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Provisional atlas and status of populations for the herpetofauna of Finland in 1980–92

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Based on 30239 records from several questionnaires and field censuses in 1980–1992 distribution maps were drawn for the amphibian and reptile species of Finland. Populations of the great crested newt (*Triturus cristatus*), smooth newt (*T. vulgaris*), slow worm (*Anguis fragilis*) and smooth snake (*Coronella austriaca*) were found outside the ranges where they were recorded in a corresponding survey of 1960–79. These recoveries were attributed to a more accurate recording of the species in the field and not to recent dispersal jumps. No considerable changes in the ranges of the common frog (*Rana temporaria*), moor frog (*R. arvalis*), common toad (*Bufo bufo*), common lizard (*Lacerta vivipara*), slow worm (*Anguis fragilis*), grass snake (*Natrix natrix*) and adder (*Vipera berus*) were observed in comparison with the ranges they occupied in 1960–79. The marsh frog (*Rana ridibunda*), recorded in Finland for the last time in 1960, was not found during the period of 1980–1992, either. The mean abundances of *V. berus*, *N. natrix* and *A. fragilis* were lower now in 50% or more of the biological provinces monitored in 1960–79. In the other species, the mean abundances were the same as in the preceeding monitoring survey. The trends reported for local herptile populations in 1980–92 imply that *V. berus*, *N. natrix*, *A. fragilis* and *T. vulgaris* have decreased more often than the other species. For none of the species did the reports indicating a population increase exceed 30% of all the reports with trends for the same species.

1. Introduction

The number of herptile species has decreased and a great number of local populations have declined or become extinct in different parts of Europe during the last fifty years or so. Direct and indirect impacts of human activies are often considered responsible for the declines. Reports showing increasing trends are very few (Honegger 1981). In order to monitor the status of different herptile species within a large area such as a country, the large data sets required are seldom

obtainable without a great number of voluntary contributors in the field. Long-term trends in local populations can be determined through repeated monitoring. If the trend is the same in many populations of the same region changes in the distributions of the species may also be expected. In that case mapping the ranges periodically can be an appropriate method to detect the changes.

Since Arnold (1973), a variety of national grid systems have been adopted in presenting the distributions of the herptile species in many European countries. In Finland Terhivuo (1981) compiled corresponding faunistic records up to the end of 1979 and presented them according to the 10×10 km squares of the Finnish (27°E) grid system (see Heikinheimo & Raatikainen 1971). The present survey is intended to determine the current ranges of the amphibian and reptile species in Finland. Based on abundances and trends estimated for local populations in 1980–92 the survey also provides a provisional report of the status of herptile populations and makes comparisons with the corresponding information for the period 1960–79 (Terhivuo 1981). The data obtained now also contribute to the survey of the Atlas of European Reptiles and Amphibians conducted by the Mapping Committee of Societas Europaea Herpetologicae (SEH).

The Finnish herpetofauna is poor in species; it comprises the great crested newt (*Triturus vulgaris*), smooth newt (*T. vulgaris*), common toad (*Bufo bufo*), common frog (*Rana temporaria*), moor frog (*R. temporaria*), common lizard (*Lacerta vivipara*), slow worm (*Anguis fragilis*), grass snake (*Natrix natrix*), smooth snake (*Coronella austriaca*) and adder (*Vipera berus*). The marsh frog (*Rana ridibunda*) evidently became extinct in the early 1960's (Terhivuo 1981). In Finland all these species live at the northern margins of their European range and they are therefore of special interest.

The committee for the monitoring of threatened animals and plants in Finland has listed *Triturus cristatus* as vulnerable and *Coronella austriaca* as an endangered species (Komiteanmietintö 1985, 1991). The present paper also provides information about these species in Finland.

2. Material and methods

In the present survey most records were obtained through questionnaires and field censuses. Faunistical records presented in Finnish nature magazines and local newspapers in 1980–92 are also included.

Two of the questionnaires were launched in 1990–92. They were directed to people interested in recording herptiles during 1980–92. Based on the records compiled up to the end of 1990 preliminary distribution maps were drawn for the species and sent to the contributors for additional recording in 1991–92. Several nature magazines as well as pertinent radio and TV programs also participated by spreading information about the survey. At the end of 1992 the data obtained totalled more than 10 000 records from more than one thousand contributors.

In 1981–83 the volunters, who had undertaken the annual route census of the Tetraonidae (Aves) species in Finland were also asked to write up the adder, grass snake, slow worm and common toad individuals observed during the census. These records, together with those of other herptiles made outside the census period of late August, totalled 944. For additional information on this data set see Terhivuo (1990).

In 1983 a questionnaire concerning the common frog, common lizard and adder was sent to schools in connection with the campaign "Tarkkaile luontoa" (=Observe nature) by six Finnish nature conservation organisations. The campaign was directed to schoolchildren aged 13–16 years. The voluntary responses of more than 10 000 participants yielded 19 979 records for the three species. This explains the high figures in Table 1. For a more detailed information of this survey see Terhivuo (1988).

A data set of 240 records referring to the the common frog and the adder in the 1980's comes from the archives of the Societas Scientiarum Fennica.

The three last-mentioned data sets were relevant for the distribution maps and they did not yield information about the abundances and trends among local populations.

Faunistically interesting records, especially those referring to the localities outside the range

of the species indicated in Terhivuo (1981) as well as those from at the northern limit of the range, were checked by contacting the observers and asking for additional information. The principles in adopting and compiling the records for final analysis are the same used in the corresponding survey of 1960–79 (Terhivuo 1981). In the present survey the records accepted total 30 239.

In addition, there were about 2000 records indicating the absence of a species in a locality, but these records were not included because conflicting information indicating the presence of the species was often received from the same 10 × 10 km square.

The records for the presence of a species in a site are located with reference to the 10 × 10 km squares of the Finnish national grid (27°E) system (Heikinheimo & Raatikainen 1971). In the distribution maps (Figs. 1, 2, 4, 6, 8, 10, 12, 14, 16 and 17) all the 10 × 10 km squares with at least one record of an amphibian or reptile species are shaded. The squares total 2287 and they make up 59% of all the 10 × 10 km squares with dry land in Finland. Table 1 shows the numbers of records and 10 × 10 km squares for each species.

In the questionnaires of 1990–92 the observers that had tracked herptiles in the same area during three or more successive years were asked to estimate the abundances of the populations according to the following scale: 1 = the species is very scarce, 2 = it is scarce, 3 = rather scarce, 4 = rather abundant, 5 = abundant and 6 = very abundant. Only those records that partly or totally referred to the period of 1980–92 were accepted. This data set comprises 3174 records, most of which came from southern and central parts of Finland. In order to indicate the provisional status of populations the records were grouped into the 100 × 100 km squares of the grid (27°E) system and these squares were grouped according to the biological province that they referred to. In each species the mean abundance was calculated on the basis of all the reports from the same province. For those provinces with < 5 records no status for the populations was calculated. This procedure follows the principles adopted in Terhivuo (1981). The biological provinces and the numbers of records for the species in them are given in Figs. 3, 5, 7, 9, 11, 13, 15 and 18.

