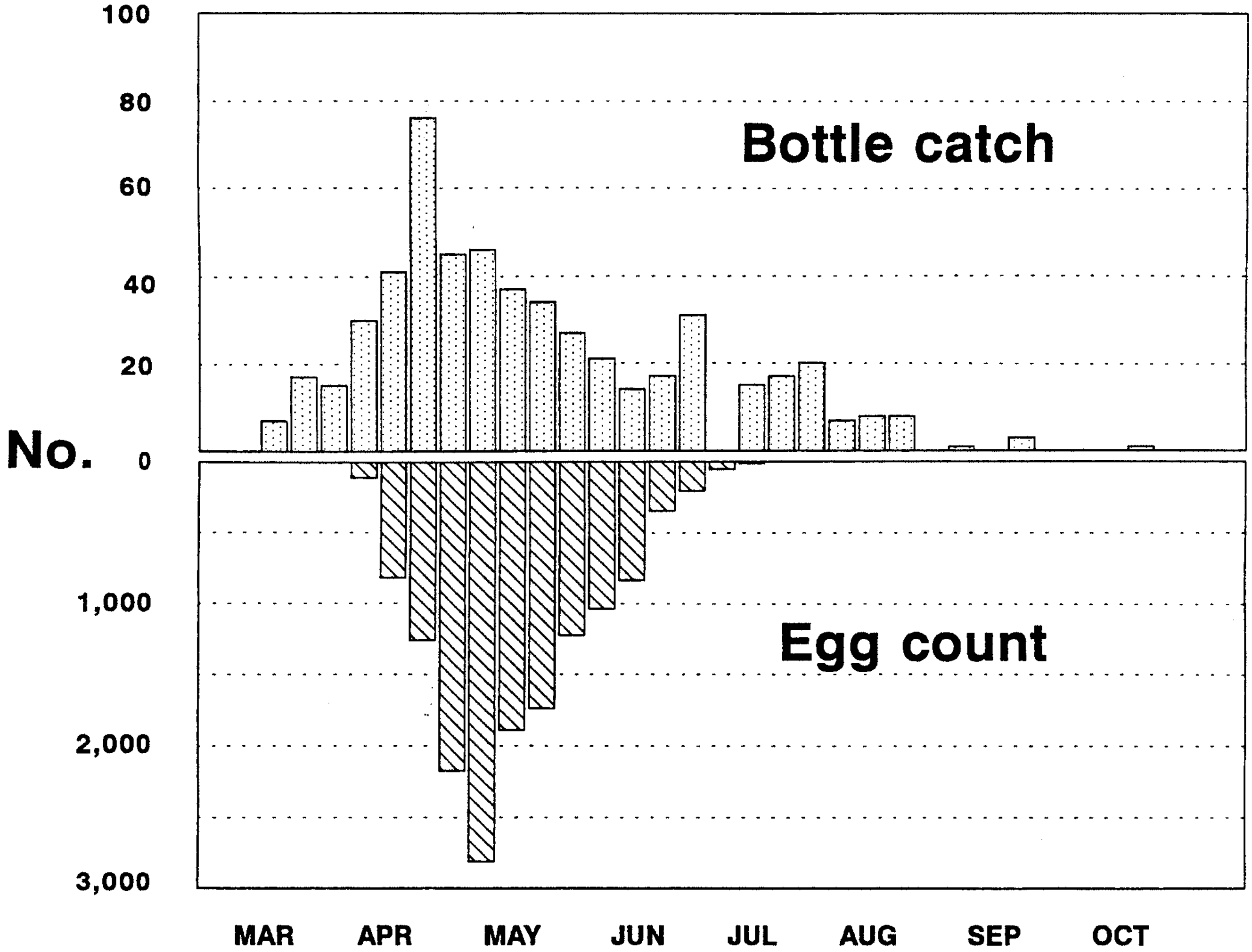


Figure 11: Weekly catch of newts in bottle traps compared with egg counts

Although eggs can be useful as a means of establishing the presence of great crested newts (Grayson, this volume) the peaked nature of the egg count curve (Figure 11) militates against their use for population size comparisons. Ponds can only be compared using egg counts if the counts are made in each pond at the same phase of the egg laying season. Again, as with the other methods, a number of variables such as vegetation characteristics affect the counts.

3.1.1.4 Larvae and metamorphs

Bottle traps are also useful for monitoring great crested newt larvae. The curve of larval catches at the same pond in 1986 (Figure 12) showed a

