Conclusions

The essence of this paper has been to provide a practical guide about when to tolerate and when to control scrub. It has not been our intention to explain the mechanisms by which scrub cover affects tadpole numbers. But such mechanisms will involve inhibition of egg laying and/or reduced performance of eggs and tadpoles. The following were noted as being associated with high levels of scrub cover: reduced amounts of water plants (apart from duckweed), lower water temperature, later emergence (Cooke 1993).

Results indicate that up to about 20% scrub cover is acceptable above a crested newt breeding site. However, the orientation of the scrub is also likely to be important. None of the four ponds with 20% cover had continuous scrub around the southern half of its edge and each pond had reasonable numbers of tadpoles. In contrast, the two ponds with 30% cover had very low numbers; one of these ponds had a more or less continuous band of scrub around its southern edge, while the other had unbroken scrub around its southern bank. It is possible therefore that scrub cover in excess of 20% may be well tolerated providing it is sited along the northern edge, while cover of 20% or less may be damaging if concentrated along the southern edge. For newt conservation purposes it is recommended that if scrub cover approaches or exceeds 20% of a pond surface, then its impact should be critically assessed and any necessary management undertaken.

Acknowledgement

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Analysis of belly patterns for individual newt recognition

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Introduction

The success of conservation measures involving translocation of great crested newts can only be assessed if the translocated animals can be distinguished from animals already at the new site. Individual newts can be recognised easily on the basis of belly patterns and these can be copied photographically, but the matching process, when more than a few dozen animals are involved, is arduous and time consuming. This problem was addressed by the development of an automated newt identification system (**ANIS**).

Operation of the system

ANIS uses the techniques of image analysis applied to six characteristics of the belly pattern: the black/white ratio, the number of spots, the compactness of the pattern, the eccentricity of spots, shapes of specified spots and the cloacal pattern. Details are provided by Sweeney (1993).

The equipment and procedures used are summarised in Figures 1 and 2. Newts captured in the field may be photographed *in situ* using apparatus similar to that described by Oldham and Nicholson (1984), or returned to the laboratory and photocopied using a standard office photocopier. Each photograph is then rephotographed using a video camera and its characteristics analysed and stored in a database on computer. Photographs obtained from each subsequent field capture session are fed into the system in the same way and then automatically compared with the first set, or with each other, using ANIS.

The principal limitation of the system is the variation in the photographs caused by differences in the positions adopted by the newts each time they are photographed. Accordingly the result of the matching process is not a single newt, but a shortlist of the animals (in descending order of probability) whose photographs most resemble the target pattern. The shortlist of patterns, presented in turn on the computer screen, is then compared with the target pattern by eye, a process aided by the use of a split screen.

System efficiency

If a target newt is known to have been entered into the database previously, then the shortlist containing a match normally consists of not more than 8% of the records held in the database. In other words if the newt is present in the database a match is likely to be achieved within this limit. If, however, the newt is not known to be present in the database, it is necessary (at the 95% probability level) to examine the top 24% of the database records to be certain of its absence. Although this involves the examination of one quarter of the records by eye, an onerous task in a large database, it represents, nevertheless, a considerable saving in time and effort by comparison with a manual system, which would involve matching 100% of the records by eye. Furthermore the manual system itself is not foolproof; Oldham and Nicholson (1986) estimated a 14% error in matching belly pattern photographs by eye.

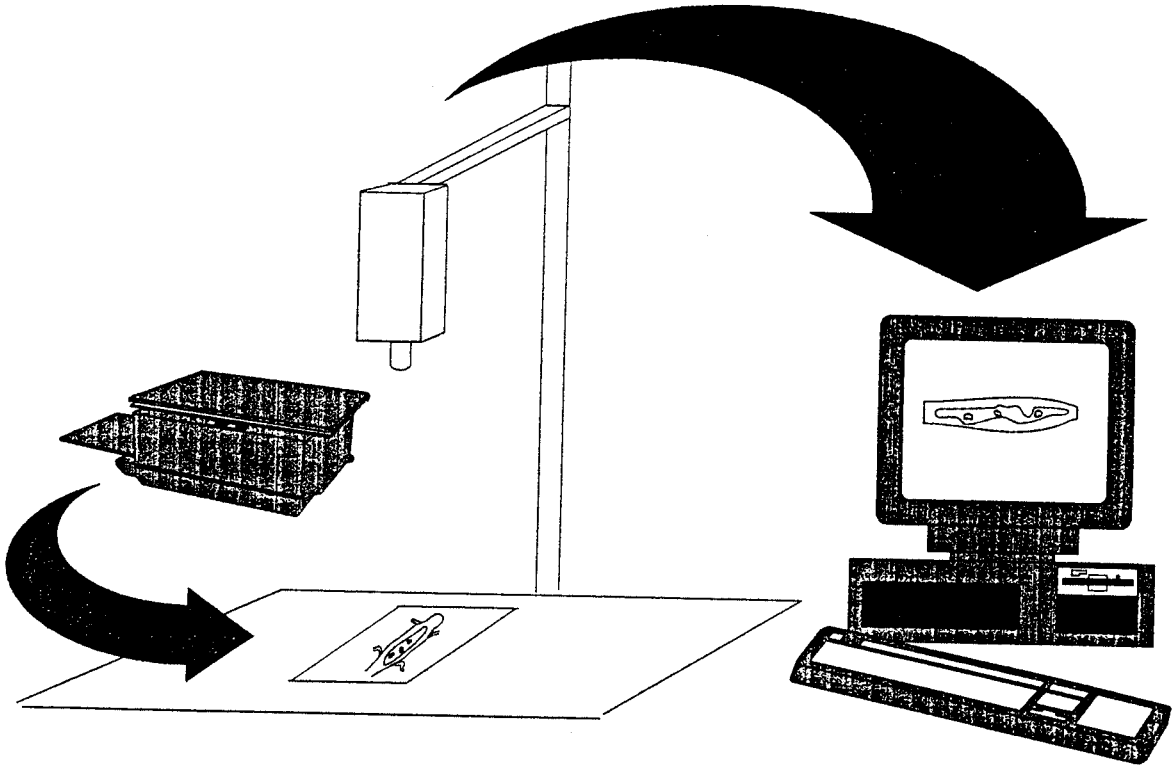

Figure 1: **'ANIS'.... photocopier and image analysis equipment**

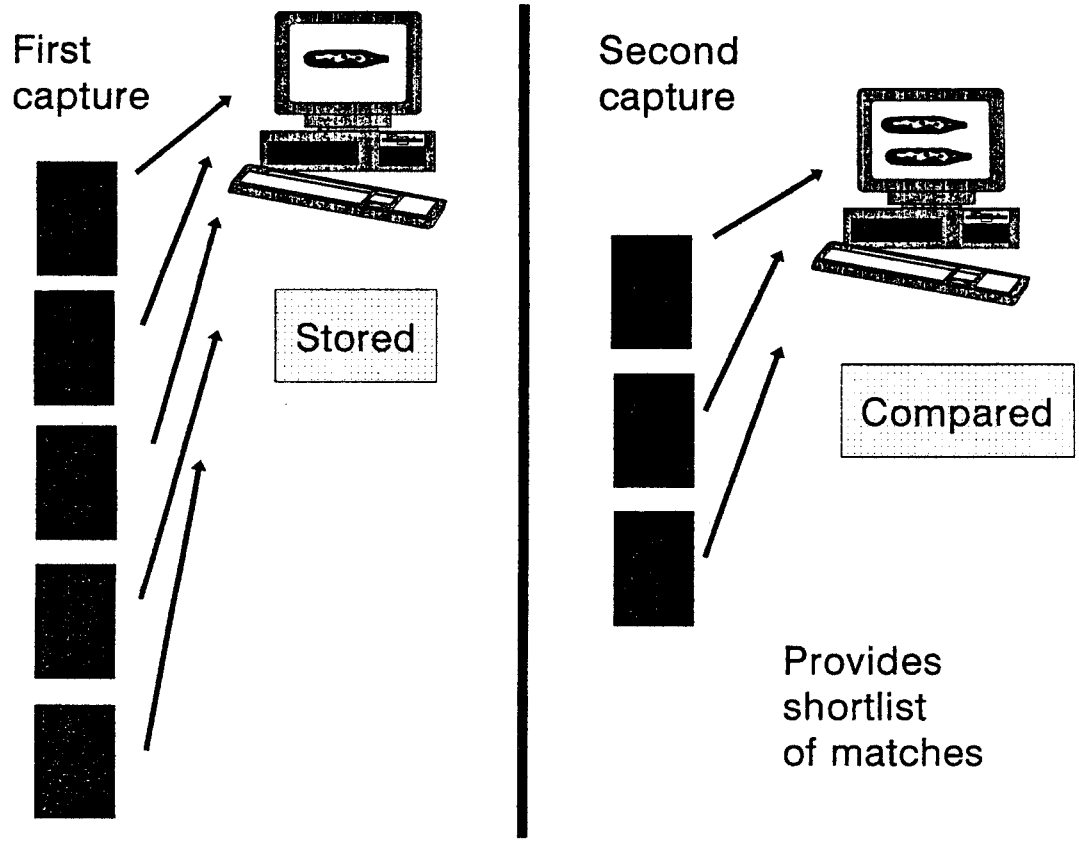

Figure 2: **'ANIS'... the processes of image capture and matching**

Acknowledgements

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Questions and discussion - Session two

Alistair McLee: Has there been any work done on great crested newts using transponder implants as has, for example, been done on birds of prey for identification purposes?

Rob Oldham: I think there has been a little work done in continental Europe on that but there are problems in it in terms, in part of the cost of the equipment and partly of the range of the equipment. As I understand it, the range is not anything like as good as radio tracking equipment.

Tony Gent: For clarification, the main use of a transponder tag is for identification of individual animals. For this, you generally need to catch the animals that you have marked before you can identify them. Radio tracking is different. This allows animals to be located from greater distances. There has definitely been work on toads in Britain using transponders where they are marked by injecting the tag subcutaneously.

Tom Tew: The last time I looked at the equipment the tags were relatively inexpensive and you could get hundreds of those cheaply, but to buy the reader was incredibly expensive.

Alistair McLee: Referring to a remark that Rob made earlier, we at Cleveland have been looking at surveying some sites which might be threatened with being filled in and where we suspected great crested newts would be present in low concentrations. Rather than torching at night, which is tedious anyway, especially as there are about 42 of these ponds, we adopted the technique (which was discussed at another conference) of using strips of black plastic rubbish bag as an indicator for eggs. Certainly, earlier on in the season newts seem to want to use these preferentially for egg laying; what it is like later in the season when other plant vegetation is more prolific, I do not know. However, it is a way of gaining a qualitative if not a quantitative indication of their presence. Would anyone else like to make a comment?

Bob Bray: I think that is one of the problems that anyone who has been surveying for newts has found is that getting a qualitative assessment of a population is not necessarily the problem; I have found that bottle traps often pick up newts where torching has not done so. To get an assessment of quantity for comparative work has been much more difficult. Although Robin didn't mention bottle trapping, I have found that a very successful means of detecting quite low populations when torching failed to pick them up at all.

Charles Gibson: I would also support the earlier suggestion of using egg counts. People have found them extremely effective relative to other single methods. There is one thing which I think is an impossible question. As a consultant, I keep on coming up with cases where we find great crested newts on a completely new site. One can get a quick qualitative idea of whether there are a few or there are a lot or, good Lord, the population is enormous but no more than that. Then I have to sit down and try to persuade the client, or at least somebody does, and persuade the planners that this is going to make 'x' difference to the proposal. It is very hard at the moment because it is so complicated to say exactly how much land one should set aside and what to do with it. Everyone has 'pond' in the brain - that's quite simple. The real problem is going for the terrestrial bit: exactly what we need and how much. I can shoot my mouth off at them until I am blue in the face but they don't often believe me as a "consultant trying to get more fees". What it really needs is some distillation of the research work that comes through as official guidance and that is simple for planners to understand and for developers to follow. Can anybody contribute to that at all. I think that is something that is needed.

Bob Bray: May I invite Rob (Oldham) to comment because of his research at Little Wittenham is relevant here.

Rob Oldham: One such distillation that I omitted to mention was that we use a figure of 0.4 hectares of suitable habitat being needed, but don't ask me to justify that in clear terms.

Charles Gibson: Yes I have heard that but is that per pond? Per hundred adults?

Rob Oldham: That is per minimum viable population.

Bob Bray: It is certainly a problem as a consultant when dealing with anybody to be able to justify your recommendations. One thing that we are hoping to come out of today is that we will be able to build up a clear picture of what you can reasonably recommend to either a developer or a landowner in terms of necessary action.

Arnold Cooke: Can I first of all have a go at tying up what we said before about bottle trapping and torching. I have done quite a bit of comparative work, although I hesitate to say this because I suspect that Rob has done more than I have. At Shillow Hill in 1984 to 1986 comparing torch counts and bottle trap totals and there was a linear relationship between the two. However, this didn't go through the origin and at low levels of newts present in the pond, ie, at either end of the season, bottle trapping tends to be rather more efficient at detecting newts. However, to come back to this plea for help when, going back to the old days of the Nature Conservancy Council, we were obviously in a position of having to advise upon sites with the best information available: it might not be very good but it is the best we have got. With regards to 'rule of thumb stuff' if you can do good torch counts if you simply add a zero on the end that will give you some idea of the population of that is using the pond. If you then look at the terrestrial habitat within 250 metres of the pond and use the rule that there are 250 adults per hectare, that will give you some idea of the land that the numbers of newts that appear to be using the pond will require. In the absence of anyone coming up with anything better this is what we generally use even now.

Bob Bray: I have been in a Public Inquiry situation where the people who were questioning that sort of information would ask me for reference to the specific research background to that and I think that it is important that if we are going to generate information for use in a recommendation and certainly in an Inquiry against counsel where the first thing they will ask is "sir, did you do this research, if you didn't do this research, who did this research and could you give us evidence to support this research". So whilst it is a good rule of thumb, as you say, it is important that it is firmed up with some sort of research that can give a clear indication to people who have other vested interests.

Charles Gibson: We are obviously beginning to get there because of the information we have seen this morning. However, one needs the range of studies at different sites on a protected species otherwise it is weak when required at Public Inquiry and is open for people to knock holes in. Also, there is a danger in it, for example, let's say I go home and get phoned up by a client who says we have newts. So we do a survey and a population estimate, apply the rule of thumb. The site that they want to build on could be mostly arable but say that there is also a piece of woodland that they want to remove. The client could say "if the animals are, let's say, five times more dense in good woodland then if we plant another half acre of woodland then we can grab the lot".

Bob Bray: Yes that indicates the need to be *au fait* with the way in which development pressure is generated.

Charles Gibson: Yes, that's the way those pressures go and that we need that hard research background and it isn't broad enough yet.

Arnie Cooke: Yes that is the fault, Chairman. What I have just said is based on my own research which is published. Likewise Rob has been talking about his own research. Admittedly it is only

a small number of sites but it is always going to be only a finite number of sites. I would throw it back at consultants and people who are working with consultants, local trusts and so on, and say that you are often in a very good position to generate good new data which can then be fed back into the system to help us decide how to go forward in the future. Even then it will only be based on a finite number of sites but perhaps we will be in a better position because we will have progressed further down that road.

Charles Gibson: Can I just add a small rider to that and that is that with the sort of client like British Coal Open Cast who have reasonable resources and a moderate to good sized population of newts, then we need the statutory body, be it SNH, CCW or English Nature, to require that research, otherwise no one is going to find a budget. On the other hand, if someone says we are going to object like fury on this site and that it ought to be an SAC for the newts because it might be a huge population, then more of that research is going to get done.

Arnie Cooke: I agree, certainly when I was involved in that sort of work that would have been a condition of the licence. If you wanted a licence to do something with crested newts, then you had to monitor for 'x years' into the future. I wonder how much of that has ever been done.

Charles Gibson: It needs that really banging in, otherwise there won't be the budgets for it.

Arnie Cooke: The first table that I put up was work that was done in my own time. I once worked out how long that took me and it turned out to be very little time at all but it just needs the commitment to go out there each year and to see what is going on.

Will Watson: Have you got much information on ponds that have been drained? There is a correlation between the different methods of recording and absolute populations that can be revealed by draining ponds. I think this is quite important. I have had some experience of a pond at one site where we thought there was a medium sized population but, on draining it, it turned out to be far larger than we had expected. We had done both torching and bottle trapping at the site and this sort of data could be very valuable.

Bob Bray: I think it could also be very confusing as well. With British Coal Opencast we did a survey on some land owned by BCO to determine the presence of crested newts. We didn't find any crested newts there. Just before a rescue found that there were smooth newts there, we drained the pond, found 500 smooth newts and again no crested newts. However, within a quarter of a mile we put in three new ponds as part of a programme of work to provide a reserve and within 18 months there were great crested newts breeding within all three ponds.

Mary Swan: I would just like to go back to a point on the choice of survey methods. I think what has come out of the discussions so far is the importance of prescribing methods appropriate to your purpose. In the national survey we had such a dilemma, we were looking basically for locational distribution information. However, we were also trying to glean as much as possible in the way of habitat information and in addition, also some systematic survey work to look at the status of the species within particular areas of the country. The way in which we got around that was to bear in mind the lowest common denominator and to instigate a tiered survey system aligned to the different levels of commitment of the people involved. This was a national survey and very widely publicised and we received responses from all levels: from children and old age pensioners through to people who are very experienced in the field. As far as possible, we hoped to maximise the potential recording source for different abilities that were out there. The bulk of our recording effort was at the medium level of recording and our main survey method for locating newts was to use the torching method. However, for the much more detailed and long term monitoring schemes a wider range of methods were involved, including those that required licensing. In summary I think you have got to be very sure of your purpose before prescribing methods.

Julian Branscombe: On the subject of where to survey for newts, is anybody aware of any colonies on moorland or upland sites. From my own experience of doing environmental assessment work in South Wales we have turned up great crested newts on moorland at about 1,000 feet on grass dominated acid moorland and we found newts in the neighbouring valley at about similar altitude in enclosed land. The consensus in the literature suggests that newts shouldn't be in such areas. Has anyone else found newts in such areas?

Tom Langton: I believe that Simon Mickleborough's study in, I think Mid Glamorgan, found great crested newts at fairly high altitudes, although I can't remember exactly what.

Kevin Morgan: And Clwyd. And at more than 1,000 feet in acid moorland.

Philip Horton: I wish to make some comments. I think that Robin mentioned that British Coal Open Cast land seemed particularly good for crested newts; we can see this at Lomax and in South Wales as has just been mentioned. Indeed, we seem to turn up great crested newts on most sites that we survey for British Coal. Is that because their land is particularly suitable or is it just that they put more effort into paying consultants to do survey?

Bob Bray: It certainly seems that some newts haven't read the literature.

Mary Swan: The national survey actually showed quite a good correlation between the presence of crested newts and the occurrence of mineral extraction sites and the surrounding land. The reason this should be is probably due to a mixture of factors that Robin referred to this morning.

Robin Grayson: I have looked at that fairly closely in the Lancashire Coalfield and the feedback goes as follows. If you have shallow coal reserves you probably have deep mining and you will have a history of subsidence with reverse drainage criss-crossing the mineral lines, with small pit heaps and large pit heaps. There will be laid back agriculture and abandoned farmsteads and (if that corresponds to soils that are clayey) either because there is no Boulder Clay at all, or because there is Boulder Clay and a history of marl pitting, then those marl pits will not be damaged by intensification of agriculture in these areas will develop a horse riding and trespass regime.

Philip Horton: During surveys in South Wales the best site for great crested newts we found was in a series of former bell pits.

Mary Swan: You also find them in sand pits in Derbyshire and chalk pits in Kent. They really do like all sorts of holes in the ground.

Bob Bray: That may just suggest that if you correlate the features that occur on these sites, you could build up an environmental checklist, that could be used, for instance, on redevelopment land that at the moment is no longer going back to agriculture. When development does proceed at the moment a lot of sites are not being turned back to agriculture but are for leisure or for amenity or for a whole lot of other functions. If there was a checklist of those features that appear to occur on sites that have a high great crested newt occurrence, then people like development agencies or landscape architects could refer to it so they could put back into the environment those things that are very easy to design out. Landscape architects are always designing out those features that do not conform to either a visual stereotype or a practical management stereotype. It is the same with agricultural restoration; it is too easy to create a 'green desert'.

Keith Corbett: We seem to be getting back to something that interests me a great deal; that is the subject of geology and the distribution of newts. One of the things that we found looking in the Greater London area and into the Weald was that, while the geology could be related to the distribution of the great crested newt, the change in geology rather than the actual hard geology seemed more important. If you had change in beds they often produced seepage and spring lines

and, if you were within a kilometre of that geological change, you could predict it would be good for great crested newts. And it almost invariably was. Conversely if you went out into an open area, say an area only of clay, then it would be less good. You had to get near to the edges before you got the real concentrations. Those sorts of things would be worth looking at. I have no idea what opencast coal mining contributes to this theory but certainly with brick pits you classically need clay and sand within the area and that is really good crested newt habitat. Before we came along, and you have got to look at what was happening three or four thousand years ago, where were the natural ponds? Presumably they would have been in these seepage areas and, of course, river valleys.

Session closed for lunch.

Herpetofauna Consultants International great crested newt commissions, 1989-1993: Projects summary and case study

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Background

Herpetofauna Consultants International (HCI) is a privately owned environmental consultancy concerned with the management of amphibians and reptiles and their habitats. Established in 1989, the company employs biologists to work on a range of commissioned applied research projects, mainly in Britain for central and local government, industry, conservation organisations and private individuals.

As a result of the protection that crested newts receive under the Wildlife and Countryside Act (1981), crested newt casework (comprising 42 projects in the first five years) has made up the highest proportion of the amphibian consultancy work of HCI. A breakdown of the scope of work carried out by these 42 projects is summarised in Table 1.

Project scope	Number of projects (all projects pooled)
Survey of ponds to determine the presence of crested newts	15
Survey of known crested newt ponds to investigate populations	14
Assessment of crested newt sites with proposals for land use change	27
Translocation of crested newt populations to new sites	3
Translocation of part of a population to avoid killing and injury of crested newts (usually retaining the breeding ponds)	6
Habitat management/construction on a site as mitigation for partial change to the habitat of a crested newt population	11
Change to the habitat of a crested newt population	11
Number of ponds surveyed by night time torch-count for crested newts	2679
Number of ponds surveyed by bottle trap for crested newts	45
Number of ponds surveyed by egg searching for crested newts	1250
Number of ponds surveyed to look for crested newts (total)	3974
Number of the total ponds surveyed in which crested newts were located	706 (18%)
Number of crested newts caught and translocated	4586
Number of other amphibians caught and translocated	21650
Number of ponds restored	10
Number of ponds constructed from new	28
Number of ponds managed	23
Number of ponds destroyed	36

The law and its influence on crested newt protection

HCI has gained an insight into the practical day-to-day operation of the Wildlife and Countryside Act, having represented, liaised with the consulted with several hundred individuals and organisations in the course of casework.

