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# Reintroduction strategy for the pool frog *Rana lessonae* in England

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# Reintroduction strategy for the pool frog *Rana lessonae* in England

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(Editors)



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This report was edited by John Buckley (The Herpetological Conservation Trust) and Jim Foster (English Nature) on behalf of the Pool frog Species Action Plan Steering Group. Members of the Steering Group (see Appendix 1) contributed text and suggestions for this document. This document is a slightly amended version of the reintroduction strategy being used as a working document by the Steering Group to guide pool frog conservation efforts. The current version is largely identical, apart from text and figure changes which were made to ensure that potential reintroduction site locations are not identifiable. It was considered necessary to keep the locations confidential to protect any released pool frogs. The methods outlined in this report were the most efficient and practical ones identified at the time of writing; it should be noted that in practice the methods used may vary slightly from these depending on the circumstances at the time of reintroduction.

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# Section 1 Introduction and background

## Purpose of this document

This document has been produced to guide the reintroduction of the northern clade pool frog *Rana lessonae* in England. Using recent guidance on conservation translocations JNCC (2003), the document sets out the rationale for the reintroduction, and then describes the proposed methods. Information on legislative and procedural considerations is also presented. It is hoped that bringing all this information together in one document will be value to those with an interest in the project. The document has been authored by members of the Pool Frog Species Action Plan Steering Group (Appendix 1).

## Pool frogs in England

The generally accepted position for most of the last century has been that only six species of amphibian are native to Britain: *Rana temporaria, Bufo bufo, B. calamita, Triturus vulgaris, T. helveticus* and *T. cristatus*. A number of other amphibian species are established in the wild in Britain and there is sound evidence in most cases that they result from introductions or escapes (Beebee & Griffiths, 2000). The most widespread introduced amphibian populations in Britain belong to the "green" or "water" frog group. Three members of this group are widespread in mainland Europe; the pool frog *Rana lessonae*, the marsh frog *R. ridibunda* and the edible frog *R. esculenta*. These three species can be difficult to distinguish in the field without expertise. Indeed, prior to the

Fig 1. Northern clade pool frog *(Rana lessonae)*

Fig 2. Common frog *(Rana temporaria)*

1970s pool and edible frogs (and until earlier the marsh frog too) were generally considered to be subspecies of *Rana esculenta.* It is now known that the edible frog is in fact a fertile hybrid of the marsh and pool frog, and is more accurately described as *R. kl. esculenta*. The hybridogenetic reproduction processes that occur among these frogs are highly complex, and the reader is referred to more detailed texts for a full explanation (e.g. Berger 1973; Graf & Polls Pelaz 1989; see review in Beebee 1996). Generally speaking, however, edible frogs have to co-exist with either pool or marsh frogs, whereas pool and marsh frogs may exist as single species populations.

The pool frog is a typical Ranid frog, superficially similar in appearance, life history and behaviour to the common frog *Rana temporaria.* It differs in appearance by having a more pointed snout, closer set eyes and relatively shorter hind legs. Maximum adult snout-vent length is 80mm, but a more typical size is 65mm. The general coloration of the northern form is brown with darker brown, black, green and yellow markings, most notably a pale vertebral stripe. The white vocal sacs are conspicuous when the male calls. The central and southern forms of the pool frog tend to have more green coloration. A more detailed description of the species can be found in Beebee & Griffiths (2000).

Water frogs have all been introduced to Britain from continental Europe on many occasions over the past two centuries. Many introductions have been well documented, dating back to a release of edible frogs to several sites in Norfolk in 1837 (Smith 1951). Given the sound evidence for deliberate introductions, the generally accepted position has been that all water frog populations in Britain are present through human agency. However, it is notable in the light of the current reintroduction project that this has not always been accepted, as knowledgeable sources have over the years questioned whether the pool frog (at that time known as the edible frog) was in fact native (e.g. Dutt, 1906).

Photograph 1. Museum specimens of pool frogs collected in Norfolk in 1853

Most if not all the water frog populations resulting from 19th century introductions have subsequently disappeared, but descendants of some recent introductions are still found in a number of locations (Wycherley, Doran & Beebee 2003).

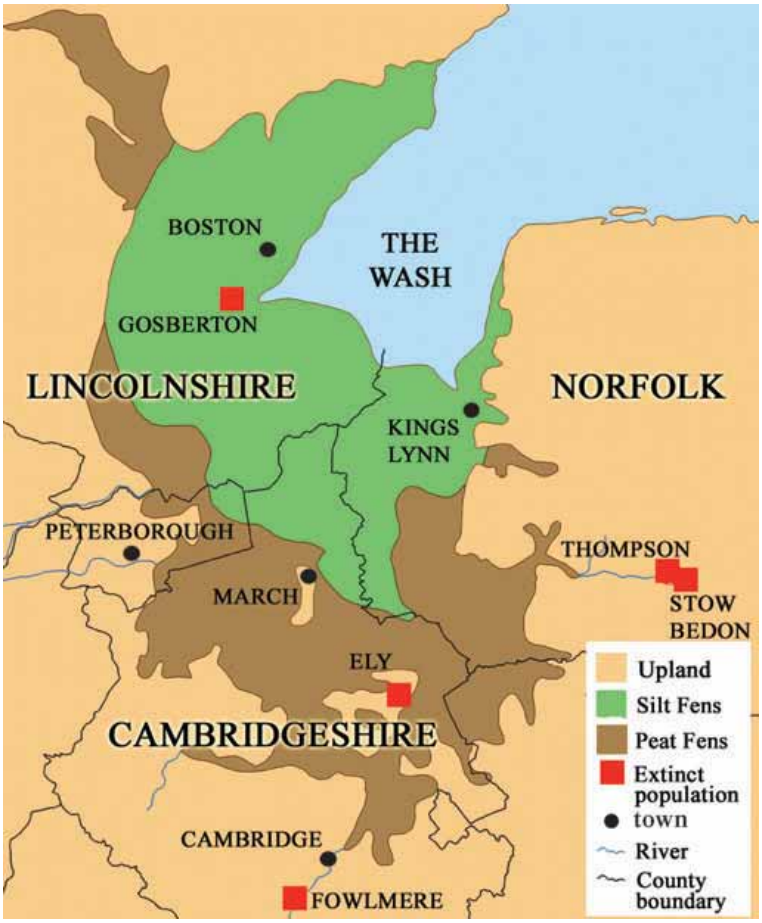
Some of the earliest recorded water frog introductions occurred in Norfolk in the 1830s, but there is evidence to suggest pool frogs were in fact already present in the area. Boulenger (1884) states that the species was "pretty generally diffused" in the area and was known to have been present by 1820. Pool frogs were recorded at Rockland All Saints and Stow Bedon, near Thetford, and these records are supported by contemporary museum specimens (Newton 1859). Boulenger (1897) provides illustrations of the Norfolk specimens. Gadow (1904) reported the species as abundant at that time and commented that they may have been native. Other authors, however, suggested early introduction via various routes, for instance by Italian monks (Boulenger 1884*b*).

Another population was discovered in 1843 at Fowlmere (formerly Foulmire) Fen in Cambridgeshire (Bond 1844*a*). Examination of museum specimens confirms that these animals were also pool frogs, and not other water frog species. Furthermore, authors at

that time indicate that the species occurred in the Fenland area before the early 1800s. Bell (1859) wrote:

> "I have to remark that the fact of the esculent frog being native to this country appears to me to rest upon irrefragable testimony. My father, who was a native of Cambridgeshire, has often described to me, as long ago as I can recollect, the peculiarly loud and somewhat musical sound uttered by the frogs of Whaddon and Foulmire, which procured for them the name of 'Whaddon Organs'. My father was always of the opinion that they were of a different species from the common frog and this opinion of his, formed nearly a century ago, was confirmed by Mr Thurnall's discovery that the frogs of Foulmire are of the species *Rana esculenta*" (now known from museum specimens actually to be *R. lessonae*).

Bond's (1844b) description of the Fowlmere frogs notes their unusual vocal sacs, timidity and restriction to water, all consistent with water frog behaviour. Pennant (1776) noted that the croaking of frogs in fen districts earned them the names of 'Dutch Nightingales' and 'Boston Waites'. The frogs at Fowlmere went extinct by 1847 as a result of fen drainage (Wolley 1847).




Map 1. Fen map showing historical pool frog records

Pool frogs were rediscovered in Norfolk during the 1960s, very close to where populations had been reported in the mid 1800s (Buckley 1986). In common with the populations near Thetford and at Fowlmere during the nineteenth century, this population comprised pool frogs only (based on coloration and morphology), whereas the documented introductions in East Anglia (also represented in museum collections) were mostly of edible frogs. Furthermore, isolated pool frog populations were discovered elsewhere in northern Europe during the twentieth century. A large metapopulation encompassing around 100 ponds on the Baltic coast north of Uppsala in Sweden was discovered during the 1940s (Forselius 1962) and a few smaller populations were discovered in southern Norway in the 1980s (Dolmen 1996). In both cases no other water frog species occur anywhere near these pool frog populations, which are at the northerly range edge of *R. lessonae*.

Detailed studies in Sweden have indicated that the pool frogs there are native (Sjögren 1991; Tegelström & Sjögren-Gulve 2004).

It may seem curious that the respected herpetologist, G A Boulenger, did not recognise the pool frog as a native species, but at that time the taxonomy of the water frog group was not understood, pool, edible and marsh frogs were deemed to be the same species, and the pool frog's known European distribution was incomplete, only having been recorded in Italy. Although Boulenger clearly realised that it had not been established as a result of the 1837 introductions of water frogs, there was little evidence available to support the claim to native status. In recent times, a gradual accumulation of evidence has prompted a major re-evaluation of the pool frog's status in Britain (Snell 1994).

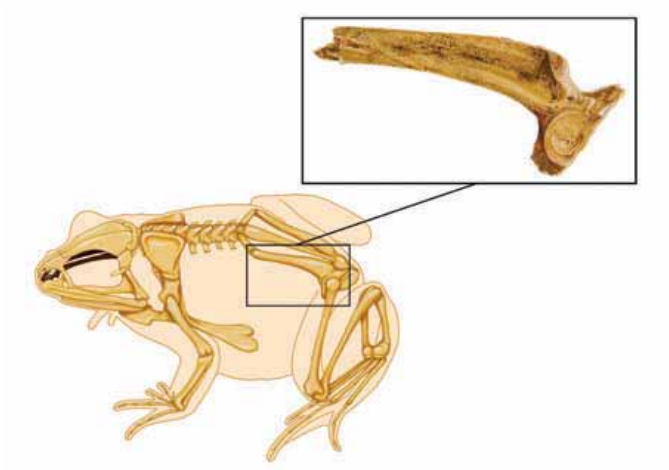


Fig 3. Frog skeleton & pool frog ilium (part of pelvis)

With a view to determining the status of the pool frog in Britain, a research programme was initiated as part of a Species Action Plan (English Nature 1998) which constitutes part of the UK Biodiversity Action Plan (BAP). These projects were devised by the Pool Frog SAP Steering Group with advice from other specialists as necessary. Research projects focused on four main areas: genetic analyses, archaeozoological investigations, bioacoustics (analysis of mating calls) and historical literature investigations.

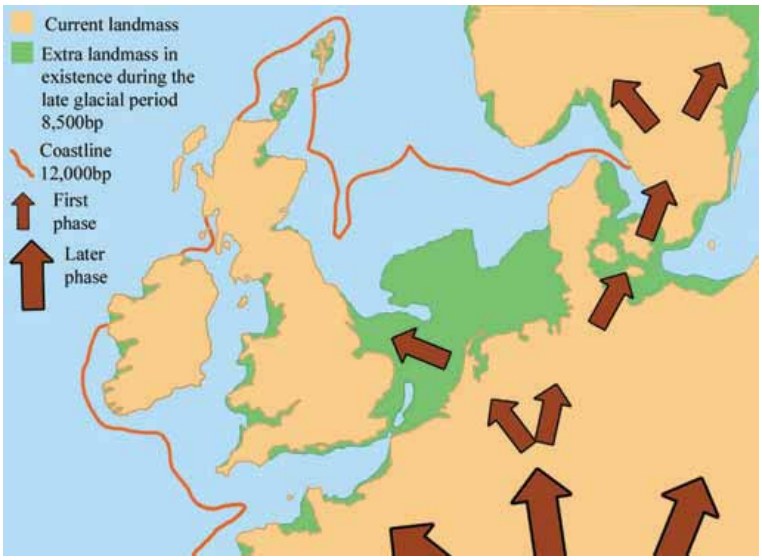
Taken together, the results of these investigations provide compelling evidence that the pool frog existed in England as a native species. The evidence is described and assessed in detail by Beebee et al (in press), and the following is a summary:

- There is a high degree of convergence between genetic and bioacoustic evidence which shows that potentially native English pool frogs are very closely related to Scandinavian pool frogs. This includes genetic analyses of museum specimens collected in the 1800s. The evidence therefore discounts introductions by French monks or Romans (a frequently-cited reason for their presence here in old and recent literature).