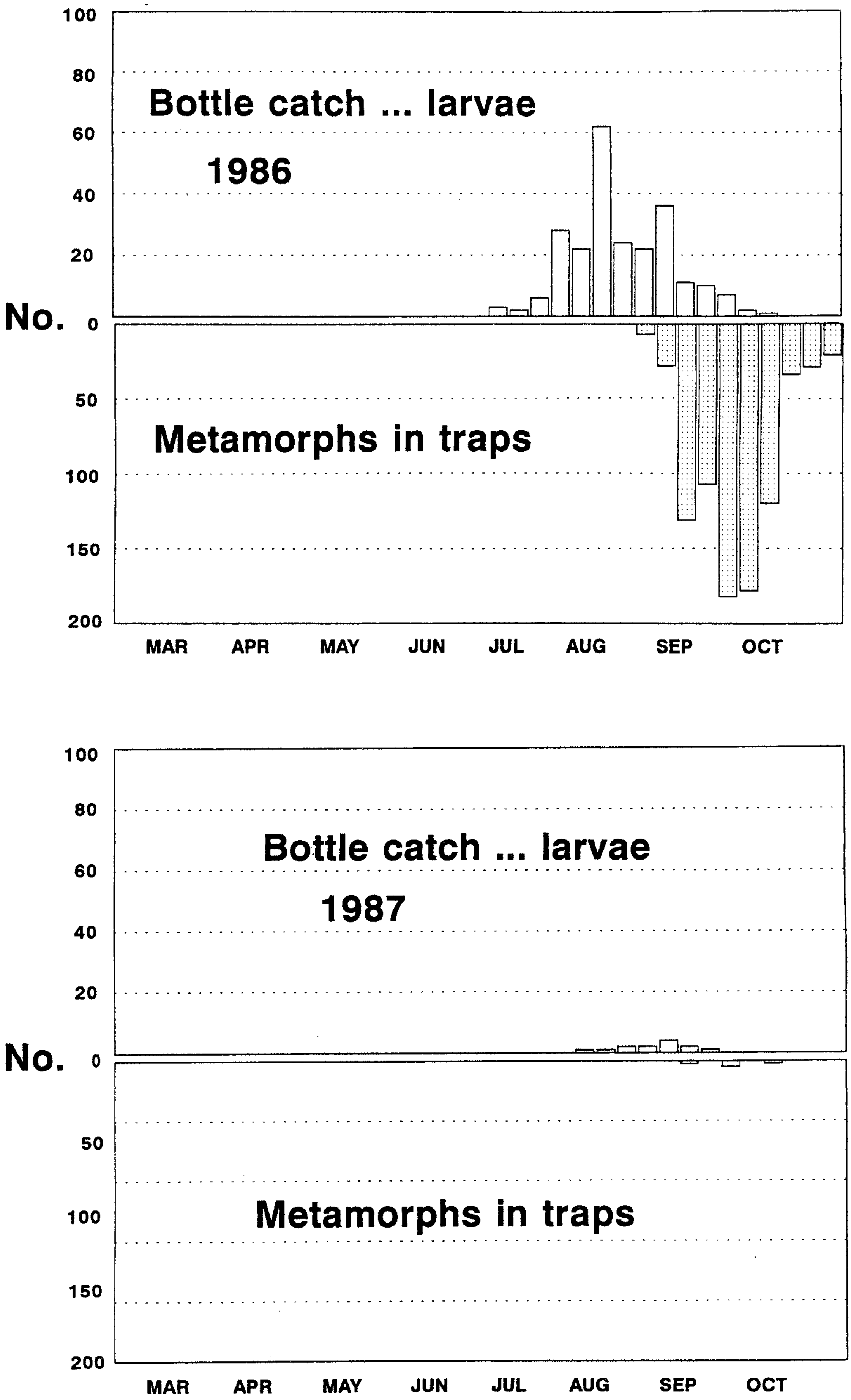


Figure 12: Weekly bottle trap catch of larvae compared with metamorph captures in two successive years (1986 and 1987)

peak during August, followed by a decline during the phase of metamorphosis in September and October. Metamorphs were monitored using pitfall traps around the pond perimeter. Figure 12 also shows data from the same pond in the subsequent year when, clearly, there was much lower productivity. This did not reflect changes in the numbers of adults in the pond, which were essentially the same in both years. The reason for the dramatic change in productivity is unknown, but major annual changes in numbers have been observed in other populations of the same species (Arntzen & Teunis, 1993, Cooke, this volume, Horton & Branscombe, this volume). It is important, therefore, that evaluation of great crested newt sites is not based upon surveys in a single season.

3.1.2 Life table and population structure

The great crested newt survivorship curve (Figure 13) is based upon the work of Arntzen & Teunis (1993) for French populations, but modified slightly to incorporate observations on Leicestershire populations. It assumes a stable age distribution, sexual maturation in two (50%) or three years and an even sex ratio. The curve is skewed in a manner typical of many egg laying animals, but with an adult stage prolonged for many years. The associated age profile, up to eight years, is shown in Figure 14. The first year is represented by the three basal bars. On land, if these data are correct, the adults comprise about 20% of the total autumn population, a higher proportion than in many animals, reflecting the relatively short time to reach sexual maturity and the relatively low mortality rate of the adults. In toads, for instance, the corresponding proportion is about 10% (Oldham, unpublished).

One of the implications of great crested newt longevity is that adults may continue to use breeding sites long after the sites have ceased to be productive of metamorphs. Assessment of viable newt populations (as distinct from relict adult populations) must include surveys of metamorphs as well as adults and eggs.

4. Population dispersion

We have examined the spatial pattern of newt distribution at a number of sites and compare some of the information below.

4.1 Leicestershire sites

At one JAEP study site supporting an estimated adult population of 1,500 in Leicestershire, habitats surrounding the breeding pond were fenced off from one another by newt fencing in an effort to determine the relative densities and mortalities of newts in each one (Arntzen *et al.* in prep.). Preliminary results indicated densities of about 250, 175, 95 and 20 newts ha^{-1}, within 250m of the pond, in hedgerow, gardens, pasture and arable respectively. Survival in those newts occupying hedgerows was similar to that of garden newts, but greater than in pasture and much greater than in arable land. A simple index of somatic condition (mass/length) showed similar relative trends. At another agricultural site woodland was shown to be important.

