

The national amphibian monitoring program in the Netherlands and NATURA 2000

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Abstract. In the Netherlands, national flora and fauna monitoring programs are organised by NGOs in close cooperation with Statistics Netherlands. RAVON (Reptile, Amphibian and Fish Research Netherlands) is the NGO that coordinates the reptile and amphibian monitoring programs. For most species, volunteers collect the field data. Preferably, monitoring is carried out in all areas where a species is present. Providing data on the NATURA 2000 species *Triturus cristatus* and *Bombina variegata* has a high priority. In addition, the relatively widespread species in the Netherlands *Bufo calamita*, *Rana lessonae* and *R. arvalis* get special attention. Populations of the Annex IV species *Pelobates fuscus* and *Hyla arborea* are monitored within the scope of Species Protection Plans.

Introduction

In the Netherlands, national flora and fauna monitoring programs are organised by NGOs in close cooperation with Statistics Netherlands. The programs are carried out within the framework of the Network Ecological Monitoring (NEM). The NEM programs are funded by the Ministry of Agriculture, Nature and Food Quality. The main target of the NEM programs is to provide information for evaluation of Dutch nature policy. In the NEM there are programs for mycoflora, flora, birds, mammals, reptiles, amphibians, dragonflies, moths and butterflies.

RAVON (Reptile, Amphibian and Fish Research Netherlands) is the NGO that coordinates the reptile and amphibian monitoring programs (Zuiderwijk et al., 1999; Smit et al., 1999). The amphibian monitoring program developed into a network of, to date, more than 150 observers. New observers are recruited every year by promoting the program especially at local nature conservation and nature study groups, and by distributing biannual newsletters.

The main targets of the Amphibian Monitoring Program are:

- Detecting changes in populations of Habitats Directive species in the Netherlands and within NATURA 2000 areas.
- Detecting changes in populations of 'target' amphibian species of the Dutch Nature Policy Plan.

Target species for the Dutch nature policy are listed in the Nature Policy Plan of 1990. In 2004, the Dutch government proposed a list of Special Protection Areas, as part of NATURA 2000. This includes areas for *Bombina variegata* and *Triturus cristatus*, the two amphibian species in the Netherlands that are listed at Annex II, as well as Annex IV of the European Habitats Directive. In 2005, the NATURA 2000 target was added to the Amphibian Monitoring Program. In this article, we discuss the developments in the Program since its start and the consequences of the implementation of the NATURA 2000 target.

Target species

In the Netherlands, 16 native amphibian species are found. Nine species are considered as Red List species (Hom et al., 1996; Ministerie LNV, 2004). Seven species are listed at Annex IV, two species are also listed at Annex II of the Habitats Directive (table 1). As a result of the international reporting obligations, the focus of the Amphibian Monitoring Program recently switched from Red List species to Habitats Directive species. Providing data on the NATURA 2000 species *Triturus cristatus* and *Bombina variegata* has a high priority. In addition, the relatively widespread Annex IV species *Bufo calamita*, *Rana lessonae* and *R. arvalis* in the Netherlands get special attention. Populations of the Annex IV species *Pelobates fuscus* and *Hyla arborea* are monitored within the scope of Species Protection Plans.

Field methods

For most species, volunteers collect the field data. Preferably, monitoring is carried out in all areas where a species is present. For several species this

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requires a high investment of resources. In practise, coverage of the entire species' distribution area is only feasible for rare species and to some extent for species with a regionally restricted distribution.

On average, a monitoring unit is an area of a maximum one hundred hectares. Within this unit a number of potential breeding waters are sampled. This includes suitable reproduction sites as well as marginal reproduction sites. In areas with a large number of waters, where field surveys are relatively time consuming, we set a maximum of waters that can be handled within half a day of fieldwork. This implies that in most cases, volunteers invest half a day of fieldwork on each visit. Each year, all waters are visited approximately four times, including night-visits. For each water surveyed, all amphibian species are recorded. For each species the abundance is estimated and registered as an index-value (0-absent; 1-rare, some individuals are present; 2-common, approximately a dozen individual adults are present; 3-very common, several dozens or more are present). For rare species, the exact numbers of individuals are registered (Smit et al., 1999). The Amphibian Monitoring Program includes calling surveys of, for instance, *Hyla arborea* and *Bufo calamita*. Registering the numbers of calling males is an efficient way for surveying large areas (Pellet and Schmidt, 2005). For *Salamandra salamandra*, transect monitoring is applied by counting sightings along fixed routes. For every observer a handbook is available with detailed information about the methodology (Groenveld and Smit, 2001).

