Rodents

A World Survey of Species of Conservation Concern

Edited by
William Z. Lidicker, Jr.
IUCN/SSC Rodent Specialist Group

Occasional Papers of the IUCN Species Survival Commission (SSC)
No. 4

IUCN–The World Conservation Union

IUCN Species Survival Commission

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The Species Survival Commission (SSC) is IUCN's primary source of the scientific and technical information required for the maintenance of biological diversity through the conservation of endangered and vulnerable species of fauna and flora, whilst recommending and promoting measures for their conservation, and for the management of other species of conservation concern. Its objective is to mobilize action to prevent the extinction of species, subspecies and discrete populations of fauna and flora, thereby not only maintaining biological diversity but improving the status of endangered and vulnerable species.

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   - promotion of the maintenance of biological diversity by monitoring the status of species and populations of conservation concern.
   - development and review of conservation action plans and priorities for species and their populations.
   - promotion of implementation of species-oriented conservation action plans and response to related issues.
   - provision of guidelines, advice and policy recommendations to governments, other agencies and organizations with respect to conservation and management of species and their populations.
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Based on the proceedings of a workshop of the
IUCN/SSC Rodent Specialist Group
held at the Fourth International Theriological Congress

August 17, 1985
Edmonton, Alberta
Canada

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Acknowledgements

We are indebted to Professor William A. Fuller of the University of Alberta, Edmonton for accommodating our request to hold a workshop at the Fourth International Theriological Congress. He and his Congress Organizing Committee gave us the logistic support that we needed to make it all run smoothly.

Gren Lucas and Simon N. Stuart, Chairman and Species Programme Officer respectively of the Species Survival Commission, encouraged us in the preparation of this report, and are responsible for its successful publication and distribution. Special thanks are due to WWF—The World Wide Fund for Nature for their sustained support of the IUCN Species Survival Commission, and to the American Association of Zoological Parks and Aquariums for their assistance with preparing this publication. As former Chairman of the RSG, I would like to add my personal thanks to all members of the Group for their considerable efforts and cooperative spirit. Collectively, we kept each other motivated and dedicated to the formidable task before us.

William Z. Lidicker, Jr.

Introduction

This report has its origins in a workshop of the Rodent Specialist Group of the IUCN Species Survival Commission held on 17 August, 1985 at the Fourth International Theriological Congress (ITC) in Edmonton, Alberta. The workshop represented the culmination of more than five years of effort by the Rodent Group, and along with the publication of this report, also marked the beginning of a new phase of Group operations. It seemed fitting that our first workshop on rodents of conservation concern should be held in Canada, a country with a rodent for its national symbol.

The Rodent Specialist Group (RSG) was initiated in March 1980 by Professor Ken Myers, who was the chairman of the Lagomorph Specialist Group. He invited six of us (Hall, Johnson, Layne, Schlitter, Taylor, and myself) to meet with him in June 1980 at the annual meeting of the American Society of Mammalogists held that year at the University of Rhode Island. At this time, an organizational plan was made, recommendations for additional members were assembled, and James N. Layne and I agreed to serve as co-chairmen of the new group. The membership of the Group was promptly expanded to its current 19 members (Appendix 2). Thirteen geographical regions of the world were established (see Fig. 1), and a Regional Coordinator appointed for each region. Group meetings were then held each year through 1984 in conjunction with annual meetings of the American Society of Mammalogists. Most of our business, however, was necessarily conducted by mail. Several meetings were held in 1985 at ITC IV, and in these we were joined by Gren Lucas, Chairman of the Species Survival Commission. At the end of 1983, James Layne resigned as co-chairman, but fortunately continues as a member of the Group.

The activities of the Group for March 1980 through June 1983 have been summarized in a written report, so there is no need to repeat that history here. Of most relevance to this workshop report, a survey of the rodent species of the world was initiated as soon as the Regional Coordinators were appointed. This in itself is a job of extraordinary proportions, as the world rodent fauna consists of an estimated 1750 species in 418 genera. Moreover, the rodent fauna is incompletely known in many large areas of the world, and a great many species are known from little more than their original taxonomic descriptions. For many Regions, therefore, this survey phase of our operations must continue into the indefinite future. Assisting us in this effort was a large cadre of regional and taxonomic experts, some of whom are listed in Appendix 3.