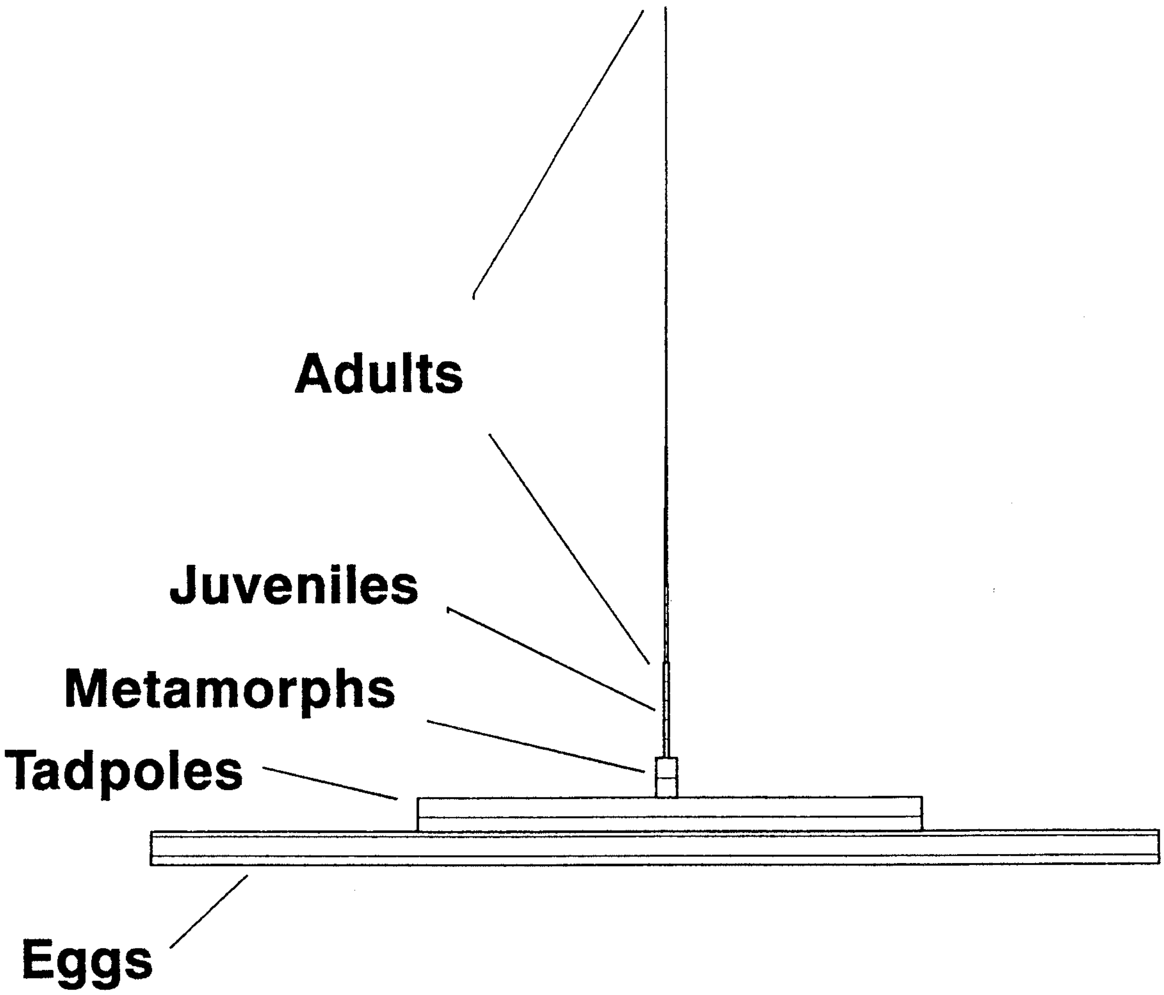


Figure 13: Generalised survivorship curve for a cohort of 20,000 great crested newt eggs

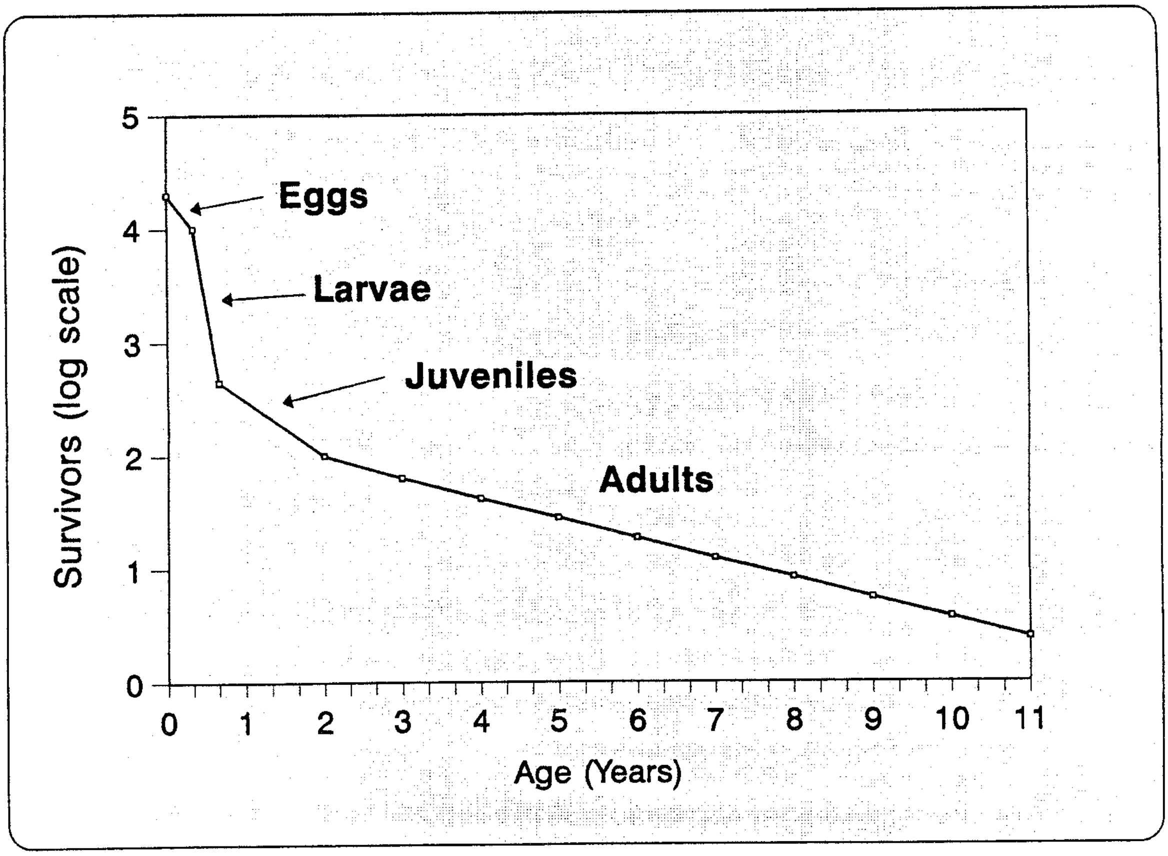


Figure 14: Age profile based upon the data used in Figure 13

4.2 Little Wittenham Nature Reserve

Little Wittenham Nature Reserve in Oxfordshire is dominated by woodland (Figure 15). The arrows indicate the relative numbers of great crested newts caught entering the ponds from four directions, as determined by Franklin (1993), using perimeter fences and drift fences (Figure 16). Large populations were supported in deciduous, coniferous and mixed woodland. Franklin also used circular fenced enclosures, built during the autumn, to assess population densities in different habitats. Estimated densities in each of these enclosures are shown in Figure 16 and range from 50 to 1,500 ha^{-1}, the highest being in deciduous woodland. Evidence that some newts entered the circles "illegally", over the fences, means that these values may be overestimates. Nevertheless the data reflect the interaction of habitat quality, distance from the breeding site and barriers on population status as discussed in Section 2.2.8.

4.3 Population densities compared

At Little Wittenham we have an example of what is presumably a particularly favourable mix of habitats, occupying well over 20 ha and completely surrounding the breeding site. The median adult population estimate within this area (Figure 16) was 250 ha^{-1}. Cooke (1985, 1986) describes a site (Shillow Hill) with similarly favourable habitat, again completely surrounding the breeding site, but in this case extending to only about 2 ha. His adult population estimates range from 25 to 125 ha^{-1}, if we assume that the population occupies 20 ha, or 250 to 1,250 ha^{-1} if it is restricted to the core habitat. In agricultural habitats (Section 4.1) and in sites studied by Oldham and Nicholson (1986) there was a range from 20 to 250 ha^{-1}. At Lomax Brow (Horton and Branscombe, this volume) the site is a mixture of reclaimed industrial land and poorly managed pasture with a cluster of ponds (Grayson, this volume). In 1991 the population density in the land surrounding the cluster was estimated at 20 ha^{-1} (Oldham, unpublished). These values are compared in Table 2. One of the most common situations is missing from the table and in need of study, the case of the pond isolated in a field with the closest newt friendly habitat at a distance (the inverse of the situation at Shillow Hill). To what extent are newts capable of extending their migratory range to cope with this situation?

