# Amphibian Habitat Management Handbook

John Baker, Trevor Beebee, John Buckley, Tony Gent and David Orchard

amphibian and reptile conservation

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Cover images:
An amphibian pond (a pingo) in Norfolk (Amphibian and Reptile Conservation)
Smooth newt and natterjack toad (Fred Holmes)

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Natterjack toad (Fred Holmes)

## Summary

The *Amphibian Habitat Management Handbook* is a resource for a range of range of users including conservation professionals and interested volunteers.

There are seven amphibians native to Great Britain. Five of these are widespread; great crested newt, smooth newt, palmate newt, common toad and common frog. Of these, the great crested newt and common toad are also Biodiversity Action Plan priorities. The great crested newt has breeding site requirements that are also suitable for the other widespread amphibian species. On the other hand the common toad can breed in relatively large water bodies with fish, which tend to be less suitable for the other species. Hence, in many areas the great crested newt is a useful target species for conservation management as an umbrella for the others.

There are two rare amphibians; the natterjack toad and the northern pool frog.

The natterjack is a conservation priority and a habitat specialist with very different ecological requirements to the other native amphibians. Hence a section of the handbook is dedicated to this species.

The pool frog is currently subject to a reintroduction project and is not covered by the current handbook.

Ponds are not only amphibian breeding sites but are also important habitat for many other species. A section of the handbook describes planning and creating new ponds. Pond restoration can greatly improve ponds in poor condition, yet the methods involved also have the potential to cause harm. Hence a section of the handbook includes a risk assessment approach developed by Pond Conservation.

The relationships between amphibians and other species is considered. Amphibians vary in their ability to withstand predation by fish. On the one hand common toads successfully co-exist with fish. At the other extreme, fish can eradicate great crested newts. Given that toads can also survive without fish, the general principle is that fish should not be introduced to amphibian ponds. Waterfowl also have negative impacts on ponds and hence should not be encouraged.

Disease is a significant issue in global declines of amphibians. Ranavirus and chytrid fungus are both present in Great Britain but the impacts of these pathogens is not yet understood. A precautionary approach is recommended, avoiding the transfer of organisms and materials between ponds. There are no practical cures for amphibian diseases in the wild. Disease symptoms and other causes of amphibian mortality are described to assist field workers in determining the likely causes of amphibian mortality.

Amphibians spend a great deal of their time on land. They inhabit a range of terrestrial habitat types, requiring cover to retain moisture and provide habitat for their invertebrate prey. Management of terrestrial habitat is usually required, especially to prevent the shading of ponds by scrub and trees. Hibernation sites can be constructed, although amphibians should be able to find their own such sites within favourably managed habitat.

Movement of individuals between neighbouring breeding sites is important for long-term health of amphibian populations. Hence, landscape issues should be considered, especially the distance between breeding ponds and the nature of intervening habitat.

Opportunities for amphibians are also considered within specific habitats; gardens, Sustainable Urban Drainage Systems and drainage ditches. Measures to reduce the impacts of roads are also reviewed.

The natterjack toad breeds in shallow, usually temporary ponds and requires sparsely vegetated terrestrial habitat. The natterjack can survive in habitat that is too arid for other amphibians. In fact, if conditions change so that sites become colonised by other amphibians, the invading species become significant predators or competitors of natterjacks.

The dispersed but limited range of the natterjack toad has meant that reintroduction is a significant element of the conservation work for this species. A section examines translocations for conservation purposes, focusing on the natterjack in particular.

Developing common toad spawn (ARC)



# 1. Introduction

## 1.1. Background

This handbook is intended to be a resource for a range of people involved in amphibian conservation, including site managers, community groups and volunteers. It is also hoped that it will be useful to local government staff and ecological consultants involved in development planning, to optimise conservation gain delivered through this process. Because of reference to the underlying legislation and policy mechanisms, we have restricted coverage to Great Britain, namely the countries of England, Scotland and Wales, However, the principles identified will be applicable more widely across northern Europe.

There are seven amphibian species native to Great Britain. Although a relatively small taxonomic grouping, they present a range of conservation challenges and opportunities. Most of the species are widely distributed (great crested newt, smooth newt, palmate newt, common toad and common frog). Nevertheless two of these (great crested newt and common toad) are listed as priorities under the UK Biodiversity Action Plan (BAP).

The remaining three widespread species, not prioritised by the BAP (smooth newt, palmate newt and common frog), still merit attention. These species have undoubtedly experienced declines and require conservation measures to reverse these. For example, the common frog is no longer a ‘common’ species in great swathes of the the countryside. Hence, there is a need for conservation information for the widespread amphibian species aimed at a broad array of user groups. Furthermore, amphibians make a good focus for education and local conservation action and can be umbrella species for habitat management.

Two of our amphibians, the natterjack toad and northern pool frog, are conservation priorities due to their rarity. The natterjack is confined to fewer than 60 locations.

The pool frog is even scarcer. It has only relatively recently been recognised as a native species – a discovery that coincided with its extinction in the wild. Pool frogs have been reintroduced, from Sweden, to a single site in England.

Both the rare and the widespread amphibian species have suffered changes in conservation status during the second half of the twentieth century. Prior to the intensification of agriculture associated with the 1939-45 World War, amphibians most likely thrived in rural areas, benefiting from the creation of ponds for functional purposes as well as by-products of resource extraction from the ground. Rural pond numbers peaked early in the twentieth century, at roughly a million. Since then ponds have been either lost or neglected as their functions have been replaced, or they have become degraded through lack of management, lowered water tables and reduced water quality.

Amphibians spend part, in some cases most, of their lives on land. The terrestrial habitat in the countryside has also decreased in quality as improved farming technology has reduced the number of invertebrates available as amphibian prey and as the area of land given over to arable or improved grassland has increased.

The direct loss of wildlife habitat to building development has also affected amphibians. For example, coastal sites favoured by the natterjack toad have disappeared as they have been targeted by humans as desirable areas for leisure developments.

Housing developments elsewhere have had mixed impacts on amphibians. Whilst traditionally managed rural land has been lost, gardens, and in particular garden ponds, have provided a new habitat. These ponds differ from their rural counterparts in several ways; in particular, they are smaller. Nevertheless, there are many more garden ponds, per comparable area of land, than there are ponds in the countryside. The varying abilities of amphibians to exploit garden habitats have a significant bearing on their current conservation status.

## 1.2. Scope

Conservation guidance for the two amphibians originally prioritised by the BAP process has been provided previously in the *Natterjack Toad Conservation Handbook* (Beebee and Denton, 1996) and *The Great Crested Newt Conservation Handbook* (Langton, Beckett and Foster, 2001). Since their publication the UK BAP species list has been revised; common toad and pool frog were included in 2007. The current *Amphibian Habitat Management Handbook* provides information on not only the former two BAP species, but also generic advice covering the newly listed common toad and the other widespread amphibian species.

The information given in the current handbook pertains to habitat management and restoration. It also includes sections on translocation and reintroduction, which are useful tools in the conservation of natterjacks. Advice is also given regarding other pond organisims including fish, waterfowl, non-native herpetofauna and plants.

Information on amphibian disease is also given, as this is a high-profile, active research issue with implications for site managers and field workers.

Amphibian survey methodology and standards are not covered in the handbook, as they constitute a large subject that is covered thoroughly elsewhere, for example:

- *Surveying for (Great Crested Newt) Conservation* (Froglife, 2003).
- *Great Crested Newt Mitigation Guidelines* (English Nature, 2001).
- Protocols for the **National Amphibian and Reptile Recording Scheme**.

Surveying for natterjacks is an exception. Although guidance is provided in *Natterjack Toad. Survey Guidelines* (The Herpetological Conservation Trust), it is repeated here as survey is essential to monitor the success of introductions.

The pool frog is subject to a reintroduction programme, which is guided by a published strategy (Buckley and Foster, 2005). Hence, further habitat management advice for this species is currently unnecessary and is not provided in the current handbook.

## 1.3. Habitat requirements and principles

Amphibians have complex life cycles. This refers to the fact that the life cycle includes a larval (tadpole) stage which is terminated by metamorphosis into a juvenile which has a completely different morphology and lifestyle. The pre-metamorphic stage is dependent on an aquatic environment; the post-metamorphic stages (juvenile and adult) include long periods living on land. Even in the terrestrial habitat, amphibians are heavily dependent on water. They have permeable skins which make them prone to desiccation, although tolerance of arid conditions varies between species.

The best amphibian breeding sites also tend to be 'good wildlife ponds'. Much of the advice given in this handbook mirrors that provided by Pond Conservation regarding high quality pond habitats (Williams *et al.*, 2010 and the **Pond Creation Toolkit**).

Terrestrial habitat requirements for most native species are fairly generic, as amphibians can occupy a variety of different habitat types. The natterjack toad is an exception, requiring sparsely vegetated sites that are inhospitable to the other species.

## 1.4. Global declines

The relatively permeable skins of amphibians, eggs unprotected by shells, and their biphasic lifestyle, relying on terrestrial and aquatic habitats, have contributed to the view that these animals are potential indicators of environmental health. The discovery that amphibians were in decline, in some cases to the point of extinction, in disparate areas of the world where habitat was presumed to be protected from human activity, created fears of a decline in amphibians driven by previously unrecognised factors perhaps acting at a global level.

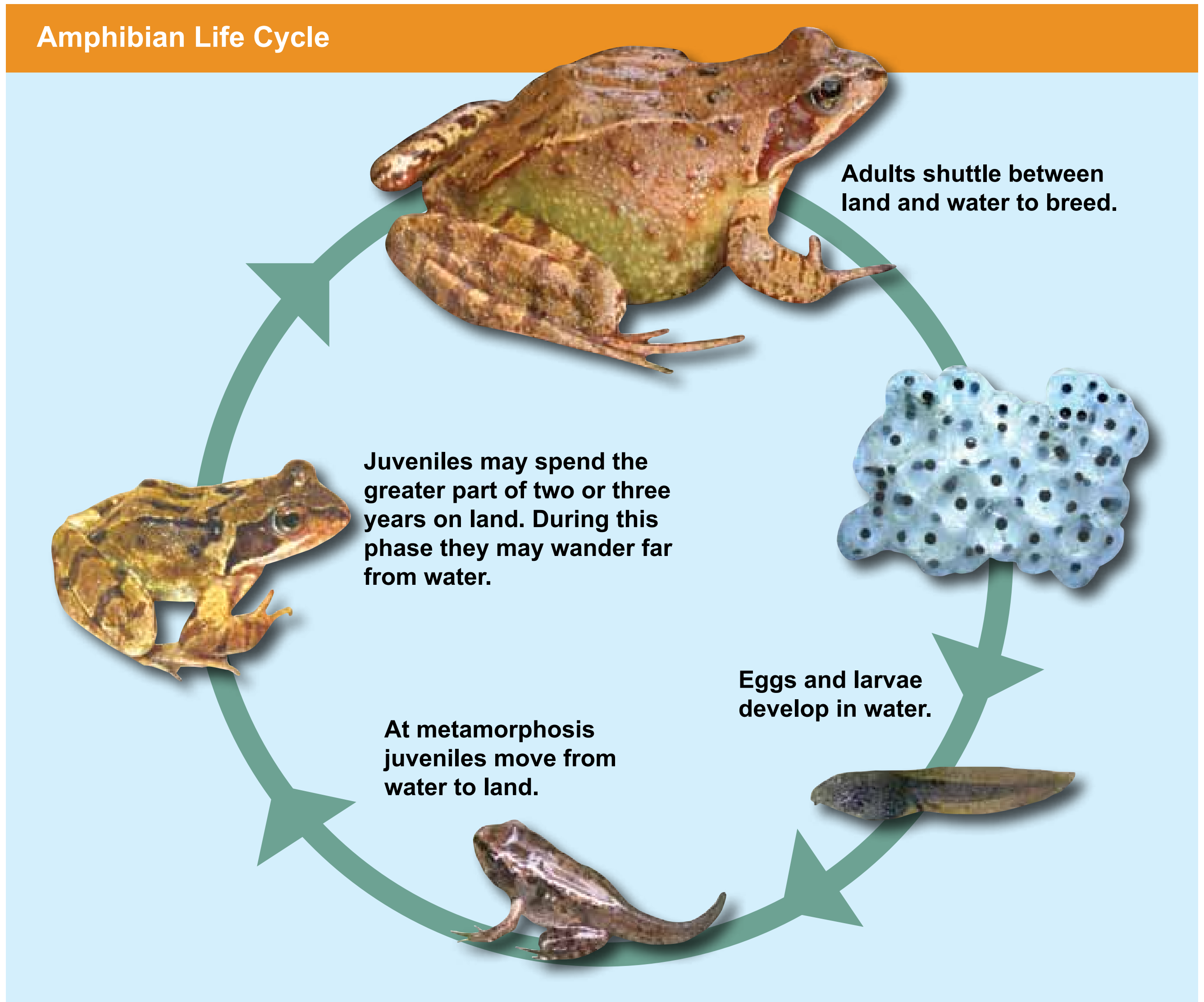
**The western toad *Anaxyrus boreas* was one of the amphibian species declining in apparently pristine habitat, sparking fears of 'global decline' (ARC)**

Arguably, the global decline phenomenon has been of little relevance to amphibian conservation in Great Britain. There is little mystery about declines in our native species. Habitat loss, fragmentation and degradation are readily apparent causal factors.

Since the initial fears surrounding the global decline phenomenon it has become clear that amphibians, as a class, are neither particularly good indicator species nor more threatened than some other groups of animals. Also, subsequent research has blurred the boundaries between the mysterious declines in apparently pristine habitats and those in obviously human-modified landscapes. Amphibian disease illustrates this point. Disease is emerging as a key driver behind many of the previously inexplicable global declines. The same diseases have been identified in native amphibian populations. Although habitats in Great Britain cannot be regarded as pristine, and hence differ from classic 'global decline' sites, the long-term impacts of disease are still a matter of interest to amphibian conservation here.





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Natterjack toadlet (Ash Bennett)



# 2. British Amphibians

| Native amphibians of Great Britain | | |
|---|---|---|
| Great crested newt | *Triturus cristatus* | England, Scotland and Wales |
| Smooth newt | *Lissotriton (Triturus) vulgaris* | England, Scotland and Wales |
| Palmate newt | *Lissotriton (Triturus) helveticus* | England, Scotland and Wales |
| Common frog | *Rana temporaria* | England, Scotland and Wales |
| Common toad | *Bufo bufo* | England, Scotland and Wales |
| Natterjack toad | *Epidalea (Bufo) calamita* | England, Scotland, and Wales |
| Northern pool frog | *Pelophylax (Rana) lessonae* | England |

There are seven species of amphibian native to Great Britain. The distribution maps included here also include Northern Ireland, the Republic of Ireland and Isle of Man. The common frog, natterjack toad and smooth newt are native to the Republic of Ireland, the smooth newt and common frog are found in Northern Ireland while the common frog is the only amphibian native to the Isle of Man. Other species of amphibian have been introduced to these areas from outside their natural ranges.

British amphibians breed primarily in standing water, especially ponds. Ponds are naturally relatively dynamic environments. Vegetation and water levels can vary substantially over the course of a year as well as more gradually over the long term. Pond-dwelling species tend to be adapted to this changeable environment. Similarly, amphibians are flexible in their ecology. The following species accounts, therefore, should be read as guides recognising that exceptions and variations may arise according to local conditions.

## 2.1. Great Crested Newt *Triturus cristatus*

**Ecology** The great crested newt is the most aquatic of the three British newt species. In the terrestrial stages it does not venture far from breeding sites. Although individual newts may move more than a kilometre from a pond, most remain within 250 m and a great deal of terrestrial activity is likely to take place closer to the pond than this.

The great crested newt is relatively long-lived; in undisturbed habitat individuals can survive into their teens. In most populations life expectancy is shorter than this but nevertheless, females usually survive to breed over several years. This longevity can allow populations to persist despite occasional years of reproductive failure. For example, if a pond dries before larvae can complete their development the population may be relatively unaffected because a large proportion of the adults is likely to survive to reproduce the following year.

