Rabbits, Hares and Pikas

Status Survey and Conservation Action Plan

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Chapter 14: Conservation Action Needed for Rabbits, Hares and Pikas

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Introduction

The data presented in the previous chapters constitute the most thorough overview ever made of the lagomorphs from a conservation perspective. In this section, the data are used to compile a list of actions needed to conserve and manage lagomorphs more effectively. These actions are divided into the following categories:

- Management Guidelines for Common Species;
- Conservation of Globally Threatened Species;
- Conservation of Other Species of Concern;
- Priorities for Conservation-Related Research on Lagomorphs.

This chapter does not attempt to go into great detail on the various conservation issues, and the reader is referred to relevant sections of earlier chapters for more information.

Management Guidelines for Common Species

Many parts of the world support some common lagomorph species. Often these are of considerable economic importance, either for the fur trade, or more usually as game species. These uses of lagomorphs can frequently be compatible with their conservation, provided that certain basic management procedures are adopted. In general, these can be summarised as follows:

Hunting

In many cases, the hunting of lagomorphs has been sustainable through luck rather than management design. In some cases, most notably the brown hare *Lepus europaeus* in Europe, hunting levels are no longer sustainable and need to be reduced. Throughout Europe, thorough population studies of the species need to be carried out and hunting quotas then set and enforced, that allow populations to recover. The long-term aim should be for each European country to set annual quotas based on regular monitoring of the populations.

Habitat Management

Recent changes in agricultural practices in Europe (including the use of fertilizers and pesticides, and the planting of huge fields of monoculture crops) have resulted in declines in the European hare population. This is part of the wider problem of decisions taken to increase the productivity of agriculture, without due consideration being given to other forms of land use, such as the management of game species. Land use planning programs should adopt a broader approach in future and should include environmental considerations. Land use decisions should be made on a cross-sectoral basis which takes into consideration the impact on other sectors (i.e. nature conservation, sport hunting, the fur industry, etc.). It should be realised that intensive agriculture is often the most profitable form of land use only because of the hidden government subsidies that it receives; its intrinsic profitability is frequently less than often assumed.

Introductions

In a number of places, lagomorphs have been introduced to areas outside their natural distribution, often in an attempt to supplement the existing range of game species. This practice should be opposed vigorously. Such introductions can severely disrupt the natural ecological balance and threaten native species. The proposed introductions of cottontails *Sylvilagus* into parts of western Europe are likely to be especially damaging and should be prevented. The IUCN/SSC Lagomorph Specialist Group Statement on the Introduction of Exotic Lagomorphs is included in Appendix 1 and is compatible with the 1987 IUCN Position Statement on Translocations of Living Organisms.

Table 14.1 The globally threatened lagomorph species

Species	IUCN Category of Threat	Countries of Occurrence
Gaoligong Pika *Ochotona gaoligongensis*	Indeterminate	China
Ili Pika *Ochotona iliensis*	Indeterminate	China
Koslov's Pika *Ochotona koslowi*	Vulnerable	China
Muli Pika *Ochotona muliensis*	Indeterminate	China
Nubra Pika *Ochotona nubrica*	Indeterminate	China, India, Nepal
Thomas' Pika *Ochotona thomasi*	Indeterminate	China
Tehuantepec Jackrabbit *Lepus flavigularis*	Endangered	Mexico
Black Jackrabbit *Lepus insularis*	Rare	Mexico
Tres Marias Rabbit *Sylvilagus graysoni*	Endangered	Mexico
Omiltemi Rabbit *Sylvilagus insonus*	Endangered	Mexico
San Jose Brush Rabbit *Sylvilagus mansuetus*	Indeterminate	Mexico
Pygmy Rabbit *Brachylagus idahoensis*	Vulnerable	United States
Riverine Rabbit *Bunolagus monticularis*	Endangered	South Africa
Hispid Hare *Caprolagus hispidus*	Endangered	India, Nepal
Sumatran Rabbit *Nesolagus netscheri*	Indeterminate	Indonesia
Amami Rabbit *Pentalagus furnessi*	Endangered	Japan
Volcano Rabbit *Romerolagus diazi*	Endangered	Mexico

Biological Control

The deliberate use of any disease or predator to control lagomorph populations should only be permitted after stringent conditions have been met, as outlined in the IUCN/SSC Lagomorph Specialist Group Statement on the Biological Control of Lagomorphs (see Appendix 1).

Conservation of Globally Threatened Species

Some 17 species of lagomorph are now considered to be globally threatened, as documented in Table 14.1; the conservation actions needed for each of these 17 species are listed below on a country-by-country basis.

China

Six species of globally threatened lagomorph occur in China, all of them pikas. In nearly every case they are still too poorly known for it to be possible to make detailed conservation recommendations.

Gaoligong Pika *Ochotona gaoligongensis*

This recently described species is known only from Mount Gaoligong, Yunnan Province, China. Nothing is known of its status.

The following priority activities have been identified for the conservation of this species:

1. **Research.** The systematic status of this species needs to be resolved, since it is possible that it is closely related to Forrest's pika *O. forresti*. This would require the collection of additional specimens and careful comparison with related species.

2. **Status Surveys.** A survey should be carried out to assess the status and conservation requirements of this species on Mount Gaoligong.

3. **Conservation Action.** Based on the results of the research and surveys outlined above, appropriate conservation measures should be introduced in the Mount Gaoligong area.

Ili Pika *Ochotona iliensis*

This recently described species is known only from Borohoro Shan area, Xinjiang Province, China. Nothing is known of its status.

The following priority activities have been identified for the conservation of this species:

1. **Research.** The systematic status of this species needs to be resolved, since it is possible that it is closely related to the red-eared pika *O. erythrotis* or the Turkestan red pika *O. rutila*. This would require the collection of additional specimens and careful comparison with related species. Research should also focus on the postulated decline of this species due to global warming.

2. **Status Surveys.** A survey should be carried out to assess the status and conservation requirements of this species in the Borohoro Shan area.

3. **Conservation Action.** Based on the results of the research and surveys outlined above, appropriate conservation measures should be introduced in the Borohoro Shan area.

Kozlov's Pika *Ochotona koslowi*

This highly distinctive pika is only known from the Arkatag Range, a spur of the Kunlun Mountains west of the junction of Xinjiang, Xizang and Qinghai Provinces in China. It is believed to be threatened.

The following priority activities have been identified for the conservation of this species:

1. **Status Survey.** A thorough survey is needed to assess the status and conservation requirements of this very restricted species. The survey should produce clear recommendations for the conservation of the species and its habitat.