We had, at the workshop, oral reports from 12 of the 13 Regions. Not all Regional Coordinators were able to attend, but those not in attendance sent written reports which were read by others. Only the South American Region was not represented, but even this report arrived shortly thereafter. The session was well attended, and discussions were enthusiastic. In addition, an attractive poster was prepared by J.S. Millar and J. N. Layne describing the RSG and its activities. The oral presentations, as well as the subsequent written reports included herein, clearly reflect the uneven level of knowledge of rodents in different parts of the world, and also the uneven complexity of the rodent faunas in various regions. In preparing the reports, each Regional Coordinator was asked to: 1) discuss the general state of knowledge regarding rodents in their region and any unique problems characterizing the area; 2) list all rodents of conservation concern, identifying them by IUCN Red Data Book categories (see Appendix 1); 3) identify priorities for action; and 4) where possible propose action plans, preferably with multiple options. As will be seen, it is possible in some regions to prioritize conservation problems and even to make a start at developing action plans. In other regions, much more exploratory research is needed before even a reliable species list can be compiled. It is our intent that this workshop report will stand as a statement of the current level of our knowledge of the conservation status of rodents around the world. As such, it should also serve as a starting point for future efforts of this Group and be a useful reference for others concerned with conservation issues.

Is rodent conservation a viable issue? This is a question that often emerges from discussions within our Group, and with other sympathetic colleagues. Merely considering the numbers of species involved, rodent conservation should be a major component of conservation efforts. Yet generally speaking, rodents do not have the appeal of various larger and more charismatic species of mammals. In fact, rodents are commonly disliked and considered pests. They often are implicated in damage to agricultural crops, or accused of transmitting zoonoses. While such problems definitely exist, they involve only a handful of species of rodents. It is abundantly clear that considerable educational effort will be needed to restore rodents as a group to a status where they will generate enthusiastic support for their conservation. Another reason for lack of enthusiasm for rodent conservation is the perception that because rodents are generally small, it is assumed that they occur at higher densities than do larger vertebrates. Concomitantly, most rodents are herbivores, and so being low on the trophic ladder, they require less area per individual. Thus, they can often persist in smaller habitat fragments and in general seem less vulnerable to local extinctions. While this scenario is true for many species, it is not for many others, as the following reports document.

Future directions for the Rodent Group seem clear, at least in broad outline. For most of the world, we must intensify our fact-finding efforts. We need to know what species occur where and as much as possible about their life histories and population dynamics. Second, we need to launch a massive educational

campaign directed not only at explaining the importance and diversity of rodents in biotic communities everywhere, but also at improving their image as necessary and desirable co-inhabitants of this planet. The public and politicians can easily relate to pandas, tigers, and gorillas, but greater sticknestrats (Chapter 13), pygmy scaly-tailed squirrels (Chapter 7), and large-eared hutias (Chapter 4) represent more esoteric causes. Third, we need to pursue cooperative efforts with other specialist groups. The key to any species conservation is habitat preservation. In the case of non-charismatic rodents, this is emphatically the best strategy. In cooperation with other groups, we need to identify areas with multiple conservation concerns, including those of rodent species, and work to develop and implement action plans for the conservation of entire biotic communities. While this report is a statement of considerable accomplishment, it is even more a call for further action. At the IUCN General Assembly held in San Jose, Costa Rica, in February 1988, I stepped down as Chairman of the RSG, and Mary Taylor has recently been appointed as my replacement. I take this opportunity to wish her every success as she leads us in the task ahead.

William Z. Lidicker, Jr.

