P-04-07

Forsmark site investigation

Amphibians and reptiles

Claes Andrén, Nature Artbevarande och Foto AB

February 2004

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Summary

Amphibian and reptile species likely to occur in the Forsmark SKB special area of investigation are listed with comments on their distribution, status, biology and environmental demands. The species are *Triturus vulgaris* (Smooth newt), *T cristatus* (Great crested newt), *Bufo bufo* (Common toad), *Rana arvalis* (Moor frog), *R temporaria* (Common frog), *R lessonae* (Pool frog), *Lacerta agilis* (Sand lizard), *L vivipara* (Common lizard), *Anguis fragilis* (Slow-worm), *Coronella austriaca* (Smooth snake), *Natrix natrix* (Grass snake) and *Vipera berus* (Adder). A short field study was performed mainly to verify the presence of suitable habitats for the species listed. Findings of amphibians and reptiles as well as their potential habitats are noted by coordinates and additional remarks are given to interesting findings. Altogether 22 findings of six different species of amphibians and reptiles were done in twelve locations. Of special interest is the reintroduction project of the pool frog in the area, which has resulted in at least three reproducing local populations.

Sammanfattning

Grod- och kräldjur som enligt litteraturen kan finnas inom SKB:s särskilda undersökningsområde vid Forsmark har beskrivits med avseende på utbredning, hotstatus, biologi och miljökrav. De aktuella arterna är mindre vattensalamander, större vattensalamander, vanlig padda, åkergroda, vanlig groda, gölgroda, sandödla, skogsödla, kopparödla, hasselsnok, vanlig snok och huggorm. En kortare fältstudie har genomförts med syfte att verifiera förekomsten av lämpliga miljöer för nämnda arter. Fynd av grod- och kräldjur och deras potentiella miljöer har angetts med koordinater. Under studien noterades 22 grodor, paddor, ödlor och ormar av sex arter på tolv olika lokaler. Särskilt bör noteras det återplanteringsprojekt av gölgroda som sedan 1993 pågår i området, och att arten på detta sätt åter har etablerat reproducerande populationer på minst tre ställen.

Contents

1 Introduction with description of mission and methods

The aim of this inventory has been to confirm which amphibian and reptile species that do occur in the special area of investigation in Forsmark. As important has been to identify important habitats especially for species regarded to be rare or threatened, e.g. listed on the national red list or placed in the EU habitat directive. The report should also include some basic information on the species that are likely to occur in the area, even though they were not found during this short field investigation. The methods used were firstly to study the variation in biotopes and vegetation structure and compare this with the habitat requirements known from literature, and combine this with own experience, for each species. A short field investigation was carried out mainly following all smaller roads in the area and checking areas of special interest. It must be kept in mind that the outcome of such a study tour on one hand depends on the time of year and day, but also on unpredicted events such as weather conditions. Dry weather reduces the findings of amphibians and rainy or cold weather makes it less likely to see reptiles out. When an interesting habitat was spotted from car (and maps), a short walk was done looking for possible amphibians and reptiles and making notes from the environment. The results from the field investigations are presented in Chapter 3, whereas photographs of species and habitats can are found in Appendix 1. The inventory was performed according to Activity Plan AP PF 400-03-39 (SKB internal controlling document) and data have been stored in SKB's GIS data base under field note no Forsmark 242.

2 Species likely to occur in the area, habitat and biology

2.1 Smooth newt (Mindre vattensalamander) *Triturus vulgaris*

The distribution includes most of southern and central Sweden up to Ångermanland and further north, up to altitudes of 500–700 m. Adult size is normally 6–10 cm. Adult specimens are recognized from the smooth and moist skin, dark dots on body sides, a dark stripe on side of head and an orange band on belly with dark dots. The male has a typical continuous, wavy and relatively low crest during the reproduction period.

The eggs are deposited one by one on water plants and difficult to detect, the larvae metamorphose and leave the water in midsummer and spend 2 years on land before returning to the water for breeding the first time. Breeding normally takes place in rather small waters (less than 100 m^2), often with much vegetation, but the species seems to be very flexible and can use many kinds of breeding pools. At least half of the water surface should be sun exposed. Increasing amount of fertilizers or pollutants in the water reduces the density of smooth newts in the water. Both adults and larvae are sensitive to predation by birds, fish and many water insects.

During the terrestrial phase most animals are found less than 400 m from the breeding pond. During daytime they hide in burrows or under logs or stones and being active in night at a temperature of more than 7°C (especially after rain) hunting small invertebrate prey such as insects and their larvae. Normally the species is connected to forest habitats, grazed areas and other non-cultivated land, but it has a wide range of habitats including also gardens and farms. It is still a very common species in most of its Swedish range and does not need special conservation measures for its future survival. A most interesting and unique population of neotenic smooth newts in northern Sweden has been lost by introduction of predatory fish. There are several records of the smooth newt along the Swedish east coast including the vicinity of Forsmark (Östhammar). It is likely to occur also in the Forsmark investigation area.

2.2 Great crested newt (Större vattensalamander) *Triturus cristatus*

The more continuous distribution is restricted to the southern part of Sweden up to the lake Vänern in northwest and Uppland in the northeast. Scattered localities are found along the Baltic coast up to the vicinity of Gävle. The species is largely connected to old forest areas in the culture landscape and mostly along the coasts. It is missing on the Baltic island of Gotland. The adult size is about twice that of the smooth newt, which means 10–16 cm including the tail. The skin is more dry and warty, the colour is dark brown or black with small white dots on the body sides. The belly is orange with scattered dark patches distributed in a specific pattern typical for each individual. During the aquatic reproductive phase, the male develops a high crest divided in two separate parts and with a spiny upper edge. The reproductive behaviour is mainly

chemical and tactile and most interesting. Eggs are deposited one by one on water plants and the larva is a predator on small invertebrates of suitable size. The larvae metamorphose and leave the water in July or August. After 2–3 years they reach maturity and return as adults for breeding, often in the same water they were born in. Breeding normally takes place in waters with much vegetation, but the great crested newt is more sensitive to pollution compared to the smooth newt. It also to some extend feeds on its smaller relative.