- The genetic and bioacoustic evidence shows that introduced central/southern European populations (known to be the origin of recorded introductions) are very clearly distinct from the potentially native populations.

- There is subfossil evidence from the Middle Saxon period (ca. 800-1000 years bp): two pool frog bones demonstrate that the species was present here at sites in Cambridgeshire and Lincolnshire well before known introductions.

- There is no archival evidence of, nor reason to suggest a likelihood of, introductions from northern Europe. There is, however, archival evidence indicating (but not confirming) native pool frog presence from at least the 1760s.



Map 2. Map showing potential post-glacial migration routes

- Human-assisted introduction from Scandinavia can be discounted given that there are small but significant differences between northern clade pool frogs of England, Sweden and Norway. The differences are consistent with the English pool frogs being separate for around 10,000 years. Furthermore, there is no archival evidence of, nor reason to suggest a likelihood of, introductions from northern Europe.

- The post-glacial colonization history inferred for the native populations fits with known climatic and geographical conditions.

- The habitat types used by presumed native populations are ancient, glacial features (natural ponds known as pingos) which is consistent with their likely colonization history.

- A similar biogeographical situation has been established in other species, for example the water beetle *Hydroporus glabriusculus*, which was found to be genetically depauperate at Norfolk sites and more closely related to a Swedish population than to populations in Scotland and Ireland.

- There is no simple explanation for the presence of northern clade pool frogs at the potentially native sites in Eastern England other than the fact that they were present as natives.

One of the many interesting points to arise from the research is that native English pool frogs were part of a genetically distinct northern clade that shows major differences in terms of genetics, vocalisation and pigmentation from pool frogs from central and southern Europe. Importantly, the northern clade is also highly threatened, being present at only a few isolated locations (2 sites in Norway, clusters of ponds totalling around 100 breeding sites in Sweden, and now none in England).

Unfortunately, the last known native pool frog site in England declined to extinction in the 1990s (the last record was in 1994). Extensive surveys during the last ten years have failed to find any native pool frogs at sites that were known or thought likely to have supported the species.

## The Pool Frog Species Action Plan

The Pool Frog SAP was initiated in 1998, and the main initial objective was to establish whether the species was native. Now that this has been achieved, and given that the species is considered to be extinct in England, the SAP called for an examination of reintroduction potential. Various studies conducted over the last few years, summarised later in this document, have assessed the feasibility of reintroducing the pool frog to England. The major remaining objective of the SAP is to restore viable populations to three suitable sites in the likely former range of the species through (re) introduction (note: initially this was programmed to occur by 2003, but the process to investigate native status and establish reintroduction methods has taken slightly longer than anticipated). The current document provides practical advice to guide implementation of this SAP objective. To link the objectives of the SAP with those of the Habitats Directive (under which the pool frog is protected), the Pool Frog SAP Steering Group has recommended that further reintroductions will be needed over a longer timescale to restore the species to favourable conservation status.

## UK and European legislation

The northern clade pool frog is currently extinct in the UK, and given the questions over its status, has never been protected by domestic legislation. This, combined with the presence of established non-native populations of central/southern pool frogs, means that a complex legal situation arises.

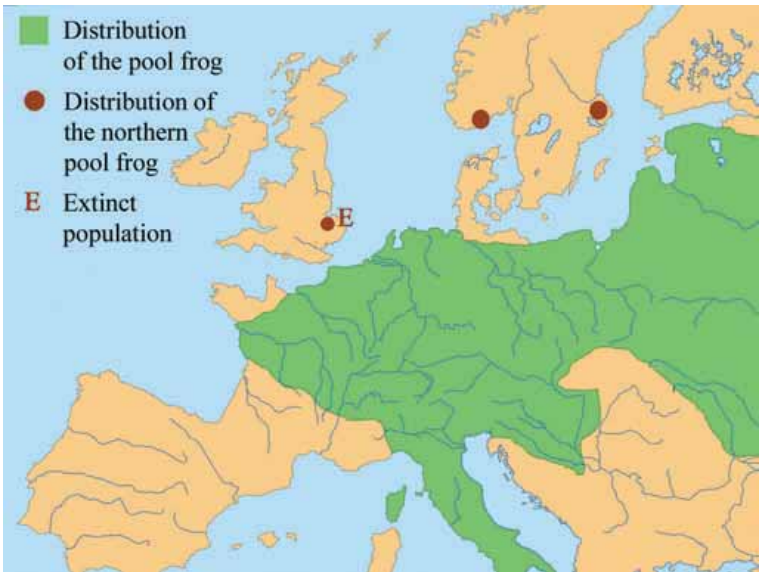
The pool frog is listed on Annexe IVa of Council Directive 92/43/EEC on the conservation of natural habitats and of wild fauna and flora (hereafter referred to as the Habitats Directive), which means member states are required to put in place a system of strict protection. However, as the native form of the species is extinct in the UK, the protection measures are not applicable, nor is the species currently protected via the Wildlife and Countryside Act 1981 or the Conservation (Natural Habitats &c.) Regulations 1994. The listing on Annex IVa of the Habitats Directive indicates that member states are required by Article 2 to work towards favourable conservation status for the pool frog, and this is interpreted to include member states where it has recently gone extinct. Article 22 of the Habitats Directive establishes a duty on Member States to consider reintroduction of species where appropriate to restore to a favourable conservation status.

Section 14 of the Wildlife and Countryside Act 1981 prohibits the release of “kinds” of animal “not ordinarily resident” and established species listed on Schedule 9. The pool frog is not listed on Schedule 9 (although marsh and edible frog are). “Kinds” is generally taken to mean species, sub-species or races. Ironically this situation permits the release of specimens from long-established pool frog populations of non-native origin. Release of pool frogs of the type closest to the original native form would be illegal without a Section 16 licence from Defra, since they do not occur ordinarily in the wild in Britain.

Once reintroduced, the northern clade pool frog would benefit from domestic legal protection (see section 11). It would also be advisable to restrict uncontrolled release of non-native pool frogs.

# Section 2 Aims and objectives of the reintroduction

The overall aim of the reintroduction programme is to establish populations of the northern clade pool frog to England in order to restore it to a favourable conservation status in its natural range. In doing so the project will help achieve Habitats Directive objectives, by restoring the world range of the northern clade pool frog, which is known to have been present in Norway, Sweden and England and occurs at only around 100 ponds.




Map 3. Distribution map of the pool frog (far eastern range not shown)

According to the Habitats Directive (Article 2), favourable conservation status will be achieved when:

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

This concept underpins all the proposed conservation work for the annexed species and the SAP implementation plan seeks to make an explicit link with the aims of the Directive and to achieve this status by 2025. Through the SAP, a working definition of the species' status applicable to the UK is proposed, but this will need to be refined based on research and progress with the reintroduction.

In the first instance the objective is to restore populations to three sites in the likely former range of the species: The Fenland region of Norfolk, Cambridgeshire, and Lincolnshire. It has not proved possible to meet this initial SAP target by 2003 because of the time taken to get the first choice of sites into suitable habitat condition and the time taken to prepare and publish the results of the work providing the evidence of native status.

To achieve favourable conservation status in the UK, the following targets are suggested:

- The northern clade pool frog needs to be present as viable populations on a series of representative sites to form a robust distribution that allows for climate change and

reflects scope for natural changes in range. The aim is to have pool frogs re-established at more than 10 sites or at least 50% of the potential/reclaimable sites, breeding in >50 ponds, occupying an area of at least 100ha within the presumed distribution of fenland and associated habitats prior to large scale drainage since the 17th century.

- The species needs to be common and have a wide distribution around key sites. Populations at all sites should be viable, breeding and sufficiently robust to be able to re-populate areas naturally following any event that leads to a depopulation. To be viable the population size at each site needs to be more than the theoretical minimum viable population size and at the core areas the population should be at an even higher level. To remain viable the populations will need to demonstrate reproductive success, with froglets produced in sufficient numbers to sustain the population. Habitat links between sites need to be developed to allow for re-colonisation in the event of adverse events especially in the case of small sites.

- Appropriate habitat management should be in place to ensure the long-term survival of the populations as viable components of the habitat and appropriate habitat. Species' protection measures should be in place to allow strict control of activities that could adversely affect the populations, to ensure there is no net reduction in status.

Further work will be undertaken to assess the applicability of the criteria outlined above as thinking on measures of favourable conservation status develops at UK BAP and European Commission levels.

A monitoring protocol needs to be developed to demonstrate progress towards the above objectives and to fulfil the requirements of Articles 11 and 17. It is suggested that the survey strategy will include both direct species assessment and "surrogate" measures to assess population size and viability. The data collected will include:

- habitat quality and extent
- presence of adults
- population structure
- presence of breeding
- distribution
- assessment of threats.

Detailed discussion of post-release monitoring at the site level is given in section 9. Further analysis will be required for a long-term monitoring strategy covering all reintroduced populations.

# Section 3 Assessment of pool frog reintroduction proposals against the IUCN Reintroduction Guidelines criteria

The JNCC has considered the IUCN Reintroduction Guidelines (IUCN, 1995) and produced an assessment procedure to standardise reintroduction evaluation (JNCC, 2003). The procedure set out in the latter's document's Annex 1 - "A process for evaluating and undertaking species translocations for conservation purposes" - is followed below for the proposed reintroduction of the northern clade pool frog to a site in Norfolk. Some consideration is also given here in a more general sense to the wider aims of the reintroduction programme, i.e. future releases at other sites in the Fenland area. For clarity, text in **bold** type here is reproduced from Annex 1 above, and the same numbering system is used. Note that in many cases further detail on the points raised is provided elsewhere in the current document.

**1. Evaluation**

**1.1 The purpose(s) of the proposed translocation will be considered.**

The translocation is to initiate a reintroduction of the northern clade pool frog *Rana lessonae*. This is a target of the ongoing Pool Frog Species Action Plan (an element of the UK BAP), and is in line with the requirements of Article 22 of the EC Habitats Directive, which looks to considering reintroduction where this assists achievement of favourable conservation status. The overall long-term aim is to work towards achieving favourable conservation status at a UK level and contribute towards its achievement at a European level. The initial translocation currently being described is intended to result in the establishment of a viable metapopulation at a specially prepared site in Norfolk. To some extent this initial release will also act as a test of the reintroduction techniques, so that future translocations can be guided by experience.

**1.2 Prior to embarking on a species translocation, the following points should be considered:**

**i) Has an appropriate survey established the current status of the species at the candidate recipient site(s)?**

Surveys and site visits at the recipient site have failed to locate any northern clade pool frogs.

**ii) Are the reasons known for the previous decline and local extinction of the species?**

Yes. Various factors have been implicated in the loss of this species, and it is likely that several were acting in concert at many sites. The wholesale draining of the Fens since the 17$^{th}$ century has resulted in massive habitat loss; this was documented as one of the earliest extinctions (Wolley, 1847). Isolated colonies have since been lost to factors such as land drainage and a change in habitat management. At the last known site a run of dry summers, the general lowering of

the water table, scrub encroachment, a reduction in grazing pressure and collection pressure may all have contributed to the extinction, though it appears that the major factor was a reduction in the water table with consequent effects on pond status (Beebee and Wycherley, 2001).