The great crested newt prefers to breed in relatively large ponds not supporting fish, such as were traditionally found in the rural landscape. Typically, breeding ponds are also well insolated, supporting abundant submerged vegetation and with a pH >5.5. Nevertheless, great crested newts can be found in a range of pond types. They fare well in water storage tanks and disused swimming pools and large populations have become established in flooded former quarry sites.

**A typical great crested newt breeding site – a sunny, well-vegetated pond on low intensity farmed land (ARC)**

**Although very different from typical breeding ponds, great crested newts can thrive in water storage tanks and disused swimming pools (ARC)**

**Reproduction** The female produces several hundred eggs in a breeding season. Each is produced individually and wrapped in a folded leaf, using her hind feet. The egg-laying period extends over several months.

Larvae are present in breeding ponds over the summer, feeding on small pond organisms, especially zooplankton. Great crested newt larvae tend to live in the water column rather than on the pond bottom. This habit is thought to explain this species' particular vulnerability to fish predation.

Larvae metamorphose from late August to mid-October. At this point metamorphs (or efts) generally move into terrestrial habitat. The great crested newt, however, is more variable in this respect than other amphibians as sometimes metamorphs either remain in the pond or return to the pond during the juvenile stage. It takes two or three years to attain sexual maturity during which time the newts live mostly on land.

**Juvenile great crested newts may stay in the water (ARC)**

**Distribution and status** The great crested newt is widespread throughout lowland England and Wales, although scarce or absent from southwest England and much of western Wales. It has a limited range in Scotland.

The great crested newt is believed to have declined more rapidly than other widespread amphibian species and has particularly suffered from the degradation of rural ponds due to agricultural intensification. It has not adapted to alternative habitat provided by garden ponds as well as have the smooth newt and common frog. Although in rural areas, where garden ponds tend to be larger anyway, gardens and their ponds may provide critically important habitat within an otherwise inhospitable landscape.

**Distribution of great crested newt (based on a map provided by Rob Still/WILDGuides)**

The great crested newt has colonised several former quarry sites with great success and several of these sites have been designated Special Areas of Conservation for the species.

**Large garden ponds in rural areas can be important breeding sites for the great crested newt (ARC)**





**Flooded brick pits at Hampton Reserve, south of Peterborough support the largest known population of great crested newts (ARC)**

## 2.2 Smooth newt *Lissotriton vulgaris*

**Male smooth newt in terrestrial phase (ARC)**

**Ecology** The smooth newt is not as aquatic as the great crested newt. Adults spend the breeding period in the water but return to land soon afterwards. The skin of the smooth newt changes texture between aquatic and terrestrial stages, which tend to be discrete phases. Occasionally adult smooth newts spend the winter in ponds but this is unusual. In most cases they remain terrestrial until early spring when they migrate to breeding ponds.

The smooth newt is not as long-lived as the great crested newt, reaching six or seven years at most.

**Reproduction** Breeding behaviour is similar to that of the great crested newt, although adult smooth newts tend to leave the water sooner than the great crested newt and smooth newt larvae tend to complete the larval stage earlier in the year, from July to September. The young newts then live on land until becoming mature two or three years later.

Occasionally, smooth (and palmate) newt larvae spend longer in the larval stage than is normal, in some cases overwintering as large larvae and completing development to efts the following year. In more extreme cases smooth (and palmate) newts may continue to grow to sexual maturity while retaining some larval features, usually just the gills. This neotenous, or paedomorphic, condition is most likely to occur in cool ponds.

**Sexually mature smooth newt retaining gills (ARC)**

**Distribution and status** The smooth newt is widespread and common but prefers hard water ponds with a neutral pH, rarely being found in ponds lower than pH 6. Its tolerance of a wide range of habitats ensures that it is probably the most abundant amphibian in Britain, although it is less abundant in soft water areas such as in western Britain and upland areas. Populations in rural areas have presumably declined with the intensification of farming, but the ability to thrive in garden ponds means that the smooth newt is common in this habitat.

**Distribution of smooth newt (based on a map provided by Rob Still/WILDGuides)**

## 2.3. Palmate newt *Lissotriton helveticus*

**Male palmate newt (David Orchard)**

**Ecology** The palmate newt leads a very similar life to the smooth newt, occupying a similar ecological niche. It does, however, prefer soft water or slightly acidic ponds, notably in upland areas and on lowland heaths. In Kent and Norfolk it is also associated with ancient woodland.

**Reproduction** Breeding ecology is very similar to that of the smooth newt.

**Distribution and status** Due to its preference for soft water the palmate newt tends to be abundant in northern and western Britain. In southwest England it is more common than the smooth newt.

**Distribution of palmate newt ((based on a map provided by Rob Still/WILDGuides)**

Where the species' ranges overlap, the palmate newt can often be found in the same breeding ponds as smooth newts. It is less likely to be found with the great crested newt.

## 2.4. Common toad *Bufo bufo*

**Ecology** The common toad is the most terrestrial of the widespread amphibians. Outside of its breeding season it may move up to several kilometres from water. It is not very fussy in its choice of terrestrial habitat. Rough grassland and woodland are particularly favoured. The common toad is more tolerant of dry conditions than other amphibians excepting the natterjack.

**Reproduction** Adults are present in breeding ponds for only about two weeks. Males greatly outnumber females. After breeding they move back into terrestrial habitat. Common toads tend to breed in larger water bodies than do other amphibians although drainage ditches are also used. This species seems to need relatively open water. The eggs and larvae are distasteful to fish, so common toads can thrive in fish ponds. Common toads may migrate considerable distances to specific, traditional breeding ponds.

**Common toad mating ball (David Orchard)**

**Distribution and status** The common toad was added to the list of priority species during the revision of the national Biodiversity Action Plan in 2007. Prioritisation was not due to scarcity of this species, rather to declines. The common toad is widely distributed throughout a large range and is probably present in every 10-km square of lowland, mainland Britain. Nevertheless, declining status has been found in southern and eastern England (Carrier and Beebee, 2003). Reasons for decline have not been firmly identified.





Mortality of toads crossing roads during annual springtime migrations to breeding sites is readily apparent and has been the focus of public attention. Although roads can adversely affect amphibian populations through direct mortalities other less readily apparent factors may also be at work, such as the fragmentation of habitat and toad populations. The common toad is also likely to have been negatively affected by a general decline in habitat quality associated with the intensification of farming.

**Distribution of common toad (based on a map provided by Rob Still/WILDGuides)**

## 2.5. Natterjack toad *Bufo/Epidalea calamita*

**Male natterjack in breeding pond (Fred Holmes)**

**Ecology** The natterjack toad is at the northwestern edge of its global range in Great Britain where it can survive in only a few early successional stage habitats. Most of these are coastal (dune and upper salt marsh/merse); together with heathland, all are lowland. The natterjack forages in areas of open ground or very short vegetation where it can see, pursue and catch its invertebrate prey. It can survive in hot, dry habitats by burrowing. It readily digs into a suitable substrate, usually sand, to avoid the extremes of temperature and dryness that would be lethal to other amphibians.

**Reproduction** For breeding the natterjack requires shallow, ephemeral pools that warm up quickly to speed the tadpoles' development. Natterjacks breed later in the year than common frogs and common toads. Spawning begins in April or May depending on weather conditions. Later spawn may be laid in June, July and even the first week of August depending upon rainfall and the availability of ephemeral pools.

Spawning takes place in shallow water, usually 5-10 cm deep. The female produces several thousand eggs as a single row in spawn strings. The eggs and tadpoles develop rapidly so that newly metamorphosed toadlets leave the water from mid-May to July, peaking in June at most sites. Natterjack tadpoles do not compete well with those of the common toad or frog and natterjacks need ponds that are not used by other anurans, or great crested newts which eat their eggs and tadpoles.

**Distribution and status** The natterjack's distribution has always been restricted in Britain due to its specific habitat requirements. Over the last 100 years or so, it has disappeared from more than 75% of its former haunts with losses from heathlands in southern and eastern England being particularly severe. It is now found in only about 60, mostly coastal, sites throughout England, southwest Scotland and north Wales. The stronghold for the species is on the northwest coast, north of Liverpool to the Solway Estuary. Nearly all breeding sites in the UK are protected, having SSSI status, and at most sites populations are monitored annually by site managers or volunteers.

The natterjack is a European Protected Species and a priority species in the UK's Biodiversity Action Plan. The plan highlights both the threats to the species and the conservation measures needed to address them.

**Distribution of natterjack toad (based on map produced by Rob Still/WildGuides)**

## 2.6. Common frog *Rana temporaria*

**Ecology** The common frog can be found in a wide range of habitats, although it is less tolerant of dry conditions in the terrestrial habitat than are toads. It breeds in a wide variety of water bodies, which means that in any particular area a frog population tends to be spread over many local water bodies.

**Reproduction** The common frog breeds early in the spring. The exact timing of spawning is related to temperature and hence varies geographically. Common frogs spawn earliest in the southwest, with spawn appearing in December on the Lizard peninsula, for example. Spawning is approximately one week later for every 100 km further east and five days later for every 100 km north (Carroll *et al*. 2009). The pattern of spawning activity within a season can also be affected by temperature, with cold snaps breaking spawning activity into several peaks.

Each female produces a single clump of spawn, usually in the warm shallows at the edge of water bodies. Spawning usually takes place in standing water, but sometimes ditches and streams are used.

**Distribution and status** The common frog is present throughout most of mainland Britain, from lowland habitat to approximately 1,000 m altitude. Populations on farm land have declined due to agricultural intensification but the common frog is sufficiently adaptable to readily exploit garden ponds, which in some areas may provide more significant habitat than agricultural land.

**Distribution of common frog (based on map produced by Rob Still/WildGuides)**

## 2.7. Northern pool frog *Pelophylax lessonae*

**Ecology** The northern pool frog is a warmth-loving species, emerging from hibernation a little later than the common frog and common toad and remaining active until late August or September. Adult frogs spend much of the active season in ponds rather than on land. Numbers in the pond peak in May and June and then decline over the summer, presumably as frogs move into terrestrial habitat. It seems likely that some frogs hibernate in ponds but mostly this occurs in terrestrial habitat.



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**Female northern pool frog basking in open area of pond bank (ARC)**

Northern pool frogs prefer relatively open ponds where emergent vegetation growth does not overly shade the water. Within the pond pool frogs occupy warm microhabitats and bask in the sun especially on floating mats of vegetation and around pond margins.

**Reproduction** Pool frogs breed from late May to early June. Each female produces a few small spawn clumps, usually deposited on top of vegetation mats, presumably benefiting from the warmth at the water's surface. Under these conditions the eggs hatch relatively rapidly, within approximately five days. The tadpoles are unpalatable to fish and pool frogs thrive in ponds supporting large numbers of sticklebacks.

Although pool frog tadpoles are very small on hatching, they grow rapidly, metamorphosing from late July until late September with numbers of froglets peaking in August. It is unclear whether late developing tadpoles can survive over winter.

**Distribution and status** Until the 1990s it was generally believed that the pool frog was not native to Britain. All populations of pool frogs present in England were believed to have originated from deliberate introduction from continental Europe. Pool frog status was reviewed in the light of several lines of research that concluded that the species had, in fact, been present prior to the documented dates of introduction. In particular a population from Thompson Common in Norfolk was more closely related to pool frogs from Scandinavia rather than to populations further south in Europe which were the sources of introduced frogs.

Re-evaluation of pool frog status came just as the sole known native Norfolk population dwindled to extinction. Since then a reintroduction programme has been devised for the northern pool frog (Buckley and Foster, 2005), importing frogs from Sweden and releasing them at a site in Norfolk. This is the currently the sole site for the northern pool frog in England although the reintroduction programme plans secondary releases to additional sites. All other pool frog populations in Britain are believed to have originated from importations from more southerly populations in Europe and are genetically dissimilar to northern pool frogs.

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Northen pool frogs in amplexus (ARC)



# 3. Legislation and Policy

## 3.1. Legislation

All native amphibians receive some legal protection in Great Britain arising from the following legislation:

- Wildlife and Countryside Act 1981 (as amended) (in Great Britain).
- Nature Conservation (Scotland) Act 2004.
- Conservation of Habitats and Species Regulations 1994 (as amended) (in Scotland).
- Conservation of Habitats and Species Regulations 2010 (in England & Wales).

In England and Wales all amphibian species are listed on schedule 5 of the 1981 Act. The great crested newt, natterjack toad and pool frog are also listed on schedule 2 of the 2010 Regulations, which designate them 'European protected species'. In Scotland natterjack toads and great crested newts are protected through the Conservation of Habitats and Species Regulations (2004).

The legislation effectively creates two levels of protection. The European protected species receive strict protection, making it an offence to capture, possess, disturb, kill, injure, or trade in individuals of these species. In addition it is an offence to damage or destroy the places they use for breeding or resting. The remaining four species are protected only against unlicensed trade. The legislation applies to all life stages of wild animals only.

Legislation also provides protection for sites of particular value to nature conservation. Some amphibian sites may be eligible for designation as Sites of Special Scientific Interest (SSSIs) (NCC, 1989):

- Important, established natterjack sites.
- Exceptional great crested newt sites.
- Outstanding assemblages of widespread species.

SSSIs have legal protection meaning that damaging activities are strictly controlled or prevented. Management is agreed with landowners to ensure that the site is maintained at, or restored to, a favourable condition. There are also special considerations in planning for development activities that might affect SSSIs.

European legislation affords the great crested newt a higher level of protection than other British amphibians. Under the Habitats Directive 1992 it is listed under schedule 2, which means that member countries should designate Special Areas of Conservation (SAC) for the species. In Britain 22 SACs have been designated for the great crested newt which is also a qualifying feature for 10 other sites (JNCC website) SAC sites are also SSSIs and so are subject to the same controls.

## 3.2. Biodiversity Action Plan 'priority species' listing

The following amphibians are priority species of the UK Biodiversity Action Plan (BAP) www.ukbap.org.uk:

- Great crested newt
- Common toad
- Natterjack toad
- Pool frog

Action plans highlight both the threats to these species and the conservation measures needed to address them (see Amphibian and Reptile Conservation's website: www.arc-trust.org).

All BAP species have been included in lists of species of 'principle importance for the purpose of conserving biodiversity' enshrined in national legislation. In Scotland there is a provision to create such a list via Section 2 of the Nature Conservation (Scotland) Act 2004, while in England and Wales the mechanism is through Sections 41 and 42 of the Natural Environment and Rural Communities (NERC) Act 2006 respectively. Section 1 of the Nature Conservation (Scotland) Act 2004 and Section 40 of the NERC act introduce a 'Biodiversity Duty' which gives responsibility to all public bodies to *have regard…to the purpose of conserving biodiversity.*

**Legal protection and BAP status of amphibians in Britain**

| Level of legal protection | Species | Killing and injury | Disturbance, capture and habitat | BAP Priority |
|---|---|---|---|---|
| Limited protection under Wildlife and Countryside Act | Smooth newt | | | |
| | Palmate newt | | | |
| | Common frog | | | |
| | Common toad | | | Priority |
| European Protected Species | Great crested newt | Protected | Protected | Priority |
| | Natterjack toad | Protected | Protected | Priority |
| | Northern pool frog | Protected | Protected | Priority |

## 3.3. Implications for site managers

The legal situation regarding the species with limited protection (palmate newt, smooth newt, common frog and common toad) is straightforward. These are protected under the Wildlife and Countryside Act 1981 but only with respect to unlicensed sale. Habitat management activity is not subject to any legal restraint in the case of these species.

Where great crested newts or natterjack toads are present, however, habitat management work must be carefully planned to comply with the legislation protecting these species. Work to improve the habitat for these species could be illegal if it risked killing, injuring or disturbing individual animals.

Otherwise unlawful activities (such as disturbance for conservation purposes) can be made lawful by a licence from the relevant government agency (Natural England, Countryside Council for Wales or Scottish Natural Heritage).

In 2007 amendments to legislation removed the defence which previously made an action lawful if it was the *incidental result of a lawful operation and could not reasonably have been avoided* (known as the 'reasonable avoidance' defence).

In practice most typical habitat management for the great crested newt and natterjack should not require a licence. Work should be planned to avoid committing an offence (such as killing great crested newts during major restoration work to a breeding pond). This may be done by careful timing of operations. For example work to a great crested newt breeding pond should be done in the winter, rather than in the spring or summer.

