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Action Plan for the Conservation of the Crested Newt *Triturus cristatus* Species Complex in Europe

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1. Introduction

The crested newt *(Triturus cristatus)* species complex is widespread in Europe but has suffered severe declines in most of the 37 known range countries. This Action Plan has been commissioned by the Standing Committee of the Bern Convention in order to assess the extent of the problems faced by this "superspecies" in Europe and to make appropriate recommendations to address these. This section, Part A, summarizes the need for this Species Action Plan and highlights the most urgent priority actions required. Further actions and much additional information can be found in Part B, the main body of the Species Action Plan.

2. Rationale

The crested newt species complex is distributed widely across most of Europe, with the exception of Ireland, the Iberian Peninsula and southwest France. Four species are currently recognized in the *Triturus cristatus* complex:

- Northern crested newt *Triturus cristatus* - northern and central Europe, eastwards to Russia
- Italian crested newt *Triturus carnifex* - Italy, southern central Europe and the western Balkans
- Danube crested newt *Triturus dobrogicus* - Danube floodplain and Delta and the Pannonian region
- Southern Crested Newt *Triturus karelinii* - eastern Balkans, Crimea, Caucasus, northern Turkey

These species occur in a total of 37 countries between them, although the only country where all four can be found is Serbia. The ranges of the four species do not actually overlap but some hybridisation and intergradation is known from the limited contact zones between them. Crested newts occupy a wide range of habitats from the Atlantic, and the far north of Europe, to the shores of the Mediterranean, Black and Caspian Seas. They are mainly found in lowland areas in the north of the range, but occupy more mountainous habitats further south. In general, however, all require diverse terrestrial habitats, particularly woodland and agricultural land, which contain a variety of small, still water bodies (usually ponds and ditches) that are used as aquatic breeding habitat.

Although not internationally threatened, all crested newt species have suffered severe declines in many parts of their respective ranges and are listed as vulnerable, threatened or endangered in many national Red Data Books. Threats to all species include direct habitat destruction and fragmentation, habitat degradation, pollution, introduced species (especially predatory fish), lack of pond management, flood control measures and a variety of other, localised problems. The Danube crested newt *Triturus dobrogicus* has the smallest range and, due to extensive habitat loss, is the most at risk. It is not known what effects climate change will have on the crested newt species, although it will be difficult for the more isolated populations to adapt. All four species are listed in Appendix II of the Bern Convention, and, in the European Union, on Annexes II and IVa of the Habitats and Species Directive, and receive protection in all of the countries covered by this Action Plan. However, the majority of crested newt populations occur outside of any protected areas.

Despite being among the most intensively studied amphibian species in Europe, only limited conservation work has taken place for these species, with *Triturus cristatus* and *Triturus carnifex* probably receiving the most attention to date. The overall goal of this Action Plan is therefore to expand on these successes and to ensure the maintenance, and restoration where necessary, of viable crested populations across Europe. A series of general objectives are outlined and specific actions are proposed that include the coordination of conservation efforts for this species, additional distribution surveys, habitat management recommendations, population and conservation status monitoring, scientific research and public awareness programmes. One the key recommendations made, in order to ensure that this Action Plan is effective, is the proposed formation of a Pan-European Crested Newt Working Group.

Figure 1: Male Northern Crested Newt *Triturus cristatus* (Photograph: Jim Foster)

3. Objectives. The main reasons for producing this Species Action Plan are to ensure that:

i. The decline of the four crested newt species in Europe is halted and reversed

ii. Viable populations are re-established and enlarged, and isolated populations are re-connected, throughout the European range

iii. All populations are subsequently maintained as a viable and integral part of the habitats and landscapes they occupy

Nine general objectives are proposed to help achieve these overall aims. These cover the protection and management of both species and habitat, additional distribution surveys, population and conservation status monitoring, scientific research, the improved coordination of conservation efforts and raising public awareness.

4. Recommended Actions

Limited conservation work for all four species is already underway in some range countries but it is important to expand on these successes to ensure the maintenance, and restoration where necessary, of viable crested newt populations in Europe. Consequently, 46 specific actions are proposed in this Species Action Plan, 13 of which have been identified as being of the most urgent priority (see Table 1, below). These actions should therefore be implemented as soon as possible. The remaining 33 actions are of a less immediate priority, or, as in the production of national recovery plans, will take time to realise, but are nonetheless still important for the conservation of crested newt populations. Among the most vital elements of future conservation work for the crested newt species complex will be the effective liaison and coordination of these efforts (both within and between range countries) and, of course, adequate funding.

Table 1: Urgent Priority Actions for the Crested Newt *Triturus cristatus* Species Complex

Area of Activity	Urgent Priority Actions	Relevant Countries
Habitat Protection	Action 4.1.1. Ensure that all key areas in each range country that are known to support substantial, internationally significant populations of *Triturus cristatus*, *Triturus carnifex*, *Triturus dobrogicus* and *Triturus karelinii* are protected from any threats of further habitat loss by appropriate national designations and, where possible, are incorporated into the Natura 2000 and Emerald Network series.	All 37 range countries
Habitat Management	Action 4.2.1. Prepare general, agreed guidelines for the management of the aquatic and terrestrial habitats occupied by the four crested newt species in Europe, taking into account the particular ecological requirements of these species.	All 37 range countries

Habitat Management	Action 4.2.2. Disseminate these guidelines as widely as possible to a range of governments, local authorities, land managers, farmers, foresters, conservation bodies and other relevant organisations and individuals, incorporating advice tailored to local conditions where appropriate.	All 37 range countries
Habitat Management	Action 4.2.3. Control, and prohibit if necessary, the excessive use of pesticides, fungicides and fertilisers in areas close to large populations of the crested newt species.	All 37 range countries
Habitat Management	Action 4.2.4. Remove introduced predatory fish from ponds or ditches that are known to be crested newt breeding sites, or are in areas that are being managed for crested newts, and prohibit any further, uncontrolled introductions of such fish.	All 37 range countries
Habitat Management	Action 4.2.5. In particular, investigate means to prevent the further expansion of the rotan, *Perccottus glenii*, and develop plans for the complete eradication of this species in Europe.	All affected (eastern Europe to Italy)
Species Protection	Action 4.3.1. Carry out a review of the effectiveness of current legal protection and its enforcement in each of the range countries of the four crested newt species. Provide recommendations for improving the situation where necessary.	All 37 range countries
Species Protection	Action 4.3.2. Ensure that derogations from the species protection legislation in all range countries are accompanied by suitable environmental assessments and, where necessary, by adequate mitigation measures to maintain the conservation status of crested newts and to replace lost habitat.	All 37 range countries
Distribution Surveys	Action 4.5.1. Collate existing records and monitoring results for *Triturus cristatus*, *Triturus carnifex*, *Triturus dobrogicus* and *Triturus karelinii* throughout Europe and further investigate the status of newly discovered or poorly known populations (e.g. *Triturus cristatus* in Bulgaria or *Triturus dobrogicus* in the Republic of Moldova).	All 37 range countries
Population and Conservation Status Monitoring	Action 4.6.1. Develop a simple, standardised sampling methodology for monitoring and calculating the condition of crested newt populations that can be readily and cheaply employed in any European country.	All 37 range countries
Population and Conservation Status Monitoring	Action 4.6.2. To most effectively target limited resources, produce a European monitoring strategy for the crested newt species complex that takes into account the reportedly higher levels of habitat destruction in certain regions, and the correspondingly greater population declines of some taxa.	All 37 range countries
Improved Liaison and Coordination	Action 4.8.1. Ensure that the signatory Governments of the Bern Convention, and the relevant authorities and conservation bodies in the countries within the range of the four crested newt species, adopt this Action Plan.	All 37 range countries
Improved Liaison and Coordination	Action 4.8.2. Establish a Pan-European Crested Newt Working Group, consisting of experts from as many range countries as possible, to improve international liaison and coordination between all those engaged in surveys, monitoring, habitat management, scientific research and political lobbying. This body should be able to provide advice to Governments, and other relevant authorities, and oversee implementation of the conservation actions recommended in this plan for all four species of crested newt.	All 37 range countries

PART B. CRESTED NEWT SPECIES COMPLEX – SPECIES ACTION PLAN

1. INTRODUCTION

The crested newt *Triturus cristatus* species complex (or superspecies) occurs across much of northern, central and eastern Europe and is made up of four species with a parapatric distribution. These are:

- Northern crested newt *Triturus cristatus*
- Italian crested newt *Triturus carnifex*
- Danube crested newt *Triturus dobrogicus*
- Southern Crested Newt *Triturus karelinii*

Although these species are found in a wide range of habitats, and are still abundant in some countries, massive population declines have occurred in many areas. This Action Plan has therefore been commissioned by the Standing Committee of the Bern Convention to address the problems faced by the crested newt species complex in Europe. An attempt has been made in this Action Plan to summarise some of the literature that is pertinent to the conservation of the four crested newt species (Section 5). In addition, a much more extensive bibliography has been compiled on the *Triturus cristatus* superspecies and this is available separately from the authors. The taxonomy and ecology of this species complex are covered briefly, while more attention is given to its distribution and status and to the threats that it is known to face. A series of general objectives and specific conservation actions are recommended for adoption by the Bern Convention and relevant national governments. In future years, the successful conservation of the crested newt species complex should be seen as an important measure of, and contribution towards, international efforts to maintain the biodiversity of Europe. It should be noted that since this Action Plan covers four species, and such a wide area of Europe, it is not intended to be a comprehensive or static document. It should be viewed instead as a strategic overview of the current status and conservation requirements of the crested newt species. As additional information is obtained, and as conservation work and scientific research progress, subsequent versions should be produced that report on any successes and make updated recommendations as necessary. A key recommendation of this Plan is the formation of a Pan-European Crested Newt Working Group and it is hoped that such a body will be able to oversee the conservation of these species well into the future.

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2. BACKGROUND INFORMATION

2.1. Systematics

The currently recognised members of the crested newt complex were originally described as separate species (see below). Later morphological studies then combined them all as subspecies of the single taxon, *Triturus cristatus* (Wolterstorff 1923). Following the recent development of more advanced taxonomic techniques, particularly in biochemistry and cytogenetics, the various subspecies of *Triturus cristatus* have once more been elevated to full species status (Bucci-Innocenti *et al* 1983; Wallis and Arntzen 1989; Macgregor 1990; Macgregor *et al* 1990; Griffiths 1996). Subsequent research has shown three of these species have two subspecies each. Various studies in the contact zones between the species led to the concept of the *Triturus cristatus* "superspecies" or species complex. A list of the recognised species and subspecies in this complex, plus relevant authors, type localities, original description names and important synonymies is shown below:

Triturus cristatus (Laurenti 1768). Originally described as *Triton cristatus.* Type locality restricted (Mertens and Muller 1928) - Nürnberg, Germany. Synonym: *Triturus cristatus danubialis* var. *intermedia* Fuhn 1853.