**iii) Have the reasons for the extinction of the species at the recipient site been remedied?**
Yes. The first reintroduction site is close to the last pool British frog site and is now in better condition than the former site, due to targeted effects at habitat restoration over the last few years. This has included pond (pingo) restoration and enhancement of adjacent terrestrial habitats.

**iv) Is there potential for natural range extension to result in the colonisation of the candidate recipient site(s) over a known timescale?**
No. There is no potential at all for natural recolonisation, because the species has been lost from the UK and the low dispersal powers of the frog preclude this.

**v) Could habitat restoration and management lead to the recovery of the species without the use of translocation?**
No. The species is lost from the UK.

**1.3 Agreed criteria for evaluating proposed conservation translocations include:**

**i) There should be good evidence that the species is absent from the proposed release site(s) before the initial conservation translocation.**
Yes: there is no evidence of the species' continued presence from surveys since 1994. The northern clade pool frog used to be present in good numbers at several sites, as described by Buckley (1986) and others. The last known population, at Site A in Norfolk, declined to extinction in the mid-1990s.

**ii) The release site(s) proposed for establishment should be within the historic range (post 1600, to take account of the species first documentation of species distributions in Britain) of the species.**
Yes: documented evidence and preserved museum specimens exist from two sites since 1700, one lost in 1847 and the other in the 1990s. Archaeozoological studies indicate the species' presence over a wider area in Anglo Saxon times. Archival research has demonstrated a likelihood of the species being present in the Fenland area since the 18$^{th}$ century.

**iii) There should be a good understanding of the reasons for the original decline and disappearance of the species considered for translocation and the causes of its reduction or elimination from the site(s) proposed for the establishment of the species.**
Yes: habitat loss and degradation are thought to have been the key factors in the decline of the species, as described above. These factors have been alleviated at the proposed release site.

**iv) There should be consideration of the outcome of any previous translocations of the species involved, either in GB or elsewhere.**
Translocations in Sweden have been successful and an acknowledged Swedish pool frog specialist has provided details of the methods used. Established populations of the non-native form of this species occur elsewhere in the UK (as a result of releases or escapes); although these are undesirable from a conservation perspective, they do demonstrate the general suitability of climatic and habitat conditions and the fact that translocations of this species can become established. Many introductions of the closely-related *Rana ridibunda* have also become well established.

**v) Consultation needs to be made with other organisations and individuals who may be interested in or affected by the proposed translocation project.**
English Nature, national conservation bodies and local landowners have all been involved and consulted through the Pool Frog SAP Steering Group. Expert opinions have also been sought and received from Sweden and Norway. Dispersal into surrounding areas is considered extremely unlikely, so it has not been necessary to consult other organisations or individuals in the area.

**vi) There should be an assessment of the benefits to the species concerned arising from the proposed translocation (over both the short and long term timescales).**
The species will be re-established in one of the counties where it was formerly native. The translocation will increase the range and numbers of the endangered northern clade of the pool frog. The reintroduction will contribute to the achievement of favourable conservation status at UK and European levels. Applied scientific and conservation benefits will accrue in terms of the assessment of amphibian reintroduction techniques.

**vii) There should be consideration of any possible harm effects to donor populations.**
The view of the Pool Frog SAP Steering Group is that there will be no harmful effect on donor populations of the collection of spawn, tadpoles or individual animals in the numbers proposed. This assessment has been arrived at after carefully considering the population structure and dynamics of the species, and after consultation with Swedish authorities. The frogs will be taken from a range of sites supporting robust populations, and the majority of animals will be in the early age classes, to reduce potential impacts.

**viii) Assessment needs to be made of any possible harm to other species or habitat at the proposed recipient sites.**
None is considered likely. In Sweden the pool frog co-exists with many of the species found at the translocation site e.g. smooth newt, great crested newt,common toad, common frog, grass snake. Indeed, the species is associated with high diversity ponds. The northern clade pool frog used to occur at sites in England where there is considerable biodiversity. The resident species at the release site are in fact likely to benefit considerably from the habitat enhancement that has been

undertaken primarily for the pool frog reintroduction. A disease risk assessment has been developed and this will be used to minimise any potential pathogen transfer risks. This indicates that there is a very low risk of any pathogen problems so long as standard procedures are adhered to.

**ix) The fit with other conservation objectives of the statutory agency concerned needs to be considered.**
Management for the pool frog will improve the other pond species such as the rare damselfly *Lestes dryas* and the crested newt *Triturus cristatus*. The management and the monitoring of the site will fit well with the conservation objectives of English Nature, as they will contribute to the enhancement of biodiversity in the wider countryside. The project demonstrates good practice in science and in partnership working.

**x) The likely chances of success of the proposed conservation translocation should be addressed.**
The likelihood of success is rated as high, based on a range of research including a Population Viability Analysis, and on previous examples of translocations of the same and closely related species.

**xi) Availability of earmarked funds to complete the planned translocation and subsequent monitoring should be confirmed.**
Anglian Water, English Nature, The Herpetological Conservation Trust and the Environment Agency are supporting the project. These organisations have provided funds in recent years and there is a reasonable expectation of futurefunding, particularly given the status of the species on the BAP and the Habitats Directive.

**xii) Use of the most appropriate donor stock, should take into account the ecology, behaviour and genetic constitution of the species.**
Scandinavian pool frogs have been identified as most similar to the native British animals in terms of genetics, bioacoustics, morphology, ecology and behaviour (e.g. Beebee *et al*, in press; Wycherley *et al,* 2002). The Swedish populations are more numerous and robust than the Norwegian ones, so it has been decided that Swedish animals would be preferable.

**1.4 The use of a scoring system could be considered to give weight to the listed criteria and to assist with evaluating candidate species for conservation translocation. Where translocations involve more than one country or there are broader policy issues involved, the Joint Nature Conservation Committee can be a forum for discussing options and agreeing decisions.**

A standard scoring system has not yet been developed, but all the above points have been thoroughly considered and indicate that there is a sound case for reintroduction. Only one country is involved (England) and consultation with the JNCC during the preparation of this strategy has confirmed that further agreement on the principle of reintroduction is not required.

## 2. The decision

**It is recommended that the decision to proceed with a translocation should be made by the forum that is responsible for planning and carrying out the conservation of the species or habitat concerned. This will typically be the appropriate UKBAP group, whose actions will be endorsed by both statutory conservation agencies and non-governmental organisations. In some difficult or contentious cases, it may be necessary in addition to refer translocation proposals to the appropriate level of authority within a country agency (such as Board or Council), or to the appropriate level of authority for the agencies working together (Chief Scientist Group or Joint Nature Conservation Committee). Where translocations involve species listed on schedules 5 or 8 of the Wildlife and Countryside Act, 1981, then the formal licensing procedures carried out by the country agencies will apply. Where the translocation involves donor or recipient sites that are designated as a SSSI, then again the permission of the relevant agency or agencies must be sought well in advance of the proposed translocation.**

Now that the native status of the species is established, the reintroduction is a key target of the Pool Frog SAP and is considered both desirable and feasible by the Pool Frog SAP Steering Group. For confirmation, the proposal has been discussed and agreed with English Nature's Chief Scientist and with the JNCC. The initial reintroduction site is not a Site of Special Scientific Interest. Licensing relating to section 14 of the Wildlife and Countryside Act, 1981, is being discussed with Defra. The necessary licences to permit the collection and export of frogs from Sweden have been agreed.

## 3. Preparation

**3.1 If a decision has been made to proceed with a conservation translocation, sufficient time should be allowed to do the following.**

**i) Obtain necessary approval from other organisations or landowners and resolve any differences of view.**
All parties have given their approval.

**ii) Communicate and discuss with other conservation organisations (statutory and voluntary) the project plans for the proposed translocation.**
All parties have been consulted or are aware of the project.

**iii) Bring together the specialist skills required (from the conservation agency and elsewhere) to complete the project.**
The specialist skills exist within the PF SAP SG and its advisers.

**iv) Itemise and obtain the equipment needed.**
Items required for the collection transport and release of the pool frog life stages have been identified, obtained or ordered.

**v) Plan the obtaining, handling and releasing of individuals from donor populations.**
The planning has taken place in discussion with the Swedish nature conservation authorities (the Swedish Environmental Protection Agency) and English Nature.

**4. Translocation**

**This comprises:**

**i) Obtaining the most suitable stock for translocation.**
Stock will be available from wild populations in Sweden in 2005. Details on the numbers and life stages required are given later in the current document.

**ii) Planning a captive breeding or propagation programme to the increase numbers to be released.**
No captive breeding programme is required, at least in the initial stages.

**iii) Screening for any disease organisms and deciding whether dependent species (such as parasites or disease organisms) should be included in the translocation.**
Health screening will take place before the release of frogs. A detailed disease risk assessment has been produced in conjunction with the Zoological Society of London.

**iv) Transporting and releasing of the species according to agreed protocols to ensure the welfare and viability of the species concerned.**
Specimens will be collected and transported using the standard procedures for live amphibians.

**v) Recording and documenting the activities of the project at each stage in sufficient detail to allow others not involved with the project to repeat the work in future.**
Biological data will be collected as planned and entered onto The HCT database. The wider reintroduction activities will be recorded by all involved. Annual reports will be produced and deposited with English Nature and other bodies as appropriate. Records will be made available on the National Biodiversity Network Gateway at an appropriate resolution. Assessments of conservation status will be developed as part of UK surveillance of the conservation status of Annex IV species in line with EC requirements through articles 11 and 17 of the Habitats Directive.

**5. Post translocation**

**5.1 Establishing appropriate monitoring for the species concerned is required in order to assess the outcome of the translocation. This monitoring will need to be continued for a sufficiently long period (in relation to the life span of the**

**species involved) so as to be able to measure the population performance over several generations. Resources to undertake this monitoring should be available to the organisation(s) proposing and undertaking the translocation at the inception of the programme and for an agreed duration to assess the outcome of the translocation.**

Methods have been established, and further details are given later in this document. Surveys will be undertaken via The HCT and other bodies. The HCT database will house the data. Records of all translocations will be deposited with the appropriate national and local recording schemes, taking into account sensitivity of the site location.

**5.2 The results of the monitoring should:**

**i) Inform decisions over future translocation proposals for the species concerned.**
All monitoring work will be reported and on will inform future reintroduction proposals.

**ii) Be deposited with the relevant conservation agency and, where appropriate, be published in suitable scientific and conservation journals**
Annual reports will be deposited with English Nature and scientific papers will be produced. Studies on the pool frog research to date have been published or are in press in scientific journals (see references).

**iii) Be communicated to other conservation organisations and, where appropriate, to the media and wider public.**
A communications strategy (later in this document) has been produced to accommodate this. Progress with the reintroduction will be communicated to the conservation community and to the wider public via the media. The Pool Frog SAP Steering Group includes representatives from the main relevant statutory and voluntary organisations.

# Section 4 Selection of reintroduction sites

Note: this section summarises work by Beebee and Wycherley (2001)

## Pool frog habitat requirements

The habitat preferences of the pool frog are considered in detail so that comparison of the suitability of the potential reintroduction sites may be made.

Photograph 2. "OG" Pond, Sweden

**Northern clade pool frogs :**

- Prefer small water bodies associated with woodland or forest habitats.
- Prefer to hibernate in terrestrial woodland and forest habitats buried in the soil or buried beneath moss, leaves and woodland debris. As hibernation is not continuous and individuals become active at irregular intervals during the winter they require alternative hibernation sites of up to100m distance.
- Require open basking and feeding areas on the pond edge and also suitable open foraging habitat on land away from the pond. Juveniles leave the pond and may move into adjacent grassland for foraging and feeding.
- Need sheltered south-facing banks or floating leaves and vegetation, for good insolation.
- Require several available ponds as these may be used separately for feeding and breeding. Females arrive shortly after the males but only remain in the breeding pond until they have mated and spawned.
- Select sheltered pond margins preferably with a mosaic of open water, submergent vegetation and low emergent vegetation. The pool frog deposits egg masses on or just beneath the surface in areas of warm water.
- Need permanent water bodies for successful breeding. The tadpoles prefer shallow,

well-vegetated margins and metamorphosis occurs between July and August.

