Rákosi Vipera

Population and Habitat Viability Assessment for the Hungarian Meadow Viper (*Vipera ursinii rakosiensis*)

Population and Habitat Viability Assessment (PHVA) For the Hungarian Meadow Viper (*Vipera ursinii rakosiensis*)

5 – 8 November, 2001
The Budapest Zoo
Budapest, Hungary

Workshop Report

A Collaborative Workshop:
The Budapest Zoo
Conservation Breeding Specialist Group (SSC / IUCN)

Sponsored by:
The Budapest Zoo
Tiergarten Schönbrunn, Vienna

A contribution of the IUCN/SSC Conservation Breeding Specialist Group, in collaboration with The Budapest Zoo.

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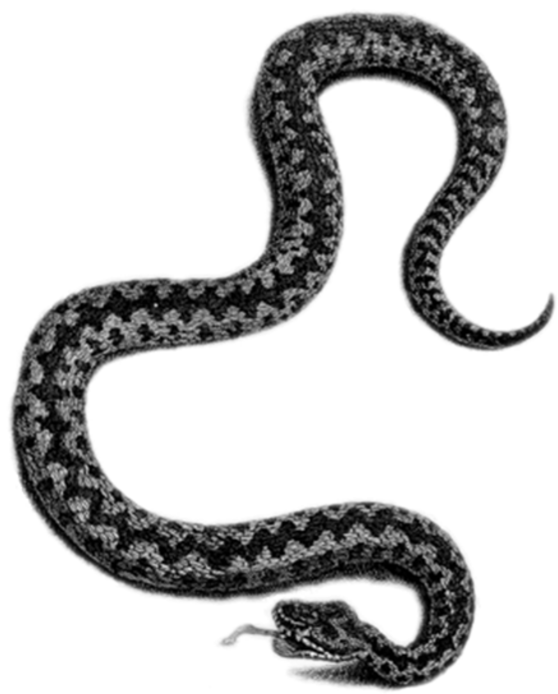

Section I
Executive Summary

Hungarian Meadow Viper (*Vipera ursinii rakosiensis*) Population and Habitat Viability Assessment (PHVA) Workshop Executive Summary

Introduction

The Hungarian meadow viper was first described by the prominent Hungarian zoologist Lajos Méhely in 1893. The name of the snake in Hungarian – rákosi vipera – is derived from the type locality, a meadow on the banks of the Rákos River (Rákos-patak) near Budapest. Since that time, these meadows have been swallowed up by the expanding national capital and the last vipers likely died in the first half of the 20^{th} century. Another Hungarian name – parlagi vipera or "meadow viper" – was introduced in the 1950s when communist dictator Mátyas Rákosi was Hungary's leader. Due to the similarities between his last name and the original description of the subspecies, he requested that the Hungarian Natural History Museum return the name to rákosi vipera. Despite this political designation, the more recent name better describes the viper and its ecology so many people prefer to retain the name "parlagi vipera".

It was not until the 1960's that the taxon was officially designated *Vipera ursinii rakosiensis* (although the subspecific status, from the taxonomic point of view, remains unclear). The former distribution of the taxon included the easternmost part of Austria, Hungary, Transylvania (Romania) and northern Bulgaria. However, at the present time the meadow viper is found in only two regions in Hungary: in the Great Hungarian Plain between the Danube and Tisza Rivers, and in the Hanság Nature Reserve in the northwestern corner of the country. Typical lowland steppe habitat in these remaining regions is characterized by patches of grass and sedge species including *Molinia coerulea*, *Festuca sulcata*, *Stipa capillata* and *Chrysopogon gryllus*. Females of this ovoviviparous species appear to give birth every other year, usually in July through August. Typical clutch sizes range from 6 to 14 individuals.

The Hungarian meadow viper has received full legal protection in Hungary since 1974 and is a high-profile species in the nation's conservation legislation activities. Nevertheless, the viper continues to be very susceptible to human persecution. In addition, human agricultural activities such as intensive grazing, burning, and machine mowing appear to constitute a grave threat to the viper and its habitat. To make matters worse, the taxon appears to be unusually sensitive to both human and natural disturbance. Because of significant declines in population size and habitat over the past two decades, the viper is listed in the 2000 IUCN Red List as Endangered. In addition, it is listed as a CITES Appendix I and Bern Convention Annexe II subspecies.

While some data on the population biology and ecology of the Hungarian meadow viper have been described, there is much yet to be learned about its population demography, the nature of its interaction with an intensively-altered landscape, and the most effective means for minimizing the risk of population extinction. Researchers in Budapest have identified the need to develop an Action Plan to guide future research and conservation activities. The PHVA workshop process developed by CBSG is ideally suited to catalyze this task.

The PHVA Workshop Process

In order to better understand the factors leading to the precipitous decline of the Hungarian meadow viper, and to develop a set of alternative population management options, The Budapest Zoo requested a Population and Habitat Viability Assessment (PHVA) Workshop. The workshop was held at the Zoo 5 – 8 November 2001, and was facilitated by the Conservation Breeding Specialist Group (CBSG) of the IUCN Species Survival Commission. A total of twenty-one people from nine European countries attended the workshop, including National Park representatives, university and NGO researchers, and zoo biologists working together closely throughout the duration of the meeting to discuss issues and assess the available biological and social information relevant to Hungarian meadow viper conservation. Workshop sponsors included The Budapest Zoo and Tiergarten Schönbrunn, Vienna.

At the beginning of each PHVA workshop, the participants derive a shared vision that guides their activities throughout the duration of the meeting: To prevent extinction of the species by maintaining viable populations in the wild. The workshop process then takes a detailed look at the species' life history and population dynamics, current and historical distribution and status, and uses this information to assess the impact of the various threats that are thought to place the species at risk. A crucial outcome of a PHVA workshop is that a substantial amount of information – much of which has not been published or subjected to external review – can be assembled and assessed through expert analysis. This information can be from many sources; those with a wide variety of expertise as well as those having a particular stake in the future of the species are encouraged to contribute their knowledge. In this way, all the data are given equal importance and consideration.

Once assessed for relevance and accuracy, the appropriate data are used to develop a computer simulation model of the growth dynamics of the population(s) under consideration. The general purpose of the model is to determine: i) the risk of population decline or perhaps even extinction under current environmental conditions; ii) those factors most responsible for generating this risk; iii) those aspects of a population's biology and ecology that tend to drive its projected growth. In effect, these modeling techniques provide an objective, neutral platform for assessing information, testing hypotheses, and assisting managers in the conservation decision-making process.

Complimentary to the population modeling effort is a dynamic process of group deliberation that forms the foundation of the workshop activities. Participants work together to identify the key issues affecting the conservation of the species and then tackle their implications within topic-based working groups. Each working group produces a report of their deliberations, which are assembled along with other information to produce this report. A successful PHVA workshop depends on determining an outcome where all participants, many coming to the meeting with different interests and needs, gain added benefits through the development of a management strategy for the species in question. Most importantly, working group recommendations are developed by, and therefore become the property of, the local workshop participants.

The Hungarian Meadow Viper PHVA Workshop

At the beginning of this workshop, the participants were asked to give individual answers to the following three questions:

- What is your personal goal for this workshop?
- What, in your view, is the primary challenge for conservation of the Hungarian Meadow Viper over the next 25 years?
- What do you wish to contribute to the workshop?

(See Appendix A for detailed responses.) This exercise clearly indicated that the primary challenges for viper conservation revolved around agency-specific habitat management conflicts, and the absence of successful communication / collaboration between the scientific and management communities. In addition to these two general themes, a smaller set of people expressed an interest in the feasibility of ex situ conservation of the taxon in the region. Based on all of this information, three working groups were formed – habitat management, life history / population viability modeling, and captive population management.

Each working group was asked to:

- Examine the list of problems and issues affecting Hungarian Meadow Viper survival as they fell out under each working group topic, and expand upon the list if needed.
- Consolidate when needed and prioritize the list of problems and issues.
- Beginning with the highest-priority issues, develop broader strategies and, ultimately, detailed actions designed to address each of the identified problems
- Prioritize the strategies to give a complete picture of the recommendations developed by the group.

Working groups presented the results of their discussions in daily plenary sessions to ensure that everyone had an opportunity to contribute to the work of the other groups and to facilitate the review of the full body of work being produced. Recommendations stemming from the workshop were accepted by all participants, thereby representing a shared agreement of the direction needed after the conclusion of the workshop.

Working Group Summaries and Recommendations

Life History and Population Viability Modeling

The Life History and Population Viability Modeling working group developed a prioritized list of relevant problems and issues pertaining to the conservation of the Hungarian meadow viper. Highest priority issues included the lack of detailed demographic data on this taxon, which made accurate quantitative modeling of future growth dynamics very difficult at best. In addition, the group recognized the importance of population modeling as a tool to guide development of population management strategies and to assist in the prioritization of research studies and/or methodologies. The group also saw that it is very important to be able to distinguish between natural and human-caused sources of variability in population growth dynamics, and to use this knowledge to decide when to intervene to avoid further population decline or perhaps even extinction. In order to do this, however, it is important to document the recent history of the species' decline in the wild, and to identify the primary forces that caused the decrease in viper numbers.

In order to investigate the population dynamics of the Hungarian meadow viper and the risk imposed by human activities on the viper's habitat, we developed a stochastic simulation model of the species using the computer modeling package known as *VORTEX*. In the absence of detailed field data on this species, we used relevant data from other meadow viper species/subspecies where available and appropriate. Using this modeling approach, the group developed a demographic sensitivity analysis that identified the importance of female reproductive characteristics – namely age of first reproduction, interbirth interval, mean clutch size, and adult female mortality – as primary determinants of population growth dynamics. In addition to this sensitivity analysis, we worked with members of the Habitat Management working group to develop scenarios simulating the impact of natural catastrophes (severe spring floods) and man-made catastrophic events (meadow burning resulting from military activity, mechanical cutting, livestock grazing, etc.). These scenarios demonstrated the considerable impact that these forces can have on meadow viper population growth; particularly in the presence of fire hazards, viper populations can be expected to decline rapidly and to face a significant risk of local extinction within the next few decades.

We also worked with the Captive Population working group to investigate the impact of removing a small number of individuals from locally isolated populations in order to initiate a founder stock for captive breeding. In general, and as long as additional human disturbance to the habitat is minimized, a population as small as just 30-40 adults could tolerate an annual removal of 3 adult females over a period of 4–5 years. However, the precise cost of this removal is dependent on the underlying rate of natural mortality in the source population. Conducting this removal operation for a shorter time period such as 2–3 years would be more prudent from the standpoint of source population security.

With these analyses in hand, the group developed a series of goals designed to address the issues discussed above. These goals included the construction of detailed demographic studies designed to improve our understanding of Hungarian meadow viper population biology and our ability to properly target population management strategies; the refinement of population viability models utilizing these new demographic data; to assemble and review relevant data to document the recent history of population decline; and to develop means to improve communication not only among meadow viper researchers throughout Europe, but also between these researchers and the involved management authorities within Hungary.

Specific actions, with identification of responsible parties and expected timelines for completion, were developed for selected goals. We did not have sufficient time to develop the details of all actions.

1. Obtain additional demographic and genetic data in order to improve our understanding of the population biology of *V. u. rakosiensis* and to enhance our ability to effectively manage its population in the wild.
   A. Carry out an annual census: transect (in 2-3 selected habitats) or CMR method (in one habitat with the highest population density);
   B. To train people (volunteers, students, National park staff) to prepare them for assisting professional herpetologist in the field (transect, CMR method);
   C. Collect data from different datasets and create a unified database;

   D. Prepare and disseminate a protocol (instructions) for standardizing field methods;
   E. Carry out genetic study of populations as many as possible (3-4).

2. Estimate the minimal viable population size (MVP) in order to evaluate the probability of extinction in different time scales.
   A. Compile a list of natural and human induced factors influencing populations of *V. u. rakosiensis*, determining their frequency and severity;
   B. Estimate the influence of natural and human induced factors on different parameters of viper populations using census methods in different habitats;
   C. Implement relevant computer analysis methods (*VORTEX*) using collected demographic and genetic data;
   D. Carry out a demographic sensitivity analysis using demographic data and the knowledge of natural and human induced factors on *V. u. rakosiensis* populations.

3. Confirm causes of the decline of *V. u. rakosiensis* populations using historic data.
   A. Collect historical information on habitat changes taking into consideration traditional and modern land use and management;
   B. Identify habitat related causes of decline using GIS analyses of vegetation, land use and other maps;
   C. Obtain information on the extent of illegal collection of individual vipers.

4. Reveal new localities of *V. u. rakosiensis* for facilitating the conservation output.
   A. Identify regions suitable for *V. u. rakosiensis* using vegetation and land use maps;
   B. Check all potential sites, undertaking intensive field investigations;
   C. Build up an international cooperation on this task (Austria, Croatia, Romania, and Yugoslavia).

5. Improve communication among scientists in order to facilitate data exchange and information updating.
   A. Compile an information base on scientists dealing with the *V. ursinii* complex;
   B. Form working groups;
   C. Organise further symposia;
   D. Publish proceedings of symposia and disseminate reports and other information reflecting the progress in *V. u. rakosiensis* study and conservation.

6. Establish greater understanding and cooperation among scientists, managers and officials in order to minimise mistakes in *V. u. rakosiensis* management and to achieve more effective conservation.
   A. Organise a seminar by scientists for managers and officials in order to introduce them to the ecology and biology of the viper;
   B. Approve the *V. u. rakosiensis* Action Plan as an official document for implementation;
   C. Establish cooperation between all stakeholders discussing problems and progress in *V. u. rakosiensis* conservation.

Habitat Management

Being aware that the decline of *Vipera ursinii rakosiensis* is still going on, the working group agreed about the following goals and actions to be the most urgent ones:

1. Achieve consensus on the priority of the conservation of *Vipera ursinii rakosiensis* by arranging a high level decision making meeting in the ministry to, amongst others goals, initiate species recovery and develop an Action Plan;
2. Achieve proper habitat management with special emphasis on tussock habitat;
3. Develop a consensus on the issue of species habitat management vs. ecosystem management;
4. Determine the likely impact and extent of proposed water retention on present *Vipera ursinii rakosiensis* habitat and determine alternate scenarios on habitat quality (Must avoid drowning or freezing individuals within threatened populations, unless or until alternative adjacent habitat has been developed);
5. Guide recovery of *Vipera ursinii rakosiensis* by preparing a map(s) showing existing and recent sites, potential and restoration / linkage habitats; transfer data to G.I.S.

Captive Population Management

According to the present knowledge the wild population of Hungarian Meadow Vipers exists under the serious risk of total extinction. The group designated and discussed the key problems associated with the critical situation of the taxon and who should be responsible for it. The evaluation of available data on the wild population resulted in the consensus that there is an urgent need to create *ex situ* conservation project for the Hungarian Meadow Viper. It is vital to establish a parallel population in captivity as a safety net, as a source of individuals for reinforcement and reintroduction actions, and as a source of valuable information for in situ conservation.

The group identified a number of issues and problems, and condensed them into four main goals. These are necessary to start the development of the base for the *ex situ* conservation of the Hungarian Meadow Viper:

- To build perspective "zoo population" with the sufficient breeding potential to serve as a gene reservoir;
- To create a breeding facility directly at Kiskunság – allowing breeding in semi-natural conditions;
- To find effective co-operation between the existing breeding facilities;
- To develop an adequate reintroduction strategy.

To accomplish individual goals we identified concrete action steps when it was available or outlined our ideas and give our recommendations for future *ex situ* conservation.

1. We recommend establishing the zoo population at Budapest Zoo, which will serve as the source of individuals for reintroduction to convenient localities already not inhabited by wild HMV but in the frame of the historical distribution of this subspecies.

2. Moreover, we recommend establishing the breeding facility at Kiskunság, where the animals will be kept under semi-natural conditions, and will serve as a source of individuals for reinforcement of the Kiskunság local wild population.
3. The following action steps are recommended: 1) immediately to start with Budapest Zoo captive program; 2) to prepare the project for the Kiskunság breeding facility; 3) to build the Kiskunság breeding facility as soon as possible; 4) to start with the removal of founders from the wild when the facilities are prepared (see the details in Section IV).

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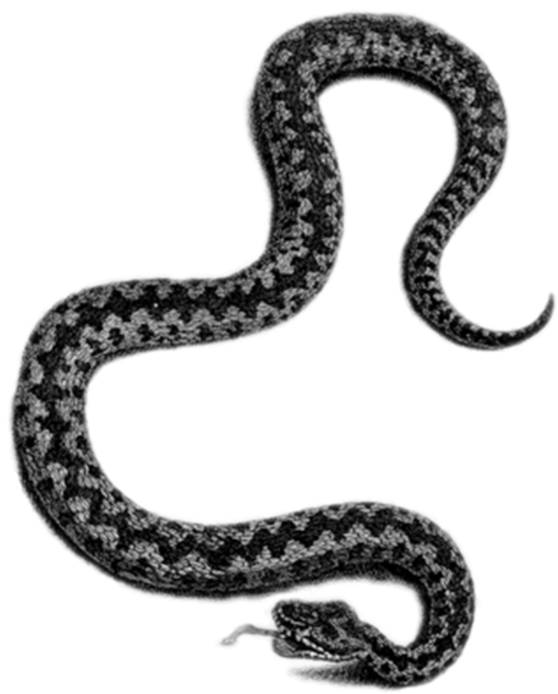

Section II
Life History and Population Viability Modeling

Life History & Population Viability Modeling

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Phil Miller, Conservation Breeding Specialist Group, USA

Introduction

While some data on the population biology and ecology of the Hungarian meadow viper have been described, there is much yet to be learned about its population demography, the nature of its interaction with an intensively-altered landscape, and the most effective means for minimizing the risk of population extinction. This Population and Habitat Viability Assessment workshop provided an excellent opportunity to bring together ecological and demographic data on remnant Hungarian meadow viper populations. We can then use computer modeling tools to evaluate the extent of our knowledge and to identify gaps in that knowledge that must be remedied if we are to successfully minimize the risk of species extinction.

Problem Formulation

The group used a brainstorming technique to identify the primary issues or problems impacting the conservation of the Hungarian meadow viper. These issues included:

- How do we separate natural processes, such as normal environmental variation, from the artificial forces (e.g., landscape modification) that can both influence meadow viper demographic rates? How do we know that significant demographic variation across years is the result of human impact? How do we know when have to intervene?
- Very little demographic data is available for this species (these data include exact population size, age structure, age specific survival and mortality rates, metapopulation structure).
- There is a general absence of standardized methods for demographic data collection.
- Is there a central location within which different field demographic and ecological datasets are assembled?
- There is very little communication between meadow viper scientists in different countries.

- It is very difficult to collect demographic data on such a secretive animal. Consequently, we are forced to extrapolate using data from related forms (*V. u. ursini, V. renardi, V. u. macrops*)
- We must recognize the importance of incorporating natural sources of variability into population demographic models.
- It is important to identify new localities of the subspecies. For example, there has been some information to suggest that a small number of individuals of *V. u. rakosiensis* may exist in Croatia. These claims need to be substantiated.
- Can we determine a minimum viable population size for the meadow viper in Hungary?
- Can we identify past and present agents of meadow viper population decline in Hungary? Can we track its recent history?
- What kind of demographic data do we have? What do we know and what do we not know?

We were then able to reduce these eleven problem statements down to a final set of six, where were finally ranked using the paired-ranking technique (total group scores shown in parentheses). It is important to note that this ranking is a group average; there was marked levels of variability among group participants in individual ranking analysis.

1. Very little demographic data is available for this species (these data include exact population size, age structure, age specific survival and mortality rates, metapopulation structure). What do in fact know, and what data are missing? How do we standardize methods for demographic, genetic, and ecological data collection in the field? (49)
2. Can we determine a minimum viable population size for the meadow viper in Hungary? (41)
3. How do we separate natural processes, such as normal environmental variation, from the artificial forces (e.g., landscape modification) that can both influence meadow viper demographic rates? How do we know that significant demographic variation across years is the result of human impact? How do we know when have to intervene? (38)
4. Can we identify past and present agents of meadow viper population decline in Hungary? Can we track its recent history? (32)
5. There is very little communication between meadow viper scientists in different countries. (10)
6. It is important to identify new localities of the subspecies. For example, there has been some information to suggest that a small number of individuals of *V. u. rakosiensis* may exist in Croatia. These claims need to be substantiated. (9)

Population Viability Analysis of the Hungarian Meadow Viper

Population viability analysis (PVA) can be an extremely useful tool for assessing current and future risk of wildlife population decline and extinction. In addition, the need for and consequences of alternative management strategies can be modeled to suggest which practices may be the most effective in conserving the Hungarian meadow viper in its wild habitat. *VORTEX*, a simulation software package written for population viability analysis, was used here as a mechanism to study the interaction of a number of meadow viper life history and population parameters treated stochastically, to explore which demographic parameters may be the most sensitive to alternative management practices, and to test the effects of selected island-specific management scenarios.

The *VORTEX* package is a Monte Carlo simulation of the effects of deterministic forces as well as demographic, environmental, and genetic stochastic events on wild populations. *VORTEX* models population dynamics as discrete sequential events (e.g., births, deaths, sex ratios among offspring, catastrophes, etc.) that occur according to defined probabilities. The probabilities of events are modeled as constants or random variables that follow specified distributions. The package simulates a population by stepping through the series of events that describe the typical life cycles of sexually reproducing, diploid organisms.

VORTEX is not intended to give absolute answers, since it is projecting stochastically the interactions of the many parameters used as input to the model and because of the random processes involved in nature. Interpretation of the output depends upon our knowledge of the biology of the Hungarian meadow viper, the environmental conditions affecting the species, and possible future changes in these conditions. For a more detailed explanation of *VORTEX* and its use in population viability analysis, refer to Miller and Lacy (1999) and Lacy (2000).

Input Parameters for Stochastic Population Viability Models

Species: *Vipera ursinii rakosiensis*

Species distribution: There are two regions of Hungary known to contain meadow vipers: The Hanság region in the northwest (one known population), and the Kiskunság area (8-11 known localities, maybe in a metapopulation structure). For the majority of our analyses, we chose to concentrate on a selected reference population from Kiskunság (Dabas), because of the relative abundance of available information compared to that available for the other populations (the following data are based on a three – year study of this particular population from 1995-1997 by Z. Korsós and B. Újvári).

Breeding System: Polygynous (polyandric)

Age of First Reproduction: *VORTEX* precisely defines reproduction as the time at which offspring are born, not simply the age of sexual maturity. In addition, the program uses the mean age rather than the earliest recorded age of offspring production. Field data from related taxa indicate that females first give birth at 4 years (*V. ursinii ursinii* in France, collected by J.-P. Baron) or 3 years of age (*V. renardi* in Ukraine, collected by T. Kotenko), while males reach reproductive age one year earlier (2-3 years).

Age of Reproductive Senescence: *VORTEX* generally assumes that animals can reproduce (at the normal rate) throughout their adult life. Captive meadow vipers have lived as long as 18 years; we recognize that this is undoubtedly considerably longer than the maximum age reached by individuals living in more stressful conditions in the wild. Data on *V. ursinii ursinii* in France, collected by J.-P. Baron, indicates that meadow vipers can live for 10-15 years depending on the altitude (or, more directly, on activity period). Because of the lowland habit of the Hungarian meadow viper, we assume that a maximum age of 10 years for this taxon.

Offspring Production: Field data on meadow vipers in general indicates that, on average, adult females reproduce every other year; in other words, only about 50% of adult females are expected to reproduce in any one year. This reproductive rate is largely influenced by the breeding energetics of adult males: Since female territories are quite small, while males occupy territories as large as 2 – 3 km^2, males must oftentimes travel relatively large distances to find available mates. Successful mating in one year by a given male may prohibit that individual from breeding in the next year as nutritional reserves are regenerated.

Annual environmental variation in female reproduction is modeled in *VORTEX* by specifying a standard deviation (SD) for the proportion of adult females that successfully reproduce within a given year. Based on expert opinion and generalized data from other meadow vipers, we assumed a standard deviation in this parameter of 10%. In other words, the percentage of adult females that successfully reproduce from year to year will range from about 30% to 70%.

There was considerable discussion on the potential for strong density dependence in reproduction (the proportion of adult females successfully reproducing offspring in a given year). We ultimately decided not to include this feature; since females attract males by pheromonal cues, an Allee-type effect – in which female reproductive success may be greatly reduced due to the difficulty in finding mates when popualtion densities are very low – is thought to be unlikely. Future modeling efforts, using *VORTEX* or any other package, could investigate the impact such dependence could have on population growth and associated risk of decline or extinction.

Direct field data on the Hungarian meadow viper indicates that a successful adult female will produce an average of 11 offspring, with possible clutch sizes across years ranging from about 5 to 17 (i.e., a standard deviation [SD] of 3). Data from other meadow vipers suggest a sex ratio (percent males) among offspring of 50%.