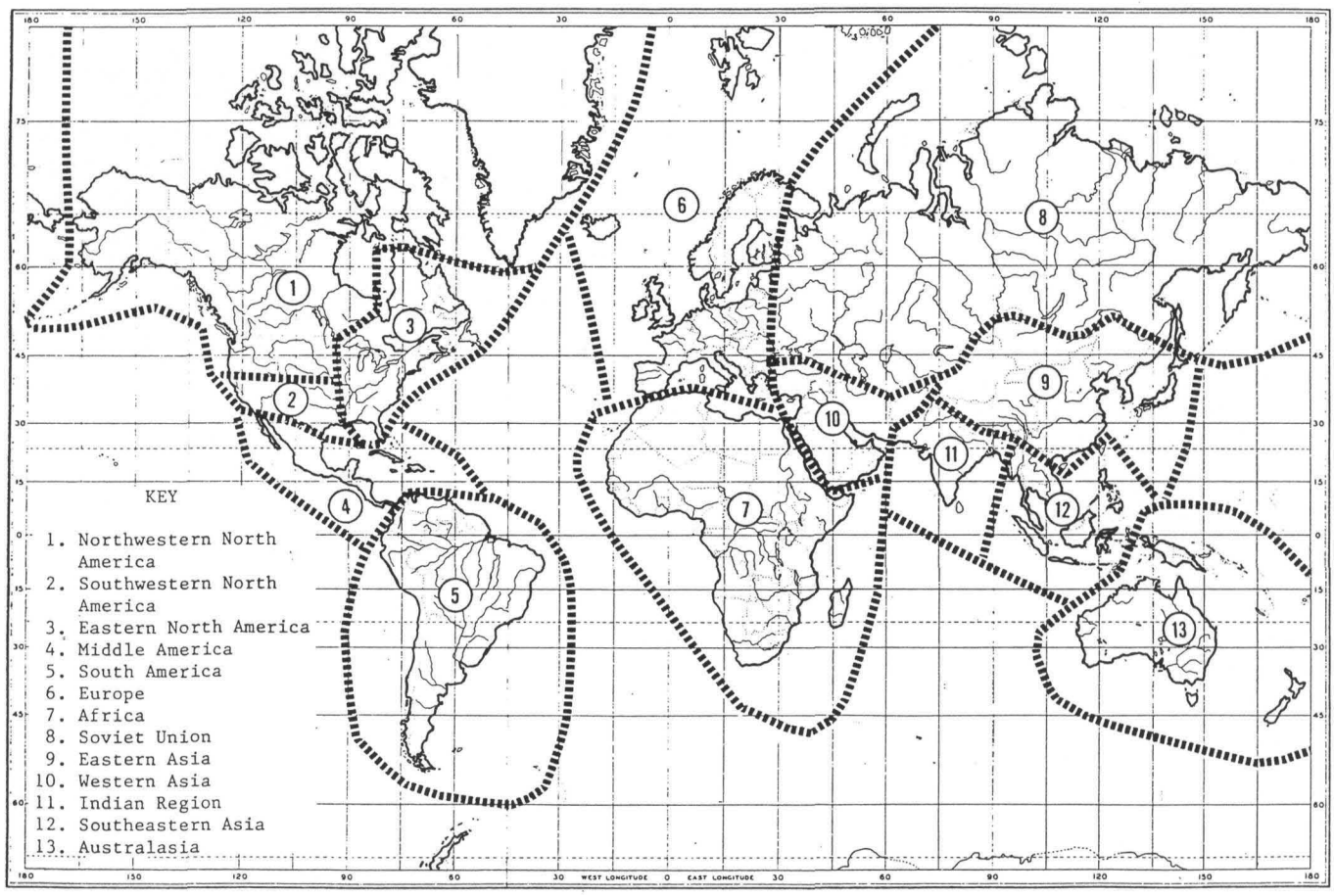

Figure 1. Rodent Specialist Group Regions.

Threatened Rodents in the Northwestern North American Region

Murray L. Johnson

Marmota vancouverensis. **(Canadian postage stamp.)**

The Northwestern North American Region is primarily populated by northern rodents. Many of the genera and some species are Holarctic in distribution. Several families are Nearctic in origin, including the pocket gophers (Geomyidae) and the *Aplodontia* (Aplodontidae) (Kurten and Anderson, 1980; Simpson, 1945). There are also a few southern intruders, several of which extend into southern Canada.

The distribution of rodents past and present has been shaped by environmental perturbations of great magnitude. Glacial events produced effects over large areas lasting for hundreds to thousands of years, depending upon the altitude and latitude. The resulting extant rodents may be looked upon as able to cope and survive through dramatic changes in their environment. The survival of pocket gophers, *Thomomys* (at least temporarily), in a severely impacted zone of Mt. St. Helens (Anderson, 1982) indicated a remarkable ability to withstand the forces of volcanic eruption better than larger animals (man, deer, elk). Subsequent (1983) field work has revealed several species of small rodents within the "Red Zone" of Mt. St. Helens, by personnel of our staff. This suggests either persistence of populations under most severe conditions or rapid reinvasion from less radically affected areas several miles distant

However, as with many other areas of the world, the endangered and threatened fauna of the Northern temperate zone is more directly involved with habitat alteration caused by man. Especially with smaller forms and fossorial species of rodents, the effects are potentially devastating. Formerly, there were broad expanses of areas that over the centuries, or longer, provided corridors or broad areas for reinvasion and spread. Now we have patchworks of urban sprawl and corridors of man's activities which are *de facto* barriers of great magnitude.

In regions of highly developed monoculture, either forest or farm, we have another potentially serious problem. Major highways with separated lanes and wide right-of-ways can be another sequestering factor, though there is also the ecotone along each border that may provide avenues for spread through or across natural barriers. Dams, artificial lakes, and alteration of the habitat by changes in the water table, all can produce adverse or in some cases unexpected beneficial results.