If habitat management work is planned for a site where great crested newts or natterjack toads are likely to be present, the following is recommended:

- Confirm that the species is in fact present
- Decide on work required.
- Conduct a risk assessment.

Some sites are well recorded but smooth newts are sometimes mistaken for great crested newts. Unless identification is definite, this should be confirmed by survey work. Note that surveying for European protected species is a licensable activity since survey techniques cause a degree of disturbance. Amphibian and Reptile Groups may be able to help with surveys.

Planned work should be reviewed to confirm whether it will benefit the conservation of the species. For example, the creation of suitable ponds would clearly be of benefit but the installation of a footpath or bird hide would not.

A risk assessment should be carried out to identify and then minimise, or ideally eliminate, the occurrence of illegal activity (i.e. disturbing, killing or injuring a European protected species) during the course of the proposed work. Risks can be minimised by planning the work when animals are least likely to be present in the area of the proposed activity. For example work on terrestrial habitat away from a pond could be planned for the late spring when amphibians could be expected to be in the pond. Work affecting the aquatic habitat is best planned for late autumn when amphibians are likely to be on land.

If having completed a risk assessment you still consider that illegal activity may occur, you must apply for a conservation licence.

If in doubt over a particular project, contact the licensing section of the relevant national agency or seek advice from a professional consultant ecologist.

Note that the above is intended for general guidance only and it is neither authoritative nor comprehensive. The original legislation should be consulted with reference to specific enquiries. Only a court can decide whether an offence has been committed.

The legal protection for great crested newts and natterjack toads must be given due consideration but it should certainly not deter site managers from undertaking work to benefit these species and this would be contrary to the purpose of the legislation. As long as reasonable measures are taken to avoid harm to amphibians during management that would be beneficial to them there should be no inadvertent breaches of legislation. A prosecution would be unlikely as it would not be in the public interest. Indeed a prosecution for harm during habitat management is likely to occur only if there were evidence of negligence or malicious intent.

When planning habitat management work the legal protection of other species should also be considered. For example, birds and bats using trees targeted for felling.

## 3.4 Local authority sites

The 'biodiversity duty' introduced in the Natural Environment and Rural Communities Act 2006 places a responsibility on all public bodies to integrate biodiversity conservation into their activities. With regard to sites managed by local authorities, effort should be made to determine which sites support amphibians. Local Amphibian and Reptile Groups (www.arguk.org) may be able to provide advice or assistance with surveys.





These sites should be managed sympathetically for amphibians, in balance with other conservation objectives. Sites managed by local authorities with the potential to support amphibians include local nature reserves, parks and public open spaces, allotments and tenanted farms.

## 3.5. Development control and forward planning

Mechanisms exist to encourage the recognition of and conservation of wildlife through the development control and forward planning processes in Great Britain and these can be relevant to amphibians. Biodiversity conservation is enshrined in national planning policy in each of the countries of Great Britain and planning authorities are directed to minimise adverse impacts on biodiversity and, in particular, protected species or species of 'principle importance for conservation'. For most developments there will be an assessment made on the effects of development on wildlife – adverse impacts on amphibians include loss of habitat or habitat features, such as ponds, and fragmentation through, for example, roads, or barriers such as walls and fences. Measures to avoid or to mitigate for these should be considered. Increasingly planning officers are being made aware through 'alert mapping' or through identifying certain types of habitat to situations where amphibians may be affected by development. Legal mechanisms may be included through planning conditions to ensure appropriate conservation measures, including long term management or 'mitigation areas', are undertaken.

Opportunities may exist within development proposals to incorporate positive measures to enhance biodiversity; landscape planting, looking for increased connections between greenspaces, use of sustainable urban drainage schemes (SUDS). In forward planning, habitat 'opportunity mapping' can be used to identify areas of importance for biodiversity. Areas of particular value to amphibians can be identified as Local Wildlife Sites (variously also known as Sites of Importance for Nature Conservation, Areas of Biological Interest, etc). These are recognised through the local planning authority, often identified by panels of local experts, and are given increased significance when planning decisions are made.

## 3.6. Agri-environment mechanisms

Conservation of amphibians in the 'wider countryside' and frequently away from nature reserves can be supported by grants. A key funding mechanism is provided through 'agri-environment' support programmes, with different schemes operating in the different countries of Great Britain. These schemes, such as Environmental Stewardship (in England), Scottish Rural Development Programme (in Scotland) and Tir Gofal (Glastir from 2012) in Wales, allow funding for positive conservation measures. They can offer general funding to maintain habitats or have specific funding measures targeted towards species, for example for pond creation for natterjack toads or for great crested newts, or survey. Funding is matched to a 'points' system based around the specific environmental benefits that are accrued.

## 3.7 Literature


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**www.herpconstrust.org.uk/downloads/HCTnewt_leaflet.pdf**

Wright, D. (2011). How great crested newts on your farm can work for Rural Priorities and Land Managers' Options. Leaflet produced by Amphibian and Reptile Conservation, Bournemouth.

Palmate newt (Fred Holmes)



# 4. Pond Creation

## 4.1. Benefits of pond creation

Creating a pond is one of the most cost effective steps that can be taken to benefit wildlife. Ponds support similar or greater aquatic diversity compared with other wetland habitats such as rivers. Carefully designed wildlife ponds rapidly become rich in species. Ponds are also central to amphibian ecology and so their creation is key to improving amphibian conservation status.

Our widespread amphibians have relatively broad requirements for breeding ponds but there is a great deal of overlap between the needs of amphibians and the features recommended for wildlife ponds in general. The principles for creating wildlife ponds (e.g. Williams *et al.* 2010) also apply well to amphibian breeding sites.

## 4.2. Pond location

There are a number of factors to consider when planning a new pond. These include:

- Water source
- Flooding
- Warmth
- Public access
- Location of neighbouring amphibian populations
- Habitat connectivity (*9. Landscape Ecology)*
- Functionality: if for example the pond is created for some other primary purpose, e.g. a fire pond or part of a Sustainable Urban Drainage Scheme (*10.2 Sustainable Urban Drainage Systems*)

## 4.3. Water source

Water quality is critical to the wildlife value of a pond. High water quality, or 'clean water', supports a great abundance and diversity of aquatic life. Clean water is simply water that it unpolluted. Common sources of pollution are agro-chemicals and run-off from roads. Of these the former are particularly significant. A large proportion of the countryside is farmed so most rural ponds are affected by agro-chemicals. It is not just pesticides that affect water quality but also fertilisers. Ponds thrive best with low-nutrient input so fertilisers are a pollutant in ponds.

Some of our amphibians can survive and breed in relatively poor water quality. Nevertheless, clean-water ponds provide better habitat so ponds should be sited to optimise water quality within the constraints imposed by the local environment. What this means in practice is that new ponds should be created in locations where they are filled by rain and ground water rather than road run-off or water drained from land subject to agro-chemical application. In some parts of the country this can be difficult, especially where groundwater is contaminated with nitrates. However, if these impacts can be minimised, amphibians may still benefit.

Where possible, ponds should be located in semi-natural habitats such as, heath, downs and woodland, where pollution inputs are likely to be minimal.

Water from ditches and streams should be avoided. Ponds on farmland are often fed by ditches that receive water from arable fields, which is effectively polluted. The temptation to use ditches to maintain a constant water level in ponds should be avoided for the same reason. Varying water levels help to create a more natural pond ecosystem anyway. Ditches and streams may also carry fine particles which cause rapid silting. Further, ponds which receive their own independent water supply will develop their own unique character. If connected to a stream or ditch, this will be compromised.

Care should also be taken in using water from springs to feed a pond. There is a misconception that spring water is always pure but in reality, in some parts of England, it contains high levels of nitrates from agricultural fertilisers.

On farmland buffer strips (areas surrounding a pond where agro-chemicals are not applied) may provide a degree of protection. Research has not identified the width of buffer needed but the greater the width, the more effective it is likely to be. Buffer zones have the additional benefit that they can provide good terrestrial habitat for amphibians.

## 4.4. Flooding

New ponds should be sited in locations free from the risk of flooding from nearby rivers or the sea. Seasonal flooding may introduce fish while inundation with seawater will harm most freshwater pond life. The natterjack is a special case as it can exploit ponds that experience seasonal flooding by salt water if the pond is freshened up with rain water prior to the breeding season (see *11. Natterjack Toad)*. The Environment Agency provides maps on the Internet that indicate areas at risk of flooding.

## 4.5. Warmth

Warm ponds are favourable for amphibian growth and development, hence new ponds should be located in sunny locations. A belt of trees or scrub several metres to the north of a pond can act as a windbreak and create a warm microclimate around the pond. The long-term management of the pond site should incorporate measures to control scrub and trees to avoid excessive shading. No more than 60% of the pond shoreline, or 25% of the surface of smaller ponds, should be shaded and in most cases less shading is preferable. The southern shoreline is best unshaded.

## 4.6. Public access

The greater the public access, the greater the chances of negative impacts on the pond. Harmful consequences of public access include:

- Disturbance by dogs
- Introduction of fish
- Introduction of non-native plants and animals
- Vandalism (e.g. damage to pond liner)
- Killing amphibians

Experience has shown that ponds constantly disturbed by dogs have a significantly lower wildlife value than those which are undisturbed, largely due to high turbidity of the water. This problem is greater on clay soils.

The degree of public access should be considered when planning a new pond. To minimise disturbance a new pond should be sited away from access points, footpaths and bridleways.

If it is not possible to locate a new pond away from areas that are heavily used by the public, it may not be worth creating a pond at all. Alternatively, such ponds could be seen as 'sacrificial', where activities such as dog swimming are tolerated in order to protect other more sensitive ponds.

As a last resort, fencing can be erected to keep the public away from pond edges. This can be unsightly but it may be essential to ensure that a good wildlife pond can develop.

## 4.7. Will the new pond hold water?

On soils where an impermeable clay layer can be found close to the surface, ponds can be created simply by digging holes in the ground. However, most of the time things are not so straightforward.

There is no foolproof way of predicting how well a pond will hold water, so the best advice is to carefully assess the evidence:

- Look at the surrounding landscape. Are ponds a common feature? If so it is a good indication that new ponds will hold water.
- If ponds are present nearby, how far below ground is the water level? If the highest water level is 50 cm below ground level, a hole 100 cm deep will only retain 50 cm of water at that time of year.
- Examine the terrestrial vegetation. The type of plants present will indicate whether the site is well drained or not.
- Check for evidence of previous disturbance to the ground. If brick rubble or the remains of land drains are present, the pond may not hold water even on wet sites. Such factors make the hydrology of brownfield sites difficult to assess.
- Ask for advice and speak to site managers; they may know the locations of land drains.

**Sensitive ponds can be fenced off to protect them from disturbance, such as these ponds at Havannah Nature Reserve, Newcastle-upon-Tyne (David Orchard)**

To determine whether a proposed pond is likely to hold water, it is advisable to dig a number of test holes and observe them for a period of time. Test holes of any convenient size can be dug to check the water-holding potential of a particular site. Ideally, such test holes should be 1 m deeper than the deepest part of the proposed pond. Check for services (buried cables or pipelines) before digging a test hole.





Test holes (and newly excavated ponds) sometimes take a while to seal themselves as the small soil particles fill the spaces between the bigger ones. Ideally, test holes should be monitored for up a year to find out how water levels fluctuate. Digging a test hole also allows inspection of the soil profile. For reasons of safety test holes should have gradually sloping sides.

**A large test hole allows water levels to be monitored for up to a year, during which it may function as an amphibian breeding pond and should not be filled in. This one is 7 m in diameter and 1.2 m deep (David Orchard)**

In the German state of Schleswig-Holstein over 1400 ponds have been created for nature conservation since 2004. This has generated a wealth of experience. Instead of test holes, trenches are dug the length and breadth of the proposed pond to check for the presence of land drains. An assessment is then made, based on the soil profile, as to whether the planned pond will retain water.

**A trench excavated in Schleswig-Holstein to determine pond creation potential (David Orchard)**

## 4.8. Lined ponds

On permeable substrates such as chalk, sand or limestone new ponds will probably need some form of liner to retain water. A variety of materials is available including:

- EDPM rubber
- Butyl rubber
- Bentonite clay

Rubber pond liners are relatively easy to use, but prone to puncture. To reduce the risk of this:

- Carefully remove any sharp objects from the excavated hole.
- Line the hole with a commercially available geotextile or polypropylene underlay. Sand may also be used, but is more difficult to work with than manufactured underlay, so is best used in conjunction with the latter.
- Place the liner on top of the underlay.
- Place a second layer of geotextile or polypropylene on top.
- Cover with a protective layer of either subsoil or sand (10-30 cm).

**Butyl liner laid over geotextile underlay, Portal Woodlands, Ipswich. This liner required four people to lay (Duncan Sweeting)**

As well as protecting the liner from puncture, the uppermost layer of underlay also stabilises the sand or subsoil on top of the liner to create a natural looking pond basin. The underlay should be unrolled in sheets that overlap approximately 25-30% of their width, with the overlapping edges facing towards the deeper part of the pond, so that overlaid sand or subsoil runs off it rather than raises its edges.

Installation guidance is sometimes provided with purchased liners.

**Here the butyl liner has been covered with a geotextile layer, topped with a 30 cm depth of sand from the excavation site (Duncan Sweeting)**

Bentonite clay is a fine powder that expands on contact with water. When sandwiched between two geotextile layers it produces a very effective pond liner. Bentonite liners are more robust than rubber and have a more natural appearance.

Bentonite based liners are available under several different trade names, such as Bentomat and RAWMAT, and they are purchased in large rolls or strips. Correct installation is the key to their success and manufacturers' guidelines must be strictly followed.

Although a bentonite liner should remain functional after a period when a pond dries, it does not withstand excessive drying. Hence bentonite liners are best used on damper substrates rather than sandy soils which may dry out completely, making the liner prone to cracking.

Pond liners are heavy. Small ponds, such as typical garden ponds can be lined by hand but for bigger ponds machinery will be needed to deliver, manoeuvre and roll out the liner which may weigh several tons.

Lined ponds lose water via capillary action (i.e. water is soaked up and away from the pond by soil around the edge). This effect has a relatively greater impact on smaller ponds.

## 4.9. Pond design

This section focuses on the individual pond. Landscape considerations are covered in section *9. Landscape Ecology.*

Amphibian ponds should ideally contain a range of microhabitats. To create microhabitat diversity within a pond, the design should incorporate:

- Gently sloping sides
- A range of pond depths
- An irregular shape

Gently sloping pond edges (gradient of 1 in 10 or if possible 1 in 20) create a wide drawdown zone which encourages a diversity of plants and invertebrates. However, if pond-dipping is planned designing a section of the pond edge with vertical sides facilitates netting access.

Shallow areas, less than 10 cm and certainly less than 30 cm deep, support the greatest range of pond plants which in turn create the habitat for most of the pond's invertebrates. Beds of submerged aquatic vegetation provide egg-laying substrates for newts, microhabitat for prey species and refuge from predators. For amphibian ponds it is not necessary for the greatest water depth to exceed 1.2 m.

**Frogs spawn in the warmest part of the pond, which is usually found in shallow margins (ARC)**



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## 4.10. Excavation

**A 21-ton excavator used to create amphibian ponds in Schleswig-Holstein, Germany (David Orchard)**

If space allows, large excavators are best for pond creation work as they allow greater flexibility and they are more cost effective.

Spoil excavated during pond construction can be used to create a bund or raised pond edge to avoid run-off from a potential nearby source of pollution.

Topsoil removed from a site during pond creation (or from any other source) should not be added to the pond after construction, as this is nutrient-rich pollutant. If creating a lined pond, sand or sub-soil should be used instead to cover the liner.

**A toothed bucket on a mechanical digger leaves an uneven finish which increases microhabitat diversity in non-lined ponds (David Orchard)**

## 4.11. Planning permission

In some areas pond creation may require planning permission, but local authority planning departments differ in how they address this issue. If planning permission is required a fee will be charged and this varies according to planning authority and the size of the proposed pond(s). In some areas these charges can be significant and the amount of time needed to complete the necessary paperwork can be daunting.

If you think that planning permission may be required for your project, speak with your local authority's ecologist or biodiversity officer and ask for advice on the best approach. Alternatively, contact the relevant planning officer and explain why your project will help to achieve local and national biodiversity targets. Planners sometimes show discretion when interpreting planning laws and they may not insist on a planning application for your project, especially if it is small scale.