Male Breeding Pool: In many species, some adult males may be socially restricted from breeding despite being physiologically capable. This can be modeled in *VORTEX* by specifying a portion of the total pool of adult males that may be considered “available” for breeding each year. Generalized meadow viper breeding ecology includes male – male competition, with larger males enjoying greater access to adult females. As a result, we assume that only about 50% of the total group of adult males are available for breeding in any given year.

Age-Specific Mortality: Unfortunately, age-specific mortality data do not exist for wild populations of the Hungarian meadow viper. In the absence of such data, we are forced to either adapt field data from other meadow vipers to our specific situation, or to develop a generalized, theoretical mortality schedule that is amenable to additional analysis. The primary population demographic dataset for meadow vipers has been collected and analyzed by J.-P. Baron on *Vipera ursinii ursinii* in France. However, as this subspecies demonstrates a rather different life history due to its preferred habitat in the more mountainous regions of France, we felt that it was inappropriate to directly apply these data to the lowland Hungarian taxon. We were therefore forced to resort to generalized rules of snake life history in our development of an appropriate mortality schedule. Our main point of reference was the observation that, in general, about 10 – 15% of newborn vipers are expected to reach reproductive age. With this in mind, we developed the following mortality schedule, with data shown as mean (SD):

Schedule A

Age Class	Females (%)	Males (%)
0-1	50.0 (10.0)	50.0 (10.0)
1-2	30.0 (8.0)	30.0 (8.0)
2-3	30.0 (8.0)	30.0 (8.0)
3-4	30.0 (8.0)	30.0 (8.0)
Adults	30.0 (8.0)	30.0 (8.0)

It is very important to realize that this initial mortality schedule does not include the direct and/or indirect effects of human activities on the landscape; therefore, we are looking at the growth dynamics of a population that is free of human impact. Preliminary analysis, however, led the group to believe that this particular schedule may include low juvenile mortality and high subadult and adult mortality. Therefore, a second and perhaps more realistic mortality schedule was developed and applied to the generalized set of risk assessment models discussed below:

Schedule B

Age Class	Females (%)	Males (%)
0-1	70.0 (10.0)	70.0 (10.0)
1-2	20.0 (8.0)	20.0 (8.0)
2-3	15.0 (8.0)	15.0 (8.0)
3-4	15.0 (8.0)	15.0 (8.0)
Adults	15.0 (8.0)	15.0 (8.0)

Both mortality schedules yield a total of about 15% of newborn individuals successfully reaching reproductive age. Note that the impact of this particular mortality schedule on population performance was not studied in this workshop. Rather, the discussion that generated this alternative life table serves as a valuable stimulus for the development of more appropriate data that could be applied to future demographic modeling for this species.

Inbreeding Depression: *VORTEX* includes the ability to model the detrimental effects of inbreeding through reduced survival of pups through their first year. Initial attempts to model the populations of Hungarian meadow vipers focus on the demographic characteristics of the population and, as such, did not incorporate inbreeding depression in the models described here. Further modeling efforts may benefit from an inclusion of this factor, especially as the viper populations across Hungary have declined significantly below recent levels and, theoretically, may now experience the deleterious effects of inbreeding.

Catastrophes: Catastrophes are singular environmental events that are outside the bounds of normal environmental variation affecting reproduction and/or survival. Natural catastrophes can be fires, floods, droughts, disease, or similar events. These events are modeled in *VORTEX* by assigning an annual probability of occurrence and a pair of severity factors describing their impact on mortality (across all age-sex classes) and the proportion of females successfully breeding in a given year. These factors range from 0.0 (maximum or absolute effect) to 1.0 (no effect), and are imposed during the single year of the catastrophe, after which time the demographic rates rebound to their baseline values.

Members from both the population modeling and habitat / distribution working groups developed two primary catastrophic events that are known to afflict populations of the Hungarian meadow vipers:

> Flood – Severe winter snows, especially when combined with major spring rains, can result in significant flooding across about 15 – 20% of the Dabas region of Kiskunság National Park. Expert opinion suggests that such events could occur about once per decade. Since these floods typically occur when the animals are still in hibernation, and with suitable habitat generally scattered across the entire region, we may assume that a flood will decrease survival of all age classes by as much about 15%. Moreover, the habitat modification and associated mortality event will likely reduce the degree of reproductive success among adult females. We assume that this decline will be as much as 25% over normal levels.
>
> Burning – While numerous, low intensity fires from human activities may occur annually in the Dabas region, we assume that major human-caused fires occur about once every decade on average. These fires may result from local military activity, grassland burning by local shepherds, or unintended tourist activities. When they do occur – as happened twice in Dabas in six years during the past decade – they will have devastating consequences. Animals in the affected areas will almost surely die: either through direct burning or smoke inhalation, or through more indirect methods such as reduced food availability or cover from predators. The recent Dabas fires incinerated as much as 80% of the total acreage; based on this observation, we assume that viper survival will be reduced by an equivalent amount when a major fire occurs.

Initial Population Size: The Dabas habitat spans about 130 hectares, but only about 10% of this is considered to be suitable meadow viper habitat. While mark-recapture analysis suggests that population size in this region is as large as about 1500 adults (based on Lincoln index analysis), it is quite likely that the true adult population size may be closer to 100 – 500, and perhaps even as low as 50. For the bulk of our analyses, we have initialized our models with a total initial population size of 30, 100 or 500 individuals. These population totals, including juveniles as well as subadults, translate into adult population sizes of about 9, 30 and 150, respectively.

Carrying Capacity: The carrying capacity, K, for a given habitat patch defines an upper limit for the population size, above which additional mortality is imposed randomly across all age classes in order to return the population to the value set for K.

Maximum density estimates for related meadow vipers in France and Ukraine range from about 15 – 20 adults per hectare. Consequently, we have adopted this value for Hungarian meadow vipers in the Dabas region. Given a total of about 200 – 300 adults potentially occupying the 13 hectares of suitable habitat, we may expect a total carrying capacity of nearly 1000 individuals. In addition, we assumed that small populations of just 30 individuals would be confined to smaller parcels of habitat with carrying capacity reduced to 100.

Iterations and Years of Projection: All scenarios were simulated 250 times, with population projections extending to 100 years. All simulations were conducted using *VORTEX* version 8.41 (June 2000).

Results of Simulation Modeling

Demographic Sensitivity Analysis

During the development of the baseline input dataset presented above, it quickly became apparent that a number of demographic characteristics of Hungarian meadow viper populations were being estimated with significant levels of uncertainty. This type of measurement uncertainty, which is distinctly different from the annual variability in demographic rates due to extrinsic environmental stochasticity and other factors, impairs our ability to generate precise predictions of population dynamics with any degree of confidence. Nevertheless, an analysis of the sensitivity of our models to this measurement uncertainty can be an invaluable aid in identifying priorities for detailed research and/or management projects targeting specific elements of the species' population biology and ecology.

To conduct this demographic sensitivity analysis, we identify a selected set of parameters from the baseline model whose estimate we see as considerably uncertain. We then develop biologically plausible minimum and maximum values for these parameters (see Table below). Data were estimated on the parameters of other subspecies (*V. u. ursinii, V. u. macrops*) as well as on other European viper species using the same habitat types (*V. berus* and *V. renardi*). Available data on *V. u. rakosiensis* were also incorporated in the analyses.

Parameter	Minimum	Estimate Baseline	Maximum
Age of first breeding	3	4	5
Longevity	9	10	11
% Females breeding	45	50	55
Clutch size	9	11	13
% Males breeding	45	50	55
Mort (0-1)	45	50	55
Mort (Ad)	27	30	33

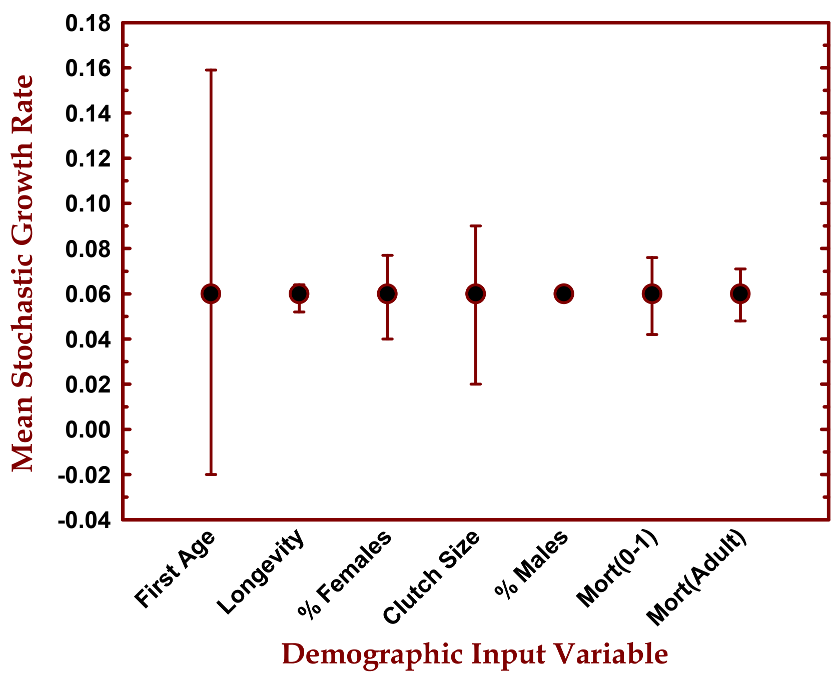
For each of these parameters we construct two simulations, with a given parameter set at its prescribed minimum or maximum value, with all other parameters remaining at their baseline value. With the seven parameters identified above, and recognizing that the aggregate set of baseline values constitute our single baseline model, the table above allows us to construct a total of 14 alternative models whose performance (defined, for example, in terms of average population growth rate) can be compared to that of our starting baseline model.

For all models comprising this analysis, we used mortality schedule A, an initial population size of 100 individuals, and a carrying capacity of 1000.

Our baseline model resulted in a rate of population growth (r) of 0.0605; in other words, we would expect that a population with this particular set of demographic parameters would increase at a rate of about 6% per year and would double in size nearly every ten years. While this specific population trajectory, assumed to be free of direct or indirect consequences of human activities, may not accurately reflect current conditions it is instructive as a reference point to compare against subsequent models designed to assess the sensitivity of the model to uncertainty in the range of demographic parameters listed above.

It is clear from Figure 1 that the model is extremely sensitive to uncertainty in the age of first reproduction in adult females: an increase in this age of just one year from 4 to 5 causes the population to decline at an average annual rate of about 2%. Of course, this particular aspect of the Hungarian meadow viper's biology cannot be manipulated by management in the wild. However, it can be vitally important to recognize that this parameter is a driving force in determining meadow viper population dynamics; consequently, more confident estimation of this parameter would no doubt yield more realistic models of the growth dynamics and extinction process acting on Hungarian meadow viper populations. In contrast to the aforementioned sensitivity to uncertainty in age of first female reproduction, the model is much less sensitive to similar levels of uncertainty in the maximum age. This is logical simply by considering that many fewer females will survive to these older age classes, with a resultant small loss in overall female reproductive potential.

Figure 1. Demographic sensitivity analysis of a simulated Hungarian meadow viper population. Stochastic population growth rate for a set of models in which the specified parameter is varied across a range of biologically plausible values. The baseline model growth rate of 0.0605 is given by the central data point for each parameter. The general model of meadow viper population dynamics is most sensitive to uncertainty in those parameters giving the widest range in simulated population growth rate. See accompanying text for additional details.



The figure also shows that overall female breeding characteristics are a more important determinant of population dynamics than those among males. In addition, while not significantly different, our models show slightly greater sensitivity to uncertainty in juvenile mortality when compared to a similar level of uncertainty in adult mortality. Despite this small difference, it is clear that accurate and realistic models of Hungarian meadow viper population demography will depend upon accurate estimates of female breeding and survival schedules.

Risk Analysis I: Population Size and Catastrophes

Our next goal was to evaluate the relative risk of population decline and extinction as a function of 1) initial population size, and 2) the inclusion of catastrophic events that can impact individual survival and/or reproductive success. To do this, we developed a series of models that included the flood and fire (meadow burning) catastrophic events discussed above. In all of these models, we used mortality schedule A, with a slight adjustment made to the annual average mortality rate among 1-year-olds from 30% to 40% for greater realism. Our results are shown in Figure 2.

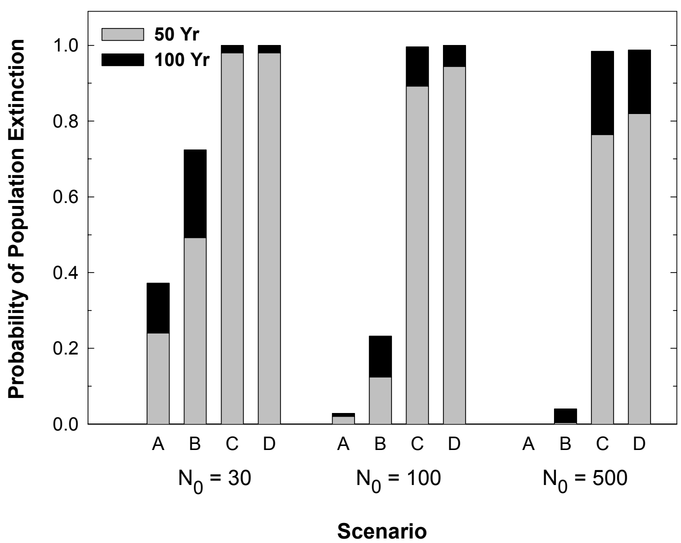


Figure 2. Probability of extinction at 50 (gray bars) and 100 (black bars) years for simulated Hungarian meadow viper populations of different initial total size (number of individuals) and under different catastrophe scenarios:

A. No catastrophes
B. Flood catastrophe
C. Burning catastrophe
D. Flood and burning catastrophes

See text for additional details on catastrophe and general model characteristics.

The following conclusions can be drawn from inspection of this figure:

- In the absence of catastrophes, extinction risk is strongly dependent on population size. A population composed of just 30 individuals of all age classes – specifically, including just 4-5 adult females – has a 24% chance of declining to extinction within 50 years and a 37% risk within 100 years. In contrast, a population of 100 individuals (including about 15 adult females) has only a 2% risk of extinction within 50 years and a 3% risk within 100 years. It is important to note that all mortality and reproductive parameters are equivalent in these two models – they differ only in the initial population size and are, therefore, differentially susceptible to the impact of random variability of birth and death rates included in the model. This is graphical illustration of the inherent risks facing small populations of wildlife directly resulting from unpredictable demography.
- Inclusion of a flood event occurring, on average, every ten years has a measurable impact on population extinction risk across all simulated viper populations. For example, the risk of extinction within 50 years in a population initially composed on 100 individuals increases from 2% in the absence of flood to 12% when it is included.

- Even more striking is the effect of a burning event on viper habitat and, consequently, the individuals themselves. Under the conditions modeled in this workshop, a burning event similar to those that have recently scorched large portions of viper habitat in the Dabas region can have a very significant impact on viper population viability. Most importantly, the effects of such an event will be severe across all population sizes. The figure clearly shows that population extinction is almost certain within 50 years in populations of less than 100 individuals, and exceeds 80% in simulated populations of 500 individuals.

Risk Analysis II: Population Harvest

Given our understanding of the risk that small populations face, it became important to evaluate the feasibility of removing small numbers of adult meadow vipers as a way to enhance the future success of a captive breeding program. To accomplish this task, we designed a set of models in which 3 adult females and 4 adult males were harvested each year for 1, 2, 3, 4, or 5 years at the onset of the simulation. The modified mortality schedule A was used in all harvest models, and catastrophes were omitted as their dramatic impacts have been discussed in the previous subsection.

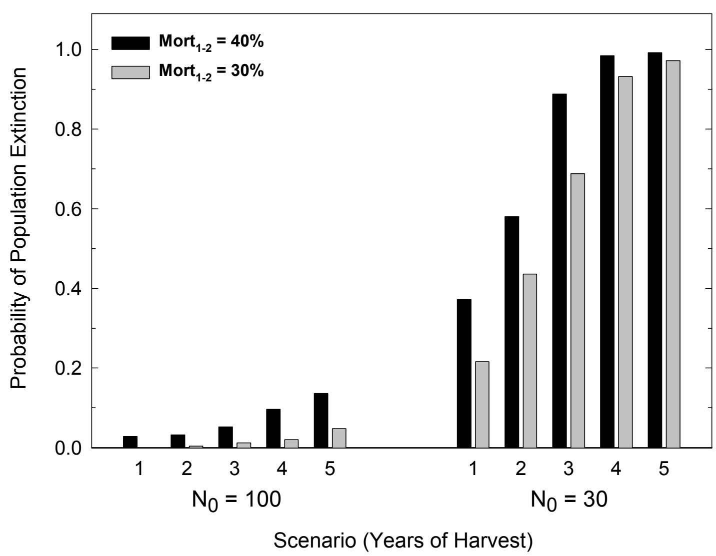


Figure 3. Probability of extinction at 50 years for simulated Hungarian meadow viper populations subjected to harvest of 3 adult females and 4 adult males annually for 1 to 5 years. Results for initial total population sizes of 100 or 30 individuals, roughly corresponding to 15 and 5 adult females respectively, are shown in addition to responses to alternative values for mean annual mortality of 1-2 year old animals (black bars = 40%, gray bars = 30%). See text for additional model details.

The results of these harvest models are summarized in Figure 3. As with Figure 2, a number of important conclusions can be drawn from these summary results:

- Under the conditions modeled here, harvest of 3 adult females annually for three years from a population initialized with 100 individuals leads to a 50-year extinction risk of no greater than 5% (black bars). If this level of harvest is extended for an additional two years to a total of five years, this risk increases to about 13%. Clearly, an extended harvest period has a noticeable impact on source population performance, even if harvest is stopped after this period.
- The precise degree of impact of this harvest can be strongly dependent on the underlying population demographic rates. This can be seen by comparing the black and gray bars on the left-hand side of the figure (N_0 = 100), which correspond to a change in mortality of 1-2 year-old animals from the baseline value of 40% to 30%. Interestingly, this seemingly

small decrease in underlying mortality has a marked effect on the impact of harvesting: removal of 3 adults annually has a less pronounced negative impact when the underlying mortality is lower. For example, a 5-year harvest results in just a 5% risk of population extinction over 50 years – less than half the risk imposed with the original 40% mortality value.

- Smaller source populations, such as the one simulated here with only 30 individuals including as few as 5-7 adult females, are clearly unable to sustain the removal of 3 adult females for even one or two years. Even under more optimistic mortality conditions, harvest during a single year leads to a 22% risk of population extinction within 50 years. As the length of harvest increases to three years, this risk rises sharply to almost 70%.

Conclusions

It is important to recognize that this is a preliminary investigation into the demographic viability of remnant populations of meadow vipers in Hungary. When making these first attempts at studying the demography of threatened populations, and especially when using stochastic modeling techniques designed to evaluate the risk of population decline or extinction, there is very commonly a relatively small amount of detailed demographic data to work with. Therefore, a comprehensive and accurate picture of the future dynamics of these populations is not possible.

Despite this limitation, PVA modeling approaches can serve an extremely important role in helping biologists and managers to understand and identify the most important determinants of overall population growth. Through the process of demographic sensitivity analysis discussed in this report, researchers will be better able to identify those aspects of the species' life history that deserve greater attention in the field, and managers may be able to target specific actions that minimize human impacts to the population.

In addition to an analysis of model sensitivity, we have attempted to develop a set of preliminary models that investigate the impact of catastrophic variation in mortality and reproductive rates on population viability, and the effect that harvesting of adult females for captive breeding can have on wild source populations. Once again, because of the uncertainties surrounding the precise demography of wild Hungarian meadow viper populations, it is impossible to predict with confidence the most likely future of a given population. However, the PVA approach allows us to compare results across a set of models and evaluate the relative response of a population to changes in specific demographic and/or environmental parameters. In this context, the *VORTEX* model was valuable for pointing out the susceptibility of small populations to the negative impacts of random fluctuations in annual rates of mortality and reproduction, and the severe effects that man-made burning of habitat such as that recently seen in the Dabas region can have on wild viper populations.

Finally, we worked with the Captive Population working group to investigate the impact of removing a small number of individuals from locally isolated populations in order to initiate a founder stock for captive breeding. In general, and as long as additional human disturbance to the habitat is minimized, a population as small as just 30-40 adults could tolerate an annual removal of 3 adult females over a period of 3 – 4 years without a significant additional risk to the population in the long-term. However, the precise cost of this removal is critically dependent on the underlying rate of natural mortality in the source population. Conducting this removal operation for a shorter time period such as 2–3 years would be more prudent from the standpoint of source population security.

In light of the significant uncertainties regarding our knowledge of the Hungarian meadow viper's biology and ecology, management of the viper will be greatly improved through a better understanding of the demography of individual populations, and the ways in which humans degrade the capacity for viper population growth. Towards this end, we have developed a set of specific goals and actions that, we hope, will address these needs in a comprehensive and timely manner.

Goals and Recommendations

Goals	**Actions**
I. Obtain additional demographic and genetic data in order to improve our understanding of the population biology of *V. u. rakosiensis* and to enhance our ability to effectively manage its population in the wild	1 a. Carry out an annual census of *V. u. rakosiensis*: transect (in 2-3 selected habitats) or CMR method (in one habitat with the highest population density) 1 b. To train people (volunteers, students, National park stuff) to prepare them for assisting professional herpetologist in the field (transect, CMR method) 1 c. Collect data from different datasets and create a unified database 1 d. Prepare and disseminate a protocol (instructions) for standardizing field methods 1 e. Carry out genetic study of populations as many as possible (3-4)
2. Estimate the minimal viable population size (MVP) in order to evaluate the probability of extinction in different time scales	2. Implement relevant computer analysis (*VORTEX*) using collected demographic and genetic data
3. Assess and distinguish the impacts of natural and human induced factors on demographic parameters, spatial distribution and population density of *V. u. rakosiensis*. Predict the probability of catastrophic events in the populations	3 a. Compile a list of natural and human induced factors influencing *V. u. rakosiensis* population, determine their frequency and extension 3 b. Estimate the influence of natural and human induced factors on different population parameters using census methods in different habitats 3 c. Carry out a demographic sensitivity analysis using demographic data and the knowledge of natural and human induced factors on *V. u. rakosiensis* populations

4. Identify causes of the decline of *V. u. rakosiensis* populations using historic data.	4 a. Collect historical information on habitat changes taking into consideration traditional and modern land use and management. 4 b. Identify habitat related causes of decline using GIS analyses of vegetation, land use and other maps. 4 c. Obtain information on illegal collecting.
5. Reveal new localities of *V. u. rakosiensis* for facilitating the conservation output.	5 a. Identify regions perspectives for searching *V. u. rakosiensis* using vegetation and land use maps. 5 b. Check all perspective sites, undertaking intensive field investigations. 5 c. Build up an international cooperation on this task (Austria, Croatia, Romania, Yugoslavia).
6. Improve communication among scientists in order to facilitate the data exchanging and information updating.	6 a. Compile an information base on scientists dealing with *V. ursinii* complex. 6 b. Form working groups. 6 c. Organise further symposia. 6 d. Publish proceedings of symposia and disseminate reports and other information reflecting the progress in *V. u. rakosiensis* study and conservation.
7. Establish better understanding and cooperation among scientists, managers and officials in order to minimise mistakes in *V. u. rakosiensis* management and receive better result in its conservation	7 a. Organise a seminar by scientists for managers and officials in order to introduce them to ecology and biology of *V. u. rakosiensis*. 7 b. Approve the species action plan as an official document for implementation. 7 c. Establish the cooperation between all stakeholders discussing problems and progress in *V. u. rakosiensis* conservation.

Description of Selected Actions

Note that, due largely to time constraints imposed by the finite length of this workshop, we were unable to complete detailed descriptions of each action item listed above. We provide the detailed work we were able to complete below, with the hope that this workshop will provide the stimulus for additional information at a later date.