The contributors of the questionnaires in 1990–92 were also asked whether or not they had observed changes in the abundances of local populations. This data set comprises 959 records and it includes only those records in which the observation period comprised five or more successive years and in which it at least partly included the period 1980–92.

Table 1. Number of records and 10 × 10 km squares for the amphibians and reptiles in Finland prior to 1980 (Terhivuo 1981) and in 1980–1992 (the present survey).

	Records		10 × 10 km squares			
	–1979	1980–92	–1979		1980–92	
Species	n	n	n	%	n	%
Triturus cristatus	27	30	15	0.3	21	0.3
T. vulgaris	606	408	340	5.9	283	3.8
Bufo bufo	1527	1389	860	14.8	839	11.1
Rana temporaria	2308	11157	1091	18.8	1853	24.5
R. arvalis	451	613	254	4.4	401	5.3
R. ridibunda	12	–	3	0.1	–	–
Lacerta vivipara	1943	8414	968	16.7	1685	22.3
Anguis fragilis	1076	835	500	8.6	483	6.4
Natrix natrix	827	604	408	7.0	358	4.7
Coronella austriaca	15	17	11	0.2	7	0.1
Vipera berus	3039	6772	1346	23.2	1633	21.6
Total	11831	30239	5796		7562	

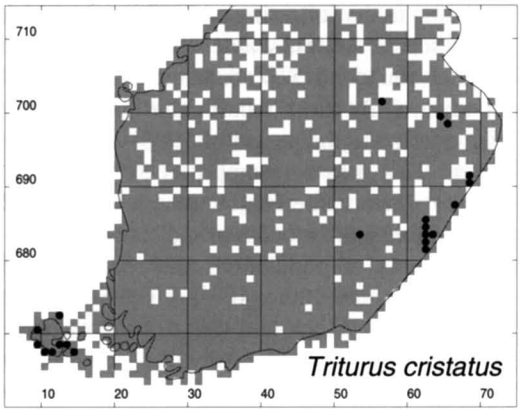

Fig 1. The 10 × 10 km uniform grid (27°E) squares (dots) with records of the great crested newt (*Triturus cristatus*) in Finland in 1980–92. Squares with records of any amphibian and reptile species in 1980–92 are shaded.

3. Provisional distribution maps and status of populations

The great crested newt (*Triturus cristatus*) (Fig. 1)

The great crested newt has a disjunctive distribution in Finland; it occurs in the Åland archipelago in southwestern Finland and in southeastern parts of the Finnish mainland (Fig. 1). In the latter area it was now found outside its continuous range there, viz., within the municipalities of Nilsiä (701:56), Eno (698:65), Kontiolahti (699:64) and Anttola (683:53). This species apparently now occupies a wider range than known in the 1960's and the 1970's in SE Finland. In

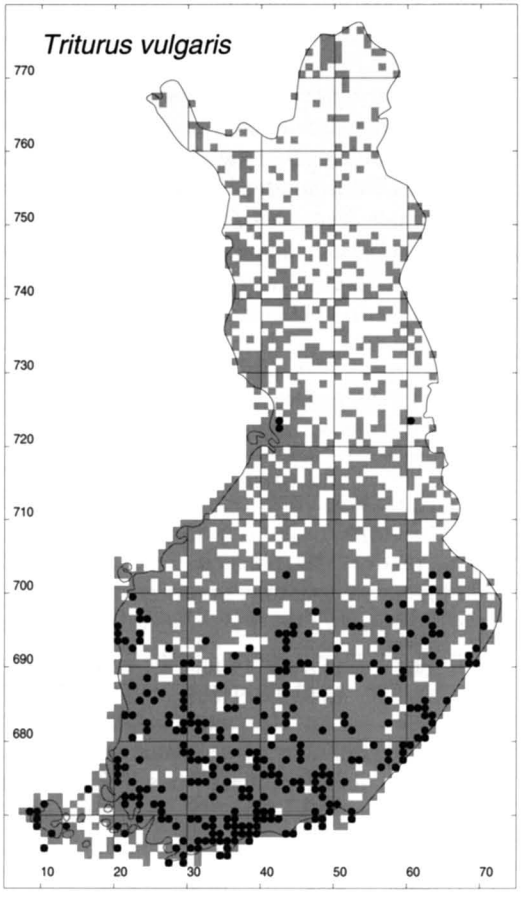

Fig. 2. The 10 × 10 km squares with records of the smooth newt (*Triturus vulgaris*) in Finland in 1980–92. See also the legend to Fig 1.

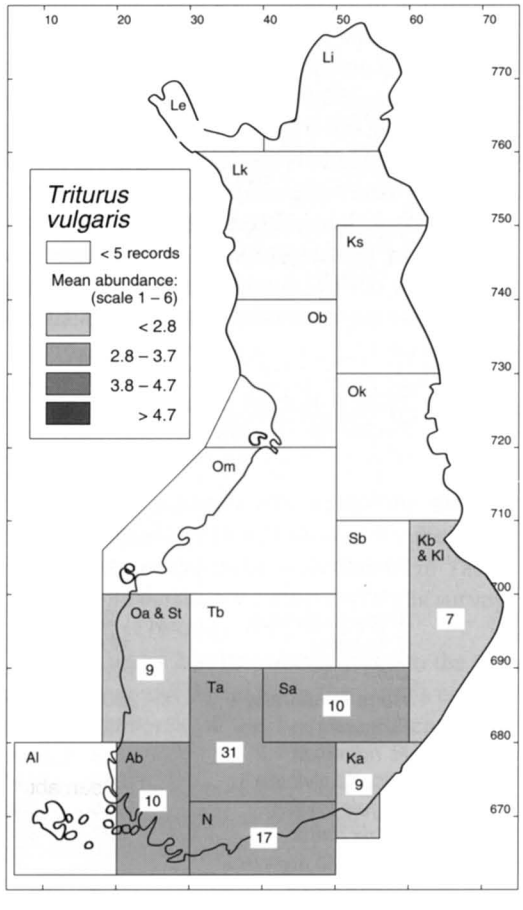

Fig 3. Provisional mean abundances for *T. vulgaris* in Finland in 1980–92. The different shades show the means for the local abundances reported in each bio-