In addition to updating the status of our single endangered species, in this chapter we briefly review the factors referred to above, and look at several of the genera or species in the region that may be threatened elsewhere, in order to give a perspective for future considerations.

Endangered Species

The single listed endangered rodent in our area is the Vancouver Island marmot, *Marmota vancouverensis*. It has never been abundant in historic times. Its habitat is the higher parts of the low mountains that characterize central and southern Vancouver Island. If we compare habitat requirements of other members of the caligata group, the alpine/sub-alpine meadows and expanses of talus slopes and rocky outcrops with variable hillside exposure are less common on Vancouver Island. Spots of "good" habitat are more sequestered. The lands are mainly private and the climate allows the production of marketable timber up and over most of the mountainous terrain. Some recreational activities, including building of ski resorts and hunting, have had apparent adverse effects in some areas.

Very active and vocal conservation efforts (especially from the Vancouver Island Marmot Preservation Society) have been effective in stimulating public interest and governmental action. This includes field research, establishment of a management plan, some acquisition of lands, and some captive breeding efforts. There are ongoing arguments concerning the degree and effect of efforts to date. This continued public debate is considered healthy, productive, and perhaps necessary, given the threats to the habitat from commercial and social pressures. The end result is that infinitely more is known now concerning the numbers and distribution of these marmots than at any time

since their discovery and original description in 1911. Officially, but without public consensus, the marmot population "has increased in both numbers and distribution since the early 1970s" (Munro *et al.*, 1985). In 1984, the total number observed was 231, including 68 young.

We can, therefore, be cautiously optimistic about the Vancouver Island marmot. Perhaps the public will discover better ways to manage in acceptably "wild and natural" ways this delightful and unique species. It is possible that limited and carefully balanced opening of more high valleys, with long term monitoring and minor habitat management, will provide basic information not heretofore available.

Species of Concern

These can be considered in two categories: 1) Those species or subspecies for which there is evidence of restricted range or numbers, or that have disappeared, and 2) those species that may be threatened in other portions of their geographic range. In the second category it may therefore be useful to evaluate the status in the Northwestern region. Is there any evidence of general decline? Is the species secure at this time?

1. Taxa with restricted range or that have disappeared.

   The range of *Thomomys talpoides douglasi* in the Vancouver, Washington area has become progressively destroyed by urbanization over the past thirty years (Johnson, 1983).

   Thomomys mazama has eight subspecies (*couchi, glacialis, louiei, melanops, pugetensis, tacomensis, tumuli,* and *yelmensis*). Of these, *couchi, glacialis, pugetensis,* and *yelmensis,* as identified by specific localities, appear to be surviving, in more or less restricted numbers (Johnson, 1983). No evidence of pocket gophers has been detected in the restricted range of *louiei* since collections in 1956. Searches have not been intensive, however. Its habitat is within an area of natural forest regeneration on private lands. Within the undisturbed confines of Olympic National Park, *melanops* has disappeared from approximately 25% of its known range, but is apparently secure in the remainder. The proposed causes of the extirpation are hypothetical only. Land use practices appear to have extirpated *tacomensis* (reasonable intermittent searches for surviving pockets have been conducted); *tumuli,* known from a small area relatively unchanged since the original description in 1942, can no longer be found. The status of several small populations of *T. mazama* in western Oregon is unknown to me.

   The Idaho ground squirrel (*Spermophilus brunneus*) may be seriously restricted in part of its limited range (Yensen, pers. comm.).

2. Species that may be threatened in other parts of their range.

   Microtus californicus. One subspecies, *scirpensis,* is listed in California; as yet, there is no evidence that the status of the northern subspecies extending into Oregon is a matter of concern.

   Glaucomys sabrinus coloratus and *G. s.fuscus.* These subspecies in Virginia and West Virginia respectively are listed. In the Northwestern Region there is no reason to believe this species is threatened.

   The Fish and Wildlife Service has published a review list of vertebrate wildlife in the Federal Register 50 CFR 17, Sept. 18, 1985. These are not formally listed and are only subject to review of particular populations (some in the Northwest Region). Within this list are several species which are relatively common and in apparent healthy status within the Northwestern Region. These include *Aplodontia rufa,*

Vancouver Island marmot, adult female. (Photo by W. Whitchcad, courtesy of Burke Museum, University of Washington, Seattle, Washington.)

Marmotaflaviventris, Tamiasciurus hudsonicus, Glaucomys sabrinus, Microdipodops megacephalus, Dipodomys ordi, Peromyscus maniculatus, Neotoma fuscipes, Clethrionomys gapperi, Microtus pennsylvanicus, Microtus montanus, Microtus californicus, Microtus longicaudus, Synaptomys borealis, Zapus hudsonicus, and *Zapus trinotatus*. This listing should alert us to evaluations in other Regions as the opportunity arises.

