Miaud C. & Guyetant R. (eds) • Le Bourget du Lac / France * SEH 1998 * Pages 397 - 402

A NATIONAL AMPHIBIAN MONITORING PROGRAM IN THE NETHERLANDS

GERARD SMIT, ANNIE ZUIDERWIJK
AND AXEL GROENVELD

University of Amsterdam, Department of Herpetology,
P.O. Box 94766, 1090 GT Amsterdam, THE NETHERLANDS

Abstract: The Dutch amphibian monitoring program started in 1997 to detect changes in amphibian populations in the Netherlands. Sixteen amphibian species are native to the Netherlands. Nine of these species can be found on the national red list, and are considered as threatened species. Populations of these threatened species are declining very rapidly as a result of human interference and environmental factors.
While setting up a monitoring network we encountered two methodological problems. First, amphibians can have large natural fluctuations in population size. Even in stable communities the number of observed amphibians within one pond often shows strong variation from year to year. Therefore, yearly variation in estimated population size is not always representative of trends in the status of a species. Secondly, in the Netherlands pond creation projects are carried out to increase the number of ponds. Monitoring individual ponds therefore does not reflect the situation in an area.
The amphibian network concentrates on the aquatic (reproduction) phase, except for *Salamandra salamandra* which is counted by terrestrial monitoring. The survey unit is an area of 100 ha which contains a minimum of three (potential) reproduction sites. Plots are visited 3 to 4 times a year, in the breeding season. During each visit the observed species are recorded for all water bodies. Their presence (not present, rare, common, abundant) is estimated 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 equipment used are torch and dip net.
The network detects changes in local distribution and average abundance. The total number of breeding sites per species is evaluated, as is the estimated numbers per site.
The network started in 1997 with 41 plots including 230 different water bodies. Our target is a minimum of 100 plots, with each species being present in a minimum of 10 plots. Volunteers and employees of nature conservation organisations carry out the surveys. Results are checked for questionable data and direct feedback to the observer is possible.

INTRODUCTION

The Dutch association for reptile, amphibian and fish research in the Netherlands (RAVON) co-ordinates two national monitoring networks, a reptile network and an amphibian network. The government funds both networks. Both networks rely strongly on the participation of volunteers. The Reptile Network is described in these proceedings by Zuiderwijk et al. This paper describes the approach for the Amphibian Network.

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 change in land use and change in water management. More intensive agriculture, more effective drainage systems, urbanisation, increasing infrastructure and organic deposition ("acid rain") all contribute to an ongoing habitat loss and habitat fragmentation for amphibians (Creemers, 1996). These are the main threats for many species of flora and fauna in the Netherlands.

NATURE POLICY PLAN

In 1990 the Dutch government published the Nature Policy Plan, in which it adopted the concept of developing a National Ecological Network (Ministerie LNV, 1990). This NEN is a network of core areas connected by ecological corridors. Core areas are defined as existing nature reserves, national parks, and nature development areas and agricultural areas with an important function for nature.
The Nature Policy Plan defines species which need specific measures of nature policy for conservation. Evaluation of the national nature policy is the motivation for the Amphibian Network. The Dutch government therefore funds the Network Ecological Monitoring. Besides the Amphibian Network, the Network Ecological Monitoring includes networks for another six species groups: reptiles, birds, butterflies, mammals, flora and mycoflora.

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.

All targets contribute to the evaluation of national nature and environmental policy.

TARGET SPECIES FOR THE AMPHIBIAN NETWORK

In the Netherlands sixteen native amphibian species are found. Nine species occur on the Red List. Two of these species are seriously threatened. *Bombina variegata* has always had a limited distribution in the Netherlands and is recently known from only one location. For *Salamandra salamandra* only two isolated populations still exist. The other seven species on the Red List are threatened or vulnerable.
For the Amphibian Network eleven target species have been selected (Table 1). The list of target species includes all the Red List species plus *Triturus alpestris* and *Bufo calamita*. The latter two species have