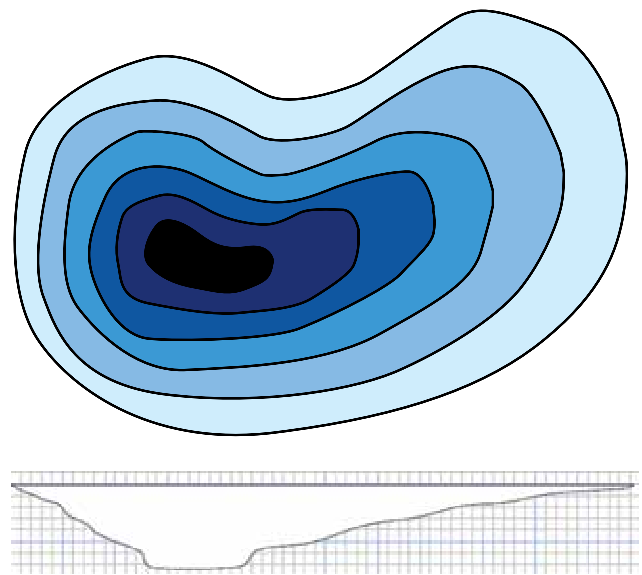
If proposed ponds will be used to water livestock, they will not need planning permission.

## 4.12. Working with contractors

Ideally a contractor will have experience of wildlife pond creation but this is not always the case. Regardless of previous experience, a contractor should be provided with a specification for the proposed work and a simple diagram showing the contours of each proposed pond.

It is highly advisable to be on site to supervise pond creation work to:

- Make the most of any opportunities that arise to create better ponds.
- Resolve problems that may arise while the machine is on site.
- Ensure that the contractor follows the specification as intended.
- Ensure that valuable habitats (such as hibernacula) are not damaged by machinery.



**Plans of pond outlines and profiles provide a useful guide for contractors who may not be used to wildlife pond specifications (Pond Conservation)**

Such supervision may sound unnecessary, but some aspects of new amphibian ponds (irregular outline, gently sloping sides and rough finish to the pond base) are contrary to the training and working practices of plant operators. Experience has shown that on-site supervision by suitably experienced staff is often the key to a successful pond creation project.

### 4.13. Stocking the pond

Many pond plants and animals, including amphibians, have evolved strategies for moving between water bodies and colonising new sites. Hence, there is no need to stock a well-designed pond with amphibians, other pond animals or plants.

In addition to being unnecessary (and potentially costly), stocking ponds can jeopardize the wildlife value of a pond due to the risk of introducing non-native, pest pond plants (see *6.5 Non-native invasive plants*) Furthermore, concerns about threats posed by amphibian disease (see *7.1 Disease*) have resulted in a cautious approach to moving any material between one pond and another.

If there is overwhelming pressure to 'plant up a pond', for example on sites frequented by the public, best practice is to avoid using plants from private gardens or garden centres. To minimise the risk of introducing non-native plants or amphibian disease, the alternative could be to translocate plants from nearby ponds, as long as landowner's permission to do this has been granted and provided that absence of pest plant species can be confirmed.

**Pond creation checklist**

- Ensure a source of clean water.
- Choose a location unlikely to be flooded.
- Choose a warm location.
- Consider public access.
- Consider connectivity with other amphibian sites (9. Landscape Ecology)
- Check that proposed pond location does not already support valuable habitat/species.
- Check that the site holds no archaeological interest (contact county archaeologist).
- Check for the presence of services (cables or pipelines) underground.
- Check the water-holding potential of the site.
- Apply for planning permission if required.

### 4.14. Literature


Environment Agency. Flood Maps. www.environment-agency.gov.uk/homeandleisure/37837.aspx

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## 5. Pond Restoration

### 5.1. Pond restoration

Most lowland ponds in Britain are in a poor state and support very little aquatic life. The Countryside Survey 2007 concluded that 80% of ponds were in poor or very poor condition. Although some of our amphibians are relatively tolerant of poor pond conditions, breeding is likely to be more successful in better quality ponds. This section considers the restoration of ponds found in the countryside (excluding those with artificial liners).

Pond restoration generally involves some or all of the following:

- Removal of pond vegetation
- Removal of silt
- Re-profiling the pond base
- Cutting back shading shrubs and trees.

These activities have the potential to harm wildlife already present or to alter a habitat that already provides a valuable role. Pond Conservation has produced a risk assessment (Williams *et al.*, 2010) to minimise the risk of causing harm during management activities (including pond restoration). This section of the handbook draws heavily on this approach.

### 5.2. Find out about species present

Information about the species that are present or likely to be present in a pond can provide guidance with regard to restoration. If no species of conservation interest are present then major restoration work can proceed. If species of conservation interested have been recorded from the pond in question, or occur within the local area and may be present in the pond, then restoration work should be modified to accommodate species requirements, reduced in scale to avoid harm or, in some cases, not carried out at all.

Information about species present or likely to be present can be obtained from:

- Pond Conservation's BAP Species Map www.pondconservation.org.uk/millionponds/bapspeciesmap
- National Biodiversity Network www.nbn.org.uk
- Local Biological Records Centres
- Specialist interest groups

Some species associated with ponds are legally protected under:

- The Wildlife and Countryside Act 1981
- The Conservation of Habitats and Species Regulations 2010

Animals listed under Schedule 5 of the Wildlife and Countryside Act 1981 are protected from intentional or reckless killing, injury or capture. Plants listed under Schedule 8 of the Act are protected from destruction, uprooting or picking. In addition the habitat of species covered by the Conservation of Habitats and Species Regulations is protected from damage or destruction.

**Pond animals listed under Schedule 5 of the Wildlife and Countryside Act 1981**

- Norfolk hawker
- Southern damselfly
- Tadpole shrimp
- Fairy shrimp
- Glutinous snail
- Fen raft spider
- Lesser silver water beetle
- Spangled diving-beetle
- Medicinal leech
- White-clawed crayfish.
- Water vole has additional protection against damage, destruction, and prevention of access to any place it uses for shelter or occupation.

## Pond plants listed under schedule 8 of the Wildlife and Countryside Act

- Adder's tongue spearwort
- Baltic bog-moss
- Brown galingale
- Creeping marshwort
- Cut-grass
- Fen violet
- Grass-poly
- Pennyroyal
- Petalwort
- Ribbon-leaved water-plantain
- Starfruit
- Strapwort
- Water germander

## European protected species associated with ponds

- Otter
- Great crested newt
- Natterjack toad
- Pool frog
- Little whirlpool ram's-horn snail
- Creeping marshwort
- Floating water plantain
- Fen orchid
- All bat species

Pond restoration work may, incidentally, harm protected species and their habitats. If any of these legally protected species are recorded from your pond then restoration work must be planned to avoid harm. Licensing will be necessary if the management action (or even survey work) would contravene any of this protection legislation. Guidance and forms are available from Natural England, Countryside Council for Wales and Scottish Natural Heritage. There is often more detailed guidance for great crested newts.

## 5.3. Pond risk assessment

In many cases, information about species in a pond will either be absent or incomplete. A risk assessment has been developed by Pond Conservation (Williams *et al.*, 2010) to assist potential pond restoration (summarised in the table overleaf). There are three levels of risk depending on the intensity of the surrounding land use, and the presence of plants in the pond.

## 5.4. Restoration of low risk ponds

Low risk ponds are unlikely to harbour significant pond species or rich communities because of poor surrounding land use/pollution. Drastic restoration work can be beneficial to such sites. Shading scrub and trees should be removed from the southern banks of the pond. A belt of trees can be left to the immediate north of the pond to act as a windbreak, creating a warm microclimate and to provide good quality terrestrial habitat. Cut timber and brash should be left on site and used as in section *8. Terrestrial Habitat*.

The accumulated silt in low risk ponds on farmland usually comprises sediments polluted by agricultural inputs. This should be removed by mechanical excavator. If the silt is deposited into a trailer it can then be spread on arable land as far as possible from the pond by tipping the trailer slowly whilst driving. The spread silt can then be ploughed in.

Pond restoration may provide an opportunity to modify the pond profile to create gently sloping sides. This should be attempted only on water-holding soils. On free-draining soils water may be retained by a clay lining, which should be kept intact. An experienced machine operator should be able to 'feel' a pond lining and hence remove overlaying silt without damaging the clay base.

Pond restoration is best carried out in late summer or early autumn. Water levels should be low at this time, allowing ease of removal of silt. Spreading silt on fields bare after harvest is a good means of disposal.

Pond restoration should be supported by subsequent management of terrestrial habitat. Livestock grazing or annual cutting is required in most cases to prevent a restored pond from becoming encroached by shading scrub after restoration. On agricultural land, designation of a buffer strip around the pond is beneficial. The buffer strip will require management as above to prevent excessive growth of shading scrub.





## Pond Risk Assessment (taken from Williams *et al.* [2010])

| Risk | Description | Recommended action |
|---|---|---|
| Low | Ponds within areas of intensive land use and which have virtually no wetland plants. Unlikely to support rare species. | Restoration work has minimal risk of harming wildlife. |
| Medium | Ponds within areas of moderately intensive land use (e.g. improved pasture) but which have good growth of pond plants. May turn out to be biologically poor but also may support BAP species or, more rarely, rare species. | Pond survey desirable. If survey is not possible, then adopt precautionary approach to restoration work. |
| High | Ponds within semi-natural habitats such as woodland, scrub, marsh, heath and unimproved grassland. At least a quarter of such ponds support nationally rare species. | Review need for restoration work. If this is still deemed necessary, then obtain full survey information and use knowledge of species present to guide management. |

## 5.5. Precautionary principles

If a pond is categorised as medium risk and there is no survey information to guide management, then the best approach is to manage gently and with caution in a minimally-invasive way that will reduce any potential harm.

- Do not destroy any microhabitats in the pond completely (retain portions of all those present prior to management).
- Do not deepen temporary ponds to make permanent water.
- Do not remove more than 1/4 of the pond's sediment over a three-year period.
- Do not remove more than 1/4 of the vegetation as a whole, or of an individual plant species, in a three-year period.
- Do not link ponds to drains or streams: these may add pollutants to the pond.
- Do not steepen the water's edge profile or reduce the extent of the drawdown zone (the area of the pond that is wet in winter, dry in summer).
- Do not allow the surrounding land use, and particularly the pond's surface water catchment area, to become more intensive (e.g. buildings, roads, arable land).
- Do not drain the pond.
- Do not cut down more than 1/4 of the trees, either in or around the pond, over a three-year period.
- Ensure that a variety of pond types is maintained in the landscape.

## 5.6. Restoring great crested newt ponds

Where survey information is available and protected species are present, then restoration work has to accommodate this. In the case of the great crested newt, pond restoration is recognised as one of the actions needed to achieve the targets of the species action plan (The Herpetological Conservation Trust, 2009). Guidance in England (Natural England, 2009) recommends that restoration takes place over winter (November 1 to January 31) so as to minimise the risk of harm to newts, thereby avoiding the need for a conservation licence.

Although pond restoration work entails intervention that may appear destructive, the long-term effect should be to enhance habitat. In such a case licensing is not required for 'damage' or 'destruction' of newt habitat.

In practice winter may not be the best time for restoration work. If restoration has to proceed when newts may be present, then the work must be licensed.

## Low risk ponds

**Pond isolated in an arable field, subject to fertiliser inputs and completely shaded by trees and scrub (ARC)**

**Pond receiving inputs from farm yard (ARC)**

## Medium risk ponds

**Pond in arable field but supporting aquatic vegetation (ARC)**

**Pond in improved pasture but with good water quality and supporting aquatic vegetation (David Orchard)**

## High risk ponds

**Pond set in scattered scrub and woodland, receiving no agro-chemical inputs (ARC)**

**Heathland pools (ARC)**





## 5.7. Literature


Natural England (2009). Pond management work and great crested newts. Natural England. **www.naturalengland.etraderstores.com/NaturalEnglandShop/Newt2**

The Herpetological Conservation Trust (2009). Great crested newt species action plan. **www.herpconstrust.org.uk/downloads/HCT_GCN_%20Action_plan_June09.pdf**

Williams, P., Biggs, J., Crowe, A., Murphy, J., Nicolet, P., Weatherby, A., Dunbar, M. (2010). Countryside Survey: Ponds Report from 2007. Technical Report No. 7/07 Pond Conservation and NERC/Centre for Ecology and Hydrology. (CEH Project Number: C03259).

Williams, P., Biggs, J., Whitfield, M., Thorne, A., Bryant, S., Fox, G. and Nicolet, P. (2010). The Pond Book: A Guide to the Management and Creation of Ponds. Pond Conservation, 2nd edition. Pond Conservation, Oxford.

Common frog (Fred Holmes)



# 6. Other Pond Species

## 6.1. Fish

Fish can be significant predators of amphibians. Large predatory fish such as pike may prey on adults but it is the impacts on the egg and larval stages which tend to be of greater significance to amphibian populations. Amphibian species vary in their abilities to co-exist with fish. In general species that breed in large, permanent water bodies have evolved to co-exist with fish, as fish are likely to colonise these larger ponds. Species breeding in temporary ponds may not survive so well with fish.

Native amphibians differ in their abilities to co-exist with fish. At one extreme the common toad is either distasteful or toxic to many predators, including fish. This defence mechanism is present at all stages of the toad's life cycle. Not only are common toads able to survive in ponds with fish, but fish may even be beneficial. Although common toad tadpoles are distasteful to fish, they are consumed by predatory invertebrates. Fish may reduce invertebrate numbers, lowering the impact of invertebrate predation on toad tadpoles. Common toads can breed successfully, even in well stocked angling ponds.

At the other extreme, the great crested newt is the least able to co-exist with fish. Great crested newt larvae spend time high up in the water column rather than hidden on the pond bottom and it seems that this behaviour makes them particularly prone to fish predation.

The remaining widespread amphibian species are intermediate in their abilities to survive with fish. Although their larvae are consumed by fish, these species frequently breed successfully in ponds with fish. The nature of co-existence is not fully understood but the survival of amphibian larvae may depend on physical refuges from predation such as may be provided by aquatic vegetation.

Due to the sensitivity of great crested newts to fish predation, and because fish are predators of other amphibian species, fish should not be stocked in amphibian ponds.

Fish are often introduced to water bodies by unauthorised third parties. To minimise this risk the location of new ponds should be considered with respect to ease of public access (see *4.6 Public access*).

**Amphibian ability to co-exist with fish varies between species**

Once fish become established in a pond it can be difficult to remove them. Fish control measures have been reviewed for the purposes of great crested newt conservation (Wright, 2010) but the removal of fish from ponds is tightly regulated. Legislation does not permit removal of for the purposes of wildlife conservation so such operations are infrequent and most likely to be approved as an experimental method rather than as recognised operations acceptable under legislation controlling the movement of fish stocks.

## 6.2. Waterfowl

Waterfowl prey on adult amphibians and their eggs. This is natural and amphibian populations can withstand a degree of such predation. However, heavy usage of ponds by waterfowl is problematic. High densities of waterfowl can strip aquatic vegetation from a pond and its shoreline, reducing the basis of its biological diversity and removing refuge and egg-laying substrates for amphibians. Waterfowl also pollute water through defecation and continually stir up sediments, further reducing water quality. Hence waterfowl should not be stocked nor encouraged by providing food or by creating 'duck islands'.

At sites with frequent public access recreation may be a greater priority than amphibian conservation. In such situations the creation of additional ponds for wildlife, or redirecting public access, should be considered.

## 6.3. Non-native amphibians

There is a range of non-native amphibians that have become established in Britain with varying degrees of success. The most widespread of these are several species of water frogs (pool, edible and marsh frogs) and alpine newts. In most cases there is little evidence that these species have adverse effects on our native wildlife but this is not always the case. Non-native species may be vectors of amphibian diseases (*7.1 Disease*). In addition, the relatively large North American bullfrog has the potential to compete with or prey on native species.

The release of non-native species is illegal under the Wildlife and Countryside Act 1981. Control measures for existing populations of non-native species should be reviewed considering:

- Threat posed by non-native population.
- Cost of control measures.
- Likelihood of success of control.
- Practicality of control measures.