In choosing a few key conclusions to draw from our work for the purpose of this seminar, I will consider what might be considered the effectiveness of the Act, in terms of how the Act operates in practice once a land use change for crested newts and their habitat has been identified. It is also important to consider how the legislation may have influence on the general decline of the species, at all its remaining locations.

To begin with, we see a very great many positive aspects that have been brought forward, and it is important to remember that the level of interest and attention and the species gained in the 1980's as a result of its full listing on Schedule 5 of the Act has resulted in an increased understanding of the ecology of the species, some (albeit few) sites protected in nature reserves and in the wider countryside, and to some degree an increased awareness by the general public and local authority planning departments of the need to protect newts.

Examples of the establishment of protected areas which include crested newt breeding ponds and land habitats on a large scale include nature reserves at Wymondham in Norfolk: and at Peterborough Southern Township. At Wymondham 6 ha of land and five ponds have been protected, and at Peterborough there is an ongoing programme (see Appendix 1) to implement a strategy for protecting the species, including the provision of a 30 ha (multi-pond) nature reserve.

There are, however, a number of problems in the Act, including the ability of the statutory bodies (Countryside Council for Wales, English Nature and Scottish Nature Heritage) to tackle casework when newt areas become threatened. Beyond the very obvious and immediate threats at a relatively few sites (eg a new road, shopping centre or housing estate) the bulk of breeding sites are threatened from 'natural' causes. These include the influence of succession on unmanaged ponds, and the incidental effects of pollution, land drainage, abstraction of water, stocking with predatory fish and other management changes that may cause newts to become locally extinct in their increasingly fragmented pond clusters.

From the work that HCI has carried out, a number of points have come to our attention that might be worth discussing by relevant groups and individuals.

a. Casework in particular can take up a relatively large proportion of the time of statutory body officials, and in many cases officers are unable to provide what might be considered as 'full' cover due to a lack of personnel with available time, training or guidance. This can result in lack of any appropriate action, poor quality compromises and, sometimes, misunderstanding and wasted effort.

b. There have been a number of half-hearted mitigation efforts for crested newts, with poor advice being given by over zealous volunteers and inexperienced or under-trained biologists, environmentalists and consultants. This may lead to possibly unlawful 'rescue' attempts and the translocation of animals to unsuitable areas. This appears to be getting less frequent now that the licensing authorities and County Wildlife Trusts are getting more experienced, but standards still need to be raised and more guidelines are required.

c. Mitigation work can maintain the status of a colony in an area, but usually at a relatively high financial cost. Meanwhile, ponds that have not been surveyed for newts are infilled, polluted, stocked with fish and otherwise made unsuitable. It could be argued that this general decline of crested newts in the wider countryside makes the mitigation at a few sites almost insignificant in terms of the increasing scarcity of the species. At some point national

intervention is going to be essential in order to address the long-term protection of crested newts (and other pond life) so that the effort spent on solving individual cases are not in vain.

d. It seems therefore a priority to encourage work in two areas:

   i. The survey of all UK ponds for amphibians (and other key species) on a county by county basis. Government-funded blanket survey work has already been carried out to a limited degree in ponds in Wales and England and should be encouraged further. The results should be prepared for use by local authorities, statutory bodies and voluntary groups on well designed, detailed and diligently circulated and updated checklists and maps. This process should be combined with a survey for other endangered species, including aquatic macrophytes and macro-invertebrates. This may represent high initial financial outlay by central government, but it would only have to prevent a few cases per year from arising to save government and non-government bodies a greater amount in mitigation costs. The costs of five cases that I am aware of, when combined, have cost the taxpayer or private companies more than £1 million, due to the need to move roads, modify housing layouts or carry out other mitigation measures.

   ii. The provision of advice (for pond owners and managers) on maintaining crested newt habitats. It is remarkable that after over a decade of studies funded by conservation bodies no popular publications have been produced advising site owners on positive management.

A case study concerning crested newt translocation

The case study that I have chosen to briefly outline is one of the more interesting of the 42 projects that HCI has carried out. This relates to a site at Crewe, in north-west England (Langton, Beckett, Morgan & Dryden, this volume). In this instance, outline planning permission for the development of the site had been granted by the local authority, and the development required the complete translocation of the crested newt population. The site was a relatively isolated two pond system with fairly well defined boundaries to newt population dispersal. The case was interesting for a number of reasons.

a. At the time, interest was increasing regarding the success of crested newt translocations, and the suspicion that no scientific evidence was available to show that such translocations work was successful (Oldham *et al* 1991).

b. HCI had to decide on an appropriate methodology for the work and this developed, with the help of others into proposed guidelines for the translocation of crested newts at such locations (HCIL 1991). (See Appendix 2)

c. The site offered an opportunity to investigate the relationship between numbers of crested newts seen during monitoring (using a variety of methods) and the numbers of newts actually occupying a pond. The newt catching process offered a comparison with the pioneering work of Arnold Cooke (then Nature Conservancy Council, Chief Scientist Directorate) who had begun the difficult process of investigating newt population ecology at the Shillow Hill study site (Cooke 1985, 1986a, 1986b).

d. The relocation site offered a long-term opportunity to monitor the progress of a translocated crested newt population.

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Appendices

1. Information leaflet for Peterborough Southern Township.

2. Proposed guidelines for the translocation of crested newts *Triturus cristatus* at 'wild' sites. HCIL (1991) *Herpetofauna News 2, No 5*, p 5-6. (Condensed to single page in this volume).

PETERBOROUGH
SOUTHERN TOWNSHIP

HERPETOFAUNA
CONSULTANTS
INTERNATIONAL

ARUP

Introduction

The extensive disused brickpits south of Peterborough in Cambridgeshire have been identified as the site of a proposed new township to cater for the projected growth of the city into the next century. The proposals include phased development of residential, commercial, industrial and leisure areas within a hierarchy of district and local centres. Green corridors and space for landscape improvement and recreation and amenity uses are major components of the development.

The land is owned by the London Brick Company Ltd. and the development is proposed by Peterborough Southern Township Ltd., both of which are subsidiaries of Hanson plc – our ultimate client.

Ove Arup & Partners have been providing extensive design input for several years, incorporating infrastructure engineering, geotechnical engineering, transportation and highway design, acoustics and environmental science. This paper deals with the ecological aspects of the proposed development, in particular crested newt *(Triturus cristatus)* ecology, which have been primarily the responsibility of Arup Environmental with specialist support from Herpetofauna Consultants International (HCI).

Site description

The site covers an area of some 1300ha, currently occupied by disused and operational brick clay workings. Brick making has been carried out in the area for over 100 years, in general working from east to west across the site. The excavated clay is transported by conveyor to nearby kilns where, after milling and pressing, the 'green' bricks are fired to produce the traditional fletton brick.

Many of the clay pits have been filled progressively with slurried pulverized fuel ash (pfa), brought by rail from the Trent Valley power stations, and then restored to agriculture. This has given rise to a range of engineering and environmental issues. However, a number of the older pits which have not been infilled contain water and have been colonised by aquatic and marginal vegetation.

The most recently excavated pits exhibit an interesting 'ridge and furrow' topography. This has resulted from the clay excavation process in which the draglines used to extract the brick clay cast aside lower quality 'callow' clay in long ridges several metres high as they work along the excavation face. The ridges and the water-filled furrows between them have been colonised by an interesting flora and fauna. This combination of habitat types extending across a wide area of relatively undisturbed land has produced a virtually unique environment within a county where much land is under intensive agricultural use. Perhaps not surprisingly, the area has developed considerable ecological interest.

Environmental assessment

The proposed township development falls within Schedule 2 of the Town and Country Planning (Assessment of Environmental Effects) Regulations (*SI 1988/1199*). This being the case, an Environmental Statement was required to accompany an outline planning application. It was prepared by Shankland Cox Ltd., masterplanners for the township, and Ove Arup & Partners in November 1989 and amended in June 1991 to accompany a masterplan for the development and its subsequent revision.

Ecology and nature conservation

As part of the overall masterplanning and environmental assessment process, Arup Environmental designed and supervised Phase 1 botanical surveys over the entire township site. Fieldwork was carried out by local experts from the Bedfordshire and Huntingdonshire Wildlife Trust (BHWT) in March 1989.

The data obtained allowed the distribution of species and habitat types to be mapped and enabled the main areas of nature conservation interest to be identified. Subsequent studies have also been undertaken on the ornithological and invertebrate interest of the site. The information has been used by the project team to design appropriate protective measures prior to, during and after site development. This process is on-going and has been carried out in close liaison with English Nature.

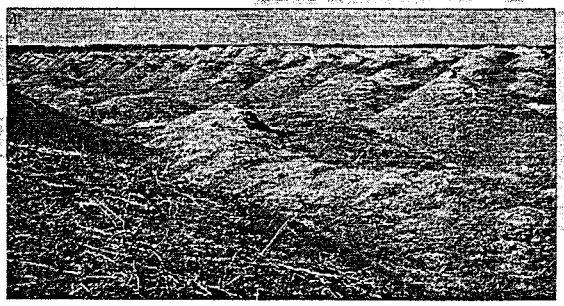
Much of the ecological interest centred on the extensive wetland areas present within the disused brickpits, and in the summer of 1989 more detailed Phase 2 ecological studies were undertaken in two selected places: the 'ridge and furrow' area of the excavated Orton Pit and the established lakes to the east of the main Peterborough - London railway line.

In the 'ridge and furrow' area the water-filled furrows and pools were found to be of considerable botanical interest. A distinct succession was apparent from the younger, species-poor, western furrows nearest to the working face of the clay pit to the longer-established pools in the east and north, which supported a diverse flora. A notable find was that of the stonewort, *Chara canescens*, a complex, filamentous green alga found in many of the younger pools. This is the first record for the species in Britain since 1956. Two other rare stoneworts were also identified, *Chara pedunculata* and *Chara aspera var curta*. The latter had not been recorded from the Peterborough area since 1909.

Following discussion with Arup Environmental, it was agreed that specialists from English Nature should survey the aquatic flora of the four eastern lakes using boats and grappling hooks to collect samples. As a result of this survey, the three largest lakes are eventually to be designated as a Site of Special Scientific Interest (SSSI), on the basis of the rich assemblage of aquatic flora that they support.

Following the publication of the Environmental Statement for the township development which contained details of the botanical surveys, English Nature requested further surveys to examine the possibility of crested newts (a species protected under the Wildlife and Countryside Act, 1981) being present in the wetland area.

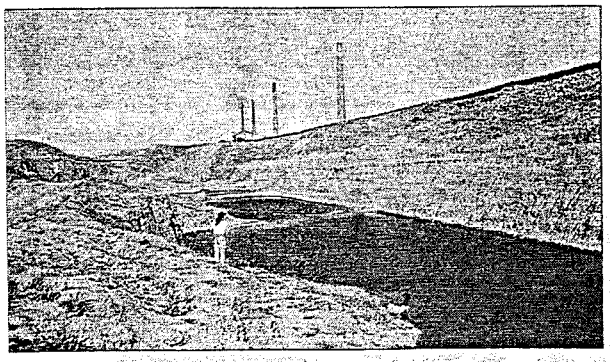
An initial survey by expert herpetologists from English Nature carried out in April/May 1990 did indeed produce a peak night count of 600 great crested newts (indicating a possible population of up to about 6000 individuals) in the northern sector of Orton Pit's ridge and furrow area. This gave the site a rating as the second-best in Britain and subsequently English Nature proposed to designate up to 30ha of Orton Pit as a SSSI. This land had previously been identified in the masterplan as a zone for light industrial and residential use.



Creative conservation

The ecological importance of certain areas of the proposed development site has been recognised by our client and we are advising the project team to ensure that proposals contain comprehensive measures to protect, enhance and augment the important habitats. The new landscape proposed for the site will include substantial provision for creative conservation measures. Full liaison is taking place between the Arup design engineers, HCI, Shankland Cox and English Nature.

Key areas of concern were highlighted in March 1990 when Arup produced a nature conservation strategy paper for discussion with English Nature. This covered issues such as the need for a landscape masterplan, a zoning policy for use of the lakes, a recreation policy, further ecological survey and research requirements and a maintenance/management strategy



Crested newts

The proposed designation of a substantial area of otherwise prime development land as a SSSI has resulted in further discussions with English Nature. Additional information on the newt population was clearly needed before strategic decisions were taken on development proposals. We sought expert assistance from specialists, Herpetofauna Consultants International (HCI). Extensive fieldwork has been undertaken since September 1990 to map newt habitats, identify breeding sites, and assess the distribution and population structure of the newt colony and identify the key characteristics of breeding ponds. Night counting at breeding ponds and pit fall trapping on land are two of the methods used in this work.

The survey was extended to include land adjacent to Orton brickpits, Orton lagoons, as this habitat was considered to have potential as good crested newt habitat. Orton lagoons are on land previously excavated for bricks and engineered for subsequent land reclamation by filling with pfa. This had been halted when the township was proposed.

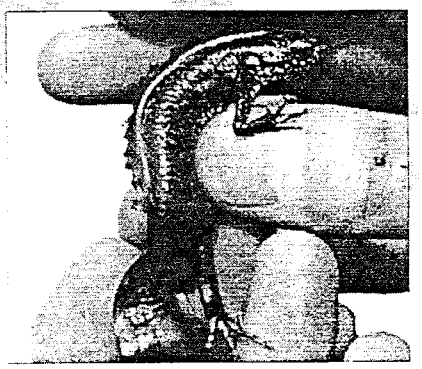
Further survey results indicated that the newt population is more widely distributed than first thought and the numbers counted make the Orton Pit colony by far the largest population in the UK.

In order to protect the colony and allow for its long-term survival, an area identified by the design team following discussions with English Nature has been set aside as a reserve. Extending to some 30ha, this is to be notified as a SSSI by English Nature and managed accordingly.

Habitat Design of Crested Newt Reserve

The reserve area encompasses the prime newt habitat at Peterborough Southern Township, identified in the preliminary survey by English Nature. This part of the reserve is on derelict land remaining after clay extraction. The terrain is dangerous and currently there is no public access. Proposals for the reserve include engineering works to maintain the hydrological integrity of the site and to make it safe for future access by the public. High quality terrestrial habitat has been included in the reserve, comprising a mixture of grassland, scrub and young woodland. This consists of land where clay extraction has not occurred and disturbed land. Detailed landscape design proposals for the reserve were drawn up by the design team.

Enhancement of this habitat was achieved by construction of seven new ponds and modification of a large pond supporting fish



to four smaller ponds in summer 1991. Ponds were designed and integrated into the existing habitat to provide minimum disturbance to the already valuable habitat. The characteristics of the newt breeding ponds at PST were incorporated into the pond design - including a predominantly linear shape to maximise available pond edge habitat and maximum depths of 1.5m – 2.5m.

Prior to the commencement of earthworks for pond excavation, vegetation was cleared by hand to ground level and left to 'dry out' for two weeks with the aim of reducing the risk of injury to crested newts already in the reserve.

Ponds were excavated during the first two weeks of September 1991. Water was pumped into the new ponds from water bodies at the township which were not of such a high ecological interest. However, complete drainage of supply ponds was avoided to reduce damage to their floral and faunal communities. As a precaution against the accidental introduction of fish to the new ponds, a filter net was placed over the outflow pump.

Marginal and aquatic vegetation was planted in and around the new ponds to accelerate natural colonisation by species selected to enhance the habitat for crested newts in particular encouraging egg laying. Log piles were constructed at a number of points to provide additional cover and suitable hibernating sites.

Trapping and Translocation

A translocation programme to relocate newts from outside the reserve area to within was drawn up in liaison with English Nature. This programme is based on six months of survey work by HCI and it is envisaged that a minimum of two years will be required to complete the project.

The first phase, whereby newts captured in the Orton lagoons are transferred to part of the enhanced habitat of the reserve, is almost complete. On completion this will enable the earthworks to commence in the lagoon area in Summer 1992 so development of PST can proceed.

Trapping was carried out for two months in Autumn 1991 to catch newts as they left their breeding ponds for hibernation. Trapping involved the installation of 1.2km of polythene drift fencing and approximately 200 pitfall traps. Traps were positioned immediately adjacent to the fence so newts moving across land were deflected by the fencing into the pitfall traps. The design and location of the fencing was influenced by the results of the night-time torch count surveys which indicated the likely density of newts and their perceived ease of capture (the latter influenced by local topography).

Captured newts were transferred to ventilated plastic buckets containing moist grass prior to being released in the newt

reserve. A safe compound was established within the reserve into which captured newts were released until earthworks were finished. To retain translocated newts within

the reserve (to prevent their movements to unprotected parts of Orton brickpits) a newt proof boundary fence was erected around

5.6 hectares of the reserve. Over 1 km of polythene fencing, 60cm high with 10cm embedded into the ground, was erected.

The number of newts captured last autumn was approximately 1.6 times as many recorded in the Spring 1991 survey. Further trapping will be carried out in Spring 1992 as newts emerge from hibernation to enter breeding ponds. Ultimately, the reserve will extend to some 30 ha so making it the largest dedicated newt reserve in the country.

Monitoring of the animals and long term management of the reserve will of course be continued after the translocation process is finished, thus ensuring the survival of Orton's crested newt population in perpetuity

Ridge and furrow excavated area

The survey undertaken on this part of the site, which supports rare aquatic and emergent plant species, confirmed the transient nature of the water filled furrow habitat. Nevertheless, the importance of protecting, as far as is practicable, the rare stonewort species by providing alternative habitats in more appropriate locations in the development area was recognised. Because of the lack of scientific data on stoneworts (especially *Chara canescens*), an ecological research programme was implemented in May 1990 following discussions with English Nature. Over the past year an extensive transplantation and monitoring programme, including water and sediment analysis, has been conducted to determine the physical and chemical requirements of the plant. The aim of the study is to enable a colony of *Chara canescens* to be established at a 'safe site'. To date, some limited success has been achieved with the trial transplants.

Eastern lakes

The masterplan proposals allow for both the retention of these water bodies and their management in a way which will not prejudice the proposed SSSI designation. English Nature has indicated that low key recreational usage of the lakes (including sailing, fishing and use of perimeter footpaths) would be compatible with their ecological status. The effect of road construction nearby and measures improve the safety of lake margins has also been assessed and a package of ameliorative measures agreed with English Nature.

A comprehensive monitoring programme for water and sediment quality of the eastern lakes has also been established. This is providing baseline data to assess the likely impact of built development in the vicinity, including discharge of surface drainage and the use of the lakes for stormwater attenuation.

Other areas

In addition to those areas of special ecological interest, the development proposals make provision for creative conservation measures elsewhere on the

site. Two small woodlands will be retained and augmented with considerable areas of new tree planting. The woodland edge habitats and main woodland blocks created will provide valuable conservation areas and act as wildlife corridors through the site. The Stanground Lode, which is the main watercourse in the brickpits area, will also provide a valuable linear wildlife corridor traversing the Southern Township site. New lakes will also be formed in various locations. These will serve a number of functions, including recreational and drainage attenuation, but certain areas will also be set aside specifically for nature conservation and be managed as such.

Conclusion

This project has been and continues to be a particularly interesting and challenging exercise and has demonstrated the importance of effectively addressing ecological considerations at an early stage in the planning process. This ensures appropriate measures are introduced to protect and maintain the ecological value of potential development sites.

The ecological constraints are, of course, only one of the many environmental and engineering issues addressed by the design team over the past few years. However, the ecological characteristics of the site have played a major role in shaping the conceptual and physical design and planning of the Peterborough Southern Township.

We have been fortunate in having a client who has demonstrated considerable fortitude, despite the many ecological 'surprises', and has reacted with sensitivity and a willingness to invest time and money in surveys and research work so that an equitable solution could be reached with the statutory authorities. We look forward to continued involvement in implementing the proposed ecological management programme for the township in the future.

Credits

Client: Peterborough Southern Township Ltd. (Hanson plc)

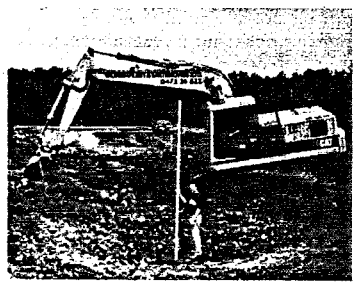
Environmental and engineering consultants: Ove Arup & Partners

Great crested newt ecology:Herpetofauna Consultants International

Masterplanners and landscape architects: Shankland Cox Ltd.

Development consultants: Chester Fanshaw

Ecological survey: The Bedfordshire and Huntingdonshire Wildlife Trust



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Proposed guidelines for the translocation of crested newts *Triturus cristatus* at 'wild' sites.

by Herpetofauna Conservation International Ltd.

Introduction

The moving of crested newts usually results from land-use conflicts concerning their breeding ponds. Newts are sometimes moved when a Local Authority has granted detailed planning permission without prior knowledge of newts being present. A landowner or developer might be expected to take 'reasonable' measures, i.e. enable the capture and removal of newts before a pond is infilled or terrestrial habitat destroyed.

On other occasions, an area may be zoned within a Town Plan, or have outline planning permission granted for its development, prior to newts being detected on the site. This then gives a Local Authority powers to require the owners to retain newt interests within a development on the site as a condition of subsequent detailed planning permission (through for example, a Town & Country Planning Act condition, or Section 52 requirement). If this is not technically possible or desired, the resiting of a breeding pond on the site, or removal of newts to another site, may be considered. To satisfy the UK Nature Conservancy Councils, who issue licences for the handling or translocation of newts, this must be properly carried out.