Triturus carnifex carnifex (Laurenti 1768). Originally described as *Triton carnifex.* Type locality restricted (Mertens & Muller 1928) - Vienna, Austria. Synonyms: *Triton carnifex, Triturus cristatus carnifex.*

Triturus carnifex macedonicus (Karaman 1922). Originally described as *Molge karelinii* var. *macedonica.* Type locality - Ohrid, Macedonia. Synonym: *Triturus carnifex* var. *albanicus* Dely 1959.

Triturus dobrogicus dobrogicus (Kiritzescu 1903). Originally described as *Triton cristatus* var. *dobrogicus.* Type locality restricted (Mertens & Muller 1928) – "lakes in the environs of Sulina", Danube Delta, Romania.

Triturus dobrogicus macrosoma (Boulenger 1908). Type locality unknown - presumed to be the environs of Vienna, Austria. Synonyms: *Triton cristatus danubialis* Wolterstorff 1923, *Triton cristatus danubialis* var. *werneri* Wolterstorff 1923, *Triton cristatus danubialis* forma *smederewana* Karaman 1948.

Triturus karelinii karelinii (Strauch 1870). Originally described as *Triton karelinii.* Type locality - south coast of the Caspian Sea, northwest Iran. Synonym: *Triturus cristatus karelinii.*

Triturus karelinii arntzeni Litvinchuk, Borkin, Dzukic and Kalezic 1999. Type locality - Vrtovac, Serbia.

Hybrids between *Triturus cristatus* and the marbled newt *Triturus marmoratus* have also been described (see below) although are not considered further in this Action Plan:

Triturus blasii (De L'Isle 1862). Type locality - Nantes, France (hybrid between male *Triturus cristatus* x female *Triturus marmoratus).* Synonyms: *Triton blas, Triton trouessarti* Peracca 1886 (the latter is a hybrid between male *Triturus marmoratus* x female *Triturus cristatus).*

2.2. Summary of the Crested Newt Species Complex

A summary of the four species contained within the crested newt species complex is given below. Further details of the ecology, distribution and status of each are also provided throughout this Action Plan.

2.2.1. Northern Crested Newt *Triturus cristatus*

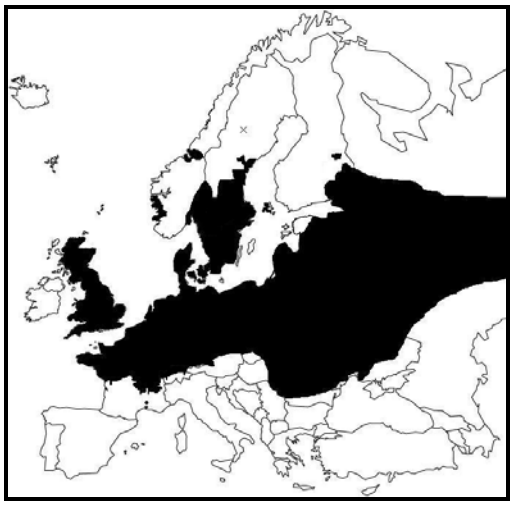
Other Common Names: great crested newt, warty newt.

Vernacular Names in Europe: madfall gribog (Welsh), triton crêté (French), Kammmolch (German), tritone crestato settentrionale (Italian), kamsalamander (Dutch), stor vandsalamander (Danish), större vattensalamander (Swedish), stor salamander (Norwegian), rupilisko (Finnish), harivesilik (Estonian), traszka grzebieniasta (Polish), Гребенчатый тритон (Russian), čolek velký (Czech), mlok hrebenatý (Slovak), veliki (krestasti) mrmoljak (Serbian), tarajos göte (Hungarian), solomîzdră de apă cu creastă, triton cu creasta (Romanian), piutscha crestada (Raeto-Romanian).

Subspecies: no subspecies recognised.

Map 1. Distribution of the Northern Crested Newt *Triturus cristatus* in Europe

(The X in Sweden marks the northernmost site, Skrattabborrtjäm in Lappland, which is now extinct)



Habitats: deciduous and coniferous woodland or areas of rank grass, usually within 500 m of ponds, ditches or slow flowing waters.

Threats: changes in agricultural systems and loss of ponds; fragmentation of suitable habitat; loss of suitable connecting habitat (such as woods or scrub) between ponds; deforestation; clearance of dead wood; eutrophication of ponds; introduction of predatory fish.

2.2.2. Italian Crested Newt *Triturus carnifex*

Other Common Names: Alpine crested newt.

Vernacular Names in Europe: Alpenkammmolch (German), triton crêté Italien (French), tritone crestato

italiano (Italian), veliki vodenjak (Croatian), glavati (veliki) mrmoljak (Serbian), veliki pupek (Slovene), Италиански тритон (Macedonian), tritoni me kreshte (Albanian), Alpesi tarajos gõte, havasi tarajos gõte (Hungarian), colek dravý (Czech).

Subspecies: two subspecies recognised - *Triturus carnifex carnifex* and *Triturus carnifex macedonicus.*

Map 2. Distribution of the Italian Crested Newt *Triturus carnifex* in Europe
(The X on the French-Swiss border marks the introduced population near Lake Leman)

Habitats: deciduous woodland to arid Mediterranean habitats where these occur close to still permanent, temporary waters and flooded quarries. Occurs from sea level to 2140m.

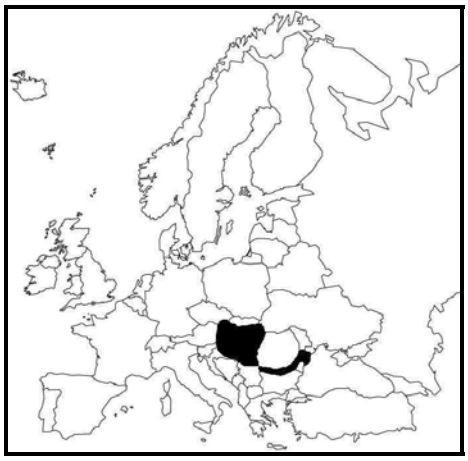
Threats: destruction of breeding sites; deforestation and changes in agricultural methods and scale; use of fertilisers and pesticides causing pollution or eutrophication; introduction of predatory fish.

2.2.3. Danube Crested Newt *Triturus dobrogicus*

Vernacular Names in Europe: Donaukammmolch (German), triton du Danube (French), tritone crestato del Danubio (Italian), Donaukamsalamander (Dutch), Podonavski pupek (Slovene), Podunavski vodenjak (Croatian), Podunavski mrmoljak (Serbian), Dunai gõte, Duna-vidéki tarajos gõte (Hungarian), čolek Dunajský (Czech), mlok Podunajský (Slovak), salamizdra de apa, triton dobrogean (Romanian), Дунавски гребенест тритон (Bulgarian).

Subspecies: two subspecies recognised - *Triturus dobrogicus dobrogicus* and *Triturus dobrogicus macrosoma.*

Map 3. Distribution of the Danube Crested Newt *Triturus dobrogicus* in Europe



Habitats: inhabits small woods and groves, around the lakes, ponds and ditches, on flood plains, on islands and in the marsh area of the Delta. Spends a greater proportion of its time in water than the other species.

Threats: changes in agriculture and drainage; pollution of watercourses; dams and dykes - these reduce the extent of flooding on the plains but produce more drastic local effects that can be detrimental to this species.

2.2.4. Southern Crested Newt *Triturus karelinii*

Other Common Names: Balkan crested newt, Iranian crested newt.

Vernacular Names in Europe: Balkankammmolch (German), triton de Karelin (French), Dugonogi

mrmoljak (Serbian), Dolgonogi pupek (Slovene), tarajos gõte (Hungarian), čolek Karelinův (Czech), Балкански тритон (Macedonian), Μεγάλος Τρίτωυας (Greek), pürtüklü semender (Turkish), Голям гребенест тритон (Bulgarian).

Subspecies: two subspecies recognised - *Triturus karelinii karelinii* and *Triturus karelinii arntzeni.*

Map 4. Distribution of the Southern Crested Newt *Triturus karelinii* in Europe

Habitats: mountain forests and their surroundings. Both deciduous and coniferous forests are inhabited by this species and it also occurs in forest steppe, relict forest, meadows and xerophytic vegetation with ponds and marshes nearby. Breeds in ponds, slow moving stream pools and drainage ditches.

Threats: destruction of breeding sites; deforestation; eutrophication of ponds (the larvae are particularly sensitive to water quality); collection for the pet trade.

2.3. Description

2.3.1. Morphology. The four species in the crested newt complex are morphologically similar. Although the tadpoles are indistinguishable, the adults exhibit some differences in features such as body and limb dimensions, skin texture, the shape of the crest that breeding males develop each spring and, internally, the numbers of vertebrae bearing ribs. The Wolterstorff Index (WI) - the ratio of the forelimb length to the distance between the fore and hind limbs - is also sometimes employed to differentiate between species. However, there can be marked variation in this ratio and identification using the WI alone may prove problematic. For example, in areas of Europe where the ranges of two of the species contact, WI results can directly contradict identification confirmed by other, more reliable means, such as genetic analysis. The general morphological features of the four species are as follows:

2.3.1.i. *Triturus cristatus*. The northern crested newt has a moderately slender body, medium sized legs and a narrow tail base. The skin is obviously warty in texture. Breeding males develop a jagged crest along the body and tail and this is deeply indented at the base of the tail. The size and shape of this crest changes as the individual ages. Females can attain a total length of about 160 mm and a weight of 6-15 g. Males are considerably lighter and usually reach a length of 140-150 mm. The WI of males is 0.54-0.63, and that of females 0.46-0.54. *Triturus cristatus* possesses 16 rib-bearing vertebrae (RBV).

2.3.1.ii. *Triturus carnifex*. The Italian crested newt has a body of medium build, large legs and a wide tail base. It is also smoother skinned than *Triturus cristatus.* Breeding males develop a high crest. Females reach

about 170 mm in total length, with a WI of 0.54-0.59. Males are generally 150-160 mm in length and have a WI of 0.64-0.67. *Triturus carnifex possesses* 15 RBV.

2.3.1.iii. *Triturus dobrogicus*. The Danube crested newt is slender bodied with a small head, short legs and narrow tail base. The skin is coarse in texture. Breeding males have a very jagged crest on the body, which reaches right to the front of the head, is deeply indented at the tail base and is distinctly separate from the much smoother-edged tail crest. Although this species can reach 160 mm in total length, the females are normally 130 mm and the males a slighter larger 145 mm. The WI of males is usually less than 0.54, and in females is under 0.46. This species possesses 17 or 18 RBV.

2.3.1.iv. *Triturus karelinii*. The southern crested newt is a stockily built species, with large legs and a wide tail base. This species quite smooth skinned compared to the other species. Breeding males develop a fairly indented crest, which is also smoother-edged along the tail than on the body although is not indented at the tail base. Females reach 175 mm in length and males 160 mm. The WI of males is about 0.67 and of females 0.55-0.70. *Triturus karelinii* normally possesses 14 RBV.