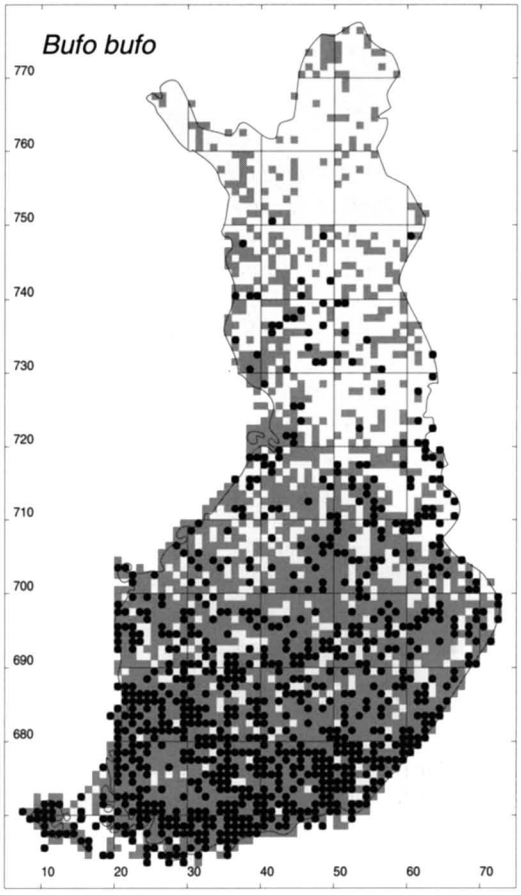

Fig. 4. The 10 × 10 km squares (= large solid dots) with records of the common toad (*Bufo bufo*) in Finland in 1980–92. See also the legend to Fig. 1.

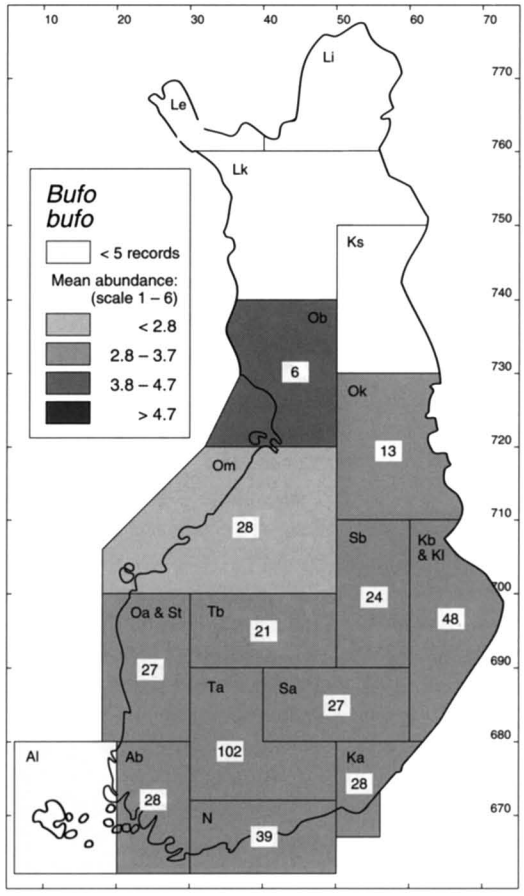

Fig. 5. Provisional mean abundances for *Bufo bufo* in Finland in 1980–92. For further explanation see legend to Fig. 3.

the Åland archipelago the great crested newt also occurs on islands outside the main island of Åland. Most populations proved to be isolated from each other. In four records its abundance was estimated and depending upon the locality it ranged from very rare to rather common.

logical province (letters in brackets). The mean abundance is indicated as follows: 1) populations abundant (mean > 4.7), 2) rather abundant (4.7–3.8), 3) rather scarce (3.7–2.8) and 4) and scarce (<2.8) on average. The figures show the number of reports in each province. No mean abundance was calculated for the provinces with < 5 records. For additional explanation see Section 2 in the text.

The smooth newt (*Triturus vulgaris*) (Figs. 2–3)

This species is rather uniformly recorded up to about 63°N in Finland. It is often found on separate islands of southern and southwestern coast of Finland (Fig. 2). There are also many records of it from the Åland archipelago including far-away small islands of the sea zone. Faunistically noteworthy northern records were made within the municipalities of Haukipudas (723:42 and 733:42) and Suomussalmi (723:60), all far from the continuous range delimited for the species in the survey of 1960–79 (Terhivuo 1981).

According to Fig. 3 smooth newt populations are on average rather scarce in southeastern and southern parts of Finland.

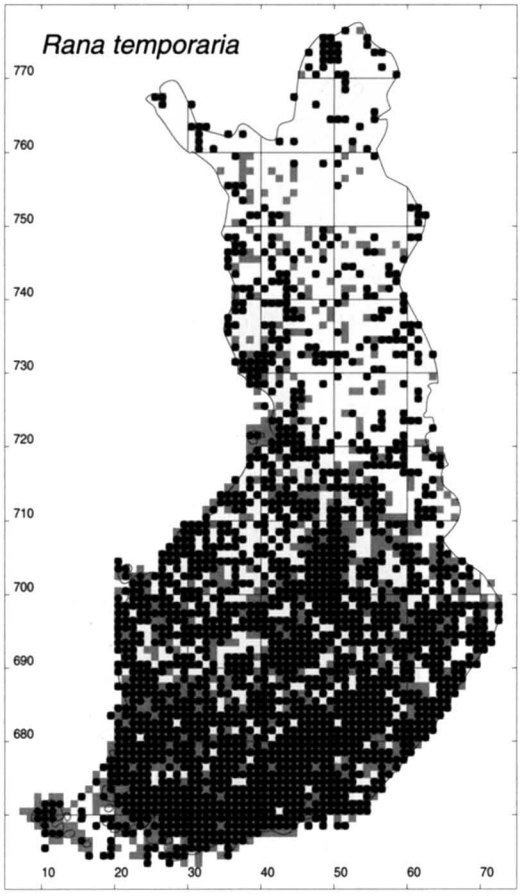

Fig. 6. The 10 × 10 km squares (dots) with records of the common frog (*Rana temporaria*) in Finland in 1980–92. See also legend to Fig. 1.

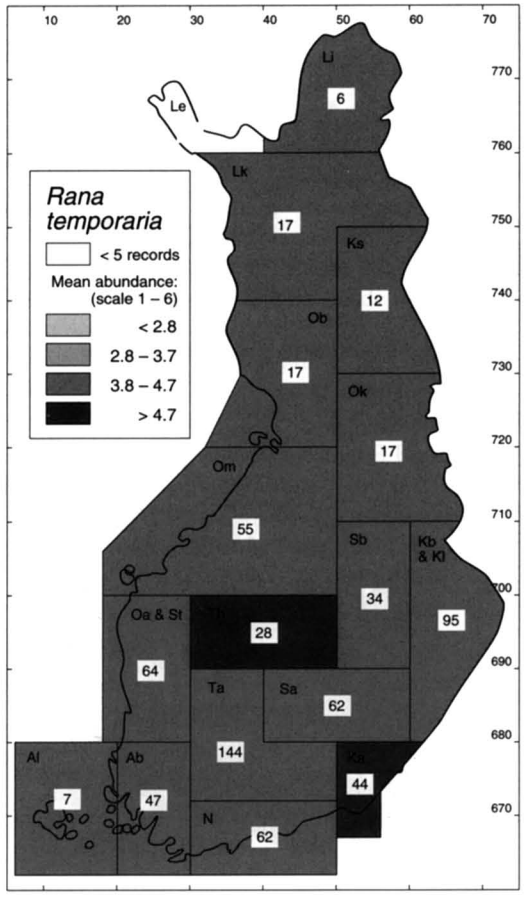

Fig. 7. Provisional mean abundances for *Rana temporaria* in Finland in 1980–92. For additional explanation see legend to Fig. 3.