Photograph 3. Good pool frog terrestrial habitat: small scale clearings with dense ground cover and uneven topography, Sweden

**Habitat analysis**

- It is clear from comparisons between Norway, Sweden and Norfolk that pool frogs can tolerate a wide range of pond sizes and densities, but a network of multiple permanent ponds (at least 10, within at most a few hundred metres of each other) is necessary to sustain a metapopulation.

- Ponds should be between 15 – 100 metres in diameter, not more than 1-1.5 metre deep in the centre and with shallow margins.

- The ponds should have extensive areas of accessible bank, not overgrown with rank vegetation or masked from the sun by emergent macrophytes or terrestrial scrub/trees. The ponds themselves should be open to the sun with large areas of open water.

- Cyprinid fish and other amphibians, including crested newts, are compatible with pool frog populations but large predatory fish such as pike and trout are not. The situation regarding sticklebacks is unclear but probably these fish do not pose a threat.

- A large range of water chemistries is compatible with pool frogs, from highly oligotrophic to extremely calcium rich ("hard water") conditions. High concentrations of $NH_3$ (> 0.1 mg/litre) or $NO_3$ (>1 mg/litre) may be best avoided, however.

Photograph 4 . Hibernation area about 100m from breeding pool, Sweden

- Terrestrial habitat surrounding the ponds

(to a radius of at least 500 m) should include a moist understory with moss or other low growing vegetation when under forest canopy, or meadow grassland elsewhere. Mixed woodland is acceptable provided it does not shade the ponds, but is not strictly required.

- Potential hibernation sites such as logs, rocks or small mammal burrows should be available within 200 metres of each pond. In most sites at least some of these features these will normally be present as a matter of course.

**Selection of introduction sites in England**

The site of the most recent native population and five other localities, which were either discovered during recent surveys for pool frogs or were suggested on the basis of apparent habitat suitability, are considered. All are potential reintroduction/introduction sites.

**i) Site A**, Norfolk, north of Thetford
The site of the most recent native population, which became extinct some time during the 1990s. Together with adjoining areas, there are >100 ha of mixed meadow and woodland with >200 ponds (pingos, of glacial origin).

**ii) Site B**, Norfolk, north of Thetford.
A site with 120-130 ha of mixed woodland with many tens of pingos that are mostly shaded by trees.

**iii) Site C**, Norfolk, north of Thetford.
A site of about 40-50 ha of mixed woodland, including a variety of alien species, with tens of pingos, mostly shaded by trees. Thearea estimation is arbitrary because habitat extends north and west into other large (but generally drier) woodlands.

**iv) Site D**, Norfolk, north of Thetford.
A site of some 35-40 ha of mixed woodland with >20 pingos are mostly shaded by trees with an area of open marsh at the western edge.

**v) Site E,** Norfolk, north-east of Downham Market.
A site of around 70 ha of mixed woodland with a central open meadow. Many wet areas exist but only one is more or less permanent, an artificially excavated pond within woodland in the SW corner.

**vi) Site F,** Cambridgeshire, south of Cambridge. A site with extensive spring-fed pools, streams and reed beds covering 40-50 ha, this is the only other area apart from Site A in which pool frogs were documented, but there have been no records since the 19$^{th}$ century when much of the fen was drained. Currently, only two pools are possibly suitable.

**Pond features – chemical**

All the British ponds exhibit typical chalk aquifer “hard water” characteristics. Some specific features were notable in the British sites: ammonia concentrations were relatively

high at Sites D and E; nitrate was high at Sites C and F (though in neither case sufficient to cause tadpole mortality); phosphate was relatively high in one Site B, at Site C and on Site F. there was a substantial difference in water quality between the two ponds sampled in Site B.

**Table A. Pond features – chemical**

| Site/Area | pH | Cond | Ca | Mg | Na | K | $NH_3$ | $HCO_3$ | Cl | $SO_4$ | $NO_3$ | $PO_4$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Site A (2) | 7.0 | 478 | 107 | 1.9 | 1.3 | 3.0 | 0.08 | 215 | 17.0 | 10.05 | <0.2 | 0.09 |
| Site B (W) | 7.4 | 726 | 165 | 2.5 | 17.8 | 3.0 | 0.09 | 305 | 30.0 | 36.0 | <0.2 | 0.24 |
| (E) | 6.9 | 306 | 72 | 1.7 | 11.5 | 3.0 | 0.19 | 110 | 22.0 | 14.0 | <0.2 | 0.11 |
| Site C | 7.6 | 1075 | 181 | 5.1 | 72.0 | 7.0 | 0.12 | 315 | 98.0 | 40.0 | 11.5 | 0.12 |
| Site D | 7.6 | 898 | 208 | 2.9 | 27.3 | 3.0 | 0.40 | 350 | 44.0 | 77.0 | <0.2 | 0.08 |
| Site E | 7.9 | 836 | 179 | 2.7 | 22.7 | 3.0 | 0.29 | 300 | 51.0 | 51.0 | 0.58 | 0.07 |
| Site F | 7.0 | 770 | 166 | 4.8 | 18.3 | 3.0 | 0.05 | 225 | 40.0 | 57.0 | 15.1 | 0.13 |

(2), Data are averages of 2 ponds. Others are single samples.

(W) (E) = ponds towards western and eastern ends of Site B.

Conductivity was measured in µmhos at constant temperature. All ions are in mg/litre

**Landscape and terrestrial habitat**

Table B summarises landscape and terrestrial habitat comparisons between the potential introduction sites. At the Site A pingoes most of the banks were potentially available for basking. Forest was almost non-existent around these ponds. By contrast, landscape around the other potential introduction sites in Britain was quite heavily forested to the extent that many of the pools suffered from excessive shade and leaf fall.

Photograph 5. Good terrestrial habitat with small pools for use in summer at Gäddalen, Sweden

Damp understory with occasional wet ditches or hollows is known to be important for movements of frogs between ponds. Suitable frost-free refugia (logs, rocks or access to underground cavities within 1-200 metres of the ponds) are also essential for hibernation, which always occurs on land. Such understory was ubiquitous around the Swedish sites and comparable habitat structures were predominant in Norway, Site A and Site B. It seems likely that most of the other potential introduction sites were also adequate in this respect, although often slightly drier.

**Table B. Landscape and terrestrial habitat.**

| Site/Area | Periphery - % open ground within 5m of pond | Forestry - % tree cover within 100 m of pond | Understory – dominant ground cover |
|---|---|---|---|
| Site A | c.92 | <10 | Rank meadow, pasture |
| Site B | 85 | 10 - 15 | Damp grass, moss; logs, bracken |
| Site C | <10 | >99 | Moss, logs, bare ground |
| Site D | <10 | >99 | Moss, logs, bare ground |
| Site E | c.10 | >95 | Damp grassland |
| Site F | c.50 | <50 | Not determined |

**Overall habitat analysis**

Previous studies in Sweden, comparing ponds used and unused by pool frogs indicated that drainage associated with forestry operations was the single most discriminating factor, evidently predisposing against frogs. Other factors which might be important were distances between ponds (large distances increasing local isolation and extinction) and ammonia levels, with the higher concentrations associated with lack of frogs.

## Land use and water regimes

Water regimes at Site A have changed over recent decades in ways that probably disadvantaged pool frogs. Since 1970, the water table has shown a consistent downward trend, and this lowering of the water table was probably due to increased local abstraction and drainage. Indeed, the main stream drain taking water off the common towards the south-west was deepened during this period to reduce local flooding. By the 1990s a large proportion of the ponds were drying up completely in some years, especially when rainfall was low. Not only is this likely to cause total breeding failure, but adult behaviour could be affected (perhaps stimulating emigration in search of water) because these frogs stay in or near ponds all summer. Lowering water levels together with reduced grazing pressure may have contributed to this change, which has almost certainly been for the worse with respect to pool frog requirements.

## Potential reintroduction sites

A summary of the prospects for the six sites currently under consideration is suggested in Table C. On this basis the six sites can be prioritised as follows:

**Table C. Assessment of possible reintroduction sites.**

| Site | Pond number | Pond condition | Pond chemistry | Terrestrial habitat | Other actors | Management needs | Time scale |
|---|---|---|---|---|---|---|---|
| Site D | A | C | B | C | A | Tree clearance Pond dredging and excavations. Pond chemistry checks | >3 years |
| Site F | C | A | B | A | B/C | Pond creation. Pond chemistry checks Predator and water temperature checks | >3 years |
| Site C | A | C | B/C | C | A | Tree clearance Pond dredging. Pond chemistry checks | >3 years |
| Site B | A | B | A/B | C | A | Tree clearance Limited pond clear-ance at this stage | 1-2 years |
| Site E | C | A | A/B | A | B | Pond creation. Pond chemistry checks Water table maintenance | >3 years |
| Site A | A | B/C | A | B | C | Pond clearance Higher grazing level Restoration of water table | >3 years |

A = Conditions already suitable; B = some work needed; C = considerable work needed.

**Sites most easily/quickly manageable into suitable condition Site B.** This site currently maintains conditions closest to those thought necessary for pool frogs. A selection of 14 of the existing ponds, perhaps towards the east end of the site, has been selected and peripheral trees removed so they become open to the sun. Some emergent vegetation removal from one or more of these ponds will be carried out in February 2004. Further work may be needed in 2004/5 dependant on how these ponds respond to management.

**Sites requiring more effort but nevertheless practicable.**
Three sites fall into this class:

**(i) Site F**.
This site has two ponds where pool frogs might breed, although water temperatures and stickleback predation effects need checking. It also has areas already within the reserve that provide good terrestrial habitat, and further sites nearby that might be purchased, where ponds could be excavated relatively easily and quickly. Further water chemistry tests would be needed to ensure that quality was satisfactory (specifically that nitrogen levels were suitably low).

**(ii) Site E**.
This site currently has just a single permanent pond, and top priority would be the construction of at least nine others in the open meadow area and/or in woodland (where peripheral trees and scrub would have to be removed). The meadow is wet in summer

Photograph 6. Site selected as reintroduction habitat

Photograph 7. Same site after further management

and currently managed by mowing, all of which provides good terrestrial habitat although grazing would probably be a better tool. It would be essential to obtain assurances that water levels would be maintained in all the ponds throughout the spring and summer.

**(iii) Site A**.

The main problem at this site is probably the lowered water table, and top priority should be the reversal of this situation. Removal of vegetation, especially emergents, from several of the ponds will be needed and a somewhat more intensive grazing regime (perhaps including cattle to control pond vegetation) is desirable. Given that Site A was the most recent home of British pool frogs, and therefore the only place we know for certain that they can survive, it is very much to be hoped that this restoration can be achieved.

### 7.3 Sites requiring very extensive work

Two sites are included here:

**(i) Site D**.

Although this site has multiple ponds, extensive clearance would be needed to open them up and new excavations would be required to create ponds in the westerly area of marsh. Even then there may be problems with water quality (such as high ammonia concentration, perhaps associated with extensive *Lemna* growth in some on the ponds). Silt dredging may be required to remove accumulated nutrients.

**(ii) Site C**.

This site has plenty of ponds, but again there were many with dense covers of *Lemna* and in this case nitrate level was high in the test sample. Management needs would include extensive tree clearance and pond dredging, followed by further chemical testing of water quality.

## Selected initial reintroduction site: Site B

This site currently maintains conditions closest to those thought necessary for pool frogs. Fourteen ponds have been identified as being potentially suitable for pool frogs although not all these would be satisfactory as breeding ponds. Most require some management tasks and some of these tasks have been successfully carried out during 2003. The status of the ponds as at December 2003 is listed in Table D.