2.3.2. Colouration. Each species exhibits typical colouration and patterning but there are marked differences among populations and, at areas of contact, these characters are often difficult to use.

2.3.2.i. *Triturus cristatus*. The northern crested newt has a dark brown body with black spots and conspicuous white tubercles on the sides and legs. The underside is usually yellow or orange with a variable pattern of black blotches that tend to be more numerous anteriorally. The throat is dark with white stippling. Breeding males have a pale whitish or bluish stripe along the middle of the tail, one on each side, while females have an orange line along the lower edge of the tail.

2.3.2.ii. *Triturus carnifex*. The Italian crested newt also has a dark brown body with black spots, but there is little or no white stippling. The belly is yellow or orange with a few large rounded grey to black spots, although the subspecies *Triturus carnifex macedonicus* has a dense pattern of small dark spots.

2.3.2.iii. *Triturus dobrogicus*. The Danube crested newt has a dark brown body with black spots and white stippling on the flanks. The underside is deep orange in colour with sharp roundish black spots - these may fuse to form two longitudinal bands. The throat is usually black with fine white spots.

2.3.2.iv. *Triturus karelinii*. Balkan crested newts also possess a dark brown body with black spots and some white stippling on the sides and, in addition, usually have white markings on the cheeks. The belly is orange with numerous small or medium-sized black spots that extend onto the throat. The underside of the tail is bright orange, especially in females.

2.4. Life History

2.4.1. Habitat Requirements. The huge geographic range of this species complex, as well as the large altitudinal range, mean that the specific habitat types occupied vary widely across Europe. In general, however, the four species require a diverse landscape of woodland and agricultural land as terrestrial habitat, with a variety of associated water bodies (usually ponds, lakes or ditches) being used as aquatic breeding habitat. Crested newt populations may be more successful when they have a choice of several water bodies in any given area and such "pond clusters" appear to be particularly important for *Triturus cristatus*.

Still waters are strongly preferred for breeding although quiet pools in streams and even slow flowing rivers can be utilised if these represent the only aquatic habitat available. Marshland is also used where this is present and seems to be particularly favoured by *Triturus dobrogicus* in the Danube basin and delta. All four species sometimes utilise artificial water bodies, such as reservoirs, gravel pits, garden ponds and even livestock troughs, for breeding. In some areas of northern Italy (in the provinces of Novara, Vercelli and the western parts of Pavia province) *Triturus carnifex* is also found in rice paddies, where it prefers deeper water with some aquatic vegetation (Andreone and Marconi 2006).

Deciduous woodland is the preferred terrestrial habitat but coniferous woodland can be inhabited in both the far north of Europe and the higher mountainous areas of the south. Where formerly continuous forest cover has been removed, small patches of relict woodland or scrub interspersed with areas of damp meadows, rough grassland and other dense ground vegetation can still provide suitable habitat for crested newts.

2.4.2. Dietary Requirements. The crested newts species all eat invertebrates such as insects, molluscs, woodlice and earthworms when living terrestrially. During the period spent in the water each spring, adult

newts feed on a variety of aquatic invertebrates, tadpoles and smaller newts. They have also been known to consume the shed skins of other amphibian species. Crested newt larvae are voracious carnivores, eating any small invertebrates and, increasingly frequently as they grow, other tadpoles (including the larvae of their own species). The actual composition of prey species consumed differs amongst populations and can even be different from one pond to the next. Covaciu-Marcov *et al* (2002) found that one population of *Triturus cristatus* studied adopted an active foraging strategy, whereas the behaviour of another suggested that a passive sit and wait strategy was being used to catch prey.

2.4.3. Activity and Movements. Crested newt species are predominantly nocturnal during both their terrestrial and aquatic phases. This nocturnal tendency is more pronounced than in the smaller species of European newts, in which active breeding often occurs during the day, especially in shady ponds. It appears that those members of this species complex possessing slimmer bodies and shorter legs (which are more suitable for swimming) spend more of their time in the aquatic phase. *Triturus carnifex* spends an average of four months each season in water, *Triturus cristatus* five months and *Triturus dobrogicus* six months of the year (Arntzen and Wallis 1999). *Triturus dobrogicus* is an exception as, from its shape, it was thought to spend less than four months per year in the water - however, Kuzmin (1999) found that this species has an aquatic phase of at least five to six months.

The majority of crested newts hibernate on land, although a small proportion of individuals hibernate in the water. In northern areas, some larvae may also overwinter in the water (Kuzmin *et al* 1996). In the warmer parts of the range, young, non-breeding specimens or any adults not remaining in the water may undergo a period of summer dormancy (aestivation), usually under logs and rocks.

In a radio-telemetry study of *Triturus cristatus,* Jehle (2000) found that more than 50% of adult newts leaving breeding ponds utilised refuges within 15m of the water and that 95 % could be found within 50m of the pond. The maximum distance moved by newts in that study was 95 m, although Kupfer (1998) recorded movements of between 230 and 1290 m in a more open agricultural landscape. Most of the dispersal of *Triturus cristatus* populations is undertaken by the juvenile and immature newts, up to one or two years old. Work on juveniles has found that they may disperse up to 860 m from the pond after metamorphosis, with the average distance moved being 254 m (Kupfer and Kneitz 2000). Movements of newly metamorphosed animals seem to be initially directed by olfactory cues, with juveniles able to follow the routes previously used by adult newts on leaving the water.

2.4.4. Reproduction. The actual timing of breeding depends on the location and the exact climatic conditions of that area in any particular year. In the UK, for instance, most adult *Triturus cristatus* move to breeding ponds in March (Verrell and Halliday 1985), although some have been captured the previous autumn. Males rapidly develop a dorsal crest and brighter colouration and start displaying to the females from late March and through April. Males do not appear to be territorial and simply move around the pond in search of females. To stimulate females, the males perform a ritualised "dance" and also waft pheromones from their cloaca with their tail. At the climax of this display, a spermatophore (basically a "packet" of sperm) is deposited on the bottom of the pond by the male. The female is then led over the spermatophore, which she picks up with her cloaca - fertilisation is therefore internal. About 250 eggs, which are ovoid in shape, about 2.5 mm long and yellow-green in colour, are laid individually throughout the season on the leaves of aquatic vegetation. The female carefully folds a leaf over each egg with her hind legs, thus concealing them from predators. Certain aquatic plants are particularly favoured by crested newt species for egg laying and include *Myosotis scorpiodes, Veronica beccabunga, Glyceria fluitans, Nasturtium officinale* and various *Callitriche* species.

The eggs hatch in about 10 to 20 days although, interestingly, the whole species complex exhibits 50 % mortality during egg development due to lethal homozygosity on the first chromosome (Macgregor *et al* 1990). The newly hatched larvae are 12 mm in total length and metamorphosis occurs in about three months, by which time they have reached approximately 70 mm. Larval development is usually more rapid in warm, ephemeral ponds than in deeper, permanent water bodies. In any event, the timing of development can vary from year to year as rainfall is the key factor driving the exodus of young newts from the ponds (Kupfer 1997). Neither the extension of larval development (giant larvae) nor neotony (paedomorphosis) are unusual in crested newts. Newly emerged juveniles live on land until they reach sexual maturity, a process that takes two to three years, when they then return to water to breed themselves. It appears that the eventual sexual dimorphism in the size of adult crested newt species (the females being larger than the males) is due to factors operating during juvenile life, rather than at adulthood (Kalezic and Djorvic 1998).

2.4.5. Predators and Competitors. Adult crested newts have poisonous skin secretions and therefore have fewer predators than other members of the genus *Triturus*. Nonetheless, a range of predators eats all four crested newt species, especially the larvae. Juvenile survival has been estimated at 0.2 and annual adult survival at about 0.68. Crested newts are vulnerable to predatory fish, as the larvae tend to swim in open water, rather than staying on the bottom or concealed in vegetation like other newt species. A range of carnivorous invertebrates and waterfowl such as ducks also eat the larvae. Adult newts are eaten by species such as European pond terrapins, grass snakes, dice snakes, herons, egrets, ducks, bitterns and various mammals.

Crested newts have few direct competitors as they are usually the only large newt species to be found in any given area, although the marbled newt, *Triturus marmoratus,* has a wide area of overlap with *Triturus cristatus* in France. Hybrids (see Section 2.1) have been found in about 25% of the ponds in this area and can make up two to seven per cent (sometimes up to 20%) of the newt populations (Duguet and Melki 2003). However, the two species are often separated by the types of ponds used (Schoorl and Zuiderwijk 1981) and by the timing of breeding (Zuiderwijk and Bouton 1987).

2.5. Distribution and Status

2.5.1. Summary of the Distribution and Status of Crested Newt Species. The crested newt species complex is distributed across most of Europe, excluding the Iberian Peninsula and southwest France (see Figures 1 to 4). In the north of the range crested newts are mainly found in lowland areas but increasingly occur in mountainous habitats further south. Although the ranges of the species do not overlap, some intergradation and hybridisation can occur along contact zones. Serbia is the only country in Europe where all four species can be found and the Prokletije region has been suggested as a priority biodiversity hotspot for this reason (Kalezic and Dzukic 2001).

2.5.1.i. Distribution and Status of *Triturus cristatus*

United Kingdom. Widespread in England and Wales but has suffered substantial declines in many areas (and is naturally absent or rare in south west England). Most numerous in the lowlands and in clay areas. Very local in Scotland where there may be fewer than 1000 individuals. A UK Biodiversity Action Plan priority species (UK Steering Group on Biodiversity 1995). 57 Natura 2000 sites are designated for this species in the UK.

France. Occurs across the northern two thirds of the country where 155 Natura 2000 sites have been designated for this species. Common in about one third of its French range and rare, or very rare, in the remaining two thirds. Two isolated populations also occur in the Mediterranean region of France, in the Rhone Valley, and are believed to be relicts from a past wider distribution (Brogard *et al* 1996). Listed as Vulnerable in the French Red Data Book (Maurin 1994).

Belgium. The rarest and most localised of the four newt species found in Belgium. Known from about 150 individual sites in Wallonia and occupies about 18 % of the area of Flanders. Absent from the Ardennes. Many Belgian populations are now isolated from each other and are often found in sub-optimal habitat. Listed as Rare in the Red List for Flanders. *Triturus cristatus* has had 68 Natura 2000 sites designated for it in Belgium.

Luxembourg. Rare in the south of the country and very rare in the north. At least two thirds of known populations have been lost since the 19th Century. Only recorded in a 2003 survey from 19% of the 5 x 5 km squares in Luxembourg - this species had been lost from 8% of these squares since a previous survey in 1996 (Proess 2003). Listed as Vulnerable and has 18 Natura 2000 sites designated for it in Luxembourg.