The common toad (*Bufo bufo*) (Figs. 4–5)

The range of the common toad extends up to about 67°30′N in Finland. It is present on many islands off the southern and southwestern coast of Finland but absent in northernmost parts of Lapland (Fig. 4).

As Fig. 5 shows, common toad populations were estimated to be rather scarce on average in most biological provinces of southern and central parts of Finland.

The common frog (*Rana temporaria*) (Figs. 6–7)

As in 1960–1979 (Terhivuo 1981), this species was found in all parts of the country including the northernmost parts of Lapland. It was also recorded on many islands of the Gulf of Finland and the Gulf of Bothnia (Fig. 6).

A great number of records with information about the abundance of local common frog populations were received from different parts of Finland, but no clear-cut differences between the provinces could be demonstrated. In most provinces the common frog populations seem to be rather abundant (Fig. 7).

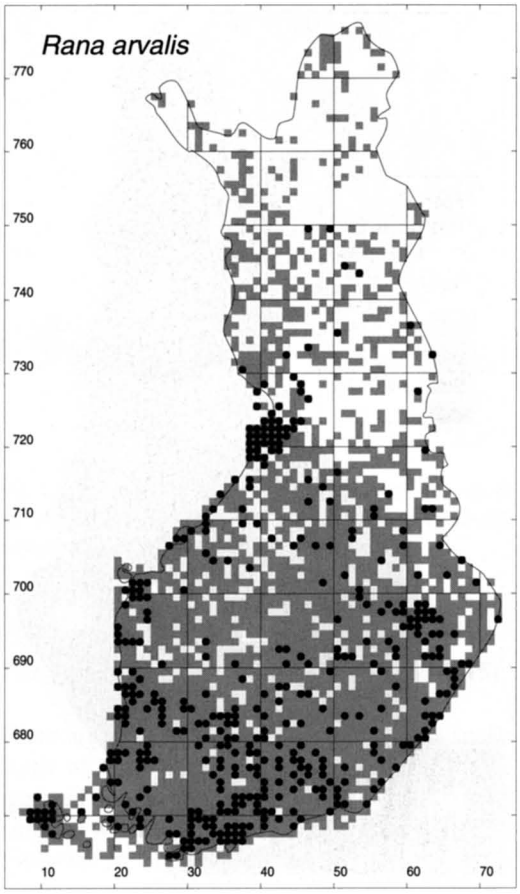

Fig. 8. The 10 × 10 km squares (dots) with records of the moor frog (*Rana arvalis*) in Finland in 1980–92. See also legend to Fig. 1.

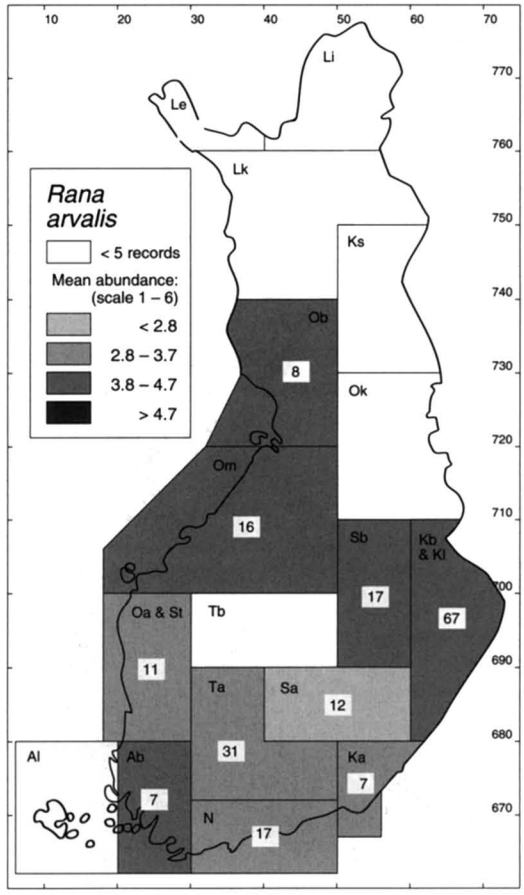

Fig. 9. Provisional mean abundances for *Rana arvalis* in Finland in 1980–92. For additional explanation see legend to Fig. 3.

The moor frog (*Rana arvalis*) (Figs. 8–9)

The moor frog often shares spawning waters with the common frog but it seems to be less widely distributed in Finland than its congener (Fig. 8). Terhivuo (1981) indicated some old records for the species further in the north than those indicated in Fig. 8, but because of the low number of the records for the moor frog in Lapland this difference hardly indicates any real change in the range.

In southern and central biological provinces of the Finnish mainland the mean abundance of the moor frog ranged from rather scarce to rather abundant. In central parts of the country it may be more abundant on average than in the south. The reports from Lapland are too few to warrant any estimation of its abundance there (Fig. 9).

The common lizard (*Lacerta vivipara*) (Figs. 10–11)

The common lizard occurs in all parts of Finland (Fig. 10) although in northern parts of the country the records are less numerous than they are for the common frog, which also occurs there.

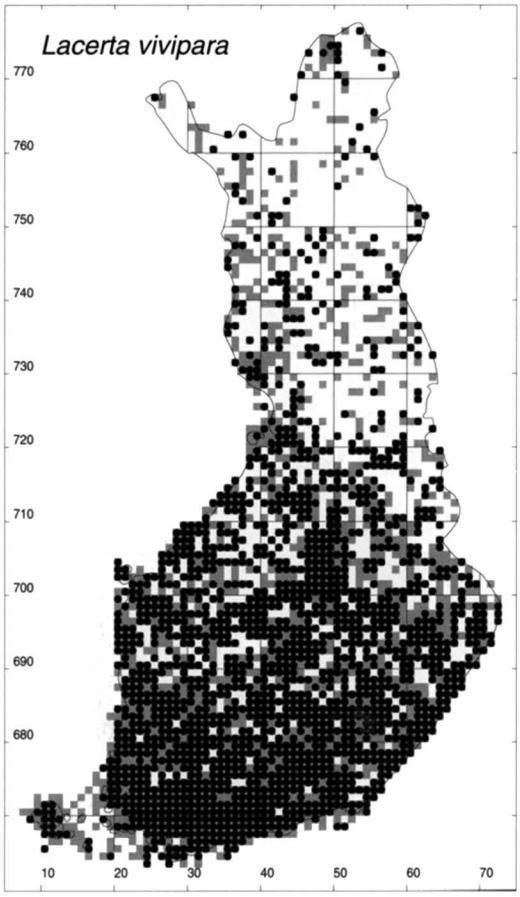

Fig. 10. The 10 × 10 km squares (dots) with records of the common lizard (*Lacerta vivipara*) in Finland in 1980–92. See also legend to Fig. 1.