**Table D. Pond status at Site B – December 2003**

| Pond | Status | Management | Potential use by pool frogs | Year available |
|---|---|---|---|---|
| 1 | Permanent | Clear *Typha* to maintain some open water<br>Fill outlet ditch<br>Some dredging needed | Feeding<br>Basking | 2004/5 |
| 2 | Semi-permanent | *Trees cleared 2003*<br>Some dredging needed | Feeding<br>Breeding *<br>Release site* | 2005/6 |
| 3 | Permanent | *Most trees cleared 2003*<br>Final tree clearance 2004<br>Some dredging needed | Feeding<br>Breeding * | 2004/5 |
| 4 | Permanent | *Trees cleared 2003*<br>Maintain sedge tussocks in open water mosaic | Breeding *<br>Release site* | 2004 |
| 5 | Permanent | *Trees cleared 2003*<br>Maintain *Typha* to present levels<br>Release site* | Feeding<br>Breeding* | 2004 |
| 6 | Semi-permanent | *Tree clearance 2003*<br>Some dredging needed<br>Maintain open basking areas | Feeding<br>Basking | 2004/5 |
| 7 | Semi-permanent | *Trees cleared 2003*<br>Occasional management of emergent vegetation | Feeding | 2004 |

| Table D Cont'd .../.... | | | | |
|---|---|---|---|---|
| **Pond** | **Status** | **Management** | **Potential use by pool frogs** | **Year available** |
| 8 | Permanent | *Tree clearance 2003*<br>Remove brash/small hardwoods | Links to ponds 4 & 5 | 2004/5 |
| 9 | Semi-permanent | *Trees cleared 2003*<br>Part-clear Typha | Link to pond 5 and Ponds 1 & 7 | 2004/5 |
| 10 | Permanent (in parts) | *Shading hardwoods removed 2003*<br>Manage *Phragmites* to keep some open water in deeper areas<br>Some dredging needed | Basking<br>Feeding | 2004 |
| 11 | Permanent? | *70% hardwoods removed 2003* | Basking | 2004 |
| | | Manage *Phragmites* to keep open bays<br>Some dredging needed | Feeding | |
| 12 | Permanent | *Trees cleared 2003*<br>Remove Water Soldier | Breeding*<br>Release site* | 2004 |
| 13 | Semi-permanent | Fell poplars 2003/4<br>remove brash 2004 | Link ponds 4,5,8 to ponds 2,12, 14 | 2005 |
| 14 | Permanent | Clear trees 2003/4<br>Clear brash from pond | Link pond as for 13 | 2004/5 |

Tasks in *italics* completed 2003

Breeding* ponds potentially suitable for 2004 which offer suitable areas for assembly, basking, chorus, egg deposition, larval development and feeding. Basking and feeding ponds offer suitable habitats for pool frogs other than breeding.

Release* ponds which may be considered as currently suitable for reintroduction in 2004.

**Note**

As standard procedure all these sites will require annual appraisal initially in order to evaluate the effects (if any) of the variable amounts of tree clearance work that has been undertaken. Emergent and marginal vegetation will also need monitoring and a regular program of management tasks prepared so that a mosaic of micro-habitats is maintained at the pond margins.

# Section 5 Selection of reintroduction stock 1: genetics, source population(s)

## Pool frog genetics

Microsatellite, RAPD (Randomly Amplified Polymorphic DNA) and male advertisement call analyses have yielded a highly concordant view of European pool frog phylogeography. Animals in "mainland" Europe, from France in the west to Poland in the east, are broadly similar in many respects. Although there is genetic differentiation across this range, frogs in central Europe generally exhibit relatively high diversity at six microsatellite and 160 RAPD loci, and male advertisement calls have strong similarities. The majority of frogs in this area also have variable amounts of green coloration on their dorsal surfaces. Pool frogs introduced into various parts of England from mainland Europe over the past century or more, which in some cases have formed longstanding populations, have mostly retained the characteristics listed above. The great majority of pool frogs currently live in this main, central European range.

By contrast, relatively small pool frog populations discovered or rediscovered within the past 60-70 years in three areas of northern Europe have distinctly different genetic characteristics. Frogs from these three areas (Norfolk, southern Norway and east-central Sweden) are geographically isolated from those in mainland Europe both by sea and by substantial areas of terrestrial habitat completely lacking in native pool frogs (or any other water frog species). These northern clade pool frogs have no diversity at the six microsatellite loci, but share the same fixed alleles at five out of six loci. They are therefore closely related, as also confirmed by the RAPD study. Moreover, male advertisement call characteristics are similar among northern clade frogs and animals from all three countries are mostly brown on the dorsal surface. There can be no doubt that pool frogs from Norfolk, Norway and Sweden are closely related and distinct from those in mainland Europe.

Phylogeographic analysis suggests that northern clade pool frogs probably colonised eastern England and southern/central Scandinavia in the period immediately after the end of the Younger Dryas cold period, about 11,000 years ago, when dry land was still present in much of what is now the North Sea. There can have been little or no contact with mainland European populations since that time.

Unfortunately we know virtually nothing about adaptive variation in these frogs. Central European pool frogs require warmer water for optimal larval development than their close relatives (edible and marsh frogs), but this seems difficult to reconcile with northern clade pool frogs living further north than either of the other two water frog types. It may be that optimal temperatures for northern clade pool frog development are lower than those of mainland European pool frogs as a result of local adaptation, but this has not been investigated. The environments in Norfolk, southern Norway and east-central Sweden also have some notable differences. The Scandinavian populations inhabit relatively well-forested habitats, although the ponds are open to the sun, whereas Norfolk animals (now extinct) occupied more open terrain. Water quality in breeding ponds varies from rather

eutrophic (Norfolk) through moderately mesotrophic (Sweden) to highly oligotrophic and acidic (Norway). Minimum winter temperatures are relatively mild in Norfolk, colder in Norway and very cold in Sweden though summer maxima are similar in all three regions. Both Norway and Sweden have very different patterns of daylight hours from those in Norfolk, particularly noticeable in late spring when breeding occurs. Any or all of these features, as well as others not yet recognised, could have resulted in local adaptations within the northern clade zone. This type of genetic variation, relating to quantitative traits that affect fitness, is much more difficult to assess than variation at neutral markers such as microsatellites or RAPDs. It is important to note that these two types of variation have different causes (genetic drift for neutral markers, selection for adaptive traits) and do not always correlate well. The fact that northern clade pool frogs are strongly related by a common recent history (as shown by neutral markers) does not necessarily infer that that they will all survive equally well throughout the northern clade distribution range.

## Source populations

There are three possible source populations for reintroducing northern clade pool frogs to Britain. These are Sweden, Norway, and captive-bred stock that probably include some of the original British genes. All have their pros and cons, and are considered in turn.

Swedish northern clade pool frog populations are the largest available source, with hundreds of adults distributed among more than 80 ponds. Permission to export some of these frogs (adults, spawn or larvae) should be forthcoming without difficulty. They have also been successfully introduced to new sites within Sweden. However, these frogs experience much colder winters than occur in Britain and substantially longer daylight hours during the summer. Either or both of these factors could prove maladaptive after translocation to Britain.

Norwegian frogs experience a climate more similar to Britain than do the Swedish frogs, though even around Arundal winters can be quite cold. Daylight hour patterns are also a little closer to those of Britain, though the advantage is small. The molecular genetic data suggest that historically the Norwegian frogs may be slightly closer relatives of British frogs than the Swedish animals. This does not, however, necessarily imply that Norwegian frogs will be better adapted to Britain than Swedish ones. Furthermore, Norwegian pool frogs are very rare, with recent breeding in just two or three ponds. Permission to export might be difficult, at least pending a good breeding year. Water quality is also very different (much more oligotrophic) from likely reintroduction sites in Britain and this could prove maladaptive.

Captive bred stocks are the descendants of hybrids between British northern clade and central European pool frogs. They may adapt relatively easily to the British environment since both parental forms have previously been established in this country. However, they may also suffer from outbreeding effects (disruption of coadapted gene complexes) and their fate in a natural environment is unpredictable. They are also, of course, not genetically pure and their reintroduction into the wild would not fully support the international objective of northern clade conservation. There are also significant concerns

over the spread of pathogens from captive populations, given the increasing evidence of amphibian diseases as a cause of population decline.

## Conclusion

At present the most favourable option is to attempt reintroductions using Swedish frogs. Should these fail, especially if the reasons can be identified as relating to local adaptations to the Swedish environment, Norwegian and ultimately captive bred frogs could be considered in that order of priority.

# Section 6 Selection of reintroduction stock 2: numbers and life stages

## Numbers and life stages

The protocol will be to translocate a mixture of life stages based on the rationale outlined below. The benefit of using a range of age classes in the reintroduction stock will be to give in a more stable age structure to the population than would be achieved by the introduction of a single age class. The disadvantage is that it is difficult to evaluate success because there are more problems in following multiple age classes than just one. The precise numbers of each life stage will, to some extent, be determined by how many are available and how easy they are to catch.

### Decision to use some adults

In Sweden, reintroductions have been undertaken successfully by the Swedish pool frog specialist, Per Sjögren Gulve. Translocations have typically involved 10 adults (5 males and 5 females) at the beginning of the breeding season to each prepared receptor pond. The adult frogs have usually bred and the subsequent offspring then formed the basis of the new colony. These reintroductions were made to ponds within the natural Swedish range at sites where the frogs had recently been lost by natural processes, although the habitat changes may have been exacerbated by human activities. The main learning point from this exercise, in the current context, is that there can be high survival of translocated adults and early breeding success.

In Sweden, some translocated adult frogs tended to stay at the reintroduction pond to breed, while others moved to nearby ponds. We cannot state with certainty whether this will happen in England. While all endeavours have been made to ensure suitability, it is possible that the release ponds might not be favoured. The adult frogs could disperse before breeding, become separated, and fail to produce any off spring in Year 1 of the project. The collection of adult frogs will deplete the breeding population at the donor sites so only small numbers are proposed, and until the behaviour of adult frogs in England is studied, the collection of many adults is not justified. Fortunately, all life stages have previously been translocated successfully, for both pool frogs and other closely related amphibians.

The decision to translocate some adults has been made on the basis that, with careful monitoring, it will help to establish the general suitability of the release site for pool frogs. Furthermore the planned release of some gravid females could provide an early test of the sites potential for reproduction. Individuals will be monitored over the initial years of release, as circumstances allow, to permit an assessment of survival. In addition, as a general principle it is considered sensible to introduce a range of age classes so that a broad demographic range will be present.

**Decision to use some young frogs**

Froglets and immature frogs (>35mm) tend to disperse after release at a pond and it is difficult to trace their fate, but there is known to be a very high mortality (possibly up to 80%) in the first winter after metamorphosis. Although on this basis young frogs might seem to be a poor choice of material to translocate, it may be that there is important natural selection at this stage in favour of individuals which can find suitable places to hibernate. For this reason, along with the desire to have a broad demographic spread, some young frogs should also be translocated.

**Decision to use some spawn or tadpoles (larvae)**

It is thought that in amphibians there is a degree of imprinting during the tadpole stage so that the frogs in general tend to return to the natal pond rather than dispersing to other, possibly less suitable, ones. Savage (1961) pointed out that the algal flora of ponds is often very characteristic and forms an important component of the tadpoles' diet, and that algae produce volatile chemicals that frogs might use to direct their migration to breeding ponds. This idea remains popular today, but unproven. Whatever the mechanism, it would seem sensible to translocate spawn or tadpoles for a number of reasons. Apart from possible imprinting, the introduction of these early life stages will allow a test of the suitability of the ponds for larval growth and development. Given that there is a degree of density dependency in larval cohorts, the removal of spawn and tadpoles will also have a proportionately lower impact on the donor populations.

**Decision on how many frogs to translocate**

Population Viability Analysis (or PVA) is a modelling process used to assess the risk of extinction of a given (meta)population. PVA can therefore be used to inform and guide reintroduction protocols, particularly with regard to the numbers of 4individuals and numbers of populations required to found a viable metapopulation. A PVA for the reintroduction of the pool frog has been undertaken (Williams & Griffiths, 2004) using data derived by Per Sjögren Gulve from his studies of Swedish populations.

In this study, a series of models was constructed to determine the effects of variation in the following parameters on metapopulation extinction risk: number of ponds, number of individuals present/introduced, the distance between ponds (= dispersal rate), the spread of introduced individuals among ponds, the number of yearly introductions made, pond carrying capacity and the frequency of recruitment failure. Various scenarios were considered and recommendations made for different sized metapopulations, such as a 4 pond metapopulation when:

- the inter-pond distance was 500m;
- all the ponds could support at least 200 females;
- individuals were divided equally between the ponds and;
- introductions were repeated for 4 consecutive years.
- introducing 160 1 year old female frogs individuals per year gave an extinction risk of 4.9%. Note that some of these standard assumptions do not

apply at the initial reintroduction site, so the figures resulting from the model need to be treated with a degree of caution.