Since 1981 there have probably been many examples of well-meaning yet unsuccessful translocations of newts to unsuitable sites. It is hard to identify any examples of newt translocations that have clearly worked. This is partly because crested newts may live for 10 years or more. If, for example, the land habitat around a pond is unsuitable for young crested newts it might be 10 years before all the transferred adult newts die, despite apparently good population recruitment observed from their egg-laying and larval metamorphoses. This may be an extreme example, but uncertainty about the fate of translocated colonies and lack of long-term monitoring creates uncertainty about the rate of success in translocation. In response to this problem, some form of simple guidelines are needed to help determine suitable places to put newts. While moving newts might be considered an action that follows failed negotiations or Public Inquiries, the transferring of newts should be carried out properly, and can potentially offer an acceptable conservation measure and in come cases an overall conservation gain. Some basic and relatively well known aspects of crested newt ecology can be used to apply to each circumstance.

Land habitats

Studies have shown that crested newts use several types of habitats. Grassland, scrub and woodland are present around many newt ponds, but the 'naturalness' of a site does not seem to be critical. Several newt sites contain suburban and urban gardens, where rockeries, compost heaps, overgrown greenhouses and other features may offer places for refuge and feeding. Other sites are sparsely vegetated mineral quarries or sand dunes. The density of adult newts has been shown to vary considerably. While newt colonies may rise and fall in numbers from year to year studies have shown that land habitats around a pond may support up to 250 adult crested newts per ha (2.4 acres). The stocking density of a new site should take this into account. A large colony might have enough newts to stock two ponds and a small colony might increase in numbers at a new larger site.

Aquatic habitats

Detailed studies show that newts will use a wide variety of pond-types and sizes and a very wide variety of pond vegetation on which to lay their eggs.

Feeding habitats

Newts will feed more easily in water than on land as they can move more easily and faster to catch invertebrates and amphibian larvae. On land, earthworms and slugs are large food items for which newts may forage. Probably few other prey species are slow enough to be caught.

Predators

Newts do not seem to be disturbed and collected as often by children as in the recent past, perhaps mainly because there are far fewer ponds than 50 years ago. Theoretically, predators ought not to be a threat to the survival of a population. Newt larvae and adult newts can be eaten by predatory fish—trout, pike and perch, for example—to a point of extinction in a pond. Sticklebacks in particular eat newt eggs and larvae. They tend to harass and 'peck' at young adult newts, but may be too small to eat them. In some circumstances, predatory invertebrates such as diving beetles and dragonfly nymphs can cause rapid decreases in numbers of newt larvae and may exclude newts from certain types of ponds. The larvae of crested newts are larger and reported to spend more time in open water than those of smooth or palmate newts. The latter also seem to hide in submerged plants to a greater extent. Crested newt larvae also may take take longer to metamorphose than other newts and so at some sites may be vulnerable for a longer period of time.

In conclusion, each candidate pond for newt introduction should be examined according to the negative indicators listed in Table 1(see page 5). If any of these negative indicators occur, the site is unsuitable until the site is managed to remove the negative indicator.

Crested newt site selection—negative indicators

	NEGATIVE INDICATOR	FURTHER INFORMATION
1.	Absence of other species of amphibians in pond	Common frog and newt tadpoles are prey of crested newts and have several similar habitat requirements. A likely site might have good numbers of frogs and 'commoner' species of newts.*
2.	Predatory fish present in pond	One or more species of stickleback, perch, pike or trout. The presence of excessive densities of other more generalist feeders, e. g. roach and carp can also be harmful.
3.	Wildfowl	Ducks or geese are present at densities of over 4 pairs per ha of open water.
4	Land habitat too small	The accessible land habitats within 300 m of the pond are less than 0.5 ha (1.2 acres)
5.	An unsuitable land barrier is present	A fast flowing river, an A or B grade road or a motorway (unless fenced with amphibian fencing) is within 100 m of the pond. Rivers and roads may confuse and cause death to 'exploring' newts. Other hostile types of land areas may be too close to a potential release pond.
6.	Habitats are unmanaged	The habitats are not and will not be managed in a way sympathetic to newts in the foreseeable future.
7.	Habitats are degraded	Land habitat shows signs of extreme toxicity from pollution, soil compaction or agricultural monoculture domination. The pond habitat is stagnant or completely covered with duckweed. Foul run-off from road or building drains enters the system without a maintained silt trap.
8.	Open public access	The general public may eventually bring fish and other unwanted species to a public open space and uncontrolled private open spaces. Secluded private sites with little or difficult access are best.
9.	Crested newts already in pond	Adding to a newt colony is hardly ever a conservation gain and could cause disruption of the resident population.

* Note: Care should be taken not to 'damage' sites that are of strategic importance to 'commoner' newts or frogs by introducing crested newts.

Translocation of a crested newt *Triturus cristatus* population from a site in Crewe, Cheshire, to a nearby receptor site

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Introduction

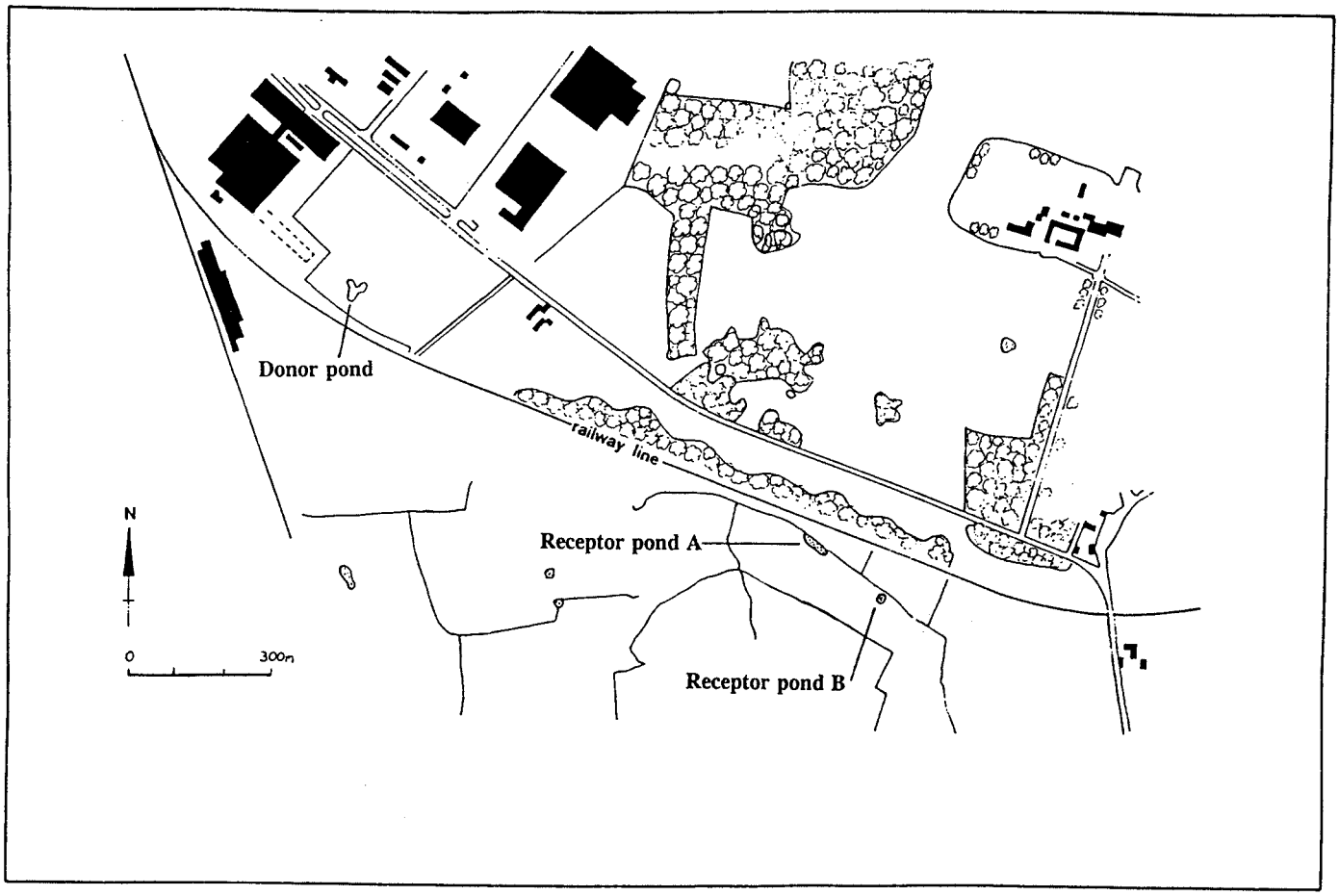
In 1990 Herpetofauna Consultants International were contracted by a steelwork company to assess the status of crested newts *Triturus cristatus* at one of its land holdings on the outskirts of Crewe, in Cheshire. Survey work during 1990 identified a population of crested newts in one of the two ponds on nine hectares of land. The ponds were located on a flat managed grassland with rough grassland/wasteland edges, the site being bounded by a main road, a railway line, industrial development and agricultural land (Map 1). Planning permission for development of the site had been granted by the Borough Council subject to provisions being made for the newt population. Following an agreement negotiated by HCI between the site owners and the Nature Conservancy Council, it was decided to translocate newts from the site, and to attempt to establish the population at a suitable nearby location. This report briefly summarises the survey work, the restoration of the receptor ponds, the capture and transferral of newts, and the monitoring of the release site in the four breeding seasons since the releases (1991-94).

Methods

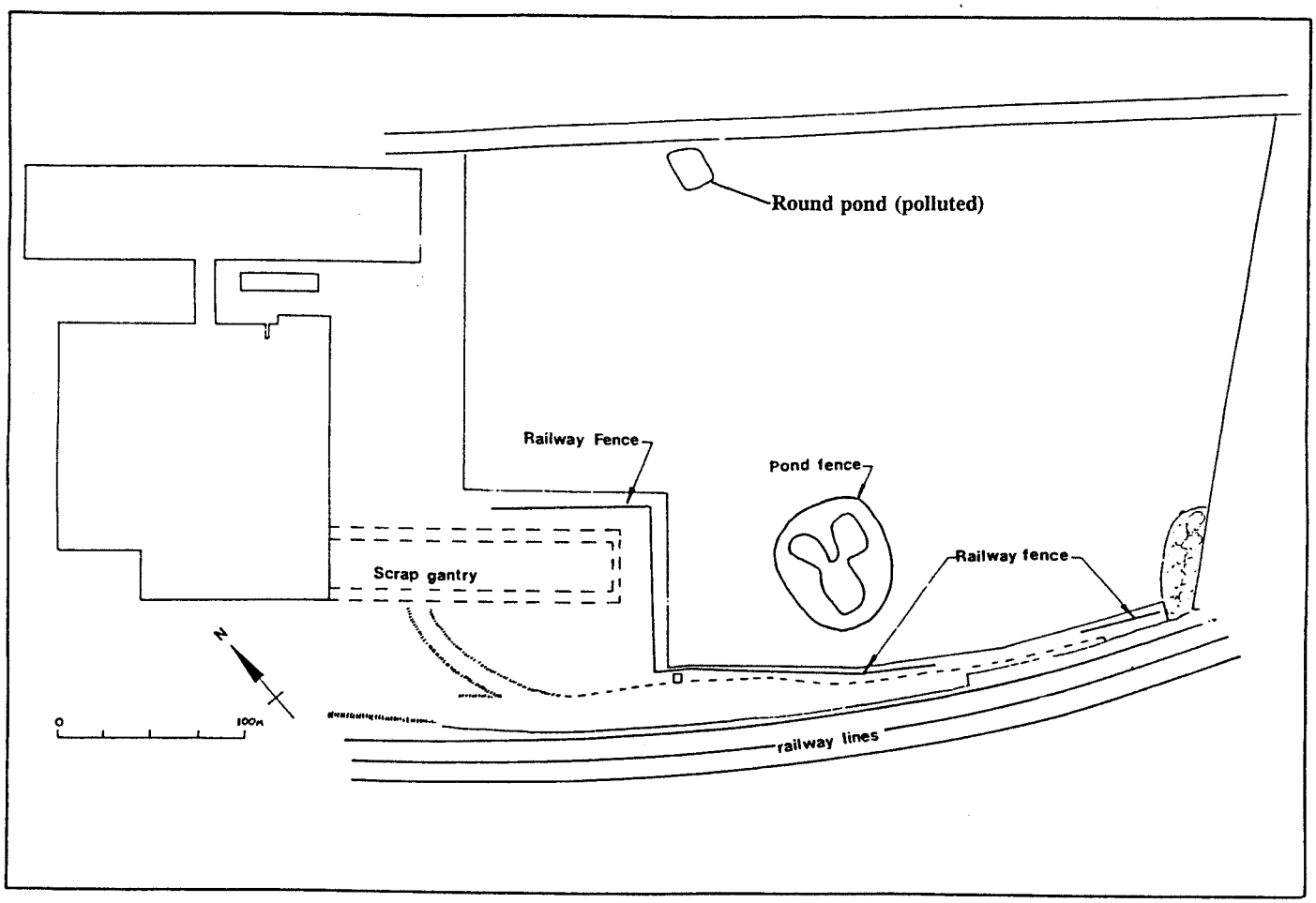
The site held two open, clear water ponds (Map 2) that were surveyed by night-time count and bottle trapping between the end of March and mid-May 1990, and checked for emerging larvae later in the season by hand netting. One pond, close to a main road, was polluted with surface water run-off from the road and contained fish. It was found to contain very low numbers of frogs and smooth newts. The main amphibian pond, and the only pond to contain crested newts, (hereafter referred to as the donor pond) was a three chambered marl pit (Plate 1). Of the three chambers, one was very deep and steep-sided, one was shallow and covered with emergent vegetation, and the third was shallow, silted up and partly shaded, with partial cover of emergent vegetation.

The terrestrial habitat of the site and adjoining land was surveyed for its higher vascular plant species composition, and the pond's aquatic macrophyte community was also identified and mapped. Aquatic macro-invertebrate sampling was carried out in the silt and for each vegetation type within the ponds.

The spring 1990 monitoring revealed a peak crested newt of 101 adults visible by torch counting. Bottle trapping (surface method) over the same period did not seem to reflect the numbers of newts torch counted (Table 1). Torch counting was carried out between 9 pm and midnight, and bottle traps checked between 6 am and 8 am, having been set the previous afternoon. There was a peak of 31 adult smooth newts *Triturus vulgaris* torch counted, but these were mainly recorded in one of the shallow pond chambers, where very few crested newts were seen. Drift fencing and pit-fall bucket sampling survey around the pond in April and May 1990 suggested that newts were moving to and from the wasteland edge of the site nearest the pond, with its deep grass litter layer and brambles. It was not known if newts were crossing about 50 metres of clinker and railway line beyond this, but it was considered unlikely due to its width, difficult surface for newts and oil and sewage staining. No adults or young were seen in this clinker area at night during searches by torch light, even in periods when newts were at their most active and visible above ground elsewhere on site.



Map 1: Location of the 'donor' pond, and the two 'receptor' ponds at the site



Map 2 Location of the drift fences and pit-fall trap systems installed at the donor site

Plate 1: 'Donor Pond': Pond to be lost to allow development (July 1990)

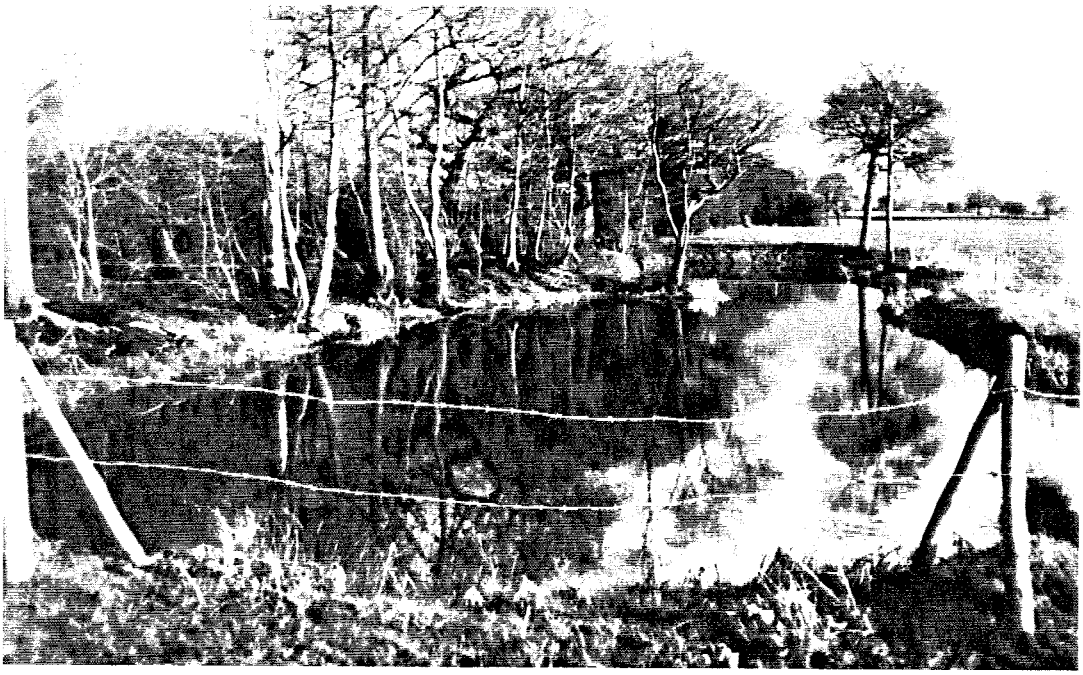


Plate 2: Release Pond A: following restoration work (May 1991)

Table 1 Numbers of *Triturus cristatus* torch counted and bottle trapped at the 'donor' pond between the end of March and mid-May 1990

Date	Torch counted	Bottle trapped
30.03.90	12	No data
04.04.90	1	No data
05.04.90	2	No data
06.04.90	2	9
07.04.90	2	2
08.04.90	No data	1
11.04.90	37	1
12.04.90	37	37
13.04.90	9	24
14.04.90	No data	4
17.04.90	1	0
18.04.90	14	3
19.04.90	8	14
20.04.90	No data	1
28.04.90	101	6
29.04.90	76	30
30.04.90	No data	18
21.05.90	29	4
22.05.90	46	7

Location and renovation of the receptor ponds

A survey of 40 ponds, marked on the 1:25000 scale Ordnance Survey map within a 4 km radius of the donor pond, was undertaken in spring 1990 in order to locate potential receptor ponds. Of the 40 ponds, only 10% (four ponds) still held water: 10 were dry, 10 lost completely, 14 heavily or completely silted up, and two were being filled with building rubble at the time of survey. Two ponds, one completely silted up and one being filled with rubbish, were identified as potential receptor sites for translocated crested newts. Both ponds had suitable terrestrial newt habitat nearby and were n a secluded area on privately owned farmland. The ponds were approximately 1.2 km from the donor site (Map 1). Approval from the Nature Conservancy Council for the translocation of newts was conditional on the complete restoration of the ponds. The farmer owning the ponds agreed to this restoration, to the translocation of crested newts and other pond life, and to the long-term monitoring of the ponds.

Restoration of the ponds was undertaken between 10 and 21 September 1990, five months before amphibian translocation commenced. The bulk of the work involved the removal of about three hundred cubic metres of silt and debris from the base of the ponds. In addition there was some selective removal of shrubs, trees and tree boughs to reduce shading of the ponds. The larger receptor pond (receptor Pond A) (Plate 2) measured approximately 57 m x 11 m after restoration, and the smaller receptor pond (receptor Pond B) 21 m x 13 m. Both ponds have a maximum water depth exceeding 2 m. A hedgerow and ditch runs along the north-east boundary of both ponds. Most of the surrounding land is cattle-grazed pasture.

In order to help create a habitat for crested newts as similar as possible to the original site, vegetation was moved to the receptor ponds from the donor pond. 'Turfs' of variable size and up to 1 m^2 were identified. These contained up to 16 species of marginal plant species and were

carefully dug out and moved in large plastic containers to the restored ponds. The turfs were planted on the shallow pond margins. In addition, many plants were individually planted around the margins of both ponds. Three species of submerged and two species of floating plants were hooked out of the donor pond and placed or planted in deeper areas of the receptor ponds. Samples of invertebrates were collected and transferred to the receptor ponds. This work was carried out between September 1990 and April 1991.

Amphibian trapping

Four techniques were used to capture crested newts and other amphibians at the donor site between 26.02.91 and 07.05.91.

A. Drift Fence and Pit-fall Trapping

Drift fences were constructed of 1000 gauge polythene sheeting, 50 cm high, with the base sunk into the ground to a depth of 10 cm. The fence was supported by wooden stakes placed at 1 m intervals. Pit-fall traps consisted of vertical sided plastic containers, 36 cm in height and 28 cm in diameter. Traps were sunk into the ground in pairs, one each side of the drift fence. Grass and bark were placed in the bottom of each pit-fall trap to provide cover for captured amphibians. Drift fence and pit-fall trap systems were installed in two areas at the donor site (see Map 2) between 20.02.91 and 01.03.91, as detailed below:

i. A fence (175 m in length with 25 pairs of pit-fall traps) was installed, completely encircling the donor pond, in order to intercept newts as they attempted to enter the water at the start of the breeding season. The fence also served to prevent movements of newts away from the breeding pond. The fence was installed 5-10 metres from the edge of the pond.

ii. 350 m of fencing with 22 pairs of pit-fall traps were installed (in two sections) in the rough grassland bordering the railway line and adjacent to the scrap gantry in order to intercept newts moving between hibernation sites and the breeding pond. The fence was also intended to trap any non-breeding individuals utilising this area of terrestrial habitat.

Pit-fall traps were opened for the first time on the evening of 26 February 1991 and trapping continued (normally for four nights each week) until 7 May. Traps were checked for amphibians early each morning. The traps were closed with snap-on lids when not in use.

B. Bottle Trapping

Forty bottle traps were placed around the edges of the donor pond. Traps were checked for newts twice a day, four days per week, both in the morning and in the evening./

C. Netting

Netting of the pond was carried out using a standard Freshwater Biological Association aluminium frame net. Netting was undertaken by torchlight at night, when crested newts are most active.

D. Searching

A few newts were located moving across land at night, on the field surrounding the pond. In addition, some newts were captured under pieces of wood lying adjacent to the railway line to the south-west of the pond. The buried portions of the drift fences were carefully searched for amphibians during the removal of the fences at the end of the trapping period.

Translocation of amphibians

Captured amphibians were transferred to large, ventilated plastic containers, that were part-filled with damp grass to provide cover. Each day's captures were transferred to the receptor ponds on the same day, or on the following morning if caught during the evening/night. Amphibians were released directly into the water at the edges of the ponds. The snout to tip of tail length of all crested newts was recorded prior to their release.