1a. Carry out an annual census of *V. u. rakosiensis*: transect (in 2-3 selected habitats) or CMR method (in one habitat with the highest population density)	
Responsible	Zoo (?)
Time of execution	01.01.2002-31.11.2004
Measurement of results	Population size, population density (capture probability for each category), number of breeding males and females, clutch size, age structure
Resources	Field trip equipment, CMR equipment (microchip, reader, radio transmitter, receiver)
Cost	5 million HUF
Collaborators	Universities, Ph. D. students, field managers, National Park staff, experts, zoo people, amateurs
Limitations	Financial support, lack of trained people, lack of equipment, changes in habitats
Consequences	Negative consequences – human impact on population due to constant and frequent field research Positive – database, scientific articles

3a. Compile a list of natural and human induced factors influencing *V. u. rakosiensis* populations, determine their frequency and extent	
Responsible	Hung. Nat. Hist. Museum

Time of execution	2002. 01.01.2002-31.11.2002
Measurement of results	Exact quantitative data on the number of human population inhabiting the area in concern; % of presently used and unused land for the agricultural purpose surrounding the habitat; the exact number of catastrophic (fires, floods in the wintering sites) events.
Resources	Statistic and collector data; literature
Cost	
Collaborators	Students, volunteers, local people, government officials
Limitations	Lack of information
Consequences	Negative – none Positive – complete historical database
3b. Estimate the influence of natural and human induced factors on different parameters of *V. u. rakosiensis* populations.	
Responsible	
Time of execution	2002-2004 01.01.2002-31.11.2004

Measurement of results	
Resources	
Cost	
Collaborators	
Limitations	
Consequences	Negative consequences – human impact on population due to constant and frequent field research Positive – scientific articles

Sample *VORTEX* Input File

```
HMVHARV3.OUT     ***Output Filename***
Y     ***Graphing Files?***
N     ***Details each Iteration?***
250     ***Simulations***
100     ***Years***
10     ***Reporting Interval***
0     ***Definition of Extinction***
1     ***Populations***
N     ***Inbreeding Depression?***
Y     ***EV concordance between repro and surv?***
2     ***Types Of Catastrophes***
P     ***Monogamous, Polygynous, or Hermaphroditic***
4     ***Female Breeding Age***
3     ***Male Breeding Age***
10     ***Maximum Breeding Age***
50.000000     ***Sex Ratio (percent males)***
0     ***Maximum Litter Size (0 = normal distribution) *****
N     ***Density Dependent Breeding?***
Pop1
50.00  **breeding
10.00  **EV-breeding
11.000000   ***Pop1: Mean Litter Size***
3.000000   ***Pop1: SD in Litter Size***
50.000000  *FMort age 0
10.000000  ***EV
40.000000  *FMort age 1
8.000000  ***EV
30.000000  *FMort age 2
8.000000  ***EV
30.000000  *FMort age 3
8.000000  ***EV
30.000000  *Adult FMort
8.000000  ***EV
50.000000  *MMort age 0
10.000000  ***EV
40.000000  *MMort age 1
8.000000  ***EV
30.000000  *MMort age 2
8.000000  ***EV
30.000000  *Adult MMort
8.000000  ***EV
1.000000     ***Probability Of Catastrophe 1***
1.000000  ***Severity--Reproduction***
1.000000  ***Severity--Survival***
1.000000     ***Probability Of Catastrophe 2***
1.000000  ***Severity--Reproduction***
1.000000  ***Severity--Survival***
N     ***All Males Breeders?***
Y     ***Answer--A--Known?***
50.000000     ***Percent Males In Breeding Pool***
Y     ***Start At Stable Age Distribution?***
100     ***Initial Population Size***
1000     ***K***
0.000000     ***EV--K***
```

Sample *VORTEX* Input File (Contd.)

```
N     ***Trend In K?***
Y      ***Harvest?***
1     ***First Year Harvest***
3     ***Last Year Harvest***
1     ***Harvest Interval***
0     ***Females Age 1 Harvested***
0     ***Females Age 2 Harvested***
0     ***Females Age 3 Harvested***
3     ***Adult Females Harvested***
0     ***Males Age 1 Harvested***
0     ***Males Age 2 Harvested***
4     ***Adult Males Harvested***
N     ***Supplement?***
N     ***AnotherSimulation?***
```

Sample *VORTEX* Output File

```
VORTEX 8.41 -- simulation of genetic and demographic stochasticity

HMVHARV3.OUT
Tue Apr 16 22:22:39 2002


  1 population(s) simulated for 100 years, 250 iterations

  Extinction is defined as no animals of one or both sexes.

  No inbreeding depression

  First age of reproduction for females: 4   for males: 3
  Maximum breeding age (senescence): 10
  Sex ratio at birth (percent males): 50.000000

Population: Pop1

  Polygynous mating;
    50.00 percent of adult males in the breeding pool.

   50.00 percent of adult females produce litters.
   EV in % adult females breeding = 10.00 SD

   Of those females producing litters, ...
   Mean litter size = 11.000000
   SD in litter size = 3.000000

   50.00 percent mortality of females between ages 0 and 1
    EV in % mortality = 10.000000 SD
   40.00 percent mortality of females between ages 1 and 2
    EV in % mortality = 8.000000 SD
   30.00 percent mortality of females between ages 2 and 3
    EV in % mortality = 8.000000 SD
   30.00 percent mortality of females between ages 3 and 4
    EV in % mortality = 8.000000 SD
   30.00 percent mortality of adult females (4<=age<=10)
    EV in % mortality = 8.000000 SD
   50.00 percent mortality of males between ages 0 and 1
    EV in % mortality = 10.000000 SD
   40.00 percent mortality of males between ages 1 and 2
    EV in % mortality = 8.000000 SD
   30.00 percent mortality of males between ages 2 and 3
    EV in % mortality = 8.000000 SD
   30.00 percent mortality of adult males (3<=age<=10)
    EV in % mortality = 8.000000 SD

    EVs may be adjusted to closest values possible for binomial distribution.
    EV in reproduction and mortality will be concordant.

  Frequency of type 1 catastrophes: 1.000 percent
    multiplicative effect on reproduction = 1.000000
    multiplicative effect on survival = 1.000000

  Frequency of type 2 catastrophes: 1.000 percent
    multiplicative effect on reproduction = 1.000000
    multiplicative effect on survival = 1.000000
```

Sample *VORTEX* Output File (Contd.)

```
Initial size of Pop1:      100
    (set to reflect stable age distribution)
 Age 1     2     3     4     5     6     7     8     9    10    Total
    18    11     7     5     3     2     2     1     1     0      50  Males
    18    11     7     5     3     2     2     1     1     0      50  Females

  Carrying capacity = 1000
    EV in Carrying capacity = 0.00 SD

  Animals harvested from Pop1, year 1 to year 3 at 1 year intervals:
    3 female adults (4 <= age <= 10)
    4 male adults (3 <= age <= 10)

Deterministic population growth rate
  (based on females, with assumptions of
  no limitation of mates, no density dependence, no functional dependencies, and no
inbreeding depression)

     r =  0.038     lambda = 1.038     R0 =     1.237
   Generation time for:  females = 5.65    males = 4.78

Stable age distribution:  Age class    females    males
                              0        0.216      0.216
                              1        0.104      0.104
                              2        0.060      0.060
                              3        0.041      0.041
                              4        0.027      0.027
                              5        0.018      0.018
                              6        0.012      0.012
                              7        0.008      0.008
                              8        0.006      0.006
                              9        0.004      0.004
                             10        0.003      0.003

Ratio of adult (>= 3) males to adult (>= 4) females: 1.516

Population 1: Pop1

Year 10
     N[Extinct] =       1, P[E] =  0.004
     N[Surviving] =   249, P[S] =  0.996
     Mean size (all populations) =  122.02 (   5.93 SE,   93.82 SD)
  Means across extant populations only:
     Population size =           122.51 (   5.94 SE,   93.68 SD)
     Expected heterozygosity =    0.938 (  0.003 SE,   0.041 SD)
     Observed heterozygosity =    0.972 (  0.002 SE,   0.035 SD)
     Number of extant alleles =   34.38 (   0.92 SE,   14.52 SD)

Year 20
     N[Extinct] =       5, P[E] =  0.020
     N[Surviving] =   245, P[S] =  0.980
     Mean size (all populations) =  191.34 (  10.94 SE,  172.99 SD)
  Means across extant populations only:
     Population size =           195.24 (  11.02 SE,  172.55 SD)
     Expected heterozygosity =    0.900 (  0.005 SE,   0.085 SD)
     Observed heterozygosity =    0.926 (  0.005 SE,   0.083 SD)
     Number of extant alleles =   23.79 (   0.79 SE,   12.41 SD)
```

Sample *VORTEX* Output File (Contd.)

```
Year 30
     N[Extinct] =       7, P[E] =  0.028
     N[Surviving] =   243, P[S] =  0.972
     Mean size (all populations) =  289.15 (  17.01 SE,  268.98 SD)
  Means across extant populations only:
     Population size =          297.47 (  17.21 SE,  268.26 SD)
     Expected heterozygosity =    0.877 (  0.006 SE,   0.088 SD)
     Observed heterozygosity =    0.898 (  0.005 SE,   0.079 SD)
     Number of extant alleles =   19.73 (   0.71 SE,   11.01 SD)

Year 40
     N[Extinct] =      10, P[E] =  0.040
     N[Surviving] =   240, P[S] =  0.960
     Mean size (all populations) =  360.32 (  19.01 SE,  300.59 SD)
  Means across extant populations only:
     Population size =          375.34 (  19.20 SE,  297.45 SD)
     Expected heterozygosity =    0.858 (  0.007 SE,   0.104 SD)
     Observed heterozygosity =    0.879 (  0.006 SE,   0.100 SD)
     Number of extant alleles =   17.56 (   0.65 SE,   10.15 SD)

Year 50
     N[Extinct] =      13, P[E] =  0.052
     N[Surviving] =   237, P[S] =  0.948
     Mean size (all populations) =  428.95 (  20.95 SE,  331.28 SD)
  Means across extant populations only:
     Population size =          452.48 (  21.06 SE,  324.20 SD)
     Expected heterozygosity =    0.846 (  0.007 SE,   0.106 SD)
     Observed heterozygosity =    0.859 (  0.007 SE,   0.105 SD)
     Number of extant alleles =   16.11 (   0.61 SE,    9.35 SD)

Year 60
     N[Extinct] =      15, P[E] =  0.060
     N[Surviving] =   235, P[S] =  0.940
     Mean size (all populations) =  474.08 (  22.06 SE,  348.82 SD)
  Means across extant populations only:
     Population size =          504.32 (  22.04 SE,  337.87 SD)
     Expected heterozygosity =    0.831 (  0.008 SE,   0.126 SD)
     Observed heterozygosity =    0.841 (  0.008 SE,   0.127 SD)
     Number of extant alleles =   15.01 (   0.57 SE,    8.79 SD)

Year 70
     N[Extinct] =      16, P[E] =  0.064
     N[Surviving] =   234, P[S] =  0.936
     Mean size (all populations) =  506.48 (  21.77 SE,  344.14 SD)
  Means across extant populations only:
     Population size =          541.11 (  21.46 SE,  328.25 SD)
     Expected heterozygosity =    0.818 (  0.009 SE,   0.136 SD)
     Observed heterozygosity =    0.827 (  0.009 SE,   0.131 SD)
     Number of extant alleles =   14.02 (   0.54 SE,    8.23 SD)

Year 80
     N[Extinct] =      17, P[E] =  0.068
     N[Surviving] =   233, P[S] =  0.932
     Mean size (all populations) =  534.67 (  21.16 SE,  334.54 SD)
  Means across extant populations only:
     Population size =          573.68 (  20.47 SE,  312.48 SD)
     Expected heterozygosity =    0.808 (  0.009 SE,   0.143 SD)
     Observed heterozygosity =    0.818 (  0.009 SE,   0.141 SD)
     Number of extant alleles =   13.28 (   0.50 SE,    7.69 SD)
```

Sample *VORTEX* Output File (Contd.)

```
Year 90
     N[Extinct] =      19, P[E] =  0.076
     N[Surviving] =   231, P[S] =  0.924
     Mean size (all populations) =  584.90 (  21.23 SE,  335.61 SD)
  Means across extant populations only:
     Population size =           633.01 (  19.89 SE,  302.25 SD)
     Expected heterozygosity =    0.801 (  0.010 SE,   0.149 SD)
     Observed heterozygosity =    0.809 (  0.010 SE,   0.148 SD)
     Number of extant alleles =   12.75 (   0.46 SE,    7.06 SD)

Year 100
     N[Extinct] =      19, P[E] =  0.076
     N[Surviving] =   231, P[S] =  0.924
     Mean size (all populations) =  601.76 (  21.23 SE,  335.74 SD)
  Means across extant populations only:
     Population size =           651.25 (  19.70 SE,  299.43 SD)
     Expected heterozygosity =    0.791 (  0.011 SE,   0.163 SD)
     Observed heterozygosity =    0.797 (  0.011 SE,   0.163 SD)
     Number of extant alleles =   12.11 (   0.43 SE,    6.61 SD)

In 250 simulations of Pop1 for 100 years:
  19 went extinct and 231 survived.

This gives a probability of extinction of 0.0760 (0.0168 SE),
  or a probability of success of          0.9240 (0.0168 SE).

19 simulations went extinct at least once.
Of those going extinct,
    mean time to first extinction was 40.74 years (5.76 SE, 25.11 SD).

Means across all populations (extant and extinct) ...
Mean final population was 601.76 (21.23 SE, 335.74 SD)

   Age 1       2       3   Adults    Total
  109.54   65.30          124.48    299.33  Males
  110.78   65.84   43.82   81.99    302.43  Females

Means across extant populations only ...
Mean final population for successful cases was 651.25 (19.70 SE, 299.43 SD)

   Age 1       2       3   Adults    Total
  118.00   70.00          134.72    323.95  Males
  119.00   71.00   47.00   88.73    327.30  Females

During years of harvest and/or supplementation
  mean growth rate (r) was -0.1083 (0.0101 SE, 0.2754 SD)

During years without harvest or supplementation,
  mean growth rate (r) was 0.0300 (0.0017 SE, 0.2544 SD)
Across all years, prior to carrying capacity truncation,
  mean growth rate (r) was 0.0256 (0.0017 SE, 0.2562 SD)

2 of 2250 harvests of females could not be completed because of insufficient animals.
2 of 3000 harvests of males could not be completed because of insufficient animals.

Final expected heterozygosity was      0.7909 ( 0.0107 SE,  0.1631 SD)
Final observed heterozygosity was      0.7973 ( 0.0107 SE,  0.1626 SD)
Final number of alleles was             12.11 (   0.43 SE,    6.61 SD)
*********************************************************************
```

Population and Habitat Viability Assessment (PHVA) For the Hungarian Meadow Viper (*Vipera ursinii rakosiensis*)

5 – 8 November, 2001
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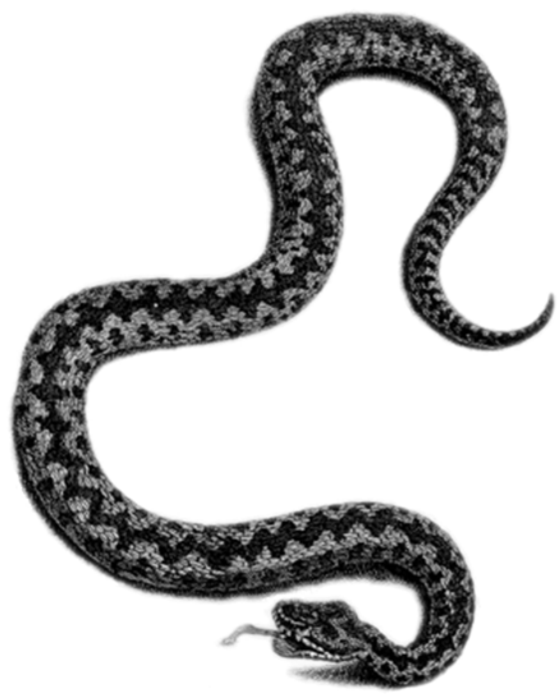
Budapest, Hungary

Workshop Report



Section III
Habitat Management

Habitat Management

Working Group Participants:

Gergely Babocsay, Budapest, Hungary
Keith Corbett, Herpetological Conservation Trust, United Kingdom
Róbert Dankovits, Gencsapáti, Hungary
Bálint Halpern, Birdlife Hungary
Werner Kammel, Austria
László Krecsák, Eötvös University, Budapest, Hungary
Tamás Pechy, Hungary
Ferenc Sipos, Kiskunság National Park Directorate
Alexander Westerström, Sweden

What is intact meadow / restoration linkage
Habitat saving is key
Habitat improvement

NOTE: Throughout this section "tussock" vegetation is defined as a tall grass plant whose base contains the dead blades and litter from the previous seasons' growth.

Idea collection

- Retaining natural waters on meadows for identifying wintering sizes, forcing *Vipera ursinii rakosiensis* to there to higher elevations
- Assess habitat – one habitat type or a habitat complex?
- Wet (winter – summer periods) – components
- Tussock vegetation as a basic item
- Monitor the habitat
- Define habitat needs as detailed as possible
- Compensate local people – private owners for extending the habitat, creating a pool of land for exchange of agricultural areas, etc.
- Survey of populations and habitat
- Is recent decline real or is it a decline of observation, are the methods good enough (e.g., do surveys happen on the days with the highest chance to locate specimens?)

Problems

- Define location and extent of winter + summer habitat
- Survey: should take place at habitat at optimal weather conditions and season
- Is recent decline real?
- Habitat assessment
- Is the protection of *Vipera ursinii rakosiensis* the highest priority in the National Park?
- How to increase the size of the habitats and their quality: why and how the population declines
- How to recover the habitats

- Given answers to some or all above, how to manage for future?
- Local liaison, wrong management, missing national/international laws

Actions

Description	**Possible to achieve now?**
Map/assess of known habitats	OK
Maintain tussock vegetation – National Park area	OK
What about on land owned by others	?
Survey/monitor *Vipera ursinii rakosiensis* populations	?
Assess winter habitats in known areas/sites after floods	?

Tussock management: Does it happen and is it different at: Kiskunság NP, Hanság NP, Ministry of Defense, Birdlife Hungary, private owners?
Different views and practices incl. political

Additional problems

We do not know enough about its habitat or its extent, and the (recent) decline is false.
OR
We know sufficient of its habitat needs and the decline is real.
If the latter is true (?), then there is no time for more difficult field research.
Also – what of previous high density populations – Hungary 50s and 60s, Austria 1890 - 1910
Are there real conservation conflicts in the National Park management?

Agreed Problems

1. **Is winter habitat an insufficiently known factor of relevance to site / population / habitat conservation?**
    - Zoltan Korsos: radio telemetry research: one radio tracked + another viper: hibernated in situ
    - Surveyors – first and last active adults were seen on the same site / area
    - Main population at Dabas and Ordito ret – very limited choice for alternative habitat, and snakes do not reach higher sandy grounds?
    - Tamas Pechy – viper moves only locally to slightly higher points (not highest available) in October → Habitat mosaic within same meadow
    - Zoltan Korsos: summer and winter habitat is close to each other, max. 100-200 m distance
    - Present habitats may be sub-optimal and recently degraded

    Agreement about relevance of the problem

2. **What is the priority of viper conservation in Kiskunság National Park? Is there a conflict of management aims and interests?**
   - Is there a conflict about viper protection being of highest priority on all sites where it exists?
     Priority for National Park: the ecosystem itself
     Priority for Nature Protection authority: Species and habitats
   - Conflict about the approach (between the National Park and the Nature Protection authorities)
     Conflict about water management:

   SCENARIO 1: Water table restoration: enough time for *Vipera ursinii rakosiensis* habitats to be restored and developed (e.g. after tree felling, etc.) –viper population adapts and survives
   SCENARIO 2: Water table restoration: no time for viper habitats to be restored and developed –population will be lost
   If there is no water table restoration, *Vipera ursinii rakosiensis* is vulnerable to uncontrollable water table changes time to time happen on present / recent habitats
   Population(s) relocated? – where? Budapest airport?
   Reestablish and assess new habitats also needs time

3. **Is there a decline or not?**
   Evidences for decline:
   - Dabas / Ordito ret: known (Janisch) for 50 years; now only sparse populations
   - Numbers/density: observed by:
     Mehely et al., Janisch, Street, Zoltan Korsos, Tamas Pechy,
   - Dense populations

Laxenburg (Austria)	lost
Ferto	lost
Dabas	sparse population

Decline caused by:
- More intensive agriculture (arable)
- Hand cutting by scythe turns to machine cutting
- Drainage
- Collection (now illegally but happens still)
- Fires (accidental and deliberate caused by shepherds and others)
- (Over)-grazing
- soil enrichment / pesticides

Agreement that decline happened/s

Habitat Management

Particularly that of tussock structure
SCENARIOS – resources for compensation and control of contracted management are necessary

1) Hand cutting by scythe: very good but uneconomic and no demand
2) Machine cutting by tractors: problems: too low cutting, too frequent, kills snakes, removes cover
3) Machine cutting: blades should be set high:
   Only mowing of a part of the meadow, only in October/November
   Monitoring viper population response
   No use of rotary cutter
4) Grazing by cattle, or by sheep. In Bugac, Ordito ret?
   Season of grazing and numbers of cattle must be strictly controlled, viper must have the priority

Agreed Basic Problems Prioritised

	Score	Priority
• Viper conservation priority – conflict between national and National park level	10	1
• Habitat (tussock) management, uncontrolled management and uses	32	2
• Habitat type management: species habitat vs. systems	34	3
• Proposed water table restoration (Kiskunság NP)	35	4
• Habitat assessment Areas with records of *Vipera ursinii rakosiensis* Areas without records of *Vipera ursinii rakosiensis* Potential areas for restoration Strategy for recovery	41	5
• Insufficient knowledge on winter habitats	47	6
• Illegal collection	63	7
• Natural and artificially maintained predators (Pheasants and others)	70	8

Goals And Actions

I. Conservation priority of *Vipera ursinii rakosiensis* in Hungary; in National Parks

- Achieve consensus on national conservation priority for *Vipera ursinii rakosiensis*
- Including urgent implementation of a recovery program
- Necessary resources?

<u>Actions needed:</u>

1. Arrange a high level decision making meeting in the ministry to, among other things, initiate a viper recovery and action plan

II. Habitat (tussock) management, uncontrolled management and uses

- Avoid damaging management in meadows with *Vipera ursinii rakosiensis* populations

- Refine methods of optimal / practical management
- Create a buffer zone
- Limit number of grazing animals, define species, races of domestic animals and the grazing season and duration
- Working out possible tussock maintenance methods

Actions needed:

1. Monitoring the tussock maintaining methods
2. Reducing Solidago sp. (or other plants with negative effect) where it is a problem, such as in Hanság NP; bushes and trees; perhaps wild boar
3. Prevent adverse management
4. Refine management of viper habitat records by closely monitoring response of this species, e.g. in the Hanság sanctuary

III. Habitat type management: species habitat management vs. ecosystem management

As in problem I, making agreement, arriving at a consensus
Recognition of need for both philosophies;

- Determine the likely impact and extent of proposed water retention on present viper habitat
  needs: hydrologist, surface geologist and ecologist
- Determine alternate scenario of vipers now in sub-optimum or unnatural habitat(s) and need of water restoration
  or: viper's current habitats are sustainable?
  needs: ecologist and herpetologist

Actions needed:

1. Preparation of hydrological, ecological and surface geological maps showing the possible effects of water table restoration on viper habitat
2. Examine and assess two opposing scenarios, derived from widely different realms of biological expertise:
   a) the present viper habitat(s) is unnatural and sub-optimal, and needs rectification; or
   b) the present known habitats are natural and sustainable
3. Resolve this basic issue, giving priority to the needs of this endangered taxon

IV. Proposed water table restoration (Kiskunság NP)

- Water table restoration measurements should not drown and freeze vipers in their habitats, must be scientifically well-founded, and done with increased caution.
- *Must avoid drowning or freezing viper populations*, unless or until alternative adjacent habitat has been developed

Actions needed:

1. Try to restore replacement habitat adjacent to any existing habitat at potential risk from future water retention

V. Habitat assessment:

Areas with records of *Vipera ursinii rakosiensis*

Areas without records of *Vipera ursinii rakosiensis*

Potential areas for restoration: habitat restoration per se and need for linkage between habitat patches

Strategy for recovery

- Preparation and presentation of an updated distribution map to show existing and potential habitats including options for linkage, in order to guide and plan recovery to be transferred to G.I.S. format in due course

Actions needed:

1. Guide recovery by preparing a map(s) showing existing and recent *Vipera ursinii rakosiensis* sites, potential and restoration / linkage habitats; transfer data to G.I.S.