After leaving the breeding pond, the great crested newt is normally found in old forests, mostly deciduous ones, with much dead wood on the forest floor. Dead wood is important as day shelter and sometimes also as winter dens. The decomposing wood is often wet (especially if the bark remains) and produces some heat during this process. The adults have small feeding territories including suitable hiding logs and the terrestrial habitats are normally found within a distance of 800 m from the breeding ponds. The great crested newt is an annex II species in the EU habitat directive and placed on the Swedish Red list under the category NT (Near Threatened). The Swedish population is estimated to be larger than 100,000 reproductive animals, but even if the population trend is not known it is likely that many local populations are lost due to exploitation, fish introductions and deteriorating water quality of many breeding ponds. The species is known to occur in Väddö and Hållnäs, and it is likely to occur also in the Forsmark investigation area.

2.3 Common toad (Vanlig padda) *Bufo bufo*

The common toad is probably the most common amphibian species in Sweden regarding both population size and area of distribution. It is distributed through almost all of the southern and central parts and at lower altitudes it follows the Baltic Sea to Finland. The northernmost record is in Nikkaluokta near Kebnekaise at almost 68° N. The common toad is a robust species with a large size difference between the sexes, the female being up to 12 cm and the adult male rarely exceeding 7 cm. The skin is relatively dry and covered with glands for secretion of mucus for keeping the skin moist and poisonous for protection from predators. Especially behind the neck (parotid glands) and on the hind legs, glands for production of poison are aggregated. The hind legs are short as in all toads and they are therefore walking or taking short jumps compared to frogs normally moving with big jumps. The common toad is normally brown or sometimes grey, but as in many amphibians the body colour can quickly change to be darker or lighter or with more pattern being seen as an adaptation to external environmental and internal physiological factors.

The species has an explosive reproductive strategy, which means that almost all individuals breed during a short period in early spring. Hundreds of amplexus pairs can be seen together and a lot of fighting between males, which are always outnumbering the females, as they start to breed at an earlier age. The eggs are laid as long strings wrapped around water plants, and often egg strings from many females form large balls of eggs. The larvae are black and often seen moving in the open water mass in large shoals, and this is possible as also the larvae have skin poison and therefore a good protection against many aquatic predators. Normally the common toad breeds in larger

and permanent waters. The species seems to do quite well also in many disturbed and exploited areas and is less sensitive towards eutrophication. The species is known to occur near Forsmark and is likely to be found also in the Forsmark investigation area.

2.4 Moor frog (Åkergroda) *Rana arvalis*

The moor frog is widely distributed in large parts of Sweden including Öland and Gotland. It is found up to about 400 m above sea level and is therefore lacking in the westernmost and northern parts of the country. Adults are 4–7 cm, rather similar to the other "common" brown frog *Rana temporaria*, but the moor frog is recognized by a more pointing snout and a typical large tubercal beside the smallest toe on the hind leg. During the reproductive period, the male can be grey or completely blue. True frogs (*Rana*) including this species deposit their eggs in round clumps. As many females lay their eggs at the same place, large clusters are formed, and this is an adaptation to be able to reproduce in a cold climate. The moor frog is found along the coast including smaller islands, and the breeding ponds can be very small and shallow. All brown frog larvae are vulnerable to predation by birds, fish and many aquatic invertebrates.

The moor frog followed the melting ice towards north after the last ice period and the species has a long history in Sweden, probably more than 10,000 years. There are many local adaptations or unique evolutionary lines. This can be seen in morphological characters as length of hind legs, size of tubercle on hind foot, a number of colour pattern morphs and differences in the mating calls. The species was described by Sven Nilsson 1842 from animals on a locality not far from Oskarshamn (Tveta socken) and these all belong to the striped morph, which is rare in other parts of the country. Normally the moor frog in Sweden is unicoloured yellowish brown with a white belly. The species has a general negative population trend in Europe and is placed on many national Red lists in northern Europe. In Sweden the species is still common and in general it is doing well. However, it is dependant on wet grazed areas surrounding the breeding ponds, and changes in the natural water regime therefore can be a problem. The species has been recorded in the vicinity of the investigated Forsmark area, and is likely to occur there.

2.5 Common frog (Vanlig groda) *Rana temporaria*

The common frog has a wide distribution throughout most of Europe. The northern border extends in Scandinavia to the coast of the Atlantic and Artic Ocean and continues in Russia to the southern border of the tundra. In Sweden the species has a peculiar distribution. It is common in Scania, but absent from the Baltic islands Öland and Gotland. It is regarded to be lacking in Blekinge east of Karlshamn and in Kalmar län as well as in great *Sphagnum* bogs in Småland and parts of Halland. However, new localities are continuously found filling these gaps slowly. It is a most interesting distribution, which may reflect an ongoing colonization which has been stopped by a strong competition with the moor frog. These brown frogs are probably strong competitors and in areas where the common frog is lacking (e.g. on Gotland) the moor frog is morphologically sharing the characters of both species.

The common frog is slightly larger than the moor frog and often reaches 7–9 cm and sometimes even more than 10 cm. It has a very variable colour pattern and a number of morphs can be seen in the same population. It can be distinguished from the moor frog by the small and soft tubercle on the hind foot, the blunt snout, the dark spots covering the belly and a larger adult size. The call is also a very good species character being very different from the moor frog. In many localities the two brown frog species are reproducing side by side, the common frog starting a week earlier. They share the vulnerability to predation during the early development in the water up to metamorphosis. A well developed submerged vegetation around the shore line therefore is important offering larval protection. The common frog often moves away from the breeding pond and is found in a wide variety of terrestrial habitats, mainly in the cultivated farm land. It is less well adapted to low pH habitats as Sphagnum bogs and pine tree forests. Acidification therefore is a more severe problem for the common frog compared to the moor frog. Several findings of the common frog have been done north and south of Forsmark, and the species is likely to occur in the Forsmark investigation area.