2. **Conservation Action.** Based on the results of the above-mentioned survey, a conservation initiative should be launched in the Arkatag Range. The habitats of this area are already known to be severely impacted, so some form of improved management will almost certainly be necessary.

3. **Research.** The possible impact of vertebrate control campaigns on populations of this species should be investigated and the results used to help design the integrated conservation program.

Muli Pika *Ochotona muliensis*

This very rare species is known only from thickets and steppes in western Sichuan Province, China. There have been no records in the last 25 years and it could be seriously threatened.

The following priority activities have been identified for the conservation of this species:

1. **Research.** The systematic status of this species needs to be resolved, since it is possible that it is closely related to the Glover's pika *O. gloveri*. This would require the collection of a limited number of additional specimens and careful comparison with related species. Research should also focus on the impact of vertebrate control programmes on the Muli pika, since it is possible that the resulting chemical contamination has severely threatened this species.

2. **Status Surveys.** A survey should be carried out to assess the status and conservation requirements of this species in western Sichuan Province.

3. **Conservation Action.** Based on the results of the research and surveys outlined above, appropriate conservation measures should be introduced in western Sichuan Province.

Nubra Pika *Ochotona nubrica*

This enigmatic species occurs in a narrow range along the southern Tibetan plateau, as well as in neighbouring India and Nepal. It is very poorly known.

The following priority activities have been identified for the conservation of this species:

1. **Status Surveys.** A survey should be carried out to assess the status and conservation requirements of this species along the southern Tibetan plateau, with a view to making conservation recommendations. The ecological requirements of the species are not understood at all.

2. **Conservation Action.** Based on the results of the surveys outlined above, appropriate conservation measures should be introduced in the southern Tibetan plateau area.

Thomas' Pika *Ochotona thomasi*

This species is known only from isolated mountain ranges in Gansu, Qinghai and Sichuan Provinces, China. It is rare and may be threatened.

The following priority activities have been identified for the conservation of this species:

1. **Research.** Research should focus on the impact of vertebrate control programmes on this species, since it is possible that the resulting chemical contamination has severely threatened Thomas' pika.

2. **Status Surveys.** A survey should be carried out to assess the status and conservation requirements of this species in Gansu, Qinghai and Sichuan Provinces.

3. **Conservation Action.** Appropriate conservation measures should be introduced, based on the results of the research and surveys outlined above.

India

Two globally threatened lagomorph species occur in India.

Nubra Pika *Ochotona nubrica*

This enigmatic species occurs in a narrow range in the Ladak Range, as well as in neighbouring China and Nepal. It is very little known.

The following priority activities have been identified for the conservation of this species:

1. **Status Surveys.** A survey should be carried out to assess the status and conservation requirements of this species in the Ladak Range, with a view to making conservation recommendations. The ecological requirements of the species are not understood at all.

2. **Conservation Action.** Based on the results of the surveys outlined above, appropriate conservation measures should be introduced in the Ladak Range.

Hispid Hare *Caprolagus hispidus*

This species is seriously endangered, surviving in a few isolated pockets across the former range of its tall grassland habitat in northern India and southern Nepal. It is threatened by habitat destruction for agriculture, forestry, human settlement, flood control and irrigation schemes, together with the adverse effects of dry season burning, overgrazing and harvesting of remaining tall grasslands.

The following priority activities have been identified to ensure the survival of this species:

1. **Maintenance of Protected Areas.** The continued survival of this species in India depends upon the maintenance of the tall grass habitat in the following protected areas (note that the species also occurs in Nepal: see that account): Manas Reserve Forest, Manas Sanctuary, Manas Tiger Reserve, Barnadi Reserve Forest, Ripu Reserve Forest, Subankhata Reserve Forest, Orang Wildlife Sanctuary, Jaldapara Wildlife sanctuary, Buxa Tiger Reserve, Valmiki Wildlife Sanctuary, Dudwa National Park and possibly Kanha National Park. It should be noted that governmental authority over some of the reserves in Assam is now weak, especially the Manas complex, as a result of security problems. In some other reserves there is heavy overgrazing by cattle, notably the Buxa Tiger Reserve, and this needs to be brought under control. It is of great importance that control of these reserves be regained, but also that in future the management plans of these areas are designed to ensure that the local Bodo people derive tangible economic benefits from the existence of the reserves. This might take the form of appropriate buffer-zone developments, especially around the very important Manas complex of reserves.

2. **Improvement of Habitat Management.** The immediate threats to the relict populations of the hispid hare should be alleviated by a change in reserve management practices, from uncontrolled dry season burning of its tall grassland habitat to a system of carefully controlled rotational burning such that large areas of suitable habitat (i.e. providing optimal cover, food resources, etc.) are available throughout the year. The detailed formulation of appropriate long-term management plans for these remnant areas of tall grassland should draw on the results of the research programs recommended below.

3. **Status Surveys.** Status surveys are needed in a number of areas that have not previously been investigated for this species. These include several areas of north-eastern India. Faecal evidence of the hispid hare occurring in Kanha National Park requires confirmation, since this site is some distance south of the present known range of the species and would indicate the need for additional surveys for hispids in remaining grassland patches between these two areas.

4. **Research.** *1: Long-term research programs* examining the effects of each of the several disturbance factors (e.g. burning, thatch harvesting and grazing) operating on hispid hare habitat are required to formulate appropriate long-term management plans for the remnants of tall grassland habitat. Research into burning, for example, should investigate the effects of factors such as timing, frequency and soil water content on both the vegetation and the hare populations so that optimum management plans can be developed for individual areas.
2: Long-term studies of the behavioral ecology and reproductive biology of the hispid hare are urgently required, concentrating on habitat requirements, breeding biology and home range use throughout the year (so far only studied in the early dry season). It is important that these studies include the monsoon period, when the marshy areas used as refugia during the early dry season post-burn period are likely to be among the first areas to become inundated.

5. **Captive Breeding.** A captive breeding program for this species needs to be initiated to provide a nucleus of animals for reintroduction into the wild, should this become necessary. At least 30 animals should be used to form the founder captive stock to avoid inbreeding problems.

Indonesia

Of the two lagomorph species that occur in Indonesia, only one is of conservation concern.