Target species	Red List
Salamandra salamandra	Threatened
Triturus alpestris	not included
Triturus cristatus	Vulnerable
Triturus helveticus	Vulnerable
Alytes obstetricans	Vulnerable
Bombina variegata	Threatened
Pelobates fuscus	Threatened
Bufo calamita	not included
Hyla arborea	Threatened
Rana arvalis	Vulnerable
Rana lessonae	Vulnerable

Tab 1: Target species of the Nature Policy Plan of the Netherlands and their status (LNV, 1990; Creemers, 1996)

a restricted distribution but are not yet considered as threatened or vulnerable. The Netherlands has an international responsibility for the conservation of those two species (Creemers, 1996).
Target species are mainly distributed within core areas of the National Ecological Network.
Five species are not recorded as target species, as they are considered fairly common species.

National Ecological Network

The NEN is expected to be realised within a period of thirty years (LNV, 1990). The NEN is used as an instrument to stop or even reverse the process of habitat loss and habitat fragmentation. The Amphibian Network will try to answer questions like: To what extent do amphibians inhabit potential habitats? Are amphibians able to colonize newly developed nature areas? Some populations of target species occur outside the NEN. Conservation of these populations deserve special attention since their breeding sites are not protected. The NEN is not designed as a nature refuge, but should serve as a sustainable source for nature to colonize rural areas. In order to evaluate national populations the Amphibian Network should not focus only on NEN areas but include sites outside the NEN as well.

THE NETWORK DESIGN

Amphibian inventories in the Netherlands usually focus on breeding sites. Most native species have a restricted breeding period in which adults gather in and around water bodies. Surveys conducted at breeding sites are an effective way of monitoring amphibian populations (Heyer et al, 1994). Designing a monitoring network for amphibians implies handling of some fundamental problems in amphibian monitoring.

Selecting the unit of monitoring

An amphibian population can make use of different breeding sites within one year and between years. The number of animals found at a site in a specific year depends on local circumstances. Shallow ponds, for example, might be temporarily unsuitable for breeding in dry years or after the pond fills up with helophytes as reed or *Typha*. In successive wet years or after removal of the vegetation, the absence of aquatic predators such as fish might result in very successful reproduction. If several suitable breeding sites are present in an area animals might migrate between those sites within one breeding season. Regular migration between breeding sites is known, for instance, in *Triturus* species (Kroese & Van Leeuwen, 1979) and *Bufo calamita* (Sinsch, 1992). There is also evidence for water frogs that suggests that populations depend rather on a network of water bodies than on single breeding sites (Gulve, 1994; Bressi, 1998).
The conclusion is that a change in numbers at one individual breeding site does not necessarily reflect a change in population size. The individual animals simply might have moved to an adjacent breeding site. Taking this into consideration, the unit of monitoring preferably includes a group of potential breeding sites. The guide-line for selecting a monitoring unit is an area of 100 hectare. This area should include a minimum of three water bodies, which serve as potential breeding sites. The area should be located in one type of landscape and not dissected by motorways or other elements that might serve as barriers for migration. The selection of units is restricted to areas with at least one target species.
In several regions of the Netherlands the number of breeding sites is increasing due to local pond creation projects. In other areas ponds still disappear as a result of the lack of maintenance or filling in. The area based approach makes it possible to

evaluate the effects of creating breeding sites or loss of breeding sites. An area based approach is also known from other studies (Scott & Woodward, 1994).

SURVEY TECHNIQUES

The most efficient survey technique for estimating numbers of animals varies between species. For some anuran species estimating the number of calling males is an efficient method to provide information about the adult population size. It is useful for species with clear distinguishable calling activity like *Bufo calamita*, *Hyla arborea*, *Rana arvalis* and *Rana lessonae*. For species like *Pelobates fuscus* and *Bombina variegata* this method is less reliable. Estimating the number of calling males is used in the North American Monitoring Program (Bishop et al., 1994; NAAMP, 1996). Estimating the number of egg clumps (Griffiths & Draper, 1994) is useful for species with clumps that can easily be seen on the surface of the water. This counts for *Rana temporaria* only, which is not a target species of the Amphibian Network.