Photograph 8. An immature pool frog, Sweden

If the sex ratio of young frogs is assumed to be 1:1, the number of young males needed would be the same as that for females, and the total number required for an introduction would be 320 individuals. However, in fact, the observed sex ratio of adult frogs is biased and ranges from 1.19 – 2.09 females per male. Using these values, the number of introduced 1 year old frogs would need to be 160 presumed females + 190 – 330 presumed males = 350 - 490 1 year old individuals.

One year old frogs are not strongly associated with ponds and it would be impractical to find and collect 350 –500 individuals. In addition, for various reasons as described above, the reintroduction strategy aims to release a range of different age classes (spawn, tadpoles, juveniles and adults). The numbers of the different life stages will be equivalent to the desired number of 1 year old animals. The PVA provides figures to convert from spawn or metamorphosing tadpoles to one year old frogs and the survival rate from one year to age two years is 0.247 . Thus:

2,450 eggs = 100 one year olds frogs;
490 metamorphosing tadpoles = 100 one year olds frogs;
25 two year old adults = 100 one year olds frogs.

Photograph 8. Pool frog larvae approaching metamorphosis

For practical and conservation reasons the collection of the different life stages will be biased towards the egg stage. It will be considerably easier to collect large numbers of eggs than other life stages, and removing mostly spawn will probably have lower impact on donor populations than taking juveniles or adults.

When material is collected, the relative numbers of each age will be determined to some extent by its availability but should equate to at least 350 one year old frogs, and ideally, closer to 500 in order to allow a greater chance of success.

Taking an arbitrary age class ratio of 3 : 1 : 1 means collecting the equivalent of 300 one year old frogs as eggs, 100 as juveniles and 100 as adults in order to translocate the equivalent of 500 one year old frogs. Thus the ideal number and life stage composition will be:

300 1 year olds is equivalent to 3 x 2,450 = 7,350 eggs; plus
100 1 year old frogs = 100 juveniles; plus
100 1 year old frogs is equivalent to 100 x 0.247 = 25 adults.

**Outline of decision to undertake wild-to-wild translocation rather than release from captive bred stock**

Captive breeding for reintroduction takes more time and resources than collecting from the wild. In addition, the pathogen risks associated with release from a captive colony are substantially greater than from screened wild frogs. Translocation stock for this project is easily obtainable from the wild without detriment to the donor populations and there is no risk of diseases being transmitted from other captive stock, or unnatural selection occurring. Currently, captive effort is being concentrated on the breeding and rearing of animals with some native ancestry. They are the descendants of the last known native male pool frog and a non–native female. The breeding of Swedish stock would require the setting up of additional vivaria at dedicated sites. The captive breeding of Swedish animals is not considered necessary as the Swedish authorities are content in principle for sufficient material to be collected for the translocation programme.

# Section 7 Obtaining reintroduction stock

One or two members of the PF SAP SG will collect reintroduction stock in May, with the help of Swedish contacts if possible. The exact dates will depend on weather conditions in Sweden, since the breeding season varies according to winter and spring temperatures. Two or three days will be allowed for the collection of specimens and on Swedish authorities' advice, the precise timing of the visit will be determined by the local weather. Ideally, a single collecting session will be made in May. However, if there are problems, for whatever reason, it may be possible to collect frogs later in summer. A second visit to collect froglets, juveniles and adults could take place in August/September if necessary. The choice of airline for the visits will be determined by whether it carries live freight and flies directly between England and Sweden.

The aim is to collect pool frogs of a range of different ages equivalent to about 500 one-year-old animals. They will be collected from a number of ponds spaced widely apart within the range of the species (probably from about four ponds, depending on conditions and logistics at the time of collection). This will ensure that potential impacts on the donor populations are minimised, and a suitable genetic mix of frogs is obtained for the founder stock.

The specimens will be caught by net and hand during the day and also after dusk with the aid of torches. In the field, the frogs of all sizes will be kept in separate, dampened cloth bags (such as BTO bird bags) suspended in a plastic container with ventilation holes and a little water at the bottom. The container will then be kept in a cool place out of direct sunshine.

Fig 4. Northern clade pool frog - dorsal view

A health examination will be undertaken and only animals in good condition will be retained. By searching pond margins after dark it should be possible to find females before they have a chance to spawn and they will be weighed and measured to confirm gravidity. It may also be possible to collect specimens from pitfall buckets along an existing drift fence. Males and juveniles will be measured (snout to vent) as a base for future growth studies.

The specimens will be photographed (dorsal view) with a digital camera for recording purposes and possibly to enable them to be individually recognised in the field using binoculars. They will also be PIT tagged to ensure certain identification in future years.

When collecting and transporting frogs, measures will be taken to transfer, as far as possible, only the frogs themselves, and to limit the amount of water, soil, plant material, invertebrates and micro-organisms. All collection material (nets, boxes, etc) will be thoroughly washed and disinfected prior to and after the collection exercise. Boots will also be cleaned to limit the transfer of material. Where possible, new equipment will be used. The procedures will follow the guidance set out by the Declining Amphibian Populations Task Force (DAPTF, 1998).

Spawn will be collected by hand or net and placed into water filtered through a net to remove weed and macroscopic invertebrates or into clean, oxygenated and aged tap water. Spawn is most robust when fresh so newly laid spawn will be collected in preference to spawn where embryos are developing. The clumps will be kept in a number of separate containers and the amount of water will be just sufficient to surround and cover it (about 4 – 5cm). All the containers will contain a large volume of air and have a single large hole or a series of smaller holes in the lid for ventilation. The spawn will be transported in the same containers and conditions from the base to the airport near Uppsala. At this stage the spawn and/or tadpoles will be transferred into large plastic bags the bags sealed and then put into plastic boxes with watertight lids. Prior to shipment the frogs will be transferred from their bags into a larger box or cool box filled with damp moss and pieces of polystyrene in order to create multiple voids where frogs can hide.

Fig 5. Pool frog spawn

No import licence is required but the export licence for Sweden and the Defra licence for the release of animals will be carried. Using a freighting agent may be the best option for this project; the specimens would be contained as above, placed inside larger containers and delivered to the freighting agents. It is essential they be carried on the same flight as the Pool Frog SAP Steering Group members so that there is the minimum of delay in collecting the specimens.

There should be a minimum of delay in making a wild-to-wild translocation. Given the rigorous disease risk assessment (see Section 11), a quarantine period is not considered necessary. Whilst in quarantine the adults could lose breeding condition, the spawn would hatch and this would reduce the chance of reintroduction success.

In England the specimens will be health checked, transferred to a larger number of containers with air holes and taken straight to the reintroduction site by car.

## Section 8 Methods for release of reintroduction stock

Releases will be made annually for four years at the reintroduction site between May and September.

Most of the animals will be released, unconstrained, into the wild as soon as possible. A proportion of adults and juveniles will be released to a fenced pond, in order to facilitate post-release monitoring of frogs and pathogens. A proportion of tadpoles/spawn will be released into mesh cages to make monitoring easier and to protect vulnerable early stages from predation. The decision to undertake a mainly hard release, at least in year 1, was taken in order to use the Swedish reintroduction method which if successful here, will be the least complicated one to use in England.

### Adults

Fig 6. Pool frogs in amplexus - lateral view

About 25 adults, half of them gravid females will be transported by car to the site, carried to the ponds in the travelling containers and released into the water during daylight hours.

Frogs will be released at the same time into the selected four ponds which will be in the central part of the site, away from the main forestry tracks and with suitable alternative breeding ponds nearby. If the adult frogs disperse, become separated and fail to breed, future release strategies may be considered.

### Juveniles

The juveniles will be transported in the same manner as the adults and released beside the reintroduction ponds where they will have the choice of entering the water or dispersing into pond-side vegetation.

### Spawn / tadpoles

The tadpole cages will be set out in four ponds during April. To satisfy recommendations of the PVA the ponds will be as widely separated as possible within the site. The 80cm x 30cm x 50cm cages will be stocked with about 25 eggs or tadpoles (see post-release monitoring section).

The rest of the spawn/tadpoles will be placed into the ponds in areas with a suitable depth of water and aspect. The location of the spawn/ tadpole release in the open ponds will be identified with an inconspicuous marker.

## Welfare

The welfare of the translocation stock will be ensured by transporting the frogs in cool damp conditions, unstressed by high temperatures or dryness. An ample supply of air will be maintained for the spawn and tadpoles by carrying them at a low density in relatively large containers and a high air to water ratio.

## Health screening

The main health screening will have been completed in Sweden, and frogs will be carefully examined immediately prior to release to ensure they are in good condition. Subsequent health checks will be undertaken on released animals to check for pathogens and to ensure they are maintaining good condition. Methods will be similar to those employed in the pre-release disease risk assessment.

# Section 9 Post-release monitoring

## Objectives

Monitoring after the release of pool frogs at British sites should have the following objectives:

(1) To estimate the survival of spawn and/or larvae through to metamorphosis in years of release, and in at least the first three years of natural breeding by adults that grew up on the site.

(2) To assess whether juveniles are surviving on the site.

(3) To estimate the survival of adults released on site for up to three years after release.

(4) To assess whether adults are breeding on the site.

(5) To ascertain pond use both for foraging (summer) and breeding (spring/early summer) where multiple ponds are present, as they normally will be.

(6) To estimate adult population sizes at each pond at every site for at least 10 years after first introduction.

(7) To assess habitat quality changes for at least the first 10 years following the start of an introduction.

## Methods

**(1) Survival of spawn/larvae**.
This should be monitored both in the open pond and in cages within the pond. In the open pond, numbers of introduced eggs or larvae should always be recorded. Around mid-August (i.e. shortly before metamorphosis) the pond should be extensively netted, any tadpoles caught should be tailfin-clipped, released, left overnight and the pond extensively netted again the next day. This work will be conducted under a Home Office licence. Numbers of tadpoles in the pond should then be estimated by standard mark-recapture analysis. From these data it will be possible to approximate the percentage of eggs surviving virtually to metamorphosis.

Each pond should also be provisioned with three mesh cages placed in such a way that pond substrate is available to growing larvae (i.e. with mesh skirts embedded in the pond floor, but with no mesh floor). About 25 eggs along with supportive vegetation, or free-swimming larvae, should be placed into each cage. The cages should be inspected (i.e. thoroughly netted to determine numbers of larvae present) every 3-4 weeks during development. These triplicated measures should give an indication of the times during larval development when most mortality occurs, and also determine whether the pond conditions are able to support pool frog development.

**(2) Survival of juveniles**
Juvenile frogs are terrestrial and unlikely to be encountered except by careful visual searching whilst walking through low herbage.

**(3) Survival of adults**
Since the only adults present on site for the first 2-3 years will be those deliberately introduced, direct counting of basking animals can be used to assess the fate of newly released frogs. Every pond should be visited under appropriate weather conditions (i.e. on warm, sunny days) at least once per month between April and September inclusive. Individual frogs, sunning themselves on the pond bank or lying at the pond surface, should be recorded by slow walks around the entire pond perimeter. This should include the use of binoculars to locate frogs before they take evasive action. Too many visits (more than one per week) should be avoided, at least in the early years, to minimise disturbance.

**(4) Assessment of breeding activity**
All ponds at or near the introduction site(s) should be visited once per week during the peak breeding season (i.e. throughout May and June) to record numbers of calling males. These visits should be carried out under suitable weather conditions, notably on mild (>12ºC) nights following warm, sunny days. Daytime visits should be made immediately after nights of calling activity to search for spawn in the calling area(s). This should be carried out by wading slowly and carefully in the pond (use of chest waders will probably be essential in most situations) and scrutinising vegetation for egg masses, with minimal disturbance. A second person should always be present, on the pond bank, as a safety precaution for this potentially dangerous activity.


Fig 7. A male pool frog calling – note inflated vocal sacs

**(5) Pond use**
Since potential reintroduction sites have multiple ponds but frogs will only be released in a subset of them, it will be important to check whether frogs move to ponds not originally selected. For this reason, every pond in the vicinity of the release sites (i.e. within 500-1000 metres) should be subjected to monthly searches as described under (2) above. Similarly, monitors should listen out for calling activity at ponds other than the release sites and follow up any such activity with spawn checks.