Sumatran Rabbit *Nesolagus netscheri*

The Sumatran rabbit is an endemic genus restricted to the montane forests of western Sumatra. There is a great scientific interest in the species because it is considered to be a primitive relict form, because of its unusual striped coloring and because it is one of the very few lagomorphs which lives in thick equatorial forest. In addition, there is possible commercial interest in domesticating this animal for use in tropical countries where the European rabbit *Oryctolagus cuniculus* is not so well adapted.

The following priority activities have been identified for the conservation of this species:

1. **Status Surveys.** The status of the Sumatran rabbit remains almost completely unknown. It seems to have a very low population density and is probably restricted to inaccessible montane forest. It may have a requirement for rich volcanic soils, further limiting its distribution, and this needs to be investigated. The highest priority for this species is to locate it in the wild through a thorough status survey of all the locations in which it has been reported in the past, and to assess its conservation requirements.

2. **Habitat Conservation.** Montane forest in Sumatra is now being cleared rapidly, through a combination of felling of timber, planting of vegetables and settling of immigrants from Java through the transmigration program. It is against this background that a new National Park is proposed for Mt. Kerinci-Seblat. It is of the utmost importance that this park be formally gazetted and measures taken to ensure the survival of the full range of habitats and species within it. The survey referred to above will need to determine whether the park contains a viable population of the Sumatran rabbit. It is essential that a management plan be developed for the new park allowing for appropriate forms of buffer-zone development in the surrounding area, to increase the standard of living of the local communities without jeopardizing important conservation priorities (possibly through the new WWF-funded project there). The same considerations also apply to the existing Gunung Leuser and Barisan-Selatan National Parks, where the species probably occurs.

3. **Research.** Once a population of this elusive species has been found, it will be necessary to carry out detailed studies on its habitat requirements. A greater knowledge of the signs left by these animals will enable surveys of other areas to proceed more rapidly. Scientific studies should also be geared towards developing habitat management guidelines for the species, to be incorporated in the management plans of reserves within its range.

4. **Captive Breeding.** If a population can be located, it is important to invest in a captive breeding program for the species to provide a nucleus of animals for reintroduction, should this be necessary.

Japan

The Amami rabbit is the only Lagomorph occurring in Japan that is of international conservation concern.

Amami Rabbit *Pentalagus furnessi*

The Amami rabbit is an endangered species found only on Japan's Amami Island and Tokuno-shima, part of the Ryukyu Island chain. These islands have many endemic terrestrial vertebrate species and subspecies. Amami Island is very important for endemic species conservation and the Amami Rabbit is a representative of the unique biocommunity of the island.

The following priority activities have been identified to ensure the survival of this species:

1. **Habitat Conservation and Management.** To enable this species to survive, a habitat mosaic of mature oak forests and young second-growth stands is required. This enables the Amami rabbit to obtain important food supplies throughout the year. In order to maintain this mosaic, careful habitat management is necessary; certain forests should be set aside to become mature, since such old forests are now greatly reduced in area.

2. **Control of Introduced Species.** The Amami rabbit suffers greatly from introduced predators such as feral dogs, feral cats and mongooses. As a result, the species tends to be absent from areas near human settlements. Populations of introduced predators should be controlled in important areas for the species.

3. **Research and Monitoring Programs.** A few research programs have been conducted, sponsored by the central government, focusing on population estimates, food habits and nest site selection of the Amami rabbit. These, however, are not sufficient to monitor the population because the studies are too infrequent and the amount of information collected during each period is too small. An ongoing budget is required for a research or a monitoring program with the aim of assessing conservation and management needs for the species. Researchers willing to carry out such long-term research programs also need to be identified.

Mexico

With six species of threatened lagomorph, Mexico (together with China) is the highest priority country in the world for the conservation of these species.

Tehuantepec Jackrabbit *Lepus flavigularis*

The Tehuantepec jackrabbit is the most endangered hare in North America. Its geographic range is restricted to a small area in Oaxaca and Chiapas in Mexico. Its historic geographic range has been reduced; unfortunately no information is available about its present distribution and population numbers.

The following priority activities have been identified to ensure the survival of this species:

1. **Habitat Conservation and Management.** The populations of the Tehuantepec jackrabbit have been depleted by habitat destruction. The species is restricted to riparian vegetation, sand dunes and shrub forest, which never exceeds a 4-5km wide strip along the shores of salt water lagoons on the northern side of the Gulf of Tehuantepec. Its habitat is threatened by expanding agriculture to support the growing local human population. The only real chance of saving this species is to establish reserves for it in areas identified as supporting the denser populations. Reserve sites should be identified by the surveys referred to below and planned to ensure that their establishment does not cause conflicts with local communities.

2. **Regulation of Hunting.** The Tehuantepec jackrabbit is also suffering from hunting. It is important to ensure an effective ban on the hunting of the larger populations which have a chance of long term viability, as part of the management programs for the new reserves referred to above.

3. **Education Program.** Education programs are needed to inform the local communities of the uniqueness of this species and the value of its preservation. These programs should include advice to the local people on forms of land use that are both beneficial to them and which are likely to be sustainable in the long term.

4. **Status Surveys.** Surveys are required to provide accurate inventories and documentation on the distribution of the species, with a view to identifying potential reserve sites and assessing its habitat requirements.

5. **Research.** The biology of the Tehuantepec jackrabbit is unknown. The only information available concerns its systematics. Research on basic biology is clearly needed. It is important to document its habitat preferences and the effect of grazing and other types of habitat disturbance on the populations of this species.

6. **Captive Breeding.** A captive breeding programme should be established to enable reintroduction in the event of extinction in the wild.

Black Jackrabbit *Lepus insularis*

The black jackrabbit is found only on Espiritu Santo Island in the Gulf of California, where its status is very little known. Although this is a species with a very restricted distribution, it is unlikely that the island will ever be settled by people and the species is probably less threatened than several other Mexican lagomorphs.

The following priority activities have been identified to ensure the survival of this species:

1. **Status Surveys.** A survey to determine the status of the species is of high priority. This should focus on distribution, population, habitat requirements and probable impacts on the species resulting from introduced animals.

2. **Habitat Management.** An integrated conservation program (emphasizing habitat management) for Espiritu Santo Island should be developed, drawing in part on the results of the survey referred to above.

3. **Research.** Genetic and morphological studies are required to determine the relationship of this species to the black-tailed jackrabbit *L. californicus* from mainland Baja California. Other studies focusing on its basic biology will be useful for long-term conservation and management.

4. **Establishment of Second Population.** As a security against unforeseen catastrophe (such as disease), it would be wise to establish a second population on a nearby island, providing that it can be demonstrated that serious ecological risks will not result from such an introduction.

