The national amphibian monitoring program in the Netherlands, preliminary results over 1997 – 2000.

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Abstract. Sixteen amphibian species are native in the Netherlands. Nine of these can be found on the national Red List, they are considered as threatened species. The numbers of those threatened species are declining very rapidly as a result of human interference and environmental factors. In 1997 a Dutch amphibian monitoring program started to detect changes in populations in the Netherlands.
The amphibian network concentrates on the aquatic (reproductive) phase, except for *Salamandra salamandra*. The survey unit is an area of 100 ha which contains a minimum of three potential reproduction sites. Plots are visited 4 times a year. During each visit all reproduction sites are surveyed and the observed species are registered. Their presence (not present, rare, common, abundant) is estimated for each water body based on the observed numbers of eggs, larvae and (sub)adults. As a consequence of working with volunteers the methods used are restricted to observation. Methods that require handling of animals or disturbing the habitat are kept to the minimum. The only equipments used are torch and dip net.
For each species two indices are calculated, using Poisson regression. One index reflects change in local distribution, the second index reflects change in the estimated numbers of animals. The trends for the two indices over the first four years are consistent.
The amphibian monitoring program is still in development. The number of plots increases every year, and reflects more and more the national species distribution. The strategy for further development of the monitoring program and its indices is discussed.

Introduction

In the Netherlands, like in many other countries, amphibian populations have declined rapidly in the last decades. The main causes for the decline are considered to be more intensive agriculture, more effective drainage systems, urbanisation, increasing infrastructure and organic deposition (Creemers, 1996).
In 1997 the national Amphibian Monitoring Program started as part of the Network Ecological Monitoring (Smit *et al.*, 1999). This Network Ecological Monitoring integrates the national monitoring programs for amphibians, reptiles, birds, butterflies, dragonflies, mammals, flora and mycoflora. The Network serves as a tool to evaluate the Dutch nature policy and is funded by the Ministry of Agriculture Nature management and Fisheries and Statistics Netherlands

Targets

For the Amphibian Network the following targets have been defined:

- Detecting changes in populations of target species of the Nature Policy Plan as well as species that occur on the Red List (Table 1);
- Detecting changes in amphibian populations within core areas of the National Ecological Network;
- Acquire knowledge of the main factors that cause changes in amphibian populations in the Netherlands.

Table 1 Target species of the National Amphibian Monitoring Program.

Alytes obstetricans	*Salamandra salamandra*
Bombina variegata	*Triturus alpestris*
Pelobates fuscus	*Triturus cristatus*
Bufo calamita	*Triturus helveticus*
Hyla arborea	
Rana arvalis	
Rana lessonae	

Organisation
The National Amphibian Monitoring Program is developed for volunteers to carry out the field surveys. The Working Group Monitoring of RAVON (Association for reptile, amphibian and fish research in the Netherlands) co-ordinates the program. The co-ordination involves tasks like recruitment of volunteers, plot selection, plot description, developing (field) methods and collection and interpretation of results. Results are published in a biannual newsletter for feedback to all participants. Statistics Netherlands developed the statistical methods for index calculations (Pannekoek & van Strien, 1998). The monitoring program is funded by the Ministry of Agriculture, Nature management and Fisheries and Statistics Netherlands.

Field methods
The basic unit of the monitoring program is an area of approximately 100 ha. Within this unit all potential reproduction waters are sampled. This includes proper breeding ponds as well as waters were breeding of amphibians is expected to be marginal. In some areas the number of waters is high or waters are difficult to access. To survey all waters in these plots can be relatively time-consuming. Therefore for practical reasons the maximum number of waters to be surveyed is set at 15 waters. In most cases the volunteers invest half a day of fieldwork each visit.
The field methods are low cost using dipnet and torch as the only equipment needed. All waters are visited four times during the reproduction season. Night visits are included. Each visit the presence of a species is estimated for individual waters. After four visits the observer does an interpretation of the results of the different methods that were used. The maximum abundance for each species per water is estimated by the observer, based on the number of eggs, egg clutches, egg strings, larvae, juveniles and adults. The estimated value is expressed by four index classes: 0-the species is not present, 1-the species is rare, 2-the species is common or 3-the species is abundant. Instructions for field methods and guide-lines showing how to apply the index are described in a manual that is send to all participants (Groenveld, 2001). A more detailed description of the monitoring program is given by Smit et al. (1999). All plots are described by the co-ordinators. Description involves general characteristics as landscape, land use, representation of the plot for the area as well as characteristics of the individual waters. The plot descriptions are used to assign plots to strata for trend calculation (e.g. trends in peat-bog areas versus trends in moor and heath land areas) and can provide useful information to interpret results.