2.6 Pool frog (Gölgroda) *Rana lessonae*

This short legged green frog is distributed over large parts of central Europe. In Sweden a very isolated and unique occurrence is found in Uppland. The most well known locality is the Hållnäs peninsula, but several recordings are from Gräsö, Rångsen, Käringsjön and Ängskär. Some of the localities are probably deserted, but a reintroductory program has been done to re-establish the species in the Forsmark investigation area (see later in this report). The pool frog is an aquatic species differing from the brown frogs in major aspects of its behaviour. It rarely leaves the water, but can be seen basking along the open and exposed water edge in very shallow water. Hibernation normally takes place on land in old forest. It is important to protect a forest border of about 50 m around known breeding localities for the species. It differs from most other populations in Europe by being more brown in body colouration. It has a typical green or yellow vertebral line and normally reaches a length of 7 cm. Reproduction is very late and takes place in late May or early June. The preferred waters are very shallow and thereby have a high temperature, which speeds up larval development.

The pool frog habitat is unique, as it is created by still rising land after the inland ice. Along the coast shallow depressions slowly become pools on land, and during a period of succession these are used by the pool frogs. Being older, they slowly become too shadowed by forest and overgrown. The green frogs in Europe are a genetically complex group of “true” species and hybrids, of which the crossing of the small pool frog and the large eastern marsh frog may result in a new species, the edible frog. The latter hybrid species also occurs in the south of Sweden and is the dominating green frog in Europe. It was not until a few decades ago that it was clear that the green frogs in Uppland belonged to a separate species, differing from south Swedish populations. The pool frog in Uppland has been recorded in about 60 ponds and forms a metapopulation. The species is classified as VU (Vulnerable) on the national red list. As the species has an old occurrence in the Forsmark area and recent reintroductions have been carried out, special attention must be given to the pool frog.

2.7 Sand lizard (Sandödla) *Lacerta agilis*

The sand lizard is distributed over major parts of central Europe and the western parts of central Asia. The Swedish range is restricted to a more or less continuous distribution in the southern and south-eastern parts of the country. Additionally, many small isolated patches of distribution are found further north up to Dalarna, which is though to reflect a former more wide continuous range in Sweden. The sand lizard lays eggs and is therefore dependent on a suitable microclimate offering good possibilities for embryonic development. The scattered northern relict populations probably reflect this climatological limitation. These distribution patches normally include e.g. deserted sand or gravel pits with a favourable microclimate, and the locality is shared by a number of high temperature demanding insects and plants. The sand lizard is heavy built, reaching a length in Sweden of about 22 cm including the tail (unbroken).
A typical colour pattern includes a brown band along the back or sometimes a row of blotches, but with a narrow vertebral continuous or interrupted white line. Along the body sides a number "eye blotches" are distributed, that is dark brown blotches with a white central spot. There are also several additional unique scale characters. During reproduction in May or June the male develops a beautiful green colour along the body sides.

Sand lizards are living in small colonies and their habitats normally include exposed areas of sand where they dig holes for hiding and egg development. Some of the Swedish localities differ from this pattern and the sand can be replaced by gravel or rocks, probably offering a similar climatic condition. In many places bare rocks with patches of heather are typical localities for the species. Quarries or roadsides with slopes exposed towards south and with stones or blocks also offer good places. The sand lizard needs open exposed ground, and changes in the landscape with increased vegetation cover, e.g. depending on less grazing by cattle, have been negative to the population development. There are some few localities in Sweden still doing well, but most local populations are small and slowly vanishing. The sand lizard has been recorded in the vicinity of Viggbyholm, Uppsala, and Älvkarleö and may occur in the investigated Forsmark area. The species is placed on our national Red list under the category VU (Vulnerable).

2.8 Common lizard (Skogsödla) *Lacerta vivipara*

The common lizard has a very broad distribution throughout most of Europe and far eastwards in Asia. This lizard has been regarded common almost everywhere in Sweden, but I think the density of lizards now is much less, even if it still has a very large distribution. It also occupies the two Baltic islands Öland and Gotland and it has been recorded towards north through Norrland up to the latitude 68° 30′ (Karesuando). It is found in many different habitats, but the highest densities may be in open and exposed *Sphagnum* bogs and exposed hillsides with stones and sparse grass vegetation. It is a more slender and flat bodied lizard compared to the sand lizard. The total length is up to 18 cm, with tail and body approximately of the same length. The body is grey, green or brown and along the body several white lines or rows of white dots occur. "Eye-blotches" are lacking or only weekly developed. It is not so easy to distinguish the two sexes. The male normally has a more swollen and pointing cloacae, a yellow belly with many dark spots and often more strong red or bluish colours on the throat, while

the female has different colours on the body and only few darker dots or is lacking these completely.

It is a day active alert lizard, hunting insects, spiders and other invertebrates. It can be seen in dry as well as wet habitats, but it should be an exposed ground for good thermoregulation. Often it is found on vegetation edges between colder places and warmer. When disturbed, it quickly finds shelter and can at the same time lower the body temperature and reduce energy consumption. Sometimes it jumps into water and stays submerged for a long time when scared away. Being a viviparous lizard it can exploit more cold areas compared to the sand lizard, and the female can select optimal microclimate and speed up embryonic development in a way not possible for the sand lizard, where the eggs have a fixed place. The common lizard has been recorded in the vicinity of the investigated area.

2.9 Slow-worm (Kopparödla) *Anguis fragilis*

The slow-worm is a legless lizard looking almost like a snake, but the movable eye lid and the long tail are typical morphological characters for lizards. The skin is armed by bone plates giving the species a hard and rigid outer "shell", but the slow-worm moves surprisingly fast in spite of its stiff body. The tail easily breaks but can be replaced through a regeneration process (autotomy). This species also has a wide distribution in Europe from the British isles, France and Spain in the west to Russia, Asia Minor and northern Iran towards east. In Sweden it occurs in southern and central parts following the Baltic coast towards north up to southern Lappland. The slow-worm also gives birth to live young, which may explain the distribution towards north. Most important habitat seems to be open forest areas with exposed ground patches. The old culture landscape is normally an optimal habitat. It feeds on snails and worms and therefore is favoured by a relatively moist ground where these prey items occur frequently.