Drainage and infilling of donor pond

Once the majority of crested newts had been caught (determined by the decline in numbers trapped) the donor pond was emptied of water (on 18/19 April 1991) by pumping through a fine 'newt proof' screen into the nearby mains drainage system. The pond base and surrounding vegetation were hand-searched for any remaining amphibians. Silt from the base of the pond was completely removed and spread on part of the adjacent field, from which the topsoil had been stripped. The pond was infilled with clay taken from existing stockpiles on site, and overlaid by a layer of topsoil. At all times care was taken to ensure that the integrity of the drift fence around the pond was maintained, in order to prevent movement of any uncaptured non-breeding newts outside the fence into the immediate vicinity of the pond.

Results

Number, sex ratio, size and population size

A total of 880 crested newts and 1820 smooth newts were captured at the donor site between 26 February and 7 May 1991 (Table 2). Of the crested newts, 492, or 56%, were male (had clearly discernable crests) and about 388, or 44%, thought to be female or immatures (with no crests). The length of the smallest mature male was in the 90-94 mm size bracket (Figure 1). This is consistent with HCI's experience of trapping newts elsewhere where the smallest adult male was 87 mm total length. The smallest adult female was thought to be in the 95-99 mm size category while seven smaller newts in the 70-84 mm size bands were considered to be immatures. Over twice as many smooth newts as crested newts were caught. Ninety percent of the total catch of crested newts, and 95% of the total catch of smooth newts, were caught during the first three weeks (26.02.91 to 16.03.91) of intensive trapping. The highest single day's catch for both species was 27 February, when 180 crested newts and 580 smooth newts were trapped (20% and 32% of the total catch of crested newt and smooth newt respectively).

The pond fence caught over half of the total catch of crested newts (56%), the overwhelming majority of which were trapped on the outer side. The railway fence caught 32% of the total number, most of which were trapped on the southern (railway) side. Bottle trapping and netting within the pond accounted for 12% of the total crested newt capture.

Receptor pond A received approximately twice as many crested newts as receptor pond B.

Table 2 Location of crested newt captures from 27 February to 8 May 1991

	Netted/bottle trapped in pond		Fence around pond				Fence between pond and land habitat				On field		
			Inside		Outside		Pond side		Rail side				
	Male	Fem	Male	Fem	Male	Fem	Male	Fem	Male	Fem	Male	Fem	TOTALS
	80	29	1	1	290	197	19	24	105	132	2	0	880
TOTALS	109		2		487		43		237		2		
	TOTALS		489				280						

The male to female ratio for crested newts caught during 1991 was 1.3 to 1. This compares with the ratio recorded by torch counts in 1990 of 1.9 to 1, and by bottle trapping in 1990 of 0.8 to 1. Since the sex ratio of the newt population at the donor pond is considered to have altered little between the two years, the indication is that for this pond, torch counts were biased in favour of seeing males, and surface bottle trapping at the pond edge favoured the catching of females.

Size distribution

The size distribution (total body length) of 849 crested newts caught during 1991 (481 males and 368 females/immatures) is given in Figure 1. On average, female crested newts were significantly larger than males. The mean snout to tail length for males was 117 mm. If the seven smallest newts (less than or equal to 84 mm) are excluded on the assumption of their being immature, and so of indeterminate sex, the mean length of females was 127 mm.

Population size

The crested newt population at the donor pond was surveyed by torching on 15 occasions between 30 March and 22 May 1990. The maximum count was on 28 April when 101 newts were recorded, with the second highest count of 76 newts on the following night. The total of 880 newts caught at the donor site during spring 1991 was equivalent to 8.7 times the maximum torch count in 1990. Expressed another way, 11.5% of the adult newt population recorded in 1991 was observed by torching on the best survey night in 1990. The number of adult crested newts using a pond have often been generally estimated to be between three and ten times the maximum number recorded by night-time torch survey. For the Crewe pond, the data for 1990 and 1991 show that the multiplier lay towards the upper end of this range.

Monitoring of receptor ponds

Monitoring of the released newts in 1991 (the year of translocation) indicated that the immediate response of the newts was to stay in the receptor ponds. Breeding was very successful in 1991, with hundreds of large mature larvae visible in the autumn. As a result of the extensive planting effort, pond vegetation growth took off in 1991, and in 1992 the pond had a 30%+ cover of emergent and floating vegetation in late spring. In 1992 with clear water quality and good edge visibility, 13% of the released numbers being seen by torch count and a later season count in 1993, with poorer visibility and greater plant cover, recorded 34% of the numbers released. The numbers of larvae observed in 1993 were as high as in 1991.

In 1994 a single night-time torch survey recorded 12% of the numbers released. In this latest count there was a noticeable number of small males present and this appeared to be evidence of the young of the translocated newts present as adults in numbers for the first time. Monitoring results are shown in Table 3.

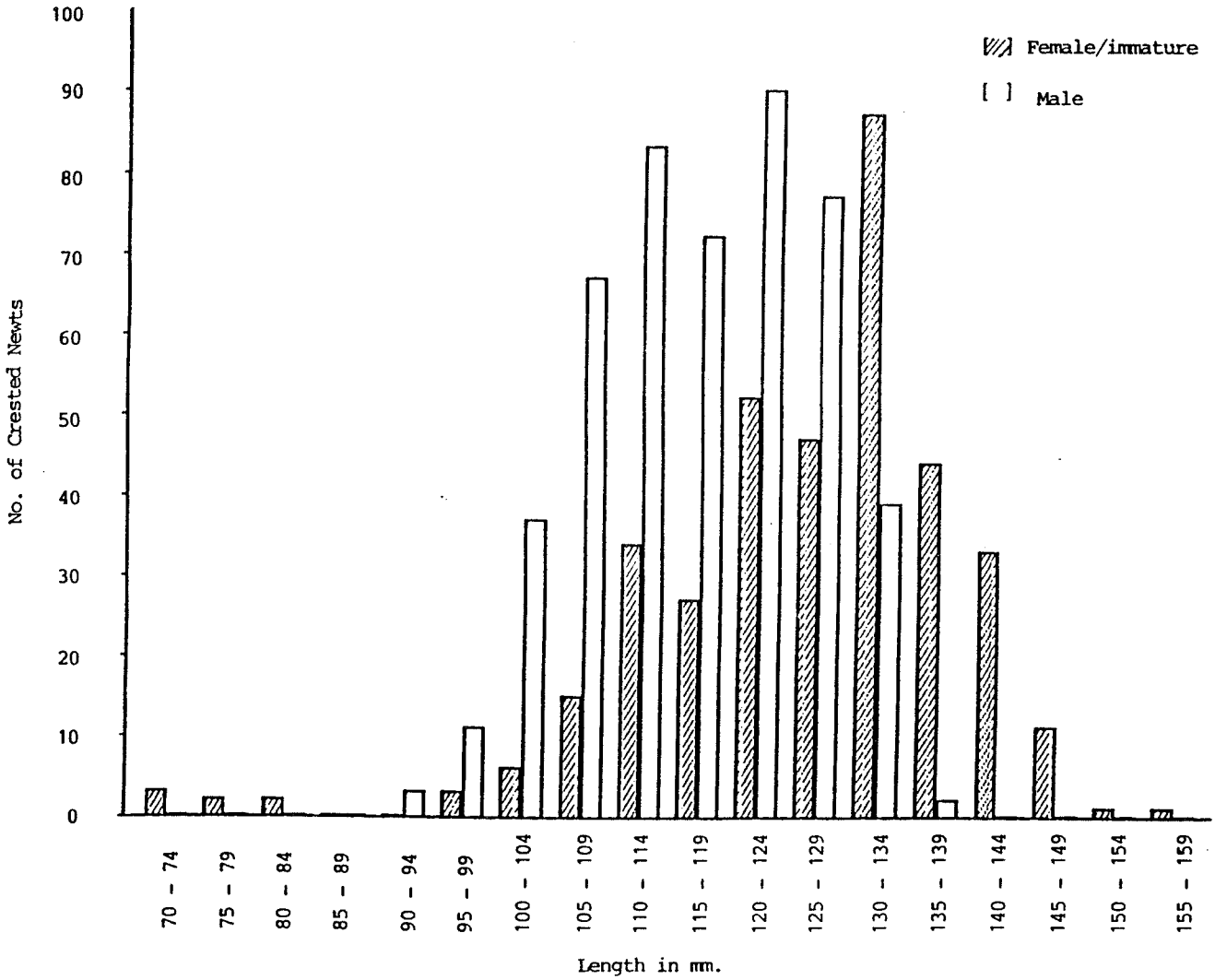


Figure 1: **Lengths of crested newts *Triturus cristatus* translocated from the donor pond in 1991; all measured captures with intact tails. n = 849**

Table 3 Numbers of crested newts recorded during monitoring at the receptor ponds, 1991-1994.

Date	Pond	Crested newt count					No. newts released to date	No. newts counted as % of released
		Male	F & I	Undet	Totals			
13.3.91	Receptor pond A	64	34	0	98	177	597	29.6%
	Receptor pond B	67	12	0	79			
21.3.91	Receptor pond A	5	11	1	17	18	784	2.3%
	Receptor pond B	1	0	0	1			
11.4.91	Receptor pond A	6	2	0	8	22	803	2.7%
	Receptor pond B	8	6	0	14			
29.4.91	Receptor pond A	89	31	3	123	141	843	16.7%
	Receptor pond B	11	7	0	18			
12.7.91	Receptor pond A	-	-	-	62	96	880	11.0%
	Receptor pond B	-	-	-	34			
23.3.92	Receptor pond A	60	21	-	81	113	880	13.0%
	Receptor pond B	31	1	-	32			
* 10.6.93	Receptor pond A	5	7	8	20	30	880	3.4%
	Receptor pond B	1	0	0	1			
10.4.94	Receptor pond A	53	29	0	82	107	880	12.2%
	Receptor pond B	18	7	0	25			

Where: F&I = female and immature; undet = undetermined

* Pond difficult to torch survey because of lateness of season and extensive growth of marginal, emergent, floating and submerged plants.

Discussion

Over-wintering and catch efficiency

The percentage of the total crested newt catch trapped at each location suggests that the majority of the population over-wintered some distance from the pond. 88% of all crested newts trapped were outside the fence encircling the pond. The remaining 12% either:

i. Over-wintered in the rough grassland in the immediate vicinity of the pond edge, or in the pond itself.

ii. Moved into the pond from outside areas prior to the erection of drift fencing (20.02.91 to 22.02.91).

iii. Moved over or under the drift fencing after it was installed.

Of these options (i) and (iii) are the more likely. Weather conditions over the weeks prior to fence installation were severe, with snow and persistent frosts, and it is very unlikely that any movement of newts would have occurred over this period. Of the newts caught outside the pond fence, the most likely over-wintering area was in the rank grassland alongside the railway line and adjacent to the scrap gantry. At night we watched crested newts try to climb the fence but none managed to

lift themselves off the ground. At the base of the fence, in the heavy clay conditions, some newts squeezed into gaps, and a few, but not many, newts may have got under the fence.

The intensity and the timing of the catching effort in 1991 has made it likely that the great majority of the crested newt population will have been captured. However, it is inevitable that a small proportion of non-breeding newts and immatures will have remained un-trapped away from the pond. Inside the pond fence it was considered that 75% of the amphibians had been captured.

Population size

The translocation of crested newts at this site suggests that the ratio of adult newts torch counted during peak activity to adult newts present in the population fell within the 10% to 33% model that has been used by statutory bodies as a guideline to population size. The subsequent spring breeding season peak counts of crested newts at the release sites in spring has resulted in 17%, 13% and 12% of the presumed adult population being counted. This adds further support to the model that is used to assess population size in conditions where torch counting is practicable.

Absence of immature newts and implications

At other sites in Britain, where HCI has trapped on land habitats, it has been possible to catch large numbers of newly metamorphosed newts dispersing from their breeding ponds in the autumn. However, the number of that cohort caught on land drops dramatically the following spring suggesting high over-wintering losses. For such a relatively long lived vertebrate with apparently few predators (although grass snakes were feeding on adult crested newts at the Crewe site) a constant annual recruitment might be anticipated. This pond had a large crested newt and smooth newt population and it was felt (but not proven) that the adult crested newt population was depending on the smooth newts as their principal pray, whilst in the pond. Few smooth newts were ever seen in the densely occupied crested newt open water areas, perhaps for this reason. Many crested newt and smooth newt larvae would have been easily available prey for both species adults in the summer and autumn. We could not be sure how much recruitment there was at this deep marl pit pond in 1990 but there was little evidence of any large maturing larvae or late summer/autumn emergence, suggesting it to be very low. This may have been the result of the dry ground conditions that occurred from 1987-1989 making it more difficult for adult newts to move and feed on land with a consequential increase in intra and inter congeneric predation. This makes us wonder if this may be evidence that crested newts can have low or high annual recruitment as a result of adult numbers in a pond in late summer. If over-wintering losses of newly metamorphosed newts are so high, then numbers of immature newts may be relatively low. This may explain what was apparent at this site: a normal-size distribution adult population unsupported by high numbers of young. One other alternative is that the young mature rapidly so that a proportion breed when less than two years old and a few even when less than one year old. While our data from elsewhere suggests that this may be possible at some sites (for at least a proportion of a cohort) it would produce a larger number of young adults, something that is not markedly seen in the size distribution data. This may be worth further research.

Conclusion

Our preliminary conclusion is that in the short term crested newts may survive and breed at relocation sites as long as very careful attention to detail is taken. The long-term monitoring of release sites will be important to determine the longer term needs.

The data gathered was the result of this (destructive) method, that would not be possible at a non-threatened crested newt locality. It demonstrates how mitigation programmes can be used to examine newt population ecology.

Acknowledgements

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Case study: Lomax Brow: Great Crested Newt Project

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Background

The proposed Lomax (Revised) Opencast Coal Site is situated to the north west of Manchester. It extends to 441 ha. Eighty seven ponds occur in and around the site and forty four ponds occur within its boundary.

The impact of site working on great crested newts (GCN) was identified as one of the main reasons for refusal of proposals for a larger opencast coal site at a Public Inquiry in 1987. Further research, in consultation with the Nature Conservancy Council (now English Nature), into the problems of translocating GCN populations and successfully re-establishing them, was recommended by the Secretary of State (Middleton, 1988).

An Amphibian Conservation Report for the proposed Lomax (Revised) Site was prepared by Humphries Rowell Associates at the end of 1990 (Humphries, Horton & Oldham, 1991). It proposes a programme of interception and transfer to three Conservation Areas. Other unaffected ponds would be managed for amphibians. It also includes a draft restoration scheme.

A pilot project at Lomax Brow to test the proposals, covering about one third of the revised site, was suggested by the mineral planning authority. This suggestion was supported by the Nature Conservancy Council.

Objectives

The pilot project was set up in the winter of 1990/1991 with objectives of carrying out the following and monitoring the effects:

i. Rescue a population of GCN from ponds which would be affected by development

ii. Transfer the population to a specially prepared Conservation Area (CA)

iii. Retain a healthy population of GCN within the CA for future recolonisation of the restored site

Stages of the pilot project

There were three stages to the pilot project:

i. Advance planning and setting up the project

ii. Interception of GCN at existing ponds

iii. Monitoring the GCN population in the CA

Stage I: Advance planning & setting up the project

As part of the preparation for the Amphibian Conservation Report, ponds in the area of the proposed Lomax site were surveyed over a three year period from 1987 to 1990. All ponds

affected by the proposals were identified, along with those that supported GCN. The latter were classed as Category A ponds. Ponds without breeding GCN were classed as Category B. A site for the Lomax Brow Conservation Area (CA) was also identified. Its location is shown on Map 1.

The CA comprised 5 ha of pasture land, including existing hedgerows, and three existing permanent ponds (Ponds 7, 8 & 16) and two existing seasonal ponds. It was stock fenced to exclude grazing animals in Winter 1990/1991, and a newt proof fence was constructed just inside the stock fence. Pitfall traps were placed on both sides of the newt proof fence. Trees and shrubs were planted, and refugia for hibernation were constructed.

Three new ponds were constructed (Ponds L1, L2 & L3). As an experiment into design of new ponds for GCN, different amounts of aquatic vegetation and invertebrates from local sources were introduced into each pond as follows:

Pond L1: No invertebrates or vegetation

Pond L2: Invertebrates and two thirds vegetation cover

Pond L3: Invertebrates and one third vegetation cover

Seven Category A ponds in the area of the pilot project (Map 1) were interception fenced, with pitfall traps around the outside. This work was completed by the end of January 1991. Category B ponds, ie. those without breeding GCN, were not interception fenced.

Stage II: Interception of GCN at existing ponds

1. The Interception Programme

The pilot project involved an Interception Programme to capture GCN each year from 1991 to 1993. GCN were intercepted on the outside of the CA fence, and at the interception fences around the Category A ponds in each Spring. Bottle trapping and netting of Category A ponds were also carried out. The seven Category B ponds were also screened for GCN by torching, netting and bottle trapping.

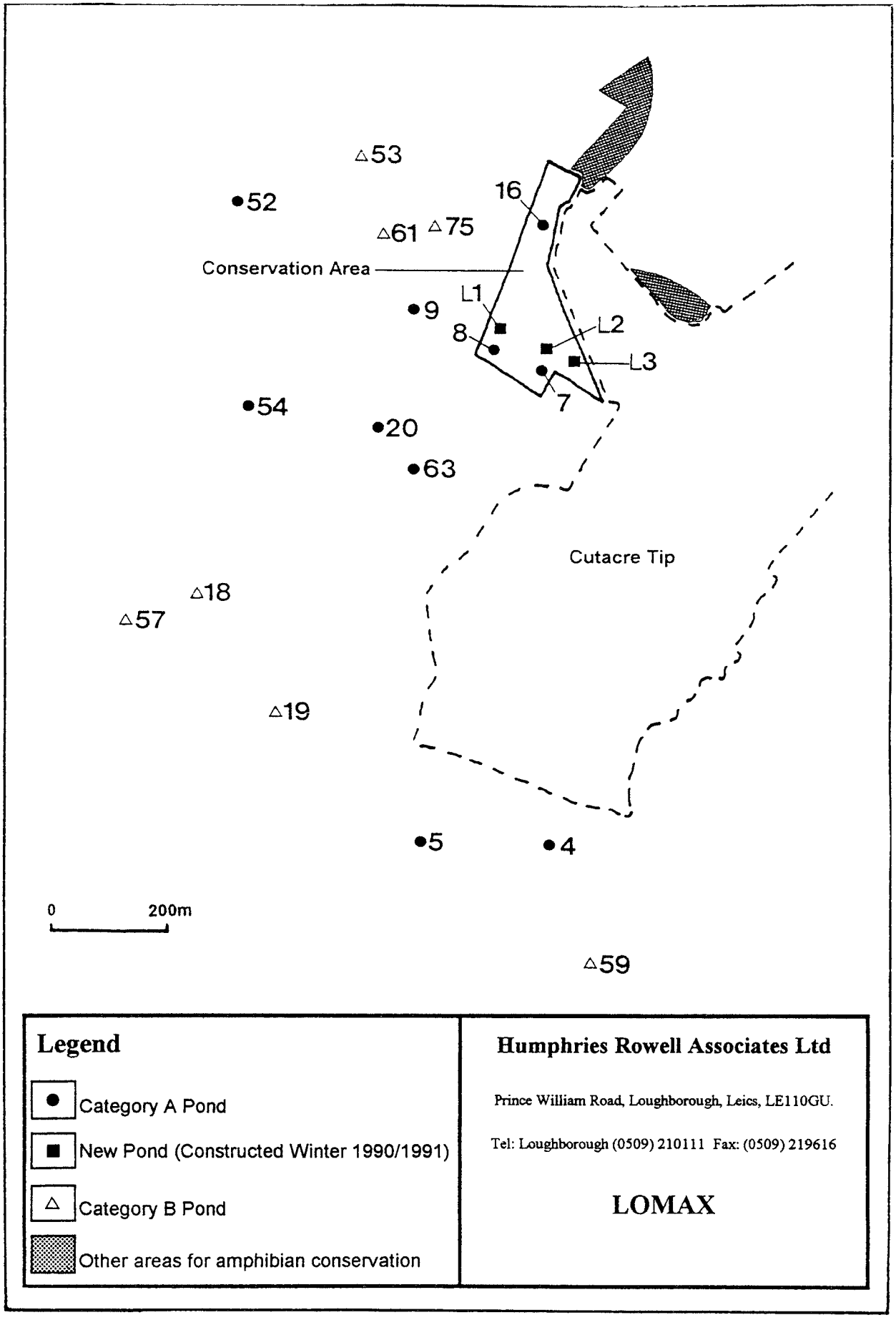
2. Comparison of Torching/Netting & Interception Figures

Between 1987 and 1990 the ponds within the proposed site had been checked for GCN both by Humphries Rowell Associates, and others including the Lancashire Wildlife Trust Newt Group, using a number of methods. Table 1 shows the maximum number of animals recorded at any one occasion by torching or netting. This number is compared with that recorded in the first year of the Interception Programme. It was only at the start of the Interception Programme that Pond 54 was clearly shown to have a much larger population than the other Category A ponds.

3. Number of GCN Captures in Each Year

Table 2 shows the numbers of GCN caught in each year of the Interception Programme. The first year of interception appears to have caused a considerable drop in the population at the interception ponds, although only slightly fewer GCN were caught on the outside of the CA fence in 1992 compared with 1991. No GCN were caught at the Category B ponds in the first year. The small number caught subsequently appear to be vagrants.

In 1993 the numbers caught were higher than in 1992, although they remained lower than in 1991. The numbers captured on the outside of the CA fence increased.



Map 1: Location of Conservation Area and Ponds at the Limax Brow Pilot Project

Table 1 Comparison of netting/torching and interception fencing

Cat. A Ponds	Max. nos. from torching or netting 1987-1990	1991 Interception Programme			
		Male	Female	Juv.	Total
4	3	31	32	7	**70**
5	1	24	16	4	**44**
9	1	16	14	8	**38**
20	1	35	20	2	**57**
52	0	17	7	15	**39**
54	6	151	135	98	**384**
63	0	19	42	2	**63**

Table 2 Number of GCN captures in each year

Site	1991	1992	1993
Category A ponds	695	395	395
Outside CA fence	118	98	225
Category B ponds	0	8	5
Total	**813**	**501**	**625**

Note: The Category A Ponds are 4, 5, 9, 20, 52, 54 & 63
The Category B ponds are 18, 19, 53,57, 59, 61 & 75

The belly patterns of all GCN captured were photocopied. Matching of an initial sample of GCN's belly patterns by De Montfort University shows that some GCN which were translocated into the CA in 1991, were recaught outside the CA in 1992 (Oldham, 1993). A higher incidence of escapes is likely between 1992 and 1993 as the CA fence began to break down in Autumn 1992, due to severe weather and degradation due to sunlight. The fence was replaced during the following Winter.