Tres Marias Rabbit *Sylvilagus graysoni*

This species is endemic to the Tres Marias Islands, approximately 86km from mainland Nayarit. Two subspecies have been recognized: *S. g. graysoni* found on the islands of Maria Madre, Maria Magdalena and Maria Cleofas; and *S. g. badistes* found only in San Juanito island.

The following priority activities have been identified to ensure the survival of this species:

1. **Habitat Conservation and Management.** The main threats to the Tres Marias rabbit are habitat alterations (principally forest clearance) caused by introduced species and human settlements (including the high security prison), and hunting. Large areas of natural vegetation have already been removed on Maria Madre and Maria Cleofas. Extensive habitat perturbations associated with the plans to convert large pristine areas into new human

settlements and agriculture will undoubtedly have a profound impact on the populations of this species. The key factor in ensuring the long term conservation of the Tres Marias rabbit is the protection of its habitat. Reserves of sufficient size for viable populations of this species should be established on Maria Madre. The uninhabited Maria Cleofas and San Juanito islands should be managed in their entirety as nature reserves. This would entail a cancellation of plans to settle Maria Cleofas. These recommended new reserves would also protect other endemic species such as the Tres Marias raccoon *Procyon insularis* and the rice rat *Oryzomys nelsoni*. The new Ecological Reserve recently designated by the Mexican government on Maria Magdalena should be assessed for its value in conserving the Tres Marias rabbit.

2. **Status Surveys.** There are no quantitative data on the present status of this species on any of the four islands. Rabbit populations are, apparently, larger on the two islands without human settlements. A survey to determine its present status, population densities and precise habitat requirements is urgently needed.

3. **Research.** The only research so far carried out on this species concerns its taxonomy. Studies of its basic biology and life history, and long term monitoring of its population dynamics are recommended. Particularly important is the study of the ecological interactions between introduced species (e.g., goats, rats) and the Tres Marias rabbit, and the response of this species to habitat disturbance caused by humans. There is also a need to ascertain the extent of reserves required to protect genetically and demographically viable populations.

Omiltemi Rabbit *Sylvilagus insonus*

The Omiltemi rabbit may be among the most endangered rabbits in the world; fewer than ten specimens, all collected during the last century, are known to science. It is known only in the Sierra Madre del Sur, in the vicinity of Omiltemi, Guerrero, Mexico, at elevations between 2,300m and 5,280m.

The following priority activities have been identified for the conservation of this species:

1. **Status Surveys.** Intensive surveys are needed to ascertain whether or not this species survives and to determine its present distribution. These surveys should also focus on habitat requirements and make an assessment of the threats to its survival. Until such information becomes available, a comprehensive conservation strategy cannot be developed.

2. **Habitat Conservation and Management.** The species is restricted to pine and pine-oak forests. Although Omiltemi has been recently declared a State Reserve by the Mexican government, habitat destruction is probably still a major threat to native species since the coniferous forests have been highly modified and fragmented by intense forestry and cattle grazing.

3. **Regulation of Hunting.** Hunting is probably a major threat to the Omiltemi rabbit. Biological surveys in the area have shown intensive hunting pressures on rabbits and other species of mammals, though so far there has been a complete lack of information about this species.

4. **Research.** There are no data on the biology of this rabbit. If a population is found, it will be extremely important to study urgently its basic biology and determine the factors that cause its rarity. Data on population dynamics, life history and feeding habits will be very useful for establishing a management plan to ensure its long term preservation.

5. **Captive breeding.** A captive breeding program would be advisable.

San Jose Brush Rabbit *Sylvilagus mansuetus*

The San Jose brush rabbit is restricted to San Jose Island in the Gulf of California, Baja California, Mexico, where its status is unknown.

The following priority activities have been identified for the conservation of this species:

1. **Status Survey.** A survey to assess the status, population and precise habitat requirements of this species is a high priority. Several species of mammals on the islands off Baja California have been depleted as a result of the effects of the introduction of exotic mammals, including competitors and predators. Rats and cats, accidentally introduced to San Jose Island, may pose a serious threat to the survival of this species and this should be investigated. Monitoring population levels at least annually will be useful to check the status of the species.

2. **Eradication of Introduced Species.** A priority action for the preservation of this species is the eradication of the introduced animals from San Jose Island, especially those which are demonstrated to be detrimental to the survival of the San Jose brush rabbit.

3. **Research.** As with several other species of Mexican lagomorphs, the biology of the San Jose brush rabbit is little known. Genetic and taxonomic studies are needed to clarify the relationship between this rabbit and the brush rabbit *S. bachmani* from mainland Baja California. Research is needed to document the natural history, population dynamics and life history of this species, as basis for developing an adequate conservation strategy.

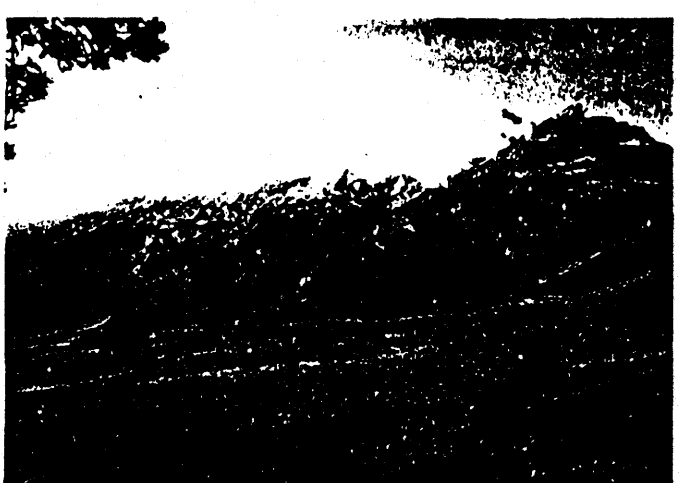
4. **Development of Conservation Program.** Based on the results of the surveys and research outlined above, an integrated conservation program should be developed, including careful habitat management and possibly protected area establishment.

Volcano Rabbit *Romerolagus diazi*

The volcano rabbit, a Mexican endemic, is endangered. Its whole geographic range is restricted to a few mountains west and south of Mexico City. Habitat destruction, fires, hunting and pollution pose a serious threat to its survival. The species has disappeared from many localities, including the Nevado de Toluca volcano. Presently the three areas that support the most important populations are the Iztaccihualtl, Popocatepetl and Pelado volcanoes.