The slow-worm is not usually seen basking out in the open, but instead thermo regulates by staying under flat warm stones, taking advantage of conducting heat. In this way predation pressure is also reduced as the time of exposure towards visually guided predators is more limited. They are normally exposed in the open a short period in the morning and in the afternoon. A good way of searching for slow-worms is to turn logs and flat stones on the ground but along stone walls and ditches. Best time to do this in late afternoon. The slow-worm including tail can reach a length of almost half a metres. The new born specimens are gold or silver in ground colour, with a longitudinal dark band along the body side and a dark vertebral line. The adult female is brown in ground colour and keeps the dark body side while the male turns unicoloured copper brown. In some populations males have blue spots scattered over the body, and this form becomes more common in the eastern parts of the range. The slowworm has been recorded in the Östhammar area, and may occur also in the investigated area.

2.10 Smooth snake (Hasselsnok) *Coronella austriaca*

The smooth snake is confined mainly to biotopes including sand or bare rocks partly covered by bushes and shrub leaving a mosaic of open patches where the sun reaches the ground. In Sweden this kind of areas dominate along the west coast and north through Bohuslän and includes also the Norwegian SE coastal landscapes. On the

east coast similar biotopes are found from Blekinge along the coast towards north up to Uppland and around the lakes Mälaren, Vänern and Vättern. It has a wide occurrence in major parts of Europe. The species is rarely seen, and the main reason for this is its secret behaviour, spending most time under warm stones or coiled up around the stem of small bushes and almost invisible from above. The shadow from leaves and small branches completely conceals the snake. Being a top predator, feeding mainly on slow-worms, and occasionally on snakes or rodents, it has naturally a low density. When taking a prey it quickly bites the victim in the head and puts a number of coils around its body and acts as a *Boa constrictor*. It is a non poisonous snake but is often aggressive, attacking an enemy with vigorous bites.

Adult size including tail is normally 60–70 cm, but can rarely be up to 90 cm. The skin is smooth (lacking keels) and gives a bright impression. The colour pattern is similar in the two sexes with brown or grey ground colour with a dark brown or black pattern of two rows of blotches along the back and a stripe on side of the head through the eye. The male is recognized (as in most snakes) by having a longer tail being more wide at the base. The smooth snake is giving birth to live young, and the litter size is normally around 10 juveniles. The winter dens can be a sloop with stones or rocks, partly overgrown by bushes. At the time of emerge in spring there are no leaves and the sun can reach the ground. This is an important factor as basking this time of the year is necessary for achieving optimal temperature allowing reproductive activity. The preferred daily temperature is about 30°C, which is also necessary for digestion, but the snake can move at much lower temperatures. The smooth snake has been recorded near Österbybruk and may occur in the investigated Forsmark area.

2.11 Grass snake (Vanlig snok) *Natrix natrix*

The grass snake has a wide distribution including most of Europe and lacking only on high altitudes and in northern parts of Scandinavia. Being an egg laying snake it is dependent on habitats including warm places where the eggs can develop up to hatching during summer. This can be heaps of leaf litter or other natural deteriorating material, but in most places the grass snake puts its eggs in dung or compost. This makes it strongly connected to the culture landscape (also including gardens). The northern distribution in Sweden along the Baltic coast far north in Norrland can probably be explained by this culture dependence. As the farming practise has changed and free laying dung heaps no longer are allowed, the northern range of the species has been lost or strongly diminished. The grass snake is also connected to wetland areas as the main food is amphibians and fish.

The most typical species characters are the two yellow or white eye blotches in the neck, clearly brought out by the surrounding black colouration. The body is usually grey, black or sometimes greenish or brownish. The neck pattern can serve different functions. It may mimic big eyes on a larger animal and look frightening when the snake lifts the head, hisses and strikes like a cobra. The grass snake has poisonous saliva but no special fangs to transfer poison. I have never heard of a grass snake biting a human even though it can be aggressive. The neck pattern may also be an effective passive defence by acting as camouflage in some habitats. On the mainland, completely black, melanistic specimens do occur but are very rare. On the Baltic island of Gotland on the other hand, a special subspecies of grass snakes occurs, where almost half of the

population is melanistic. “Normal coloured” specimens often have a yellow or orange band in the neck and large dark spots or stripes along the body sides. The mainland grass snake has had a continuous population decrease and is classified as NT (Near Threatened) on the national Swedish red list. The grass snake is known from reports in the literature to occur on Gräsö near Forsmark and is therefore likely to be found in the investigated area.

2.12 Adder (Huggorm) *Vipera berus*

The adder is the only venomous snake in Sweden. It has special fangs for transferring venom in to the body of a prey or an enemy. The venom is comparatively powerful and a human being bitten may have a strong reaction and need medical care. However, a new excellent anti-venom is available in most hospitals and almost no fatal cases of adder bites of humans are known. The adder is still a common snake in Sweden with a large range covering most of the country except small alpine areas. It is regarded to be the species with the widest range of all terrestrial snakes. As for most snakes at our latitudes, suitable habitats must include a mosaic of open patches where the sun reaches the ground. The culture landscape with a combination of grazed and cultivated areas, ditches, stone walls, bushes and bare rocks offers these optimal conditions. Farming also normally increases the density of rodents, which is the main food for the adder. After a farm has closed down, there is a period during early succession when meadows produce high numbers of rodents, which also may result in extreme densities of adders (up to 4 per hectare). When bushes and trees start to cover the ground, the adder population again decreases as a result of lower prey density.

The adder is one of very few snakes with pronounced colour pattern differences between the sexes. Males are grey or even white with a black zigzag pattern, while females are brown, reddish or yellowish, with a dark brown pattern. When laying still on the ground, the zigzag pattern makes it difficult for a predator to detect the snake. Melanism (being completely or partly black) is common in many adder populations. The black colour effects heat uptake from sun radiation, which in turn effects the time period when digestion of food is possible. The black colour can on the contrary be a disadvantage as visually hunting predators as birds of prey may easier detect a black snake. The adder gives birth to live young and the litter size is about ten juveniles. All newborn adders are reddish brown and adult colour morph as well as melanism develops when they grow older and is fully developed after two to three years. Adult size including tail is normally up to 70 cm in males and 80 cm in females. The adder is recorded from the vicinity of Forsmark and is likely to occur in the investigated area.