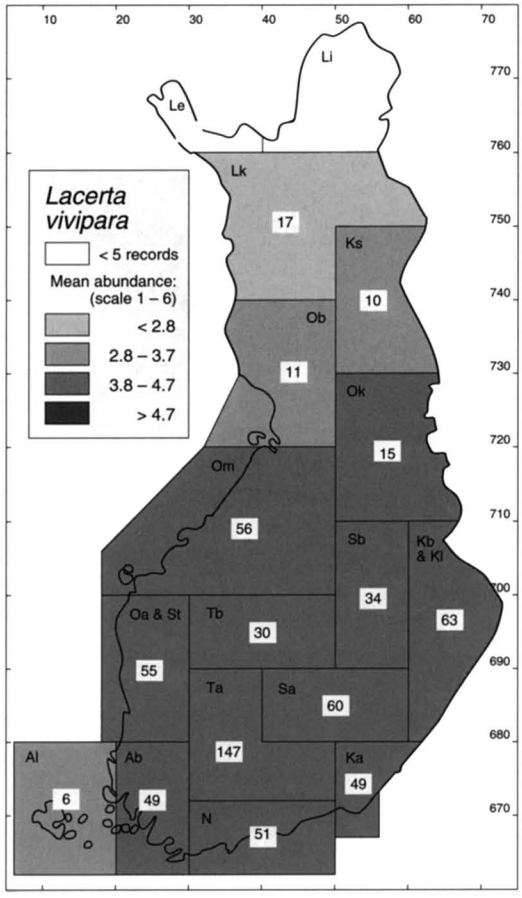

Fig. 11. Provisional mean abundances for *Lacerta vivipara* in Finland in 1980–92. For additional explanation see legend to Fig. 3.

In southern and central parts of Finland populations of the common lizard are rather abundant on average but they become scarcer northwards. In the Åland archipelago the species was estimated to be less abundant than in southern parts of the Finnish mainland (Fig. 11).

The slow worm (*Anguis fragilis*) (Figs. 12–13)

Most records for the slow worm refer to southern and southeastern parts of Finland, but only a few records refer to islands close to the mainland (Fig. 12). Surprisingly, one individual was found in 1991 on the island of Lågskär in Åland where the species was thought to be absent, since no records had been made there in about 50 years or so. In the mainland of Finland the range of the slow worm accords with that indicated for it in the period of 1960–79 (Terhivuo 1981). This also holds true for the blue-spotted individuals of the species which occupy the same range as those lacking blue spots.

Slow worm populations are on average rather scarce in eastern and southernmost parts of South Finland and scarce or very scarce on the western coast and in central parts of the country (Fig. 13).

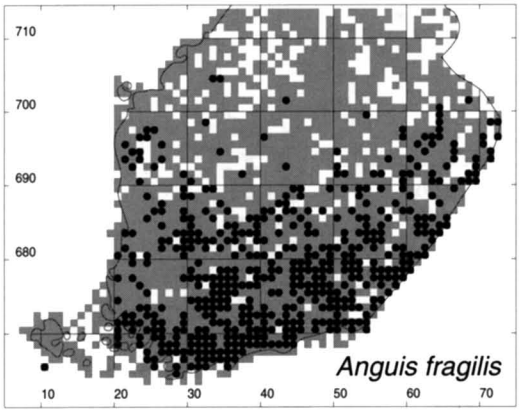

Fig. 12. The 10 × 10 km squares (dots) with records of the slow worm (*Anguis fragilis*) in Finland in 1980–92. See also legend to Fig. 1.

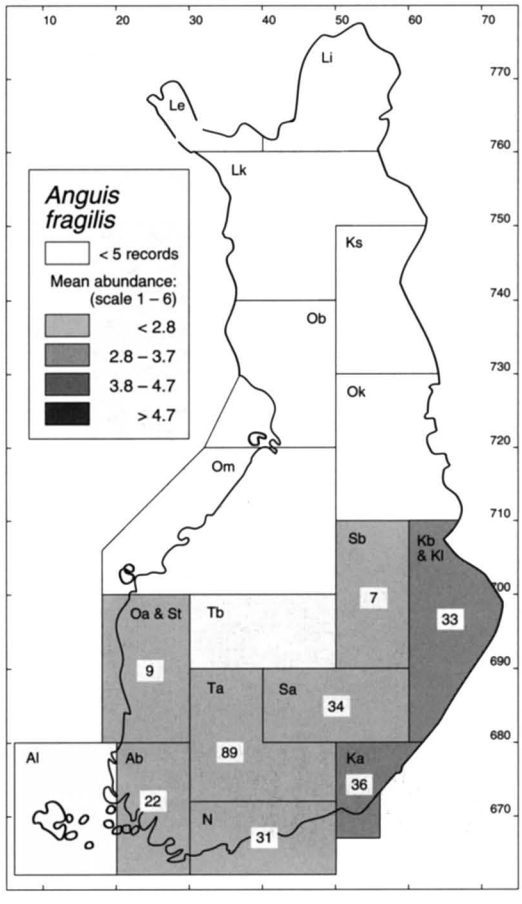

Fig. 13. Provisional mean abundances for *Anguis fragilis* in Finland in 1980–92. For additional explanation see legend to Fig. 3.

The grass snake (*Natrix natrix*) (Figs. 14–15)

There are very few localities for the grass snake north of 63°N (Fig. 14) compared with those reported for it in 1960–79 (Terhivuo 1981). Its range as whole is still almost the same now as in 1960–79. In Fig. 14 numerous records refer to coastal parts of southern Finland and also south-eastern parts of the country where large bodies of water exist such as the Saimaa lake. In central parts of South Finland the localities for the species are separate from each other and these records often refer only to one individual, implying that the species is unevenly distributed there.

The grass snake shows a very characteristic abundance pattern: it is less scarce in the Åland archipelago and in southern provinces of the mainland but it becomes scarcer in the neighbouring provinces (Fig. 15).

The smooth snake (*Coronella austriaca*) (Fig. 16)

In Finland the smooth snake occurs only in the Åland Islands (Fig. 16). Though there are more records of it from the period of 1980–92 than before (Table 1), information about the abundance and biology of the species in Finland is still very meagre. Unlike in the survey of 1960–79 (Terhivuo 1981) the smooth snake was also recorded on some islands close to the main island of the Åland archipelago.