The following problems were not further discussed, being judged as having the lowest priority among all the problems proposed:

Insufficient knowledge on winter habitats

Illegal collection

Natural and artificially maintained predators (Pheasants and others)

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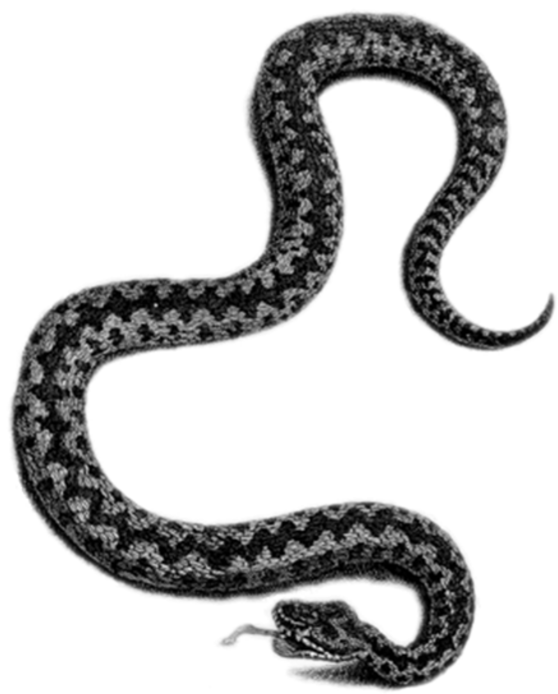

Section IV
Captive Population Management

Captive Population Management

Working Group Participants:

Ivan Rehák, Prague Zoo, Czech Republic
Endre Sós, Budapest Zoo, Hungary
Tamás Tóth, Budapest, Hungary
István Vidákovits, Budapest Zoo, Hungary

Key problems in Hungarian Meadow Viper conservation:

- The total abundance of the wild population is decreasing, some of the populations are declining rapidly, we do not have information on other populations
- Habitat loss and fragmentation
- Low abundance, genetic risk
- Existing problems in appropriate habitat management - lack of compensation in the management system, control of grazing, control of water level, etc.
- Illegal collecting
- The risk that natural reproduction is reduced or not realised at all, because of the critically low abundance, poor knowledge of demography at all

Is there a need for a captive breeding program? Reasons for a program:

- Conservation measures already taken *in situ* did not stopped the rapid declining of the wild population
- To avoid the repeating of the situation in Austria, where the exclusive using of only *in situ* conservation measures did not achieved their goals
- The wild population exists under the serious risk of total extinction – there is a great importance to create parallel (reserve) population in captivity as a safety net
- To have a genetic reservoir (in case of unexpected events)
- To have a breeding nucleus with the potential for future reintroduction projects
- Contribution to the knowledge of life history, the information will service the *in situ* conservation
- The possibility of overcome the problems created by fragmented population by better reproduction rate
- Advantages of the intensive captive management: survival rate of youngsters is much higher, they reach sexual maturity sooner, general natality is higher
- Educational impact to local people and wider publicity for the conservation measures associated with one of the rarest Hungarian (and European) vertebrate

Problems associated with a captive breeding program for Hungarian Meadow Vipers

- We do not know exact wild numbers, but the number is certainly small, making estimation of precise numbers difficult
- It can be a problem if we take out too many animals or genetic problems can arise if the captive population is too small
- If there is a need for captive breeding, we have to decide what kind of breeding is needed (zoo or close to natural habitat)

- Shall we wait until better knowledge is collected?
- We should assess the risk of diseases
- The abundance of the wild population will be lowered in the first phase
- Genetic risk of mixing local populations
- Whether we have enough knowledge of meadow viper biology to create a program

How to establish a captive breeding program and what this program should be:

- We have two available institutions in Hungary (Budapest Zoo and Birdlife Hungary)
- Close co-operation is possible and necessary
- Birdlife Hungary: Seminatural enclosures
- Budapest Zoo: intensive husbandry techniques in the zoo and produce as many animals as possible
- Before any actual steps are taken both institutes must possess the approved permits of the Ministry of Environment (KTM TvH) and Kiskunság National Park

Ex situ conservation: Main goals:

- To create the breeding facility directly at Kiskunság – breeding amongst seminatural conditions
- To build a perspective "zoo population" with the sufficient breeding potential to serve as a gene reservoir
- To find effective co-operation between the existing breeding facilities
- To develop the adequate reintroduction strategy

Goals and Actions

1. Zoo population – action steps

Founder population

- The removal should have as low impact as is possible for the wild population (for the estimation of the impact we can use *VORTEX*)
- The founder population should be 4.3.0 adult animals to start in Budapest Zoo
- Time of capture should be in the early spring (immediately after hibernation), because it is better for collecting, safer for animals, better respect to the natality of the wild population
- Date of realisation of the collecting the founder population April 2003 (responsible person is Tamás Tóth in co-operation with competent persons from Kiskunság National Park)
- In order to maintain the genetic diversity of the founder population, in the case of a successful captive breeding program, we may collect more individuals from the wild or get animals from the Kiskunság facility by the help of DNA studies and *VORTEX* estimates

Breeding facility and founder animals in Budapest Zoo

- Must be an isolated place in the zoo to avoid the possibility to meet with other reptiles to prevent transmitting diseases, all management and equipment strongly separated from other exotic reptiles
- Designated head keeper only for HMV (Tamás Tóth)

- After the arrival of founder population immediate and continual veterinary screening must be started (Dr. Endre Sós)
- Genetic evaluation (in co-operation with different universities eg. Godollo and ELTE)
- Snakes should be kept separately except special events like mating, combats or other ethological aspects, enclosures should respect all physiological and behavioural requests
- Food management: wild locusts and crickets, breeding colony of locusts *(Locusta migratoria)* and crickets (breeding colony fed with natural plants), rodents (breeding colony of *Microtus arvalis* with natural founders), other available small mammals
- Photoperiod and temperature cycle: the current facility is without windows, the lightening must follow the external photoperiod cycle, additional UV lamps has to be used, temperature cycle respecting data given by field herpetologists
- Hibernation of the adults will take place in another separated facility via respecting all the above mentioned criteria
- Individual recognition marking is essential (microchip for adults and other supporting methods), labelling of terraria
- Creating a studbook which could be assisted by István Vidákovits
- Data collection has to be done from the very beginning to create a husbandry guidelines and veterinary database
- The facility should be prepared completely before the upcoming season 2003 (Dr. Miklos Persanyi)
- Costs for the first two action steps will be covered by Budapest Zoo

What we expect from the Budapest Zoo captive breeding program (if we take into account the following natural history data)

- Biennial or triennial female sexual cycle
- Average fertility 5-15 youngsters
- 5-10 offspring/ year in year 2003, 2004
- 2005 the first offspring of F2 generation
- 2006 individuals for other institutions (close cooperation with Amphibian and Reptile TAG of EAZA, Ivan Rehák)
- 2007 and further – continuing increasing number of individuals available for the reintroduction

2. Breeding facility at Kiskunság

The breeding facility at Kiskunság associated closely with the original habitat of existing wild population should fulfil the following expectations:

- The possibility to keep animals in seminatural conditions minimally influenced behaviourally, physiologically and morphologically by the captive conditions
- The production of juveniles better pre-adopted for the releasing if compared with zoo born juveniles
- Convenient conditions for the pre-releasing preparation of the captive born juveniles
- The risk of the contact with the exotic reptile diseases is practically eliminated

- Excellent opportunity to study life history under seminatural conditions, what is of especially great importance to raise our knowledge of life history, and consequently to help to develop the appropriate methodology for the releasing of captive born animals, and to get important information for *in situ* conservation (hibernation, habitat use, thermal biology etc.)

Requirements and realisation

The facility should fulfil the following basic requirements

- Two types of outdoor enclosures with antipredator protection and fulfilling all behavioural and physiological needs of vipers, especially the adequate space, the spatial elements necessary for the "natural" life e.g. hiding places, basking places, thermal gradients, humidity gradients, hibernation hollows and chambers
- Type 1 enclosures are smaller in size, they will be used for individual keeping of vipers which are involved in more intensively managed captive reproduction
- Type 2 enclosures are larger; they will be used for the seminatural keeping of less intensively managed individuals eg. pregnant females with their offspring, breeding nuclei of several adults, individuals which are prepared for reintroduction
- The indoor enclosures for the eventual temporary keeping of animals according to the special needs or for the case of necessity to relocate the animals from outdoor enclosures
- The facility must be safe against thieves and other human and animal intruders e.g. foxes and wild boars etc., not to overlook such predators like *Coronella austriaca* or big individuals of *Lacerta viridis*

Recommended actions

- Birdlife Hungary is following the given recommendations and will prepare the project for the breeding facility at Kiskunság, with all technical specifications relevant to keeping and breeding methodology – the recommended deadline is 30.6.2002.
- The draft of the project will be submitted for critical reading and comments to Zoltán Korsós (Hungarian Natural History Museum), Miklós Persányi (Budapest Zoo), Göran Nilson (Göteborg Museum), Keith Corbett (SEH Conservation Committee), Ivan Rehák (EAZA Amphibian and Reptile TAG) – the comments should be sent back as soon as possible, preferably in two weeks time
- The complete preparation of the facility prior upcoming season (hopefully February 2003)
- Removal of founders from the wild: recommended steps:
  a) Early spring, prior the mating season – to remove 3.3, each of three couples should represent different local (Kiskunság) populations, we strongly recommend to reject any ideas to use pregnant females as founder animals because of many reasons e.g. the pregnant female is extremely valuable for wild population and her removal can be detrimental for the well functioning breeding nucleus at the given micro locality, the very perspective juveniles will be excluded from the natural process of the wild population recovery, the acclimatisation time in the new enclosure will be very short for this female and it may increase the mortality of juveniles or the female herself etc.;
  b) Individual keeping in smaller enclosures until the mating season;
  c) The completion of pairs for the mating;

d) Separate the female when pregnancy is confirmed, and then move the individual into a large enclosure to give birth there,
e) Hibernation in the same outside enclosure under natural condition, female remains with juveniles (ethological reasons)

- Individual recognition marking is essential (microchip for adults and other supporting methods), labelling of enclosures
- Creating a studbook which could be assisted by István Vidákovits (Budapest Zoo) but a record keeper must be designated by Birdlife Hungary in Kiskunság as well (with the help of the studbook we may avoid the further harvesting of wild population to maintain genetic variability)
- Data collection has to be done from the very beginning to create husbandry guidelines and veterinary database

3. To find effective co-operation between the existing breeding facilities is an essential requirement

- Contact persons: Dr. Endre Sós and Tibor Kovács (Budapest Zoo), Bálint Halpern (Birdlife Hungary)

4. Developing the adequate reintroduction strategy

- We do not have many exact information on the degree of the success of reintroduction in snakes
- The creating of appropriate methodology for releasing will be continuous process and will be depend on captive breeding results, and modified according to newly gained knowledge, experience and information
- Two different reintroduction strategies could be carried out:
  1. The first, which is short term strategy is the reinforcement of the existing Kiskunság population, for this purpose exclusively the individuals originated from Kiskunság breeding facility will be used, at least 15-20 animals has to be released after second hibernation
  2. Second, which could be a long term strategy is the reintroduction to the suitable locality already not inhabited by HMV but in the frame of historical distribution (e.g. near Budapest's Ferihegy Airport?), the selection of this place must be done with close co-operation amongst the stakeholders, for this purpose the animals originated from zoo programs will be used (the zoo born animals will be not used for reinforcement of the existing wild population of HMV to avoid the possible problems e.g. diseases),
- Preliminary recommendations for Kiskunság reinforcement:
  a) Juveniles born in large enclosure will be not handled after the birth and will be hibernate under seminatural conditions in the enclosure together with the mother
  b) Juveniles will be kept in the same enclosure, not handled but monitored until reaching subadult size,
  c) Consequently these juveniles will be used (at the beginning) for establishing of the enough numerous captive population in Kiskunság breeding facility, and later for release to the wild (or eventually used for the genetic enriching of the zoo population)

d) The released animals should be marked with transponder or radio transmitter for further monitoring
e) The monitoring project must be developed and guaranteed before the animals are released (possible co-operations with universities)

- Preliminary recommendations for the reintroduction program of the zoo born animals:
  a) The selection of the release site must be the result of a complex evaluation
  b) Budapest Zoo will create the field station, which is convenient for the implementation of soft release techniques (pre-releasing preparation of captive born animals)
  c) Well prepared subadults will be released (minimum preparation is equal to the life under seminatural conditions starting with removing from artificial hibernation, placing into outdoor enclosure and kept there until mid summer when the releasing should be realised),
  d) The releasing animals has to be marked with transponder or radio transmitter for further monitoring
  e) The monitoring project must be developed and guaranteed before the animals are released (possible co-operation with universities)

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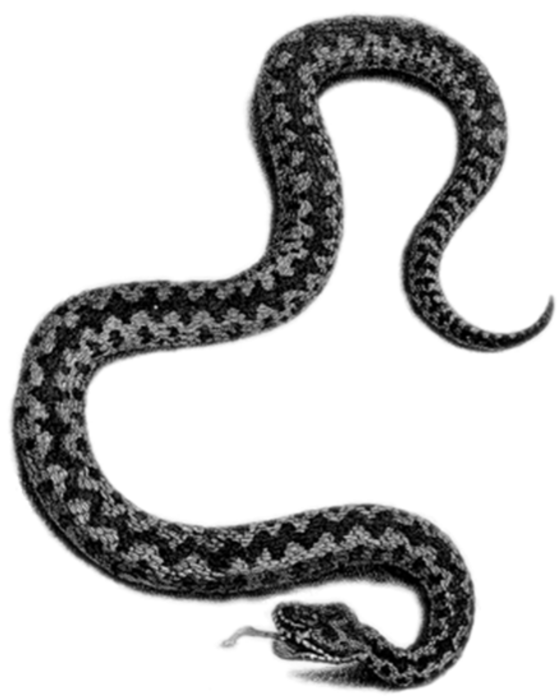

Section V
List of Workshop Participants

List of PHVA Workshop Participants

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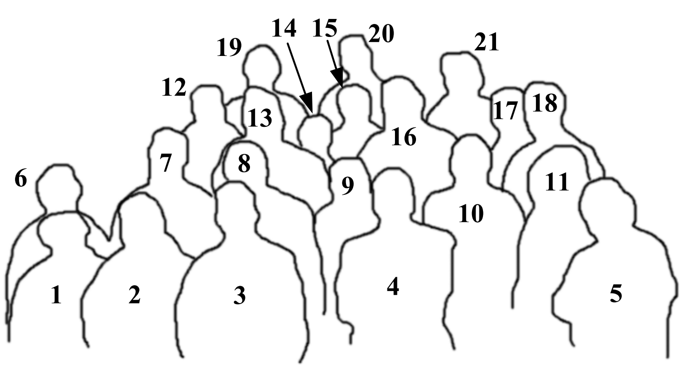
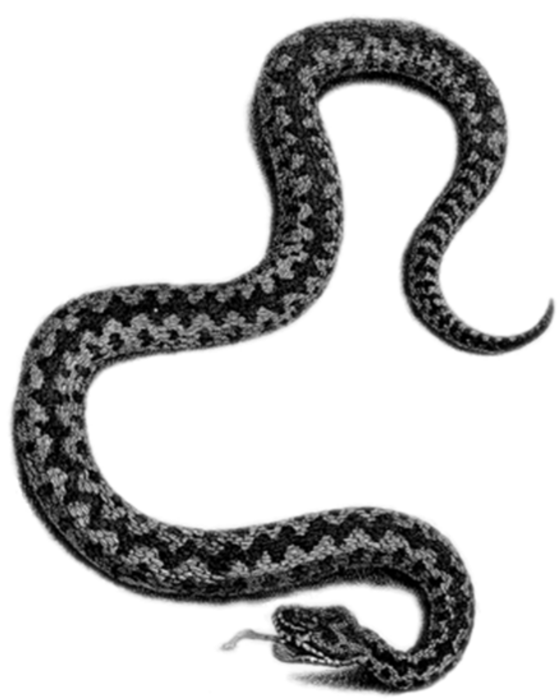


Population and Habitat Viability Assessment (PHVA)
For the Hungarian Meadow Viper
(*Vipera ursinii rakosiensis*)

5 – 8 November, 2001
The Budapest Zoo
Budapest, Hungary

Workshop Report



Section VI
Appendices

Appendix I
Participant Responses to Day 1 Introductory Questions

What is your personal goal for this workshop?

- I would like to see a recommendation which could be used for the action plan of *Vipera ursinii rakosiensis*.
- To get acquainted with *V. u. rakosiensis* – its status, biology, conservation problems; to see its habitats in nature. To get an experience in action planning and PVA, that will be useful for my work in Ukraine. I wish to see a realistic action plan which will work.
- To meet colleagues, to see and understand others' views. To convince stakeholders what they should do.
- To find out about the biology, reproduction, and ecology of meadow viper. I would like to see the way how to preserve the habitat of the population, so I could extrapolate experience to the species in my country
- Learning the ways of meadow viper protection and using them for the *V. u. moldavica* population; a well stated action plan for Hungarian meadow viper protection
- To get insight into the genetic variability of the species in order to decide on the conservation strategy
- I do not expect an Action Plan, but I'd like to see a process that has been started. I'd like to say that we established the foundations of a Plan. To find the place of the Zoo in this Programme, of course we already have some ideas about this
- To contribute with hopefully useful knowledge. An outcome with a concrete plan of action would be nice to see. Resulting in a hopefully fruitful plan of action. Learn! Concretely establishing the situation of the Bulgarian *Vipera ursinii*
- To learn about conservation strategies. I hope that in the end of the workshop, the aims of the conservation work in the near future will be clear
- Finding a solution for stopping habitat destruction and for strengthening habitat reconstruction where it is possible. Systematic research of habitats and their classification with regard to *V. u. rakosiensis* presence
- I'm interested in nature conservation. One of the best ways for the growth of the Hungarian meadow viper's population
- I would like to get results which will help this species conservation
- The evaluation of the ex-situ conservation project for *V. u. rakosiensis*. To support the creation of the adequate management for the wild population
- I wish to see how this workshop is working because I think that the PHVA is very important tool for saving endangered species like the Hungarian meadow viper or the primates
- Saving this taxon (in vivo) from its impending extinction. Updating the situation in order to brief the Bern Convention Steering Committee
- To gain information and also to provide data on the current situation. A common guide line for the future steps
- I would like to know what are the news now in this problem
- To see a program for recovery work on the remaining habitat and to see ways of increasing the habitat sizes. Key matters
- Defining concrete measures and protected Austria – habitats and monitoring
- ecology and conservation of the meadow viper; a complete method for protecting the subspecies
- getting information in order to do better land conservation activity in Kiskunság National Park

What, in your view, is the primary challenge for conservation of the Hungarian meadow viper over the next 25 years?

- Protect natural habitats
- Improper habitat management; lack of cooperation between national parks and private citizens.
- Reduced ecological structure in HMV habitat
- Preservation of natural habitat
- Proper management of actual and potential meadow habitat
- Inefficient governmental authority for HMV management
- Lack of control among management authorities
- Improper habitat management; need for better stakeholder involvement
- Habitat conservation
- Habitat destruction and need for management
- Improved cooperation between scientists and management administration
- Need for protection of entire landscape level habitat system
- Habitat conservation
- Need for a complex conservation method
- Can we cooperate to manage HMV habitat?
- Need to collect more population data (Pop size, pop ecology, etc.);
- Establish population viability parameters
- Chaotic historic land management
- Need for continuous population monitoring for conservation management
- Major information gap between scientific and management communities
- Development of captive breeding program, habitat restoration, and management
- Large scale of species/habitat management program; difficulty in moving forward on all fronts simultaneously
- Overcome problems of small population size
- Develop common ground between scientific and management authorities

What do you wish to contribute to this workshop?

- Veterinarian aspects of conservation breeding and reintroduction
- I hope my knowledge in ecology and biology or *Vipera renardi* in Ukraine and *V. u. moldavica* in the Romanian part of the Danube delta can be useful for the conservation of *V. u. rakosiensis* in Hungary
- Scientific background, biological results of our studies and observations, personal experience from the past 15 years
- I would like to start and improve the communication between the experts of Hungary and Yugoslavia, since we are bordering countries, and to share the information about the habitat disturbance (especially steppe) in Hungary and Serbia. I would like to share the information about the possible occurrence of meadow viper in Vojvodina
- To share my knowledge and expertise with *V. u. moldavica* and see what is common and what is different between these two subspecies
- Importance of molecular genetic analysis of genetic diversity (basic ideas)
- Brief knowledge of snake ecology
- Everything I possibly can
- I don't have the experience with the Hungarian meadow viper, but I hope that a few ideas of use or maybe my appearing questions should help
- Sharing my knowledge of ecology of the species and captive breeding of vipers
- With my ideas
- My experience in viper husbandry
- To help evaluate the significance of the captive breeding programme for *V. u. rakosiensis* in the frame of the general conservation strategy for the subspecies, and to prepare recommendations for an appropriate captive breeding project, with methods of captive breeding and keeping
- I would like to use knowledge I got from this workshop in my future work. So therefore mainly I would like to learn
- To select Priority actions for conservation – in situ
- My personal experiences gained during field-work and other aspects of my job
- I want to find the lost habitats in this area and help to protect it. Help to translate between the scientist and the public
- To discuss the dangerous effects of captive breeding based on the remaining wild specimens. To discuss homing behavior, problems with disease in the captive stock, etc
- Knowledge of actual Austrian situation
- Share my knowledge of the other lowland subspecies *V. u. moldavica* with others which could provide some information for the protection of *rakosiensis*
- Information and corrections about previous interpretations about the habitats of viper in Great Hungarian Plain and thoughts about its ecology. Local management in ecological background

Appendix II:
Workshop Presentation Summaries

The biology and ecology of *Vipera ursinii rakosiensis*

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The Hungarian Meadow Viper (*Vipera ursinii rakosiensis* Méhely, 1893) is a small sized lowland steppe form of the complicated *Vipera ursinii* species-group. Its systematic status is yet unclarified, although a subspecific rank seems most probable on both morphological and biochemical evidences. Description of the viper is recalled by Korsós (1991) and by Korsós & Fülöp (1994) from a historical point of view, however, for a more detailed taxonomic overview see the revisions of Herrmann et al. (1987, 1992), Joger et al. (1992), Nilson et al. (1993), and Nilson & Andrén (in press).

Former distribution included westernmost part of Austria, Hungary, Transsylvania – now in Romania, and northern Bulgaria (Dely & Janisch 1959). Populations only exist presently in two districts of Hungary (Takács et al. 1987), from all the other territories it is most probably extinct (Beschkov 1973, Kammel 1992, Korsós & Újvári 1998, Korsós et al. 1997, Krecsák & Korsós 2001, Tiedemann 1986, Vancea et al. 1985).

Its habitats are isolated small meadows in the Great Hungarian Plain between the rivers Danube and Tisza, and in the Hanság Nature Reserve, NW Hungary. Presently we know eight different localities in the Kiskunság, and only one in the Hanság. This number, however, may be adjusted by the opinion how „populations" in such a fragmented landscape can be defined. Typical vegetation is characterized by non-uniform distribution of clumps of different grass species like *Molinia coerulea, Festuca sulcata, Koeleria gracilis, Chrysopogon gryllus* and *Stipa* spp., organized in a way giving micro-levels and coarse-grained, mosaic-like structure to the habitat. Abundance of potential prey insects (grasshoppers and crickets) as well as small sized lizards (*Lacerta agilis* and *Podarcis taurica*) are often remarkably high.

The ecology and the biology of the Hungarian meadow viper is still insufficiently known, because of the rarity of the viper (Corbett 1989). Pet-keepers consider it to be easy to handle for short terms in terrarium, however, no evidence of captive breeding or raising of hatchlings in more generations are available. Venom effect on humans is very modest; no medical treatment were ever recorded (Takács et al. 1987). Population size in nature is estimated not exceeding five hundred specimens in one place. Sensitivity of the snake against meteorological changes, habitat alteration and human disturbance is widely believed.

Its conservation status means full legal protection in Hungary; one of the highest priority in legislation among the vertebrates (Báldi et al 1995, 2001). Theoretical nature conservation value of one specimen has recently been raised to 1 million Hungarian Forints (~3300 EUR). Most parts of the distribution area are under protection, the majority of them is in governmental property; however, proper management seems to be all the time a matter of discussion between conservation people, ecologists, agriculturist, and local farmers. This makes especially difficult the conservation through habitat protection. A preliminary

Recovery Plan was already set up as early as in 1994 (Korsós & Gór 1994), but still, unfortunately, no officially approved Action Plan exists for this extremely threatened species.

Populations are most probably subject of short term (cold winter, high soil water level, minimum prey density, predators, etc.) as well as long term natural threats (isolation, genetic drift, inbreeding, etc., see also Újvári & Korsós 1999b). However, the meadow viper is immediately and most significantly threatened by human agricultural activities like intensive grazing, burning (Újvári et al. 1998), mechanical mowing, and ultimate habitat destruction (ploughing and breaking the meadows). Illegal collection by pet keepers and dislike of locals play also an important role in population decline.