4. Design of Fence

The CA fence was made of 1000 gsm builder's plastic membrane, backed with chicken wire to the outside. It had an overhang at the top, and it extended at least 10 cm underground with a lip of around 15 cm, to help prevent escapes of GCN from the CA. The construction is typical of newt-proof fences.

A UV-stable membrane such as Monarflex Blackline 500 should last longer and reduce the problems of breakdown. The initial cost of such a membrane would be higher. Other improvements to fence design are being investigated.

Stage III: Monitoring the GCN population within the CA

1. Monitoring of Numbers Within the CA

In 1992 and 1993, GCN within the CA were intensively trapped by the use of pitfalls on the inside of the CA fence and on the outside of the internal fences around the CA ponds. Ponds were also bottle trapped before any GCN were transferred to them. The results are shown in Table 3. This table also shows the cumulative number of GCN introduced to the ponds.

Table 3 Number of GCN recorded in each year

	Interception Captures				
	1991 Transferred to CA	**1992 Recorded Inside CA**	**1992 Transferred to CA**	**1993 Recorded Inside CA**	**1993 Transferred to CA**
Total	813	473	250	892	625
Accumulative Total	**813**	*	**1063**	*	**1688**

Four hundred and seventy three GCN were captured within the CA in 1992, while in 1993 this rose to eight hundred and ninety two. It therefore appears that a significant population of GCN is being maintained within the CA, despite escapes. The population within the CA also provides a representative sample to monitor the health of the population from year to year by means of mass and length comparisons.

2. Mean Masses of GCN Pitfall Captures

Mass and length were recorded for every GCN captured. Table 4 shows the average mass of pitfall captured GCN from inside or outside the CA in the three seasons. A slight decline in average mass is apparent between the adult GCN captured in the 1991 Interception Programme and those captured inside or outside the CA in 1992. This decrease may be largely due to natural yearly fluctuations in mass, as it affected both GCN outside and inside the CA. Captures of GCN both inside and outside the CA generally appeared healthy in each year.

Table 4 Mean Masses of GCN Pitfall Captures (in grams)

	Interception Captures				
	1991 Outside CA	**1992 Inside CA**	**1992 Transferred to CA**	**1993 Recorded Inside CA**	**1993 Transferred to CA**
Males	**7.01**	**6.44**	**6.29**	**6.26**	**6.50**
Females	9.25	8.09	8.72	7.96	8.40
Juveniles	2.59	2.61	2.86	2.69	2.87

3. **CA Metamorph Production**

Metamorphs (ie. young GCN produced from the pond that year) were intercepted leaving the three new CA ponds in each year, and the three permanent original CA ponds in 1992 and 1993. The numbers of metamorphs captured is shown in Table 5.

Table 5 Number of Metamorphs Intercepted Leaving CA Ponds

Pond	1991	1992	1993
L1	59	223	61
L2	13	28	1
L3	63	55	42
7	No count	50	21
8	No count	197	56
16	No count	14	1

It appears that 1992 was the best year for metamorph production, and 1993 the worst. Large year to year variations in GCN metamorph production have been recorded elsewhere (Oldham & Nicholson, 1986).

Certain ponds seem to produce consistently higher numbers of metamorphs. It is interesting to note that Pond L1, which had no deliberate planting of vegetation or addition of invertebrates, was the most productive of the new ponds in 1992 and 1993. It also appears as productive as any of the original ponds. Pond L1, however, tended to produce relatively light metamorphs.

Predation of metamorphs by fish is thought likely to severely reduce metamorph production at several ponds. Local anglers are thought to have introduced fish to at least two of the new ponds, but Pond L1 has been largely free of fish. All ponds have been electrofished and netted by the NRA during the winters of 1991/1992 and 1992/1993.

Artificial egg laying substrate, comprising thin plastic strips attached to wire netting, was provided in all the new ponds, with most being added to Pond L1. Large numbers of GCN eggs were laid on this artificial substrate. Artificial substrates can be easily moved after egg laying has taken place. This could be used to introduce GCN to new ponds on a restored site.

Conclusions

i. The interception method used was successful in capturing a significant number of GCN from each pond.

ii. A large population of GCN has been maintained in a healthy condition within the CA.

iii. GCN have successfully bred and produced metamorphs from new ponds constructed the previous winter.

iv. Metamorph production can occur in new ponds provided egg laying substrate is present and there are few predators. Invertebrate production does not appear to limit metamorph production in lowland mesotrophic ponds.

v. GCN escaping from the CA is identified as the main problem.

vi. Eggs laid on artificial egg laying substrate in the CA ponds can be used to introduce GCN to new ponds on a restored site.

vii. Advance planning, including amphibian surveys of all ponds, has been instrumental in the success of the project.

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Questions and discussion - Session three

Bob Bray: I wonder whether the way in which ponds and habitats are created at present and the way that great crested newts are being managed is simply a reflection of the fact that we are either lacking information or are not confident that they will work. When we create ponds we create 'super ponds' and these sorts of methodologies are being based on fail-safe techniques. One of the things that seem to come from Philip Horton's talk is that the newts seem to be very much more robust than perhaps we had hitherto thought; they do seem to be able to cope with less than optimal conditions. I don't know if other people have found great crested newts behaving in that way.

Philip Horton: May I comment further on what I said before. We have surveyed an awful lot of very unlikely sites for British Coal and found great crested newts in them. These sites included compounded water in a disused railway cutting which was red with ochre (we found six great crested newts in there) and some old water treatment works from a previous deep mine. These were concrete containers with vertical sides. As a newt surveyor you might follow Robin's techniques of looking for nice clusters of ponds but if you look in other less likely ponds it is amazing how often newts turn up.

Simon Pickering: You say they turn up in unusual places; are they breeding sites or are they just being used by newts?

Philip Horton: Unfortunately we mostly just find adults, so we don't know. They look likely as breeding places and they are the only ponds around. I can't say definitely that they are breeding ponds though.

Simon Pickering: I wish to ask you more details about your fencing. You seem to have a great problem here. More generally there is a problem with fencing. You said you were using a plastic fencing with a wire backing and dug in?

Philip Horton: Yes, that's right, the plastic and wire is dug in to about 10 cm with a 10 cm lip.

Simon Pickering: Are they going under or going over the fence?

Philip Horton: We haven't seen them; some people say over, some people say under.

Alan Stopher: The top of the fence is turned over to give a lip at the top. This would make it more difficult for them to go over.

Philip Horton: My theory is that most go under. One reason for saying this is that where we have repaired bits of the fence and pulled it up from the ground, we found a great crested newt hibernating underneath. When you think of the places that you find crested newts hibernating, they are very rugged, bits of rubble which you couldn't dig into easily and yet beneath it there could be a party of great crested newts. Digging in soil to go under a fence a foot or so is probably quite within their capability. I wonder, also, whether small mammals are involved in making tunnels under fences.

Henry Arnold: What is significant is that whatever method they are using animals are getting passed the fences. If fences are to be effective one must establish how they are getting through them and whether it's possible to circumvent this. Obviously they can burrow quite successfully. It may be partly a result of the disturbed ground from digging-in the fences.

Philip Horton: The digging of the fence does create good conditions for burrowing.

Henry Arnold: Perhaps without driving sheet steel directly into the ground without any digging, it might be impossible to keep them in.

Tom Langton: I would like to come back on both those points. Regarding Bob Bray's first point - we tend to look upon the construction of new ponds not only within the context of crested newts. Where possible in construction, we try to mimic what has been lost. That is not always possible, but it is in some cases. For example, in one place where we constructed 18 ponds, we effectively mimicked brickworks ponds which involved digging big linear trenches of the types that are left behind from the brick workings. We feel that when you are translocating, effectively you are transferring a community. In some cases it is very important for other species, for example, the invertebrates and plants. It can be quite surprising when you look closely to see what is going to be lost when a pond is going to be filled in. So I would say that it is very important that, you look at the entire community when you are constructing or manipulating a great crested newt habitat or population.

On the fencing issue, HCI has put in a lot of fencing; about 4 km length over the last five years. Completely newt proof fencing is extremely difficult to construct. Putting in a shoddy fence where you don't compact back the ground against the edge of the plastic means that the newts can meet the fence and go straight down and possible under. Really you need to put the fences to deeper depths than people have mentioned today and (although we haven't actually done this) I would suspect getting a soil compactor would also be useful. The soil type and the time of year all play a role. If you are cutting up lumpy clay, it can be incredibly difficult to pack it back. You almost need a vibrating plate to go along the edge to pack it all back down. In fact at one site at the moment, which is a railway site where we can't dig because of buried wires, we are thinking of laying a thin skin of concrete along the bottom of the plastic to seal it off. I think we should pay more attention to standardising the methodology. If you are installing several hundreds of metres of fencing, it's probably worth spending the extra pound per metre to get a good job done. Otherwise you might find you end up with an unknown and possible high 'leakage' of newts that may seriously jeopardise a project.

Close of session for tea.

Case study: A programme of habitat creation and great crested newt introduction to restored opencast land for British Coal Opencast

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Summary

- Great crested newts are known to occur on British Coal Opencast land.
- New ponds and terrestrial habitat were created for the introduction of great crested news to restored opencast land.
- Management plans were prepared for long term care of the newly created habitat.
- Great crested newt eggs were collected and reared in aquaria for release into newly created ponds during 1991, 1992 and 1993.
- New ponds were monitored for newt occurrence through 1991, 1992 and 1993.
- The return of adult newts and confirmed breeding in new ponds as a probable result of tadpole introduction is discussed as a technique for great crested newt conservation.

Introduction

British Coal Opencast has been responsible for major land redevelopment in recent years. The extraction of coal by opencast methods eliminates existing terrestrial features and requires a complete reinstatement of the landscape. On a number of occasions in the past great crested newts have been found on potential opencast sites. The planning process has highlighted the problems of great crested newt viability following development. Appropriate measures to foster existing populations and the effectiveness of translocation have not been fully evaluated.

This project developed from a small scale rearing and introduction of great crested newt tadpoles into garden ponds undertaken by the author over a 15 year period.

Project aims

1. To create new habitat on restored opencast land suitable for great crested newts.
2. To establish great crested newts on restored opencast land where the animal is absent or cannot easily colonise from an adjacent population.
3. To develop a technique for introduction of great crested newts to restored opencast land using egg collection from existing newt ponds and rearing tadpoles to pre-metamorphosis condition.
4. To monitor the establishment of great crested newts on Restored Opencast land.

Survey and site selection

Site selection for future tadpole release was determined initially by map survey of restored opencast land and then with local knowledge of the Staffordshire area and site survey. Sites were selected with few or no adjacent ponds. All ponds near the proposed introduction sites were night torched to confirm newt presence as far as possible.

Donor pond selection on British Coal Opencast land was attempted by night torching suitable ponds. No great crested newt populations were identified locally, even where known records existed for the animal. A known garden population of great crested newts in Staffordshire was used as the donor pond for egg collection. Night torching was supplemented in Year Two and Three of the project by bottle trapping and in Year Three by netting for tadpoles.

Habitat creation

Three sites were eventually selected for tadpole introduction and habitat creation.

Site 1

Site 1 is an elevated plateau recently restored with three recently excavated ponds, two in excess of 30m x 20m and one 25m x 15m approximately. There is a mature pond off the plateau area which was night torched twice with negative results. During the project a silt trap was constructed adjacent to the mature pond (an old silt lagoon is sited in the SW corner of the site and was included in the survey).

The three new ponds had been created as shallow bird scrapes and were therefore deepened in part to 1.5 m approximately to provide refuge areas for adult newts. Due to the inhospitable nature of the plateau only the mature pond was stocked in Year One. All new ponds received submerged and marginal water plants, the plateau area itself being planted with native shrub corridors and a wildflower grass mix.

A Site Maintenance Plan was prepared by Gloucestershire Wildlife Management Ltd which is the management part of the then Gloucestershire Trust for Nature Conservation (now Gloucestershire Wildlife Trust).

Site 2

Site 2 is recently restored flat ground largely planted with trees to become part of the West Midlands Community Forest. Drainage ditches cross the site which support a common frog population and empty into a silt trap pond. A small remnant of mature woodland survives on the site.

Two new ponds were created in 1991 to a specification based on current opinion. The larger pond was excavated on a ditch line to gain water quickly whilst the smaller was isolated to allow the possible drying out in the future.

Due to an extremely dry spring only the larger of the ponds and the silt trap were stocked during 1991.

A site Maintenance Plan was prepared as for Site 1.

Site 3

Site 3 contains a large pond created in 1990 under the guidance of the County Ecologist (Staffordshire). It is larger than 30-20 m with a variable diameter due to very gently shelving edges. This pond was stocked in 1991.

In 1992 the pond was found to contain an existing population of great crested newts and was therefore omitted from the programme.

Pond Specification

Ponds were created in clay subsoil which is used to cap restored opencast land. The optimum size taken was 30m x 20m with a 1.5 m deep refuge area to the centre of the pond. Pond edges were designed as 450-750 mm deep shelves to allow display and egg laying areas.

Ponds were planted with submerged aquatic and pond edge plants although natural colonisation by pondweed and water crowfoot in particular was rapid.

Species list (priority introductions recommended in consultation with Gloucestershire Wildlife Management Ltd).

Floating sweet grass	*Glyceria fluitans*
Water-cress	*Nasturtium officinale*
Water starwort	*Callitriche* sp
Spiked water-milfoil	*Myriophyllum spicatum*
Common water-crowfoot	*Ranunculus aquatilis*
Broad-leaved pondweed	*Potamogeton natans*
Water forget-me-not	*Myosotis scorpioides*
Water mint	*Mentha aquatica*

Terrestrial habitat

Important vegetation types adjacent to ponds to include the following were designed and implemented during the project.

- Scrub/woodland
- Rough grassland
- Ditches and hedges as corridors
- Tree and shrub clumps on north edge of newt ponds.

Great crested newt egg collection - tadpole rearing & release 1991

Egg collection

Great crested newt eggs were collected by placing 1 cm wide plastic strips (black plastic bin liner quality) in the donor pond. Female great crested newt actively select these strips and lay eggs individually gluing the strips in concertina fashion. At least 50 eggs may be laid on a single 1 cm wide strip approximately 450 mm long. There is naturally a 50% mortality of great crested newt eggs and so 1,000 hatched young come from 40 strips.

The donor pond in this case had a high population of great crested newts and female newts could be observed 'queuing' to lay on the strips due to limited natural egg laying substrate.

Tadpole rearing

Tadpole rearing set-up: Twenty glass aquariums 36" x 12" x 13" high were used to accommodate up to 50 tadpoles per tank. There were two spare aquariums for water conditioning food storage and other functions. Aquariums were placed on polystyrene tiles on strong tables. A wooden frame was constructed to hold fluorescent light tubes approximately 12" (300 mm) from the top of the aquariums.

A single full light spectrum fluorescent tube (Interpret Triton 30 watts 1.0 diameter) was installed over two aquaria. Each aquarium was supplied with an air pump and air line to oxygenate and agitate the water. The lights were connected to a timer switch set to mirror day length and adjusted through the rearing period. The aquaria were set up next to windows fitted with translucent blinds.

The aquaria were installed and filled with tap water, 11 March 1991, and egg strips added 11 April 1991 (two per aquarium).

Initial tadpole hatching and mortality: Within five days of adding the strips, eggs hatched. Large quantities of *Daphnia* were added to aquaria which were only slightly green. By Monday 15 April, nearly 300 tadpoles had hatched and by Friday 19 April, over 1,000 tadpoles had hatched. *Daphnia* were added.

During weekend 20-21 April, over 800 tadpoles died. This affected all aquaria except No. 18 which was very green and contained only 12 tadpoles.

After a further seven days all tadpoles were dead except 12 in aquarium No. 18.

All aquaria were set up identically and therefore reasons for failure were considered to be either:

a. conditioning of water inadequate;

b. *Daphnia* added too early and competed for microscopic food of tadpoles.

Second tadpole hatching and rearing:

Aquaria were set up as follows:

1. Four aquaria were set up with fresh tap water and added tropical fish flake food to promote microscopic organisms. Shop source waterweed *Elodea crispa* was added.

2. Four were left with existing water and waterweed added from garden pond with tropical fish flake food added.

3. Four were set up with water from local pond and waterweed from pond.

4. Four were set up with fresh tap water and waterweed from another local pond.

5. Four were left as existing including aquarium No. 18 with remaining newt tadpoles.

New egg strips (two per aquarium) were added 16 May 1991.

Predators hatched from pond sources; although waterweed was constantly removed predation on tadpoles was still observed. Water snails *Planorbis* sp and *Lymnaea* sp were observed on egg strips, possibly predating eggs.

On Monday 20 May, 90% waterweed was removed to aid the counting of tadpoles. Screened *Daphnia* (to remove large individuals) was added to aquaria during the week in small amounts. Approximately 300 tadpoles were observed on Friday 24 May. *Tubifex* worms were added to aquarium No. 18; tadpoles were observed to feed on them immediately.

At 40 days old (approximately) larger tadpoles will begin to cannibalise smaller individuals. Food must always be available to tadpoles and size sorting must be undertaken.

By Sunday 2 June, there were 400 tadpoles feeding on bloodworms *Chironomus*, midge larvae, *Tubifex* worms and large *Daphnia*.

Third egg strip batch: As only 400 tadpoles were available for release, a further 10 egg strips were added to eight aquaria; existing tadpoles were removed to the remaining aquaria. 230 tadpoles were raised from the third egg strip batch.

Tadpole release: As tadpoles approached metamorphosis they were selected for release. Tadpoles were netted and transferred to large plastic bags and tied with approximately a 50% water: 50% air ratio. The bags were placed in polystyrene boxes (with a little ice if the weather was hot). At the release site the bags were floated in the pond for a few minutes to equalise temperature prior to release of the tadpoles

Table 1 Great crested newt release numbers 1991

	Site 1	Site 2	Site 2	Site 3
Date	Mature Pond D	New Pond B	Silt Trap C	New Pond
19.06.91	-	27	-	-
16.07.91	121	117	107	-
25.07.91	-	-	-	39
08.08.91	-	-	-	32
09.08.91	10	-	-	-
21.08.91	-	-	-	77
29.08.91	21	-	-	-
30.08.91	-	13	32	-
TOTAL	152	157	139	148

Discussion

Rearing great crested newt tadpoles requires conditioned water to provide microscopic food 3-4 days after hatching. Allow 4-6 weeks with light and a nutrient source (eg tropical fish food flake) for conditioning process.

Small quantities of screened water fleas *Daphnia* should be added only after tadpoles have hatched. Then allow a further 3-4 days. When tadpoles are free swimming screened *Daphnia* should be available at all times. (Note: *Daphnia* are stored in cool and aerated conditions.) At 14 days (approximately) add a small quantity of *Tubifex*. (Note: *Tubifex* must be kept in cold running water. Use a glass fish bowl and large aquarium fish net supported on wooden screen for this. Run a tap vigorously. Wash *Tubifex* which migrate to bottom of bowl and replace in net every other day. *Tubifex* will survive at least seven days).

Tadpoles should be graded at three weeks (approximately). Wooden framed net just smaller than width of aquarium drawn to aquarium end allows easy tadpole management.

Feed bloodworms to tadpoles when large enough to eat them. (Note: Bloodworms can be kept in fridge at warmest setting.)

Costs for food and equipment to rear tadpoles 1991 (596 tadpoles):

Daphnia	£5.00 x 36 gallons	£180.00
Tubifex	£9.20 x 26 pounds	£239.00
Bloodworm	£0.20 x 373 bags	£ 74.60
	TOTAL	£493.60

Equipment installation and service visits excluding personnel to look after rearing aquaria £1845.46

Costs for construction of ponds £2300.00

Time allowed for on-site care: 179 hours.

Great crested newt monitoring 1992 and 1993

All new ponds described in section 4 together with the silt trap at Site 2, the silt trap intercepting water off the plateau at Site 1 and an old silt trap lagoon from coal extraction operation peripheral to the plateau were monitored during 1992.

To obtain a more complete record of great crested newt presence than in 1991 bottle trapping was undertaken as well as night torching. Techniques substantially followed those described in Griffiths (1987).

Results of monitoring during 1992

Generally 10-15 bottle traps were set during early evening to each pond and night torching carried out later the same evening. The following results indicate presence of great crested newt (GCN) male or female, smooth newt (S) male or female and palmate newt (P) male.