Index calculation
Indices for the species are calculated using TRIM, a statistical program based on Poisson regression designed for fauna monitoring data with missing values (Pannekoek & Van Strien, 1998). An example of applying TRIM is given by Van Strien *et. al* (2001) who applied the

method to data of European bird populations. TRIM tests possible trends and assigns to it predefined categories based on the percentage of difference compared with the first year of monitoring.
In the analyses of amphibian monitoring data two indices are calculated. One index, the P-index, represents the number of waters per plot where a species is found. The index is based on the presence/absence per water. Trends for this index can be interpreted as chances in local distribution. The second index, the A-index, represents the number of animals per plot. The index is based on the estimated abundance per water. For each species the A-index calculation involves the following steps: 1) for each water the maximum abundance is established, 2) per plot the maximum abundances are summed. The summed value is used for the index calculation. Trends for the A-index can be interpreted as chances in average abundance. In some plots, not all waters are surveyed every year. If waters are skipped without reason (they could be skipped because of e.g. early desiccation) all its values are omitted.

Results over 1997 - 2000

Growth of the network

This growth of the network is presented in figure 1. The network increases steadily from 43 in 1997 to 105 plots in 2000. The total numbers of waters that are surveyed adds up to 696 waters. The overall turnover of surveyed plots is low, except for 1998. In 1998 most of the newly added plots were not surveyed in the following years.

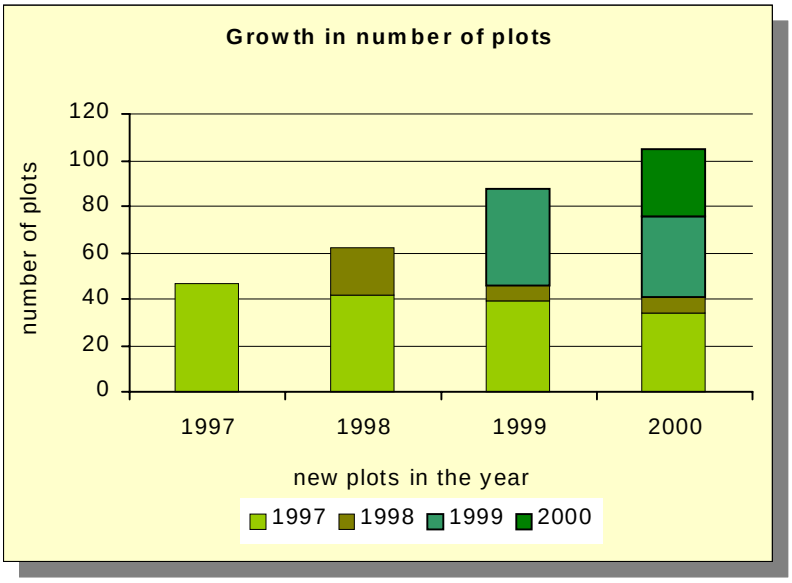

Figure 1 Growth in number of plots of the National Amphibian Monitoring program since 1997.

Distribution of plots

Figure 2 gives the distribution of plots projected on a 5 x 5 km grid presenting the number of target species. The highest numbers of target species occur in the southern part of the Netherlands. The density of plots in these areas is relatively high. In the northern and coastal areas still a few plots are surveyed. *Rana lessonae* and *Bufo calamita* are the target species that are relatively wide spread in these areas.

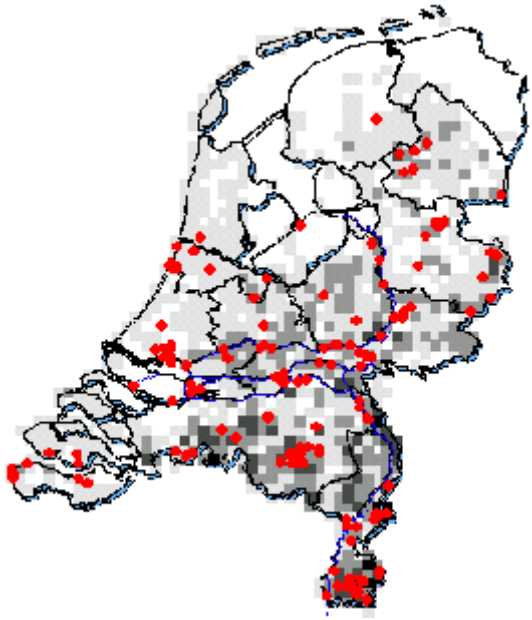

Figure 2. The distribution of plots projected on a 5 x 5 km grid presenting the number of target species within each grid cell (white 0 species, light grey 1-2 species, middle grey 3-4 species, dark grey 5-6 species, black more than 6 species).

Indices

Indices are calculated for 15 species, including the more common species. The three forms of green frogs are treated as one, *Rana esculenta* synklepton, because of the difficulties in recognising the different forms and estimating numbers for each species in mixed populations. The A-index gives detectable trends for 4 of the 15 species, indicating a presumable increase, a strong increase or a stable trend. For 11 species the data is not consistent for trend detection. The P-index gives detectable trends for 7 of the 15 species, indicating a presumable decline, a strong increase or a stable trend. For 8 species the data is not consistent for trend detection. The A-index and P-index presenting detectable trends are shown in table 2. The number of plots (Nplots) represents the situation in 2000. Two species in the table are surveyed at less than 10 plots (*Triturus helveticus* and *Hyla arborea*). The other species in the table are surveyed at 26 up to 114 plots. For each index the slope and its error is given, calculated using Poisson regression. The slope presented in the table is calculated using the regression line through an arbitrary value at the Y-axis. The interpretation is assigned by TRIM (Pannekoek & van Strien, 1998).