The adder (*Vipera berus*) (Figs. 17–18)

The northern limit for the distribution of the adder in 1980–92 (Fig. 17) is almost identical to that indicated in Terhivuo (1981) for the period of 1960–1979. In the north, the 10 × 10 km squares with records are in small clusters or

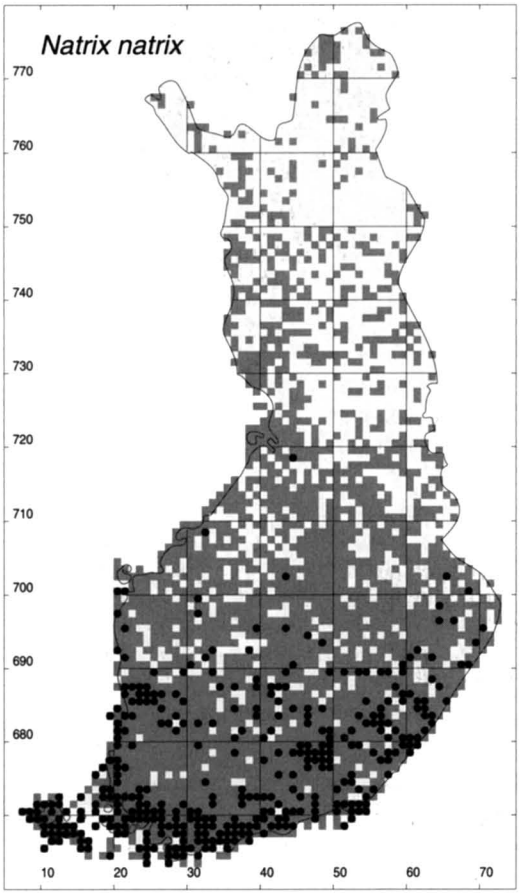

Fig. 14. The 10 × 10 km squares (dots) with records of the grass snake (*Natrix natrix*) in Finland in 1980–92. See also legend to Fig. 1.

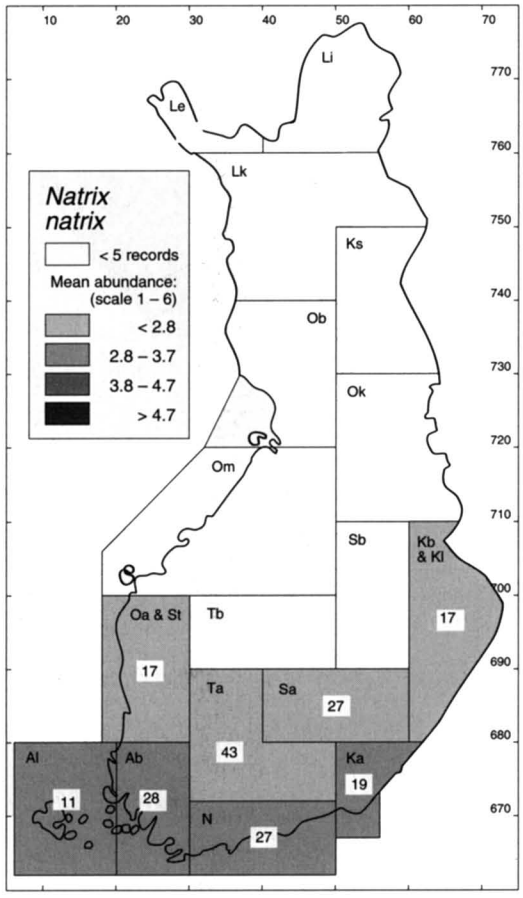

Fig. 15. Provisional mean abundances for *Natrix natrix* in Finland in 1980–92. For additional explanation see legend to Fig. 3.

separate from each other, indicating a more patchy occurrence than in the south where the records are rather evenly distributed (Fig. 17). The adder is also present on many islands of the Gulf of Finland and the Gulf of Bothnia.

Adder populations are rather scarce on average in most biological provinces of southern and central parts of Finland. It may be more abundant in central parts of South Finland. In Lapland the adder is scarce or very scarce, and absent in the two northernmost biological provinces (Fig. 18).

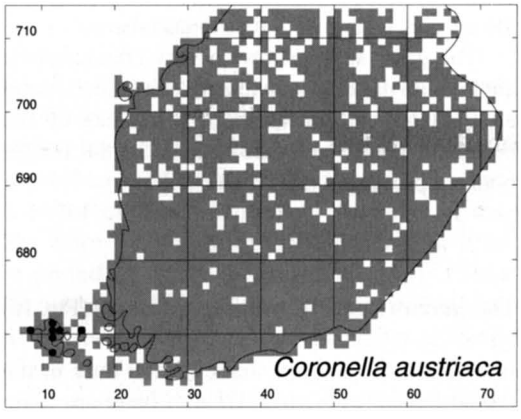

Fig. 16. The 10 × 10 km squares (dots) with records of the smooth snake (*Coronella austriaca*) in Finland in 1980–92. See also legend to Fig. 1.

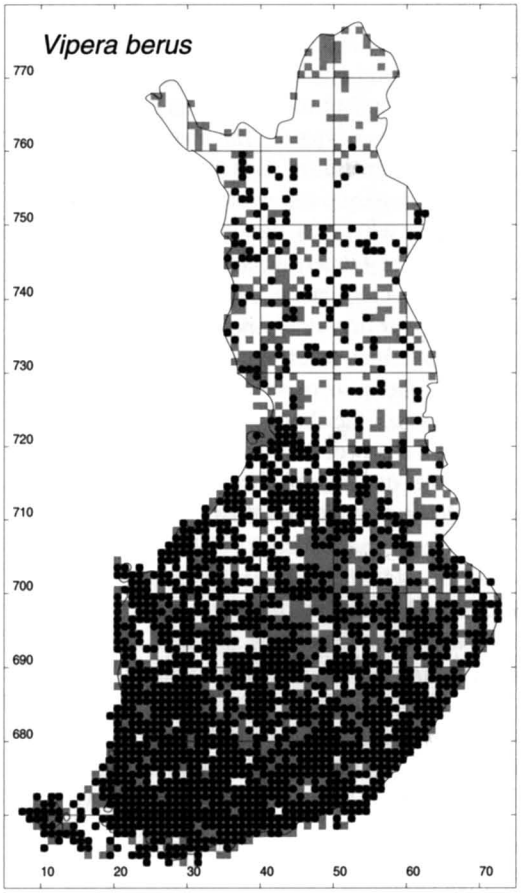

Fig. 17. The 10 × 10 km squares (dots) with records of the adder (*Vipera berus*) in Finland in 1980–92. See also legend to Fig. 1.