Full and long term study of populations in nature has been initiated by the Hungarian Natural History Museum, Budapest, and the Conservation Committee of Socieatas Europaea Herpetologica. Based on regular field visits since 1985, both in the Hanság and Kiskunság localities we gained a valuable knowledge about the ecology of the species. Later on, a group of the Hungarian Ornithological and Nature Conservation Society joined to the intensive study, which finally was supported by two Hungarian National Research Fund projects (OTKA Nos.T-13305, and F-23454) between the period 1995-1997 (in Dabas), and 1998-2000 (in Bugac). Capture-mark-recapture, as well as radiotelemetry (Újvári & Korsós 2000) as methods were used to clarify the conditions of the survival chance of the vipers. Details of population size estimation, population structure (sexes, age groups, growth, life span), life history (daily and seasonal activity rhytm, breeding, karyology, hibernating), ecological and behavioural details (feeding, reproduction, ontogeny) were published in a series of publications (Újvári & Korsós 1997, Újvári & Korsós 1999a, Liptói et al. 1999, Újvári et al. 2000).

The table below gives a summarized overview about our present knowledge, and at the same time points out the possible targets of future studies:

We know	We don't know
distribution	exact population size
habitat choice	mating success
daily and seasonal activity	breeding success
thermobiology	survival rate
food	immigration – emigration
growth	population contact
breeding, parturition (partly in captivity)	exact genetic variability and its dangers
karyotype	
hibernation	
a few on genetic variability	

References

Báldi, A., Csorba, G. & Korsós, Z. (1995): Setting priorities for the conservation of terrestrial vertebrates in Hungary. – Hungarian Natural History Museum, Budapest, 59 pp. (in Hungarian, with English summary)

Báldi, A., Csorba, G. & Korsós, Z. (2001): Setting priorities for the conservation of terrestrial vertebrates in Hungary. – Biodiversity and Conservation 10: 1283-1296.

Beschkov, W. (1973): Über die subgenerische Zugehörigkeit der bulgarischen *Vipera ursinii* (Bonaparte, 1835) (Serpentes). – Bull. Inst. Zool. Mus., 37: 103-112.

Corbett, K. (1989) (ed.): Conservation of European reptiles and amphibians. – Christopher Helm, London, 274 pp.

Dely, O. Gy. & Janisch, M. (1959): La répartition des viperes de champs (*Vipera ursinii rákosiensis* Méhely) dans le Bassin des Carpathes. – Vertebr. hung., 1: 25-34.

Fülöp, T. (1992): Distribution and conservation measures of *Vipera ursinii rakosiensis* in the Hanság Nature Reserve. – In: Korsós, Z. & Kiss, I. (eds): Proc. Sixth Ord. Gen. Meet. S.E.H., Budapest 1991, pp. 165-169.

Herrmann, H.-W., Joger, U., Nilson, G. & Sibley, C. g. (1987): First steps towards a biochemically based reconstruction of the phylogeny of the genus Vipera. – In: Van Gelder, J. J., Strijbosch, H. & Berers, H. (eds): Proc. Fourth Ord. Gen. Meet. S.E.H., Nijmegen, pp. 195-200.

Herrmann, H.-W., Joger, U. & Nilson, G. (1992): Molecular phylogeny and systematics of viperine snakes I. General phylogeny of European vipers (Vipera sensu stricto). – In: Korsós, Z. & Kiss, I. (eds): Proc. Sixth Ord. Gen. Meet. S.E.H., Budapest 1991, pp. 219-224.

Joger, U., Herrmann, H.-W. & Nilson, G. (1992): Molecular phylogeny and systematics of viperine snakes II. A revision of the *Vipera ursinii* complex. – In: Korsós, Z. & Kiss, I. (eds): Proc. Sixth Ord. Gen. Meet. S.E.H., Budapest 1991, pp. 239-244.

Kammel, W. (1992): Zur Situation der Wiesenotter, *Vipera ursinii rakosiensis* (Méhely, 1894) (Squamata: Serpentes: Viperidae), in Niederösterreich. – Herpetozoa, 5: 3-11.

Korsós, Z. (1991): The most threatened venomous snake of Europe, *Vipera ursinii rakosiensis* – Természetvédelmi Közl., 1: 83-88. (in Hungarian)

Korsós, Z. & Fülöp, T. (1994): One hundred years of the meadow viper (*Vipera ursinii rakosiensis*). – Állattani Közl., 78 (Suppl.) (in Hungarian)

Korsós, Z. & Gór, A. (1994): Recovery program for the threatened meadow viper (*Vipera ursinii rakosiensis* Méhely, 1893) in Hungary. – Davies, M. & Norris, R. (eds): Abstracts of the Second World Congress of Herpetology, Adelaide, South Australia, p. 143.

Korsós, Z. & Újvári, B. (1998): The Hungarian meadow viper in the vicinity of Cluj. – Állatt. Közlem., 83: 123-128. (in Hungarian, with English summary)

Korsós, Z. & Újvári, B. (in press): Conservation of the Hungarian Meadow Viper (*Vipera ursinii rakosiensis*). – In: Schuett, G. W., Höggren, M., Douglas, M.E. & Greene, H. W. (eds): Biology of the vipers. Biological Sciences Press, Traverse City, MI, USA

Korsós, Z., Újvári, B. & Török, Zs. (1997): Searching for the meadow viper in Romania. – Miscnea zool. hung., 11: 77-88.

Krecsák, L. & Korsós, Z. (2001): The Hungarian meadow viper in Transylvania. – 2. Biologist Days in Cluj, Abstracts, Kolozsvár, pp. 15-16. (in Hungarian)

Liptói, K., Újvári, B., Korsós, Z. & Hidas, A. (1999): Investigation of the karyotype of *Vipera ursinii rakosiensis*. – Állattenyésztés és Takarmányozás, 48(1): 90-91.

Méhely, L. (1893): Die Kreuzotter (Vipera berus L.) in Ungarn. – Zool. Anz. Leipzig, 16(420): 186-192.

Nilson, G., Andrén, C. & Joger, U. (1993): A re-evaluation of the taxonomic status of the Moldavian steppe viper based on immunological investigations, with a discussion of the hypothesis of secondary intergradation between *Vipera ursinii rakosiensis* and Vipera (ursinii) renardi. – Amphibia-Reptilia, 14: 45-57.

Takács, Z., Janisch, M. & Korsós, Z. (1987): Contribution to the epidemiological and clinical aspects of snake bites in Hungary. – Toxicon, 25: 376.

Takács, Z., Korsós, Z. & Janisch, M. (1987): Conservation status of the endangered *Vipera ursinii rakosiensis* in Hungary. – In: Gelder, J. J. van, Strijbosch, H. & Bergers, P. J. M. (eds): Proc. Fourth Ord. Gen. Meet. S.E.H., Nijmegen, pp. 391-394.

Tiedemann, F. (1986): Die Wiesenotter in Österreich. – ÖGH Nachrichten, 6/7: 30.

Újvári, B. & Korsós, Z. (1997): Thermoregulation and movements of radiotracked *Vipera ursinii rakosiensis* in Hungary. – In: Böhme, W., Bischoff, W. & Ziegler, T. (eds): Herpetologia Bonnensis. Bonn (SEH), pp. 367-372.

Újvári, B. & Korsós, Z. (1999a): First observation in situ on the hibernation of the Hungarian Meadow Viper (*Vipera ursinii rakosiensis*). – In: Miaud, C. & Guyétant, R. (eds): Current studies in herpetology. Proceedings of the 9th Ord. Gen. Meeting of the SEH. Le Bourget du Lac (SEH), pp. 435-438.

Újvári, B. & Korsós, Z. (1999b): Risk of translocation programs, with special reference to reptiles. – Természetvéd. Közlem., 8: 195-204. (in Hungarian, with English summary)

Újvári, B. & Korsós, Z. (2000): Use of radiotelemetry on snakes: a review. – Acta zool. Hung. 46(2): 115-146.

Újvári, B., Korsós, Z. & Kisbenedek, T. (1998): Fire hazard in the habitat of the endangered Hungarian meadow viper. – Természetvéd. Közlem., 7: 151-165. (in Hungarian, with English summary)

Újvári, B., Korsós, Z. & Péchy, T. (2000): Life history, population characteristics and conservation of the meadow viper (*Vipera ursinii rakosiensis*). – Amphibia-Reptilia 21(4): 267-278.

Vancea, S., Saint Girons, H., Fuhn, I. E. & Stugren, B. (1985): Systématique et répartition de Vipera ursinii (Bonaparte, 1835) (Reptilia, Viperidae), en Roumanie. – Bijdr. Dierk., 55: 233-241.

Eurasian vipers and the systematics of the *Vipera ursinii* complex

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There are five lineages of Eurasian vipers which all have been tracked down to Miocene, of which one is the *Pelias* branch, which includes *Vipera berus* and similar forms. The delicate bones of *Vipera ursinii,* which is another member of the Pelias lineage, have not been recognised in available samples. However, immunological studies based on albumins, indicate that the *Vipera ursinii* complex was separated, according to the Biological clock hypothesis, from the base of the *Pelias* lineage during the periods of grassland dispersal during the upper Miocene about ten million years ago.

Immunological studies of the different taxa within the *Vipera ursinii* complex show differences in the albumin serum profile that are similar to differences between full viper species. The twelve different taxa within the complex have branched off during the Pliocene and Pleistocene and correspond to series of sibling species rather than subspecies. Of these the lowland taxa are severely endangered due to habitat destruction, and especially the unique Hungarian taxon, *Vipera ursinii rakosiensis* is critically threatened.

Literature

Nilson,G. & C. Andrén (2001): The Meadow and Steppe Vipers of Europé and Asia – The *Vipera (Acridophaga) ursinii* complex. Acta Zoologica Hungarica 47 (2-3) (in press).

Conservation of *Vipera ursinii rakosiensis* (Hungary)

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This endangered taxon is a glacial relict confined to fragmented habitat within the Pannonian Danubian Plain. It has been lost from Austria and Romania, and its only surviving populations are now in Hungary.

Ecological needs are reflected by meadows with dry sandy and damp components, either in adjacent sites or within the same meadow. Open conditions (cf. bushes or trees) with a mosaic including some "tussocky"[1] ground vegetation of grass or rush are essential habitat structural factors.

The dense populations known from its E.Austrian range are now considered extinct; the taxon still survives in Hungary but not since the 1950's at its previously renowned densities.
During this time, and to date, habitat and population decline has continued:
the main causes involve drainage; improved agriculture (especially arablisation); urbanisation; burning (including deliberate); over-grazing; collection and persecution have also been locally implicated.
While protective legislation for the individual animal has been progressively elevated to a national zenith in terms of flora and fauna, legal protection for its habitats is clearly not implemented.

The S.E.H. Conservation Committee, and more latterly its extension into the IUCN SSC. Group for European Herpetofauna, have spent more time assessing and advising on this taxon than on any of more than 60 other threatened herptiles from Cyprus to Norway, and the Caucasus to the Canaries! Our work is majored on habitat association, threats and conservation needs. Necessary conservation actions have then been pursued 'politically' via the Council of Europe's Bern Convention, presently having 45 ratifying countries.

Three current recommendations concern the Meadow Viper:
- General – No.14 (1989); and
- Specific – Nos. 23 & 26 (1991).

Conservation proposals for this taxon (and 47 others) were abstracted from our draft Action Plans, and presented to and approved by Bern's Expert Herpetofauna Group, and thence by its 1998 Standing Committee.

There had been a close and positive working relationship with the Hungarian government's Nature Conservation service. In 1997 SEH. financed governmental purchase of the important Orditó-rét meadow near Kunpeszer, thence transferred to the Kiskunság National Park. An updated assessment and proposals for a national Recovery Plan were submitted on request in 1998; this was followed nationally in 1999/2000 by the formulation of a detailed Action Plan proposal. To date, neither strategy has been adopted or pursued by the government authorities, a situation quite contrary to the above Recommendations.

In contrast to the necessary actions of site acquisition, site protection, and sensitive habitat management, a series of adverse situations have been allowed to arise with absolutely no progress towards species recovery. This situation appears to have been exacerbated by a lack of co-operation from the two National Park authorities, and by the essential lack of national nature conservation control over private or

[1] The tangled mat of the previous seasons' growth, at the plant base

Defence Ministry habitats. The predictable result, in those populations where studies are still allowed, is continued decline.
The absence of official participation in this timely Seminar by either the Nature Conservation service or the Hanság or Kiskunság National Park authorities further reflects this alarming situation.

Hungary is now on the verge of joining the European Union which requires adherence to the binding Habitat and Species Directive, a legal instrument worded principally to achieve better implementation of the Bern Convention throughout the Union. The Meadow Viper is a priority species in its Annexe II, and is also listed on Annexe IVa; this designation obliges legal protection for resting and breeding habitat; Favourable Conservation status; and the designation of all significant populations and habitats within the Natura 2000 suite. No exemption or ignoring of private or Defence lands will be possible, as is sadly the case at present in Hungary.

Let us hope that there are still significant populations of Meadow Vipers left by then and within a semblance of their remnant world range!

Meanwhile, the basic yet unfulfilled measures required to save this taxon remain :

A National Recovery Plan, formally adopted and accepted by relevant Ministries and the two National Parks, implemented on an agreed priority timescale via a co-ordinating post now necessarily to commence as early as possible in 2002.

This Plan must involve:

- Protective designation and management control for all surviving populations;
- The acquisitions of key sites;
- The prevention of all adverse management and its impact on tussock vegetation;
- The restoration, extension and linkage of habitats, especially within the Hanság, and between Dabas and Fulophaza;
- The monitoring of selected populations;
- Applied research, eg. on the effect on habitat of partial/rotated cutting.

While this in-situ conservation is undoubtedly the first priority there may also be a role for captive breeding. If so, the prior preparation of receptor sites/habitat must be given equal resourcing. One currently overlooked option appears to be presented by the surviving meadows within the large periphery of Budapest (and Vienna) International Airport.

Conservation activities on Hungarian meadow vipers (*Vipera ursinii rakosiensis*) in the field

Bálint Halpern & Tamás Péchy
BirdLife Hungary

At present time this small venomous snake can only be found in Hungary. During the last 50 years it became extinct in other European countries like Austria (Wienna basin), Romania (surrounding hills of Kolozsvár) and Northern-Bulgaria. The cause of this stunning decrease in the number of populations and animals is increasing agricultural activities and a change to intensive cultivation on those areas where previously there where no such activities and though served as last refuges of the viper populations. Also in Hungary only small and isolated populations remained. One very small (9 ha) population in the Hanság (North-western region) and 11 in the region between the river Danube and Tisza, called the Kiskunság. The Kiskunság populations are also fragmented using areas of 200 hectare on average, ranging from 100 to 400 hectare.

The Hungarian Meadow Viper is protected since 1982 in Hungary. From 1986 it is strictly protected. Today its conservation value is 1 million HUF (3962 EURO). It is Hungary's most endangered vertebrate, Europe's most endangered venomous snake. It is protected in the European Union as well (Bern Convention II., CITES I. Appendix). The IUCN categorised it as "threatened". The Bern Convention has two recommendations to Hungary regarding the Hungarian Meadow Viper. The Societas Europea Herpetologica (SEH) donated a significant amount for Hungary to buy one of its habitat in 1996. Today 70% of the vipers' habitats are located on protected areas, as the remaining 30% is military area, leased by BirdLife Hungary. Eighty per cent of the protected habitats are state properties, in the management of conservation authorities.

In 2000 the draft of the Action plan for the conservation of the Hungarian Meadow Viper was prepared by BirdLife Hungary and Natural History Museum. It is now under the process of making it compatible to the country's legal system. Since 1998 Kiskunság National Park and BirdLife Hungary are trying to enforce 'viper-friendly' management on the known habitats. This can be carried out more easily on the areas leased by BirdLife Hungary, while on state-owned areas the nowadays' leasing-system that lacks compensation makes it difficult.

The population and habitat assesment studies and research carried out regularly by BirdLife Hungary since 1993 have shown rapidly decreasing population sizes. These were carried out at 2 habitats (120 ha each) in Kiskunság achieving 155 observed individuals with 10 recapture so far. Our data is showing stunning decrease in number of individuals. Looking at the age-structure of the observed individuals we can claim the so called subadults (aged between 1-3 years) missing from recent populations suggesting a recruitment rate close to zero. Populations lacking recruitment are aging populations or after reaching the Minimal Viable Population (MVP) size they are considered as dying populations. We have to deal with the probable fact that in some of the areas, counted as 'viper population are present' in the 1996-97 study, the Hungarian Meadow Viper has already became extinct.

What are the basic causes leading to the recent situation? The drainage programs of the post-war developement gave way to agriculture on several areas of Kiskunság. The switch to intensive agriculture and afforestations on those areaas are the prime causes of first loss of habitats. That is how the fragmented, isolated and shrinking populations were 'created'. The intensive management of the remaining areas (hay-making, overgrazing) meant that these places became habitats far from optimal regarding the species' needs. Although Kiskunság National Park tries to enforce 'viper-friendly' management through the contracts but the system lacks financial compensation for 'lost income'. Killing and illegal collection of animals also took its tolls in the '70s and '80s. The most recent blow to the populations was the extremely high winter and spring ground water levels (98/99) as remaining habitats are mainly on deeper areas lacking local elevations. Further severing the situation is the probable low reproduction success arising from the usual problems of small and isolated populations. These are genetic drift, inbreeding depression and as numbers are low adult individuals find it physically difficult to find a mating pair.

In order to save this unique species for the future generations BirdLife Hungary together with Kiskunság National Park and the Ministry of Environment Nature Conservation Authority have already applied to the European Union's LIFE-Nature Fund for financial support of a project which includes the proposed actions to overcome these problems. The proposed actions are as followed.

The most important point is to create a legally compatible 'Action plan for the conservation of the Hungarian Meadow Vipers' accepted by all competent participants. This recovery plan will provide guidelines to achieve the following goals. It is very important that all areas thought to be inhabited by the vipers to become state properties, as it is a precondition of effective conservation effort. During recent years from these areas (1800 ha) 1587.5 hectares became state property (in the management of Kiskunság National Park and Ministry of Defence). Negotiations are on the way between the two ministries on the handing over of areas managed by the army to conservation authorities. The state started the purchase of 150 hectares of the privately owned 212.5 hectares. The remaining 62.5 hectares would be purchased in the project and this will enable us to connect the neighbouring habitats.

Reconstruction of habitats in some areas is needed as we have to cut down the forests that were planted some 20 years ago to the elevated fields next to the habitats. While reconnecting these elevated areas to the recent habitats the animals will have a better chance to survive high ground-water levels while hibernating in winter.

'Viper-friendly' lawn-management must be ensured on the recent viper habitats. First of all it means the change in the recently used hay making method by a considerate one that will be provided by the project. Through that the management will be gentler and we will have a better chance to organize the spatial and time dimensional realization of hay making activities in the region. Secondly we have to increase the number of grazing animals on certain areas by keeping a herd of traditional Hungarian grey cattle. As the habitats are situated in mosaic pattern among the network of small farms in Kiskunság, we have to consider the needs of the families living there. Although through a system of lease and compensation it can work very effectively.

Our long term studies shows that the isolated population are unable to grow whilst the best management effort either. To achieve the goal of the program we have to start the reinforcement of the populations. This will be carried out at the Viper Conservation and Recovery Centre, created on a former habitat next to a recent population. The minimised predation and maximised food abundance provided by the Centre's seminatural conditions will enable the subadult individuals to join the breeding population by releasing them step by step to the nearby habitat, enlarged by that time thanks to the recultivation, providing enough food and diversity in the features of terrain.

The active protection of a venomous snake can be hardly accepted by the local people in particular if it means certain restriction in the use of land. A good compensation system, information tables, leaflets and public forums will enable to understand and accept the importance of the conservation of this snake species.

Through the proposed project the recent habitats will be enlarged and connected with areas 'stolen' by agriculture in the recent 20-50 years. The life conditions of the vipers will improve. On the 'viper inhabited grass-lands' the management will be subordinated to the vipers' needs. Financially and morally the local people will accept the conservation of the vipers. Ecological corridors will connect the isolated populations, which will be strengthened. On a longer term the survival of this unique species will be ensured in Hungary and though on the Earth.

On the situation of the Bulgarian *Vipera ursinii*

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To date four specimens of *Vipera ursinii* have been found in Bulgaria. They originate from two, widely separated localities, one in the eastern parts of the country in the areas surrounding Shumen and the other immediately west of Sofia, in Lyulin planina. The two Lyulin specimens were caught at different localities within the mountain range the first of which was caught in the surroundings of the village Verdikal (650-680 m elevation). The second Lyulin specimen is a large female. The specimen was found in the lower parts of the ski slope in the forested area around the monastery formerly known as Sveti Kral. The locality of this specimen is at a somewhat higher elevation (950-m elevation) and it has been subjected to many changes - unlike that of the surroindings of Verdikal - caused by human activity in the area and should be considered almost completely destroyed.

Another small specimen of *Vipera ursinii* was caught somewhere in the forested plateau above Shumen at an elevation of approximately 350 m. Furthermore an additional, already preserved specimen was discovered in 1934. The date of capture is unknown but the locality is thought originate from the plateau above Shumen. This specimen had already turned pale when discovered and therefore indicating that the specimen was probably old when discovered.

There are a couple of possible records of *Vipera ursinii* from Bulgaria: these are records of *Vipera berus* reported from Ruse, Mesembria (nowadays known as Nessebar) and Burgas. It should be noted that at that time there was great confusion about the proper naming of *Vipera berus* and *Vipera ammodytes* at that time and therefore those specimens are most likely records of *Vipera ammodytes* – especially those around Nessebar and Burgas which lack suitable habitat. These observations do however indicate a possible occurance of *Vipera ursinii* in the above mentioned localities since a distinction of *Vipera ursinii* would have been very unlikely and hence these records constitute at least hypothetical records of *Vipera ursinii*.

A fifth specimen probably belonging to *Vipera ursinii* was found by a group of Swiss ornithologists a few years ago in north-eastern Bulgaria. They used a field guide to determine the species and took photographs. The true identity remains unresolved until the photographs can be examined. The only other snake in the region: *Vipera ammodytes* can be easily distinguished by the presence of the horn. Until the photographs have been seen no definite conclusion can be drawn about the identity of the snake.
The habitat of the Shumen plateau has been subjected to destruction due to extensive human activity in the area – in 1981 Bulgaria celebrated its 1300 anniversary and a huge memorial was built which further destroyed the habitat and increased the human activity in the area. Today this area is a park and frequently visited.

The environment in Lyulin planina has changed little since the specimens of *Vipera ursinii* were found. The forested areas have probably expanded to some degree but the main change has been the increase of cultivated areas and perhaps also expanding areas with bushes. Some patches of undisturbed habitat remain but whether or not they host populations of *Vipera ursinii* is not known with certainty. No serious effort has been undertaken in recent years and it is therefore possible that Lyulin planina hosts small populations of *Vipera ursinii* – it should be pointed out that of all Bulgarian habitats the occurance in Lyulin planina seems to be the most likely. Recently, the European Union has funded a project of improving the highway between Greece and Bulgaria and the road will be pass somewhere in the area of Lyulin planina - depending on the route chosen this might pose a threat to any possibly remaining population(s).

Situation of *Vipera ursinii moldavica* in Romania

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The Moldavian meadow viper (*Vipera ursinii moldavica*) is one of the endangered forms from the *ursinii* group. This subspecies occurred in the steppe biotops in Moldova (Romania) and the Besarabia (Republic of Moldova). Its distribution range could be delimited from the Eastern Carpathian Mountains to the Danube at Galați and to the Ukrainian steppes.

From the Moldova region of Romania the snake was recorded during the last decade from seven locations:
"Valea lui David" Natural Reserve, Tomeşti;
The Româneşti- Avântul- Ursoaia- perimeter;
"Dealul lui Dumnezeu" (Iaşi District);
Călăraşi;
Horlăceni (Botoşani District);
Tecuci (Galați District); and
Rarău Mountains (Suceava District).

From all these, one population was known to survive until 2000, in the "Valea lui David" Natural Reserve. This is the single habitat where the vipers are in a protected area, all the other habitats belonging to private or District properties. Thus, even when the snake occurs in a habitat we cannot compel the owner to manage the field properly for the viper, we can only suggest him, how it should be used.

The hayfields from the "Valea lui David" have been proclaimed a protected area in 1969, on the decision of the District council of Iaşi. This habitat is situated at 8 km from the city of Iaşi, in the valley of a secondary stream of the Bahlui River on the hills of Coşeri, with an area of 46.36 hectares. In the '70s the Reserve and its buffer zone formed a complex hayfield of 80 ha (the whole valley is 180 ha). By today its size had decreased due to the extending agricultural field from the east of the Reserve and the extension of the vineyard from the south. Its vegetation consists of different associations: hygro-mesophytons, xerophytons, halophytons, nitrophil associations and steppe shrubs. The most common plants are *Stipa lessingiana, S. capillata* and *Festuca valesiaca*. In the fauna we can also find specific steppe elements, like the grasshopper, *Saga pedo*, *Lacerta agilis chersonensis*, or rare species like *Evergestes ostrogovichi* or *Bradyporus dasypus*.