Table 2: Examples of population densities associated with different habitats (sources in text)

Site	Habitat	Estimated population density (no./ha; see text)
Little Wittenham	Large area of woodland	50 to 1,500
Shillow Hill	Small area of woodland surrounded by agriculture	25 to 1,250
Leics agriculture	Agriculture mosaic	20 to 250
Lomax Brow	Agricultural and old industrial land	~ 20

5. Temporal and spatial patterns combined

The difficulties of determining optimal terrestrial habitat characteristics (the influence of distance from the breeding site, habitat dispersion pattern etc; Section 2.2.8) apply equally to any attempt to understand population dispersion. This is further complicated by the annual fluctuations in numbers (Section 3.1.1.4) and the paucity of information on the juvenile phase.

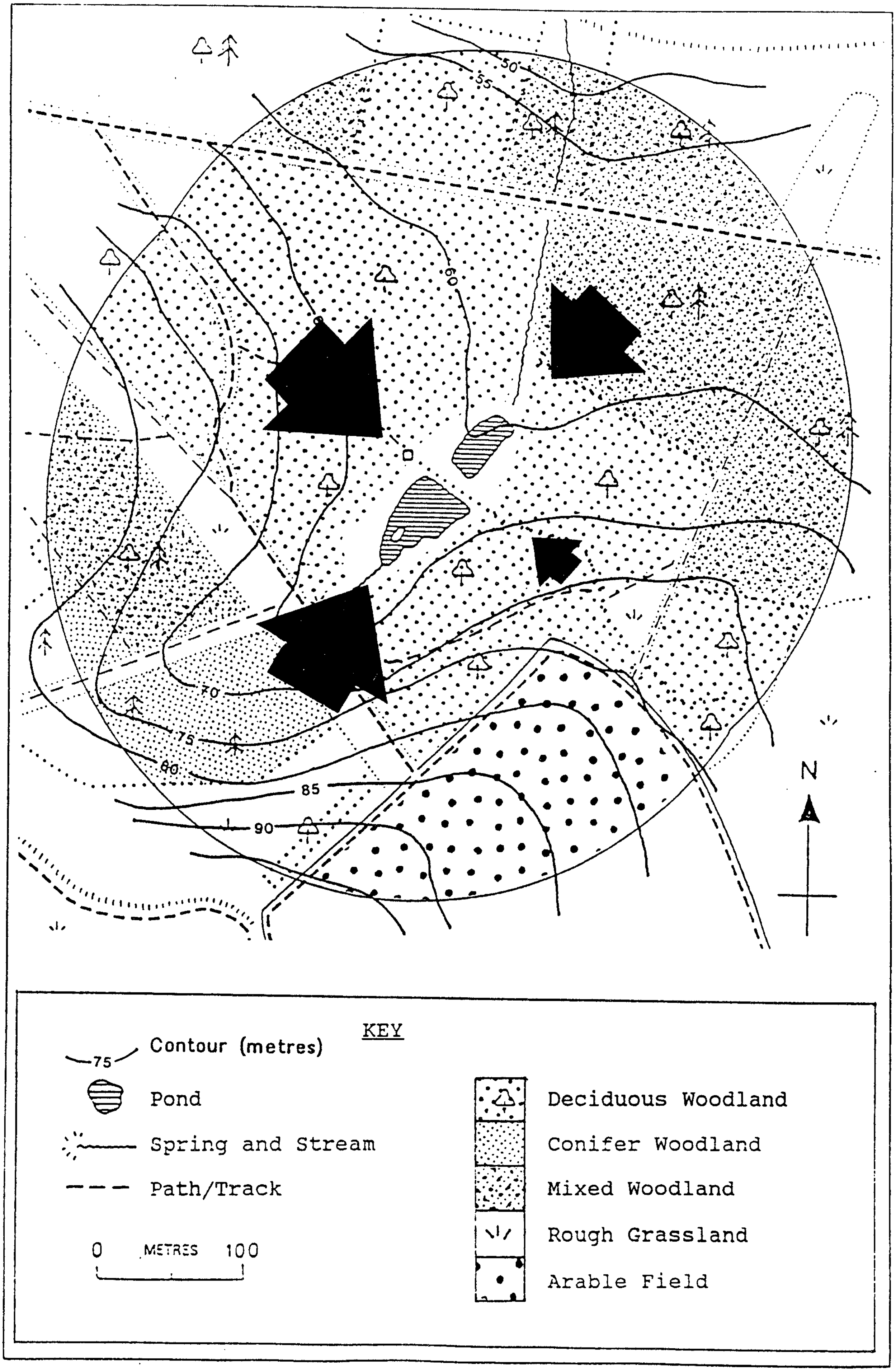


Figure 15: Habitats within 250 m of a newt breeding site at Little Wittenham. The arrows show the relative proportions of animals arriving from different directions (from Franklin 1993)