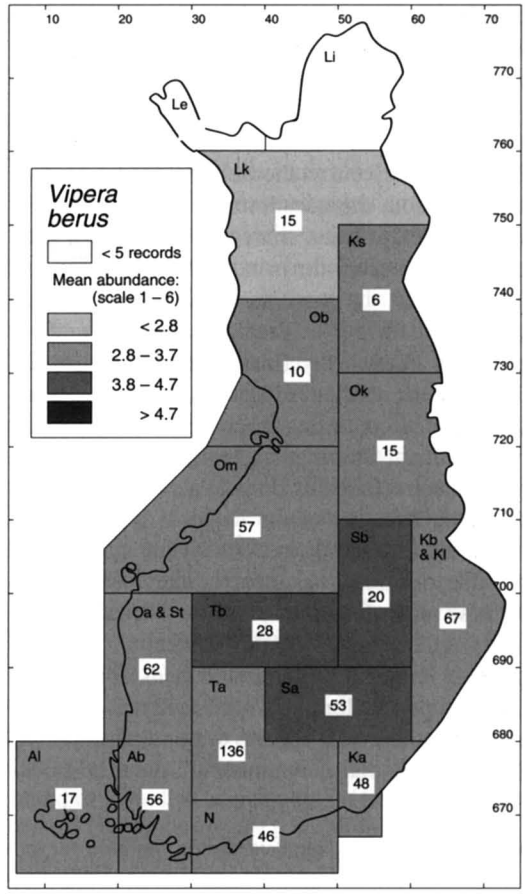

Fig. 18. Provisional mean abundances for *Vipera berus* in Finland in 1980–92. For additional explanation see legend to Fig. 3.

4. Long-term trends in populations

Table 2 summarizes the proportions of the reports with negative trends for local herptile populations in 1960–79 and in 1980–92. Concerning the latter period the χ^2-heterogeneity test applied to the original numbers of reports with negative or positive (+ no change) trends showed that the species were not considered to be equal in this respect ($\chi^2 = 74.463$***, $df = 7$). In *N. natrix*, *V. berus*, *T. vulgaris* and *A. fragilis* the reports that show a trend, more than 50% indicated a decrease. In the other species the corresponding figures were less than 50%, implying that the declining trend for them is now less prominent than it was in the survey of 1960–79 (Terhivuo 1981) and that these populations maintain themselves better than those of the four previously mentioned species. It is also noteworthy that for every species the proportion of the reports indicating an increase in numbers was < 17% of all the reports showing a trend for the species in question, excepting the moor frog, for which it was 30%.

5. Discussion

5.1. Quality of data

Most of the herptile species in Finland are not difficult to key out in the field. In order to aid in identification, the questionnaires were provided with figures of traits characteristic of each species. In this survey the principles of checking the records were the same as those adopted in the survey of 1960–79 (Terhivuo 1981), i.e. faunistically noteworthy finds, including those referring to the northern margins of the ranges, were confirmed by contacting the contributors once more for additional information. Inside the continuous range incorrect records do not cause drastic errors in the delimitation of the range as a whole. By indicating the records in 10×10 km squares it is possible to diminish the impact of individual records because more than one record for a species often refers to the same 10×10 km square.

The information of abundances and trends for local populations was not based on a systematic recording of the species or populations in the field; thus no definite numbers of records underlie the abundance categories adopted. Therefore the entire data base is 'semiquantitative' and it is also subject to errors such as differences between the contributors in finding and identifying the species, in estimating the abundances, etc. It is also worth recalling that the herptile species differ in behaviour and ecology from each other and that is why they cannot be recorded with equal efficiency in any census, either. The impacts of all these factors cannot be considered accurately enough in the final analysis, and I have therefore not calculated any 'coefficient of correction' for the raw data. Because of these sources of error no comparisons of the abundances between the different species in any of the biological provinces can be made; the quality of the data warrants only intraspecific comparisons between the provinces.

5.2. Distributions

Amphibians

A comparison of Fig. 1 with the distribution map for *T. cristatus* in 1960–79 (Terhivuo 1981, Fig.

Table 2. Negative trends reported for local Finnish amphibian and reptile populations in 1960–79 (Terhivuo 1981) and in 1980–92. The instructions for the estimation of these trends are explained in the text in Section 2.

Species	Period	Decreased or disappeared (%)	Number of records	Difference between periods (χ^2)
Triturus vulgaris	1960–79	83.3	24	
	1980–92	54.3	35	*
Bufo bufo	1960–79	78.4	50	
	1980–92	47.5	101	***
Rana temporaria	1960–79	60.3	65	
	1980–92	33.5	206	***
Rana arvalis	1960–79	–	–	
	1980–92	23.0	61	–
Lacerta vivipara	1960–79	60.0	55	
	1980–92	26.6	173	***
Anguis fragilis	1960–79	74.4	39	
	1980–92	54.0	63	*
Natrix natrix	1960–79	70.0	50	
	1980–92	60.3	73	ns
Vipera berus	1960–79	78.4	148	
	1980–92	58.3	247	***

3) shows that there are new localities for the species in southeastern Finland whereas in the Åland archipelago no considerable differences in the range can be detected. In southeastern Finland the recovery of these populations is attributable to the improved accuracy of recording this species in the field, rather than to substantial dispersal jumps of the species. In fact, at some of these sites local people seem to have been aware of the *T. cristatus* populations for a long time. Also, separate populations of *T. vulgaris* were found far beyond its continuous range (Fig. 2). Thus it seems that the northern separate populations of both *Triturus* species represent remnants of a wider postglacial range. It is also noteworthy that in Sweden (Gislén & Kauri 1959, Ahlén et al. 1992), Norway (Dolmen 1980) and in Russia (Bannikov et al. 1977) there are separate populations for both species far in the north. This supports the view that they occupied wider ranges in Fennoscandia long ago. Moreover, in Finland their northern populations live at sites with neglible human impact where they could hardly have established themselves through anthropochory.

Raatikainen (1989) reported several decreasing *T. vulgaris* populations in southern parts of Central Finland. According to Tables 2 and 3 its populations may have become scarcer in some biological provinces but the possible declining trend has not yet had any clearcut impact upon the Finnish range of the smooth newt. Unfortunately, there are rather few records with the trends for local populations.

The distributions for *R. temporaria*, *R. arvalis* and *B. bufo* in 1980–92 did not indicate any considerable changes in the ranges compared to those worked out for them in 1960–79 (Terhivuo 1981). The marsh frog (*Rana ridibunda*), which probably originated in Finland due to human introduction in the early decades of the present century, occupied two localities in southern Finland up to 1960 (Terhivuo 1981). It was not recorded any more in 1980–92 and it also lacked any record from the period of 1961–79. Evidently, it does not belong to the herpetofauna of Finland today.