For *Triturus* species the most efficient method depends on the type of water to be surveyed. In shallow water bodies with little vegetation the observation of eggs, larvae and adults reveals the relative abundance of the species present. Night counts, using a torch, is a simple and effective method (Cooke, 1995). In water bodies with dense vegetation, dipnetting is necessary to obtain additional information. Amphibian traps require regular checking, up to several times a day in shallow, warm water bodies (Griffiths, 1985; Mölle & Kupfer, 1998). Because using traps is time consuming and carries a risk of fatalities, this method is unsuitable for volunteers.

There is no one reliable standard method for estimating numbers of animals that can be applied in different situations which is easy for volunteers to use. Therefore the network relies on the judgement of volunteers in choosing the methods for inventory. The guide-lines for available methods and the situations in which they can be applied have been described in a manual that is sent to each participant. A simple guide-line for the determination of amphibians in their successive developmental stage is also available.

The exception to the described survey techniques is *Salamandra salamandra*, the only native terrestrial salamander. For this species a visual encounter survey is used, by counting the observed animals at night along a predefined transect (compare: Crump & Scott, 1994; Jaeger, 1994).

ESTIMATING NUMBERS OF AMPHIBIANS

For each field survey the observed numbers of eggs, larvae and adults are recorded for each species and water body. When large numbers of animals are present, the estimation of numbers often becomes problematic. For instance, estimating small numbers of calling males requires relatively little effort. When large choirs are involved the estimation of the total calling population might show a considerable variation between observers. The North American Amphibian Monitoring Program developed the so called Wisconsin index for calling amphibians. This index is adopted by the Dutch Amphibian Network, it is presented in Table 2.

Index Value	
0	No amphibians calling
1	Individuals can be counted. There is space between the calls.
2	Calls of individuals can be distinguished but there is some overlapping of calls.
3	Full chorus. Calls are constant, continuous, and overlapping.

Tab 2: Wisconsin index values for calling amphibians (NAAMP, 1996).

The lack of a standard method for estimating numbers of newts, makes trend analysis based on the actual observed numbers disputable. Changes in numbers are easily biased. Observers are therefore asked to assign an index value for each species based on their judgement of the field observations. The index value gives

the status of each species for each water body. The value is expressed by four index classes: the species is not present, rare, common or abundant. Guide-lines showing how to apply the index to each developmental stage of the different species are described in the manual (Groenveld, 1997).
Amphibian populations often show strong natural fluctuations (Gollman, 1986; Arntzen & Teunis, 1993) and show changes in local distribution patterns (Schoorl & Zuiderwijk, 1981). Trends in the number of water bodies occupied by a species are expected to be more representative than trends based on actually observed numbers. An analysis of this approach has yet to be carried out.

PRELIMINARY RESULTS

In 1997 the Amphibian Network started with 41 monitoring units. Although all native species are represented, the selected units are not yet representative of the Dutch situation. Not all distribution areas are yet equally sampled. The number of units is expected to be doubled in 1998. The aim is to survey a representative network with a minimum of 100 units by the year 2000.
The 41 monitoring units represent a total of 232 surveyed water bodies, an average of 6 water bodies per unit. An average of 4 to 5 species per unit where observed, with a maximum of 9 species. The units where visited 3 to 4 times during the breeding season, with an average of 2,5 hours per visit. In 1997 a total of 360 hours of field work was invested in the monitoring network, most of it by volunteers.

FEEDBACK TO OBSERVERS

Recruitment of observers is done by presentations at herpetological, nature and environmental events, publications in periodicals and maintaining a website. Non-governmental nature conservation organisations show interest in the results of the network for evaluation of their management practices. They are requested to co-operate or participate in the field work with their own employees .
Participation is strictly on a voluntary base. Every participant receives feedback of the network by means of a newsletter which is published twice a year.