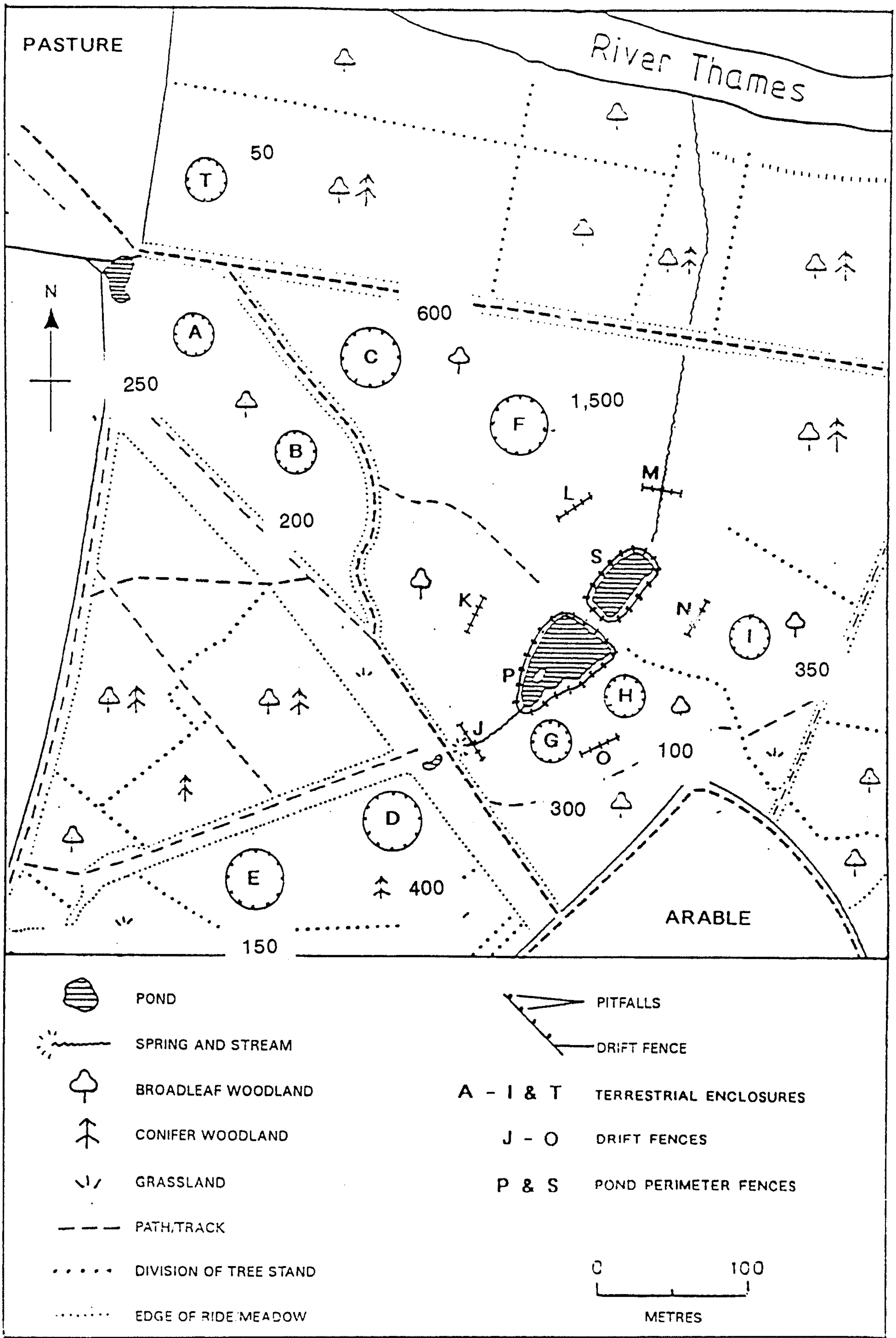


Figure 16: Fenced circles used to estimate newt numbers at Little Wittenham. The number beside each circle represents the estimated adult population density (no/ha) (from Franklin 1993)

Figure 17 presents a simplistic summary of the relationship between temporal and spatial aspects of the great crested newt's population ecology in the terrestrial environment. Metamorphosis occurs in late summer and the metamorphs have time for only limited dispersal before winter. The immediate surroundings of ponds are commonly occupied by scrub and this may suffice as a habitat for the metamorphs in the first autumn. Our knowledge of the juvenile stage is extremely limited, but we assume that its mainly outward migration continues during the second year, perhaps establishing a home range. Subsequently as it matures sexually in the second or third year, it may disperse to a new site. At Little Wittenham a new site 350m from the central ponds was colonised within one year of its creation (Franklin 1993). Alternatively young adults may migrate back to the natal site. Analysis of the preliminary experiments with the Conservation Area at Lomax Brow (Oldham 1993) indicates that about 50% of translocated adults were faithful to their site of origin and returned to it from over 400m, despite efforts to confine them in the Conservation Area. It may be, as with toads (Oldham & Latham, in prep) that great crested newts remain faithful to both breeding site and terrestrial range.

A JAEP exercise in mathematical modelling (Halley *et al* in prep.) based upon great crested newt population characteristics indicated that the species can avoid extinction even at relatively low population sizes. The probability of extinction was calculated as less than 5% when there were more than 50 breeding females in a population, regardless of the distance to a source of colonists. The probability rose to 50% when the number of females fell to about 12 and the closest source of colonists was 2km distant. In the long term, despite this evidence, the survival of the species depends upon the exchange of genetic material within the metapopulation, and work within JAEP has shown a positive correlation between genetic distance and ecological distance (Arntzen *et al* in prep.). Work on the juvenile, dispersive, phase of the life cycle is singularly difficult because of the problems of monitoring a small, nocturnal, cryptozoic, widely dispersed animal, but is nevertheless important for a proper understanding of the ecology of the species.

Acknowledgements

Parts of the work were undertaken whilst the researchers were in receipt of funding from NERC under its Joint Agriculture and Environment Programme (AFRC/NERC/SERC), from the Nature Conservancy Council, from SERC and from the Leverhulme Trust.

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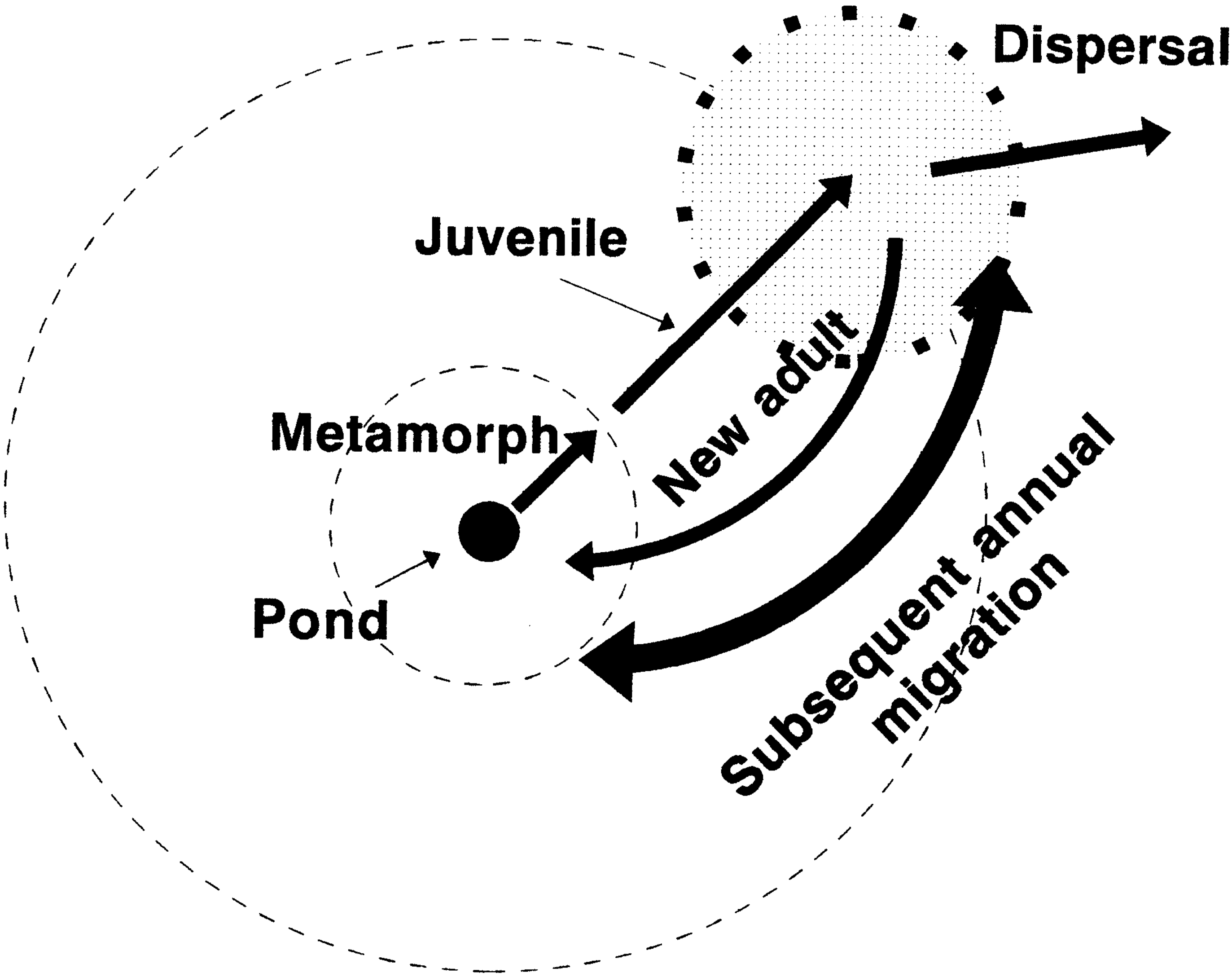