We started our research in 1997, and the study still continues. In '97 two specimens of the meadow viper were recorded, in '98 four. From '99 two surveys were made each year, and the results show that this is a viable population. In '99 we captured, measured, marked and released sixteen individuals, in 2000 nineteen. From these we had just two recaptures. Probably there are around 100-150 specimens in the area. It should also be mentioned that eight specimens were captured in the buffer zone of the reserve. The reserve is manually mowed, but unfortunately this procedure is made at the end of August. No killed specimen was found after the mowing. The threatening factors for the vipers could be the followings: a) human disturbance – the Reserve was enclosed in the '70ies but by today just a few poles from the fence remained; b) grazing – although it is a Reserve the shepherds sometime bring the sheep from the buffer zone into the Reserve; c) pollution – 1 km from the area lies a great medicine factory from Iaşi, d) expansion of the surrounding agricultural fields.

The Moldavian meadow viper was known in the ’40s from Tomeşti, but since that time there is no new data from the area. A part of the plains where the vipers have been collected has become a residential area. The intensive grazing had also changed the specific steppe vegetation, and by now only small spots of *Stipa* and *Festuca* remained. The former village is now a suburb of the city of Iaşi, and there can be little doubt that the snake had disappeared from this region.

>From the surroundings of Româneşti, Avântul and Ursoaia, Prof. Ştefan Vancea collected several specimens from a place called “Dealul lui Dumnezeu” in the years 1976-1977. In Moldova there are many hills called “Dealul lui Dumnezeu” which means “The Hill of God”, most probable because the major part of the population is very religious. Therefore the surfaces located between communal lands are thought to belong to God. In September 2000 and March 2001 we visited the habitats between the three villages. We could not found any hill with the “Dealul lui Dumnezeu” name on a topographic map. The single one with this name is in the vicinity of Larga Jijia, at a 12-km distance from Ursoaia. There is no doubt that this hill has been used as a vineyard for many years and could not host a population of vipers in the last 30-40 years. A shepherd had also showed us a “Dealul lui Dumnezeu” place in the vicinity of Ursoaia, which has been proved to be a hill named “Dealul Mare” according to a topographic map. We were not able to find this hill. Probably Prof. Vancea had been misled by the villagers concerning the name of the hill where he collected the vipers. Based on this shepherd’s story we found a killed specimen and two hours later and despite of the windy and rainy weather an adult female was also found on a hill called “Holm” or “Lanu Mare” according to the map. In 2001 a mature male was found at 2 km from “Holm” in a valley called “Ciritei”.

The two habitats where we found *V. u. moldavica* are situated at 150 m elevation between the villages Româneşti, Avântul and Ursoaia. Although agricultural fields surround them, they span over a few kilometres. The sheep represent the only disturbance for the vipers, the fields being used by shepherds. It is mowed manually just like the “Valea lui David” Natural Reserve. They are covered with steppe-like vegetation . Both habitats are bigger than the one from the “Valea lui David” Natural Reserve and possibly could shelter a bigger viper population.

Vipera ursinii moldavica was also recorded from Tecuci (Galați District), Călăraşi and Horlăceni close to Şendriceni-Dorohoi (Botoşani District). The Nature Protection Agency from Galați and Botoşani informed us that the habitats at present are unsuitable for a population of vipers and most probably they had already disappeared from these locations.

Two specimens were collected from the Rarău Mountains, which were believed to be *V. u. moldavica*, but their taxonomical position is still questionable.

Only a few specimens were known from the Republic of Moldova, but these were collected in different locations. The subspecies was reported from Chişinău and Tighina, Ciucur-Mingir (Raion Chimişlia, Lăpuşna District), Benderei, Hânceşti, Baltsy, Ialoveni, Sekareni, Oknitsa and Ikela. Based on a field survey made in 1998 by Zoltán Korsós, Beáta Újvári and Vladimir Țurcanu, the existence of *V. u. moldavica* in these locations is questionable.

The viper has been protected in Romania only since 1993, by the Law No. 13/1993, recommended by the Bern Convention. It should be outlined that this subspecies has been already included as critically endangered on the IUCN Red List from 1994. We still believe that despite the present unfortunate situation of the subspecies, it can and it will survive in the future.

On the possible presence of meadow viper (*Vipera ursinii rakosiensis*) in FR Yugoslavia

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Some authors (e. g. Radovanović, 1964) indicated that past distribution range of meadow viper in FSR Yugoslavia included only northern parts of Croatia (Slavonia). However, Sochurek (1984) assumed that meadow viper was distributed also in Vojvodina (north of Novi Sad). More recently, Stumpel (In: Stanners and Bourdeau, 1995) indicated that previous distribution range of meadow viper included (among others) the northwestern part of Vojvodina.

However, the present distribution range of the species is restricted to few areas of Hungary (e. g. Korsós, 1992). We went through all available literature in testing possibilities of the presence of meadow viper in the indicated part of Vojvodina.

Two incidents lead us to take into account certain previously disregarded data. We recorded the data of Dr. Jenö Purger who had told us about the case of snakebite in the village of Svilojevo, near Apatin (UTM 10x10 CR 45/55) by poison snake. According to him, a dominant vegetation type in that area was a steppe. The second case was recorded in the daily newspapers “Politika” from 14^{th} August, 1980. The local journalist from Bajmok wrote about the case of snakebite in Bajmok village, near Hungary-Yugoslavian border, in the Subotičko-Horgoška peščara sands (UTM 10x10 CR 79). The man who was bitten explained that the snake had been more than 20 cm long, with yellow (pale) trunk pattern. Since the bitten man had the local tissue damage and swelling, it was concluded that the snake was poisonous.

In the northern part of Serbia, especially Vojvodina, only adder (*Vipera berus*) was recorded at Mt. Fruška Gora, Mt. Vršački Breg and in Obetska Bara swamp (Džukić & Purger, 1988; @ivković, 1956; Radovanović 1964, Popović *et al*., 1999).

Dominant vegetation types at the above mentioned localities are forests of Sessile Oak and Hornbeam (*Querco-Carpinetum* HT. 1938), mountain forests of Beech (*Fagetum montanum* HT. 1938) and forests of Common Oak and Hornbeam (*Carpino betuli – Quercetum roboris* Anić 1959 emend. Rauš 1969) (In: Jovanovič *et al*., 1986).

Contrary to this, according to Map of Natural Potential Vegetation of FSR Yugoslavia (In: Jovanovič *et al*., 1986) the typical vegetation of the area in question consists of the forest - steppe vegetation of the alliance *Festucion rupicolae* Soo 1940 and meadow-steppe vegetation on saline soils (*Festuco - Puccinellietea* Soo 1968) vegetation communities. This means that the possibility of the presence of adder (*Vipera berus*) in this steppe region is negligible.

The other possibility is that another viper species *(Vipera ammodytes*) was brought to the mentioned localities by the train, concerning the fact that the closely situated railways are used for the transport of the stones and pebbles from the mountain regions inhabited by the sand viper. The ignorance of other possibilities and lack of support by the experts could be referred to numerous cases of sand viper’s bites that were recorded several times in lowlands all over the country.

In addition to the northern Bačka, another part of Vojvodina should be a subject of special interest concerning the possible presence of the meadow viper. South of Novi Kneževac, between the Tisza river and the Romanian – Yugoslavian border, is the habitat of the Great Bustard (*Otis tarda*), a steppe faunistic element. The vegetation types in the area are very similar as the ones in the northwestern Bačka. In our opinion only exchange of information between the experts of neighboring areas of ecology, distribution and especially conservation and protection measures of the meadow viper and joint research of indicated areas would provide unambiguous data about the presence of *V. u. rakosiensis* in Vojvodina.

References

Džukić, G., & Purger, J. (1988). Significance of Adder – *Vipera berus* (Linnaeus, 1758) Presence in Vojvodina. Arch. Biol. Sci., Belgrade **40**: 13P – 14P.

Jovanović, B., Jovanović, R., Zupančić, M. eds. (1986). Prirodna potencijalna vegetacija Jugoslavije. Komentar karte M 1:1.000.000 – Rezime – Naučno veće vegetacijske karte Jugoslavije, Ljubljana.

Korsos Z. (1992). The most threatened venomous snake of Europe, *Vipera ursinii rakosiensis*. Termeszetved, Kozlem, **1**: 83 – 88.

Popović, E., Kostić, D., & Karaman, I. (1999). Nalaz podvrste *Vipera berus bosniensis* Boettger 1889 na Fruškoj Gori. Zbornik radova PMF, Serija za biologiju, Novi Sad, **25**: 16 – 20.

Radovanović, M. (1964). Die Verbreitung der Amphibien und Reptilien in Jugoslawien. Senck. Biol. **45** (3/5): 553 – 561.

Sochrek, E. (1989). Liste der Schlangen Jugoslawiens. Elaphe **2**: 34 – 35.

Stumpel A. (1995). Amphibians and Reptiles (In: Stanners D., & Bourdeau Ph. (Eds.): Europe's Environment). European Environment Agency, Copenhagen, p. 230.

@ivković, S. (1956). Crna Šarka u Fruškoj Gori. Priroda, Zagreb, **43**(6): 152 – 153.

On the situation of potential habitats of *Vipera ursinii rakosiensis* in Austria

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In Austria there are four areas left which can be discussed as potential areas of *Vipera ursinii rakosiensis,* two of them in lower Austria (Niederoesterreich: Moosbrunn, Pischelsdorfer Wiesen, both southeast of Vienna), and two of them in Burgenland (Lake Neusiedl: Zitzmannsdorfer Wiesen, area at Zwikisch – Neudeck).

The area of Moosbrunn can be defined as being lost as potential habitat: These about 40 ha of meadows are overexploited since many years, fertilized and drained. Mowing takes place too early starting in June, microstructure of meadows are destroyed. There are only some 1000 m^2 of wet meadows close to drainages with some variety of plants.

The meadows called Pischelsdorfer Wiesen are strictly protected, showing a high variety of vegetation associations and microstructure. The dryer part is formed by old meander of the rivulet Fischa, inhabited by *Citellus citellus* and rabbits. A lot of plant species like 10 species of orchids and *Gladiolus* as well as *Iris sibirica* in more humid parts shows its good condition. The problems there are the small size of the area – just 12 ha -, the lack of puffer zones, mowing still takes place too early (end of August / begin of September) and the low extent of tussock vegetation. There has been an unconfirmed record of *Vipera ursinii rakosiensis* at the end of the 1990s.

The Zitzmannsdorfer Wiesen at the Lake Neusiedl have a large extent but do not provide proper habitats for *Vipera ursinii rakosiensis* anymore. The southern parts are widely covered by dense reed, main parts by grassland without any structures mowed in summertime. There are just few small better structured meadows left in the northern part but being a more proper habitat for *Lacerta vivipara pannonica*.

At the area of Zwikisch – Neudegg the conditions for *Vipera ursinii rakosiensis* are better than that at the Zitzmannsdorfer Wiesen, but there still is a lack of tussock vegetation. In the northern parts the meadows have been drained leaving meadows with suboptimal conditions. More interesting are the meadows in the surrounding of an artificial forest with some highly endangered plant species. What has gone lost is a wintering habitat with adequate good conditions. There has been an unconfirmed record of *Vipera ursinii rakosiensis* in 1992.

Situation with *Vipera renardi* in Ukraine

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In the past the steppe viper (*Vipera renardi*) was widely distributed in the Steppe Zone of Ukraine. It also inhabited the southern regions of the Forest-Steppe Zone and the northern slope of the Crimean Mountain Ridge. Later due to the human induced transformation of habitats resulted mainly from plowing, overgrazing, afforestation, land improvement, urbanization and recreation, the distribution of the steppe viper became highly fragmented on the most territory of Ukraine. In some big areas, first of all westwards of the Dnieper River, this viper seemed to be completely disappeared. For the Crimea it was considered by N. N. Shcherbak (1966) as a rare snake.

In 1980 *Vipera ursinii renardi* was included by V. I. Tarashchuk to the first edition of the Red Data Book of Ukraine as subspecies in the process of extinction, and in 1994 by N. N. Shcherbak— to its second edition as vulnerable subspecies.

My field investigations, undertaken since 1974 in the southern part of Ukraine, revealed that *V. renardi* was not so rare as it was considered before, and my expeditions to Kherson Region and the Crimean Peninsula in 1997–2001 showed that in the southern part of Kherson Region and in the Sivash area of the Crimea the snake distribution was almost continuous.

In Ukraine the steppe viper inhabits various types of virgin steppes, some meadows (usually on sodic soils), sand dunes and beach barriers with psammophytes, idle fields and vineyards, dams, swells, hills and road shoulders with steppe and weed vegetation, wind forest strips, natural light forests. Census carried out in localities with high population density demonstrated usually 0.2–4.0 individuals per 1 km of a transect, width of a strip being 2 m (this approximately corresponds to comparative abundance 1.0–20.0 indiv./ha), but in some habitats 5–11 indiv./km were observed (25–55 indiv./ha).

In Ukraine *V. renardi* is active from March till November. It is the most cold-resistant reptile of the Southern Ukraine. This allows *V. renardi* to have the longest period of seasonal activity and to appear on the surface in winter during thaws. In some populations the majority of females become mature at the age of 20 months at body length more than 34 cm. Others start reproduction after their third wintering (at the age about 32 months) at body length more than 39 cm. The mating period lasts usually the whole April. The young are usually born at the end of July — in August, sometimes this period lasts till the middle of September. In Ukraine *V. renardi* usually produce 4–20 young, but on Orlov Island in the Black Sea — up to 25–28. Positive correlation is observed between the productivity and body length of females. Individuals with body length more than 60 cm were often caught, and vipers 70 cm long (without tail length) were registered for Orlov Island. The adult molt usually 3 times per year, the young do this on the average once a month before leaving for hibernation.

The diet of adult vipers consists mainly of Orthoptera (especially of Acrididae), lizards and muroid rodents, the young feed on insects and small lizards. There is a seasonal change in the diet: in spring adults consume lizards and/or small rodents, in summer — rodents, lizards and orthopterans, in autumn — orthopterans, in the late autumn — small rodents. On Orlov Island in May–June vipers feed almost exclusively upon nestlings of gulls, sterns, ducks and waders, and during the rest time they consume the rodent *Microtus rossiaemeridionalis* and the lizard *Lacerta agilis*. The viper's diet depends on their age (size) and on the available food, which is determined by the character of the habitat, by seasonality and peculiarity of the year.

The main conditions necessary for the survival of *V. renardi* are the presence of reliable daily and wintering shelters, sufficient food supply and absence of intensive direct elimination (harvesting). Given these conditions *V. renardi* inhabits various open and semiopen habitats. Since the middle of 90-s the increase of snake numbers is observed in the Southern Ukraine and, especially, in the Crimea. This results from the decline of economics in the country — reducing numbers of people and machines in fields, reducing volume of chemical treatments of fields, emergence of many abandoned fields. On the other hand, last years the illegal commercial harvesting of reptiles, and especially *V. renardi*, becomes a very serious factor influencing the abundance of species. In the Crimea the situation is also coming worse because of returning the Tatar people, which receive plots (often — virgin or abandoned lands) for agriculture activities and building houses. Because of this the establishment of strictly protected areas in the Crimea is very important.

Appendix III:
Simulation Modeling and Population Viability Analysis

A model is any simplified representation of a real system. We use models in all aspects of our lives, in order to: (1) extract the important trends from complex processes, (2) permit comparison among systems, (3) facilitate analysis of causes of processes acting on the system, and (4) make predictions about the future. A complete description of a natural system, if it were possible, would often decrease our understanding relative to that provided by a good model, because there is "noise" in the system that is extraneous to the processes we wish to understand. For example, the typical representation of the growth of a wildlife population by an annual percent growth rate is a simplified mathematical model of the much more complex changes in population size. Representing population growth as an annual percent change assumes constant exponential growth, ignoring the irregular fluctuations as individuals are born or immigrate, and die or emigrate. For many purposes, such a simplified model of population growth is very useful, because it captures the essential information we might need regarding the average change in population size, and it allows us to make predictions about the future size of the population. A detailed description of the exact changes in numbers of individuals, while a true description of the population, would often be of much less value because the essential pattern would be obscured, and it would be difficult or impossible to make predictions about the future population size.

In considerations of the vulnerability of a population to extinction, as is so often required for conservation planning and management, the simple model of population growth as a constant annual rate of change is inadequate for our needs. The fluctuations in population size that are omitted from the standard ecological models of population change can cause population extinction, and therefore are often the primary focus of concern. In order to understand and predict the vulnerability of a wildlife population to extinction, we need to use a model which incorporates the processes which cause fluctuations in the population, as well as those which control the long-term trends in population size (Shaffer 1981). Many processes can cause fluctuations in population size: variation in the environment (such as weather, food supplies, and predation), genetic changes in the population (such as genetic drift, inbreeding, and response to natural selection), catastrophic effects (such as disease epidemics, floods, and droughts), decimation of the population or its habitats by humans, the chance results of the probabilistic events in the lives of individuals (sex determination, location of mates, breeding success, survival), and interactions among these factors (Gilpin and Soulé 1986).

Models of population dynamics which incorporate causes of fluctuations in population size in order to predict probabilities of extinction, and to help identify the processes which contribute to a population's vulnerability, are used in "Population Viability Analysis" (PVA) (Lacy 1993/4). For the purpose of predicting vulnerability to extinction, any and all population processes that impact population dynamics can be important. Much analysis of conservation issues is conducted by largely intuitive assessments by biologists with experience with the system. Assessments by experts can be quite valuable, and are often contrasted with "models" used to evaluate population vulnerability to extinction. Such a contrast is not valid, however, as *any* synthesis of facts and understanding of processes constitutes a model, even if it is a mental model within the mind of the expert and perhaps only vaguely specified to others (or even to the expert himself or herself).

A number of properties of the problem of assessing vulnerability of a population to extinction make it difficult to rely on mental or intuitive models. Numerous processes impact population dynamics, and many of the factors interact in complex ways. For example, increased fragmentation of habitat can make it more difficult to locate mates, can lead to greater mortality as individuals disperse greater distances across unsuitable habitat, and can lead to increased inbreeding which in turn can further reduce ability to attract mates and to survive. In addition, many of the processes impacting population dynamics are intrinsically probabilistic, with a random component. Sex determination, disease, predation, mate acquisition -- indeed, almost all events in the life of an individual -- are stochastic events, occurring with certain probabilities rather than with absolute certainty at any given time. The consequences of factors influencing population dynamics are often delayed for years or even generations. With a long-lived species, a population might persist for 20 to 40 years beyond the emergence of factors that ultimately cause extinction. Humans can synthesize mentally only a few factors at a time, most people have difficulty assessing probabilities intuitively, and it is difficult to consider delayed effects. Moreover, the data needed for models of population dynamics are often very uncertain. Optimal decision-making when data are uncertain is difficult, as it involves correct assessment of probabilities that the true values fall within certain ranges, adding yet another probabilistic or chance component to the evaluation of the situation.

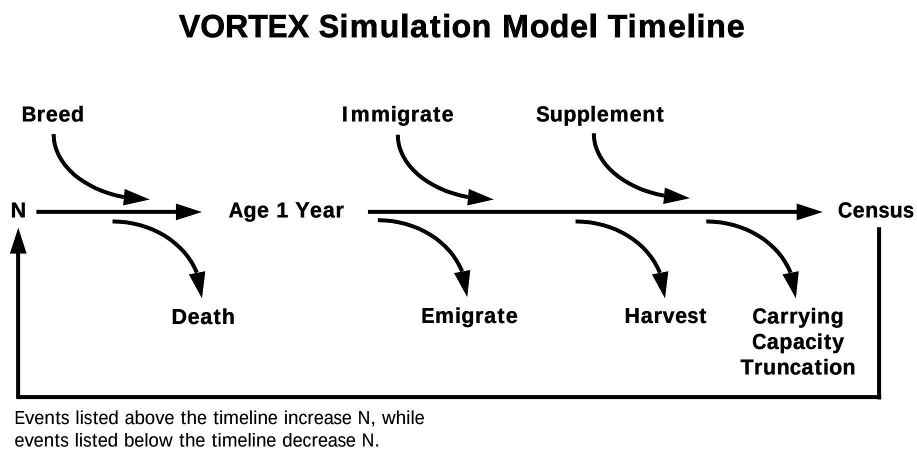
The difficulty of incorporating multiple, interacting, probabilistic processes into a model that can utilize uncertain data has prevented (to date) development of analytical models (mathematical equations developed from theory) which encompass more than a small subset of the processes known to affect wildlife population dynamics. It is possible that the mental models of some biologists are sufficiently complex to predict accurately population vulnerabilities to extinction under a range of conditions, but it is not possible to assess objectively the precision of such intuitive assessments, and it is difficult to transfer that knowledge to others who need also to evaluate the situation. Computer simulation models have increasingly been used to assist in PVA. Although rarely as elegant as models framed in analytical equations, computer simulation models can be well suited for the complex task of evaluating risks of extinction. Simulation models can include as many factors that influence population dynamics as the modeler and the user of the model want to assess. Interactions between processes can be modeled, if the nature of those interactions can be specified. Probabilistic events can be easily simulated by computer programs, providing output that gives both the mean expected result and the range or distribution of possible outcomes. In theory, simulation programs can be used to build models of population dynamics that include all the knowledge of the system which is available to experts. In practice, the models will be simpler, because some factors are judged unlikely to be important, and because the persons who developed the model did not have access to the full array of expert knowledge.

Although computer simulation models can be complex and confusing, they are precisely defined and all the assumptions and algorithms can be examined. Therefore, the models are objective, testable, and open to challenge and improvement. PVA models allow use of all available data on the biology of the taxon, facilitate testing of the effects of unknown or uncertain data, and expedite the comparison of the likely results of various possible management options.

PVA models also have weaknesses and limitations. A model of the population dynamics does not define the goals for conservation planning. Goals, in terms of population growth, probability of persistence, number of extant populations, genetic diversity, or other measures of population performance must be defined by the management authorities before the results of population modeling can be used. Because the models incorporate many factors, the number of possibilities to test can seem endless, and it can be difficult to determine which of the factors that were analyzed are most important to the population dynamics. PVA models are necessarily incomplete. We can model only those factors which we understand and for which we can specify the parameters. Therefore, it is important to realize that the models probably underestimate the threats facing the population. Finally, the models are used to predict the long-term effects of the processes presently acting on the population. Many aspects of the situation could change radically within the time span that is modeled. Therefore, it is important to reassess the data and model results periodically, with changes made to the conservation programs as needed.

The *VORTEX* Population Viability Analysis Model

For the analyses presented here, the *VORTEX* computer software (Lacy 1993a) for population viability analysis was used. *VORTEX* models demographic stochasticity (the randomness of reproduction and deaths among individuals in a population), environmental variation in the annual birth and death rates, the impacts of sporadic catastrophes, and the effects of inbreeding in small populations. *VORTEX* also allows analysis of the effects of losses or gains in habitat, harvest or supplementation of populations, and movement of individuals among local populations.



Density dependence in mortality is modeled by specifying a carrying capacity of the habitat. When the population size exceeds the carrying capacity, additional morality is imposed across all age classes to bring the population back down to the carrying capacity. The carrying capacity can be specified to change linearly over time, to model losses or gains in the amount or quality of habitat. Density dependence in reproduction is modeled by specifying the proportion of adult females breeding each year as a function of the population size.

VORTEX models loss of genetic variation in populations, by simulating the transmission of alleles from parents to offspring at a hypothetical genetic locus. Each animal at the start of the simulation is assigned two unique alleles at the locus. During the simulation, *VORTEX* monitors how many of the original alleles remain within the population, and the average heterozygosity and gene diversity (or “expected heterozygosity”) relative to the starting levels. *VORTEX* also monitors the inbreeding coefficients of each animal, and can reduce the juvenile survival of inbred animals to model the effects of inbreeding depression.

VORTEX is an *individual-based* model. That is, *VORTEX* creates a representation of each animal in its memory and follows the fate of the animal through each year of its lifetime. *VORTEX* keeps track of the sex, age, and parentage of each animal. Demographic events (birth, sex determination, mating, dispersal, and death) are modeled by determining for each animal in each year of the simulation whether any of the events occur. (See figure below.) Events occur according to the specified age and sex-specific probabilities. Demographic stochasticity is therefore a consequence of the uncertainty regarding whether each demographic event occurs for any given animal.

VORTEX requires a lot of population-specific data. For example, the user must specify the amount of annual variation in each demographic rate caused by fluctuations in the environment. In addition, the frequency of each type of catastrophe (drought, flood, epidemic disease) and the effects of the catastrophes on survival and reproduction must be specified. Rates of migration (dispersal) between each pair of local populations must be specified. Because *VORTEX* requires specification of many biological parameters, it is not necessarily a good model for the examination of population dynamics that would result from some generalized life history. It is most usefully applied to the analysis of a specific population in a specific environment.