Table 2 Ponds surveyed in 1992

DATE	SITE 1						SITE 2		
	A	B Plateau	C	Silt Trap	D Mature Pond	E Lagoon	A Small Pond	B Large Pond	C Silt Trap
16.03.92									
Torch	-	-	-		-	-	1 M (GCN)	-	-
Bottle	-	-	-		-	-	1 M (S)	-	1 M (S)
25.03.92									
Torch	Turbid	Turbid	Turbid		-	1 M (S) 4 F (S)			
Bottle	-	-	-		1 F (S)	2 F (S)			
24.04.92									
Torch	Turbid	Turbid	Turbid		2 F (S)	3 F (S) 5 F (S)			
Bottle	-	-	-		2 F (S) 1 M (S) 1 F (GCN) juv	7 F (S) 9 M (S) 1 M (GCN)			
25.4.92									
Torch							-	-	1 M (GCN) juv
Bottle								F (S)	F (S)
13.05.92									
Torch	-	-	-	-	-	2 M (S) 5 F (S)			
Bottle	-	-	-	2 M (S)* 1 F (GCN) juv	3 M (S) 2 F (S) 1 F (GCN) juv	16 M (S) 6 F (S) 1 M (P) 3 M (GCN)			
14.5.92									
Torch							1 (S)	-	-
Bottle							-	-	1 F (S)

* Silt trap included for first time in sample

Table 3 Great crested newt - tadpole release numbers 1992

DATE	SITE 1					SITE 2		
	A	B Plateau	C	Silt Trap	D Mature Pond	A Small Pond	B Large Pond	C Silt Trap
10.06.92-20.07.93	293	107	200	100	66	243	200	157

Total newts released at Sites 1 and 2:

Site 1 766 newts released
Site 2 600 newts released

Table 4 Ponds surveyed in 1993

DATE	SITE 1						SITE 2		
	A	B Plateau	C	Silt Trap	D Mature Pond	E Lagoon	A Small Pond	B Large Pond	C Silt Trap
10.02.93									
Torch							-	-	-
Bottle							-	- Too early in season	-
20.03.93									
Torch							-	-	-
Bottle							-	- Too early in season	-
20.03.93									
Torch	-	-	-	-	-	-			
Bottle	-	-	-	-	1 M (GCN) 1 M (P)	1 M (GCN)			
28.04.93									
Torch							5 M (GCN) 6 M (S) 5 F (S)	4 M (GCN) 4 M (S) 10 F (S)	
Bottle							10 F (GCN) 6 M (S) 5 F (S)	1 M (GCN) 2 M (S) 7 F (S)	2 M (S)
29.04.93									
Torch	-	-	-	-	1 M (GCN) 2 F (GCN)	-			
Bottle	-	-	-	7 M (GCN) 1 F (GCN) 9 M (S)	3 M (GCN) 1 F (GCN) juv	20 M (S) 19 F (S) 1 M (P)			
08.06.93							2 F (S)	6 F (S)	1 M (S)
							1 F (GCN) 9 M (S) 8 F (S)	1M (GCN) 3 M (S)	
09.06.93									
Torch			Not undertaken due to heavy rain						
Bottle	1 F (GCN)	-	1 M (GCN)	20 M (GCN) 6 F (GCN) 1 M (P)	5 M (GCN) 5 F (GCN)	Not trapped			

Table 5 Great crested newt - tadpole release numbers 1993

DATE	SITE 1					SITE 2		
	A	B Plateau	C	Silt Trap	D Mature Pond	A Small Pond	B Large Pond	C Silt Trap
1993	100	100	100	-	-	75	80	45

Table 6 Great crested newt - tadpole release numbers 1991-1993 inclusive to Site 1 & 2

DATE	SITE 1					SITE 2		
	A	B Plateau	C	Silt Trap	D Mature Pond	A Small Pond	B Large Pond	C Silt Trap
1991-1993	393	207	300	100	217	318	437	350
TOTAL			1217				1105	

Great crested newt monitoring 1993 tadpole survey

Ponds which have shown consistent presence of great crested newts during 1993 were netted during 19 July 1993 to check for presence of great crested newt tadpoles; these are easily distinguished from tadpoles of other British newts.

Each pond was netted by sweeping a fine mesh hand net along the outer edge of marginal vegetation in mid water 10 times for each pond.

Table 7 Great crested newt tadpole survey in 1993

DATE	SITE 1					SITE 2		
	A	B Plateau	C	Silt Trap	D Mature Pond	A Small Pond	B Large Pond	C Silt Trap
19.07.93								
Great crested newt tadpole		Not netted		3	Not netted due to access problem	5	2	Not netted
Smooth newt tadpoles						2	2	

Large fish were observed feeding at the surface in Pond A at Site 1 (ref fish predation).

Discussion of results

Surveying for great crested newts carried out between February and June in any year shows inconsistencies between methods used, the time of year undertaken and weather conditions prevailing when surveying. Design and management of ponds can aid access and visibility by the observer but a more consistent survey method for adult animals would aid comparative work. However, a recognised technique for assessing population density in the pond is the ideal requirement. Bottle traps are relatively easily made using 2 litres plastic drink bottles. A code of practice for counting out and counting in bottles should be observed with a recommendation that red tape is used to highlight cane tops emerging from the pond.

The survey techniques used in this project have identified low populations of great crested newts in various ponds although probably not infallibly so. The apparent increase in adults found in 1993 at Site 1 pond D and the silt trap and Site 2 ponds A and B can be considered circumstantial evidence of a greater than normal expected occurrence of the great crested newt following two years of low counts.

The finding of two adult great crested newts in two ponds on the inhospitable plateau of Site 1 suggests an enhanced colonisation in advance of expected invasion by the 'common' smooth newt.

Habitat creation

Pond construction in spring 1991 provided an adequate resource for pre-metamorphosis tadpoles during June, July and August 1991. However, construction in late summer the previous year would provide optimum conditions for site work and a winter period to fill with water and 'condition' the pond.

The problem of fish predation and other unknown habitat factors can be addressed by creating clusters of ponds to different design criteria which allows periodic drying of ponds and other environmental alternatives for newt colonisation. Pond construction and terrestrial habitat design are standard landscape design techniques which can easily be written into development plans.

Management plans for both ponds and land habitat are standard requirements for the care of development land and can be designed to include amphibians as part of the planning process.

Tadpole rearing procedure

Standard tropical fish keeping equipment which is readily available throughout the country can be used to rear great crested newt tadpoles. A convenient batch size is 1,000 tadpoles in 20 aquaria 36" x 12" x 13" at 50 per aquarium.

The critical stages in tadpole rearing are as follows:

1. Conditioning the water by light and nutrient supplement over a 4-6 week period.

2. Hatching egg strips with minimum predator effects.

3. Commencing feeding with screened *Daphnia* once the egg sac of the tadpole has disappeared and feeding on microscopic life in the water is evident.

4. Constant presence of suitable food items.

5. Size selection to prevent cannibalism.

6. Aeration or water filtering throughout the rearing process.

(Note: Day to day details on rearing can be obtained from the author.)

Return of adult great crested newts to new pond sites

The two sites considered as newt introduction sites show evidence of great crested newt presence in low numbers. Site 1 in particular has a small population centred on the old silt lagoon to the SW corner of the plateau. Site 2 recorded a single male great crested newt in 1992 at pond A and a juvenile in pond C.

In 1992 at Site 1 apart from two juvenile female great crested newts in pond D and a juvenile female in the silt trap all great crested newts were found in the silt lagoon over three visits.

In 1993 at Site 1 a total of 33 great crested newts were found either in the silt trap or the adjacent mature pond over three visits. Two adult great crested newts were found in ponds on the plateau during June.

In 1992 at Site 2 a single male great crested newt was sighted in pond A and a juvenile in pond C.

In 1993 at Site 2, 19 great crested newts were found in ponds A and B.

In 1992 and 1993 the same survey techniques of night torching and bottle trapping were employed.

The peak of newt frequency coincides with the third year following great crested newt tadpole release.

Incidental observations

Rearing newt tadpoles artificially gives a head start of up to three months into the terrestrial habitat. The effects of this on the young newts are not known.

Pond C at Site 2 has always contained a large population of 3-spined sticklebacks. Although an approximately equal number of newt tadpoles were released in this pond during the three year period, no adult great crested newts were recorded at pond C during 1993 although 19 were found at ponds A and B. The possibility of avoidance of ponds with fish by great crested newts could be investigated as a research topic in view of the major predation effect on great crested newt tadpoles by fish.

The observation of a single great crested newt in each of ponds A and C at Site 1 in advance of evidence of smooth newt colonisation suggests that tadpole introduction has been effective in this hostile environment. However, the slow establishment of vegetation cover on the plateau was not expected. In retrospect it will have adversely affected newt population prospects. Effective vegetation establishment should be ensured for future newt introduction programmes.

British Coal Opencast has used this technique together with natural colonisation in advance of coal extraction and site restoration at a current opencast site.

1. A reserve group of three ponds were constructed off site prior to work beginning on site in 1992.

2. A rescue of newts was undertaken from a small pond to be lost in site development.

3. Great crested newt tadpoles were introduced during 1992.

4. Although no great crested newts were located on the site in 1992 the three ponds were torched and bottle trapped during 1993 and the following results obtained:

Table 8: Survey results at a current opencast site

	Pond 1	**Pond 2**	**Pond 3**
13 April 1993			
Torching	-	5 Male GCN	-
Bottle Traps	1 Female GCN	1 Male GCN 2 Female GCN	1 Male GCN
10 May 1993			
Torching	1 Male GCN	9 Male GCN	-
Bottle Traps	8 Male GCN	6 Male GCN 3 Female GCN	1 Male GCN 1 Female GCN
24 June 1993			
No torching due to rain and turbidity			
Bottle Traps	3 GCN Tadpoles	1 Male GCN 9 Female GCN 3 GCN Tadpoles	
10 net passes to each pond	14 GCN Tadpoles	10 GCN Tadpoles	6 GCN Tadpoles

5. In an 18 month pond establishment period breeding populations of great crested newt are present in all three ponds.

6. This rapid colonisation of new ponds probably from newts existing on the site shows the value of pond creation and monitoring prior to site development.

7. The three ponds adjacent to the British Coal Opencast site will provide a refuge and recovery point for a local population of the great crested newt.

8. Development proposals for site restoration will include habitat requirements for amphibians in general and great crested newts in particular.

Conclusions

Survey for great crested newts

Surveying for great crested newts can be difficult when habitat is poor or when a population exists in low numbers. Recognised survey techniques by torching at night or bottle trapping can give erratic results which do not correlate to each other.

Torching at night gives the most inconsistent results but is the technique recognised by English Nature for assessing newt habitat population density.

A reliable and nationally recognised comparative technique is required for surveying great crested newts.

Habitat creation

Pond and terrestrial habitat for great crested newts is relatively easy to create on suitable sites provided basic design criteria are followed. Optimum habitat is not required to establish a breeding population of great crested newts. Opportunities exist for environmental design during land use change to encourage the establishment of great crested newt populations.

A Habitat Design Guide is required for land managers and planners to incorporate appropriate environmental design at Development Planning stages.

Great crested newt source habitat

Where great crested newts occur in low numbers or are locally absent, a managed donor population can be used to colonise new habitat. Management of known great crested newt habitat can provide a local resource for recolonisation of newly created habitat through natural colonisation or translocation.

Tadpole rearing and release

Great crested newt eggs can be obtained easily from a healthy population with minimum interference to newt life history using plastic strip egg collection.

A standard tadpole rearing technique can produce large numbers of pre-metamorphosis young newts with enhanced survival rates at this vulnerable stage in the life history. The release of large pre-metamorphosis young at this critical point in newt life history causes minimum interference to the terrestrial orientation process following emergence from the pond. Disturbance to newt generation time is minimal as only the tadpole stage is affected.

Adult newt return to new ponds

Clear evidence exists to show that adult great crested newts return to new pond surrounded by recently created terrestrial habitat following tadpole release. Breeding of great crested newts in these new ponds is shown by the presence of characteristic tadpoles in the third year following introduction. Monitoring of all introduction or habitat creation schemes is a critical requirement to determine successful newt establishment.

Colonisation of newt ponds by fish

Fish predation of great crested newt tadpoles is recognised as a major factor in local population decline. Large permanent ponds which are accessible to the public can quickly become stocked with fish by anglers or children. Natural colonisation of ponds by fish through waterfowl carrying fish eggs on their feet and other agencies should be considered in pond design. Location of new ponds in controlled sites may be required to prevent the likelihood of anglers or children introducing fish to critical ponds in great crested newt habitat.

Clusters of ponds offer greater insurance against fish colonisation. Pond design should consider occasional drying out to remove fish predators.

Monitoring

Monitoring population establishment and seasonal changes is necessary to understand newt population dynamics. Commitment by landowners or managing agents to monitoring will be required where any project is proposed.

Monitoring requirements with agreed comparative survey techniques should be set out for habitat management projects.

Recolonisation and introduction

The provision of habitat infrastructure for natural recolonisation by common amphibians and reptiles from known populations should be considered the ideal process for conservation of herpetofauna.

An introduction programme can be considered as an option when habitat is fragmented or populations cannot be naturally established in suitable areas.

Development Requirements

Development agencies such as Local Authorities, National Land Managers and Developers should be directed by planning requirement to provide habitat for herpetofauna.

Habitat Creation and Management Guidelines should be part of a planning information package.

Pre-emptive landscape management for herpetofauna and the great crested newt in particular will:

a. conserve abundant herpetofauna populations;

b. preserve local herpetofauna genetic integrity;

c. create safe reserve areas;

d. offer enhanced new for old opportunities where development is inevitable;

e. raise public profile of a fragile fauna group in the planning process.

References

GRIFFITHS, R. 1987. *How to begin the study of amphibians.* Surrey: Richmond Publishing.

Questions and discussion - Session four

Chris Sluman: Could you give me some further information about the mortality of the tadpoles in the rearing system?

Bob Bray: The first mortality was almost total; that we deemed to be due to starvation. It was odd to see live *Daphnia* pecking away at dead newt tadpoles that a week later would have been eating them. Thereafter there was about 95% success, once the eggs had hatched and the tadpoles were swimming there was very little mortality subject to preventing cannibalism. As the rearing process goes on you have to keep up feeding constantly and, from memory, after about three weeks you need to separate the various sizes of tadpole otherwise there is dreadful carnage.

Chris Sluman: You mentioned disorientation; what evidence did you have and what sort of disorientation do you mean?

Bob Bray: Again, this is an assumption. It is an assumption that if adults are translocated and, I am not criticising adult translocation when it must happen, if you want establish new populations, you want a technique that doesn't disorientate adults that have become habituated to the land around a particular pond. By using tadpoles, once they come out of the pond, they are in a position to orientate themselves in the normal fashion.

Chris Sluman: Do you have evidence that that is happening?

Bob Bray: No, but everybody tells me that great crested newts tend to go back to the original pond they came from. That's the received knowledge for me. Therefore, this was designed to get round that particular perceived problem.

Julian Branscombe: Do you have weights for any of the larvae that actually went over and metamorphosed?

Bob Bray: No.

Julian Branscombe: I wondered because I was interested to know if the intensive feeding made them larger or making them mature earlier?

Bob Bray: There are a number of problems there in terms of head starting these animals. They were certainly larger and more robust than, for instance, those coming out of my garden pond two months later. I don't know what the effects are of animals entering the habitat two months earlier than they would normally expect to. For example, there could be adverse predation; whether it would have a good, bad or indifferent effect upon them, I can't say. I must say that this was a budget exercise and a lot of things that could have been done weren't done because of time considerations and other constraints.

Julian Branscombe: When you said you had adult animals in the pond the next year, have you wondered whether the animal could have matured within a year because of the head start that they had had in life?

Bob Bray: Yes. At the other project area that I was talking about earlier on, just over the border in Derbyshire, the young newts were liberated in June. It was quite a damp summer, they were large and the adult newts that came back next spring in breeding condition were small. If they had been a remnant population you would have expected the adult newts to have been larger, unless they were newly colonising from another pond which I didn't know about. I would stress that I didn't do a full survey on that but only that we felt it was important to get a great crested newt

population established. They were certainly small adults in breeding condition but I don't know where they came from ultimately.

Chris Sluman: Do you think there would be a difference if you had introduced an age structured population rather than a single generation?

Bob Bray: Yes, I am sure there would. What happened in a mildly haphazard sort of way was that as newts began to metamorphose they were introduced over probably six weeks into the various ponds. So it wasn't just one batch. There were a number of batches that went into the various ponds.

Chris Sluman: But it was all one year?

Bob Bray: No, there were three years of releases.

Chris Sluman: And I suppose the first ones will be breeding by the time the last ones went in?

Bob Bray: Yes, that's correct.

Henry Arnold: If you kept them in captivity you could release that age structure all at once unless you got one and two year olds from somewhere else.

Bob Bray: My objective was to cause minimum interference with the life history of the animal. We have seen in one of the graphs that this is a very critical stage in the life history, yet one that is quite easy to manage, namely from egg to pre-metamorphosis tadpole with minimum mortality, and introduce it into a new habitat.

Arnold Cooke: Did I understand you to say that the newts might avoid ponds that have got fish in?

Bob Bray: Well it's a question I would ask of someone who has more time and more resources than I had but on Site Two the silt trap had a lot of sticklebacks; the other two ponds didn't have fish in. The same number of tadpoles roughly were introduced to two or three ponds. A number of great crested newts were found in ponds A and B but none, with the exception of one immature in 1992, no adults were found in 1993 but adults were found in the other two. It's purely an idea but it seems to me it is an animal which is particularly susceptible to fish predation and has evolved for how ever many millions of years it might just be possible that it actively avoids ponds that have fish in.

Arnie Cooke: I have certainly had the same thoughts from time to time and Tom will no doubt correct me if I am wrong. The work that I did at Peterborough Southern Township indicated that out of the vast array of ponds that were there, those with fish in had relatively few newts and vice versa.

Bob Bray: Well that's interesting that there are two associations.

Alistair McLee: With the Cleveland Wildlife Trust, Rotenone treated a pond in February or March and sticklebacks were all dead within a week of the treatment and we had great crested newts and these were full adults, which was interesting, they weren't just immatures returning for their first spawning, these were full adults, in the pond in May. Now there were many adjacent ponds and it is possible that the animals had moved around between the ponds.

Bob Bray: Were there adults in the pond prior to your treatment.

Alistair McLee: Although it's very difficult to prove a negative, we never saw any. The ponds were very eutrophic with the sticklebacks eating all the invertebrates, they were just a green algal soup. Although netting and bottle trapping had never shown adults in that pond. It was interesting that the adults were full adults and not some small, perhaps, baby two year old ones and that they were in the pond within two months of Rotenone treatment.

Henry Arnold: It might seem a bit circumstantial but perhaps they do put their toes in the water to see if they get nibbled by sticklebacks.

Case study: A34 Wilmslow and Handforth Bypass

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The proposed Wilmslow and Handforth Bypass (and a section of the Manchester Airport Eastern Link Road) runs, for approximately 14km, around the settlements of Wilmslow, Handforth and Heald Green in Cheshire and Stockport Metropolitan District. Following a public inquiry in 1991, Penny Anderson Associates were commissioned to undertake an amphibian survey of the ponds situated on or close to the road corridor. The survey showed that 17 ponds would be destroyed, 15 of which contained breeding populations of great crested newts. Superstore and other development proposals adjacent to the road scheme would lead to the destruction of further ponds. Of the ponds lost to the road, one was assessed to be of exceptional value (12 NCC points), whereas the others were of more modest importance for amphibians (0-3 NCC points). The road scheme had the further deleterious impact of bisecting and fragmenting pond clusters.

In summer 1992 we were commissioned to produce a mitigation programme to minimise the impact of the road on the amphibian populations. The agreed programme, which commenced in winter 1992 and is still on-going (January 1994), comprised the following:

1. The construction of 17 new ponds and the renovation of nine existing but derelict ponds. Priority criteria for the selection of new pond sites were the presence of sufficient, good quality terrestrial habitat in the vicinity and the long-term security of the site. Land ownership, however, represented a significant constraint to the selection of new pond sites. All the sites eventually chosen, except one, were in the ownership of the County Council or Borough Authorities.

2. The ponds were planted up by transferring aquatic vegetation from existing ponds and by purchasing native plants from professional growers.

3. A capture programme was implemented between February and May 1993. Six people were employed on the scheme for a total of 68 person weeks.

4. Capture methods included the erection of *c*6.7km of plastic amphibian fencing with pitfall traps, bottle trapping, transfer of egg laying strips from donor to receptor ponds, transfer of frog spawn and toad spawn, and direct search for amphibians following the dewatering of the ponds which would be lost.

5. Animals were released into safe compounds containing the new/restored ponds and suitable terrestrial habitat (unmanaged grassland/scrub/hedge etc). The relevant compounds were encircled by amphibian fencing.

6. In total, *c*.11,000 animals were caught using the pitfall traps, of which 142 were great crested newts.

The road scheme had a budget of £87 million and the cost of the amphibian mitigation is estimated at *c*.£200,000 (0.23% of the total road budget). Permanent provision, including permanent amphibian fencing and amphibian underpasses is being provided at one site where the road cuts across the migration route of a large toad population.

The scheme has attracted considerable publicity, both locally and nationally. It is probably the largest amphibian mitigation programme for a new road scheme adopted in Britain to date. It is

proposed to monitor the progress of the translocated amphibian populations over the next few years. Results in Spring 1994 have revealed toad, frog and crested newt spawning in the new and restored ponds.

The role of the local group in the conservation and management of the great crested newt

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Surrey Amphibian and Reptile Group

It has been recognized that a major factor influencing the number of Great Crested Newt populations remaining has been the loss of suitable habitat for both the terrestrial and aquatic phases of the life cycle. The reasons for this loss have been well documented (Pond Conservation Group 1992, Pond Conservation Group 1993).

Voluntary groups can provide a vitally important role in the conservation of this species. The many areas in which help can be offered include pond status assessment, amphibian surveying, the production of pond management plans,and pond restoration and subsequent maintenance. Rescues can also be undertaken especially if suitable sites for transfer have been identified in advance.

This brief report will include work carried out by the Surrey Amphibian and Reptile Group, the Nutfield and Merstham Pond Restoration Group, and by individual workers. It will also give sources of any grants obtained,so giving acknowledgment to those awarding the grants,and hope to others looking for sources of help.

Surrey Amphibian and Reptile Group was set up by volunteer members of the Surrey Wildlife Trust in order to carry out countywide surveying for amphibians as part of the National Amphibian and Reptile Survey based at De Montfort University (Leicester Polytechnic). An initial grant by the Vincent Wildlife Trust was essential to the acquisition of appropriate equipment in the form of nets and torches. Despite a regular programme of surveying, since 1986 less than 60 ponds have been recorded with populations of the Great Crested Newt. The highest density of records were found in the south-east part of the county (see Figure 1). Throughout the county local groups of volunteers and individuals sent in these records to add to the County totals so that the current status and distribution is now more clearly understood (Wycherley 1990; Wycherley 1993; Swan & Oldham 1993).

Since this information was centralized the County Recorder has been able to offer to local Councils site lists so that these sites could receive better protection from external pressures due to possible development etc.

One dominant fact that was shown in the field surveys was the number of ponds 'lost' through lack of management. These ponds previously recorded on old maps had undergone natural successional change such that they were no longer suitable as amphibian breeding sites. As a result a local group was established in South East Surrey with the specific aim of restoring ponds where the Great Crested Newt had been recently reported or where individuals had been located adjacent to the pond. In 1987 the Nutfield and Merstham Pond Restoration Group surveyed Marsh Pond on Nutfield Marsh and developed a restoration plan. Substantial funding was obtained from Tandridge District Council and Shell Better Britain Campaign. Equally important was the help offered by local industry.

Tasks involved the removal of invading trees, clearance of tree roots and silt, recontouring, establishment of silt traps and overflow dam and spillway, and finally puddling a clay lining. Valuable help was obtained from Laportes plc who provided equipment to remove the silt, and lorries to carry it off site. Equally important was the donation of 500 tons of puddling clay by Redlands plc and the offer of transport of this to the pond by Browns, a local haulage firm. Great

Crested Newt adults were recorded in the first spring following restoration and in October of the same year larvae were netted confirming that breeding had been successful.