3 Field studies

A field study was carried out in the Forsmark area during the 2nd to the 6th of June, 2003 with the aim to identify interesting herpetological sites and habitats.

Below a list of amphibians and reptiles and potential habitats are given. Coordinates are given as RT90 2.5 gon Väst/West. The locations are presented in the map in Figure 3-1.

01. Guest house Y 6700174, X 1630844
Parking area near power station
Adder, 1 ad, live near road

02. Jungfruholm Y 6698981, X 1633463
Open forest along coast with bare rocks and grass
Moor frog, 1 ad, live in grass

03. North of Karsudden Y 6698693, X 1634268
Open forest along coast with rocks and grass
Grass snake, 1 ad, live in grass
Adder, 1 ad, live in grass
Common lizard, 1 ad, live in grass
Slow-worm, 1 ad, live in grass
Moor frog, 1 ad, live in grass

04. Granskäret Y 6698083, X 1635498
Potential good habitat for slow-worm, smooth snake, adder, and grass snake

05. Storskäret Y 6697221, X 1634361
Open grazed meadows with small water bodies in old culture landscape
Potential good habitat for brown frogs (common frog and moor frog)

06. Johannisfors Y 6695026, X 1632603
Old and small industrial community including old stone bridge
Potential good habitat for amphibians and reptiles

07. Storäng Y 6696126, X 1633617
Adder, 1 ad, live on road

08. Near drill point 1 Y 6699630, X 1631172
Old closed pine forest with overgrown wetland, and a small pool
Potential locality for grass snake, brown frogs, salamanders and pool frog

09. Drill point 1 (Hunting tower no 14) Y 6699316, X 1631330
Old clearing with shrub, low trees, stones and patches with open ground
Potential locality for adder and common lizard, but the habitat will be too covered by dens forest within a few years and no longer interesting for these species

10. Open area with stones Y 6699085, X 1631473
Old clearing with patches of open exposed ground including large blocks suitable for hibernation
Potential locality for adder, grass snake and common lizard

11. Crossing Y 6698626, X 1631681
Old pine forest with small waters
Potential locality for salamanders (hunting areas)

12. Hunting tower no 17 Y 6698196, X 1631652
Small clearing with a mosaic of open patches
Potential good habitats for reptiles

13. Clearing from forest fire Y 6698028, X 1631726
Potential good reptile habitat for another 10–15 years

14. Crossing near Stocksjön Y 6697694, X 1632063
End of fire clearing with Stocksjön and wetland covered with reed on other side
Potential good habitat for reptiles along the edge of open and closed landscape

15. Clearing from forest fire Y 6697467, X 1632005
Not far from Eckarfjärden, potential good reptile habitat
Common toad, 2 ad, killed on road
Adder, 1 ad, killed on road

16. Small meadow with scattered bushes in forest Y 6696982, X 1631582
Slow-worm, 1 ad, killed on road
Common toad, 1 ad, killed on road

17. Meadow with scattered trees and stone heaps Y 6696846, X 1631443
Common toad, 1 ad, killed on road
Adder, 1 semi adult, killed on road

18. Old pine forest with small clearings Y 6698021, X 1632555
Partly good reptile habitat in less overgrown parts

19. Old forest with wet ground Y 6698143, X 1633005
Potential good habitat for salamanders, toad and moor frog

20. Drilling point 2 Y 6698695, X 1633204
Old pine forest biotope, not important for herpetofauna
Potential locality for common toad

21. Nature reserve Kallriga Y 6699223, X 1633362
Interesting small lake for amphibians and potential good habitat for reptiles along the coast

22. Open clearing Y 6699607, X 1633052
Potential good reptile habitat with open exposed patches another 5–10 years, after which it will be overgrown by trees

23. Near crossing in forest Y 6698155, X 1633178
Old mixed forest with ditches and small water bodies
Potential good habitat mainly for salamanders

24. Grazed area in forest with wetland Y 6698042, X 1633458
Wetland covered with dens reed in forest. After wooden gate old farm buildings with stone fundament in open grazed meadow biotope, potential very good biotope for amphibians and reptiles
Common lizard, 1 ad, live in grass
Grass snake, one semi adult basking on stones near remains of house
Common toad, 1 ad, live in grass
Moor frog, 1 semi adult, live in grass

25. Meadow overgrown by trees Y 6698216, X 1633940
Former interesting area, but now destroyed as a herpetofauna biotope by over growing trees

26. Flat rocks, boulders in forest plantation Y 6698335, X 1634035
On top of hill with exposed stony areas in young forest near lake
Potential habitat for common lizard and adder

27. Old forest near coast Y 6698652, X 1634210
A very interesting biotope with mixture of old forest, and exposed forest edges along the coast and road. Also more open coastal habitat with exposed flat rocks and low vegetation. Also near small lake
Potential habitat for many amphibians and reptiles

28. Small meadow in forest Y 6697903, X 1633858
Potential habitat for brown frogs, slow worm, common lizard, grass snake and adder

29. Old forest (former cultivated area) Y 6697912, X 1634304
Potential habitat for slow-worm, salamanders and common toad. Former possible smooth snake habitat near edge towards open meadows

30. Clearing overgrown by birch Y 6698385, X 1634431
Large clearing, now too dens with few exposed patches of ground
Low values as herpetofauna biotope

31. Old deciduous forest Y 6698208, X 1634721
Coastal old forest with high value, combination of forest with much decomposing material, large boulder and hassle with stone heaps and edges towards the coast and open exposed habitats along the coastline
Potential habitat for many species such as salamanders, brown frogs, common toad, common lizard, grass snake, adder and smooth snake

32. Grazed pasture with trees Y 6697225, X 1634385
Interesting biotope with grazed open meadows and scattered oaks and bushes
Potential habitat for many amphibians and reptiles