Netherlands. Recorded from all provinces except Friesland. Mostly widespread in parts of the country that are above sea level, except parts of Groningen and Drenthe, but extremely rare in areas below sea level. Most populations occur on clay or loam soils, more rarely on sand or peat. Still present at many sites, with 46 Natura 2000 sites designated for this species, but on the whole a slight decrease has been recorded (Council of Europe 2003). Red List - Vulnerable 1996.

Denmark. Widely distributed but absent from the northern and west central areas of Denmark. Listed as Least Concern in the Danish Red Data Book (Fog 2004) but has been considered to be decreasing for some time (Miljoministeriet 1991). 55 Natura 2000 sites are designated for *Triturus cristatus* in Denmark.

Sweden. Occurs in the southern part of Sweden, as far as Lake Vänern in the northwest and Uppland in the northeast. Scattered sites occur along the Baltic coast up to Gävle. Absent from Gotland. Most populations

occur in the lowlands, often in mosaic landscapes with grazed areas, farmland, ponds, wetlands and deciduous dominated forests. Sites in coniferous forests are mostly confined to tarns and small lakes. It is estimated that more than 100,000 breeding animals are present with declines due to exploitation, fish introductions and deterioration of water quality in the breeding ponds (Andren 2004). Loss of populations is occurring over most the distribution, with an estimated 2-3% loss of breeding ponds per year between 1990 and 2005 (J. Malmgren *pers. com.*). Southernmost Sweden (Skåne) is an exception since massive efforts to restore amphibian ponds have been undertaken here. The northernmost known locality for crested newts in Europe, Skrattabborrtjäm in Lappland, plus its surroundings were resurveyed in 2006, although no newts at all could be found. It is assumed that this population is now extinct as a result of the introduction of trout (J. Malmgren *pers. com.*). *Triturus cristatus* is listed as Least Concern in the Swedish Red List. The number of Natura 2000 sites designated for this species in Sweden is 141 (as of August 2005).

Norway. Most populations occur in the southeastern lowlands and mainly breed in eutrophic ponds, cattle ponds or reservoirs that are situated on clay soils and are devoid of fish. This species is more sparsely distributed in western and central Norway, where it utilises dystrophic ponds. Considered Endangered in the Norwegian Red List (1998), although recent surveys have discovered more populations than expected (Dolman *pers. com.*)

Finland. Only found in a restricted area of southern Finland, north to Koli National park, and has one Natura 2000 site designated for it. About 90 % of breeding sites occur in lakes in Finland. Listed as Vulnerable in the Red List of Finnish species (Rassi *et al* 2000; Finnish Environment Institute 2004).

Latvia. Irregular distribution over the whole country. Most sites are found in the southwest of Latvia and also in the River Daugava (Dvina) valley. Few sites have been recorded in the north of Latvia. Populations seem to be generally stable. Listed as vulnerable in the Red Data Book of Latvia (Andrusaitis 2003).

Estonia. Found in scattered localities in most regions, although absent from the west coast and from islands. Considered Threatened in Estonia. Has become extinct in some breeding ponds in the central and northern parts of the country (Talvi 1992; R. Rannap *pers. com.*).

Lithuania. Data deficient - known to live in one nature reserve but has an indeterminate status.

Germany. Widely distributed, although it has suffered substantial declines in many areas, and 711 Natura 2000 sites have now been designated for this species. Considered Vulnerable in the national Red List in 1994 (Nowak *et al* 1994), but this status had been downgraded to Rare by 1998 (Binot *et al* 1998).

Switzerland. Found on the northern side of the Alps up to about 1100 m. Most abundant in northeast Switzerland, where numerous populations are distributed over a large area. Fewer, more isolated populations (about 300 sites in total) are found in north, west and central Switzerland. Many "amphibian breeding sites of federal importance", which are selected on the number of species, rarity of species and population size, contain this species in Switzerland. Formerly listed as Vulnerable in the national Red List (Duelli 1994) but this has been changed to Endangered in the latest Red List (Schmidt and Zumbach 2005).

Austria. Occurs north of the Alps and in the extreme west of the country between about 250 and 850 m in altitude. Populations of the Niederosterreich Land seem to be decreasing but no specific surveys or conservation measurements have been carried out (Council of Europe 2003). Fifteen Natura 2000 sites and one Biogenetic Reserve have been designated for this species in Austria.

Czech Republic. Widespread in Moravia and Bohemia. Recorded in 255 133-km2 quadrats (i.e. grids that are 12 x 11.1 km) - 37.6 % of the total number of quadrats. Found up to about 800 m in altitude. In areas where this species has been investigated, e.g. Ust nad Labem, a considerable decrease has been noted (Moravec 1994). Classified as Critically Endangered/Endangered in the national Red Data Book (Necas *et al* 1997), more recently listed as Endangered (Zavadil and Moravec 2003).

Slovakia. Widespread in northern and Central areas up to about 250 - 550 m. A contact zone of hybridisation/introgression with *Triturus dobrogicus* is present in the Carpathian foothill region. According to the Red List (Kautman, Bartik & Urban 2001) the species is listed in the cathegory EN (endangered species).

Poland. Occurs throughout the country in both the lowlands and highlands, although rarer in mountainous regions. Considered Lower Risk in Poland.

Russia. Widespread in western Russia but is in decline (Vial and Saylor 1993). This species shows the greatest decline, when compared with other widespread amphibians, throughout its Russian range. Considered the most endangered amphibian in Moscow province (Kuzmin *et al* 1996).

Belarus. Moderately widespread but rare. Does not occur near human settlements and population numbers are decreasing.

Moldova. Widespread and relatively common. Although not considered endangered, its habitats have been greatly decreased in extent as a result of the drainage of marshy land in river valleys (|S. Drucioc *pers. com.*)

Ukraine. Widespread and relatively common. Inhabits both forests and forested steppes. A 'near contact' zone with *Triturus dobrogicus macrosoma* occurs in the Transcarpathians, where the two species can be separated by a minimum gap of as little as four km. Considered Lower Risk in the national Red Data Book.

Romania. Found across most of the country except the extreme west and in the southern Danube lowlands. Vulnerable in the national Red Data Book (Vial and Saylor 1993; Cogalniceanu 1997).

Serbia. Found in the pericarpathian part of Banat province, on Vrsac and Lokva mountains and their slopes, as well as in the vicinity of Negotin, Jabucovac, Stubik and Zajecar. A contact zone with *Triturus karelinii* occurs near the towns of Bor and Klokocevac (Litvinchuk *et al* 1999). *Triturus cristatus* habitat is reported to be decreasing in Serbia (Kalezic and Dzukic 2001; Crnobrnja-Isailovic *et al* 2005).

Bulgaria. *Triturus cristatus* has very recently been confirmed for the first time from Bulgaria (Dobrev *pers. com.*), where it was discovered in the Bulgarian part of the western Stara Planina (Balkan) Mountains, a locality that extends its distribution southwards (Tzankov and Stojanov, in press). N.B. this location is not shown on Map 1 and no further information is currently available about the size or status of the population(s) here.

2.5.1.ii. Distribution and Status of *Triturus carnifex carnifex*

France. Found in the Haute-Savoie region, near the western tip of Lake Leman in the Lake Geneva basin (see Map 2), where it was recorded for the first time in 1987, possibly as a result of an introduction from Tuscany.

Germany. Data deficient – previously recorded in Bayern, southern Germany, although there has been speculation that these specimens were in fact hybrids between *Triturus carnifex* and *Triturus cristatus*.

Italy. Widespread, and can be locally very abundant. In some areas, however, the Italian crested newt is quite rare and localised: this is most likely due to generally unfavourable climatic conditions in the Prealpine and Alpine zones (e.g. Aosta Valley and Trentino), and to habitat alteration by humans for agricultural (e.g. Liguria, Apulia) and other purposes (Andreone and Marconi 2006). Typically a plain or hill dweller, this species seems to be particularly vulnerable to extinction when it lives in valleys: for example populations have declined dramatically in the Ossola Valley, the Val Sesia and the Val di Susa (Andreone and Marconi 2006). Some populations have become extinct in the Po valley region (GAA 2004). In an area of the karst region near Trieste, 74 ponds known in 1970 had been reduced to 29 by 1996 - only 10 % of these supported *Triturus carnifex carnifex* (Bressi 1999). Three Natura 2000 sites and three Biogenetic Reserves have been created for *Triturus carnifex* and five sites have also been declared as Aree di rilevanza erpetologica nazionale (AREN) for this species by the Societas Herpetologica Italica (1996). It is not unusual to find this species in syntopy with *Triturus* (*Lissotriton*) *vulgaris meridionalis* and *Triturus* (*Lissotriton*) *italicus*, although it is rare to find it with *Triturus* (*Mesotriton*) *alpestris* (Fasola and Canova 1992).

Switzerland. Found in Tessin, where 40 sites are known, and introduced to the Lake Geneva area where it is hybridising with *Triturus cristatus* (Arntzen and Thorpe 1999; Arntzen 2001). As with Triturus cristatus, many populations have been included in "amphibian breeding sites of federal importance" (Schmidt *pers. com.*).

Austria. Occurs over the eastern half of the country in river valleys and on mountains between 190 m and 1480 m in altitude.

Czech Republic. Confined to a very small area near Masovice in Moravia, where it was only discovered in 1997. Many localities in this area have since disappeared and numbers have decreased - considered critically endangered in the Czech Republic (Council of Europe 2003) and listed as CR by Zavadil and Moravec (2003)

Hungary. Occurs in only two separate 10x10 km squares in the western most part of the country. These represent range edge populations and *Triturus carnifex* is a protected species in Hungary. However, further habitat protection is also needed to secure its long-term survival in the country (Szovenyi *et al* 2001).

Slovenia. Rare and locally threatened in Cerknica Polje (Veenvliet 2001). In an area of karst in western Slovenia, 80 ponds known in 1970 had been reduced to 42 in 1996, of which only 25% contained this taxon (Bressi 1999). Dense populations can be found in temporary ponds in lowland gravel pits in northeast Slovenia (Vogrin 1999). Status listed as Indeterminate in the national Red List (Vogrin 1997).

Croatia. Data deficient - occurs in the northwestern area of Croatia.

Bosnia Herzegovina. Data deficient - occurs in the northwestern tip of the country.

2.5.1.iii. Distribution and Status of *Triturus carnifex macedonicus*

Bosnia Herzegovina. Data deficient - occurs in the southeastern corner of the country.

Serbia. Data deficient - occurs in the southwestern part of Serbia.

Montenegro. Data deficient - habitat decreasing (Kalezic and Dzukic 2001). Some paedomorphic populations exist (where the larvae remain in water and can eventually breed) but are very rare.

Macedonia. Data deficient - occurs in the western part of the country.

Albania. Data deficient - recorded from the plains, Albanian Alps and the Ikeseria region (Bruno 1989).