Figure 17: **Spatial dynamics of the great crested newt on the terrestrial environment**

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Fluctuations in night counts of crested newts at eight breeding sites in Huntingdonshire 1986-1993

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Introduction

There has been a recent attempt by de Montfort University, Leicester, funded by the Nature Conservancy Council/English Nature, to initiate a national monitoring programme for crested newts. However, systematic long-term monitoring data do not seem to have been published for any British population, although a few continental populations have been studied for four to six consecutive years (Arntzen & Teunis 1993). Therefore, in 1986 a programme was started in the vice county of Huntingdonshire to monitor the fortunes of newts at a sample of eight sites. One aim was to determine the degree to which populations appeared to fluctuate, both between consecutive years and over a longer time period. Results are given here for the period up until 1993.

Sites and methods

Sites were selected to include those with small, moderate and very high night counts. They included an introduction site and a site incorporated into a building development; apart from these two, sites were subject to relatively little interference.

The two Shillow Hill sites are less than 100 m apart, and exchange between them has been documented (Cooke 1985). The two Stanground sites are 100-200 m apart and the two Monks Wood sites are about 400 m apart. No other crested newt site is known within 500 m of any of the sampled sites.

Night counting was used as a guide to (longer-term) changes in abundance. Conditions at time of counting were recorded, so that, for instance, it was possible to check whether high turbidity might be blamed for a low count during a particular year. Whenever possible, counts were done under favourable weather conditions (mild, dry, calm nights). All counts were undertaken from the second week of April to the first week of June, except for sites where adult newts were known to be particularly active in the water outside this period.

Results

Monitoring data are given in Table 1 for the eight sites over the period 1986-1993. Sites are listed in order of number of newts counted in 1986.

Worlick Farm. A group of six ponds at Worlick Farm received 38 rescued adult newts in 1985. No crested newts had been recorded on a night count immediately prior to the introduction. Low numbers were found 1986-1988 but none was found 1989-1991. Adult newts were found again in 1992 and 1993. The site is isolated, large and complex with much of the shoreline being inaccessible. Although there are several possible explanations for the apparent failure of the introduction, followed by reappearance of newts, the most plausible is considered to be that a small population persisted throughout, but that the low numbers present 1989-1991 were simply not detected.

Table 1 Night counts of crested newts at eight sites in Huntingdonshire, 1986-1993

	1986	1987	1988	1989	1990	1991	1992	1993
Worlick Farm	3	2	3	0(2)	0	0	3	5
Monks Wood: Pond 75	3	12	7	0	4	12	13	11
Shillow: Wood	6	8	3	2	0	0	dry	0
Ramsey: Field Road	9	23	8(2)	2(3)	0(3)	0(2)	1(2)	2
Monks Wood: Hillside	12	7	0	2	3	9	12	11
Stanground: Peterborough Road	17	16	11(2)	31	30	39	29	19
Stanground: Buntings Lane	102	29(2)	16(3)	67(4)	55(3)	106(3)	74(3)	123(3)
Shillow: Top	150(9)	187(9)	140(5)	40(5)	35(5)	19(5)	3(5)	43(5)

Single figures indicate single counts
Numbers followed by a number in brackets are means followed by the number of counts

Monks Wood: Pond 75. This small pond in a National Nature Reserve has a population that is stable or possibly increasing. The zero count in 1989 can be blamed on extreme natural turbidity.

Shillow: Wood Pond. This pond has suffered from progressive siltation and also from the drought in 1991 and 1992, but has now refilled. Crested newts have not been recorded since 1989.

Ramsey: Field Road. Because of the inaccessible nature of most of the bank, the same 10-20% of relatively accessible edge has been routinely counted. Sticklebacks were not noted up to 1989, but four counts in 1990 and 1991 gave a mean of 25 (SE±8). During 1990 and 1991 no crested newts were seen. However, during 1992 and 1993 small numbers of crested newts were detected again, while the mean number of sticklebacks fell to less than 1.

Monks Wood: Hillside. Night counts have been fairly consistent in this pond between arable fields, just outside the National Nature Reserve. However, in 1988, a new ditch was dug which emptied into the pond; the pond became eutrophic and turbid having previously had clear water. Whether the newts avoided the pond that year or simply could not be seen in the turbid water is not known.

Stanground: Peterborough Road. Here numbers have been higher since 1989. The slight decrease in 1993 may have been due to the removal in the spring of branches overhanging the pond. The shallows beneath the trees have previously been the favourite haunt of courting newts.

Stanground: Buntings Lane. This well known and important crested newt site has been safeguarded within a building development. Most construction around the breeding site took place in 1988; hydrological problems forced the deepening of both ponds at the end of 1988. Stickleback predation of newt larvae appeared to lead to emergence failure in the main pond in 1990; this pond was drained later in the year and the fish translocated. Night counts 1991-1993 indicate that this conservation exercise has succeeded through a combination of site safeguard, monitoring and management.

Shillow: Top Pond. The data in the Table indicate a considerable decrease. However, this site has been monitored since 1983 and numbers in 1983 and 1984 did not differ significantly from those in 1993. There was a significant rise between 1984 and 1985 and a corresponding significant decrease between 1988 and 1989. The low numbers counted in 1991 and 1992 were due to site desiccation in the drought. The pond was recharged by high rainfall during the second half of 1992 and reasonable numbers of adults returned to breed in 1993.

Conclusions

A number of conclusions can be drawn:

1. Considerable changes can seemingly occur at a site between years or over a longer period. Such changes are not always readily explicable.