In many cases control or eradication proposals will be either impractical or not cost-effective. Exceptions where control measures should be taken include the North American bullfrog and populations of other non-native species that may threaten ecologically sensitive sites.

The North American bullfrog is a pest species in many parts of the world. This frog is able to thrive when introduced to new areas and its relatively large size means that it can be a significant predator of native species. The ecological threat posed has led to a ban on importation into Europe. This frog is unlikely to be encountered in the wild in Great Britain, but two populations have become established in southern England since the import ban. It is important to maintain vigilance so that further introduced populations can be controlled before they become firmly established.

**Although now unlikely to be found, the North American bullfrog is a priority for control (ARC)**

Marsh frogs can grow to a large size and are sometimes mistaken for bullfrogs. Care should be taken to ensure the correct identification of non-native species.

Control of other non-native species may be deemed appropriate if, for example, a population is found near to a nature reserve. In such a case action should be taken promptly and is likely to be successful only if the population in question is recently established and relatively small.

In general, discouraging the further release of non-native species is the most practical action that can be taken.

Information on non-native species can be found on the **GB Non-Native Species Secretariat's website** or the **Alien Encounters** section of Amphibian and Reptile Conservation's website.



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## 6.4. Terrapins

Several terrapin species can be found in ponds in Britain, originating as unwanted pets. They are incapable of successful breeding because summer temperatures are not warm enough to hatch eggs that are occasionally produced here.

Terrapins are most likely to be found in ponds in urban and suburban areas, especially in public parks. Non-breeding populations can build up due to people releasing former pets in ponds where other terrapins already occur.

There has been no study of the impact of terrapins on amphibians in Great Britain. Nevertheless, a few terrapins in a large pond are unlikely to have a great impact. The predatory nature of terrapins is sometimes exaggerated, especially in the media. Large red-eared terrapins, for example, feed mainly on plant material. Where terrapins occur in large numbers their impact may be great and removal should be considered.

Terrapins can be humanely trapped and some wildlife rescue organisations capture and re-home them. Nevertheless, removal of terrapins can be a time-consuming operation and should be undertaken only where clear benefits are likely. Removal of terrapins from ponds on nature reserves may be desirable, to discourage further releases. Terrapins, however, tend to be found in ponds with easy public access and such ponds may experience a range of other impacts. For example, there is unlikely to be great benefit to amphibians in removing a terrapin from a pond that supports large numbers of fish. The impact of the terrapin in such a pond is likely to be relatively trivial.

## 6.5. Non-native invasive plants

Water bodies in Britain are now host to several non-native plants. Some of these are now so common that one in six plants found in ponds are non-native. Some of these are pernicious weeds which are difficult to control once established. Hence, steps should be taken to minimise the chance of their introduction to more ponds.

An example of a problematic, non-native plant is New Zealand pygmyweed or swamp stonecrop *Crassula helmsii*. This plant was very popular in the horticultural trade because it becomes established and grows rapidly. These traits have created a serious pest species in ponds outside the garden. In some cases *Crassula* co-exists with other plants but more commonly it outcompetes them and can form thick mats covering the whole pond and its margins. There does not seem to be any practical way of removing *Crassula* from a pond once it has become established.

*Crassula* is a weed species within aquatic nurseries and can propagate from small fragments. It is sometimes introduced into ponds unintentionally, with other plants. If ponds are not stocked with purchased plants it reduces the risk of contamination with non-native invasive species.

Unwanted plants are sometimes introduced by human visitors to ponds. For example, dumping the contents of the aquarium of no longer wanted pet fish or moving unwanted frogspawn from a garden pond to 'the countryside' runs the risk of contamination with pest pond plants. Hence public access issues should be considered as a means of minimising risks of establishment of non-native, pest plants.

Non-native, pest pond plants include:

- New Zealand pygmyweed *Crassula helmsii*
- Parrot's feather *Myriophyllum aquaticum*
- Floating pennywort *Hydrocotyle ranunculoides*
- Water fern *Azolla filiculoides*
- Waterweeds *Elodea species*
- Curly waterweed *Lagarosiphon major*

Guidance for the control of non-native aquatic plants is provided by the Centre for Ecology and Hydrology **www.ceh.ac.uk**. Eradication of these plants is difficult and costly, hence the emphasis on minimising the risk of their introduction. Steps to minimise risks include:

- Avoid moving material or animals between ponds.
- Avoid stocking new ponds with plants.
- In situations where planting up is demanded, then take care in sourcing plants (e.g native species from nearby ponds).
- Monitor ponds and remove any non-native species before it becomes established.
- Consider measures to minimise easy public access to ponds.

### 6.6. Literature


Alien Encounters (website).
**www.alienencounters.arc-trust.org/**

GB Non-Native Species Secretariat (website).
**www.secure.fera.defra.gov.uk/nonnativespecies/home/index.cfm**

Webley, J. (2007). *Triturus cristatus* (Great crested newt): predation by birds. The Herpetological Bulletin, 100, 39-40.

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**New Zealand pygmyweed, *Crassula* (ARC)**

**Floating pennywork (David Orchard)**

**Parrot's feather (ARC)**

**Blanket of water fern in autumn (ARC)**





# 7. Disease and Mortality

## 7.1. Disease

In the last decade amphibian diseases have received a great deal of scientific attention, and public awareness of what might otherwise be an esoteric issue is relatively high. This high profile is due to links to the phenomenon of amphibian global declines (*1.4 Global declines*).

In the UK there are two pathogens of known significance to amphibian conservation:

• *Ranavirus*
• Chytrid fungus

*Ranavirus* affects mainly common frogs and is found less commonly in other amphibians. It causes two forms of disease in frogs; skin ulcers and internal bleeding. In the first case ulcers can readily be seen on the skin, especially on the underside of the pelvic region and on the hind limbs and feet, in extreme cases causing loss of digits. Bleeding is sometimes evident from the mouth or cloaca or as a reddening of the underside. The latter symptom led to the name 'red-leg', a term which does not encapsulate the wider range of symptoms associated with *Ranavirus*, which also include lethargy and emaciation. Adult amphibians killed by the virus may also be found dead with no other apparent symptoms.

***Ranavirus*** *Ranavirus* may be a new disease in Britain, possibly spread from North America through the commercial importation of bullfrogs or goldfish (Cunningham *et al*., 2003). The impacts of *Ranavirus* on frog status nationally are unknown. Individual populations respond differently (Teacher *et al*., 2010). In some cases mass mortalities are followed by population recovery, in others the disease is recurrent and there can be long-term declines of up to 80% (Teacher *et al*., 2010).

**Symptoms of *Ranavirus*: large ulcer under joint of front leg and emaciation (Amber Teacher)**

**Symptom of *Ranavirus*: large ulcer on right hand thigh (Amber Teacher)**

**Symptom of *Ranavirus*: small ulcers under thigh (Amber Teacher)**

**The reddened underside of this dead frog indicates *Ranavirus*, but red coloration also occurs naturally in female frogs (Jim Foster)**

**Chytrid** Chytridiomycosis is a disease caused by chytrid fungus *Batrachochytrium dendrobatidis*. Chytrid is microscopic and in most cases infection cannot be detected by eye. The fungus lives in amphibian skin that is hardened by keratin (the protein also found in hair, teeth and nails). In frog and toad tadpoles only the mouthparts contain keratin. After metamorphosis the skin becomes more generally keratinised, particularly the undersides and feet, providing chytrid with a greater range of growth substrates.

Symptoms are non-specific i.e. they could also be indicative of other diseases. They include lethargy, reddening of the skin and sometimes ulceration and necrosis of digits (all also symptoms of *Ranavirus*). Chytrid can also cause excessive skin shedding.

Chytrid probably infects amphibians by direct contact between one animal and another and by mobile spores that are released into water. The presence of chytrid disrupts normal skin functions.

Chytrid has been found in all species of native amphibians. A national screening survey carried out in 2008 (Cunningham and Minting, 2008) found chytrid particularly prevalent in natterjack toads and non-native Alpine newts, and often at sites where amphibians had been introduced. Similarly to *Ranavirus*, the impacts of chytrid on amphibians nationally are unknown. Natterjacks appear able to tolerate low fungal loads. However, heavy infection appears to have increased mortality rate in at least in one population.

There are no cures to treat wild populations of amphibians infected with either *Ranavirus* or chytrid. The impacts of these diseases on national population status are not yet understood. There are however good reasons to adopt a precautionary approach to the potential spread of amphibian disease:

- *Ranavirus* has had a substantial impact on some infected populations in Britain.
- Chytrid has had devastating impacts on various amphibian species around the world.
- *Ranavirus* has been listed as a notifiable disease by the OIE (World Organisation for Animal Health), making control measures a legal requirement.

Guidelines for amphibian field workers have been produced to minimise the risk of transmission of amphibian disease (ARG UK, 2008). These guidelines are likely to be reviewed as more is learned about amphibian disease. In practice if disease is present at a particular site then amphibian migration between local ponds is likely to transfer disease anyway, making within-site control measures redundant. In general, though, the following precautions are advised:

- Avoid moving animals or other materials between different pond locations.
- Sterilise survey equipment before moving between sites.

## 7.2. Other diseases and causes of mortality

Amphibians can be affected by other diseases which may not necessarily be fatal. For example, amphibians may be infected by a protozoan, *Amphibiocystidium,* resulting in lumps on the skin. As with other amphibian diseases, there is no practical cure. Fortunately, *Amphibiocystidium,* infection is not always fatal.

Most diseases are a natural part of the amphibians' environment. Healthy amphibians within genetically diverse populations are more likely to be able to withstand infections than individuals that have disease resistance reduced by environmental stress, or those from genetically impoverished populations. Hence, habitat management may have an important role to play in combating disease, by providing high quality environments that allow gene flow between local populations.

Disease is not the only cause of amphibian mortalities. Dead amphibians, sometimes in large numbers, can also be the result of:

- Winterkill
- Breeding associated mortality
- Predation

## 7.3. Winterkill

Some amphibians, especially common frogs, spend the winter hibernating in ponds. Usually they can survive beneath the ice of frozen ponds. During prolonged cold spells, however, they may die, possibly due to lack of oxygen or perhaps due to the toxic effects of gases produced by decomposing organic material. Bodies of dead frogs are most often noticed in garden ponds following a thaw after prolonged freezing. Typically, frogs that have died this way are grey and bloated.



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**Frogs may die under the ice on ponds during prolonged freezing periods (Jim Foster)**

In the past garden pond owners have been encouraged to maintain holes in the ice of frozen ponds to allow exchange of gases with the air. This was thought to help maintain oxygen levels in the pond and to avoid any possible build-up of gases that may be harmful to amphibians. The effectiveness of this strategy has not been tested. In fact, oxygen levels may not be depleted under ice as long as sunlight reaches the pond allowing plants or algae to release oxygen into the water (through photosynthesis).

The effectiveness of maintained holes in allowing escape of noxious gases has not been thoroughly evaluated.

To minimise the risk of winterkill, snow should be swept from the pond surface to allow in sunlight. Maintaining a hole in the ice is a precautionary measure that may release noxious gases.

## 7.4. Breeding associated mortality

Common frogs and common toads breed shortly after emergence from hibernation and, in some cases, after a lengthy migration to water. Breeding activity is physically demanding. Frogs and toads do not feed during the breeding period which is undertaken after months with little or no food. It is perhaps not surprising then that some individuals die during the breeding period. These may be females asphyxiated by mating males or perhaps individuals that have died simply through exhaustion.

## 7.5. Predation

Many predatory birds and mammals kill and eat all or parts of amphibians. Predators may exploit the seasonal abundance of prey when amphibians are present in breeding ponds. Piles of dead amphibians can sometimes be found around breeding ponds, perhaps remains left at a feeding location, or bodies stored by a predator for later consumption

**Footprints around these dead toads are signs of predation by rats (Duncan Sweeting)**

## 7.6. Literature


ARG UK (2008). ARG Advice Note 4. Amphibian disease precautions: a guide for UK fieldworkers. **Amphibian and Reptile Groups of the UK.**

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Teacher, A.G.F., Cunningham, A.A. and Garner, T.W.J. (2010). Assessing the long-term impact of *Ranavirus* infection in wild common frog populations. Animal Conservation 13, 514-522.

Non-native marsh frog (Tim Bernhard)



# 8. Terrestrial Habitat

## 8.1. Overview

Amphibians spend some, usually most, of their time on land. The proportion of time spent in the aquatic and terrestrial habitats varies between species and environmental conditions but land habitats are important to all as seasonal habitat and as migratory routes. This section considers the terrestrial environment primarily as seasonal habitat. Migratory issues and the importance of connecting patches of habitats with areas that amphibians can travel across are considered in *9. Landscape Ecology*.

Once young amphibians leave the water after the tadpole/larval stage, most of them spend the juvenile part of their life on land. This can be the best part of two or three years before they reach sexual maturity and return to water as breeding adults. The great crested newt differs from the other species in that juveniles may spend time in the aquatic as well as the terrestrial habitat.

**This young smooth newt may not return to water until it is two or three years old (ARC)**

In the adult stage amphibians shuttle between aquatic and terrestrial habitats on a seasonal basis. The timing of these migrations varies between species, populations and individuals. Variation between populations is probably in response to different environmental conditions.

**Fallen and cut timber left on this site has provided valuable cover for amphibians (ARC)**

Over time some populations will be very productive, while others dwindle – perhaps due to local circumstances. Habitat links between the populations that allow movement of animals is essential to ensure long-term viability and to allow natural re-colonisation of areas if a species becomes extinct in any locality. Terrestrial habitats are therefore important for sustaining individual animals during part of their life cycle, for allowing movement to breeding ponds and for ensuring that animals can move between populations over time.

## 8.2. Terrestrial habitat requirements

Amphibian terrestrial habitat requirements are simple – they need cover to provide damp resting places and to support the invertebrate prey on which they feed. The type of habitat favoured by amphibians varies between species but in general they can find cover in most semi-natural habitats such as grassland, scrub and woodland. Woodland seems particularly favoured by the newts.

Tree stumps, mammal burrows, stone walls and the foundations and loose brickwork of old buildings may also provide places for amphibians to shelter or hibernate in.

It is important that cover is present immediately around the pond (but not shading it) because young frogs, toads and newts need damp habitat to move into as they leave the water. Adequate cover in the terrestrial habitat not only provides places to hide and somewhere to find their invertebrate food, but retained moisture prevents desiccation of small amphibians during the driest parts of the year. Most adult amphibians do not move far from the pond, so habitat immediately surrounding a breeding site is the most important.

**Male and juvenile great crested newt sheltering under decomposing dead wood (ARC)**

## 8.3. Management of terrestrial vegetation

Vegetation immediately surrounding amphibian ponds usually requires some management, as left unattended it can rapidly succeed to scrub and shade the water surface. Some shading may be beneficial, maintaining open areas within otherwise continuous beds of submerged aquatic vegetation, but in general warm, sunny ponds facilitate more rapid growth and development of amphibian eggs and tadpoles. Vegetation directly overhanging more than about a quarter of the pond surface of small ponds (approximately 20 $m^2$) has been found to reduce counts of great crested newt larvae (Cooke *et al.*, 1994). Management of terrestrial habitat should ensure that ponds are not overly shaded. Control of trees and scrub on the southern side of a pond is particularly important. Natterjack toad ponds should not be shaded at all (*10. Natterjack Toad*).

On intensively managed sites such as parks and gardens vegetation is likely to be controlled via existing management activity. However, ponds on nature reserves or on farm land often require measures to control vegetation.

**Cuttiing/Mowing** Repeated cutting or mowing can prevent growth of scrub and trees that may otherwise overly shade ponds. Cutting or mowing may already be part of existing management schemes to maintain mid-successional stage habitats. On informally managed sites (nature reserves, field margins on farmland etc.) cutting vegetation during winter when amphibians are inactive is the best option. Ideally the cut should be high (minimum15 cm).

If vegetation has to be cut when amphibians are active, then a high cut is unlikely to harm newts or toads. During the daytime amphibians tend to hide away in vegetation litter, or among the lower stems of herbaceous vegetation where moisture is retained. Hence, cutting vegetation is unlikely to harm great crested newts, for example, if the cut is high and carried out in dry weather. Low cuts may risk harming individual amphibians and the remaining short sward will not retain sufficient humidity and cover for amphibians during their terrestrial stages.