The following priority activities have been identified to ensure the survival of this species:

1. **General Habitat Conservation and Management.** Volcano rabbits require grasslands above the tree level and conifer forests with a dense cover of zacatones (bunch grasses) for food and cover. The survival of the species clearly revolves around the control of burning and overgrazing in the prime "zacaton" habitats and the enforcement of laws that prohibit the catching, sale and hunting of the animal. Forest areas where the volcano rabbit is found are significant not only for this species but also as a reservoir for other endemics. It is also an important zone for life-support systems in the Mexico City region. These forests are crucial as water catchment zones and could be exploited sustainably for timber and other renewable resources. Consideration of these broader issues would promote the protection of volcano rabbit habitats. Habitat restoration may be possible in certain areas and this needs further investigation.



Habitat of the volcano rabbit *Romerolagus diazi* in the grasslands at Volcán, Popocatepetl, Mexico (Photo G. Ceballos)

2. **Protected Area Management.** Volcano rabbit habitats are disappearing so fast that it is extremely important to select a number of areas as new reserves, in addition to those already established. Where possible, these reserves should be connected with corridors of suitable habitat and located across the species' geographic range to ensure the preservation of the highest possible genetic diversity. Within the protected areas and other zones scheduled for future protection, appropriate management needs to start as a matter of high priority. The supervision so far given by the Secretaria de Desarrollo Urbano y Ecologia (SEDUE) or the Comision Coordinadora de Desarrollo Ecologico y Rural in Mexico City (COCODER) to volcano rabbit areas is not sufficient. Provision of necessary staff to manage the Izta-Popo National Park and the Special Protected Zones to the south of Mexico City (Volcan el Pelado and Volcan Tlaloc) is required. Although actions to reduce hunting need to be enforced, ways must be identified of making sustainable exploitation of natural resources compatible with wildlife protection. Controlled burning can be made compatible with the recovery of habitats and the conservation of wildlife.

3. **Education Programs.** Education campaigns at village, national and international levels need to be started. Most local inhabitants are unaware of the protected status of the species. Public awareness of the species' habitat is essential. Information on the impact of land use methods that are incompatible with sustainable development and conservation should be made available to villages adjacent to the core habitats. In particular, villagers need to be provided alternatives to land-use practices that are jeopardizing their own livelihoods. Agricultural extension work is required to demonstrate sustainable and ecologically-sensitive farming practices.

4. **Captive Breeding.** A captive-breeding program in the Chapultepec Zoo, Mexico City, has been very successful, indicating the potential for restoring some of the extirpated populations. More scientific supervision of the captive breeding program is probably required and the number of animals in captivity needs to be built up. The captive breeding program requires close international cooperation between all the institutions concerned and the number of breeding facilities involved should be enlarged. In addition, the value of the captive colonies (particularly at the Mexico City and Jersey Zoos) in creating and fostering public awareness should be further developed. Under no circumstances should the species be introduced as a laboratory animal as suggested by some authors (e.g. Granados, 1981), since this could create a demand that could eventually imperil the wild populations.

5. **Status Survey.** Although the general distribution of the species is well known, intensive and extensive surveys are needed to identify the precise distribution of its popula-

tions, especially in areas where the habitat has been fragmented. These data should be collected with a specific view to planning the necessary network of protected areas and corridors (as outlined above) for this species and other forms of endemic wildlife.

6. **Research.** Studies on population densities of the volcano rabbit throughout its geographic range, habitat relationships, population dynamics and life history are needed to ensure that appropriate management is implemented. There is almost no information on the effect of habitat fragmentation on the genetics and population dynamics of the species. It is particularly important that the interactions between cattle grazing and habitat quality for the volcano rabbit are assessed.

Nepal

Two globally threatened lagomorph species occur in Nepal.

Nubra Pika *Ochotona nubrica*

This enigmatic species occurs in alpine steppe habitats in the Himalayas, as well as in neighbouring China and India. It is very little known.

The following priority activities have been identified for the conservation of this species:

1. **Status Surveys.** A survey should be carried out to assess the status and conservation requirements of this species in the Himalayas, with a view to making conservation recommendations. The ecological requirements of the species are not understood at all.

2. **Conservation Action.** Based on the results of surveys outlined above, appropriate conservation measures should be introduced in the Himalayas.

Hispid Hare *Caprolagus hispidus*

This species is seriously endangered, surviving in a few isolated pockets across the former range of its tall grassland habitat in northern India and southern Nepal. It is threatened by habitat destruction for agriculture, forestry, human settlement, flood control and irrigation schemes, together with the adverse effects of dry season burning, overgrazing and harvesting of remaining tall grasslands.

The following priority activities have been identified to ensure the survival of this species:

1. **Maintenance of Protected Areas.** The continued survival of this species in Nepal depends upon the maintenance of the tall grass habitat in the following protected areas (note that the species also occurs in India: see that account): Royal Chitawan National Park, Royal Bardia Wildlife Reserve and Royal Suklaphanta Wildlife Reserve. In some other reserves there is heavy overgrazing by cattle, notably the Royal Suklaphanta Wildlife Reserve, and this needs to be brought under control.

2. **Improvement of Habitat Management.** The immediate threats to the relict populations of the hispid hare should be alleviated by a change in reserve management practices, from uncontrolled dry season burning of its tall grassland habitat, to a system of carefully controlled rotational burning such that large areas of suitable habitat (i.e. providing optimal cover, food resources, etc.) are available throughout the year. The detailed formulation of appropriate long-term management plans for these remnant areas of tall grassland should draw on the results of the research programs recommended below.

3. **Status Surveys.** Status surveys are needed for this species in a number of areas that have not previously been investigated. These include several areas of southeastern Nepal, where it is not clear whether the species survives.

4. **Research.**
   1: Long-term research programs examining the effects of each of the several disturbance factors (e.g. burning, thatch harvesting and grazing) operating on hispid hare habitat are required to formulate appropriate long-term management plans for the remnants of tall grassland habitat. Research into burning, for example, should investigate the effects of factors such as timing, frequency and soil water content on both the vegetation and the hare populations so that optimum management plans can be developed for individual areas.
   2: Long-term studies of the behavioral ecology and reproductive biology of the hispid hare are urgently required, concentrating on habitat requirements, breeding biology and home range use throughout the year (so far only studied in the early dry season). It is important that these studies include the monsoon period when the marshy areas used as refugia during the early dry season post-burn period are likely to be among the first areas to become inundated.