Index calculation

Indices and trends for the species are calculated using TRIM, a statistical program based on Poisson regression designed for fauna monitoring data with

missing values (Pannekoek and Van Strien, 1998, Van Strien et. al., 2001). Trends are presented with their slopes and standard errors. Annual indices represent the yearly numbers as a percentage of the numbers in the first year of monitoring. The index can be based on presence/absence and on the estimated abundance of a species. Assessing presence/absence is assumed to be more reliable than estimating numbers of animals. An index based on numbers of animals (abundance-index) is expected to be more sensitive for trend detection. We tested four options for calculating the indices:

1. the total presence per site as unit;
2. the total abundance per site as unit;
3. the total presence of all waters;
4. the total abundance of all waters.

The index based on the presence/absence can be interpreted to represent changes in local distribution (option 1). The index based on abundance represents the number of animals per sample site (option 2). The option for calculating the abundance differs for each species. In general, the procedure involves the following steps: 1) for each water-body the maximum abundance in a year is established, 2) the maximum abundances are summed.

Bufo calamita and *Hyla arborea* are an exception to this option. The index for this species is based on the maximum abundance per sample site per visit. This option takes into account the possible migrations of choruses within one season. For other species this behaviour is omitted. Tests performed by Statistics Netherlands did not indicate a dependency between waters within sample sites. Therefore a calculation based on presence/abundance in individual waters is also an option. This results in a higher number of units (larger sample size) and will increase the reliability (options 3 and 4).

Species	Red List	Habitats Directive	Occurrence
<i>Salamandra salamandra</i>	Threatened		Few localities
<i>Triturus cristatus</i>	Vulnerable	Annex II, IV	Nationally
<i>Triturus helveticus</i>	Vulnerable		Regionally
<i>Alytes obstetricans</i>	Vulnerable		Regionally
<i>Bombina variegata</i>	Endangered	Annex II, IV	Few localities
<i>Pelobates fuscus</i>	Threatened	Annex IV	Regionally
<i>Bufo calamita</i>		Annex IV	Nationally
<i>Hyla arborea</i>	Threatened	Annex IV	Regionally
<i>Rana arvalis</i>	Vulnerable	Annex IV	Nationally
<i>Rana lessonae</i>	Vulnerable	Annex IV	Nationally

Table 1. Target species of the Dutch Amphibian Monitoring Program and their status. Red List categories refers to the national Red List of the Netherlands.

Table 2. The four options for calculating indices with *Rana arvalis*.

1997	1998	1999	2000	2001	2002	2003	2004	n	slope	stdev
Indices based on presence per site										
100	116	122	122	104	124	128	102	42	1.0063	0.0246
Indices based on abundance per site										
100	116	121	118	89	128	128	97	42	1.0016	0.0230
Indices based on presence in all waters										
100	116	122	122	104	124	128	102	125	1.0064	0.0203
Indices based on abundance in all waters										
100	116	121	118	89	128	128	97	125	1.0016	0.0195

Table 3. The indices over 1997–2004 calculated over the total number of waters (*Triturus cristatus*, *Rana arvalis*, *R. lessonae*) or total number of sample sites (*Bufo calamita*).

Species	1997	1998	1999	2000	2001	2002	2003	2004	slope	stdev
<i>Triturus cristatus</i> 160 waters (54 sample sites)										
	100	115	121	102	96	104	104	136	1.0138	0.0224
<i>Triturus cristatus</i> in NATURA 2000 55 waters (16 sample sites)										
	100	115	140	82	80	103	75	161	1.0032	0.0341
<i>Rana arvalis</i> 125 waters (42 sample sites)										
	100	116	121	118	89	128	128	97	1.0016	0.0195
<i>Rana lessonae</i> 266 waters (sample 55 sites)										
	100	124	134	128	125	108	114	105	0.9916	0.0099
<i>Bufo calamita</i> 76 sample sites (251 waters)										
	100	91	98	111	93	81	80	80	0.9653	0.0387

Results 1997 - 2004

The Amphibian Monitoring Program has grown steadily from 61 sample sites in 1997 to 253 in 2004. The total numbers of waters that has been surveyed so far adds up to 2,200. Not all sample sites are visited annually. Some observers stop monitoring for private reasons. Of all sites that have so far been surveyed, about 50% were visited in 2004. Below we present the results of four more widely distributed target species and the contribution of volunteers to data collection.