Care should be taken when young common frogs and toads leave the water in the summer. Mowing grassland adjacent to amphibian breeding ponds at this time risks harming newly emergent frogs and toads and should be avoided. Amenity grassland and lawns should be kept mown short immediately prior to this emergence to ensure that the amphibians are not tempted to remain among grass that may be mown shortly afterwards.





**Grazing** is an increasingly common means of conservation management with a great deal of promise for ponds. Livestock with a liking for water can be used to maintain relatively open ponds and prevent domination by tall, emergent species such as reedmace and reed. Cattle, particularly Highland cattle, and konik ponies are potentially suitable grazing species.

Livestock access to ponds does create some risk of harming the habitat and wildlife by removing useful vegetation, trampling and eutrophication of the water. Stocking density should be maintained at levels such that the beneficial effects of maintaining ponds with diverse vegetation structures greatly outweigh any temporary harm. There is no simple formula to calculate the ideal stocking density so it is important to incorporate flexibility into grazing management, changing stock numbers to achieve the desired vegetation composition and structure. In practice, relatively low stocking densities are likely to yield the desired results (0.2-0.3 head of cattle per hectare have been applied to sites managed for amphibians).

If necessary ponds can be part-fenced to prevent livestock access to some of the perimeter.

**Low intensity grazing by these Highland cattle maintains a relatively open vegetation structure around this pond (ARC)**

## 8.4. Hibernation sites

During winter amphibians seek damp (but not saturated) places sheltered from freezing. They may burrow into loose soil or squeeze into gaps and cavities underground, sometimes using the foundations or cellars of old buildings.

Purpose-built hibernation sites, or hibernacula, are sometimes created for amphibia particularly within development mitigation work. They generally comprise mounds of timber or other material covered by turf to provide damp, sheltered habitat. Intuitively, such structures are likely to be beneficial to amphibians although their benefits are rarely tested. Limited investigations indicate that they are used by amphibians, at least in low numbers (Neave and Moffat, 2007; Latham and Knowles, 2008).

Within high quality terrestrial habitat it is likely that amphibians will be able to find suitable hibernation sites without needing specially provided structures. The value of purpose-built structures on such sites is questionable especially if the artificial hibernacula are small and hence represent only a miniscule proportion of the potential hibernation habitat on site.

Artificial hibernacula may be beneficial on sites where natural vegetation cover is sparse, for example on newly restored sites or in otherwise formally managed settings such as gardens and parks. In other cases site management would be better focused on the maintenance of extensive favourable terrestrial habitats which should provide an abundance of hibernation sites without the need for specially created hibernacula.

In spite of the questionable ecological value of specially constructed hibernation sites, they can be a convenient way of utilising spoil and arisings from pond creation and habitat management.

Hibernacula should be located:

- Close to a breeding site (within 250 m maximum).
- In an area unlikely to flood.
- Within habitat likely to be used by amphibians.
- In an area with minimal disturbance.

To construct a hibernaculum:

- Remove the turf from the footprint of the hibernaculum and set aside.
- On well-drained soil excavate to a depth of approximately 50 cm and set aside spoil (this is unnecessary on poorly drained soils).
- Fill the footprint or pit with core material. Materials likely to retain moisture are preferable, such as cut timber, brash and grubbed up tree roots. Other material such as inert hardcore, bricks, rocks, and building rubble may also be used. Materials that will decompose should not be placed beneath heavy components such as bricks or rocks, to reduce the risk of collapse.
- Pack the larger spaces within the core materials with wood chippings, loose topsoil or spoil.
- Cover the hibernaculum with the turves removed from the footprint.
- Take care not to create structures that might attract rodents, such as piles of rubble with many entrance holes.

There has been no rigorous investigation of the optimum size of hibernacula, but larger hibernacula are probably more useful than small constructions because they contain a variety of different microhabitats and are more likely to maintain stable conditions. A suggested minimum size is 4 m long by 2 m wide by 1 m deep.

## 8.5. Dispersal from ponds

The distances that amphibians cover when dispersing from ponds is considered in *9. Landscape Ecology*. Frogs and toads can migrate up to one or two km from a pond whereas newts usually migrate shorter distances of several hundred metres. Habitat in close proximity to a pond is therefore more important than distant habitat.

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# 9. Landscape Ecology

## 9.1. Overview

Compared to other species such as birds and many insects and plants, amphibians have limited powers of dispersal. Hence landscape issues are critical to their survival. Important considerations are:

- Distance between breeding ponds
- Nature of intervening habitat
- Major barriers to dispersal

In spite of the reputation of returning to breed in the ponds in which they were spawned, there is usually some movement of amphibians between breeding sites. Some species, for example great crested newts and common toads, are capable of returning to the same breeding pond year after year. Common toads in particular are noted for relatively long migrations to specific breeding sites. Nevertheless the long-term survival of populations is also dependent on movements of individual animals between ponds. This allows amphibians to move from one breeding site to another, should pond conditions change, and it maintains genetic variability of populations (avoiding inbreeding).

## 9.2. Maintenance of genetic diversity

Prolonged isolation of very small populations (< 50 adults) can cause inbreeding depression and a loss of fitness that habitat management alone cannot rescue. Because isolation has to be complete (even an occasional immigrant every few years usually prevents it) and continue for many generations (meaning decades for amphibians) it remains an unusual problem but nevertheless emphasises the need to maintain habitat connectivity between ponds. The only authenticated case in the world, so far, of inbreeding depression causing fitness reduction in an amphibian relates to natterjack toads at Saltfleetby in Lincolnshire (Rowe and Beebee, 2003).

## 9.3 Metapopulations

The principles of metapopulation ecology are sometimes applied to amphibians. Metapopulations are populations that comprise several sub-populations occupying different patches of habitat but with some movement of individuals between habitat patches. This can be a useful way to think about amphibian populations, because the status of the whole population depends on the health of the component sub-populations and the exchange of individual animals between habitat patches (ponds in the case of amphibians). Present day landscapes are often fragmented, so conservation planning needs to consider the ease of movement between ponds and conversely, the problems of isolation.

## 9.4. Pond networks and clusters

Ideally new ponds should be created within migration distance of existing breeding sites. Frogs and toads are able to colonise ponds within one kilometre of an existing breeding site whereas newts have lower effective colonisation ranges and new ponds intended for them should be within 400-500 m at most from existing populations.

Pond creation and restoration should be planned to establish or enhance pond networks. Ideally, ponds within the network should be linked by a landscape that is hospitable to amphibians (as described in section 8. Terrestrial Habitat). Failing that, ponds should be closely spaced to minimise the migration distance across unsuitable habitat.

Continuous tracts of amphibian friendly habitat between ponds are optimal but in most cases corridors of suitable habitat are the only practical option (e.g. field margins and hedgerows linking ponds on farmland).

Some landscape features such as major roads and rivers or extensive tracts of unsuitable habitat are barriers to dispersal. Pond networks should be planned to avoid them.

Because there are always site-specific differences in terrestrial habitat composition as well as behavioural differences among species, it is not possible to give universally applicable estimates of maximum dispersal distances. Those shown in the table overleaf are the best available. Dispersal in most animals is leptokurtic, meaning that most individuals stay all their lives close to where they were spawned but a few (usually < 1%) venture very much further – in the case of amphibians this can mean up to several kilometres from their natal pond.

A good example of a landscape-scale project is the Vision for Wildlife Project in the Peak District (Peak District National Park Authority and Natural England). This focused on dewponds and great crested newts in the White Peak area, targeting pond restoration around the great crested newt:

- Surveyors from Derbyshire Amphibian and Reptile Group established the local distribution of the newts.
- A programme of pond restoration work was developed to extend this distribution and target ponds to provide links within a network of newt breeding sites.

## Migration limits and inter-pond distance

| | Upper migration distance | Maximum recommended inter-pond distance |
|---|---|---|
| Great crested newt | 1300 m | 500 m |
| Smooth newt | 1000 m | 500 m |
| Common toad | 5000 m | 1000 m |
| Natterjack toad | > 2000 m | 500 m |
| Common frog | 2000 m | 1000 m |
| Pool frog | 1000 m | 300 m |

- Pond restoration work was also guided by the suitability of the terrestrial habitat for the great crested newt.

The success of this targeted, landscape approach is indicated by the relatively rapid colonisation rate of the restored or re-created ponds; more than half of them were colonised within less than two years.

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# 10. Specific Habitats

**Dense planting around this garden pond provides habitat for amphibians within a formal garden setting (David Orchard)**

## 10.1 Gardens

Gardens can be excellent habitat for the widespread amphibian species. Ponds are popular garden features and provide breeding sites for common frogs and smooth newts and, to a lesser extent, common toads and palmate newts. Gardens with plenty of vegetation and other features offering shelter for amphibians and their invertebrate prey usually provide favourable terrestrial habitat as well.

In spite of the great potential habitat contained within gardens, there are indications that this is not always achieved. For example, the movement of amphibians between ponds in developed areas, where most gardens are found, is limited compared with that seen in the open countryside (Hitchings, 1997). Built-up areas, including other gardens, are generally unfavourable habitat. The latter apparent inconsistency may be due to the fact that although an individual garden managed favourably for wildlife can provide excellent amphibian habitat, most gardens are not managed this way and may conversely create areas of unsuitable habitat.

There are steps the individual garden-owner can take to make a garden favourable to amphibians but to exploit the full potential of wildlife gardening requires more people doing it.

Information on encouraging amphibians (and reptiles) in gardens is provided in the booklet aimed at garden owners, *Dragons in Your Garden* (Baker *et al*., 2009), available from Amphibian and Reptile Conservation.

In general following wildlife gardening principles as provided by many publications (e.g. Natural England's website) will benefit amphibians.

The single most beneficial activity for amphibians is to create a wildlife pond:

- Create a pond with gently sloping sides
- Allow vegetation cover to develop around the pond's edges
- Take care in sourcing pond plants
- Do not stock with fish

**Create a pond with gently sloping sides** Many preformed ponds have steep sides. Using a pond liner gives the flexibility to create the desired pond profile.

**Take care in sourcing pond plants** Although allowing natural colonisation by plants is recommended practice for ponds in natural (or semi-natural) environments, garden pond owners are likely to want more instant vegetation. Care should be taken in sourcing plants for garden ponds. Invasive non-native plants (section 6.5) are found in many garden ponds so care should be taken to identify potential donations from a neighbour. Native pond plants can be obtained from garden centres or can be taken from nearby 'natural' ponds with the landowner's permission.

Allow vegetation cover to develop around the pond's edges Extensive paved areas around a pond should be avoided. Instead, aquatic and terrestrial vegetation should be allowed to develop around the pond edges to provide damp cover for young amphibians leaving the water.

**This rural garden includes a small pond set within a meadow area which provides ideal terrestrial habitat for amphibians (ARC)**

**Do not stock with fish** Fish can be significant predators of some amphibian tadpoles (section 6.1) and other pond dwellers. Goldfish seem to be particularly harmful to newts. Pond weeds may provide tadpoles with some refuge from fish predation. Fish may be beneficial to common toads but generally, fish should not be stocked in garden ponds for amphibians.

The remainder of the garden should be managed to provide refuges for amphibians and habitat for their invertebrate prey. In general dense vegetation should suit amphibians. Additional steps may also help:

- Allow grass to grow into 'meadows'.
- Create a compost heap.
- Create a log pile.

**A combination of lawn, dense plantings, meadow areas and hedgerow (Lee Brady)**

**Allow grass to grow into 'meadows'** Closely-mown lawns are poor habitat for amphibians and their invertebrate prey. Allowing areas of grass to develop as meadows provides habitat for amphibians and their prey. Meadows should be cut during winter and cuttings raked up and placed on a compost heap.

**Create a compost heap** Compost heaps provide habitat piles for amphibians and invertebrate prey. Open heaps are better than enclosed bins.

**Create a log pile** Stacking logs or other woody cuttings is another way of creating a habitat feature that may be useful to amphibians. As wood ages and decomposes it holds more moisture and offers an increasingly favourable habitat. Amphibians prefer to shelter in small spaces rather than large cavities, so packing some of the spaces in a log pile with loose soil or wood chippings should improve its value.

**Decomposing wood in this log pile holds moisture and provides habitat for amphibians their invertebrate prey (ARC)**





## 10.2 Sustainable Urban Drainage Systems

Sustainable Urban Drainage Systems (SUDS), or Sustainable Drainage Systems, as they are now more usually called, manage rainwater by using the landscape to regulate water flow, volumes and pollution. Typically such approaches include permeable surfaces, filter strips, filter and infiltration trenches, swales (shallow ditches), detention basins, underground storage, wetlands and ponds. Increasingly the use of SUDS is becoming regarded as best practice and well designed systems offer considerable benefit to wildlife as well as providing effective management of the water resource.

SUDS offer several opportunities for amphibians as they:

- Remove risks associated with traditional gully pot drainage systems (see *10.5 Roads*).
- Provide additional habitat, both terrestrial and aquatic.
- Serve as corridors for migration.

The main principle of SUDS is to mimic the natural drainage of a site. Rainfall is captured and as much as possible allowed to evaporate or soak away. SUDS should achieve a controlled flow of clean water discharging into natural water courses at a rate comparable to that prior to development. In a well designed SUDS most of the storage and treatment is performed by the upstream control elements, ensuring that the water is largely clean before it passes further through. Ponds and wetlands provide open areas of shallow water that provide temporary storage during rainfall events and will, by ensuring a slow flow of water over an extended period of time, allow final 'polishing' of the water to remove any remain pollution.

**Pond drainage system alongside a road in Oxfordshire (Tony Gent)**

Design considerations In designing any SUDS system professional advice is needed and for all but the smallest of developments consent from the Environment Agency or Scottish Environmental Protection Agency (SEPA) obtained. SUDS need to be designed to ensure that their primary functions of water management and flood control are achieved and have due regard to safety. This is especially the case in an urban environment or as a feature, for example in a school. However within these constraints there are usually opportunities to further wildlife conservation or provide opportunities for people to experience and enjoy nature.

Although SUDS ponds are unlikely to fit two criteria for good wildlife ponds – clean water source and independent supply (*4.3 Water source*) – they can be created using the same design principles as amphibian ponds given in *4.9 Pond design* – gently sloping sides, a range of depths and irregular shape.

Other considerations that may benefit amphibians include:

- Establishing wildlife 'sanctuary areas' with limited public access, where SUDS areas are large enough.
- Creating a series of different wetland features rather than a single large pond.
- Varying sizes of ponds to offer a range of conditions and hydroperiods at any one time.
- Locating and designing to discourage the introduction of unsuitable species – notably fish and non-native plants (*see 6. Other Pond Species*).

SUDS systems provide challenges for designers and should combine the skills of the landscape designer and ecologist with those of SUDS engineers to ensure maximum benefits can be obtained.

Gradients within SUDS ponds should not not exceed 1:3 for reasons of health and safety, to prevent erosion and for ease of maintenance. Gently sloping sides also tend to be better for wildlife.

SUDS can be especially beneficial if the network connects to adjacent areas of other potential habitat (fields, allotments, gardens, road verges).

Consideration should also be given to wildlife hazards, such as adjacent roads, discouraging movement towards these and providing alterative corridors if possible. Where fencing or other 'hard landscaping' in provided measures should be included to prevent these forming barriers to amphibian movement. For long-term value of any SUDS scheme for amphibians, all the features needed to sustain a population of the species during all stages of its life cycle should be provided within the immediate area or connected directly to it.

**The SUDS system at Hopwood Park motorway service station includes a series of small ponds, some of which have been colonised by amphibians including the great crested newt (ARC)**

**Golf courses provide excellent habitats for amphibians where areas of 'rough' are interconnected and where water features are created (Tony Gent)**

## 10.3 Ditches

On some sites amphibians breed in drainage ditches. At Offham Marshes, designated as a SSSI on the basis of its amphibian populations, alterations in ditch management had major consequences for the resident common toads. Changing from a regime of total clearance on a rotational basis to partial clearance, removing vegetation from only one side of the ditch, coincided with a crash in the toad population. Reversion to the original management system allowed population recovery.