REFERENCES

- ARNTZEN, J.W. & S.F.M. TEUNIS (1993). A six year study on the population dynamics of the crested newt *Triturus cristatus*, following the colonization of a newly created pond. Herpet. J. 3.
- BISHOP, C. , D. BRADFORD, G. CASPER, S. CORN, S. DROEGE, G. FELLERS, P. GEISSLER, D. M. GREEN, R. HEYER, M. LANNOO, D. LARSON, D. JOHNSON, R. MCDIARMID, J. SAUER, B. SHAFFER, H. WHITEMAN, AND H. WILBUR (1994). A Proposed North American Amphibian Monitoring Program. Proceedings from the 1994 North American Amphibian Monitoring Program Conference.
- BRESSI, N. (1998): Habitat fragmentation, metapopulation dynamic and declining amphibian population: a field evidence in Green frogs (Rana kl. esculenta). In Programme and Abstracts of the 9th Ordinary General Meeting of the SEH, Chambery.
- COOKE, A.S. (1995). A comparison of survey methods for crested newts (*Triturus cristatus*) and night counts at a secure site, 1983-1993.
- CREEMERS, R.C.M. (1996): Threatened and vulnerable reptiles and amphibians in the Netherlands; Proposal for the Red Data List. Publicatiebureau Stichting RAVON, Nijmegen. [in Dutch with English summary].
- CRUMP, M.L. & N.J. SCOTT JR (1994). Visual Encounter Surveys. In Heyer et al. 1994, Measuring and monitoring biological diversity. Standard methods for amphibians. Smithsonian Institution.
- GOLLMAN, G. (1986). Genetic analysis of *Bombina* hybrids from Eastern Slovakia. In Proceedings of the European Herpetological Meeting /3rd Ordinary general Meeting of the Societas Europaee Herpetologica/ Prague 1985. Charles University, Prague.
- GRIFFITHS, R.A. (1985). A simple funnel trap for studying newt populations and a evaluation of trap behaviour in smooth and palmate newst, *Triturus vulgaris* and *T. helveticus*. Herpet. J. 1, 5-10.
- GRIFFITS, R.A. & S.J. DRAPER (1994). How many clumps are there in a mass of frog spawn? The British Herpetological Society Bulletin, 50: 14-17.

- GROENVELD, A. (1997). Manual for the monitoring of amphibians in the Netherlands. RAVON Werkgroep Monitoring / CBS, Amsterdam. [in Dutch]
- GULVE, P.S. (1994). Distribution and extinction patterns within a northern metapopulation of the Pool frog, *Rana lessonae*. Ecology, 75(5): 1357-1367.
- HEYER, W.H., M.A. DONNELLY, R.W. MCDIARMID, L.C. HAYEK & M.S. FOSTER (1994). Measuring and monitoring biological diversity. Standard methods for amphibians. Smithsonian Institution, Washington.
- JAEGER, R.G. (1994). Transect sampling. In Heyer et al. 1994, Measuring and monitoring biological diversity. Standard methods for amphibians. Smithsonian Institution.
- KROESE, J. & F. VAN LEEUWEN (1976). Amphibians in the surroundings of Ambleteuse. Verslagen en technische gegevens No. 19, Universiteit van Amsterdam, afdeling Herpetologie, Amsterdam. [in Dutch]
- MÖLLE, J. & A. KUPFER (1998). Amphibien mit der Auftauchfalle: Methodik und Evaluierung im Freiland. Zeit. Feldherp. 5, 219-227.
- MINISTERIE LNV (1990). National Nature Policy Plan. Ministry of Agriculture, Nature Conservation and Fisheries, The Hague: SDU publishing business. 272 p. [in Dutch]
- NAAMP, 1996: URL: http://www.im.nbs.gov/amphibs.html
- SCHOORL, J. & A. ZUIDERWIJK (1981). Ecological isolation in *Triturus cristatus* an *Triturus marmoratus* (Amphibia: Salamandridae). Amphibia-Reptilia 3/4: 235-252.
- SCOTT, N.J. & B.D. WOODWARD (1994). Surveys at breeding sites. In Heyer et al. 1994, Measuring and monitoring biological diversity. Standard methods for amphibians. Smithsonian Institution.
- SINSCH, U. (1992). Structure and dynamic of a natterjack toad metapopulation (*Bufo calamita*). Oecologia 90: 489-499
- ZUIDERWIJK, A., A. GROENVELD & G. SMIT, this volume. Monitoring of reptiles in the Netherlands.