Further information on *VORTEX* is available in Miller and Lacy (1999) and Lacy (2000).

Dealing with Uncertainty

It is important to recognize that uncertainty regarding the biological parameters of a population and its consequent fate occurs at several levels and for independent reasons. Uncertainty can occur because the parameters have never been measured on the population. Uncertainty can occur because limited field data have yielded estimates with potentially large sampling error. Uncertainty can occur because independent studies have generated discordant estimates. Uncertainty can occur because environmental conditions or population status have been changing over time, and field surveys were conducted during periods which may not be representative of long-term averages. Uncertainty can occur because the environment will change in the future, so that measurements made in the past may not accurately predict future conditions.

Sensitivity testing is necessary to determine the extent to which uncertainty in input parameters results in uncertainty regarding the future fate of the pronghorn population. If alternative plausible parameter values result in divergent predictions for the population, then it is important to try to resolve the uncertainty with better data. Sensitivity of population dynamics to certain parameters also indicates that those parameters describe factors that could be critical determinants of population viability. Such factors are therefore good candidates for efficient management actions designed to ensure the persistence of the population.

The above kinds of uncertainty should be distinguished from several more sources of uncertainty about the future of the population. Even if long-term average demographic rates are known with precision, variation over time caused by fluctuating environmental conditions will cause uncertainty in the fate of the population at any given time in the future. Such environmental variation should be incorporated into the model used to assess population dynamics, and will generate a range of possible outcomes (perhaps represented as a mean and standard deviation) from the model. In addition, most biological processes are inherently stochastic, having a random component. The stochastic or probabilistic nature of survival, sex determination, transmission of genes, acquisition of mates, reproduction, and other processes preclude exact determination of the future state of a population. Such demographic stochasticity should also be incorporated into a population model, because such variability both increases our uncertainty about the future and can also change the expected or mean outcome relative to that which would result if there were no such variation. Finally, there is “uncertainty” which represents the alternative actions or interventions which might be pursued as a management strategy. The likely effectiveness of such management options can be explored by testing alternative scenarios in the model of population dynamics, in much the same way that sensitivity testing is used to explore the effects of uncertain biological parameters.

Results

Results reported for each scenario include:

Deterministic r -- The deterministic population growth rate, a projection of the mean rate of growth of the population expected from the average birth and death rates. Impacts of harvest, inbreeding, and density dependence are not considered in the calculation. When r = 0, a population with no growth is expected; r

< 0 indicates population decline; r > 0 indicates long-term population growth. The value of r is approximately the rate of growth or decline per year.

The deterministic growth rate is the average population growth expected if the population is so large as to be unaffected by stochastic, random processes. The deterministic growth rate will correctly predict future population growth if: the population is presently at a stable age distribution; birth and death rates remain constant over time and space (i.e., not only do the probabilities remain constant, but the actual number of births and deaths each year match the expected values); there is no inbreeding depression; there is never a limitation of mates preventing some females from breeding; and there is no density dependence in birth or death rates, such as a Allee effects or a habitat “carrying capacity” limiting population growth. Because some or all of these assumptions are usually violated, the average population growth of real populations (and stochastically simulated ones) will usually be less than the deterministic growth rate.

Stochastic r -- The mean rate of stochastic population growth or decline demonstrated by the simulated populations, averaged across years and iterations, for all those simulated populations that are not extinct. This population growth rate is calculated each year of the simulation, prior to any truncation of the population size due to the population exceeding the carrying capacity. Usually, this stochastic r will be less than the deterministic r predicted from birth and death rates. The stochastic r from the simulations will be close to the deterministic r if the population growth is steady and robust. The stochastic r will be notably less than the deterministic r if the population is subjected to large fluctuations due to environmental variation, catastrophes, or the genetic and demographic instabilities inherent in small populations.

P(E) -- the probability of population extinction, determined by the proportion of, for example, 500 iterations within that given scenario that have gone extinct in the simulations. “Extinction” is defined in the VORTEX model as the lack of either sex.

N -- mean population size, averaged across those simulated populations which are not extinct.

SD(N) -- variation across simulated populations (expressed as the standard deviation) in the size of the population at each time interval. SDs greater than about half the size of mean N often indicate highly unstable population sizes, with some simulated populations very near extinction. When SD(N) is large relative to N, and especially when SD(N) increases over the years of the simulation, then the population is vulnerable to large random fluctuations and may go extinct even if the mean population growth rate is positive. SD(N) will be small and often declining relative to N when the population is either growing steadily toward the carrying capacity or declining rapidly (and deterministically) toward extinction. SD(N) will also decline considerably when the population size approaches and is limited by the carrying capacity.

H -- the gene diversity or expected heterozygosity of the extant populations, expressed as a percent of the initial gene diversity of the population. Fitness of individuals usually declines proportionately with gene diversity (Lacy 1993b), with a 10% decline in gene diversity typically causing about 15% decline in survival of captive mammals (Ralls et al. 1988). Impacts of inbreeding on wild populations are less well known, but may be more severe than those observed in captive populations (Jiménez et al. 1994). Adaptive response to natural selection is also expected to be proportional to gene diversity. Long-term conservation programs often set a goal of retaining 90% of initial gene diversity (Soulé et al. 1986). Reduction to 75% of gene diversity would be equivalent to one generation of full-sibling or parent-offspring inbreeding.

Literature Cited

Gilpin, M.E., and M.E. Soulé. 1986. Minimum viable populations: processes of species extinction. Pages 19 – 34 in: Soulé, M.E. (ed.). *Conservation Biology: The Science of Scarcity and Diversity*. Sunderland, MA: Sinauer Associates.

Jiménez, J.A., K.A. Hughes, G. Alaks, L. Graham, and R.C. Lacy. 1994. An experimental study of inbreeding depression in a natural habitat. *Science* 266:271-273.

Lacy, R.C. 2000. Structure of the *VORTEX* simulation model for population viability analysis. *Ecological Bulletins* 48:191-203.

Lacy, R.C. 1993b. Impacts of inbreeding in natural and captive populations of vertebrates: implications for conservation. *Perspectives in Biology and Medicine* 36:480-496.

Lacy, R.C. 1993/1994. What is Population (and Habitat) Viability Analysis? *Primate Conservation* 14/15:27-33.

Miller, P.S., and R.C. Lacy. 1999. *VORTEX: A Stochastic Simulation of the Extinction Process. Version 8 User's Manual*. Apple Valley, MN: Conservation Breeding Specialist Group (SSC/IUCN).

Ralls, K., J.D. Ballou, and A. Templeton. 1988. Estimates of lethal equivalents and the cost of inbreeding in mammals. *Conservation Biology* 2:185-193.

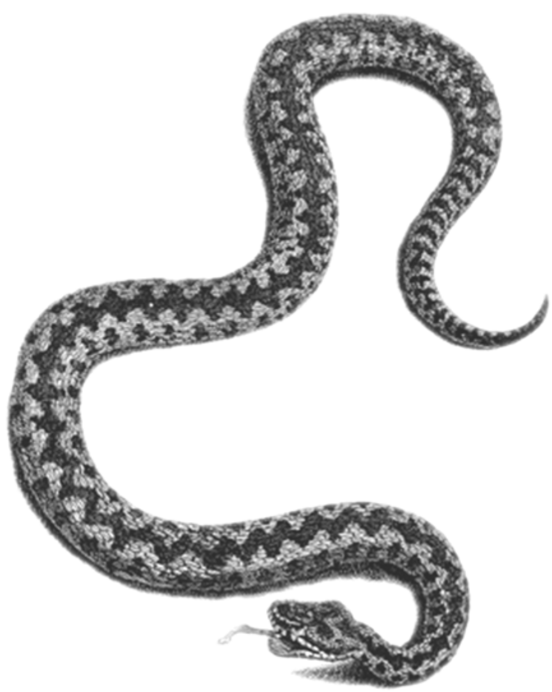
Shaffer, M.L. 1981. Minimum population sizes for species conservation. *BioScience* 1:131-134.

Soulé, M., M. Gilpin, W. Conway, and T. Foose. 1986. The millennium ark: How long a voyage, how many staterooms, how many passengers? *Zoo Biology* 5:101-113.

Population and Habitat Viability Assessment (PHVA) For the Hungarian Meadow Viper (*Vipera ursinii rakosiensis*)

5 – 8 November, 2001
The Budapest Zoo
Budapest, Hungary

Workshop Report



Section VII
IUCN Policy Statements

IUCN Policy Statement on Captive Breeding

Prepared by the SSC Captive Breeding Specialist Group *
Approved by the 22nd Meeting of the IUCN Council, Gland Switzerland, 4 September 1987

SUMMARY: Habitat protection alone is not sufficient if the expressed goal of the World Conservation Strategy, the maintenance of biotic diversity, is to be achieved. Establishment of self-sustaining captive populations and other supportive intervention will be needed to avoid the loss of many species, especially those at high risk. In greatly reduced, highly fragmented, and disturbed habitats Captive breeding programmes need to be established before species are reduced to critically low numbers, and thereafter need to be co-ordinated internationally according to sound biological principles, with a view to the maintaining or re-establishment of viable populations in the wild.

PROBLEM STATEMENT

IUCN data indicate that abut three per cent of terrestrial Earth is gazetted for protection. Some of this and much of the other 97 per cent is becoming untenable for many species and remaining populations are being greatly reduced and fragmented. From modern population biology one can predict that many species will be lost under these conditions. On average more than one mammal, bird, or reptile species has been lost in each year this century. Since extinctions of most taxa outside these groups are not recorded, the loss rate for all species is much higher.

Certain groups of species are at particularly high risk, especially forms with restricted distribution, those of large body size, those of high economic value, those at the top of food chains, and those which occur only in climax habitats. Species in these categories are likely to be lost first, but a wide range of other forms are also at risk. Conservation over the long term will require management to reduce risk, including ex situ populations which could support and interact demographically and genetically with wild populations.

FEASIBILITY

Over 3,000 vertebrate species are being bred in zoos and other captive animal facilities. When a serious attempt is made, most species breed in captivity, and viable populations can be maintained over the long term. A wealth of experience is available in these institutions, including husbandry, veterinary medicine, reproductive biology, behaviour, and genetics. They offer space for supporting populations of many threatened taxa, using resources not competitive with those for in situ conservation. Such captive stocks have in the past provided critical support for some wild populations (e.g. American bison, *Bison bison*), and have been the sole escape from extinction for others which have since been re-introduced to the wild (e.g. Arabian oryx, *Oryx leucoryx*).

RECOMMENDATION

IUCN urges that those national and international organizations and those individual institutions concerned with maintaining wild animals in captivity commit themselves to a general policy of developing demographically self-sustaining captive populations of endangered species wherever necessary.

SUGGESTED PROTOCOL

WHAT: The specific problems of the species concerned need to be considered, and appropriate aims for a captive breeding programme made explicit.

WHEN: The vulnerability of small populations has been consistently under estimated. This has erroneously shifted the timing of establishment of captive populations to the last moment, when the crisis is enormous and when extinction is probable. Therefore, timely recognition of such situations is critical, and is dependent on information on wild population status, particularly that provided by the IUCN/Conservation Monitoring Centre**. Management to best reduce the risk of extinction requires the establishment of supporting captive populations much earlier, preferably when the wild population is still in the thousands. Vertebrate taxa with a current census below one thousand individuals in the wild require close and swift cooperation between field conservationists and captive breeding specialists, to make their efforts complementary and minimize the likelihood of the extinction of these taxa.

HOW: Captive populations need to be founded and managed according to sound scientific principles for the primary purpose of securing the survival of species through stable, self-sustaining captive populations. Stable captive populations preserve the options of reintroduction and/or supplementation of wild populations. A framework of international cooperation and coordination between captive breeding institutions holding species at risk must be based upon agreement to cooperatively manage such species for demographic security and genetic diversity. The IUCN/SSC Captive Breeding Specialist Group* is an appropriate advisory body concerning captive breeding science and resources.

Captive programmes involving species at risk should be conducted primarily for the benefit of the species and without commercial transactions. Acquisition of animals for such programmed should not encourage commercial ventures or trade. Whenever possible, captive programmed should be carried out in parallel with field studies and conservation efforts aimed at the species in its natural environment.

Notes:
Currently the *Conservation Breeding Specialist Group and the
** World Conservation Monitoring Centre

IUCN Position Statement on Translocation of Living Organisms:

INTRODUCTIONS, REINTRODUCTIONS AND RE-STOCKING
Prepared by the Species Survival Commission in collaboration with the Commission on Ecology, and the Commission on Environmental Policy, Law and Administration
Approved by the 22nd Meeting of the IUCN Council, Gland, Switzerland, 4 September 1987

FOREWORD

This statement sets out IUCN's position on translocation of living organisms, covering introductions, re-introductions and re-stocking. The implications of these three sorts of translocation are very different so the paper is divided into four parts dealing with Introductions, Re-introductions, Re-stocking and Administrative Implications, respectively.

DEFINITIONS:

Translocation is the movement of living organisms from one area with free release in another. The three main classes of translocation distinguished in this document are defined as follows:

- **Introduction** of an organism is the intentional or accidental dispersal by human agency of a living organism outside its historically known native range.
- **Re-introduction** of an organism is the intentional movement of an organism into a part of its native range from which it has disappeared or become extirpated in historic times as a result of human activities or natural catastrophe.
- **Re-stocking** is the movement of numbers of plants or animals of a species with the intention of building up the number of individuals of that species in an original habitat.

Translocations are powerful tools for the management of the natural and man made environment which, properly used, can bring great benefits to natural biological systems and to man, but like other powerful tools they have the potential to cause enormous damage if misused. This IUCN statement describes the advantageous uses of translocations and the work and precautions needed to avoid the disastrous consequences of poorly planned translocations.

PART I

INTRODUCTIONS

BACKGROUND

Non-native (exotic) species have been introduced into areas where they did not formerly exist for a variety of reasons, such as economic development, improvement of hunting and fishing, ornamentation, or maintenance of the cultures of migrated human communities. The damage done by harmful introductions to natural systems far outweighs the benefit derived from them. The introduction and establishment of alien species in areas where they did not formerly occur, as an accidental or intended result of human activities, has often been directly harmful to the native plants and animals of many parts of the world and to the welfare of mankind.

The establishment of introduced alien species has broken down the genetic isolation of communities of co-evolving species of plants and animals. Such isolation has been essential for the evolution and maintenance of the diversity of plants and animals composing the biological wealth of our planet. Disturbance of this isolation by alien species has interfered with the dynamics of natural systems causing the premature extinction of species. Especially successful and aggressive invasive species of plants and animals increasingly dominate large areas having replaced diverse autochthonous communities. Islands, in the broad sense, including isolated biological systems such as lakes or isolated mountains, are especially vulnerable to introductions because their often simple ecosystems offer refuge for species that are not aggressive competitors. As a result of their isolation they are of special value because of high endemism (relatively large numbers of unique local forms) evolved under the particular conditions of these islands over a long period of time. These endemic species are often rare and highly specialised in their ecological requirements and may be remnants of extensive communities from bygone ages, as exemplified by the Pleistocene refugia of Africa and Amazonia.

The diversity of plants and animals in the natural world is becoming increasingly important to man as their demands on the natural world increase in both quantity and variety, notwithstanding their dependence on crops and domestic animals nurtured within an increasingly uniform artificial and consequently vulnerable agricultural environment.

Introductions, can be beneficial to man. Nevertheless the following sections define areas in which the introduction of alien organisms is not conducive to good management, and describe the sorts of decisions that should be made before introduction of an alien species is made.

To reduce the damaging impact of introductions on the balance of natural systems, governments should provide the legal authority and administrative support that will promote implementation of the following approach.

Intentional Introduction

General

1. Introduction of an alien species should only be considered if clear and well defined benefits to man or natural communities can be foreseen.
2. Introduction of an alien species should only be considered if no native species is considered suitable for the purpose for which the introduction is being made.

Introductions to Natural Habitats

3. No alien species should be deliberately introduced into any natural habitat, island, lake, sea, ocean or centre of endemism, whether within or beyond the limits of national jurisdiction. A natural habitat is defined as a habitat not perceptibly altered by man. Where it would be effective, such areas should be surrounded by a buffer zone sufficiently large to prevent unaided spread of alien species from nearby areas. No alien introduction should be made within the buffer zone if it is likely to spread into neighbouring natural areas.

Introduction into Semi-natural Habitat

4. No alien species should be introduced into a semi-natural habitat unless there are exceptional reasons for doing so , and only when the operation has been comprehensively investigated and carefully planned in advance. A semi-natural habitat is one which has been detectably changed by man's actions or one which is managed by man, but still resembles a natural habitat in the diversity of its species and the complexity of their interrelationships. This excludes arable farm land, planted ley pasture and timber plantations.

Introductions into Man-made Habitat

5. An assessment should be made of the effects on surrounding natural and semi-natural habitats of the introduction of any species, sub-species, or variety of plant to artificial, arable, ley pasture or other predominantly monocultural forest systems. Appropriate action should be taken to minimise negative effects.

Planning a Beneficial introduction

6. Essential features of investigation and planning consist of:
    - an assessment phase culminating in a decision on the desirability of the introduction;

- an experimental, controlled trial;
- the extensive introduction phase with monitoring and follow-up.

THE ASSESSMENT PHASE

Investigation and planning should take the following factors into account:

a) No species should be considered for introduction to a new habitat until the factors which limit its distribution and abundance in its native range have been thoroughly studied and understood by competent ecologists and its probable dispersal pattern appraised.

Special attention should be paid to the following questions:

- What is the probability of the exotic species increasing in numbers so that it causes damage to the environment, especially to the biotic community into which it will be introduced?
- What is the probability that the exotic species will spread and invade habitats besides those into which the introduction is planned? Special attention should be paid to the exotic species' mode of dispersal.
- How will the introduction of the exotic proceed during all phases of the biological and climatic cycles of the area where the introduction is planned? It has been found that fire, drought and flood can greatly alter the rate of propagation and spread of plants.
- What is the capacity of the species to eradicate or reduce native species by interbreeding with them?
- Will an exotic plant interbreed with a native species to produce new species of aggressive polyploid invader? Polyploid plants often have the capacity to produce varied offspring some of which quickly adapt to and dominate, native floras and cultivars alike.
- Is the alien species the host to diseases or parasites communicable to other flora and fauna, man, their crops or domestic animals, in the area of introduction?
- What is the probability that the species to be introduced will threaten the continued existence or stability of populations of native species, whether as a predator, competitor for food, cover, breeding sites or in any other way? If the introduced species is a carnivore, parasite or specialised herbivore, it should not be introduced if its food includes rare native species that could be adversely affected.

b) There are special problems to be considered associated with the introduction of aquatic species. These species have a special potential for invasive spread.

- Many fish change trophic level or diet preference following introduction, making prediction of the results of the re-introduction difficult. Introduction of a fish or other species at one point on a river system or into the sea may lead to the spread of the species throughout the system or area with unpredictable consequences for native animals and plants. Flooding may transport introduced species from one river system to another.
- introduced fish and large aquatic invertebrates have shown a great capacity to disrupt natural systems as their larval, sub-adult and adult forms often use different parts of the same natural system.

c) No introduction should be made for which a control does not exist or is not possible. A risk-and-threat analysis should be undertaken including investigation of the availability of methods for the control of the introduction should it expand in a way not predicted or have unpredicted undesirable effects, and the methods of control should be socially acceptable, efficient, should not damage vegetation and fauna, man, his domestic animals or cultivars.

d)When the questions above have been answered and the problems carefully considered, it should be decided if the species can reasonably be expected to survive in its new habitat, and if so, if it can reasonably be expected to enhance the flora and fauna of the area, or the economic or aesthetic value of the area, and whether these benefits outweigh the possible disadvantages revealed by the investigations.

THE EXPERIMENTAL CONTROLLED TRIAL

Following a decision to introduce a species, a controlled experimental introduction should be made observing the following advice:

- Test plants and animals should be from the same stock as those intended to be extensively introduced.
- They should be free of diseases and parasites communicable to native species, man, his crops and domestic livestock.
- The introduced species' performance on parameters in 'the Assessment Phase' above should be compared with the pre-trial assessment, and the suitability of the species for introduction should be reviewed in light of the comparison.

THE EXTENSIVE INTRODUCTION

If the introduced species behaves as predicted under the experimental conditions, then extensive introductions may commence but should be closely monitored. Arrangements should be made to apply counter measures to restrict, control, or eradicate the species if necessary.

The results of all phases of the introduction operation should be made public and available to scientists and others interested in the problems of introductions.

The persons or organisation introducing the species, not the public, should bear the cost of control of introduced organisms and appropriate legislation should reflect this.

ACCIDENTAL INTRODUCTIONS

1. Accidental introductions of species are difficult to predict and monitor, nevertheless they "should be discouraged where possible. The following actions are particularly important:
    - On island reserves, including isolated habitats such as lakes, mountain tops and isolated forests, and in wilderness areas, special care should be taken to avoid accidental introductions of seeds of alien plants on shoes and clothing and the introduction of animals especially associated with man, such as cats, dogs, rats and mice.
    - Measures, including legal measures, should be taken to discourage the escape of farmed, including captive-bred, alien wild animals and newly-domesticated species which could breed with their wild ancestors if they escaped.
    - In the interest of both agriculture and wildlife, measures should be taken to control contamination of imported agricultural seed with seeds of weeds and invasive plants.
    - Where large civil engineering projects are envisaged, such as canals, which would link different biogeographical zones, the implications of the linkage for mixing the fauna and flora of the two regions should be carefully considered. An example of this is the mixing of species from the Pacific and Caribbean via the Panama Canal, and the mixing of Red Sea and Mediterranean aquatic organisms via the Suez Canal. Work needs to be done to consider what measures can be taken to restrict mixing of species from different zones through such large developments.

2. Where an accidentally introduced alien successfully and conspicuously propagates itself, the balance of its positive and negative economic and ecological effects should be investigated. If the overall effect is negative, measures should be taken to restrict its spread.

WHERE ALIEN SPECIES ARE ALREADY PRESENT

1. In general, introductions of no apparent benefit to man, but which are having a negative effect on the native flora and fauna into which they have been introduced, should be removed or eradicated. The present ubiquity of introduced species will put effective action against the majority of invasives beyond the means of many States but special efforts should be made to eradicate introductions on:
    - islands with a high percentage of endemics in the flora and fauna;
    - areas which are centres of endemism;
    - areas with a high degree of species diversity;
    - areas with a high degree of other ecological diversity;
    - areas in which a threatened endemic is jeopardised by the presence of the alien.
2. Special attention should be paid to feral animals. These can be some of the most aggressive and damaging alien species to the natural environment, but may have value as an economic or genetic resource in their own right, or be of scientific interest. Where a feral population is believed to have a value in its own right, but is associated with changes in the balance of native vegetation and fauna, the conservation of the native flora and fauna should always take precedence. Removal to captivity or domestication is a valid alternative for the conservation of valuable feral animals consistent with the phase of their evolution as domestic animals.

    Special attention should be paid to the eradication of mammalian feral predators from areas where there are populations of breeding birds or other important populations of wild fauna. Predatory mammals are especially difficult, and sometimes impossible to eradicate, for example, feral cats, dogs, mink, and ferrets.
3. In general, because of the complexity and size of the problem, but especially where feral mammals or several plant invaders are involved, expert advice should be sought on eradication.

BIOLOGICAL CONTROL

1. Biological control of introductions has shown itself to be an effective way of controlling and eradicating introduced species of plants and more rarely, of animals. As biological control involves introduction of alien species, the same care and procedures should be used as with other intentional introductions.

MICRO-ORGANISMS

1. There has recently been an increase of interest in the use of micro-organisms for a wide variety of purposes including those genetically altered by man.
    Where such uses involve the movement of micro-organisms to areas where they did not formerly exist, the same care and procedures should be used as set out above for other species.

PART II

THE RE-INTRODUCTION OF SPECIES*

Re-introduction is the release of a species of animal or plant into an area in which it was indigenous before extermination by human activities or natural catastrophe. Re-introduction is a particularly useful tool for restoring a species to an original habitat where it has become extinct due to human persecution, over-collecting, over-harvesting or habitat deterioration, but where these factors can now be controlled. Re-introductions should only take place where the original causes of extinction have been removed. Re-introductions should only take place where the habitat requirements of the species are satisfied. There should be no re-introduction if a species became extinct because of habitat change which remains unremedied, or where significant habitat deterioration has occurred since the extinction.

The species should only be re-introduced if measures have been taken to reconstitute the habitat to a state suitable for the species.

The basic programme for re-introduction should consist of:

- a feasibility study;
- a preparation phase;
- release or introduction phase; and a
- follow-up phase.