It seems likely that clearance of only one side of a ditch allowed invertebrate predators to increase rapidly at the expense of the toad tadpoles. Toad tadpoles do best in open water, which presumably allows them to escape from invertebrate predators.

## 10.4 Other land uses

Opportunities exist for amphibian conservation in a wide range of other land uses. Sometimes relatively minor changes in management can considerably increase the value to wildlife generally and specifically for amphibians by following the principles outlined above.

In urban areas green spaces such as parks, allotments and schools form significant refuges for amphibians and offer opportunities for people to find and experience them. Features such as church yards provide valuable habitat in both rural and urban settings, benefitting from long periods without significant ground disturbance or cultivation. Sports grounds, and especially golf courses provide large areas where positive wildlife conservation measures can be implemented without compromising their primary use.

Allotments are local havens for amphibians; their value can be improved by leaving some areas uncultivated and reducing the use of chemical fertilisers and pesticides.

**The amphibian value of green spaces such as allotments can be increased by leaving some 'wild areas' and adding a pond (ARC)**

## 10.5 Roads

Roads are barriers to amphibian dispersal and may have adverse effects on nearby populations through the numbers of animals killed by road traffic or, less frequently, road salt. There are several measures that may reduce the impacts of roads on amphibians:

- Planning the location of new ponds.
- Road tunnels and fencing.
- Modifications of gulley pots and kerbs.
- Assisting amphibians across roads.
- Informing motorists by road signs.
- Temporary closure of roads during sensitive periods.





Amphibian and Reptile Conservation produces a booklet Common toads and roads (Barker and Benyon, 2009) to provide more detailed guidance for planners and highways engineers.

Road tunnels and fencing Specially designed tunnels have been installed at several sites to allow migrating amphibians to safely cross underneath roads. Low fences are used to guide amphibians to the tunnel entrances. Construction materials have been adapted for these purposes and so are commercially available. Nevertheless there is uncertainty about the effectiveness of amphibian tunnels, especially as animals appear unwilling to enter some of them. Lack of maintenance may also contribute to a lack of effectiveness.

Tunnels should be placed every 50-60 m and those with a rectangular cross-section are preferable; if round pipes are used, the bottom should be filled with concrete to create a flat 'floor'. For construction, concrete is preferable. Water should drain easily from tunnels and they should be neither completely waterlogged nor completely dry.

**Road closed during amphibian migration period in the Netherlands (Jelger Herder RAVON/DigtalNature.org)**

**Minimum size requirements for amphibian tunnels.**
**Taken from COST 341 Wildlife and Traffic (Iuell *et al*, 2003).**

| | Length of tunnel | | | |
|---|---|---|---|---|
| **Tunnel shape** | **< 20 m** | **20-30 m** | **30-40 m** | **40 m +** |
| Rectangular (width x height) | 1.0 x 0.75 m | 1.5 x 1.0 | 1.75 x1.25 | 2.0 x 1.5 m |
| Circular/pipe (diameter) | 1.0 m | 1.4 m | 1.6 m | 2.0 m |

Guiding fences should be as close to the road as possible to minimise the length of the tunnel. The guiding fence should be at least 40 cm high and it should have u-shaped returns at the open ends to contain amphibians. The panels should be smooth to prevent amphibians climbing over and ideally the top edge of the fence should be bent over. The ground along the bottom of the fence should be kept free from vegetation to allow amphibians easy progress as they follow the fence.

It is essential to maintain and monitor use of tunnels after construction to ensure the system continues to help animals effectively. Information gathered will also help inform future guidance. Monitoring should take place over a seven-day migration period.

Responsibilities for annual maintenance and monitoring should be agreed upon during the planning stages. Maintenance includes clearing blockages and repairing fences.

**Modifications of gulley pots and kerbs** Amphibians attempting to cross roads can become trapped in gulley pots. This problem is exacerbated by high kerbs which act as barriers, deflecting animals towards gulley pots. New building developments can take simple steps to modify the placement of gulley pots and the design of kerbs to minimise their impacts on amphibians.

Gulley pots should be located to allow a gap of approximately 10 cm between them and the kerb to allow amphibians following the lower edge of the kerb to bypass the gulley pot. Alternatively, the kerb can be inset to allow a similar sized gap around the edge of the gulley pot. ACO Wildlife produces an amphibian kerb which includes a recess for the same purpose.

Kerbs should be lowered at intervals to allow migrating amphibians an easy route off the road. In some situations allowing gaps in the kerb lining a road or car park may serve the same function.


**Toad migrations across roads put them at risk from traffic and from hazards such as high kerbs and drainage gully pots (Ben Driver)**






**Road closed during amphibian migration in the Netherlands (Jelger Herder RAVON/ DigtalNature.org)**

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Natterjacks in amplexus (Fred Holmes)



# 11. Natterjack Toad

## 11.1. Background

The natterjack toad is a European Protected Species and a priority within the UK's Biodiversity Action Plan. Its Species Action Plan (The Herpetological Conservation Trust, 2009) highlights both the threats to the species and the conservation measures needed to address them. Habitat management advice for the natterjack toad, originally provided in the *Natterjack Toad Conservation Handbook* (Beebee and Denton, 1996) has been updated here.

In Britain the natterjack toad is a habitat specialist restricted to warm, open habitats on:

- Coastal dune
- Upper salt marsh
- Lowland heath

As a pioneer species its ecology differs considerably from that of our other amphibians. Hence, it warrants its own section within this handbook.

## 11.2. Habitat requirements

The terrestrial habitat requirements of natterjacks are:

- Open, unshaded habitat.
- Extensive areas of unvegetated or minimally vegetated ground (maximum sward height 1 cm).
- Substrate(s) to burrow into.

**Natterjack burrows (Bill Shaw)**

During the day natterjacks shelter in burrows they dig for themselves in the open or beneath objects on the surface such as large stones, pieces of wood or other debris. They also shelter in crevices in rock piles or slag at sites where such features are present. By burrowing more deeply they escape daily and seasonal extremes of temperature.

**Sand excavated from a natterjack burrow under a piece of roof tile (Anna McGrath)**

Adult and juvenile natterjacks actively hunt their prey at night. They need open ground to see, pursue and capture invertebrates. Toadlets newly emerged from the tadpole stage are active by day.

**Toadlets are active in the daytime and need damp, sunny areas of sparsely vegetated ground near breeding ponds where they can feed without the risk of desiccation (Ash Bennett)**

Natterjacks breed primarily in ephemeral ponds that are highly weather-dependent and unpredictable. Consequently reproduction is 'boom or bust' with spectacular successes in some years being interspersed with partial or total failures in others. Natterjacks are relatively long-lived, which enables them to overcome occasional years of reproductive failure.

## Characteristics of natterjack breeding ponds

- Unshaded
- Ephemeral
- Shallow with gradually sloping sides
- Free of predators and competitors
- Little or no vegetation

Natterjacks spawn in shallow water (5-10 cm), so ponds with shallow margins and gently sloping sides are ideal. During the daytime tadpoles feed in warm shallow water and at night they move deeper.

**Natterjack tadpoles using shallow edges of breeding pond (David Woodhead)**

Natterjacks thrive in relatively dry habitats where other amphibians find it very difficult to survive. However, should changes to the habitat allow their breeding ponds to be colonised by common frogs, toads and great crested newts, then natterjacks may become eradicated.

Common frogs and common toads breed earlier in the year than the natterjack, and their tadpoles may feed on natterjack spawn. Surviving natterjack tadpoles fare very poorly with the more advanced tadpoles of the other two species, which outcompete them. Where the more common species are abundant they tend to dominate all of the locally available breeding ponds and exclude natterjacks.

Great crested newts eat large numbers of natterjack toad eggs and tadpoles. Most other vertebrates leave them alone because of their distasteful skin. Natterjack tadpoles do, however, fall prey to a range of invertebrate predators especially dragonfly and damselfly nymphs, dytiscid water beetle larvae and adults and water-boatmen.

Fortunately the natterjack has a great capacity to recover once key habitat features have been restored. The management work required might be as straightforward as recreating breeding ponds or increasing the number of livestock grazing terrestrial habitat.

Agri-environment schemes (Environmental Stewardship in England, Sustainable Rural Development Programmes in Scotland and Glastir in Wales) may fund management options appropriate to natterjacks toads. See *Natterjack Toads and Environmental Stewardship Options* (The Herpetological Conservation Trust, 2008) for guidance regarding suitable options.

### 11.3. Natterjack habitat

**Coastal dune** Natterjacks prefer frontal dune systems with extensive areas of bare sand with some vegetation cover such as marram grass. Overly fixed dunes, supporting extensive birch, willow, sea-buckthorn or rank grasses are unsuitable because they provide little open ground on which natterjacks can forage. Furthermore, the dense vegetation may support other amphibian species which are competitively superior to natterjacks during the tadpole stage.

**Natterjack coastal dune habitat, North Walney, Cumbria (Bill Shaw)**

In dune systems natterjacks breed in shallow, ephemeral slacks that typically desiccate around midsummer. Poorly vegetated slacks on frontal ridges are especially suitable as they contain few invertebrate predators of tadpoles. Other pools on the seaward side of dunes may also be used where fresh water flows out from the dune system.





**Dry stone wall and bank used by natterjacks as shelter and a hibernation site (Bill Shaw)**

**Upper saltmarsh** On most upper saltmarsh sites natterjacks use features such as embankments, patches of dune and dry stone walls for burrowing and shelter.

Natterjacks breed in shallow pools at the upper edge of saltmarsh, which are inundated with seawater during high tides in spring and autumn, but which freshen up due to rainfall or run-off from in land in late spring and early summer. Seasonal saltwater inundation removes predators and competitors from the breeding pools leaving them in an ideal state for natterjacks.

**Upper saltmarsh habitat, Campfield Marsh, Cumbria (Bill Shaw)**

**Lowland heath** Sparsely vegetated heath provides habitat for natterjacks. Heath supporting low-growing mosses or lichens with areas of open sand interspersed with heather shrubs forms ideal terrestrial habitat. Uniformly dense stands of heather are unsuitable because they hinder foraging. Scrub encroachment is problematic as sites supporting scrub and dense vegetation may favour other amphibian species.

Shallow, ephemeral heathland pools provide breeding sites. Occasionally the shallow margins of larger water bodies are used. Coarse fish such as perch may be helpful in larger ponds; they prey on invertebrate predators of natterjack tadpoles but avoid the tadpoles themselves due to their distasteful skin toxins.

Vegetation in and around breeding ponds should be minimal.

**Natterjack breeding pond on heathland, Woolmer Forest (Tim Bernhard)**

Natterjack eggs and tadpoles cannot tolerate very low pH levels so breeding ponds must be pH 6 or greater for spawn and tadpoles to develop successfully.

**Other habitats** In Britain atypical habitats include a disused sand quarry, an area of moorland and a disused ironworks, all in Cumbria. These sites provide habitat characteristics similar to those described above. Thus the quarry approximates to dune, the moorland to lowland heath and the ironworks is covered by rubble and slag with very little vegetation but plenty of refugia.

**Slag from a disused ironworks provides terrestrial habitat for natterjacks in Millom, Cumbria (Ash Bennett)**

Under favourable conditions natterjacks may move from their more typical habitats to adjacent farmland. A broken or blocked field drain may result in shallow flooding that provides an ideal short-term breeding site. Before financial incentives were provided to make marginal land more productive through drainage and infilling, natterjacks made great use of ephemeral pools on pastoral farmland but this is now an unusual situation.

Natterjacks benefit from some common farming practices e.g. grazing on dunes and merse (coastal marsh). Other activities inevitably kill individual toads or damage their day or winter hiding places so it is necessary to minimise risk. As long as there is no large-scale loss of land habitat and breeding ponds remain in good condition, occasional small-scale losses can be borne by the population.

Both Entry and Higher Level Stewardship in England include options of considerable value to natterjack toads. These are detailed the in the leaflet *Natterjack Toads and Environmental Stewardship Options* (The Herpetological Conservation Trust, 2008).

## 11.4. Habitat management

In most situations the priority for conservation management should be to maximise the breeding success of natterjack colonies by increasing the number of suitable breeding ponds. Research has shown that toadlet and juvenile survival is a key factor limiting the growth or recovery of populations. In simple terms, increasing the number of ponds should produce more toadlets which in turn will lead to a population increase. The extent of suitable terrestrial habitat should then be increased as breeding success improves.

**Aquatic habitat** Breeding ponds should be free from surrounding scrub and minimally vegetated throughout. Grazing provides the best long-term means of maintaining short vegetation but annual cutting is an alternative. In the autumn relatively short vegetation in the pond basin can be cut by mowing or flailing and the arisings collected and removed. If necessary the original depth of the pond can be restored by removing a few centimetres of substrate from the pond basin.

The temptation to deepen ponds after a period of low rainfall and early desiccation should be resisted unless there is good reason to believe that the water table is experiencing a long-term downward trend.

**Fish stocking as a management tool** Most natterjack ponds are ephemeral and consequently do not support fish but a number are more permanent. Large ponds often support coarse fish which, by eating invertebrates and common frog tadpoles, can reduce both predation of, and competition with, natterjack tadpoles. At a suitable density small perch (approximately 8 cm) improve natterjack tadpole survival to metamorphosis by removing invertebrate predators, as also have carp (Denton, Hitchings and Beebee, 1995). On the other hand rudd are unsuitable because they eat natterjack tadpoles.

If ponds fail to desiccate due to a series of wet summers and natterjack reproduction declines, the introduction of fish should be considered as a management option to restore productivity. When ponds finally begin to dry the fish should be removed and released elsewhere. Further experimental research is needed to identify other beneficial fish species and test the technique further in the field.

**Terrestrial habitat** The appropriate management of terrestrial habitat not only directly favours natterjacks but also makes it less suitable for competitors and predators such as common toad, common frog and great crested newt.





**Grazing (left of fence) maintains the short sward required by natterjacks in merse at Anthorn, Cumbria (John Buckley)**

**Ungrazed terrestrial vegetation renders this site inhospitable to natterjacks (David Orchard)**

On most natterjack sites grazing is key to the maintenance of the required short sward. At some sites grazing by rabbits may suffice. Otherwise a choice of domestic livestock (sheep, cattle and ponies/horses) should be considered. Cattle are usually the most useful because they require less attention than sheep, are less prone to interference by dogs and, through their size, can break up turf to create bare ground in places. A lot depends, however, upon how sites have been grazed traditionally, what grazing is currently in place and what further animals are available. Stocking density should be tailored to individual sites, dependent on factors such as the amount and type of grazing available, existing rabbit numbers, and the level of natural erosion. It is virtually impossible to overgraze a site for natterjack conservation.

Where necessary, rabbits can be encouraged to graze new areas by providing corridors of shorter vegetation. Providing cover/shelter in the form of piles of loose brash/tree branches can be used to encourage rabbits to start burrows and create warrens.

**Short sward maintained by scrub clearance and grazing at Woolmer Forest (ARC)**

**Changes in vegetation at Drigg from 1987 to 2005 due to decreased grazing intensity, reducing the suitability of habitat for natterjacks (David Simpson, Richard Cooper and Ash Bennett)**

## 11.5 Habitat restoration

When terrestrial habitat is in poor condition various techniques, including mowing and collecting, foliar spraying, weed wiping, chain sawing and grubbing out vegetation with machinery, may be used as appropriate to achieve the desired result.

Where large areas of scrub encroachment have developed there is little alternative to manual or mechanical clearance as a first step towards the recreation of open habitat. Mechanical methods are not as damaging to the habitat as might be expected and they have been used very successfully at sites throughout the country. The precise methodology for each site should be chosen by considering the size of the trees/scrub to be removed, the types of machine available and the level of funding.

Essentially the job consists of cutting down/grubbing out the scrub, moving it to a fire site and burning all the material. The ashes from the fire should be deeply buried (not simply covered), along with the humus rich layer developed under the scrub. Burying such material prevents the growth of ruderal vegetation such as docks and nettles and creates bare clear ground. Alternatively, unwanted material can be removed off site although this usually incurs extra costs.

Cut stumps left in the ground should be treated with a glyphosate or triclopyr based herbicide to prevent regrowth. Small saplings might best be dealt with by foliar spraying.

Restoration management techniques may simply be repeated at intervals to maintain terrestrial habitat but this can be a costly approach. Far better and potentially cheaper is to establish a grazing regime.