Greece. Found in western Greece, including Corfu. Only partial knowledge of a few populations exists. Fourteen locations, from drinking troughs to alpine lakes, have been recorded in the Ioannina district and occur in both hilly and mountainous areas up to 2140 m (Denoël 2004). Considered endangered due to habitat loss.

2.5.1.iv. Distribution and Status of *Triturus dobrogicus dobrogicus*

Romania. Recorded from areas of *Phragmites* in marshland in the Danube Delta. Has decreased from being locally common to very rare and is now listed as Endangered in the national Red Data Book (Vial and Saylor 1993; Cogalniceanu 1997). It is not clear how far north this subspecies occurs along the tributaries of the Danube. A contact zone with *Triturus cristatus* may be present in the southwest corner of Dolj county (Lazar 2004).

Bulgaria. Data deficient - occurs just along the northern border area with Romania but only recorded in 0.72 % of the 10 x 10 km squares in the country. Its status is unknown in Bulgaria and it is not clear how far south this taxon occurs along the tributaries of the Danube and if, or where, there is a contact zone with *Triturus karelinii*.

Moldova. Data deficient - recorded from the southernmost tip of Moldova, along the lower reaches of the Prut River (Borkin *et al* 1997; Kuzmin 1999) although, at present, this species is not recognised as a member of the Moldovan herpetofauna. Further surveys are planned to prove its existence (S. Drucioc *pers. com.*).

Ukraine. Data deficient - found in the Danube Delta in areas of *Typha* and *Phragmites*. This species is probably not rare in Ukraine.

2.5.1.v. Distribution and Status of *Triturus dobrogicus macrosoma*

Austria. Data deficient - found in eastern Austria in the Danube valley at 115-350 m altitude. Thirteen Natura 2000 sites have been designated for this taxon in Austria.

Czech Republic. Occurs in only two km^2 quadrats (0.3 % of the country) in the southeast corner of Moravia. Of four localities known in 1994 along the Dyje and Morava rivers, at 152 and 154 m (Moravec 1994), two had become extinct by 1997 due to anthropogenic changes in the landscape (Zavadil and Necas 1997). Locally but not nationally protected and not listed in the national Red Data Book (Necas *et al* 1997; Council of Europe 2003). Critically endangered in the Czech Republic, listed as CR by Zavadil and Moravec (2003).

Slovakia. Data deficient - found in the lowlands of the eastern and western part of the country, mostly below 250 m in altitude. A zone of hybridisation/introgression with *Triturus cristatus* exists in the Carpathian foothill region.

Slovenia. Data deficient - forms hybrids with *Triturus carnifex*.

Croatia. Data deficient - found only in northeast Croatia.

Bosnia-Herzegovina. Data deficient - confined to the northeastern tip of the country.

Serbia. Only occurs in the north and east of the country, as far south as Svetozarevo. The areas around Debrc, Trbusac and Tresnja appear to be a contact zone with *Triturus karelinii* (Litvinchuk *et al* 1999). Habitat known to be decreasing and considered endangered.

Hungary. Widespread over the whole of the country but status unknown. A Council of Europe Biogenetic Reserve has been created for this taxon in Hungary.

Romania. Data deficient - locally distributed along the western edge of the country. Endangered.

Ukraine. Data deficient - occurs in Transcarpathia below 125 m altitude in plains habitat with a mix of small woods, groves and water meadows. The range of this taxon here is in close proximity to, but separate from, that of *Triturus cristatus,* with a distance of as little as four km between the two species.

2.5.1.vi. Distribution and Status of *Triturus karelinii karelinii*

Turkey. Data deficient - occurs on the northern Aegean coast and in northern Anatolia, along the south coast of the Black Sea eastwards to the Hopa region on the border with Georgia. Status unknown.

Georgia. Found on the southern macroslope of the main Caucasian ridge between 200 and 2000 m, where it is considered rare (Kuzmin 1999). Known from 33 localities but is now absent in extreme southwest Georgia (Tarkhnishvili 1996). Declines in some locations in west and central Georgia have been correlated with decreasing mean annual temperature. Extinct in the Tana valley as suitable breeding sites have been lost due to anthropogenic habitat changes. Also presumed extinct in the Baniskhevi valley although, as some minor ponds are still being used here by the related taxon, *Triturus vittatus*, the reasons for its apparent disappearance are unknown (Tarkhnishvili *et al* 2002).

Azerbaijan. Occurs on the southern macroslope of the main Caucasian ridge. Known from the Talysh Mountains in southern Azerbaijan from 200 - 2000 m. Also recorded from seven localities in northern Azerbaijan and four in the southeast of the country (Tarkhnishvili 1996). Considered rare (Kuzmin 1999).

Russia. Found along the northern macroslope of the main Caucasian ridge at 200- 2000 m. Known from at least six localities in the Krasnowdar region (Tarkhnishvili 1996). Considered vulnerable (Kuzmin 1999). There have also been reports of crested newts in the Don River basin, in Rostov province. Although it is not known which member of the species complex these belong to they are most likely to be *Triturus karelinii karelinii*, the closest taxon in geographical terms.

Ukraine. Occurs in the Crimea from Sevastopol and Alushta north to Simferopol. Still common in some deciduous forests but rare in the more heavily populated areas. Distributed from sea level to 1710 m in altitude. Considered vulnerable (Kuzmin 1999).

2.5.1.vii. Distribution and Status of *Triturus karelinii arntzeni*

Serbia. Data deficient - found in southeast Serbia. The area near the towns of Bor and Klokocevac is a contact zone with *Triturus cristatus* and this taxon is also in contact with *Triturus dobrogicus* in the vicinity of Debrc, Trbusac and Tresnja (Litvinchuk *et al* 1999).

Macedonia. Data deficient - occurs in the eastern part of the country.

Bulgaria. Widely distributed south of the Danube lowlands although its occurrence is sparse and patchy here. Has only been recorded from 4.7 % of the 10 x 10 km UTM squares in the country. Has been found from sea level to 1400 m in altitude.

Greece. Data deficient - found in northeast Greece where many of the coastal plains, marshes and deltas are now intensively farmed and settled but the upland areas, especially the Rhodopi Mountains, remain largely undeveloped. Only partial knowledge of some populations exists.

Turkey. Data deficient - occurs in the European part of Turkey (Thrace), although its distribution and status are unknown here.

2.5.2. International Conservation Status

The international conservation status of the four crested newt species is shown below. There have been concerns expressed about the validity of such assessments, however, and the categories indicated may not accurately reflect the actual status of these species in each range country.

2.5.2.i. Northern crested newt *Triturus cristatus.* IUCN Red List Category - Least Concern. *Triturus cristatus* is listed as Least Concern in the IUCN Red List in view of "its wide distribution, tolerance of a broad range of habitats, presumed large population and because it is unlikely to be declining fast enough to qualify for listing in a more threatened category" (GAA 2004).

2.5.2.ii. Italian crested newt *Triturus carnifex.* IUCN Red List Category - Least Concern. *Triturus carnifex* is also listed as Least Concern in the IUCN Red List in view of "its wide distribution, tolerance of a broad range of habitats, presumed large population and because it is unlikely to be declining fast enough to qualify for listing in a more threatened category" (GAA 2004).

2.5.2.iii. Danube crested newt *Triturus dobrogicus.* IUCN Red List Category - Near Threatened. *Triturus dobrogicus* is listed as Near Threatened in the IUCN Red List as a species that is "in significant decline (probably less than 30% per 10 years) due to widespread habitat loss through much of its range, making it close to qualifying as Vulnerable" (GAA 2004). However, this species has the smallest range of the four crested newt species, occupying about 0.23 million km^2 in Europe. Furthermore, its typical plains habitat is one of the most severely threatened in Europe, due to changes in agriculture and flood schemes, and it was considered Vulnerable by Arntzen *et al* (1997).

2.5.2.iv. Southern Crested Newt *Triturus karelinii.* IUCN Red List Category - Least Concern. Again, *Triturus karelinii* is listed as Least Concern in the IUCN Red List in view of "its wide distribution, tolerance of a broad range of habitats, presumed large population and because it is unlikely to be declining fast enough to qualify for listing in a more threatened category" (GAA 2004). However, many populations of this species have now been physically isolated from each other, and are consequently more at risk from human activities, so its status will need to be reassessed in the near future.

2.6. Threats

Amphibians across much of Europe are under threat from a wide range of factors, most of which are directly related to human activities. The crested newt species are particularly vulnerable due to their life history and general lack of long distance mobility. As a result, this species complex contains some of the most rapidly declining amphibian taxa in Europe. Of course, the rates of population decline for such widespread species, especially in a complex area like Europe, can vary considerably but these have undoubtedly become critical in some regions. The following sections attempt to briefly summarise known threats to the crested newt species complex as a whole. Although some threats such as habitat destruction are obviously detrimental, detailed assessments of current amphibian declines and the significance of other potentially negative factors (Kminiak 1986) are still urgently required for most European countries.

2.6.1. Habitat Destruction. Huge areas of wetland habitat have been destroyed in Europe, mainly for agricultural improvements and urban expansion. In recent decades, the large-scale destruction of wetland habitats has been most severe in Eastern Europe. For example, some 5000 km^2 of the Danube flood plain and Delta region in Romania have been drained in the last 50 years and, in Serbia, 10000 km^2 in Vojvodina and 5550 km^2 in the Morava river basin have also been drained (Kalezic and Dzukic 2001). Crested newts have little chance of surviving such enormous and rapid land use changes and the modern intensive agricultural methods that accompany them.

Obviously, crested newts have faced equally significant land use changes in previous centuries, especially in Western Europe, but were able to adapt better to agricultural expansions that occurred over far longer periods, and to more traditional farming methods. In the United Kingdom, for example, the huge wetlands of the East Anglian Fens were reduced from an estimated 3380 km^2 in 1637 to about 100 km^2 in 1934 (Environment Agency 2005). Nonetheless, *Triturus cristatus* had remained widespread in this region and only the more recent intensification of agriculture here has started to cause serious declines. Nonetheless, numerous crested newt populations throughout Europe still occupy traditional agricultural landscapes. Woods, hedges and rough grassland, intermingled with small fields and water meadows, provide ideal terrestrial habitat and associated aquatic habitats such as stock watering ponds can often be very abundant. However, recent economic pressures have seen widespread changes to many of Europe's ancient, small-scale agricultural

landscapes. The enlargement of fields, especially where small permanent pastures are converted to arable, has resulted in the destruction of much crested newt terrestrial habitat. Huge numbers of crested newt ponds, that are now deemed unnecessary by farmers, have been filled in and the disappearance of slow flowing irrigation canals has also been detrimental. Meanwhile, urban and road developments (Hels and Buchwald 2001) have been steadily encroaching on rural landscapes all over Europe. Areas of rapid urban growth often occur in river valleys and huge swathes of amphibian habitat have been lost as a result. Crested newts seem to adapt less well to urban and suburban environments than many other amphibian species and usually decline as a consequence. Similarly, although the flooding of crested newt habitats for reservoirs or hydroelectric schemes may increase the amount of water available, this is usually far too deep to be used by crested newts and is often stocked with predatory fish.