Table 2 The A-index and P-index given for species with detectable trends. For the non-listed species the data is not (yet) consistent to present a reliable interpretation.

A - indices 2000 national (non weighed)								
Species	1997	1998	1999	2000	Nplots	Slope	ErrSlope	Interpretation
Triturus vulgaris	100	107	98	96	102	0,9805	0,0383	more or less stable (<50% in 5 yr.)
Bufo bufo	100	98	114	101	108	1,018	0,0332	more or less stable (<50% in 5 yr.)
Rana temporaria	100	106	106	120	114	1,0581	0,0406	presumable increase
Rana esculenta synklepton	100	136	161	152	111	1,1542	0,0382	significant strong increase (>75% in 5 yr.)
P - indices 2000 national (non weighed)								
Species	1997	1998	1999	2000	Nplots	Slope	ErrSlope	Interpretation
Triturus helveticus	100	118	95	94	8	0,961	0,0436	more or less stable (<50% in 5 yr.)
Triturus vulgaris	100	104	95	87	102	0,9508	0,0361	more or less stable (<50% in 5 yr.)
Bufo bufo	100	95	103	88	108	0,969	0,0333	more or less stable (<50% in 5 yr.)
Bufo calamita	100	95	87	75	26	0,9104	0,0568	presumable decline
Hyla arborea	100	81	71	83	8	0,9314	0,0539	presumable decline
Rana temporaria	100	101	93	97	114	0,983	0,0338	more or less stable (<50% in 5 yr.)
Rana esculenta synklepton	100	136	147	139	111	1,1132	0,0371	significant strong increase (50-75% in 5 jr.)

Discussion

A-index or P-index?

Data over the first four years of monitoring based on the presence/absence of species is more consistent and produces detectable trends for more species as data based on the estimated abundance. This was expected. In general the presence of a species in the field is relatively easy to detect. One observation of an adult, egg clutch or larvae is sufficient for a positive registration. To estimate the number of animals involved requires more intensive survey. The estimation of abundance is easily effected by the activity of the animals (the weather, period of the day, season) and is biased by personal interpretation. Although the manual provides guide-lines for estimating the abundance it can be expected that observers judge the same situation different between years. The clear difference between both indices for *Rana temporaria* can be explained by the strong variety of the estimated abundance from year to year. For other species the abundances within plots does not vary strongly.

The preliminary results indicate a preference for the P-index as the index to define national trends in amphibian populations. The abundance data however is still considered as valuable in providing information about underlying patterns of trends. The A-index might serve as a control for the P-index as well.

Are we monitoring national trends?

The number of plots in which species are monitored varies strongly. For species that are monitored by random sampling it is not yet known how many plots are needed in order to represent the national population. As a rule of thumb in the Dutch Fauna Monitoring Programs Statistics Netherlands aims at a minimum of 25 plots where a species is monitored by random sampling. For widespread species the required number of plots might be higher. The rule of thumb implies that for eight of the target species discussed in this paper several new plots should be added to the program. For *Salamandra salamandra* and *Bombina variegata* there are just a very few plots in the Netherlands. Since 2000 these species are counted on all known locations.

Bufo calamita meets the minimum requirements with 26 plots. This species has its main distribution in the coastal region, where it is locally very abundant (Bergmans & Zuiderwijk, 1986). It is expected that this region inhabits about half of the national population. Seven of

the 26 plots where *Bufo calamita* is monitored until 2000 are located in the dunes, all in a restricted area in the southern part of the province Noord-Holland (figure 2). As a result the coastal area is strongly under sampled. In order to get a more representative sampling new plots are needed in other part of the dunes.
Given the overall distribution of plots, we can for neither species conclude that the program has a representative sampling. Even the plots of the more abundant species as *Triturus vulgaris, Bufo bufo, Rana esculenta* synklepton and *Rana temporaria* are not evenly distributed, since the northern and western part of the Netherlands are under-sampled. The fieldwork of the Amphibian Monitoring Program relies on volunteers, therefore also in future it can not be excluded that areas are under sampled to a certain degree.
Local trends might have a strong influence on the national index. To reduce this effect future indices will be calculated using a weight factor. Each plot is weighted according to the regional significance for the national trend. Plots in areas that are under sampled will get a larger weight than plots in areas that are over sampled.

Conclusion

The preliminary results discussed in this article indicate that the approach of the National Amphibian Monitoring Program might help to detect changes in amphibian populations. The program is still in development. In the near future the main target is to improve the representativeness of the program. New plots are needed especially in the western and northeastern areas. Further improvement is required for the method of trend calculation. Within a few years we expect to be able to produce reliable trends for most species. For this we owe great respect to the enthusiastic cooperation of many volunteers.

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