5. **Captive Breeding.** A captive breeding programme for this species needs to be initiated to provide a nucleus of animals for reintroduction into the wild, should this become necessary.

South Africa

Although seven species of Lagomorph occur in South Africa, only the riverine rabbit is of serious conservation concern.

Riverine Rabbit *Bunolagus monticularis*

The riverine rabbit is the only species of lagomorph on the African continent regarded as endangered. This is mainly due to its extremely small numbers and narrow habitat specificity, although habitat clearance appears now to have stopped.

The following priority activities have been identified to ensure the survival of this species:

1. **Habitat Conservation and Management.** The riverine rabbit inhabits dense riparian growth along the seasonal rivers in the central Karoo. Almost 68% of the remaining riverine rabbit habitat is associated with an interconnected network of rivers, principally the Sak, Klein Sak and Riet, Klein Riet in the central Karoo. No national reserve has yet been proclaimed for the species, but recent additions to the Karoo National Park (32°12'S, 22°16'E) may prove suitable for relocation of the species once the vegetation has recovered from the effects of overgrazing. Also, plans to have the farm which has formed the focus of research on the species proclaimed a conservancy under South Africa's Natural Heritage Programme should be implemented. The site (31°21'S, 22°38'E) is situated along the Klein Brak River near the town of Victoria West.

2. **Status Surveys.** No active monitoring of the riverine rabbit population is currently in progress. It is important that a long-term program be established, since although habitat destruction is no longer taking place, the threat of local extinctions of tiny, fragmented populations remains very real.

3. **Education Program.** The riverine rabbit awareness programme that has been initiated amongst the farmers of the central Karoo needs to be continued and expanded.

4. **Research.** A study is needed of the habitat area requirements of the species, focusing in particular on the degree of population fragmentation and the amount of gene flow between nearby populations. Research should also examine the feasibility of rehabilitating habitat in parts of the species' former range, with a view to building up the wild population to a safer level.

5. **Captive Breeding.** The development of a captive breeding program, which will allow the eventual reintroduction of the species into areas of suitable habitat in which it no longer survives or where it has become very rare, is a very high priority. Following recent investigations, it is clear that the captive breeding program should have the following characteristics: (a) an initial founder population of not less that 16 individuals (eight pairs); (b) breeding pairs remain mated for several litters; (c) the offspring from each breeding pair are subsequently systematically mated to members of other litters; and (d) inbreeding and the degree of relatedness is reduced through the periodic introduction of wild caught individuals into the captive population.

United States of America

One lagomorph of international conservation concern occurs in the United States.

Pygmy Rabbit *Brachylagus idahoensis*

The pygmy rabbit is found through much of the sagebrush habitat of the Great Basin and surrounding areas, where its status varies locally from being highly threatened to common.

The following priority activities have been identified to ensure the survival of this species:

1. **Habitat Conservation and Management.** The main threat to the pygmy rabbit is habitat loss. The removal of big sagebrush to increase forage production or create cropland has greatly reduced and fragmented the available habitat. Pygmy rabbits require dense sagebrush, for both food and cover, and soft soils for burrowing. Where population levels have become small and fragmented, nature reserves should be established and, where possible, connected by corridors of sagebrush cover. Fire can destroy the habitat and a fire protection plan should be developed for each critical site. In general, cattle-grazing is incompatible with the conservation of pygmy rabbit habitat, except in areas that have become so open that grazing is likely to increase the sagebrush density. The conservation of this species will therefore require compromises with livestock interests; these might include protecting the densest deep soil sagebrush areas and a surrounding buffer zone (of several hectares), which should be sufficient to maintain viable populations. Management plans should aim to ensure that such protected sites are not too widely scattered, thereby permitting some genetic interchange between subpopulations.

2. **Habitat Restoration.** Where sagebrush habitat has been removed, efforts should be made to restore it. In some regions, such as Douglas County, Washington, this may occur through natural succession; in other regions planting may be needed. In either case, twenty or more years may be required for this program. Restoration should be carried out adjacent to sites occupied by the species to increase the size of the conservation area and to reduce the fragmentation of populations.

3. **Research.** Most past research has been directed at understanding the natural history and behavior of the pygmy rabbit. This has contributed important information for management, such as the importance of big sagebrush. The highest research priority now is to determine the dispersal capability of the pygmy rabbit and how different

levels of habitat fragmentation relate to the genetic isolation of subpopulations. This should enable managers to plan for the correct areas and configurations of habitat patches needed to support genetically and demographically viable populations.

4. **Status Surveys.** The status of the pygmy rabbit varies widely across its range. In southern Idaho, it is considered secure and locally common. By contrast, in Washington it occurs only at three known sites in one county and is considered threatened. Throughout the rest of its range its status probably lies between these extremes, but in general its distribution is reduced from historic levels. Survey efforts are needed, especially in areas where habitat has been fragmented, to determine the pygmy rabbit's status more accurately.

Conservation of Other Species of Concern

In addition to the globally threatened species listed above, there are another 21 species of conservation concern. These are discussed below on a country-by-country basis. In most cases, they are too poorly known to assess conservation needs without additional survey work, though it is believed that they are less seriously threatened than the species listed in the previous section.

Afghanistan

Turkestan Red Pika *Ochotona rutila*. This species occurs in low numbers in fragmented populations in the Soviet Union. Its status and conservation requirements in the mountains of Afghanistan are poorly known and need to be assessed.

Bhutan

Forrest's Pika *Ochotona forresti*. This is a very little known species occurring in forested regions at high altitude, as well as in Burma, China and India. Its conservation status needs to be assessed; it is possibly a subspecies of Royle's pika *O. roylei*.

Burma

Forrest's Pika *Ochotona forresti*. This is a very little known species occurring in forested regions at high altitude in the north of the country, as well as in Bhutan, China and India. Its status needs to be assessed.

China

Alpine Pika *Ochotona alpina*. Although this species as a whole is not of conservation concern, three of its subspecies are. *O. a. argentata* is known only from the Helan Shan area near the borders of the Ningxia, Hexizoulang and Gansu Provinces, where it might be at risk from vertebrate control programs and habitat clearance, in addition to having a tiny, isolated and possibly inviable population (there have been no records for over 50 years). No information is available on *O. a. nitida* (see account under Soviet Union) and there is an undescribed subspecies (see account under Mongolia).