2. Zero counts in one or more years do not necessarily indicate local extinction. Even Shillow Wood pond is likely to be recolonised in time by newts from Top Pond.

3. Comparing data for 1986 with data for 1993, the ranking orders were significantly related (Spearman Rank correlation coefficient = 0.768, $p<0.05$). The two sites with the largest counts in 1986 had the highest counts in 1993, but failed to maintain counts over 100 for lengthy periods. Apart from the decrease at Shillow Hill Top pond and the loss of the small population at the Wood pond there was little difference between the counts for 1986 and for 1993. For reasons given above, these events at Shillow Hill do not give cause for great concern.

4. Site safeguard alone does not guarantee long-term survival of a crested newt population. Adequate monitoring, in part to identify problems or opportunities for enhancement, coupled with a management ability are also required to maximise chances of long-term survival.

Acknowledgements

The following have helped with the counting: Henry Arnold, Roy Bradley, Steven Cooke, Lynne Farrell and Tony Gent. I thank Henry Arnold for commenting on a draft of the manuscript.

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Effects of scrub cover of ponds on great crested newts' breeding performance

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Introduction

A pond that is totally surrounded and overgrown by trees and scrub is likely to be relatively cool and dark and unattractive or unsuitable for breeding crested newts. On the other hand, in a less shaded pond, crested newts displaying at night in the breeding season may frequently be found in good numbers in poorly vegetated areas under overhanging branches (eg Cooke 1986). In simple terms therefore, a little shade may be beneficial, but a lot is detrimental. This paper describes an attempt to quantify the relationship between scrub cover of ponds and breeding outcome, and in particular determine the point at which scrub cover may require control.

Site and methods

In 1961, 20 ponds were dug on a 4 x 5 grid in Woodwalton Fen National Nature Reserve in Cambridgeshire. Each pond is circular and approximately 5 m in diameter; the distance between ponds is 25 m. Water depth is usually 1-2 m in winter and about 1 m in summer. The soil excavated from each pond was used to form a circular bank around the pond. Each pond with its bank is fenced, the area outside the fences being grazed or mown. Hawthorn and willow scrub has invaded the banks of most ponds. Since 1987, scrub growth around some of the ponds has been controlled; this has resulted in great differences in the degree to which the 20 ponds have scrubbed over.

Smooth newts started to colonise the ponds naturally in 1964 with crested newts first being observed in 1968 (Cooke & Frazer 1976). In the breeding season of 1974, crested newts were recorded in 10 ponds (Cooke & Frazer 1976); by 1979 crested newts were found in 17 ponds (Cooke, Scorgie & Brown 1980); during night counts in the 1980s, crested newts were recorded in 18 ponds in 1982, 19 in 1985 and all 20 in 1987 (unpublished observations).

In 1992, the following methods were used to provide comparative data for each pond. In mid July, scrub cover of each pond was assessed by eye. A value of x% scrub cover means that at a gross level x% of the water surface had leaves and branches of scrub directly above it; but it does not imply that there was a total lack of any small gaps in the canopy. At the same time, water depth and turbidity were measured. Each pond was netted for five minutes during each of six netting sessions that took place at fortnightly intervals from mid July till the end of September. Tadpoles were counted and returned to their ponds. A special note was made of tadpoles in the 'walking phase' immediately prior to emergence (Cooke & Cooke 1992). Cumulative totals of tadpoles or 'walkers' were used as measures of comparative breeding performance in each pond in 1992. Netting was done under licence from English Nature.

Results

Logarithmic transformations of count data for crested newts were negatively related to pond scrub cover both for total tadpoles (Figure 1, $p<0.001$) and for walkers (Figure 2, $p<0.05$), with 54% and 24% of the variation being explained respectively. Including depth or turbidity in stepwise multiple regression did not significantly improve the relationships. The relationship between logarithmic transformation of count data for smooth newts and pond cover just failed to achieve statistical significance ($0.05<p<0.1$).

However, a straightforward relationship of this kind between crested newts and scrub cover implies that a small amount of scrub leads to a relatively large reduction in numbers of tadpoles caught. Distance-weighted least squares smoothing of the raw data indicated this not to be the case, with an initial small rise in numbers caught. Therefore critical exponential curves were fitted to the untransformed count data for crested newts. The relationship failed to reach significance for walkers ($0.05<p<0.1$) but was significant for total tadpoles (Figure 3, $p<0.05$, 43% variation explained). While the line in Figure 3 fits the data slightly less well than that in Figure 1, it may describe the data better in an ecological sense. The peak corresponds to about 5% scrub cover. The graph indicates that if scrub cover reaches 30% then tadpole numbers are considerably reduced.

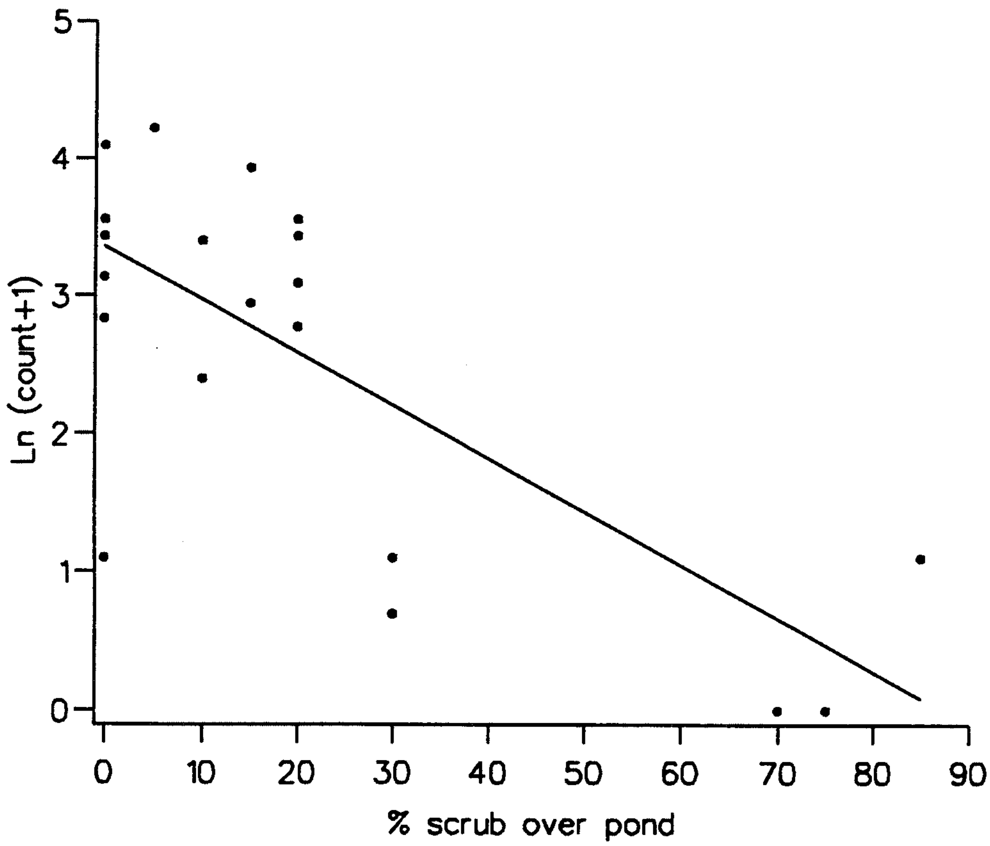

Figure 1. **Relationship between $\log_e$ (catch of all crested newt tadpoles + 1) and percentage scrub cover**