Conversely, some land use changes have provided limited opportunities for the expansion of crested newt populations. Old mineral workings, once abandoned, can provide a good habitat for crested newts although these are increasingly being utilised as landfill sites or for recreational use, which renders them less valuable. It is difficult to assess the impact of new irrigation systems, such as the extensive networks constructed in southern and southeastern Romania. The drainage canals can create breeding habitat and dispersal routes for crested newts although most are polluted with pesticides and fertilisers, and are therefore heavily eutrophic, and often have predatory fish introduced to them (Arntzen *et al* 1997).

2.6.2. Habitat Fragmentation. As crested newts do not exhibit long distance migratory behaviour (from hibernation sites to breeding ponds), which has been recorded for many other amphibian species, they are particularly vulnerable to habitat fragmentation. Any stretch of unsuitable habitat that is wider than the maximum distance typically moved by crested newts (see Section 2.4.3.) can effectively isolate populations. Lack of genetic interchange, and the eventual loss of genetic diversity that results, plus a lack of immigration to replace natural losses, can lead to the eventual extinction of isolated populations. These problems are increasingly occurring in much of the range of all four crested newts species.

Several modelling studies have predicted the chance of extinction of crested newt populations under various circumstances. Halley *et al* (1996) estimated that isolated populations would persist if they supported more than 40 females and that this number could be smaller if the population was open to a source of immigration. However, more recent research (Griffiths and Williams 2000; 2001) predicted that even larger populations of 100-200 individuals faced a relatively high risk of extinction if they remained isolated for 50 years or more. A further examination of metapopulation dynamics that incorporated subpopulation numbers and sizes (Griffiths 2004), produced a result where a minimum of 16 subpopulations, with at least 100 animals per subpopulation, were needed if the survival of an isolated crested newt metapopulation was to exceed 100 years. However, if such a population was not isolated, and juvenile dispersal and immigration could therefore take place, then eight subpopulations supporting 50 animals each would have the same chances of surviving for 100 years

2.6.3. Pollution. Many commonly used insecticides, fungicides, herbicides and seed dressings have been found to have adverse effects on the tadpoles of most amphibian species and to cause a population declines (Berger 1987). Increasing agricultural pollution is therefore a serious threat to crested newt populations throughout Europe, although the extent of this problem has yet to be accurately quantified. The pollution of water bodes and water tables by run-off from roads and by the waste products and chemicals used in mineral extraction may also have local adverse effects on crested newts. In some areas, acid rain may affect these species. For example, acidic precipitation in southern Norway, which is already known to have affected fish populations, also appears to have caused a decline in *Triturus cristatus* populations (Dolmen 1987).

2.6.4. Introduced Species. Invasive introduced species are an increasingly serious threat to Europe's native flora and fauna. In the UK, for example, the introduced Australian swamp stonecrop, *Crassula helmsii*, is often imported and sold as a garden pond plant but has also spread enormously in the wild. This species completely replaces native aquatic plants and its smaller stiffer leaves are unsuitable for egg laying by *Triturus cristatus* (Watson 1999). It also produces very dense cover, which reduces the amount of sunlight entering the pond, the numbers of aquatic invertebrates and the availability of open areas for male crested newts to display to females.

The pelagic habits of the larvae renders established crested newt populations particularly vulnerable to the introduction of predatory fish to their breeding ponds. Ponds where trout, *Salmo trutta*, or stickleback, *Gasterosteus aculeatus*, have been deliberately introduced by humans usually lose

their crested newt populations. The northernmost known population of *Triturus cristatus* in Europe, Skrattabborrtjäm in Lappland, was eradicated by introduced trout and many other populations in Sweden have also been destroyed by these fish (J. Malmgren *pers. com.*). Inappropriate fishpond management in the Czech Republic, including overstocking, the use of unsuitable fish species, the wrong composition of fish species, water pollution caused by overfeeding of fish and pond fertilisation, and damaging management interventions, are known to have caused declines of crested newts and at least one well documented extinction of a *Triturus carnifex* population (P. Roth *pers. com.*). Ornamental fish are also often introduced into crested newt ponds, often by well meaning people who are unaware of the damage they are causing (Beebee 1997). Many other instances of this are known and it is almost certain that this practice occurs all over Europe. Paedomorphic newts are at particular risk, as they spend their entire lives in water - several such populations (of other newt species) have recently become extinct in Montenegro due to fish introductions (Dzukic *et al* 2005) and it is feared that the paedomorphic *Triturus carnifex macedonicus* here are similarly under threat.

One of the most worrying threats is posed by the predatory fish species the rotan, *Perccottus glenii*, which has been introduced widely in Eastern Europe from the Amur basin (Reshetnikov and Manteifel 1997; Reshetnikov 2001). This species can thrive in waters of almost any condition, including those that freeze and dry up, and its preferred food is amphibian tadpoles (Shatunovsky *et al* 1988). *Perccottus glenii* has caused significant declines of *Triturus cristatus* in Moscow province over the last 30 years (Kuzmin 1999) and is spreading west. It has now reached the Tisza, Latorica and Bodrog river basins, so is expected to reach the Danube in due course (L. Kalous *pers. com.*), and has also been recently recorded in the Po basin (P. Veenvliet *pers. com.*). Humans appear to be assisting the spread of the rotan between river basins by the widespread use of this species as a baitfish, through accidental transfers following commercial fish stocking and by deliberate releases.

2.6.5. Other Threats

2.6.5.i. Lack of Pond Management. The advent of piped water and drinking troughs on most pastures has led to the abandonment of the traditional management of stock watering ponds. This allows natural succession to proceed unchecked and ponds subsequently become shaded and overgrown with scrub and trees, and increasingly eutrophic, before disappearing altogether. Although this process provides a range of temporary habitats for other species, it also makes ponds unsuitable for breeding by crested newts (Kuzmin *et al* 1996).

2.6.5.ii. Flood Management. Human control of the natural processes on flood plains has led to crested newt declines in some areas. For example, flood control along certain sections of the River Danube has increased the intensity and effects of flooding in other, more natural areas. This has led to the occurrence of high levels of disturbance and made habitats far less suitable for *Triturus dobrogicus* (Cogalniceanu and Miaud 2002).

2.6.5.iii. Forestry Management. The replacement of natural deciduous forests with monocultures of introduced conifers has been detrimental to crested newts across Europe, since coniferous forests do not provide adequate foraging or hibernation opportunities, although fortunately this trend is now being reversed in some countries. However, along the northern margins of the range of *Triturus cristatus* the clear cutting of deciduous forests around breeding ponds and their replacement with spruce plantations constitutes one of the main threats to this species, especially in Finland where most populations are currently situated in such wooded areas (A. Päivärinta *pers. com.*).

2.6.5.iv. Illegal Collection. The size and striking appearance of crested newts has made these species vulnerable to exploitation by the pet trade. *Triturus cristatus* is been collected for trade in Russia and can be found in the pet market of Moscow in large numbers each spring (Kuzmin *et al* 1996; Kuzmin 1999). This species is also collected illegally for the pet trade in Romania (Council of Europe 2003). Examples of illegal trade in *Triturus karelinii* were also reported in Azerbaijan in the 1990s. It is not known what effects commercial exploitation has on the long-term conservation status of wild populations.

2.6.5.v. Climate Change. Although the potential future effects of climate change are hard to predict, the increasingly isolated nature of many crested newt populations ensure that this species will have difficulty in responding and adapting to them. Changes in hydrological conditions in northern Europe appear to be increasing the frequency of breeding ponds drying out and prolonged droughts in the south of the range are thought to be having an impact on crested newt species (Kalezic and Dzukic 2001).

2.7. Current Protection

2.7.1. Species Protection. The four crested newt species are all listed in Appendix II of the Council of Europe's 'Convention on the Conservation of European Wildlife and Natural Habitats' (the Bern Convention) as well as in Annexes II and IVa (although *Triturus dobrogicus* is not actually listed on Annex IV) of the European Community's 'Directive on the Conservation of Natural and Semi-natural Habitats and of Wild Fauna and Flora, Directive 92/43/EEC' (the Habitats and Species Directive). European Union member states have drafted their own laws that transpose the EU Habitats and Species Directive into national legislation, thereby affording all crested newt species strict protection. The crested newt species are also protected by national legislation in most of non-EU countries of Europe.

2.7.2. Habitat Protection. EU member states are required to declare Special Areas of Conservation for the protection of Species of Community Interest that are listed on Annex II of the Habitats and Species Directive, with these sites then being incorporated into the Natura 2000 network. These sites are indicated under the relevant countries in Section 2.5.1. However, it is clear that the designation of Natura 2000 sites alone is not sufficient to fully protect such widespread species. In the UK, for example, the 57 Natura 2000 sites identified for *Triturus cristatus* fall well short of including the estimated 18,000 – 22,000 populations in the country. Non-EU states in Eastern Europe are preparing a similar series of protected sites, known as the Emerald Network. All countries also have various national and local designations of protected areas, many of which support important populations of crested newts.

2.8. Recent Conservation Actions

2.8.1. Habitat Management. The amount of management carried out specifically for crested newts varies enormously across the ranges of the four species. No management at all is done for these species in some countries while, in others, extensive conservation work is carried out for crested newts on a regular basis. This work includes the enhancement and creation of aquatic and terrestrial habitats, as well as habitat corridors, and the control of invasive species. Langton, Beckett and Foster (2001) provide useful information about habitat management for crested newts and a review of the methods used to remove predatory fish from ponds has also been produced (Watson 2002). No attempt is made here to review the huge amount of work that takes place in many European countries for crested newts, although it should be noted that the increasing trend towards international cooperative efforts, such as the LIFE-Nature Project (LIFE04NAT/EE/000070) "Protection of *Triturus cristatus* in Eastern Baltic region" (which involves Estonia, Finland and Denmark) is a particularly encouraging sign. A further welcome trend is the increasing funding for large-scale agri-environment schemes, which will deliver conservation management in the wider European countryside (i.e. outside protected sites) and have the potential to produce enormous benefits for all four crested newt species.