Gansu Pika *Ochotona cansus*. Although this species as a whole is not of conservation concern, two of its subspecies are. *O. c. sorella* is restricted to the Yunzhong Shan in Shaanxi Province, where it is probably threatened by habitat loss and vertebrate extermination programs, in addition to having a tiny, isolated and possibly inviable population (there have been no records for over 50 years). *O. c. morosa* is restricted to the Tsing Ling Shan in Shaanxi Province, where the population is probably small, isolated and vulnerable, though there is no recent information on its status.

Forrest's Pika *Ochotona forresti*. This is a very little known species occurring in forested regions at high altitude in northwest Yunnan and Southeast Xizang Provinces, as well as in neighbouring Bhutan, Burma and India. Its status needs to be assessed.

Glover's Pika *Ochotona gloveri*. This species occurs in talus habitat at high altitudes in southwest Qinghai, northeast Xizang, northwest Yunnan and western Sichuan Provinces. Nothing is known of its conservation requirements, and research could show that it is closely related to the red-eared pika *O. erythrotis*.

Himalayan Pika *Ochotona himalayana*. This pika is known only from the Mount Jolmolungma (Mount Everest) area in southern Xizang. It is possibly a subspecies of Royle's pika *O. roylei*. Its conservation requirements are unknown.

Ladak Pika *Ochotona ladacensis*. This species is restricted to barren areas at very high elevations in Qinghai, Xizang and Xinjiang Provinces, as well as in neighbouring India. It is not known whether it faces any conservation problems.

Pallas's Pika *Ochotona pallasi*. Although this species as a whole is not of conservation concern, three of its subspecies are. *O. p. hamica* occurs on isolated mountains in the Gobi Desert in China (Xinjiang Province) and Mongolia, and is probably threatened by climate change, habitat degradation and population fragmentation. *O. p. pricei* is heavily controlled through vertebrate extermination near the Mongolian border (also occurs in Mongolia and the Soviet Union). *O. p. sunidica* is extremely isolated and is likely to be at risk from vertebrate extermination programs and habitat alteration.

Steppe Pika *Ochotona pusilla*. Though not definitely known to occur in China, it might do so on the southern slopes of the Tarbagatai Mountains, and this requires investigation. For further details of the species, see under Soviet Union.

Turkestan Red Pika ***Ochotona rutila.*** This species occurs in low numbers in the Soviet Union. Whether it occurs in the mountains of Xinjiang Province needs to be determined, along with its conservation requirements.

Moupin Pika ***Ochotona thibetana.*** Although this species as a whole is not of conservation concern, two of its subspecies are. *O. t. huangensis* is restricted to the Tsing Ling Shan in Shaanxi Province, where the population is probably small, isolated and vulnerable, though there is no recent information on its status. For details of *O. t. sikimaria*, see account under India.

Hainan Hare ***Lepus hainanus.*** This species is restricted to Hainan Island, where its populations have been reduced through overhunting and agricultural expansion. A survey of its status is needed, and public education programs might be necessary to supplement protection measures. The relationships of this hare to other Asian species need to be assessed.

Manchurian Hare ***Lepus mandshuricus.*** Though widely distributed in China (Manchuria) and adjacent parts of the Soviet Union, the forest habitat of this hare is being cleared rapidly. It is important to assess the effectiveness of existing reserves for safeguarding this species.

Manchurian Black Hare ***Lepus melainus.*** This hare is restricted to a smaller area within the range of the previous species and the taxonomic relationships between the two need to be clarified. Its conservation requirements are unknown.

Costa Rica

Dice's Cottontail ***Sylvilagus dicei.*** This species is restricted to high elevations in Costa Rica and Panama. Nothing is known of its status or conservation requirements and these should be assessed.

Ethiopia

Ethiopian Hare ***Lepus fagani.*** This species occurs at high altitudes in northern and western Ethiopia, and also in Kenya; it is probably not threatened, but in view of its relatively restricted range, its status should be periodically monitored. Its relationship to other African hare species should be studied, since it might not be a valid species.

Ethiopian Highland Hare ***Lepus starcki.*** This species is restricted to high altitudes in the central Ethiopian highlands, where it is probably not threatened. However, it needs to be monitored in view of its small range. Its relationship to other African hare species also needs to be studied.

India

Forrest's Pika ***Ochotona forresti.*** This is a very little known species occurring in forested regions at high altitude in Assam and Sikkim, as well as in neighbouring Bhutan, Burma and China. Its status needs to be assessed.

Ladak Pika ***Ochotona ladacensis.*** This species is restricted to barren areas at very high elevations in Kashmir, as well as in neighbouring China. It is not known whether it faces any conservation problems.

Moupin Pika ***Ochotona thibetana.*** Although this species as a whole is not of conservation concern, two of its subspecies are. *O. t. sikimaria* is known only from Sikkim where its rhododendron thicket habitat has been severely damaged, perhaps bringing this race to the verge of extinction. For details of *O. t. huangensis* see account under China.

Indonesia

Indian hare ***Lepus nigricollis.*** In Java hares are restricted to the extreme west of the island and are declining. Because they were thought to have been introduced from India, they have been of no conservation concern. The recent suggestion from fossil evidence that they may be endemic changes this view. Taxonomic and historical research is urgently needed to clarify their status before they become extinct.

Kenya

Ethiopian Hare ***Lepus fagani.*** This species occurs at high altitudes mainly in northern and western Ethiopia and also in northern Kenya; it is probably not threatened, but in view of its relatively restricted range, its status should be periodically monitored. Its relationship to other African hare species should be studied, since it might not be a valid species.

Mexico

White-sided Jackrabbit ***Lepus callotis.*** This species is largely confined to Mexico, where it has a wide distribution, but it could be at risk due to changes in its open grassland habitat. Small, declining populations survive in New Mexico, United States. Overgrazing by livestock tends to result in an increase in shrubs, thus favoring the black-tailed jackrabbit *L. californicus* instead.

Mongolia

Alpine Pika ***Ochotona alpina.*** Although this species as a whole is not of conservation concern, three of its subspecies are. For details of *O. a. argentata* and *O. a. nitida* see accounts

under China and the Soviet Union). There is an undescribed subspecies which is known only from the Bajan Ulan Mountains, where its status is unknown and needs to be assessed.

Pallas's Pika ***Ochotona pallasi.*** Although this species as a whole is not of conservation concern, three of its subspecies are. *O. p. hamica* occurs on isolated mountains in the Gobi Desert in Mongolia and China (Xinjiang Province) and is probably threatened by climate change, habitat degradation and population fragmentation. *O. p. pricei* occurs in the Choyr Mountains, where populations are now very depressed and threatened (though numbers may be higher in China and the Soviet Union). For *O. p. sunidica* see account under China.