The four options for calculating the indices mentioned above are given for *Rana arvalis* in table 2 as example. *R. arvalis* is monitored at 42 sites, in a total of 125 waters. If the standard deviation is below 0.02, we consider the indices to be reliable. The standard deviation using all water-bodies is better in comparison to the site indices. The last index, the total abundance of all waters, is the most reliable. We will use this approach to analyse the other Annex IV species.

Rana arvalis.—The development of the indices over the last eight years (table 3) shows a steady increase from 1997 to 2003 and low figures in 2001

and 2004. For the overall period the population of *Rana arvalis* is considered to be stable. The index is representative for its eastern distribution areas. Not all major areas where *R. arvalis* occurs are yet included.

Triturus cristatus.—The development of the indices at national level (table 3) shows an increase since 1997 with the highest index for 2004. The standard deviation is 0.0224. There is no trend in the indices at national level (Table 3). The indices for NATURA 2000 sample sites show a strong variation. The number of sample sites within NATURA 2000 is 16, observed in 55 water-bodies and can be considered to be still too limited for reliable trend detection.

Rana lessonae.—For most people it is not feasible to distinguish the three types of *R. esculenta* synklepton. People just monitor ‘green frogs’. The index of *Rana lessonae* is based on sample sites where, to our knowledge, *R. lessonae* is present. The index increased in the first period, but for the overall period the situation is considered to be stable. The standard deviation is 0.0099. All major distribution areas are included. The index is not corrected for over and under sampling. We intend to apply such corrections in the future.

Bufo calamita.—The coverage of the sample sites improved strongly since the introduction of routes that focus only on calling animals. The indices shows a decrease since 2002. The standard deviation is 0.0387. All major distribution areas are included. The index is not corrected for over and under sampling. We expect to detect reliable trends within the next two years of monitoring.

Discussion

The national Amphibian Monitoring Program exists since 1997. Reliable indices are available for species that are monitored within the framework of Species Protection Plans. Reliable indices are also available for the common species *Triturus vulgaris* (624 waters), *Bufo bufo* (703 waters), *Rana temporaria* (754 waters) and *R. esculenta* synklepton (806 waters). The number of surveyed waters for the target species *T. cristatus*, *B. calamita*, *R. arvalis* and *R. lessonae* is less than 25% of that of the common species. The limited set of data for target species affects the reliability of the indices. This reliability has improved considerably over the years with the increasing number of sample sites and longer data series per sample site.

The sample sites are not yet evenly distributed over the major distribution areas of the four species. Improvement of the coverage of the sample sites is one of the main targets for the near future. Weighing the indices of sample sites according to the surface of the area it represents can be applied to correct for over and under sampling. However, for the available data of the four species, applying weight factors results in a reduction of reliability. A substantial increase in the number of sample sites is still necessary to present national indices.

The reliability of the indices is affected by the nature of the data. A relatively high proportion of the field data is incidental. This is especially the case for *Triturus cristatus*. During subsequent visits the species is often only occasionally observed. This is assumed to be caused by low detection probabilities due to low densities or possibly inappropriate field methods. Observers will receive stricter instructions and novice observers will receive more intensive field training.

What is the conclusion for the implementation of the NATURA 2000 as a new target for the Amphibian Monitoring Program? Although national indices can be expected in the near future, this is not to be the

case for NATURA 2000 with the present collection of sample sites. The target is based on a subset of sample sites. The number of sample sites within NATURA 2000 needs to increase substantially to approximately 50 sites. In the larger areas several sample sites are necessary. The local availability of observers (volunteers) may be limiting for monitoring within NATURA 2000 areas. For the NATURA 2000 target professional input will be required for fieldwork. A cost-effective approach is proposed with at least one sample site per area that is surveyed annually and additional sites which are surveyed in a circulating program and frequency of once every three years.

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