33. Old mixed forest near coastal Fiskarfjärden Y 6696834, X 1634214
Potential habitat for amphibians and slow-worm in old mixed forest
Potential habitat for amphibians and grass snake along coastal biotope
Common toad, 1 juv, live in forest

34. Open pasture Y 6696315, X 1633802
Old culture landscape on both sides of road with open meadows (should be more grazed), stone heaps, old house foundations, scattered trees and many exposed edge zones
Potential habitat for many amphibians and reptiles

35. Forest with clearings Y 6695705, X 1633133
Forest including several small clearings, exposed flat stones, boulders and a small meadow
Potential habitat for common lizard and adder

36. Johannisfors Y 6695072, X 1632695
Old industrial community with a mixture of old trees, open pasture land with many exposed edge zones, stone heaps, stone bridge and a stream
Potential habitat for many amphibians and reptiles
Common lizard, 1 ad, live in grass
Slow-worm, 1 ad, live near road

37. Between Johannisfors and Forsmark Y 6696562, X 1630560
Forest with several interesting meadows with exposed edge zones
Potential habitats for several amphibians and reptiles

38. Open forest Y 6698677, X 1631350
Towards new drilling point open area in forest
Slow-worm, 1 ad, live on road

39. New drilling point in forest Y 6698942, X 1630998
Pine forest, mostly dens but with small open exposed patches, small plantation on old clearing, big stones
Minor interest as a herpetofauna habitat

40. Mixed forest with stones Y 6699236, X 1630771
Large stones and open patches in mixed forest combined with wetland
Potential habitat for amphibians and reptiles

41. Clearing Y 6698978, X 1630599
Clearing with many water filled depressions from heavy vehicles
Potential habitat for common lizard and adder

42. Old forest with nearby clearing Y 6698570, X 1630236
Exposed edge zones and suitable combination of open and closed vegetation
Potential good habitat for reptiles another 10 years

43. Hermansbo (near main road) Y 6696642, X 1630414
Old culture landscape with open grazed pastures, stone walls and scattered trees
Potential very good habitat for many reptiles and amphibians

44. Road crossing in old pasture Y 6696383, X 1631053
Former good biotope, but now largely overgrown by bushes and trees
Slow-worm, 1 ad, live on road

45. Old pasture Y 6695998, X 1631713
Combination of old meadows with stone heaps, scattered deciduous trees and a nearby forest clearing
Potential good reptile habitat

46. Grynören Y 6695422, X 1634315
Farm with combination of cultivated fields, grazed meadows, stone walls, nearby wetland and old pine forest with small clearings
Potential good reptile and amphibian habitat

47. Pasture Y 6697559, X 1635421
Grazed meadows with stone heaps and scattered old deciduous trees. Nearby deciduous forest with hazel and small clearings
Potential good habitat for reptiles and amphibians

48. Kallriga Y 6698079, X 1635489
Entrance to nature reserve with old forest including decomposing logs, big stones, wetlands and nearby more open coastal biotopes
Potential good area for many species of reptiles and amphibians

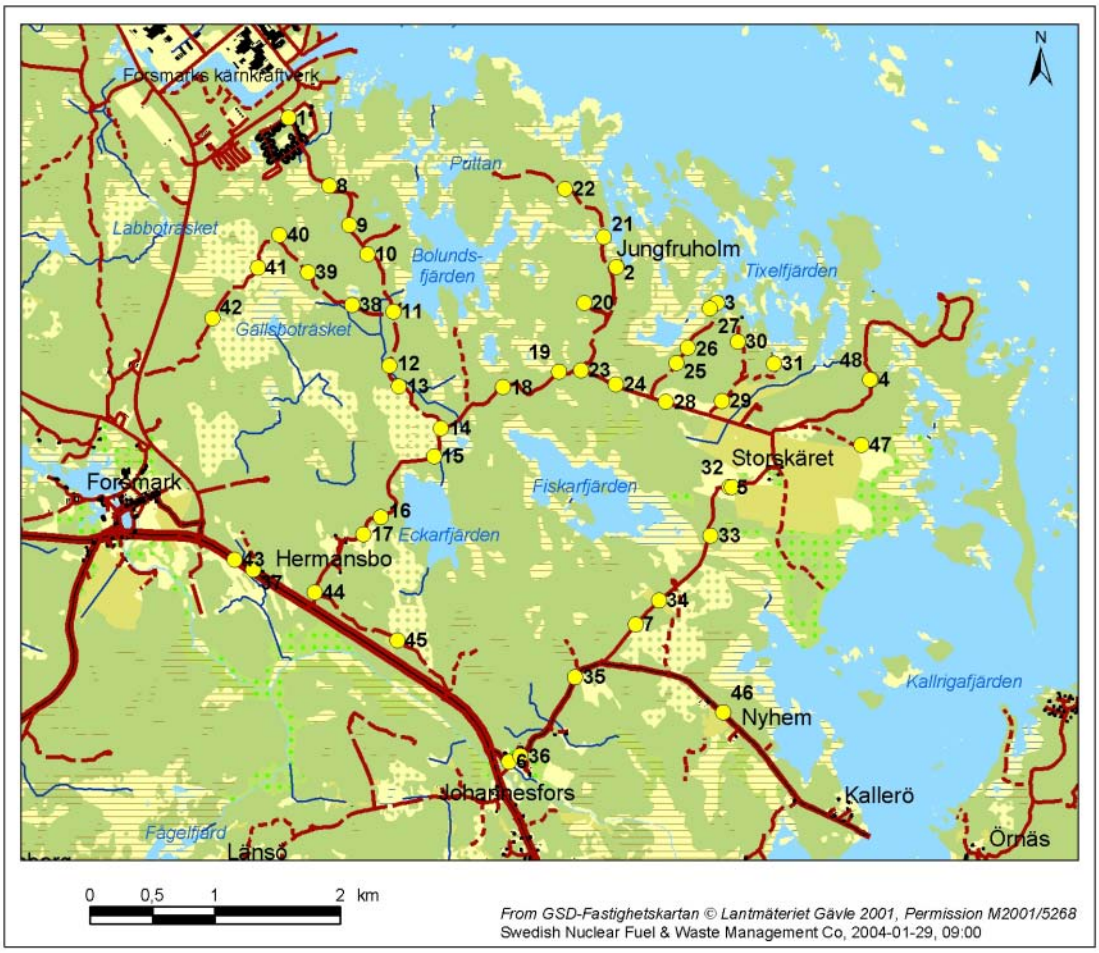

Figure 3-1. *Geographical distribution of described reptile and amphibian localities in the site investigation area at Forsmark. Map: Helena Nyman.*