Pakistan

Ladak Pika ***Ochotona ladacensis.*** This species is restricted to barren areas at very high elevations in neighbouring China and India. It is not known whether it occurs as far west as Pakistan, nor whether it faces any conservation problems.

Panama

Dice's Cottontail ***Sylvilagus dicei.*** This species is restricted to high elevations in western Panama and Costa Rica. Nothing is known of its status or conservation requirements and these should be assessed.

Soviet Union

Alpine Pika ***Ochotona alpina.*** Although this species as a whole is not of conservation concern, three of its subspecies are: *O. a. argentata* (see account under China); *O. a. nitida*, which has an isolated and restricted distribution which may place it at risk, and so its status should be evaluated; and an undescribed subspecies (see account under Mongolia).

Steppe Pika ***Ochotona pusilla.*** This species is not globally threatened, but its range has declined considerably in historical times, possibly as a result of the modification of its preferred steppe-shrub habitat. However, research is needed to investigate the reasons for its decline more thoroughly and to assess the actions required to secure its populations in the future.

Pallas's Pika ***Ochotona pallasi.*** Although this species as a whole is not of conservation concern, three of its subspecies are. For details on *O. p. hamica* see accounts under China and Mongolia. *O. p. pricei* was formerly heavily controlled in southwestern Tuva ASSR (also occurs in China and Mongolia). For *O. p. sunidica*, see account under China.

Turkestan Red Pika ***Ochotona rutila.*** This species occurs in low numbers in fragmented populations in parts of the Uzbek, Tadzhik, Kirgiz and Kazakh SSRs, and perhaps in neighbouring Afghanistan and China. Its conservation requirements are poorly known and need to be assessed.

Manchurian Hare ***Lepus mandshuricus.*** Though widely distributed in China (Manchuria) and adjacent parts of the Soviet Union, the forest habitat of this hare is being cleared rapidly. It is important to assess the effectiveness of existing reserves for safeguarding this species.

Manchurian Black Hare ***Lepus melainus.*** This hare is restricted to a smaller area within the range of the previous species and the taxonomic relationships between the two need to be clarified. Its conservation requirements are unknown.

Spain

Broom Hare ***Lepus castroviejoi.*** This poorly differentiated species is restricted to the Cantabrian Mountains in northern Spain. It is probably not threatened at present, though hunting in the west of its range should be restricted. Its relationships with the European hare require closer investigation.

United States

American Pika ***Ochotona princeps.*** Although this species as a whole is not of conservation concern, four of its subspecies are: *O. p. goldmani*, *O. p. nevadensis*, *O. p. obscura* and *O. p. tutelata*. These have isolated populations which may be at risk. The population from the type-locality for *O. p. tutelata* has disappeared and recent studies have shown that *O. p. nevadensis* may have lost most, or all, of its genetic variability.

White-sided Jackrabbit ***Lepus callotis.*** This species is largely confined to Mexico, where it has a wide distribution but could be at risk due to changes in its open grassland habitat. Small, declining populations survive in New Mexico. Overgrazing by livestock tends to result in an increase in shrubs, thus favoring the black-tailed jackrabbit *L. californicus* instead.

Alaskan Hare ***Lepus othus.*** This species appears to have declined in numbers and work is needed to assess its status and conservation requirements. It is probably conspecific with the Arctic hare *L. arcticus*, and this needs to be clarified.

New England Cottontail ***Sylvilagus transitionalis.*** This species occurs in the higher parts of the Appalachian chain and its status varies considerably locally. The genetics and taxonomic status of this species need clarification, as well as its supposed competitive relationship with the eastern cottontail *S. floridanus*. Detailed investigations into the habitat requirements of the New England cottontail are needed in order to develop management programs.

Marsh Rabbit ***Sylvilagus palustris.*** This species is common throughout most of its range. However, the Lower Keys marsh rabbit, *S. p. hefneri* is an endangered subspecies. The taxonomic status of this insular form as well as its biology, ecology and habitat requirements need thorough study.

Priorities for Conservation-Related Research on Lagomorphs

In addition to all the activities listed above, some general research approaches are needed to underpin conservation efforts on behalf of the lagomorphs. These are as follows:

Taxonomy

The systematics of the two genera, *Ochotona* (the pikas) and *Lepus* (the hares and jackrabbits) is highly confused, making it difficult to assess conservation priorities between species. This is also true, to a lesser extent, with *Sylvilagus* (the cottontails). A cladistic analysis, using mitochondrial DNA, should be performed as a means of resolving these problems. This analysis would entail the collection of tissues from all species and subspecies; analyses could be performed at the Smithsonian Institution or a number of other laboratories in the United States, or elsewhere.

Survey

Field surveys should be carried out to assess the status and conservation requirements of all the globally threatened lagomorph species and all other species of conservation concern listed above. The aim of these surveys should be to ensure that all conservation actions are based on the best possible data, including biological, ecological, sociological, economic and political aspects.

Biology of Small Populations

To assess the nature of insularisation of pika populations, a joint research program should be initiated between United States, Soviet, Chinese and/or Mongolian biologists. This research program would address the effect of "island" size and degree of isolation in terms of population viability analysis (including a genetic analysis of each population). These data will form a benchmark against which extinction probabilities of isolated populations of pikas can be assessed. The data should also be robust and useful for the assessment of other similarly isolated taxa. This work should start with the pikas but should be expanded to include other lagomorph species and populations as appropriate.

Assessment of Pika Control Programs

There is an urgent need to carry out a full environmental impact assessment of the mammal control programs being carried out in central Asia. This assessment should consider the costs and benefits of these programs from the following aspects: risks to threatened species (including pikas); risks to economically valuable species; effects on rangeland management; effects on human health; and impact on the livestock industry and on agriculture. The assessment should produce guidelines for the best management options for the areas in which the control programs are taking place, from both the human welfare and biological conservation viewpoints.

Setting Offtake Quotas for Commercially Valuable Lagomorphs

Certain lagomorph populations appear to be harvested at rates too high to be sustained. In these cases it is necessary to establish long-term monitoring programs and set annual quotas based on the best possible scientific data. This program is a particularly high priority for European hare populations in most European countries.

Reconciling Agricultural Practices with Lagomorph Management

Research is needed to determine how agricultural improvements can be made in ways that do not jeopardize lagomorph populations, including game species. Again, this is a high priority for the brown hare in Europe.