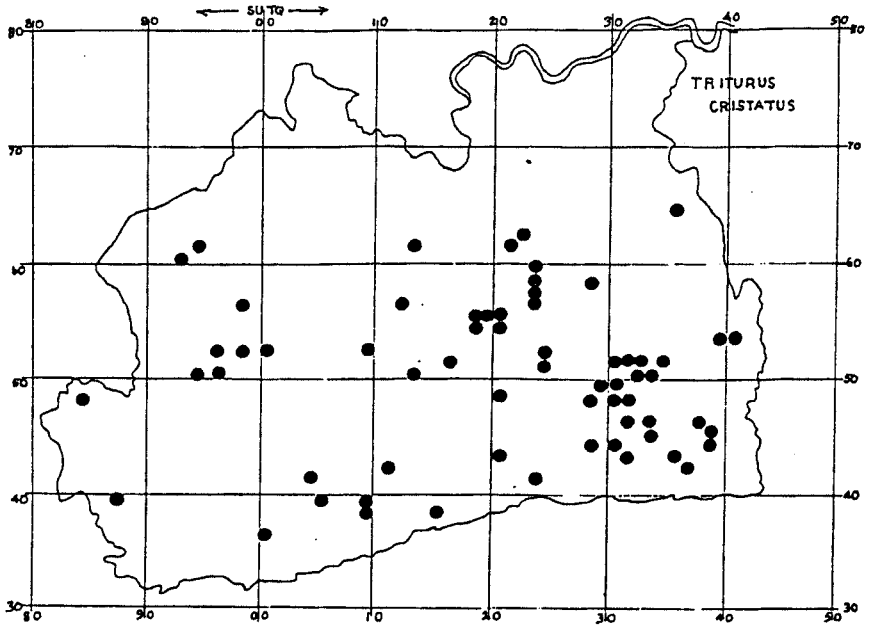

Figure 1 Distribution of the great crested newt in Surrey
(each dot records presence in 1km squares)
(Julia Wycherley 1993)

Following this success a further six historic breeding sites have been re - established with the aid of grants from Shell Better Britain Campaign, Surrey Pride of Place Awards, and Trust House Forte Community Chest. Current work on Hever's Pond Bletchingly has been helped by British Gas Grass Roots Action Scheme and a grant from Wimpey Environmental. Without these the work would have been extremely difficult if not impossible.

As a result of the above surveying and restoration work it was decided that more detailed and precise information was required on the status of ponds in the area. A major pond survey was initiated by Gwyneth Fookes and Julia Wycherley whereby all the ponds in the Tandridge District were to be surveyed and the amphibians present recorded. To date over 1000 ponds have been identified and over 700 visited for the initial botanical survey and status designation.

Every pond created undergoes natural successional changes in vegetation over the years, and without management procedures to halt the progress of these changes the pond will ultimately progress towards a woodland, this being the natural climatic climax vegetation for the region. Gwyneth Fookes has analysed these stages of aquatic succession and created a key by which ponds can be usefully designated into 9 stages as shown in Table 1. Stages 2-5 have suitable conditions for the presence of amphibian populations and these will be surveyed in 1994 -1995. Figure 2 shows the distribution of ponds in Tandridge according to this aquatic succession. The number of new ponds recorded was unexpected. In general floating plant species were poorly represented (Table 2), but the presence of Glyceria spp in 104 out of 706 ponds was encouraging as this is one of the preferred egg laying substrates of the Great Crested Newt. This study is being supported by a grant from English Nature (Fookes 1993).

Table 1: Aquatic succession - FAS: Tandridge Pond Survey 1993-1994 (devised by Gwyneth Fookes)

FAS 1	Vertical banks, deep water, no marginal plants. ± floating water weeds as well as footed aquatic plants. Few surrounding trees.
FAS 3	Banks shallow, abundant marginal plants. Few waterweeds. Saplings in surrounding area.
FAS 4	Marginal plants extend over almost entire surface of pond. Marsh developing around as bottom of pond being raised by organic debris. No waterweeds. More abundant small trees, birch, willow, alder.
FAS 5	Marginal plants cover centre of pond and marsh plants encroach around margin. Very shallow water. Surrounding trees larger, often collapsing through lack of root support in marshy ground.
FAS 6	Small number of marginal plants remain in centre of pond. Marsh plants cover remaining area. Water only visible after periods of heavy rain. Trees maturing.
FAS 7	Pond surrounded by mature trees with only an occasional patch of reed or sedge. ± holding water.
FAS 8	Pond area densely surrounded by mature trees, shallow, full of leaves, very little, if any, ground flora. ± holding water; or incorporated into meadowland with banks visible.
FAS 9	Pond lost due to deliberate infilling; or only evidence of pond on old maps.

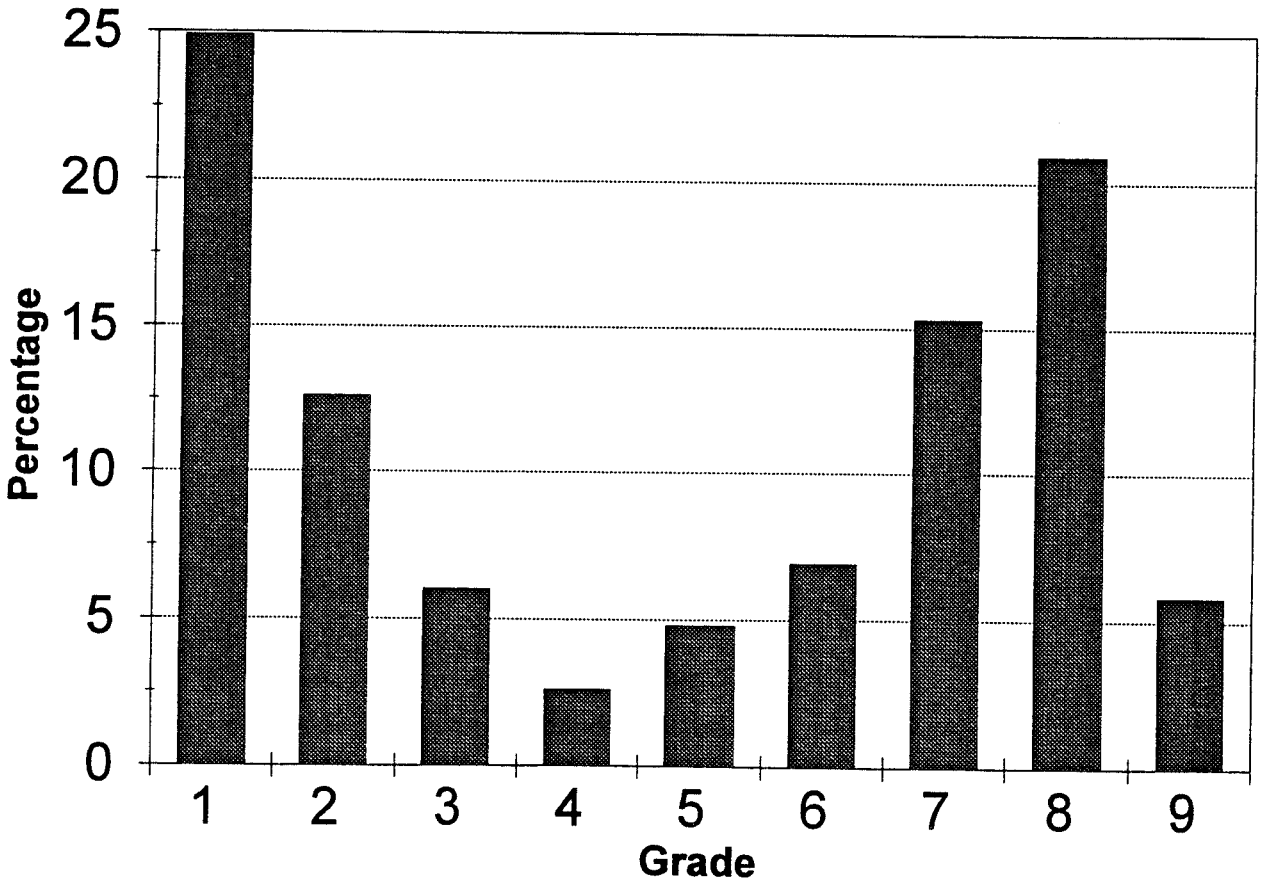

Figure 2 Percentage of ponds in each aquatic succession category: Tandridge Pond Survey 1993-1994
(data to end January 1994 from Gwyneth Fookes; sample size - 725 ponds)

Table 2: Occurrence of floating plant species and some typical marginal species: Tandridge Pond Survey 1993-1994 (data from Gwyneth Fookes)

From 706 ponds	
Total floating species	**No of ponds**
Azolla filiculoides	1
Callitriche sp.	40
Ceratophyllum demersum	6
Crassula helmsii	2
Elodea sp.	13
Lagarisiphon sp.	5
Lemna sp.	99
Myriophyllum sp.	7
Potamogeton sp.	33
Ranunculus sp.	10
Water lilies	42
Some typical marginal species	
Caltha palustris	20
Carex pendula	63
Glyceria sp.	104
Iris pseudocorus	119
Juncus sp.	175
Oenanthe sp.	43
Sparganium erectum	43
Typha sp.	123

Needless to say there is much work to be done in both surveying for the Great Crested Newt and in registering each site at local level and nationally at the Biological Records Centre.

The role of voluntary groups is very important in surveying and recording new sites,monitoring these and subsequently carrying out the habitat restoration, management, and enhancement. Funds are available for restoration work but these are not automatic and often volunteers must wait in a queue of many other applicants whose projects are of historic or amenity value. Equally difficult is the lack of funds for maintenance work once a pond is restored. The general implication of current grants is that once restored the pond should be abandoned. It should be recognized that this is an ongoing procedure and funds made available accordingly to enable volunteers to continue their work once the initial tasks are completed.

It is encouraging that two new pond restoration groups are being established in the area and it is hoped that these can also make a significant contribution to the improvement of the status of the Great Crested Newt in Surrey.

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Construction of hibernacula for great crested newts

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Ponds supporting great crested newts vary greatly in shape, size, shading, amounts of aquatic vegetation and nature of surrounding habitat. The availability of suitable hibernacula is a significant factor in determining population size.

One of the largest populations of great crested newts in the West Midlands occurs at a site in Warndon in Worcester. One of the chief characteristics of the site is the large amounts of building rubble and other assorted debris within 100 m of the site. When leaving a pond in preparation for hibernation, newts will seek cover. These are most easily found under flat refuges; although the majority will seek out more permanent residences some can be found, even in June, below small pieces of debris.

To ensure survival, newts must seek out conditions where frost cannot penetrate and where they will not suffer the effects of desiccation. Frost rarely penetrates 30 cm or more below ground. Voids and crevices are necessary to allow access to the right micro-environmental conditions. Building rubble can be very beneficial in this respect.

I have gained some first-hand experience here through supervising the dismantling of such a site. Six cubic metres of debris were turned over during an eight day period; 59 great crested newts were retrieved and relocated. This was necessary to allow the development of the site (for a Tesco superstore). This operation provided an opportunity to observe and record the conditions in which newts were found.

The field data collected from this exercise, together with information gleaned from available literature sources, has allowed me to design purpose built hibernacula for newly created and restored ponds.

Wildlife legislation protects both the individual newts and their habitat. Consequently housing and property developers must on occasions undertake significant measures to protect and even enhance populations and habitats of great crested newts.

At one site, in Stone in Staffordshire, where full planning permission had been granted the developer was required to relocate the population to a newly created site. In our role as Environmental Consultants to the project we were required to design the new pond and associated features such as purpose built hibernacula. The availability of resources dictated the scale of the operation and the size of the construction.

The hibernacula at Stone were constructed using a mechanical excavator. The newly created pond was constructed in Autumn 1992 to receive translocated newts from the adjacent threatened site the following year. The hibernacula were excavated after the main profiling work was completed. The initial stages of construction involved the excavation of a trench up to a metre in depth and nearly a metre wide. Two trenches were created. These run parallel to the pond above the maximum flood level of the pond. A further five side trenches were excavated in the bank at right-angles to the original two trenches. These side trenches connect to the parallel trenches and are angled, sloping towards the pond, to facilitate drainage.

Materials used in the construction of the hibernacula are readily available on building sites. The base of the trench was lined with native wood trimmings or tree-brash. The trench is then filled

with alternate layers of building brick and loose top-soil, before capping it with a layer of four inch (10 cm) crusher stone.

For good measure, at each of the T-junctions, saw dust was added. A vertical pipe is filled with saw dust and will maintain a plug to provide ready access by great crested newts and other amphibians to the base of the hibernaculum.

At a second site, in Bromsgrove in Worcestershire, available materials included sandstone blocks that were used to cap the hibernaculum and a Scots Pine tree that was cut up to form log piles to provide temporary refuges. At the Stone site logs were in short supply.

At these sites fencing is valuable to keep people away from interfering with the structures and more importantly as a safety feature.

Other feature that have been used in building hibernacula include the addition of pipes inserted horizontally to provide permanent access in to the refuge. At a site in Somerset pieces of marine ply were used to assist the separation of the alternating bands of rubble, top-soil and saw dust.

Smaller scale hibernacula can be built on a smaller scale simply using wood. Log piles should be covered with soil to a depth of at least 30 cm. In time the wood will rot, providing both voids and soft spongy wood where the hibernating requirements of newts will be satisfied. During construction, it helps if gaps are left at the base. This can be achieved by arranging parallel logs at the base of the pile. Additional logs or ply wood should be laid on top to form a semi-permanent roof.

One of the biggest problems that we face as consultants is justifying the need for habitat features and the like. It should be made a condition of the work to require follow up research, for example, by placing amphibian barriers around hibernacula to monitor how many newts are using it and how they survive the winter in hibernation. Developers require considerable persuasion before they will be prepared to pay for such work. If such work is going to get done then a joint approach between conservationists, scientists and consultants is needed.

Questions and discussion - Session five

Philip Horton: Concerning the point about newts settling into new environments in conservation areas, perhaps I could prompt Rob Oldham to make some comments on work that he did studying the belly patterns of newts intercepted in the conservation area (at Lomax) during the first year. I seem to remember you came to some quite interesting conclusions. As I said in my talk, we put 800 newts into the conservation area in the first year. Although I didn't talk about any monitoring during the first year, we had pitfall traps on the inside of the fence around the whole conservation area and we also bottle trapped the ponds. The newts that we caught there were photocopied along with the rest, as I recall, Rob, you looked at all the male newts that we caught during 1991 and from what I remember we found that quite a lot of them were re-caught on the outside of the conservation area, as if they had been trying to escape. They were then brought back into the centre of the conservation area and after that they were re-caught trapped in bottle traps in the ponds. It seems that there is a wandering about period and after that if they can't get out, they then seem to settle down and go into the pond.

Rob Oldham: There did seem to be different 'attitudes' as it were amongst the newts. Some of them were intent at getting out at all costs, some of them stayed put and some of them went to and fro and eventually accepted the situation. There were roughly a third of the newts in each category.

Henry Arnold: If I may interject, you said that the newts were intent on getting out. That might not have been an escape wish as such but might rather have just been their natural inclination. We have talked about night counts in ponds. You might, for example, see 50 in the pond on one night and, say, 50 two weeks later - it is not necessarily the same 50. There might have been some newts which were on the edge of leaving the pond any way when you lifted them and put them into the conservation area. They might have been moving from their original pond to another pond, say, they have might wanted to have been at point C not point B. So they might not have just been trying to get out for the sake of getting out, they might have been wanting to move between two different areas.

Rob Oldham: It's impossible to know but I interpreted it as them wanting to 'go back home' because the majority of them were moving in that direction and it was that time of the year. However, it is impossible to be sure.

Arnie Cooke: On that point, is there information on the optimum distance that newts should be translocated? If you are translocating them within their known home range they might say "we don't want to be here we want to go back somewhere else we know"; whereas if you translocate them just outside their known home range, perhaps a kilometre or two, that might actually be better. That's what we certainly used to try but I am not sure if the information on that has been improved recently.

Rob Oldham: Yes, I would agree with that, certainly with other amphibian species that has been demonstrated.

Chris Sluman: It seems a little unclear that we are being told that pond clusters are popular sites and then at the same time we are being told that you have sites without them: so those two bits of information seem to contradict each other. It depends on how large a pond cluster is and how faithful they are to a single pond rather than talking about being faithful to a pond cluster.

Henry Arnold: That may, of course, be the case. Perhaps somebody would like to comment on that. To me, it seems entirely possible that if for some reason pond clusters are particularly good, perhaps because of the influx of sticklebacks that make the use of certain ponds unsuitable, so the

newts accept they have to move off to other ponds a short distance away. Whereas if it is an isolated single pond, then obviously there's no where else in the environment for them to go. However, I would imagine they could have fidelity to a cluster of ponds rather than just to a single pond within the cluster.

Arnie Cooke: Well we know from your very own garden, Chairman, that there's no evidence at all that they attempt to cross the main road that goes past your house. Yet we know from marking individuals in the old days when they were using a second pond as well, that there was actually quite a bit of interchange within the same season with newts turning up in both ponds, which were about 50 yards apart.

Chris Sluman: That's something else I wanted to ask about site fidelity. Is there a difference between year to year fidelity and night to night?

Henry Arnold: Is there anyone who wants to pick up on that point? I think this is something that needs to be looked at further.

Trevor Beebee: I was wondering about the rather elaborate hibernacula that we have just heard about. Is there any evidence to suggest that sort of exercise is really necessary? In other words, I was wondering whether there was any evidence to suggest that the availability of hibernacula actually limits or in any way effects the size of great crested newt populations. It seems to me that we are in the business of trying to minimise the costs of most of the things that we do, some of the aspects are going to be expensive any way. Do we really need to worry about hibernacula?

Henry Arnold: If I may comment on that, you say that we want to minimise costs. We have had an example this afternoon where the cost of the mitigation was 0.2% of the cost of the whole project. Would it really matter if it was 0.21%?

Trevor Beebee: Can I put it another way. If you had the choice of building one pond and a hibernaculum or two ponds, which would be the better choice?

Will Watson: Can I just come back on that point to explain that at the site where the newts were discovered we were actually dealing with quite a small area of land. There are existing ponds which we still hope to restore but there is very complicated land ownership with the two developers on the land and, therefore, the availability of hibernation areas, in fact habitat areas, is a little bit restricted on that site, certainly in the south area. So we felt we would go ahead and construct the hibernacula. You should also bear in mind that it takes up a considerably smaller area than a pond and, therefore, it wasn't a case of this feature replacing an additional pond.

Henry Arnold: It seems to me that, although, the one you showed was particularly elaborate if I might say so, that to dig a couple of trenches and fill them with rubble is only two minutes work with a JCB if it's there already digging the pond. It isn't going to be a case of doing that or digging another pond or at least I wouldn't have thought so.

Bob Bray: Regarding a point that Tom brought up. If you are doing work, for instance, either translocation or reintroduction or monitoring that is going to have a scientific pay-off, then it may be worth throwing some degree of money at to get the best possible results. But then again, speaking as a landscape architect, there are a lot of developments that are going on where land is being managed or developed or changed all over the country and where there is no such imperative. No planner has ever suggested to me that any group or animal or plant should be conserved or that the design of that landscape should take them into account. It strikes me that you should continue to do the rescues and translocations as one opportunity to conserve existing populations. However at the moment there are no clear instructions to a planning officer or to a development manager on how to create new habitat simply and effectively that is going to enhance

herpetofauna. I think that what we have been discussing today, to some degree, is a rearguard action against damage to existing populations and at the moment we haven't got any blue-prints on how to be proactive in terms of how to create the next generation of habitats for herpetofauna. I just wonder if people would feel nervous about somebody keep saying "just dig more holes in the ground and that may be enough".

Henry Arnold: Trevor's original question was to ask what evidence do we have to show that hibernacula are necessary. We don't have any evidence but the way in which we are going to get evidence is for people to do things, for example, to build hibernacula and to monitor them and to compare with places where hibernacula haven't been built. Perhaps, then say in five years time we find that those sites with hibernacula are considerably more successful than those without, then we have answered Trevor's question. So we do need to do both types of project but we do need to monitor them.

Dave Bentley: I agree with Will. It is important that we mitigate for the animal's whole life style and it is important that we stress that to the developer and to the planning officers. I have had a little bit of a success in my home town in Bury. Wherever there is a development against the pond the planning authorities are ensuring that the developers installed rubble and soil filled gabions in the pond banks.

Henry Arnold: Yes I can see that you need to try to ensure that the habitat is made as good as it can be for amphibians.

Mary Swan: I would like to develop that point a little further and ask the consultants here whether in the course of any of their mitigation schemes there has been a requirement from any of the conservation bodies for the mitigation to be carried out on a habitat for habitat basis. We have had some good illustrations of ponds for ponds and we have seen scrubby little holes being turned into beautiful and apparently ideal amphibian ponds. However, I have also noticed that we have had large populations of newts moved from quite extensive areas into much smaller conservation areas and I have been wondering whether there's been any attempts to enhance the terrestrial habitat to perhaps compensate for the absolute reduction in area. To develop that point slightly further I feel that on the whole there is an over emphasis on the ponds as opposed to terrestrial habitat. The National Survey, which is a pretty reasonable dataset to use does indicate that in particular habitats, especially those that themselves are pretty featureless, it is the terrestrial habitat components and particular features within the landscape which may be the more important determinants of the presence or absence of newts than the ponds themselves. Obviously ponds are essential for continued breeding so that given that ponds are present, the actual structure and landscape components of the terrestrial habitat are extremely important.

Philip Horton: Again, quoting the Lomax project and as I mentioned in the talk, besides the three conservation areas every pond that British Coal had control of around the site is being protected and have amphibia. Getting away from ponds, the terrestrial habitat is being enhanced as well in terms of planting of trees and allowing grazed grassland to grow rank. The restoration scheme as well very much points to replacing the ponds that were there backed up by suitable areas of terrestrial habitat. Coming back to the point that Bob raised about what we should be advising developers to put back into terrestrial habitat and one of the dangers is the tidy sort of classical landscape architect approach with a nice pond with lovely fringing vegetation surrounded by mown lawns with lots of lollipop trees. If you allow what you plant around your pond to grow wild with the vegetation growing ranker and denser areas of scrub, then you will probably be all right so long as you have areas of this unmanaged vegetation. The over tidy approach is one of the dangers of a lot of the landscape schemes.