4 Reintroduction of the pool frog in the Kungsträsket area

During 1993 Per Sjögren Gulve at Uppsala University and Naturvårdsverket carried out a reintroduction project of pool frogs in the investigated area. In each of four pools 5 adult males and 5 adult females were reintroduced. All reintroductions were done in the vicinity of Kungsträsket. During 2001 an inventory was carried out to confirm if the reintroduction had been successful. Below the outcome of this inventory is presented (the coordinates are given with an accuracy of ± 10 m). The locations are presented in the map at Figure 4-1.

Locality A. Kungsträsket Y 6698790, X 1631370
Calling males and confirmed reproduction in 2001

Locality B. Y 6699390, X 1631600
Calling males and confirmed reproduction in 2001

Locality C. Y 6699500, X 1631540
Calling males in 2001

Locality D. Y 6699370, X 1631260
Calling males and confirmed reproduction in 2001

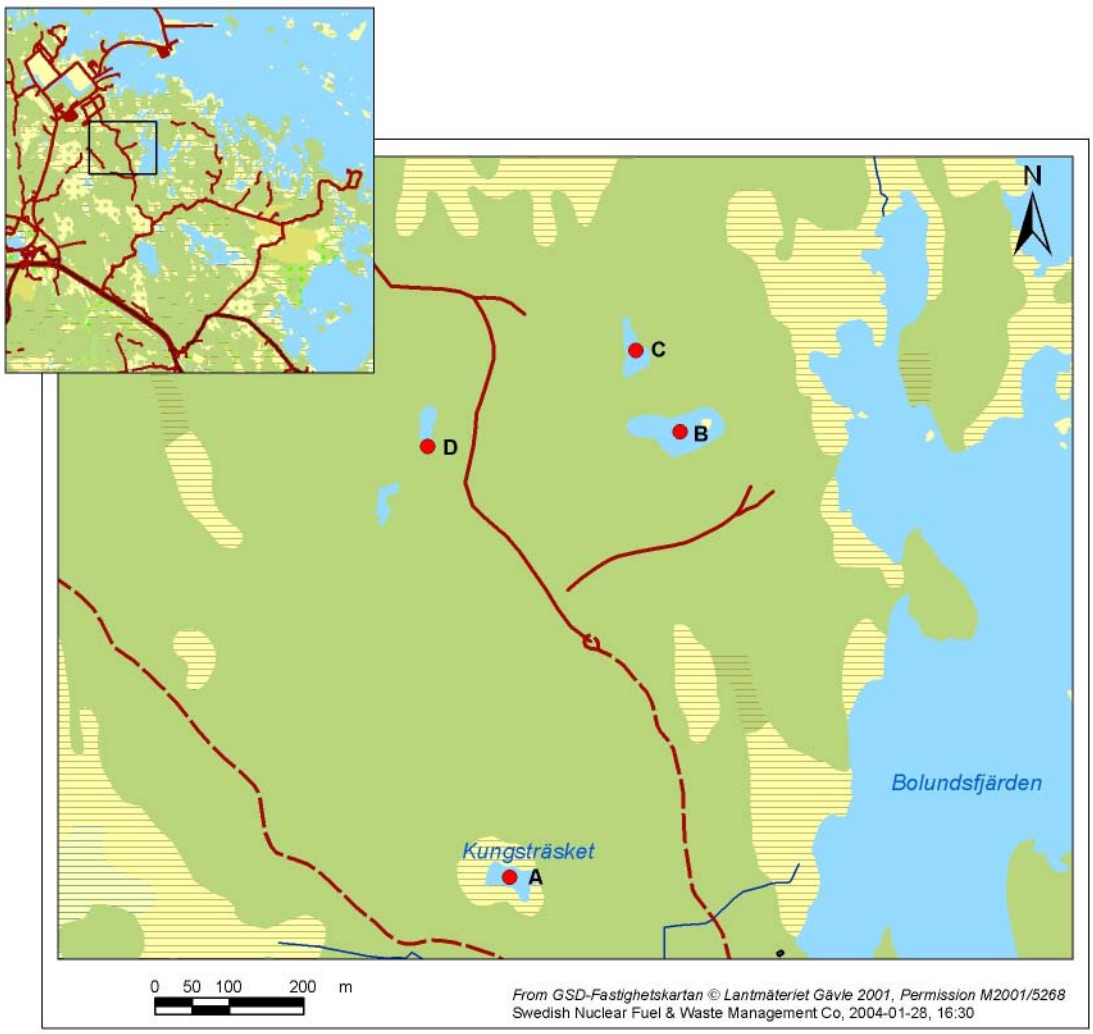

Figure 4-1. *Locations for the confirmation of the reintroduction of pool frogs. Map: Helena Nyman.*

5 Special consideration of rare or threatened species with suggestions on the management of their habitats

Normally habitat management implies specific knowledge of the species concerned. However, for amphibians and reptiles some general aspects of their biology make it possible to describe composition and structure of suitable vegetation as well as management.

Amphibians have a thin and moist skin and use it for supplementary oxygen uptake. It means that they are more or less dependent upon a moist or wet surrounding. All amphibians in Sweden lay their eggs in water, where also larval development up to metamorphosis takes place. In most cases amphibians spend a relatively short period in spring in water for breeding, and during the rest of the active season they are terrestrial, but avoid dry places. Because of this most species are night active, and they produce a special skin secret to keep the skin moist and reduce the risk of drying. If active in daytime, they prefer soils covered with vegetation, which keeps the ground humid. If the weather is dry, amphibians hide in burrows or dig down into the soil. Among the species concerned in this study the pool frog differs from the "normal" behaviour by being almost completely aquatic during the entire active period. It is often seen basking, but sitting in shallow water.