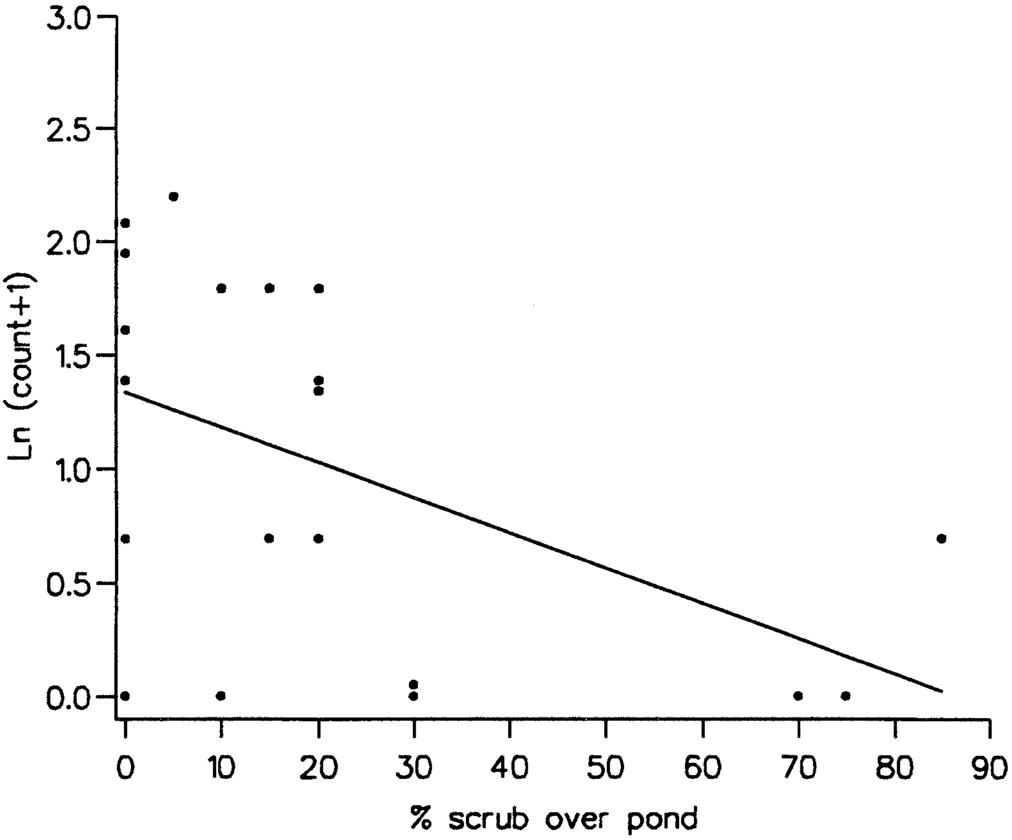

Figure 2. Relationship between $\log_e$ (catch of crested newt 'walking' tadpoles + 1) and percentage scrub cover

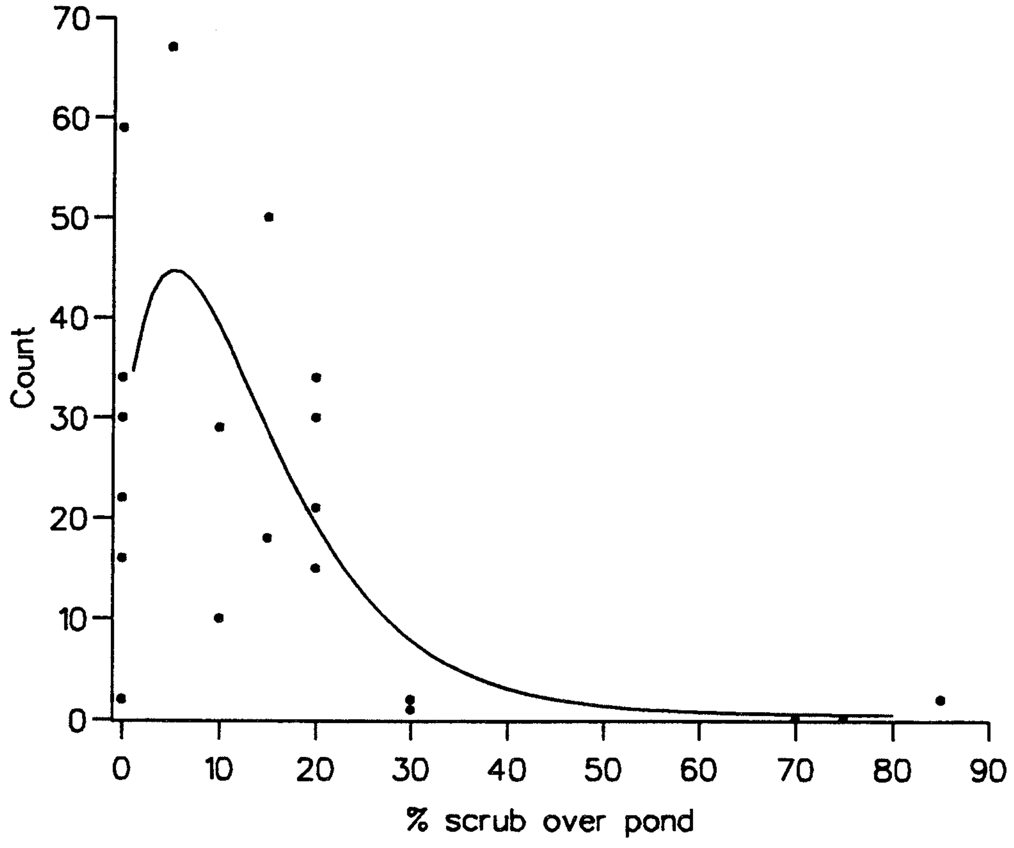

Figure 3. Relationship between catch of all crested newt tadpoles and percentage scrub cover, fitted with a critical exponential curve