Reptiles

The updated distribution maps for *L. vivipara* and *A. fragilis* (Figs. 10 and 12) correspond well to those drawn for them in 1960–79 (Terhivuo 1981). Faunistically, the most interesting record refers to *A. fragilis* on the island of Lågskär. This island is a well-known bird banding station visited by ornithologists almost all year round. Finding one slow worm individual there for the first time implies that its presence is due to human introduction. I was informed that firewood was annually transported there from Flaka on the main island of Åland. If this is the origin for the slow worm individual, the species should live in the Åland archipelago although it has not been recorded there during the last fifty years or so (Terhivuo 1981).

N. natrix and *V. berus* had much the same range they had in 1960–79 (Terhivuo 1981). Although they have decreased much in abundance their ranges have not diminished during the past 30 years or so.

The number of records for *C. austriaca* in 1980–92 compared with all those made prior to 1980 (Table 1) indicates an increase in interest towards the species in Finland. It also shows that the populations have survived in 1980–92, and, that they inhabit some islands outside the main island of Åland. A correspondent from the Åland Islands did not consider it to be extremely rare, at least in the northern part of the main island of Åland.

5.3. Comparison of trends between local populations in 1960–79 and 1980–1992

The records with trends for local populations allow provisional comparisons between abundances of the same species in 1960–79 and 1980–92. In Table 2 application of the χ^2-test to the original figures for the period of 1960–79 shows statistically significant heterogeneity ($\chi^2 = 14.691^*$, $df = 6$) and the same holds true for the corresponding data set of 1980–92 ($\chi^2 = 72.738^{***}$, $df = 7$). This warrants the conclusion that in both periods the species show dissimilar trends and it also suggests that the contributors have considered the species separately instead of reporting uniform trends for all the species in their observation area.

According to Table 2 the decreasing trend reported for *V. berus*, *B. bufo*, *A. fragilis*, *R. tempo-*

raria, *T. vulgaris* and *L. vivipara* has been less prominent in 1980–92 than in 1960–79, but in *N. natrix* it was as pronounced as it was in 1960–79.

Table 3 warrants provisional estimation of long-term trends among populations of the species from 1960 to 1992. Comparisons were made between the provinces with at least 5 records in both study periods. There are 44 cases (= biological provinces) showing a decrease and 44 cases indicating no change in the abundance category; only in 2 cases was an increase indicated in the mean abundance category. Table 3 also shows that in *B. bufo*, *R. temporaria* and *L. vivipara* the changes in the mean abundance category are few, whereas in *V. berus*, *N. natrix*, and *A. fragilis* the cases with a decrease were the same or more numerous than those indicating no change.

The ultimate reasons for the declines among Finnish herptile populations remain obscure, but undoubtedly local and interspecific variations are wide in this respect. For instance, Raatikainen (1989) has stressed the role of excessive land use in the declines of northern *T. vulgaris* populations. On the other hand, the declines in snake populations seem to have taken place in most biological provinces of southern Finland (Table 3), where human population is more dense (Rikkinen 1981), land use more intense (Pölkki & Ikäheimo 1982), the number of summer cottages by length of shoreline higher (Juusela & Vuoristo 1985) and the traffic higher (Kaartama 1985) than elsewhere in Finland. The relative impact of these factors cannot be quantified but they all can be decribed as direct or indirect human impacts.

Table 3. Comparison of mean abundances for amphibians and reptiles in the Finnish biological provinces based on reports for the periods of 1960–79 (Terhivuo 1981) and 1980–92 (Figs. 3, 5, 7, 9, 11, 13, 15 and 18 show the biological provinces and the numbers of records). Symbols: ? = less than five records, no mean abundance calculated, A = populations are abundant on average (mean of abundances > 4.7), B = rather abundant (4.7–3.7), C = rather scarce (3.7–2.8) and D = scarce (< 2.8). Changes in abundance categories are indicated with + = mean abundance higher and – = mean abundance lower in 1980–92 than in 1960–79. For further information see the text in Section 2.

		Al	Ab	N	Ka	TaSt+0a	Tb	Sa	Kb	Sb	KP	Kn	Ob	Ks	Lk	Le	Li
Triturus vulgaris	1960–79	?	C	C	C	C	C	C	?								
	1980–91	?	C	C	D	C	D	?	C	D							
	change				–		–										
Bufo bufo	1960–79	B	B	C	B	C	C	C	C	C	C	C	?	C			
	1980–91	?	C	C	C	C	C	C	C	C	D	C	B	?			
	change		–		–						–						
Rana temporaria	1960–79	B	B	B	A	A	A	A	B	B	B	B	A	B	B	B	D	C
	1980–91	B	B	B	A	B	B	A	B	B	B	B	B	B	B	B	?	B
	change					–	–						–					+
Lacerta vivipara	1960–79	B	B	B	B	B	B	B	B	B	B	B	B	B	B	D	D	D
	1980–91	C	B	B	B	B	B	B	B	B	B	B	B	C	C	D	?	?
	change	–												–	–			
Anguis fragilis	1960–79	?	C	C	D	C	D	C	C	C	?							
	1980–91	?	D	D	C	D	D	?	D	C	D							
	change		–	–	+	–			–									
Natrix natrix	1960–79	B	B	B	B	D	C	C	C	?	?	D						
	1980–91	C	C	C	C	D	D	?	D	D	?	?						
	change	–	–	–	–		–		–									
Vipera berus	1960–79	B	B	B	B	B	B	B	B	B	B	B	B	B	C	C		
	1980–91	C	C	C	C	C	C	B	B	C	B	C	C	C	C	D		
	change	–	–	–	–	–	–			–		–	–	–		–		

In *N. natrix* the decline may have been facilitated by e.g. the disappearance of manure heaps from the backyards of cow-houses where they offered favourable egg-laying sites for the species. In coastal regions the sudden disappearance of wrack beds comprising *Fucus vesiculosus* from shores in the 1980's may also have diminished egg-laying sites for the grass snake. Information on the breeding biology of *N. natrix* in Finland today is meagre. It is worth mentioning in this context that one of the contributors had observed a female grass snake laying eggs in the abandoned nest of a muskrat (*Ondatha zibethica*) and another report indicated that manure heaps left inside an abandoned cow-house served as good wintering and egg-laying sites for the grass snake.

5.4. Conservation measures in the future

The information in Tables 2 and 3 warrants the conclusion that populations of *V. berus*, *N. natrix* and *A. fragilis* are declining and need careful monitoring in the future. Different populations of *T. cristatus* and *C. austriaca* should also be inspected to assess their status and to estimate possible local threats.

Excepting *V. berus*, all the amphibian and reptile species are protected in Finland but this is hardly preventing the continuation of declining trends observed in local populations. The construction of spawning pools for amphibians as well as sites for egg-laying and overwintering for the grass snake (probably some kinds of sheltered places with heaps of decaying organic material to produce favourable conditions) can support local populations. However, in the long run the establishment of nature conservation areas should be considered wherever the number of threatened herptile species is high.

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