Reptiles were the first animals to concur the terrestrial environment. They are in fact extremely well adapted to survive in dry and hot areas, and it is the dominating animal group in most steppe and desert communities. As they cannot produce necessary body heat for normal activity they are dependent upon either radiant heat or heat from the ground to reach optimal temperature. Therefore open exposed patches in their environment are necessary for regulating the body temperature by exposing different parts of the body to the sun. Often a mosaic of closed and open microhabitats is very good, preferably also including edge zones with open areas for basking on one side and dense vegetation for hiding on the other side. The old culture landscape usually includes this variation in biotope structure and is a preferred environment.

The great crested newt is favoured by breeding ponds with clean water (no pollutants or acidification), much vegetation (for egg depositing on submerged leaves) and at least exposed to the sun from the south (to keep water temperature high). The terrestrial habitat (within 500 m from the breeding water) should be old forest, preferably deciduous, but pine will do also, with much decomposing wood. This decomposing material on the ground is often wet and is used as day shelter. In the night they are out hunting various invertebrates. In the old forest they also find their hibernation places. It is important that fallen logs and other old wood remain on the ground.

The pool frog prefers shallow ponds with stony bottom, which keep the water temperature high. The pond must be largely exposed and open but also have scattered vegetation like reed on which the female wraps the egg strings 10–15 cm under the water surface. As the adults stay in the pond all summer, at least part of the shores must be open for sun exposure. During winter the pool frog uses a hibernation dens in the forest. The animals may spread in all directions, and therefore a forest zone of about 50 m should be left surrounding the pond. A special reintroduction program, under the supervision of Per Sjögren Gulve at Naturvårdsverket, is running in the investigated area. He should be consulted before major changes in the surrounding of the breeding ponds are carried out.

The sand lizard lives in small colonies and the habitat normally includes climatically favourable slopes towards south. These can be of sand, gravel, stone or flat rocks partly covered with scrub. The habitat must be open and exposed to the sun and the slope itself increases the ground temperature. As the sand lizard lays eggs, suitable egg depositing places must also be available, which can be sand or sometimes decomposing material.

The smooth snake has a very secret behaviour and is therefore a difficult species to investigate. Even in an area where the species is known to occur, it may be very difficult to verify this. The population density is normally low as it is a top predator. Often the smooth snake basks on flat stones,, coiled up around the stem of small bushes or shrub and being almost invisible from above. It may also use the heat from warm stones instead of basking in the open as most reptiles do. However, in early spring and early autumn the smooth snakes can be found in the hibernation area and as the temperature this time of the year is lower, the snake usually needs to bask in the open. This can also be true after rain or in early mornings in the summer. Several suitable habitats with possible over-wintering dens were located in the investigated area, and these places should be checked at the best time of year and at right time of day to confirm if the species do occur in the area. The areas of special interest are slopes with stones towards south with scattered bushes of hazel and nearby open deciduous forest with many open patches. A high density of slow-worms (the main prey of smooth snakes) in the area also supports the possible occurrence of the snake. Important management includes keeping the hibernation slope partly open and an open forest with bare ground patches nearby.

The grass snake is feeding on amphibians and fish and therefore largely dependent on habitats where these prey items occur, e.g. marshland, bogs or along the shore of lakes. As most amphibians are terrestrial during summer and can spread far away from open water, the grass snake can also be connected to terrestrial habitats with moist ground. However, to be able to thermo-regulate, these areas must include open sun exposed patches or better edge zones along low and higher vegetation. The species is highly dependent on the old culture landscape for finding suitable egg depositing places. Some more “natural” places with decomposing material are available, but dung heaps and compost heaps are excellent places for egg deposition. As these elements become more and more rare due to new regulations and reconstruction of farming practice, the grass snake can no longer find suitable places for egg laying. Management for this species includes keeping the ground water regime natural and leave leaf litter or dung in heaps outside.

The diversity of species and population sizes of amphibians and reptiles recorded in any study of the same character as the Forsmark investigation will vary depending on many, more or less predictable factors. Most important are season and time of the day when field work is carried out. Temperature, wind and rain also strongly influence the number of findings. Considering these factors the result of the investigation is about what could be expected in the composition of biotopes available in the studied area. Compared to an average culture landscape in this part of Sweden it has a very interesting diversity of structures, variation and vegetation, and many exposed open patches or edges. From a herpetological point of view it must be regarded as having high values for conservation.

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Appendix 1

Photos of species and habitats

Figure 1. *Coastal bare rock habitat with possible breeding pond for common toad. (Strandnära klippig kustmiljö med tänkbar lekdamm för vanlig padda.)*

Figure 2. *Minor road trough deciduous forest in former open grazed landscape with good basking and hiding places for reptiles. (Mindre väg genom lövskogsområde i tidigare öppet betat landskap med fina solplatser och gömställen för reptiler.)*

Figure 3. *Old culture landscape with still open grazed pastures. Good habitat for many amphibians and reptiles. (Gammalt kulturlandskap med fortfarande öppna betade ängspartier. Bra livsmiljö för många grod- och kräldjur.)*

Figure 4. *Forest area burnt some years ago and now with large open sites for basking reptiles and with rich insect live as food resource for lizards. (Skogområde som bränts några år tidigare, nu med öppna ytor där solen når marken, vilket gynnar reptiler, och en rik insektsfauna som födoresurs för ödlor.)*

Figure 5. *Coastal mosaic area with very good habitats for many reptiles and amphibians. (Kustområde med stor variation och mycket fin miljö för grod- och kräldjur.)*

Figure 6. *Old forest habitat, especially good for newts. (Gammal skog, särskilt värdefull miljö för vattensalamandrar.)*

Figure 7. *Grass snake on road. (Vanlig snok på väg.)*

Figure 8. *Road killed adder. (Överkörd huggorm.)*

Figure 9. *Road killed slow-worm. (Överkörd kopparödla.)*

Figure 10. *Road killed Common toad. (Överkörd vanlig padda.)*