**(6) Adult population sizes**
In general it is preferable to use methods that require minimal disturbance and thus avoid

routine handling of wild pool frogs. Greater precision might be obtained using mark-recapture methods, including the injection of PIT tags. This level of monitoring will be considered if resources are available. Fortunately, pool frog numbers can be assessed with sufficient accuracy by the counting of basking individuals as described under (2) above. As populations become established it will become important to record numbers of adult and sub-adult (< c.50 mm) frogs separately wherever possible. It will also become increasingly important to monitor ponds distant from the original introduction sites. The maximum count in any one year should be used as a minimal population size estimate for that year.

**(7) Habitat quality**
Since many of the ponds at reintroduction sites will have been newly managed prior to frog releases, it will be important to assess how stable any successful sites become. On a single visit each year, around midsummer, various habitat parameters should be recorded for every pond (used and unused) at the site. These should include: extent of tree regeneration within 10 metres of the pond (mean height of saplings, proportion of perimeter affected, N, S, E, W aspects etc affected); rankness of terrestrial vegetation around pond bank (proportions with <10 cm, 10-30 cm, >30 cm mean heights); approximate proportion of pond margin dominated by emergent vegetation (reeds, irises etc); approximate proportion of pond surface that is open water; and water clarity (very opaque, moderately clear, completely clear) reflecting growth of unicellular algae.

## Effort

Evidently the monitoring programme outlined above will require a substantial effort with respect to personnel time, but will not be otherwise expensive. Cages for tadpole rearing in the ponds are already available at the University of Sussex. Other necessary equipment will be sturdy pond nets, binoculars and chest waders. Each site will require 12-20 visits per year, all between April and September with maximum intensity in May and June. Most monitoring could be done by single individuals, though in some cases pairs of monitors will be needed for safety reasons. Depending on the number of ponds at a site, individual visits (on-site time) will probably each require 1-4 hours.

## Evaluation of project success

Several criteria will be applied to evaluate success:

**Early indicators**
i) Survival of eggs/larvae through to metamorphosis. The production of metamorphs is a key indicator, and the combination of cage tests and monitoring survival in the open ponds should provide a rapid indication of which ponds have the potential to support pool frog populations. Survival to the pre-metamorph stage of at least one or two large larvae per cage, and at least tens of large larvae in the open ponds, should be the expectation for a good prospect of establishing a population. Survival in cages but not the pond should result in a study of predators present in the pond. This preliminary assessment should be available within six months of the initial releases.

ii) Survival of adults released on site. Monthly monitoring should provide information on initial survival rates and on movements of frogs among ponds. The expectation for a successful translocation is that, over an entire site, at least 50% of adult frogs should survive the first summer. Substantially lower values would give cause for concern, especially if the adults failed to breed in the year of their release. Again this information should be available within six months.

Photograph 10. A juvenile northern clade pool frog -dorsal view

iii) Breeding activity. The expectation is that adults translocated in early-mid May should breed the same year. Failure to do so could indicate serious problems ahead, but since small numbers of frogs will be involved it may be difficult to determine whether breeding has occurred or not. Lack of breeding observations in the first year would therefore be a worry, but should be considered a relatively uncertain indicator of future prospects.

**Long-term indicators**

Success requires the establishment of self-sustaining populations of reasonable size. Only long-term monitoring (5-10 years) will provide sound indicators of this. Relevant criteria include:

Establishment of adult population sizes, within 5-10 years, in excess of 50 individuals per site (the minimum to avoid serious inbreeding risks), and preferably >100 adults per site.

Mixed population structures, with juveniles and adults regularly recorded, in turn indicating regular breeding success.

Progressive colonisation of multiple ponds, at least five per site over 5-10 years, indicating the establishment of a robust metapopulation structure.

**Habitat indicators**

It will be important to respond quickly to adverse changes in habitat quality such as extensive growth of aquatic or terrestrial vegetation. The use of different ponds by the frogs should be related annually to any changes recorded in the habitat. Rapid and widespread deterioration of pond quality would indicate poor long-term prospects and signal the need to promptly develop new management strategies.

Fig 8. Northern clade pool frogs in amplexus – dorsal view

## Evaluation strategy

The early indicators should be assessed every year that new animals are introduced to a site, and changes made (e.g. using different ponds for release) year on year if the indicators suggest a need for this.

Long-term indicators should be assessed annually, starting two years after the first successful metamorphosis at a site, to monitor trends. Prospects of long-term success should, barring earlier catastrophes, be fully assessed after 5 years and again at 10 years after first metamorphosis on site.

Habitat quality should be related to frog numbers and breeding success every autumn, and any need for new management assessed and implemented rapidly.

# Section 10 Communications strategy

## Introduction

Plans for the reintroduction of threatened species should examine the relationship between the project's biological aims and the public understanding of the issues. The reintroduction of the pool frog will be an historic occasion given the species' history and status in England. If conveyed in the correct manner, information about the project can help gain support for and raise understanding of the reintroduction itself as well as broader conservation messages. Risks may also be associated with communications about the project, and so it is prudent to consider at the outset how any such work should be organised.

## Communications: primary aims

The table below shows the key communications considered to be valuable in the pool frog reintroduction project. This has been arrived at by examining first what the desired outcomes would be in order to progress the project's aims.

| Desired Outcome | Summary of Key Messages | Audience | Delivery Method |
|---|---|---|---|
| Understanding among the general public of the reintroduction, and the rationale for it. Notional support for the project. | The pool frog is a native species that has declined to extinction. Debate about its true status has been resolved through innovative research. Reintroduction is occurring by importation of Swedish animals, through a high standard partnership project. Eventually: outcome of reintroduction attempts | Primary: general public in UK<br>Secondary: general public overseas. | Media: broadcast, press, electronic. News release as a proactive measure; opportunistic publicity as circumstances allow. Captive frogs on display at remote location. |
| Understanding of the project, and general learning points arising from it, among conservation practitioners and scientists | Methods of establishing native status. Procedure for reintroduction. Eventually: outcome of reintroduction attempts | Statutory conservation agencies; conservation NGOs; scientific community – general ecological and amphibian-specific. Primary audience in UK, secondary audience overseas. | Papers in academic journals and specialist publications. Presentations at conferences. Information on internet web pages |
| Favourable habitat management at reintroduction sites and, eventually, adjacent areas. | Pool frogs require particular habitat features and management regimes. | Primary: Landowners and managers at reintroduction sites. Secondary: those with control over suitable land adjacent to release sites. | Direct liaison by face-to-face meetings, and provision of advisory literature. |

Regarding general public issues, the direct impact of the reintroduction on the general public will be minimal given that the current planned release sites belong to conservation bodies or at least those with a strong conservation remit. It is thought unlikely that pool frogs will spread a long distance from the reintroduction sites, although in some cases there may be limited colonisation of ponds in other ownership, such as agricultural landholdings. The potential consequences of this will need to be considered before each release and addressed through appropriate consultation.

The reintroduction sites are subject to varying degrees of public access, so it is possible that members of the public will encounter released pool frogs by chance. The landowners will by briefed by the pool frog SAP steering group on suitable responses to this, given that it is desirable to keep the locations confidential at least initially (see below). However, it is recognised that the locations will inevitably become known eventually, and it is certainly not advised to mislead any member of the public enquiring about the frogs.

## Communications: secondary aims

Communications about the project may provide opportunities to convey some related broader issues, or solicit a response, through:

- fostering a better understanding among the general public of the risks of releasing exotic species;
- the Biodiversity Action Plan, and how it aims to enhance the richness of wildlife through a partnership approach (in this case involving government, NGOs, amateur specialists, universities, and international collaborators;.
- amphibian conservation in England targeted at species (even familiar ones such as the common toad) suffering from declines brought about by various factors;
- volunteers forming an important part of our response to conservation issues, where the public can help in conservation issues in various ways (e.g. collecting species records; helping to safeguard important sites).

## Methods and opportunities

The main initial work will be to publicise the release of imported Swedish pool frogs at the reintroduction site. A news release undertaken by English Nature would be the best way to gain the appropriate coverage. This would need to be carefully co-ordinated so that all the bodies involved are kept informed. A press launch to allow coverage of the release of the frogs may be possible; in order to get optimal coverage, actual pool frogs will need to be on display.

A further opportunity for effective communications would be a captive colony of pool frogs at a remote location (i.e. not at the reintroduction site) where the public can view the frogs and learn about the project. This approach has a number of attractive features, namely that (1) pool frogs in captivity would be more easily viewable than wild frogs; (2) interpretive material and activities could be easily produced and undertaken; (3) there would be no risk to the reintroduced population. The pool frog SAP steering group has spoken to a number of collections about this possibility. Such a facility could be used for the initial publicity work, if done in good time, or - more realistically - for ongoing

publicity and as a general resource for interested members of the public.

The production of papers on northern clade pool frog status for peer-reviewed journals has been happening for the last few years, and a number are already published or are in press at the time of writing. The future need will be to report on the methods and outcome of the reintroduction attempts. The pool frog SAP steering group has the appropriate expertise to undertake this. Presentations should be prepared for conferences including an element of amphibian conservation.

Aside from an academic audience, conservation practitioners would benefit from information on the pool frog reintroduction. Articles should be considered for outlets such as British Wildlife magazine, as well as more specialist publications such as Re-introduction News (IUCN/Species Survival Commission Re-introduction Specialist Group).

In all communications work, it will be important to give due acknowledgement to the range of organisations and individuals who have assisted with the pool frog reintroduction project.

## Risks, complications and control measures

The following table identifies potential risks and complications of undertaking publicity about the pool frog reintroduction project, and suggests measures to reduce their incidence or severity:

| Risk / complication | Control measures |
|---|---|
| Once frogs are reintroduced to the wild there is a risk that people may remove them. This danger is not to be under-estimated, given that<br>• there are many private amphibian keepers, northern clade pool frogs are rare (and therefore considered "collectable" by some),<br>• there was a history of collection of pool frogs from native sites before the population went extinct,<br>• pool frogs are relatively easy to capture,<br>• circumstances at the reintroduction sites will not allow for comprehensive wardening. Collection pressure would be particularly important to avoid in the first few years of the reintroduction, before the population has become properly established. | For initial release and first 3 years of the project: do not reveal location outside the landowners and reintroduction group; ensure checks on reintroduction ponds as frequently as possible. Following this, and based on a further assessment, it may be acceptable to release the location details. Such an assessment should examine the benefits of revealing the locations against the risk and consequences of collection. It may be that, once the frogs are released, the locations become known gradually through passive means, given that the reintroduction sites have a degree of public access and that eventually information is bound to "leak" out. The pool frog SAP should keep a watching brief on these issues as the reintroduction proceeds. Legal protection should also be considered. |
| Individuals may wish to interfere with the reintroduction site or with monitoring efforts. This is considered unlikely, but in the past amphibian sites have been subject to haphazard vandalism or, occasionally, by sabotage (i.e. someone acting with the intention of damaging a project). A particular concern is with the release of exotic amphibians, especially water frogs, or exotic invasive plants, at or near the reintroduction sites. | As with the above risk, do not reveal location and ensure frequent checks. Ensure that publicity materials underline the risks of releasing exotic species. |
| Causing confusion about the conservation issues surrounding native and non-native species. The history of water frogs in England, and pool frogs in particular, is very complex. There are also sensitivities surrounding the control of some non-native species. Care will be needed to avoid conveying an account that is very complex and runs the risk of being ignored or distorted (inadvertently or deliberately) by the media. | Ensure in any media opportunities that a concise and clear message is presented. Particular attention should be paid to the fact commentators and the public might ask why conservation bodies assign high value to reintroducing a frog that looks very similar to many apparently almost identical frogs that are already in England, and which are deemed not to have conservation value. |
| Private individuals and institutions wishing to set up captive-breeding projects for the pool frog, or wishing to have some frogs to release in gardens, nature reserves etc. Although made with the best of intentions, if granted, these sorts of requests rarely progress conservation aims. | The pool frog SAP should develop a brief guidance note on the issues raised by such requests. Generally it will be unwise to provide pool frogs for such purposes. However, opportunities for captive collections of pool frogs accompanied by high quality interpretation in suitable locations may be desirable. |
| Media representatives may wish to visit the reintroduction sites in order to cover the story. This can be very helpful if the resulting coverage is accurate and positive, but there are risks that the site location may be revealed, possibly inadvertently. Note that most often there will be an expectation to see the frogs themselves, and this will not always be predictable or easy in the first few years of the project or out of season. | Assess on case by case basis as to whether to allow access to the reintroduction sites. Maintain a stock of high quality photos of the pool frogs, the release activities, and the reintroduction ponds. Help set up a remote captive collection where frogs can be more easily viewed. |

# Section 11 Legal and procedural considerations

This section reviews the legal and procedural aspects of key activities which are to be undertaken during the reintroduction.