Henry Arnold: Just a comment on leaving large areas of rank and unmanaged vegetation is it becomes an eyesore and then becomes an ideal place for development.

Bob Bray: If I could reply to those particular points. A lot of the current landscape design does involve landscape management that is intended to do this sort of thing. New woodlands or new hedgerows, for example, are being implemented all the time by landscape architects. It's not just a defence of landscape architects, there is a whole environmental movement which can be exploited by the sort of requirements that we have if only we have those critical requirements for herpetofauna that we can plug into what is happening in the rest of the world. The rest of the world is going on and developing and the rest of the world is designing landscapes. What it doesn't know is how to design those particular things that are going to be good for reptiles and amphibians. It is up to people like ourselves to let them know what they have to do. People who are involved in land design don't know what to do, don't know those critical things. If they are told they can include them.

Julian Branscombe: I think on this point of offering guidelines for new landscape schemes we should remember that there is more to nature conservation than just herpetofauna. I think there's a danger that landscape architects will think "so I must do something for the herpetofauna but someone has just asked me to do something for butterflies and someone has just asked me to put hedgerows back and of course we must do something for birds". So, rather than just getting guidelines for herpetofauna, although I'm no expert on the landscape side, I would imagine that it would be quite hard for landscape architects to cope with requirements from all the different cells of the nature conservation movement.

Bob Bray: Yes that happens all the time.

Julian Branscombe: Perhaps if one of the things that we are recommending here is to produce guidelines for landscape architects, then perhaps this could form part of a much broader set of proposals and produce a set of guidelines relating to nature conservation which might be much easier taken on-board rather than a bitty approach.

Henry Arnold: It would be nice to think that it would be possible to produce a set of guidelines for nature conservation that would keep everybody happy. Apart from the fact that I suspect it would take rather a long time to prepare them, I suspect that it wouldn't make everybody happy any way. I think simply due to human nature we are going to be stuck with the bitty approach and that will probably lead to conflict. Some things that 'amphibian people' want to do to ponds, for example, are going to upset entomologists and probably some botanists as well; so there's always going to be some degree of conflict. That is something that people have got to deal with. I am not saying that it's the landscape architects' job but rather the role of the nature conservation movement to sort the differences out as far as possible. How do you come to terms with all these different requirements? It's very difficult.

Simon Pickering: I thought we actually had statutory nature conservation bodies to actually do that: that is the role of English Nature or the relevant statutory authority in each area. It was raised earlier on that they were being over-stretched and asked to interpret the legislation. Now some say that they are doing that but my point is that increasingly they are not, possibly because of funds. It will then come back to the wider nature conservation movement who have to draw up these guidelines. Leading on from that we have heard about a lot of projects where people are doing things and trying things out and surely the key to that is that people should monitor what's going on so that the consultants or the advisers can, in a few years time, draw together this information. If monitoring is not included within a job surely the statutory nature conservation bodies should push or get the local planning authorities to push to make sure, perhaps via a Section 106 Agreement, that there is ongoing monitoring. That way there can be changes in the management in the responses to the changes in the population observed through the monitoring. It should be on everyone of us to try and get this sort of thing, perhaps put in a 106 Agreement, to ensure that we do get this long term monitoring and then as a condition, that in response to this monitoring that certain management is carried out.

Alistair McLee: A very good example of what the previous speaker has just said was the Tees Barrage that was developed by the Teesside Development Corporation near Stockton. One of the requirements was the prolonged monitoring for five years afterwards of the impact of this development mainly of birds downstream on the estuary and even upstream of the Barrage. That was one of the planning requirements. However, that was a very large project and it would be very difficult to force such requirements, particularly on smaller projects, after the completion of the development but it should be part of the planning consent condition.

Robin Grayson: A point I would like to raise is about acquiring land for mitigation purposes. Many schemes come forward where developers say they hope to get local landowners or local authorities to do X, Y and Z but this is very difficult. It strikes me that local planning authorities do have Compulsory Purchase powers to acquire land as local nature reserves; no local authority has ever used those powers that are in the 1949 Act, so it's about time that somebody did. As they have got those powers, it would be rather nice that in a test case. For example, on a road proposal where Department of Transport has Compulsory Purchase powers for highways purposes only, therefore, the mitigation that came, for example, in the Wilmslow and Handforth by-pass is crammed a little bit too close certainly in some places. You could get more value for money if it could be legalised or at least legitimised that a proportion of the highway budget for the road could go to the local authority under the guidance of English Nature to CPO land for nature conservation purposes. The mere fact that the local planning authority was thinking of doing it might make local landowners negotiate more quickly.

Mary Swan: I would just like to go back to the representation of other interest groups in great crested newt conservation and I think that's actually a bit of side issue. Great crested newts are a species that can very well accommodate themselves in habitats that are very much degraded in natural history terms, in agricultural and derelict land and so forth, therefore, with a minimum of restoration you make ideal sites for these groups of animals. It might not even be worth considering bringing in other specialists in the other area groups of animals and plants.

Henry Arnold: Well that's all very well for the great crested newts but what about the rare invertebrates that are living in the pond that is going to be destroyed? Should you ignore those or should you add more weight to their conservation? Should you dig better ponds for them?

Mary Swan: I'm not sure that the evidence really shows that there are many Red Data Book species of invertebrate living in ponds in degraded situations. The representative from Pond Action might be able to clarify that but I think they tend to be more in association with rather nice and more pleasant habitats in general.

Henry Arnold: That's not necessarily true.

Penny Wilson: What I would say, although certain degraded habitats are not that good for some of the rare invertebrates and some of the rare plants, there is perhaps a problem where we are talking about ponds that are either shaded by scrub or perhaps are very silted up. These are all very natural situations for invertebrates. There is certainly a number of very uncommon invertebrates that are associated with ponds that are polluted by leaf matter, that is polluted by natural organic matter. These are, therefore, situations certainly in cases where the people have been talking about cleaning out existing ponds what they are talking about is almost creating new ponds because they are cleaning out all the existing sediment and completely clear the surroundings. What I am interested in is that when you are going to do translocations do you normally have a policy of introducing great crested newts into existing ponds. Because personally, I would say, if you can, always create new ponds.

Tony Gent: As a general point, we endorse that view. We recognise that old ponds that have been there for some time without crested newts may have an inherent interest without the newts

and that putting newts into it might cause problems to whatever that interest might be. Conversely if it doesn't have newts there might be a very good reason why it doesn't. So we would certainly endorse the approach that creating new ponds is the best way of introducing animals to a new area.

Keith Corbett: I think perhaps there's a compromise that can be made there. I have come across the scenario where a local invertebrate specialist is crying his or her eyes out saying that there's some invertebrate species that we are going to clobber by restoring a pond. So we always try to restore just half a pond at a time; we can then go back to do the second half. But the question we would ask is how long is that particular narrow seral stage going to last if we don't do any work any way? You will loose that invertebrate come what may. I think you do have to understand that and you have to go along and find out as much as you can. However, morally you shouldn't try to do a whole pond during a normal management task. It's slightly different when you have got a translocation for a road.

Penny Wilson: There is a slight problem with that, there is a certain pond stage which is a very permanent feature within the landscape, perhaps, even one of the most permanent in the landscape and that is the temporary pond. Temporary ponds can out-live large lakes, especially in landscapes that are grazed. After all grazing is a natural or semi-natural activity in its own right. By half managing a pond, by creating conditions that are not temporary, you can reduce or even eliminate the interest of that pond to certain groups.

Keith Corbett: I quite agree with you with shallow ephemeral ponds that's fine. But you originally talked about ponds that were full of leaves or covered with overhanging branches and that's a different situation.

Penny Wilson: Yes it is an additional situation. There are certainly ponds that have become temporary, perhaps over a period of a couple of hundred years which are filled up with silt but have been dried out to form temporary ponds. But that can be a fairly stable situation in its own right.

Keith Corbett: I will have to write to Pond Action to find out how stable willow swamps are because that's the sort of ponds I normally deal with.

Penny Wilson: That is a habitat in its own right too. It is very important that we don't just think about ponds as just one seral stage or that are just suitable for amphibians. As Julia was saying, there is a very good situation in her area where there are ponds that are newly created, those that are at an intermediate stage and those that have filled up and are providing a further habitat type for some plants but particularly for invertebrates.

Tom Langton: Referring to Trevor Beebee's question earlier where he asked about resources and whether, for example, two ponds would be better than one pond and a hibernation area. Also, Robin's question was about resources and whether it's better to spend resources on setting up an ideal newt area but not necessarily crammed next to a road (although this is often Hobson's choice when dealing with land ownership), I would just like to broaden the resources question out a bit.

The actual cost of mitigation work when you include the cost of professional fees, trapping, the earthworks etc is rather high. The average cost of mitigation work would probably go a long way to funding survey, let's say, an egg search in every pond in a county. If we are sitting here because we really are interested in the conservation of great crested newts it strikes me as being rather obvious that we are 'fiddling while Rome burns'. The actual loss of great crested newts is due to the loss of ponds. There is a lot of woodland about and a lot of terrestrial habitat that isn't used by great crested newts, so we really must address the issue of where these animals are distributed. If we are in the process of using the mitigation resources of thousands of pounds to save just one population surely there is a shortfall here in not being able to cater for those sites

that we don't know about. For every site that we do now about there must be a very large number that are being lost that we don't. Until we can get at those we are not addressing the conservation of the species properly: we are mucking about really. I would like to know whether funding for that's going to happen. Julia Wycherley pointed out that local groups have the capacity but have no funding whatsoever. There have been a few contracted Government studies, but on a costs basis with all this money floating about, we should be able to have a go at the real problem which is finding out where these animals are, and to help local authorities or local planners to stop or to prevent the problems that require mitigation from occurring.

Henry Arnold: Yes that's quite true but, as Julia has shown, although their group doesn't have any resources of their own, they are able to attract funding and they do a tremendous amount of work. So it is possible for local groups to go out and do this work, although you could argue that it shouldn't be the responsibility of the local groups to have to do the work that all these other organisations require but at the end of the day the difficulty is where are you going to find the money to do such an enormous survey.

Tom Langton: Yes that's exactly my question.

Henry Arnold: I think everybody knows by now that the Government isn't going to fund such projects.

Tom Langton: But it is so cheap relatively speaking.

Henry Arnold: But it's not only ponds, there are bats, there are badgers and there are umpteen other rare plants that need to be surveyed thoroughly and once that somebody puts money into one, then there's going to be a great deal of pressure for people to put money into all of the others.

Bob Bray: I agree with Tom's point. I accept that there is an element of work that must be addressed to the existing amphibian population and that can probably be best done by checking out exactly what is here and knowing what is going on. However, we are talking about ponds that were all created with nothing to do with amphibians in mind. The ponds that we are talking about now were all created as processes and as by-products of day to day living and unless we find a way of creating more habitat as a by-product of our commercial lives in this country, not necessarily in a way that has to be paid for specifically for amphibians but paid for as part of the development of the landscape, then we are just going to be fighting this rearguard action that we have all been talking about today. Certainly, and I take Tom's point that if money that was going to be directed towards saving a certain pond was put towards a county assessment of what is there, it would be valuable. Yet, if all the development that was going on around now all the time was very slightly changed so that ponds and suitable terrestrial habitat was being created in the way that it was created two centuries ago, we would have some chance of halting what is an inevitable decline in amphibian populations.

Julia Wycherley: In the Tandridge Pond survey over 25 ponds were newly established, that is less than one year old. I think we should mention the quality of the design of these ponds. The majority of these were in golf courses with vertical sides and loads of chemicals being poured in, so it's not a true perspective; you have to analyze the quality of it. It's very important that in education, perhaps of our landscape architects, that if they are going to put in ponds that they put in proper ponds.

Henry Arnold: Perhaps we could look at other examples. The Marl pits, for example, when they were first dug probably didn't look very suitable for amphibians and it's only with the softening of the decades that they have become good amphibian habitat.

Kevin Morgan: Perhaps in a system where there is a pond that is going to be destroyed and a developer does show some interest, perhaps he could say that as well as paying for looking after this pond you could provide some further money for paying for conservation in the area in general. There are some developers that show this interest and in these cases you suggest that they provide some extra funds on top of the work that absolutely has to be done and that way these projects could be looked at in the context of the local environment.

Trevor Beebee: Perhaps I could just make one point that is perhaps just too simple minded. If we take the facts as I understand them and, in answer to Tom's point and I think that Tom's point is very important. Behind all of us there is this big backlog of ponds being lost all the time. If we look at the facts that have come from Rob Oldham's work in the early 1980s it looks to me that if we assume that there's 18,000 sites and we are losing over 2% over five years, we can come up with a fairly simple minded calculation that we are losing about 60 populations per year. It would, therefore,be a reasonable target for the conservation movement throughout Britain to say that we will create 60 great crested newt ponds each year or one per county or whatever it works out as. It shouldn't be beyond our whit through the English Nature Regions or Counties as they will become, to become involved with organising an exercise on that relatively small scale and which is not all that expensive.

Arnie Cooke: Speaking as an amateur herpetologist and not as a member of English Nature on this occasion, Trevor's comments are useful. Regarding survey, we try to find out where newts are but -no matter how much money you throw at that exercise it is never going to be complete - there are always going to be sites that you don't find and whilst I would like to see survey continue, I think you ought to bear that point in mind. I think that taking this other tack is much the better way of proceeding. You have got to admit that no matter how good our site knowledge and site protection is you can't protect every site. You have got to accept that. Therefore, you have to try to enhance the general countryside in order to make it better not only for newts but for other things as well. No one has mentioned the phrase 'Landscape ecology', this is one of the growing fashions in ecology and this is the way that people are starting to move.

Philip Horton: I would like to make a point about the funding of these projects. Obviously British Coal has put a lot of money into the Lomax scheme and have also organised a lot of public meetings around the Lomax site. At those meetings there has been the one complaint about the Lomax newts and that has been 'I wish you wouldn't pay so much money to those newt people and put more money into looking after the local population instead'. It might appear a frivolous point but one has to take the public with you and, although we are all newt enthusiasts and say that developers should be paying for this and paying for that. Unless we take the public with us and they are happy to see the money spent on newts, then we won't get very far. The public at large don't care very much about the Lomax newts, quite frankly.

Alan Stopher: Speaking as a developer, and we seem to be a bit thin on the ground at this meeting, concerning the issue about funding community projects and things like that, it seems to me that the trick to make things work must be some form of management that avoids actually having to throw money at the problem. Presumably 200 years ago when the marl pits were dug that the farmers didn't put in a commuted sum to ensure management continued in such a way that the newt population reached the peak that they must have done. So it must all be to do with land management and I would beg the question as to how that is handled and that's coming from me as a land manager. I'm interested in that, not least because 'sustainability' is one of these buzz words that has been about recently and no one has been able to define what it means. I note that it hasn't been used in this meeting today, perhaps because people are fighting shy of using it, but I think it is all to do with some form of self sustainability to make what we do today is sustainable at a reasonable cost for the foreseeable future. It's just a general question as to how we are going to achieve that and, perhaps that's what we are all trying to ask whether it be for newts or for any other form of nature conservation. Any ideas?

Keith Corbett: I very much agree with what Tom, Bob and Trevor said on the two subjects of doing more survey and of creating more ponds but I think they are being less than ambitious to say that we must look at other groups and to say that this is too hard to achieve. The neighbouring countries have exactly the same problem that ponds are now obsolete; how is it that last year they managed to put 600 new ponds in one Province in the Netherlands (I think it was Lynburg), they are doing a thousand new ponds in one island in Denmark and they are doing a similar project in southern Sweden and they already know what is in the existing ponds. Why do we sit back in England and hold our heads and say that ponds are going to carry on declining.

Henry Arnold: Who funded that work?

Keith Corbett: The Governments every time.

Henry Arnold: Well, there you are, there's your answer. Until we get a green Government we won't get it.

Keith Corbett: We won't get it unless we can show there is a need for projects like this. Just as long as we sit back and say, "Well they won't agree to it", then of course it won't happen.

Tom Langton: Can I come back to Mary's question earlier on about the premise that consultants use requiring 'land for land' at mitigation projects. We tend to work on the basis of 'one for one' if possible. At the Crewe site that I talked about there was a woodland edge pond that had completely silted up and I suspect hadn't held water for decades. There is a particular type of pond (which can be Medieval and not necessarily a Victorian pond) which sits on the edge of woodland that has very often been derelict for decades or even 100 years. Those to me are ideal amphibian mitigation sites. Often they are next to a block of woodland which studies have shown are often optimal habitat. If you can find them on the south facing side of those woodlands you have a 'newt site waiting to happen'. I would suggest that rather than just constructing ponds from new and (despite what people are saying) I strongly resist the suggestion that existing great crested newt ponds and the communities that they live in are expendable units. It is wrong of people to overlook the importance of protecting sites from being lost before they have been surveyed. To me there seems to be a very large number of derelict ponds which are usually thick with black sediment. These are potentially exceedingly good ponds. If you are able to choose those ponds (and they might not be in the County Councils or damaging party's ownership) you can very often get more than 'one for one'; you can often get three or four for every one lost. You can often swap a small grotty wasteland site for an open countryside site where you are going to get a bigger population of newts. Quite often you can even find pond clusters and I would suggest that you would aim to restore derelict pond clusters, taking care not to remove important late successional pond communities; go for the ponds that are really dried out and don't get much if any water in them. Then you will have got your cheap and easy answer, from which you should get very good response from amphibians.

Closing remarks

by Henry Arnold

I am not really sure what I can say in the way of closing remarks. We have heard a tremendous amount today but I think I would like to make just two points. One is that it is clear from what we have heard today, you can create new great crested newt ponds and that these will be successful, at least in the short term. I don't think that we have heard anything about introductions to new ponds which have been with us for anything more than three or four years and I would be very interested to know how these ponds continue to develop or survive in the longer term. Monitoring is therefore very important in all of these projects. We are not going to get information on what to do or how to do it unless we monitor what we have done.

The second point I would like to make is that we have heard a lot of information today but that a lot of it is not very accessible to those people who need to know it. One thing that we must try to do is to make this information more accessible, so that people know, for example, whether or not they need to introduce invertebrates or vegetation from the old pond into the new pond, whether or not they need to build hibernacula and whether or not they need to move newts more than say 250 metres or a kilometre or whatever. Indeed, they will need to know how well they have to build fences around ponds and whether it's important to exclude or enclose all of the newts or whether a much simpler construction that wasn't as newt proof would do just as well. So I think that it is important that we can make this information more available to the wider community, particularly to developers and consultancies, then we will be doing a good job.

Last of all, of course, I would like to thank everyone who has contributed to this meeting, both to those who stood up in front of everyone and for those who sat down and listened patiently and finally, of course, to British Coal Opencast and to English Nature for the time and effort that has gone into making this a successful day. Thanks also to the staff at Kew for the provision of the facilities and for the lunch as well.

Appendix 1: seminar programme

Seminar on the conservation and management of the great crested newt: Kew Gardens - Tuesday 11 January 1994

Programme

1000 **'Registration' and coffee**

1020 Morning session: Chair - Bob Bray

1025 **Introduction**

Representative of British Coal Opencast

1030 **Status of the great crested newt in Britain**

Trevor Beebee (British Herpetological Society)

1045 **European perspective and status in Europe**

Keith Corbett (Herpetological Conservation Trust)

1055 **Legislation**

Tony Gent (English Nature)

1105 **Questions and discussion**

11.15 **Survey and monitoring**

Robin Grayson (Lancashire Wildlife Trust Newt Group)

1135 **Questions and discussion**

1145 **Ecology**

Rob Oldham (De Montfort University)

1215 **Short presentation(s)**

Arnie Cooke (English Nature)
Rob Oldham (De Montfort University)

1230 **Discussion - Ecology**

1300 **Lunch**

1400 Afternoon session: Chair - Henry Arnold

1405 **Case study**

Tom Langton (Herpetofauna Consultants International)
Questions

1435 **Case study**

Phil Horton (Humphries Rowell Associates)
Questions

1505 **Tea**

1520 **Case study**

Bob Bray (Landscape Architect)
Questions

1550 **Short presentations**

Peter Tattersfield (Penny Anderson Associates)
Julia Wycherley (Surrey Amphibian & Reptile Group)
Will Watson (Ecological Consultant)

1620 **General discussion - management and translocation**

1710 **Concluding remarks**

1715 **Tea and depart**

There will be scope to continue formal or informal discussion until 1800.

Appendix 2: attendees

Keith Alexander	National Trust
Henry Arnold	Biological Records Centre
Charles Baker	British Coal Opencast
John Baker	Open University
Trevor Beebee	British Herpetological Society
David Bentley	Freelance Surveyor, Greater Manchester
Peter Blatt	Royal Botanic Gardens, Kew
Julian Branscombe	Humphries Rowell Associates
Pat Brassley	Derbyshire Wildlife Trust
Bob Bray	Landscape Architect
Mark Bridger	Royal Botanic Gardens, Kew
Ian Carolan	British Coal Opencast
Arnie Cooke	English Nature (Science Directorate)
Keith Corbett	Herpetological Conservation Trust
Paul Day	Countryside Council for Wales
David Denman	English Nature (East Region)
Christine Eddleston	Christopher Betts Consultancy
Sheila Galvin	English Nature (Licensing section)
Tony Gent	English Nature (Science Directorate)
Charles Gibson	BIOSCAN Environmental Consultancy
Robin Grayson	Lancashire Wildlife Trust Newt Group
Stephen Head	The Northmoor Trust; Little Wittenham Nature Reserve
Andrew Heaton	National Rivers Authority (Severn Trent Region)
Philip Horton	Humphries Rowell Associates
Liz Howe	Countryside Council for Wales
Alan Hume	Royal Botanic Gardens, Kew
Tom Langton	Herpetofauna Consultants International
Alistair McLee	Cleveland Wildlife Trust
Chris Monk	Derbyshire Wildlife Trust
Kevin Morgan	Herpetofauna Consultants International
Rob Oldham	De Montfort University
Simon Pickering	Wildfowl and Wetlands Trust
Susanna Raper	Durrell Institute of Conservation and Ecology
Steve Ruddy	Royal Botanic Gardens, Kew
Chris Sluman	Open University/Little Wittenham
Alan Stopher	British Coal Opencast
Mary Swan	British Herpetological Society
Peter Tattersfield	Penny Anderson Associates
Tom Tew	Joint Nature Conservation Committee
Will Watson	Ecological Consultant
Sue Weldon	Lancaster University
Penny Williams	Pond Action
Julia Wycherley	Surrey Amphibian and Reptile Group

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