Ponds that have been lost through drainage can often be restored by simply disrupting the drainage system (for example by blocking a ditch or field drain).

**The turf dam in central foreground blocks a ditch and slows the passage of fresh water to the sea. Water is now held in breeding pools and the surplus spills out over the saltmarsh (Ash Bennett)**



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## 11.6. Natterjack pond creation

Natterjack ponds are often called scrapes as this best describes how they are made with a machine. With a knowledge of water table behaviour at the chosen site, ponds should be created with very gently sloping sides (1:10 or more gradual) dug down to a maximum water depth of 50-70 cm. In some situations it might not be possible to create a pond with all sides gently sloping and a compromise has to be made. Ideally the slope of the pond basin should be such that the scrape has a wide drawdown zone and an almost imperceptible edge. The scrape should dry out in late summer in an average year. This may require a trial and error process, making the scrape and then slightly deepening or infilling it in a subsequent year. Experience shows that it is probably better to err on the side of making the pond too shallow in the first instance.

**A scrape with an asymmetrical cross-section to give a shallow edge on the left and deeper water to the right (David Coward)**

Late summer/early autumn, when the water table is low, is the best time of year for making natterjack ponds. A tracked, 360o machine or JCB are suitable for the purpose. Scrapes vary in size from a few to hundreds of square metres. Small scrapes can be very productive but they require a lot of maintenance. A scrape with a 10-m diameter of water (approximately 80 m2) at the start of the breeding season is a good starting point for planning.

**Machinery such as a 13 tonne, tracked, 360° excavator is suitable for creating natterjack scrapes (John Buckley)**

Spoil from the scrape should be spread on the ground away from the pond edges and not compacted. Low piles of spoil, < 50 cm high, may be of some use to natterjacks, whilst taller engineered features tend to be less attractive to them.

A natterjack site should ideally include a range of ponds of differing depths so that at least one or two will successfully produce toadlets in any one year.

**Three scrapes with different characteristics in relatively close proximity (David Coward)**

## 11.7. Lined natterjack ponds

Lined, or artificial, ponds are made by lining a suitably shaped hollow with a waterproof layer such as butyl sheeting, bentonite roll or concrete.

Lined ponds have the advantage that they do not rely on ground water for supply and they can be topped up if low.

A disadvantage of concrete lined ponds is that they lack a damp drawdown zone where toadlets can feed, grow and shelter before dispersal.

**A concrete-lined natterjack breeding pond in sand dunes (Chris Gleed-Owen)**

**Natterjack scrape being lined with prehydrated bentonite (RAWMAT® HDB) at Mawbray Banks (Bill Shaw)**

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# 12. Translocation and Reintroduction

## 12.1. Translocations

People often move amphibians between breeding ponds, especially within gardens. Common frog spawn in particular is frequently moved, either to 'get rid of excess spawn' or to populate newly created ponds. In reality such movement is usually either unnecessary or an unsatisfactory conservation strategy. Amphibian populations regulate themselves and fluctuate over time. So there is rarely need to intervene by moving 'excess' spawn to other sites. Creation of new ponds is a crucial conservation measure for amphibians and their siting should be planned to allow natural colonisation as far as possible (see *8. Landscape Ecology*). As a conservation measure, translocation should be an option of last resort.

Genetic studies indicate that in urban and suburban areas the natural movement of common frogs and toads may be hindered by barriers such as major roads. In such situations moving amphibians around may substitute for natural migration. There are, however, risks associated with moving amphibians between sites:

- Transfer of disease.
- Transfer of invasive plants.
- Unsuitability of new site.

The study of amphibian disease is still in its early stages and the impacts of two relatively new diseases in Britain are not fully understood (*5.3 Amphibian disease*). Until better information becomes available a precautionary approach avoids the movement of amphibians (and anything else) between water bodies.

Non-native invasive plants (Section 5.5) can severely harm ponds and their incidental transfer can be avoided by not translocating amphibians.

If amphibians are not present at a particular site this may be because the habitat is unsuitable. Introducing amphibians to such a site does not address this problem. In general most ponds fall within colonisation distance of existing populations of the widespread amphibian species. For example, a newly created pond in a suburban garden will almost certainly be surrounded by many other garden ponds, some of which will support amphibians. In most cases new garden ponds are colonised by amphibians in their first year, rendering assisted movement of amphibians unnecessary.

Only when natural colonisation is impossible should translocation be considered. This has been the case with natterjack toads because range restoration has involved sites that are in some cases isolated from remaining populations. Translocation was also the only option available to restoring the pool frog to England following its extinction. Translocation of frogs from Sweden involved thorough health screening of pool frogs and other amphibians resident at the donor site both prior to the translocation and for several subsequent years.

Reintroductions should adhere to procedures set out in Annex 1 of A policy for conservation translocations in Britain JNCC (2003), which in turn is based on the IUCN 1995 guidelines for re-introductions.

## 12.2. Natterjack toad reintroduction

The limited and widely dispersed range of the natterjack means that after it disappeared from some sites natural re-colonisation has not been possible. A programme starting in 1975 has successfully established populations in 19 out of 27 translocations (70%), with greater success on dunes than on heathland sites (Griffiths et al. 2010). Reintroduction is one of the actions of the *Natterjack Toad Species Action Plan* (The Herpetological Conservation Trust, 2009).

## 12.3. Site selection

To identify a site suitable for the reintroduction of natterjacks several factors require consideration:

**Geographic location** Priority should be given to those areas within the historical range and where declines have been greatest. These include: coastal dunes in Lincolnshire, Norfolk, Clywd and the Wirral, coastal saltmarshes in south Cumbria and heathlands in Norfolk, east Suffolk, north Surrey and the western Weald.

**Site security** Proposed translocation sites should have a sympathetic land owner and appropriate land management plus, ideally, nature reserve status and statutory nature conservation designation.

**Habitat quality** Both aquatic and terrestrial habitats should meet the criteria outlined in Section 9 or be readily restorable to such condition. Any necessary restoration should be completed prior to translocation.

**Predators and competitors** Large populations of competitors such as common frogs or common toads, and predators such as grass snakes, corvids, gulls, rats and aquatic invertebrates should be absent from a reintroduction site and its environs.

**Absence of natterjacks** Absence of natterjacks should be certain and confirmed through survey work. Where remnant populations exist the priority should be to rescue these through habitat management. Where natterjacks are definitely absent, the reasons for this absence must be identified to ensure that they have been remedied prior to a reintroduction.

**Consultation and agreements** It is essential to consult widely with and gain the approval of all interested parties including landowners and managers of recipient sites. Translocation proposals should be put to the Natterjack Toad Species Action Plan Steering Group, which can be contacted through Amphibian and Reptile Conservation.

**Licensing** Strict legal protection of the natterjack requires that any translocation be licensed by the appropriate statutory nature conservation agency (Countryside Council for Wales, Natural England or Scottish Natural Heritage). Once a translocation proposal has been approved by the Species Action Plan Steering Group, Amphibian and Reptile Conservation will apply for the necessary licence.

**Oversight of the project** Translocations tend to be most successful when the site manager or dedicated volunteers manage the project on a day to day basis to minimise tadpole loss.

## 12.4. Preparing a reintroduction site

Where necessary the terrestrial habitat should be managed to meet the necessary criteria before ponds are created. Preference should be given to creating scrapes of differing depths based on the natural water table rather than using lined pools. An advantage of lined pools is that they may be topped up with water artificially and, even if not needed for the long term, temporary lined pools may be a useful insurance against desiccation at the start of a project. Artificial refugia should be provided to help maximise the number of toadlets surviving to disperse from the damp pond margins. Discarded roof tiles, slightly raised to allow toadlets to crawl beneath or leafy branches, e.g. sycamore, which dry to provide many hiding places, should be laid around the water's edge.

## 12.5. Translocating natterjacks

The donor population should be the closest one to the new site and certainly within the same geographical area.

To ensure the best chance of success a reintroduction should take place over three successive years. This establishes a mixed-age structure in the new population relatively rapidly.

The equivalent to at least two spawn strings (approximately 4,000-8,000 eggs), preferably made up from short sections of several strings to give a broad genetic base, should be obtained from the donor site. Freshly laid spawn is best because it travels well. Sections should be cut with sharp scissors and transported in a bucket containing approximately 5 l of water (at a depth of approximately 5-10 cm) from the ponds in which the spawn originated. Buckets with snap-on lids make good transport containers.

**A hole cut in the centre of the lid allows ventilation but prevents water spillage during transport (John Buckley)**

Spawn should be moved to the recipient site rapidly, certainly within one or two days. During transportation care should be taken to avoid exposing the spawn to extreme temperatures (for example leaving in the sun).

Free swimming tadpoles without any signs of limb development can also be moved. Well developed spawn, or tadpoles showing signs of metamorphosis, should not be translocated because mortality during transportation can be high in these developmental stages.

Tadpoles are susceptible to suffocation and should be moved in cool water with minimal amounts of dissolved or suspended organic matter.





## 12.6. Releasing natterjacks

Translocated spawn should be released directly into the recipient pool(s). Spawn strings or segments should be laid out extended rather than coiled, in shallow water (approximately 10 cm deep) at the pond margins. It should be covered with suitably formed wire mesh if disturbance by birds or mammals is likely.

**Releasing translocated natterjack spawn into the shallows of a recipient pond (John Buckley)**

If water levels are likely to fall rapidly daily inspection will be necessary until the tadpoles have hatched and are free-swimming (approximately 7-10 days). If lowering water levels threaten spawn with desiccation, then it should be gently moved to avoid drying.

Translocation should be repeated over three consecutive years unless some form of catastrophe indicates that the project should be stopped. Toadlet production (many tens, preferably hundreds, and ideally more than a thousand) in two or three years is normally enough to start a colony. Adult males are likely to return to the pond(s) and call two years after the first translocation but females do not appear until a year later to spawn. Such spawning is a strong indicator of success but the appearance of spawn three years after that is the most convincing evidence that a colony has been established.

## 12.7. Head-starting natterjack tadpoles

When spawn is collected for translocation it may be appropriate to rear on (head-start) some tadpoles before release into the wild. Rearing large numbers of tadpoles requires a high level of commitment and becomes increasingly time consuming as the tadpoles develop and grow but it can be very successful in producing hundreds of large tadpoles for release. Cat litter trays have proved to be good tadpole receptacles/containers for captive rearing. The trays should be filled to a depth of 5 cm with aged tap water (water left to de-chlorinate for 24 hours) and spawn introduced into several of them. The trays should be placed on flat ground where they can receive full sunshine for much of the day and not covered except perhaps for wire netting to prevent predation by birds such as blackbirds. On days when there is a lot of evaporation the trays will need to be topped up with aged tap water. Pond water should not be used as it may introduce predators or disease. In an emergency water straight from the tap may be used.

As the tadpoles become free swimming their density should be reduced to a few hundred per tray by gently lifting excess tadpoles with a plastic tea strainer into vacant water filled trays. The tadpoles should be fed with rabbit pellet food (compressed vegetable matter). About four pellets per tray per day is usually sufficient at the start. As they grow the tadpole density needs to be steadily reduced to <100 per tray and thus more trays are required. As soon as tadpole droppings become obvious on the bottom the tray the water needs to be replaced with fresh aged tap water and rabbit pellets resupplied. There is a tradeoff between the number and size of tadpoles per tray and the frequency with which the water should be changed. Changing the water in every tray daily soon becomes the norm. A water change is best achieved by gently pouring the water and tadpoles into a plastic flour sieve, retaining the tadpoles, and returning them to fresh water. Unless feeding and water changes are carried out meticulously mass mortality will result.

The tadpoles may be released at any stage before they are fully grown and showing signs of limb buds. For translocation they should be collected when the water is cool (early morning) and placed into tubs of cool aged tap water just a few centimetres deep. The water should contain no food or sediment, be kept out of the sun and taken to the release site without delay.

## 12.8. Monitoring natterjacks

Monitoring is important to:

- Determine the success of a reintroduction.
- Assess the status of local populations.
- Contribute to national status assessment.

Most natterjack populations are monitored and data are collated by Amphibian and Reptile Conservation to give an overview of national population status. Detailed guidance on monitoring natterjacks is given in *Natterjack Toad. Survey Guidelines* (The Herpetological Conservation Trust, undated).

**Monitoring a reintroduction** After translocated spawn has hatched occasional visits should be made to monitor the development of the tadpoles and to determine whether, and approximately how many, toadlets emerge.

It is important to monitor introduction sites carefully for at least five years after starting a translocation and preferably longer.

**Long-term monitoring** Annual monitoring of spawn and toadlet production is useful in assessing the status of natterjack populations.

Natterjack reproduction can be erratic, with some females not breeding in some years or, more rarely, spawning twice in the same year. More typically each female produces a spawn string annually. Spawn strings are deposited in shallow water usually separate from one another so that individual clutches can be readily identified. In situations where strings are deposited together they can be counted by gently moving them apart with a stick or similar, to count individual spawn strings. Counting spawn strings (individual clutches) is useful because such counts are equivalent to the number of females spawning in a particular year. Spawning can be influenced by seasonal weather conditions before and during the breeding season but in the long term, spawn string counts give a good indication of the number of females in a population. In natterjacks the sex ratio is approximately 1:1, so spawn string counts also give an estimate of adult population size.

To count spawn strings:

- Each potential breeding pond should be visited at least once every 10 days from early April to early June.
- Night time surveys during this period to locate calling males can be useful in identifying likely breeding ponds.
- Once the first spawn is detected the frequency of visits can be increased.
- Each potential breeding pond should be searched by walking around the perimeter, and through shallow water in the case of larger ponds.
- Spawn string locations should be noted and the counted strings discretely marked by pushing a small stick into the pond substrate, to avoid double-counting on a later visit.
- The total number of spawn strings recorded in each pond over the season should be recorded as the spawn string count.

**Counts of spawn string pairs provide a useful estimate of the number of females breeding (ARC)**

The production of toadlets from ponds is a useful indicator of breeding success in a particular year. The success of toadlet production may also give an earlier warning of local population problems than spawn string counts. Natterjacks are long-lived so females can potentially spawn for many years in a population where recruitment is actually low or absent due to repeated failure of tadpoles to achieve metamorphosis.

Metamorphosis occurs between mid-May and Mid-July but June is the peak month for most sites in most years. Metamorphosing toadlets are active by day. They emerge from ponds in a few favoured spots and often aggregate to conserve moisture.

To assess toadlet production:

- Visit breeding pond(s) weekly from mid-May to mid-July until the first toadlets are found.
- Once toadlets have been detected, increase the frequency of site visits to daily.
- Walk around the margins of each breeding pond, taking care not to trample toadlets.
- Search under any debris that may be present around the pond margins.
- Estimate the number of toadlets to within an order of magnitude (zero, tens, hundreds, thousands etc.).





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Natterjack spawn (Howard Inns)

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## Amphibian and Reptile Conservation

The Amphibian and Reptile Conservation (ARC) Trust (Registered Charity No 1130188) is the UK's leading non-governmental organisation dedicated to native herpetofauna (amphibians and reptiles). Formerly named The Herpetological Conservation Trust it benefits from the experience of that organisation, which was founded in 1989. ARC's work includes:

- Protecting key sites for herpetofauna
- Improving habitat through practical conservation management
- Furthering understanding of herpetofaunal ecology and conservation
- Promoting effective legislation, policy and action for conserving biodiversity
- Raising awareness

ARC owns or manages 80 nature reserves. It has pioneered habitat management techniques for amphibians and reptiles. ARC also provides advice, training and assistance to a variety of people, including major landowners, on all aspects of amphibian and reptile conservation through formal courses, workshops, site visits and guided walks.

ARC works throughout the British Isles (including the Channel Islands) in partnership with other nature conservation organisations, government bodies and institutions. Its role in promoting and developing legislative and policy mechanisms for wildlife conservation extends its remit and influence into Europe and beyond. This is achieved, in particular, though a close working relationship with the European Herpetological Society (Societas Europaea Herpetologica) and participation in the European Habitats Forum. Hence, ARC influences conservation action for threatened amphibians and reptiles in Britain and abroad.

**Hyton Marsh, an ARC reserve for the natterjack toad in Cumbria (Angela Reynolds)**