2.8.2. Development Mitigation. In some EU countries, increasing numbers of projects are being undertaken that attempt to mitigate for the adverse effects of various types of development (especially housing and road construction) on the conservation status of protected species such as crested newts. To date, this type of work has been most extensive in the United Kingdom. In England in particular, the statutory nature conservation agency, English Nature, has produced guidelines for developers and detailed practical advice on mitigation procedures (English Nature 1996; 2001). The development mitigation process in England has recently been critically examined (Edgar *et al* 2005). In the best examples, entire populations have been translocated prior to the proposed destruction of their habitats and have been successfully re-established in specially created aquatic and terrestrial habitats elsewhere (but usually fairly close to the original site). In exceptional cases, these new habitats have greatly exceeded those destroyed, in both overall extent and quality, and a real conservation gain has been achieved. In many cases, however, varying numbers of newts are simply moved elsewhere and only scant regard is paid to the suitability of habitats, or to the long-term survival of the population. However, even when mitigation information was provided as a requirement of licensing (and reports are often not supplied), the majority of such projects have involved very little or no post-development habitat management or population status monitoring. Moreover, across much of Europe crested newt habitats continue to be destroyed and fragmented and little in the way of compensation or mitigation is even attempted. This situation is gradually improving and would continue to do so if relevant information were to be included in all national action plans for this species – for example, the Norwegian *Triturus cristatus* Action Plan includes advice on planning and development issues affecting this species (D. Dolmen *pers. com.*)

2.8.3. Species Management. Although captive breeding will generally not be a requirement for most crested newt conservation projects, translocations are often used to re-establish populations or as part of development mitigation projects (see Section 2.8.2. above). Successful reintroductions of captive bred juvenile *Triturus karelinii* to wild populations have been carried out near Sochi, Russia (Kuzmin 1999). Mixed translocations of adults and release of captive bred young have also been shown to be successful in the long term in *Triturus cristatus* (Breuckmann and Kupfer 1998). Kinne (2004) showed that successful re-introduction and habitat management of areas where *Triturus cristatus* has become extinct, for example due to agricultural changes, can be carried out with limited financial resources.

2.8.4. Surveys and Monitoring. Increasing numbers of herpetological surveys are being conducted across Europe and, in recent years, many new crested newt populations have been discovered as a result. Countrywide surveys have been undertaken in countries such as Estonia, Latvia, the Netherlands, Hungary and Switzerland. A systematic resurvey of *Triturus cristatus* sites in was undertaken in southern Sweden from 1985-1990 and 296 of these (about a quarter of known sites) were resurveyed in 2005 (J. Malmgren *pers. com.*). National mapping of the occurrence of newts was undertaken in the Czech Republic between 2000 and 2003 (P. Roth *pers. com.*). The Societas Herpetologica Italica produced a provisional herpetological atlas of Italy in 1996 (Societas Herpetologica Italica 1996) and a substantially updated atlas has recently been published (Sindaco *et al* 2006). The Internet has considerably improved the quality, speed and accuracy of such this work. For example, Herpetofauna Austria has developed an online system whereby members can click on the relevant Land and easily add their amphibian records. An atlas has also been produced of the distribution of reptiles and amphibians of Austria (Cabela *et al* 2001). Most of this work has produced useful distribution data but much more still needs to be done in terms of assessing and monitoring the long-term conservation status of crested newt populations. A National Amphibian and Reptile Recording Scheme (NARRS) is currently being developed to address both needs in the UK.

2.8.5. Scientific Research. Properly directed scientific research is essential for improving conservation measures for amphibians (Foster and Beebee 2004) and, fortunately, crested newts have been among the most intensively studied amphibians in Europe. A huge amount of research has been carried out on this species complex in recent years, especially in the fields of taxonomy, population ecology and molecular genetics. Much of the work on populations and general ecology has been focussed on *Triturus cristatus* and there have been several meetings and symposia devoted to this species alone (Gent and Bray 1994; Cummins and Griffiths 2000; Krone 2001). A recent monograph on the natural history of this species has also been written (Thiesmeier and Kupfer 2000). Oldham *et al* (2000) produced a habitat suitability index for *Triturus cristatus* based on a modified habitat evaluation procedure that uses ten key habitat criteria. A recent study on habitat matrix effects and pond occupancy concluded that thin linear corridors, such as hedgerows, may not be wide enough to provide connectivity and that *Triturus cristatus* behaviour dictates that wide strips of uncultivated land are required to join terrestrial habitat with breeding ponds (Joly *et al* 2001). Research to assess the effectiveness of translocations has shown that this can very successful, but also that the receptor pond must be at least 500m away otherwise adult newts will attempt to return to the old pond (Oldham and Humphries 2000).

The identification of individuals in mark and recapture studies has been improved to the extent that belly pattern maps or PIT tags can now be reliably employed. The latter have been shown to have no adverse effects effect on survival, even when newly metamorphosed newts are tagged (Jehle & Hodl 1998; Cummins and Swan 2000; Arntzen *et al* 2004). A simple non-invasive method for taking DNA samples has also been devised (Poschadel and Moller 2004) and the molecular identification of the three species found in the in Czech Republic and Slovakia, *Triturus cristatus, Triturus dobrogicus* and *Triturus carnifex*, has been developed using RAPD markers (Mikulicek and Pialek 2003). In areas at the extremity of the ranges of the four species, where declines do not appear to be due to a loss or fragmentation of suitable habitat, work is needed on population genetics – research for which microsatellite markers will undoubtedly prove invaluable (Jehle and Arntzen 2002).

3. ACTION PLAN OBJECTIVES

3.1. Overall Goal

The overall goal of this action plan is to ensure that the decline of the crested newt superspecies in Europe is reversed and that all populations are subsequently maintained as a viable and integral part of the habitats and landscapes they occupy.

3.2. Objectives

In order to achieve this goal, it is necessary to identify and then remove (or mitigate for) any threats to crested newt populations and their habitats. The following objectives are integral to this process:

Objective 1. To establish a Pan-European Crested Newt Working Group, consisting of experts from as many range countries as possible, to improve international liaison and coordination between all those engaged in surveys, monitoring, habitat management and scientific research. To more effectively achieve Objectives 2-9 (below), this body should be able to provide advice to Governments and other relevant authorities and also oversee the practical implementation of the conservation actions that are recommended in this plan for all four species of crested newt.

Objective 2. To plan, coordinate and carry out field surveys as required to fill all gaps in current knowledge about the distribution and status of the four crested newt species in Europe.

Objective 3. To ensure that any unprotected populations of the four crested newt species in Europe that are agreed by the relevant experts to be of major international significance are formally safeguarded by suitable national and international designations, and are also of a sufficient size to allow for the natural metapopulation dynamics of these species.

Objective 4. To help with the production of management plans (or to assist with the amendment of existing plans if necessary) for protected areas that support significant crested newt populations, taking into account the particular ecological requirements of the four species and thereby ensuring that appropriate management regimes are established.

Objective 5. To encourage the sympathetic management of the wider countryside and landscape in Europe in a manner that prevents further destruction, fragmentation or degradation of both the aquatic and terrestrial habitats of the four crested newt species and also allows populations to cope with land use changes and natural fluctuations or extremes in prevailing climatic conditions.

Objective 6. To help define and quantify 'Favourable Conservation Status' targets for crested newt species, particularly in European Union countries but extending this concept to other European states, in order to plan monitoring programmes and provide an accurate measure of the success of future actions.

Objective 7. To encourage and support scientific research relevant to the conservation of all members of the crested newt species complex.

Objective 8. To promote a positive public attitude towards crested newts in Europe and secure the support of all relevant governments, policy makers, organisations, institutions, landowners and individuals.

Objective 9. To identify all sources of funding and grants for the activities outlined in Objectives 1-8, ensuring that all relevant organisations, institutions and individuals are made aware of such opportunities.

4. ACTIONS REQUIRED

4.1. Habitat Protection

The severe declines of the four crested newt species in many parts of Europe are mainly attributable to human activities, particularly habitat destruction, the development of roads and various changes in land management. As much habitat of international significance for these species as possible should therefore be fully protected, preferably within the Natura 2000 and Emerald Network series. This process is already well advanced in some countries but, in others, more surveys will be required to determine what proportion of crested newt habitat is already protected and what else needs to be done.

A. Urgent Priority Actions

Action 4.1.1. Ensure that all key areas in each range country that are known to support substantial, internationally significant populations of *Triturus cristatus*, *Triturus carnifex*, *Triturus dobrogicus* and *Triturus karelinii* are protected from any threats of further habitat loss by appropriate national designations and, where possible, are incorporated into the Natura 2000 and Emerald Network series.

B. Medium Priority Actions

Action 4.1.2. If any significant new crested newt metapopulations are discovered through future distribution surveys, ensure that these are brought to the attention of the relevant governments and conservation bodies and that they receive appropriate protection at the earliest opportunity.

4.2. Habitat Management

All sites formally protected for the crested newt species should be positively managed. This management should aim to protect and enhance both the aquatic habitats, which are essential for successful reproduction and larval development, and the surrounding terrestrial habitats that provide the feeding, shelter and hibernation sites for the longest period of the life cycle. Obviously it would be impossible, and politically unacceptable, to fully protect every crested newt metapopulation across the entire European range of all four species. However, ensuring that land in the wider countryside is managed more sympathetically for these species (and indeed for all wildlife) will have significant positive benefits for crested newt species. A series of simple measures will, if adopted, ensure that suitable habitats are maintained and enhanced for these species.

A. Urgent Priority Actions

Action 4.2.1. Prepare general, agreed guidelines for the management of the aquatic and terrestrial habitats occupied by the four crested newt species in Europe, taking into account the particular ecological requirements of these species.

Action 4.2.2. Disseminate these guidelines as widely as possible to a range of governments, local authorities, land managers, farmers, foresters, conservation bodies and other relevant organisations and individuals, incorporating advice tailored to local conditions where appropriate.

Action 4.2.3. Control, and prohibit if necessary, the excessive use of pesticides, fungicides and fertilisers in areas close to large populations of the crested newt species.

Action 4.2.4. Remove introduced predatory fish from ponds or ditches that are known to be crested newt breeding sites, or are in areas that are being managed for crested newts, and prohibit any further, uncontrolled introductions of such fish.

Action 4.2.5. In particular, investigate means to prevent the further expansion of the rotan, *Perccottus glenii*, and develop plans for the complete eradication of this species in Europe.

B. Medium Priority Actions

Action 4.2.6. Assist with the production of management plans (or amend existing plans if necessary) for all formally protected areas that support significant crested newt populations, thereby ensuring that appropriate management regimes are established and maintained.

Action 4.2.7. Wherever possible, encourage local initiatives to specifically enhance crested newt aquatic and terrestrial habitats. These could include the creation of additional ponds, terrestrial habitat and hibernation sites.

Action 4.2.8. Prevent inappropriate habitat management, such as the sloughing or drainage of water meadows.

Action 4.2.9. Develop plans to improve connections between crested newt populations, and to physically re-link currently isolated populations, by the creation of corridors of suitable terrestrial habitat. These should ideally contain a series of ponds and other features, such as road crossing tunnels, where necessary.