THE FEASIBILITY STUDY

An ecological study should assess the previous relationship of the species to the habitat into which the re-introduction is to take place, and the extent that the habitat has changed since the local extinction of the species. If individuals to be re-introduced have been captive-bred or cultivated, changes in the species should also be taken into account and allowances made for new features liable to affect the ability of the animal or plant to re-adapt to its traditional habitat.

The attitudes of local people must be taken into account especially if the reintroduction of a species that was persecuted, over-hunted or over collected , is proposed. If the attitude of local people is unfavorable an education and interpretive programme emphasizing the benefits to them of the re-introduction, or other inducement, should be used to improve their attitude before re-introduction takes place.

The animals or plants involved in the re-introduction must be of the closest available race or type to the original stock and preferably be the same race as that previously occurring in the area.

Before commencing a re-introduction project, sufficient funds must be available to ensure that the project can be completed, including the follow-up phase.

THE PREPARATION AND RELEASE OR INTRODUCTORY PHASES

The successful re-introduction of an animal or plant requires that the biological needs of the species be fulfilled in the area where the release is planned. This requires a detailed knowledge of both the needs of the animal or plant and the ecological dynamics of the area of re-introduction. For this reason the best available scientific advice should be taken at all stages of a species re-introduction.

This need for clear analysis of a number of factors can be clearly seen with reference to introductions of ungulates such as ibex, antelope and deer where re-introduction involves understanding and applying the significance of factors such as the ideal age for re-introducing individuals, ideal sex ratio, season, specifying capture techniques and mode of transport to re-introduction site, freedom of both the species and the area of introduction from disease and parasites, acclimatisation, helping animals to learn to forage in the wild, adjustment of the gut flora to deal with new forage, 'imprinting' on the home range, prevention of wandering of individuals from the site of re-introduction, and on-site breeding in enclosures before release to expand the released population and acclimatise the animals to the site. The re-introduction of other taxa of plants and animals can be expected to be similarly complex.

FOLLOW-UP PHASE

Monitoring of released animals must be an integral part of any re-introduction programme. Where possible there should be long-term research to determine the rate of adaptation and dispersal, the need for further releases and identification of the reasons for success or failure of the programme.

The species impact on the habitat should be monitored and any action needed to improve conditions identified and taken.

Efforts should be made to make available information on both successful and unsuccessful re-introduction programmed through publications, seminars and other communications.

PART III

RESTOCKING

1. Restocking is the release of a plant or animal species into an area in which it is already present. Restocking may be a useful tool where:
    - it is feared that a small reduced population is becoming dangerously inbred; or
    - where a population has dropped below critical levels and recovery by natural growth will be dangerously slow; or
    - where artificial exchange and artificially-high rates of immigration are required to maintain outbreeding between small isolated populations on biogeographical islands.
2. In such cases care should be taken to ensure that the apparent nonviability of the population, results from the genetic institution of the population and not from poor species management which has allowed deterioration in the habitat or over-utilisation of the population. With good management of a population the need for re-stocking should be avoidable but where re-stocking is contemplated the following points should be observed:

    a) Restocking with the aim of conserving a dangerously reduced population should only be attempted when the causes of the reduction have been largely removed and natural increase can be excluded.

    b) Before deciding if restocking is necessary, the capacity of the area it is proposed to restock should be investigated to assess if the level of the population desired is sustainable. If it is, then further work should be undertaken to discover the reasons for the existing low population levels. Action should then be taken to help the resident population expand to the desired level. Only if this fails should restocking be used.
3. Where there are compelling reasons for restocking the following points should be observed.

    a) Attention should be paid to the genetic constitution of stocks used for restocking.

    - In general, genetic manipulation of wild stocks should be kept to a minimum as it may adversely affect the ability of a species or population to survive. Such manipulations modify the effects of natural selection and ultimately the nature of the species and its ability to survive.

- Genetically impoverished or cloned stocks should not be used to re-stock populations as their ability to survive would be limited by their genetic homogeneity.

b) The animals or plants being used for re-stocking must be of the same race as those in the population into which they are released.

c) Where a species has an extensive natural range and restocking has the aim of conserving a dangerously reduced population at the climatic or ecological edge of its range, care should be taken that only individuals from a similar climatic or ecological zone are used since interbreeding with individuals from an area with a milder climate may interfere with resistant and hardy genotypes on the population's edge.

d) Introduction of stock from zoos may be appropriate, but the breeding history and origin of the animals should be known and follow as closely as possible Assessment Phase guidelines a, b, c and d (see pages 5-7). In addition the dangers of introducing new diseases into wild populations must be avoided: this is particularly important with primates that may carry human zoonoses.

e) Restocking as part of a sustainable use of a resource (e.g. release of a proportion of crocodiles hatched from eggs taken from farms) should follow guidelines a and b (above).

f) Where restocking is contemplated as a humanitarian effort to release or rehabilitate captive animals it is safer to make such releases as re-introductions where there is no danger of infecting wild populations of the same species with new diseases and where there are no problems of animals having to be socially accepted by wild individuals of the species.

PART IV

NATIONAL, INTERNATIONAL AND SCIENTIFIC IMPLICATIONS OF TRANSLOCATIONS

NATIONAL ADMINISTRATION

1. Pre-existing governmental administrative structures and frameworks already in use to protect agriculture, primary industries, wilderness and national parks should be used by governments to control both intentional and unintentional importation of organisms, especially through use of plant and animal quarantine regulations.
2. Governments should set up or utilise pre-existing scientific management authorities or experts in the fields of biology, ecology and natural resource management to advise them on policy matters concerning translocations and on individual cases where an introduction, re-introduction or restocking or farming of wild species is proposed.
3. Governments should formulate national policies on:
    - translocation of wild species;
    - capture and transport of wild animals;
    - artificial propagation of threatened species;
    - selection and propagation of wild species for domestication; and

- prevention and control of invasive alien species.

4. At the national level legislation is required to curtail introductions:

   Deliberate introductions should be subject to a permit system. The system should apply not only to species introduced from abroad but also to native species introduced to a new area in the same country. It should also apply to restocking.

   Accidental introductions

   - for all potentially harmful organisms there should be a prohibition to import them and to trade in them except under a permit and under very stringent conditions. This should apply in particular to the pet trade;
   - where a potentially harmful organism is captive bred for commercial purposes (e.g. mink) there should be established by legislation strict standards for the design and operation of the captive breeding facilities. In particular, procedures should be established for the disposal of the stock of animals in the event of a discontinuation of the captive breeding operation;
   - there should be strict controls on the use of live fish bait to avoid inadvertent introductions of species into water where they do not naturally occur.

   Penalties

5. Deliberate introductions without a permit as well as negligence resulting in the escape or introduction of species harmful to the environment should be considered criminal offences and punished accordingly. The author of a deliberate introduction without a permit or the person responsible for an introduction by negligence should be legally liable for the damage incurred and should in particular bear the costs of eradication measures and of habitat restoration where required.

INTERNATIONAL ADMINISTRATION

Movement of Introduced Species Across International Boundaries

1. Special care should be taken to prevent introduced species from crossing the borders of a neighboring state. When such an occurence is probable, the neighboring state should be promptly warned and consultations should be held in order to take adequate measures.

   The Stockholm Declaration

2. According to Principle 21 of the Stockholm Declaration on the Human Environment, states have the responsibility 'to ensure that activities within their jurisdiction or control do not cause damage to the environment of other states'.

   International Codes of Practice, Treaties and Agreements

3. States should be aware of the following international agreements and documents relevant to translocation of species:
   - ICES, Revised Code of Practice to Reduce the Risks from introduction of Marine Species, 1982.
   - FAO, Report of the Expert Consultation on the Genetic Resources of Fish, Recommendations to Governments No L 1980.
   - EIFAC (European Inland Fisheries Advisory Commission), Report of the Working Party on Stock Enhancement, Hamburg, FRG 1983.

- The Bonn Convention MSC: Guidelines for Agreements under the Convention.
- The Berne Convention: the Convention on the Conservation of European wildlife and Natural Habitats.
- The ASEAN Agreement on the Conservation of Nature and Natural Resources.
- Law of the Sea Convention, article 196.
- Protocol on Protected Areas and Wild Fauna and Flora in Eastern African Region.

In addition to the international agreements and documents cited, States also should be aware of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES). International shipments of endangered or threatened species listed in the Appendices to the Convention are subject to CITES regulation and permit requirements. Enquiries should be addressed to: CITES Secretariat**, Case Postale 456, CH-1219 Chatelaine, Genève, Switzerland; telephone: 41/22/979 9149, fax: 41/22/797 3417.

Regional Development Plans

4. International, regional or country development and conservation organisations, when considering international, regional or country conservation strategies or plans, should include in-depth studies of the impact and influence of introduced alien species and recommend appropriate action to ameliorate or bring to an end their negative effects.

Scientific Work Needed

5. A synthesis of current knowledge on introductions, re-introductions and re-stocking is needed.
6. Research is needed on effective, target specific, humane and socially acceptable methods of eradication and control of invasive alien species.
7. The implementation of effective action on introductions, re-introductions and re-stocking frequently requires judgements on the genetic similarity of different stocks of a species of plant or animal. More research is needed on ways of defining and classifying genetic types.
8. Research is needed on the way in which plants and animals are dispersed through the agency of man (dispersal vector analysis).

A review is needed of the scope, content and effectiveness of existing legislation relating to introductions.

IUCN Responsibilities

International organisations, such as UNEP, UNESCO and FAO, as well as states planning to introduce, re-introduce or restock taxa in their territories, should provide sufficient funds, so that IUCN as an international independent body, can do the work set out below and accept the accompanying responsibilities.

9. IUCN will encourage collection of information on all aspects of introductions, re-introductions and restocking, but especially on the case histories of re-introductions; on habitats especially vulnerable to invasion; and notable aggressive invasive species of plants and animals.

Such information would include information in the following categories:

- a bibliography of the invasive species;
- the taxonomy of the species;
- the synecology of the species; and
- methods of control of the species.

10. The work of the Threatened Plants Unit of IUCN defining areas of high plant endemism, diversity and ecological diversity should be encouraged so that guidance on implementing recommendations in this document may be available.
11. A list of expert advisors on control and eradication of alien species should be available through IUCN.

Note:
* The section on re-introduction of species has been enhanced by the Guidelines For Re-Introductions
** The address of the CITES Secretariat has been updated.

IUCN/SSC Guidelines for Re-Introductions

Prepared by the SSC Re-introduction Specialist Group *
Approved by the 41st Meeting of the IUCN Council, Gland Switzerland, May 1995

INTRODUCTION

These policy guidelines have been drafted by the Re-introduction Specialist Group of the IUCN's Species Survival Commission (1), in response to the increasing occurrence of re-introduction projects worldwide, and consequently, to the growing need for specific policy guidelines to help ensure that the re-introductions achieve their intended conservation benefit, and do not cause adverse side-effects of greater impact. Although IUCN developed a Position Statement on the Translocation of Living Organisms in 1987, more detailed guidelines were felt to be essential in providing more comprehensive coverage of the various factors involved in re-introduction exercises.

These guidelines are intended to act as a guide for procedures useful to re-introduction programmes and do not represent an inflexible code of conduct. Many of the points are more relevant to re-introductions using captive-bred individuals than to translocations of wild species. Others are especially relevant to globally endangered species with limited numbers of founders. Each re-introduction proposal should be rigorously reviewed on its individual merits. It should be noted that re-introduction is always a very lengthy, complex and expensive process.

Re-introductions or translocations of species for short-term, sporting or commercial purposes - where there is no intention to establish a viable population - are a different issue and beyond the scope of these guidelines. These include fishing and hunting activities.

This document has been written to encompass the full range of plant and animal taxa and is therefore general. It will be regularly revised. Handbooks for re-introducing individual groups of animals and plants will be developed in future.

CONTEXT

The increasing number of re-introductions and translocations led to the establishment of the IUCN/SSC Species Survival Commission's Re-introduction Specialist Group. A priority of the Group has been to update IUCN's 1987 Position Statement on the Translocation of Living Organisms, in consultation with IUCN's other commissions.

It is important that the Guidelines are implemented in the context of IUCN's broader policies pertaining to biodiversity conservation and sustainable management of natural resources. The philosophy for environmental conservation and management of IUCN and other conservation bodies is stated in key documents such as "Caring for the Earth" and "Global Biodiversity Strategy" which cover the broad themes of the need for approaches with community involvement and participation in sustainable natural resource conservation, an overall enhanced quality of human life and the need to conserve and, where necessary, restore ecosystems. With regards to the latter, the re-introduction of a species is one specific instance of restoration where, in general, only this species is missing. Full restoration of an array of plant and animal species has rarely been tried to date.

Restoration of single species of plants and animals is becoming more frequent around the world. Some succeed, many fail. As this form of ecological management is increasingly common, it is a priority for the Species Survival Commission's Re-introduction Specialist Group to develop guidelines so that re-introductions are both justifiable and likely to succeed, and that the conservation world can learn from each initiative, whether successful or not. It is hoped that these Guidelines, based on extensive review of case - histories and wide consultation across a range of disciplines will introduce more rigour into the concepts, design, feasibility and implementation of re-introductions despite the wide diversity of species and conditions involved.

Thus the priority has been to develop guidelines that are of direct, practical assistance to those planning, approving or carrying out re-introductions. The primary audience of these guidelines is, therefore, the practitioners (usually managers or scientists), rather than decision makers in governments. Guidelines directed towards the latter group would inevitably have to go into greater depth on legal and policy issues.

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1. DEFINITION OF TERMS

"Re-introduction": an attempt to establish a species(2) in an area which was once part of its historical range, but from which it has been extirpated or become extinct (3) ("Re-establishment" is a synonym, but implies that the re-introduction has been successful).

"Translocation": deliberate and mediated movement of wild individuals or populations from one part of their range to another.

"Re-inforcement/Supplementation": addition of individuals to an existing population of conspecifics.

"Conservation/Benign Introductions": an attempt to establish a species, for the purpose of conservation, outside its recorded distribution but within an appropriate habitat and eco-geographical area. This is a feasible conservation tool only when there is no remaining area left within a species' historic range.

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2. AIMS AND OBJECTIVES OF RE-INTRODUCTION

a. Aims:
The principle aim of any re-introduction should be to establish a viable, free-ranging population in the wild, of a species, subspecies or race, which has become globally or locally extinct, or extirpated, in the wild. It should be re-introduced within the species' former natural habitat and range and should require minimal long-term management.

b. Objectives:
The objectives of a re-introduction may include: to enhance the long-term survival of a species; to re-establish a keystone species (in the ecological or cultural sense) in an ecosystem; to maintain and/or restore natural biodiversity; to provide long-term economic benefits to the local and/or national economy; to promote conservation awareness; or a combination of these.

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3. MULTIDISCIPLINARY APPROACH

A re-introduction requires a multidisciplinary approach involving a team of persons drawn from a variety of backgrounds. As well as government personnel, they may include persons from governmental natural resource management agencies; non-governmental organisations; funding bodies; universities; veterinary institutions; zoos (and private animal breeders) and/or botanic gardens, with a full range of suitable expertise. Team leaders should be responsible for coordination between the various bodies and provision should be made for publicity and public education about the project.

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4. PRE-PROJECT ACTIVITIES

4a. BIOLOGICAL

(i) Feasibility study and background research

- An assessment should be made of the taxonomic status of individuals to be re-introduced. They should preferably be of the same subspecies or race as those which were extirpated, unless adequate numbers are not available. An investigation of historical information about the loss and fate of individuals from the re-introduction area, as well as molecular genetic studies, should be undertaken in case of doubt as to individuals' taxonomic status. A study of genetic variation within and between populations of this and related taxa can also be helpful. Special care is needed when the population has long been extinct.
- Detailed studies should be made of the status and biology of wild populations(if they exist) to determine the species' critical needs. For animals, this would include descriptions of habitat preferences, intraspecific variation and adaptations to local ecological conditions, social behaviour, group composition, home range size, shelter and food requirements, foraging and feeding behaviour, predators and diseases. For migratory species, studies should include the potential migratory areas. For plants, it would include biotic and abiotic habitat requirements, dispersal mechanisms, reproductive biology, symbiotic relationships (e.g. with mycorrhizae, pollinators), insect pests and diseases. Overall, a firm knowledge of the natural history of the species in question is crucial to the entire re-introduction scheme.
- The species, if any, that has filled the void created by the loss of the species concerned, should be determined; an understanding of the effect the re-introduced species will have on the ecosystem is important for ascertaining the success of the re-introduced population.
- The build-up of the released population should be modelled under various sets of conditions, in order to specify the optimal number and composition of individuals to be released per year and the numbers of years necessary to promote establishment of a viable population.
- A Population and Habitat Viability Analysis will aid in identifying significant environmental and population variables and assessing their potential interactions, which would guide long-term population management.

(ii) Previous Re-introductions

- Thorough research into previous re-introductions of the same or similar species and wide-ranging contacts with persons having relevant expertise should be conducted prior to and while developing re-introduction protocol.

(iii) Choice of release site and type

- Site should be within the historic range of the species. For an initial re-inforcement there should be few remnant wild individuals. For a re-introduction, there should be no remnant population to prevent disease spread, social disruption and introduction of alien genes. In some circumstances, a re-introduction or re-inforcement may have to be made into an area which is fenced or otherwise delimited, but it should be within the species' former natural habitat and range.
- A conservation/ benign introduction should be undertaken only as a last resort when no opportunities for re-introduction into the original site or range exist and only when a significant contribution to the conservation of the species will result.
- The re-introduction area should have assured, long-term protection (whether formal or otherwise).

(iv) Evaluation of re-introduction site

- Availability of suitable habitat: re-introductions should only take place where the habitat and landscape requirements of the species are satisfied, and likely to be sustained for the for-seeable future. The possibility of natural habitat change since extirpation must be considered. Likewise, a change in the legal/ political or cultural environment since species extirpation needs to be ascertained and evaluated as a possible constraint. The area should have sufficient carrying capacity to sustain growth of the re-introduced population and support a viable (self-sustaining) population in the long run.
- Identification and elimination, or reduction to a sufficient level, of previous causes of decline: could include disease; over-hunting; over-collection; pollution; poisoning; competition with or predation by introduced species; habitat loss; adverse effects of earlier research or management programmes; competition with domestic livestock, which may be seasonal. Where the release site has undergone substantial degradation caused by human activity, a habitat restoration programme should be initiated before the re-introduction is carried out.

(v) Availability of suitable release stock

- It is desirable that source animals come from wild populations. If there is a choice of wild populations to supply founder stock for translocation, the source population should ideally be closely related genetically to the original native stock and show similar ecological characteristics (morphology, physiology, behaviour, habitat preference) to the original sub-population.
- Removal of individuals for re-introduction must not endanger the captive stock population or the wild source population. Stock must be guaranteed available on a regular and predictable basis, meeting specifications of the project protocol.
- Individuals should only be removed from a wild population after the effects of translocation on the donor population have been assessed, and after it is guaranteed that these effects will not be negative.
- If captive or artificially propagated stock is to be used, it must be from a population which has been soundly managed both demographically and genetically, according to the principles of contemporary conservation biology.
- Re-introductions should not be carried out merely because captive stocks exist, nor solely as a means of disposing of surplus stock.
- Prospective release stock, including stock that is a gift between governments, must be subjected to a thorough veterinary screening process before shipment from original source. Any animals found to be infected or which test positive for non-endemic or contagious pathogens with a potential impact on population levels, must be removed from the consignment, and the uninfected, negative remainder must be placed in strict quarantine for a suitable period before retest. If clear after retesting, the animals may be placed for shipment.
- Since infection with serious disease can be acquired during shipment, especially if this is intercontinental, great care must be taken to minimize this risk.
- Stock must meet all health regulations prescribed by the veterinary authorities of the recipient country and adequate provisions must be made for quarantine if necessary.

(vi) Release of captive stock

- Most species of mammal and birds rely heavily on individual experience and learning as juveniles for their survival; they should be given the opportunity to acquire the necessary information to enable survival in the wild, through training in their captive environment; a captive bred individual's probability of survival should approximate that of a wild counterpart.

- Care should be taken to ensure that potentially dangerous captive bred animals (such as large carnivores or primates) are not so confident in the presence of humans that they might be a danger to local inhabitants and/or their livestock.

4b. SOCIO-ECONOMIC AND LEGAL REQUIREMENTS

- Re-introductions are generally long-term projects that require the commitment of long-term financial and political support.
- Socio-economic studies should be made to assess impacts, costs and benefits of the re-introduction programme to local human populations.
- A thorough assessment of attitudes of local people to the proposed project is necessary to ensure long term protection of the re-introduced population, especially if the cause of species' decline was due to human factors (e.g. over-hunting, over-collection, loss or alteration of habitat). The programme should be fully understood, accepted and supported by local communities.
- Where the security of the re-introduced population is at risk from human activities, measures should be taken to minimise these in the re-introduction area. If these measures are inadequate, the re-introduction should be abandoned or alternative release areas sought.
- The policy of the country to re-introductions and to the species concerned should be assessed. This might include checking existing provincial, national and international legislation and regulations, and provision of new measures and required permits as necessary.
- Re-introduction must take place with the full permission and involvement of all relevant government agencies of the recipient or host country. This is particularly important in re-introductions in border areas, or involving more than one state or when a re-introduced population can expand into other states, provinces or territories.
- If the species poses potential risk to life or property, these risks should be minimised and adequate provision made for compensation where necessary; where all other solutions fail, removal or destruction of the released individual should be considered. In the case of migratory/mobile species, provisions should be made for crossing of international/state boundaries.

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5. PLANNING, PREPARATION AND RELEASE STAGES

- Approval of relevant government agencies and land owners, and coordination with national and international conservation organizations.
- Construction of a multidisciplinary team with access to expert technical advice for all phases of the programme.
- Identification of short- and long-term success indicators and prediction of programme duration, in context of agreed aims and objectives.
- Securing adequate funding for all programme phases.
- Design of pre- and post- release monitoring programme so that each re-introduction is a carefully designed experiment, with the capability to test methodology with scientifically collected data.

Monitoring the health of individuals, as well as the survival, is important; intervention may be necessary if the situation proves unforseeably favourable.

- Appropriate health and genetic screening of release stock, including stock that is a gift between governments. Health screening of closely related species in the re-introduction area.
- If release stock is wild-caught, care must be taken to ensure that: a) the stock is free from infectious or contagious pathogens and parasites before shipment and b) the stock will not be exposed to vectors of disease agents which may be present at the release site (and absent at the source site) and to which it may have no acquired immunity.
- If vaccination prior to release, against local endemic or epidemic diseases of wild stock or domestic livestock at the release site, is deemed appropriate, this must be carried out during the "Preparation Stage" so as to allow sufficient time for the development of the required immunity.
- Appropriate veterinary or horticultural measures as required to ensure health of released stock throughout the programme. This is to include adequate quarantine arrangements, especially where founder stock travels far or crosses international boundaries to the release site.
- Development of transport plans for delivery of stock to the country and site of re-introduction, with special emphasis on ways to minimize stress on the individuals during transport.
- Determination of release strategy (acclimatization of release stock to release area; behavioural training - including hunting and feeding; group composition, number, release patterns and techniques; timing).
- Establishment of policies on interventions (see below).
- Development of conservation education for long-term support; professional training of individuals involved in the long-term programme; public relations through the mass media and in local community; involvement where possible of local people in the programme.
- The welfare of animals for release is of paramount concern through all these stages.

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6. POST-RELEASE ACTIVITIES

- Post release monitoring is required of all (or sample of) individuals. This most vital aspect may be by direct (e.g. tagging, telemetry) or indirect (e.g. spoor, informants) methods as suitable.
- Demographic, ecological and behavioural studies of released stock must be undertaken.
- Study of processes of long-term adaptation by individuals and the population.
- Collection and investigation of mortalities.
- Interventions (e.g. supplemental feeding; veterinary aid; horticultural aid) when necessary.
- Decisions for revision, rescheduling, or discontinuation of programme where necessary.
- Habitat protection or restoration to continue where necessary.
- Continuing public relations activities, including education and mass media coverage.
- Evaluation of cost-effectiveness and success of re- introduction techniques.
- Regular publications in scientific and popular literature.

Footnotes:

1. Guidelines for determining procedures for disposal of species confiscated in trade are being developed separately by IUCN.
2. The taxonomic unit referred to throughout the document is species; it may be a lower taxonomic unit (e.g. subspecies or race) as long as it can be unambiguously defined.
3. A taxon is extinct when there is no reasonable doubt that the last individual has died

The IUCN/SSC Re-introduction Specialist Group

The IUCN/SSC Re-introduction Specialist Group (RSG) is a disciplinary group (as opposed to most SSC Specialist Groups which deal with single taxonomic groups), covering a wide range of plant and animal species. The RSG has an extensive international network, a re-introduction projects database and re-introduction library. The RSG publishes a bi-annual newsletter RE-INTRODUCTION NEWS.

If you are a re-introduction practitioner or interested in re-introductions please contact:

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