## General procedure

**i) *A Policy for Conservation Translocations of Species in Britain* (JNCC, 2003)**
This document outlines the British nature conservation agencies' approach to species translocations (including reintroductions) for conservation purposes. It contains a very useful summary of the legal and procedural steps that need to be followed when planning and implementing a reintroduction. Annex 1 of the policy ("A process for evaluating and undertaking species translocations for conservation purposes") is effectively a checklist of points to consider, based on the *IUCN Guidelines for reintroductions* (IUCN, 1995). The pool frog SAP Steering Group has addressed this (see Section 3).

**ii) *IUCN Guidelines for reintroductions* (IUCN, 1995)**
This is the international standard for reintroductions, and the pool frog project has been working to address the *Guidelines* over recent years, for example by establishing the scientific rationale for reintroduction and preparing a health-screening protocol. In practice, the steps outlined in the *Guidelines* are covered by the JNCC species translocation policy.

**(iii) Habitats Directive**
Article 22(a) states that Member States shall study the desirability of re-introducing Annex IV species where it might contribute to their conservation, taking into account the experience of others. Furthermore it states that reintroduction should take place only after proper consultation of the public concerned. For the current pool frog proposals, studies discussed elsewhere in this document have indicated that reintroduction is feasible and would contribute to enhancing conservation status. Those directly affected by the proposed reintroduction have been consulted about, and are content with, the proposals. Primarily this has been with the landowners of the reintroduction site, though a range of other activities, such as meetings and media events, have involved a broader array of people and organisations. Article 22(c) states that Member States shall promote education and general information on the need to protect species of wild fauna and flora and to conserve their habitats and natural habitats. It is proposed (see Section 10, Communications Strategy) to undertake media events to raise awareness of pool frog conservation issues.

**Capture from wild populations in Sweden**
Permission will need to be sought from the Uppsala County Administration Board (Länsstyrelsen i Uppsala Län in Swedish) as pool frogs are protected in Sweden (since they are listed on Annex IV of the Habitats Directive). Discussions with the Board have resulted in permission being granted for capture from 6 ponds in Uppsala. The application was made on the basis that the capture can be demonstrated to be part of a properly planned conservation initiative and there will be no significant impact on the donor populations.

## Transportation and short-term captivity in Sweden

The permission for capture has also stated that transport and the short-term keeping of pool frogs will be required.

## Export from Sweden

To export the frogs, permission will be needed from the Swedish Agricultural Agency. This has been granted.

## Imports to the UK

A thorough disease risk assessment was undertaken according to good practice in 2003-4 by the Institute of Zoology in conjunction with English Nature. This work sought to establish (a) the risks to resident UK amphibians from the reintroduction of pool frogs, and (b) the risk to introduced pool frogs from pathogens already present at the reintroduction site. The work involved a literature review to identify pathogens of prime concern. Chytrid fungi and ranavirus were rated as high risk, with *Dermocystidium* of medium risk. Extensive laboratory tests were performed on amphibians collected from the proposed donor populations in Sweden and at or near the proposed reintroduction site in Norfolk. This involved collecting samples from several hundred individual amphibians (including 138 pool frogs), and a range of tests including bacteriology, mycology, parasitology and virology.

No pathogens of prime concern were detected in the proposed donor populations. It is concluded that there is an extremely low risk that the proposed reintroduction would have any adverse pathogen-related effects on UK amphibians. The prevailing "background" level of introductions of potential disease vectors was assessed as being very high, and has been for some time. This includes the unregulated, often inadvertent introduction of amphibians and fish, often in high numbers and from a range of locations. To illustrate the potential for disease entry via such pathways, it was noteworthy that the only pathogen of major concern detected in the course of the risk assessment was from introduced North American bullfrogs, at a site distant from the proposed pool frog reintroduction.

The proposed reintroduction site currently supports only low populations of amphibians. The pool frogs would be released to the central area, and it is considered extremely unlikely that released frogs would disperse and establish populations in surrounding areas given the poor habitat around the release area and the distances involved. Various disease controls measures were proposed, including supplementing standard guidance (DAPTF 1998) with specific additional measures following consultation with the Institute of Zoology and others. The extremely low risks posed specifically by the pool frog reintroduction were assessed as negligible compared to the broader disease risks, especially when considering the limited predicted exposure, and the proposed disease surveillance and control measures. English Nature concluded that a release of pool frogs would pose negligible pathogen risks if the proposed methods are followed.

There are certain regulations concerning the welfare of animals in transit which will have to be followed. The main article of legislation is the Welfare of Animals (Transport) Order 1997, which states that all animals must be transported in a way which does not cause, or is unlikely to cause, injury or unnecessary suffering. There are particular

responsibilities on the part of the person transporting the animals. Further details can be found in the Defra leaflet *Trade Information Note Animals: Number 1 (TIN A/1): General information about veterinary checks and animal welfare requirements for the importation of live animals and genetic material into Great Britain*.

Defra has confirmed that importing pool frogs will not entail mandatory veterinary checks, importer notification, certification, export health certificates, or route plan/transport certificates (as may be required for other live imports).

The pool frog is not listed under CITES (Convention on International Trade in Endangered Species of Wild Fauna and Flora) and so no particular procedures apply in this area.

## Keeping the frogs in captivity (short-term) for pre-release screening in UK

As pool frogs are not protected in England, there is no need for a specific licence for this activity. However, the frogs would become subject to the provisions of the Protection of Animals Act 1911, which prohibits cruelty and ill-treatment of captive animals. Care will therefore be required to maintain high standards of husbandry whilst the animals are held captive.

## Keeping the frogs in captivity (long-term) for interpretation and research purposes in UK

Some pool frogs may be kept at a captive facility for the long-term. The controls on these frogs would be, as a minimum, as for the previous point. There may be additional legislative requirements depending on the type of facility in which they are held.

## Release into the wild

The northern clade pool frog is not of a kind ordinarily resident in Great Britain, and therefore a release to the wild requires a Section 16 licence from Defra in order to prevent a breach of Section 14 of the Wildlife and Countryside Act 1981. English Nature has been in discussion with Defra about the proposals. In order to obtain a licence, a risk assessment will be required, following the guidance set out in the document *The Regulation and Control of the Release of Non-native Animals and Plants into the Wild in Great Britain* (DoE, 1997).

Where a reintroduction is planned to occur on a SSSI, a consent will be required from the Area Team of English Nature because deliberate release of any species is normally considered an “Operation Likely to Damage”. This must be discussed well in advance with the relevant Conservation Officer, and care should be taken to consider the implications of the reintroduction on the interest features (and other wildlife) present on the site.

## Capture and re-release, once in the wild in UK, for health checks and monitoring

Re-release to the wild of reintroduced animals after capture, for instance for the purpose

of undertaking health checks and monitoring, would require a Section 16 licence. It is proposed that the licence application for the initial release should request that further releases at the site of capture are also to be allowed within the terms of the licence.

## Longer Term Goals

**Legislative status** It would be desirable to list the pool frog (ideally the northern clade pool frog only) on domestic legislation, in order to afford it legal protection once established. This would involve listing on Schedule 5 of the Wildlife and Countryside Act 1981, and Schedule 2 of the Conservation (Natural Habitats &c.) Regulations 1994. It would also be advisable to provide legislative restrictions (e.g. addition to Schedule 9 of the Wildlife and Countryside Act 1981), linked with further awareness campaigns, to restrict the uncontrolled release and movement of wild pool frogs of non-native origin (see Section 12).

**Habitat management on protected sites** Where the pool frog is reintroduced onto existing SSSIs in future, there will be a need to ensure management is favourable for the species and does not conflict with existing interest features. This will involve early liaison with the site owners and managers in order to discuss the range of species and habitat requirements. Ideally the needs of the pool frog will be incorporated into the conservation objectives for the site. These discussions have already started at some potential reintroduction sites which have SSSI status.

**Pool frogs and SSSI designation** There will be a need to consider creating a new section in the *Guidelines for the selection of biological SSSIs* (NCC, 1989) to allow selection of sites on the basis of pool frog populations. An England supplement to this document is currently (2004) under consideration by English Nature, and so an additional section on pool frogs may be feasible in the coming years.

# Section 12 Conservation significance and legal issues regarding water frogs in England

The following table shows the categories of water frogs occurring in England, with comments on their known or suspected distribution and UK conservation significance.

| Taxon | Notes on distribution and origin | UK conservation significance |
|---|---|---|
| Pure northern clade pool frog *Rana lessonae* | Would be present through proposed reintroduction using Swedish animals. There is a minute possibility that there are currently undiscovered populations still in England; extensive surveys have failed to detect these so for all practical purposes this taxon is currently considered extinct in England. | High |
| Hybrids of northern clade pool frogs with non-northern clade pool frogs | Populations that may include hybrids are known in England, though this has not been verified genetically. Northern clade pool frogs collected from Norfolk and kept in captivity appear to have been bred with non-northern clade pool frogs, and some may have escaped (or been released) from private collections. | None |
| Pool frogs *R. lessonae*, other than northern clade | Several populations occur (notably near Dorking, Surrey). These are the result of escapes or releases from collections or imports. | None |
| Other water frog taxa | Other water frogs occur in single or mixed species groups at a range of locations across England, with most in the south-east. To date, the following have been identified: marsh frog *R. ridibunda*, southern marsh frog *R. perezi,* edible frog *R. kl. esculenta,* and Italian pool frog *R. bergeri*. In some cases, pool frogs (non-northern clade animals) also occur. These are likely the result of escapes or releases, the later established populations often associated with fish farms. | None |

### Identification

Water frogs can be identified by a range of techniques, depending on which species are present. Some species can be reliably identified by external characters (colouration, size, morphology). Recently, techniques have been developed to allow confident identification based on male advertisement call characteristics (Wycherley et al, 2003). Finally, genetic methods can be used (e.g. Zeisset & Beebee, 2001).

### Proposed legal protection

It would be desirable to protect the pool frogs once they are reintroduced. However, it would be important to ensure that such protection covers only the taxon of conservation significance, i.e. the northern clade pool frogs in the reintroduction areas. Concerns have been raised that legal protection would cause confusion to, and possibly pose restrictions on, landowners outside the reintroduction areas who have pool frogs (or other water frogs) on their land. However, this should not arise because (a) northern clade pool frogs are positively identifiable, (b) northern clade pool frogs are highly unlikely to occur, at

least as pure populations, outside the proposed reintroduction areas; (c) legal scheduling would be proposed to relate only to northern clade pool frogs, and would not affect the other taxa. Legal protection would not be proposed for hybrids of northern clade pool frogs with non-northern clade animals (if any such animals occur in the wild).

The reintroduction itself will not cause any immediate change to the legal status of the reintroduced animals, nor to that of any other water frogs already present in England. Initially, therefore, the introduced pool frogs would enjoy no special protection in law. In order to introduce legal protection by adding northern clade pool frog to the appropriate schedules, under current arrangements a case would need to be put to the Secretary of State. This is under consideration at the time of writing.

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# Appendix 1

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Top left: Using a home-made moth trap.
Peter Wakely/English Nature 17,396
Middle left: $Co_2$ experiment at Roudsea Wood and Mosses NNR, Lancashire.
Peter Wakely/English Nature 21,792
Bottom left: Radio tracking a hare on Pawlett Hams, Somerset.
Paul Glendell/English Nature 23,020
Main: Identifying moths caught in a moth trap at Ham Wall NNR, Somerset.
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