4.3. Species Protection

Conflicts with a variety of development projects and agricultural improvements are inevitable with such widespread species. The four crested newt species already receive a high degree of legal protection across Europe, although this has often failed to reduce activities such as habitat destruction. In some cases, the protected status of crested newts is not even considered but, where it is, the response is often to simply license and record any derogation from the species protection legislation. This, in effect, is merely creating an official record of population declines. Other projects have involved an animal welfare orientated approach of removing some of the newts from harms way. These animals are then relocated either to existing populations (which has no real conservation gain and may even be damaging) or to smaller, newly created areas of habitat that are not adequately monitored. Very little practical mitigation work specifically aimed at maintaining the conservation status of these species, and adequately compensating for habitat loss, has been attempted in most European countries. However, the amount of this type of work carried out has increased enormously in recent years, a development that may offer some hope for the continued survival of crested newt species within the rapidly changing landscapes of Europe.

A. Urgent Priority Actions

Action 4.3.1. Carry out a review of the effectiveness of current legal protection and its enforcement in each of the range countries of the four crested newt species. Provide recommendations for improving the situation where necessary.

Action 4.3.2. Ensure that derogations from the species protection legislation in all range countries are accompanied by suitable environmental assessments and, where necessary, by adequate mitigation measures to maintain the conservation status of crested newts and to replace lost habitat.

B. Medium Priority Actions

Action 4.3.3. Evaluate the implementation of previous Council of Europe recommendations relating to the four crested newt species (e.g. Council of Europe 1991), and provide a report to the Standing Committee of the Bern Convention detailing successful outcomes and any remaining problems.

4.4. Species Management

The appropriate management of protected areas, habitat re-creation and habitat corridor schemes and adequate mitigation for damaging developments will go a long way towards maintaining many populations of the four crested newt species in Europe. However, opportunities for natural recolonisation no longer exist in many areas, especially where development or road construction has isolated habitats. In such cases, direct intervention through species management projects will be required to re-establish these species or to ensure that existing populations remain genetically viable. Such projects should mainly involve well-planned translocations of newts, larvae or eggs directly from healthy populations but may, in occasional circumstances, require a captive breeding and release programme. The latter method has already been successfully employed for crested newt translocations in Europe (Breuckmann and Kupfer 1998; Kuzmin 1999; Kinne 2004), as well as for the palmate newt *Lissotriton helveticus* (Zavadil and Necas 1997), although it is expensive, time consuming and not without its problems (Storfer 1996; Margan e*t al* 1998).

B. Medium Priority Actions

Action 4.4.1. Assess the requirement for species management initiatives for the four crested newt species, particularly in areas such as the Danube basin where a large number of populations have become isolated.

Action 4.4.2. Where it is considered necessary and feasible, and where previous known threats have been removed, develop new strategies and plans for the potential re-introduction of crested newts into parts of the historical range of these species and for translocations to boost genetically impoverished populations.

Action 4.4.3. Investigate pathogens likely to affect the four crested newt species if or when any translocation programmes are implemented. Ensure that, prior to release, all animals receive adequate health screening for any diseases or parasites that may compromise the survival of both the released newts and any other wildlife species.

4.5. Distribution Surveys

The distribution of crested newt populations in Europe requires further clarification before the success of conservation efforts can be properly planned and implemented, let alone measured. Distribution data for all four species are still incomplete for every range country and, in some cases, published information about crested newts in Natura 2000 and Corine sites contains references to the wrong species altogether. Standardised survey methods and mapping techniques, particularly the use of Geographic Information Systems (GIS), will be useful tools to help fill gaps in the current knowledge of all four species.

A. Urgent Priority Actions

Action 4.5.1. Collate existing records and monitoring results for *Triturus cristatus*, *Triturus carnifex*, *Triturus dobrogicus* and *Triturus karelinii* throughout Europe and further investigate the status of newly discovered or poorly known populations (e.g. *Triturus cristatus* in Bulgaria or *Triturus dobrogicus* in the Republic of Moldova).

B. Medium Priority Actions

Action 4.5.2. Develop, coordinate and support an expanded network of recorders able to carry out surveys for crested newt species, as appropriate, throughout the range countries of this species.

Action 4.5.3. Use this network to extend distribution surveys of *Triturus cristatus*, *Triturus carnifex*, *Triturus dobrogicus* and *Triturus karelinii*, concentrating on those areas where records are poor or non-existent and on the zones of contact between the four species (including areas of possible hybridisation), and to eventually produce accurate distribution maps for all European range countries

4.6. Population and Conservation Status Monitoring

It will be important to regularly monitor crested newt populations to detect changes in status and to assess the effectiveness of conservation actions taken. The techniques employed, and their timing, need to be specific to the four crested newt species to be effective. For example, during general herpetological surveys of the lower Danube area of Romania only one specimen of *Triturus dobrogicus* was actually recorded (Török 2001). It is likely that monitoring will need to be carried out on a sample basis for such widespread species, in which case the methods should be standardised across Europe and be statistically robust. The results then can be used to refine and adjust conservation actions and to prioritise the allocation of available resources. Defining and quantifying "Favourable Conservation Status" for the four crested newt species in the European Union range countries should be central to this process, and a similar approach would be valuable elsewhere. This will enable a clear set of goals, targets and funding requirements for conservation actions to be produced.

As crested newt species are declining at varying rates in different countries, it is imperative to have a clear strategy for monitoring. For example, *Triturus dobrogicus*, with the smallest area of distribution, occurs where many substantial land use changes are taking place - the monitoring of its population trends is therefore extremely important. In addition, *Triturus karelinii* is the least known member of the species complex, and, due to its disjunct distribution, addressing any declines is crucial before these become irreversible. Establishing a central database will facilitate the detection of long-term population declines, over and above the natural fluctuations in numbers that occur in these species, and permit comparisons between countries and regions. This will then allow cost-effective targeting of more comprehensive monitoring and research projects, which are aimed at identifying problems and finding solutions. These may include investigation of physical changes to both aquatic and terrestrial habitat (including fragmentation), the levels of pesticides, fertilisers and other pollutants, disease and parasite loads and the spread of introduced species (Kminiak 1986; Cogalniceanu 1997; Carey *et al* 2001). Such work should also enable any future effects attributable to climate change to be detected.

A. Urgent Priority Actions

Action 4.6.1. Develop a simple, standardised sampling methodology for monitoring and calculating the condition of crested newt populations that can be readily and cheaply employed in any European country.

Action 4.6.2. To most effectively target limited resources, produce a European monitoring strategy for the crested newt species complex that takes into account the reportedly higher levels of habitat destruction in certain regions, and the correspondingly greater population declines of some taxa.

B. Medium Priority Actions

Action 4.6.3. Develop a standardised GIS-based database for the collation and interrogation of monitoring data, as well as for distribution and habitat mapping, to enable the future assessment of any changes in the status of the four crested newt species in Europe. Such a database could be or located in each range country or, ideally, centrally run by the proposed Pan-European Crested Newt Working Group.

Action 4.6.4. Inform national governments, the Standing Committee of the Bern Convention and other relevant parties of all monitoring results, as well as the conclusions and recommendations based on them.

4.7. Scientific Research

Appropriate scientific research can be used to inform and refine conservation management. Significant bodies of work on various aspects of crested newt ecology have already been published but there is still a lot to learn about all four species. As much support as possible should be given to academic institutions planning to conduct any research on the crested newt species complex that is relevant to the objectives of this Action Plan.

B. Medium Priority Actions

Action 4.7.1. Encourage and support scientific research investigating the general ecology, behaviour and habitat use of *Triturus cristatus*, *Triturus carnifex*, *Triturus dobrogicus* and *Triturus karelinii* throughout Europe.

Action 4.7.2. Expand on previous studies into the genetic variation of declining and isolated crested newt populations, especially comparing these with surrounding populations that are not undergoing any decline.

Action 4.7.3. Investigate the potential for research projects looking into the effects of climate change on the crested newt species complex to help inform any resulting changes to habitat management that may be necessary, as well as the planning of dispersal corridors if required.

4.8. Improved Liaison and Coordination

Conservation efforts to halt the decline of populations of this species complex in Europe have been erratic to date and there is still much to be done to ensure the long-term viability of the four crested newt species across their ranges. Although conservation is always more effective when carried out by local workers, international liaison will be essential for the conservation of these species (although local factors obviously still need to be considered when addressing any population declines). There is an outstanding and urgent need to improve international cooperation in order to facilitate the exchange of information and ideas about crested newt conservation and to provide mutual support.

A. Urgent Priority Actions

Action 4.8.1. Ensure that the signatory Governments of the Bern Convention, and the relevant authorities and conservation bodies in the countries within the range of the four crested newt species, implement this Action Plan.

Action 4.8.2. Establish a Pan-European Crested Newt Working Group, consisting of experts from as many range countries as possible, to improve international liaison and coordination between all those engaged in surveys, monitoring, habitat management, scientific research and political lobbying. This body should be able to provide advice to Governments, and other relevant authorities, and oversee implementation of the conservation actions recommended in this plan for all four species of crested newt.

B. Medium Priority Actions

Action 4.8.3. Develop and coordinate common, agreed protocols to standardise further distribution surveys and the effective population and conservation status monitoring of the four crested newt species across Europe.

Action 4.8.4. Where it is considered necessary, and where these do not already exist, encourage the production and implementation of National Crested Newt Recovery Plans (in a standard format). At the very least, Recovery Plans should be produced for those countries in the north and west of the range of *Triturus cristatus*, and all countries within the ranges of *Triturus dobrogicus*, *Triturus karelinii* and the Italian crested newt subspecies, *Triturus carnifex macedonicus*. Ensure that these Recovery Plans are formally adopted by the relevant Governments and are thus binding on all key players.

4.9. Public Awareness

Responses generated by attempts to promote crested newt conservation tend to be very mixed. On the one hand they are attractive, impressive looking amphibians that are extremely popular with many people while, on the other hand, the combination of their widespread distribution and strict legal protection is often a cause of great frustration and annoyance to various economic interests. In the UK, for example, conflicts between the requirements of developers and those of northern crested newts, *Triturus cristatus*, are frequent - and local people often cite the presence of this species in their opposition to planning applications. This has lead to vociferous complaints from certain quarters, such as the house building industry, about the levels of protection afforded to this species (and also, no doubt, to a certain political nervousness). Ironically, many of the necessary mechanisms are already in place to solve these problems, thereby allowing sustainable development and crested newt conservation to proceed hand in hand. In many ways, their striking appearance and the widespread publicity they are able to generate makes any of the crested newts an ideal flagship species for amphibian conservation in Europe.

B. Medium Priority Actions

Action 4.9.1. The public awareness and educational campaigns initiated in some countries should be extended to all range countries. These should produce appropriate educational and other material targeted at local people and stress the conservation significance of the crested newt species and their habitats.

Action 4.9.2. Publicise the damage caused by introducing alien species, such as aquatic plants and predatory fish, into water bodies where crested newts are present.

Action 4.9.3. Develop promotional material and other information that highlights solutions to the potential conflicts between economic interests and crested newt conservation and how these can fit into a sustainable development agenda for Europe.

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