On the same list there are included several forms occurring in the Northwest Region, including *Microtus pennsylvanicus kincaidi, Microtus oeconomus anakensis, M. o. elymocetes*, and *Microtus townsendi pugeti*. The status of the first and last are satisfactory to my knowledge; I do not have information regarding the two Alaskan subspecies of *Microtus oeconomus.*

In summary, the health of Rodentia in the Northwest Region appears satisfactory in general. There are, however, numerous populations about which we have no information. To evaluate these populations properly, much more intense field work than has so far been carried out would be required.

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Rodents of Concern in Southwestern North America

Joseph G. Hall

The Southwestern North American sub-region, smaller than any of the others, is nevertheless remarkably diverse, topographically and biologically. It encompasses two of the world's largest metropolitan complexes, two major mountain chains, areas of intensive agricultural development, marine coastline, prairies, woodlands, deserts and canyonlands. Its rodent fauna has been relatively well studied.

Representing five families, nine species and twelve subspecies are known to be in sufficient danger to warrant concern regarding their status. For species not formally assigned a Red Data Book category, an estimate of the probable status is given in parentheses immediately following the scientific name: (E) Endangered, (V) Vulnerable, (R) Rare, or (I) Indeterminate.

***Aplodontia rufa,* Mountain beaver. (Photo by V.B. Scheffer, courtesy of the American Society of Mammalogists.)**

Family Aplodontidae

Aplodontia rufa nigra (I), the Pt. Arena mountain beaver, and *Aplodontia r. phaea* (I), the Pt. Reyes mountain beaver, are restricted to small areas of Mendocino and Marin counties, respectively, in California. Both subspecies live in overgrown thickets and seepage areas. Although only preliminary studies have been conducted, the status of both is probably precarious (D. F. Williams, pers. comm.).

Family Sciuridae

Ammospermophilus nelsoni (R), the San Joaquin antelope squirrel, and *Spermophilus mohavensis* (R), the Mohave ground squirrel, both occur in arid environments of several south-central counties of California. Listed as rare by the state, the former has been studied by D.F. Williams. Further information on them is lacking at present.

Cynomys parvidens, the Utah prairie dog, occurs only in six counties of southwestern Utah. It is classed as Vulnerable in the Red Data Book and is considered threatened but not endangered by the state of Utah (Pizzimenti and Nadler, 1972; Crocker-Bedford, 1975). According to R. Hasenyager (pers. comm.), the population recently peaked at about 4,000 animals in 1983 and then declined to just under 3,700 by early 1985. The total population, comprising 131 colonies, is divided into five separate subpopulations. Approximately 70% are on private lands, 20% are on public and partly-public lands, and 10% represent transplants to public lands. A Recovery Plan, underway for over a decade, is focused on transplanting cohorts of this species from private lands, which are subject to loss of habitat by development, to suitable public lands. A cooperative evaluation of the success of these transplants indicates that most of the mortality occurs among juveniles and adult females. Other projects within the Plan involve re-vegetation in certain colonies to eliminate some undesirable plant species and enhance desirable ones, and controlled grazing to keep vegetation low enough that prairie dogs can detect predators from a distance. Although problems remain, there is no immediate danger of losing the Utah prairie dog.

Family Heteromyidae

Three pocket mice are in danger, but available information is limited for all of them.

Perognathus alticola (V), the white-eared pocket mouse, once ranged widely in the forest of the Tehachapi and San Bernardino mountains of southern California. Now, a viable

Perognathus alticola inexpectatus, **White-eared pocket mouse. (Photo by J.M. Sulentich, courtesy of the American Society of Mammalogists.)**

population of the subspecies *inexpectatus* is found only in Tejon Canyon, Mt. Pinos, and subspecies *alticola* occurs only in Big Bear Valley. The species is presently a candidate for listing by the federal government.

Perognathus inornatus psammophilus (E), the Salinas pocket mouse, and *P. longimembris brevinasus* (E), the Los Angeles pocket mouse, both restricted to small areas in southern California, are in precarious circumstances according to D.F. Williams (pers. comm.). *P. i. psammophilus* is restricted to a few scattered sites from Arroyo Seco, thence up the Salinas Valley

Perognathus longimembris arizonensis, **Little pocket mouse. (Photo by J.G. Hall.)**

to the vicinity of San Miguel. The original distribution of *P. l. brevinasus* was grassy areas from San Fernando eastward to San Bernardino, but it has become restricted to much smaller sites near San Bernardino and Riverside.

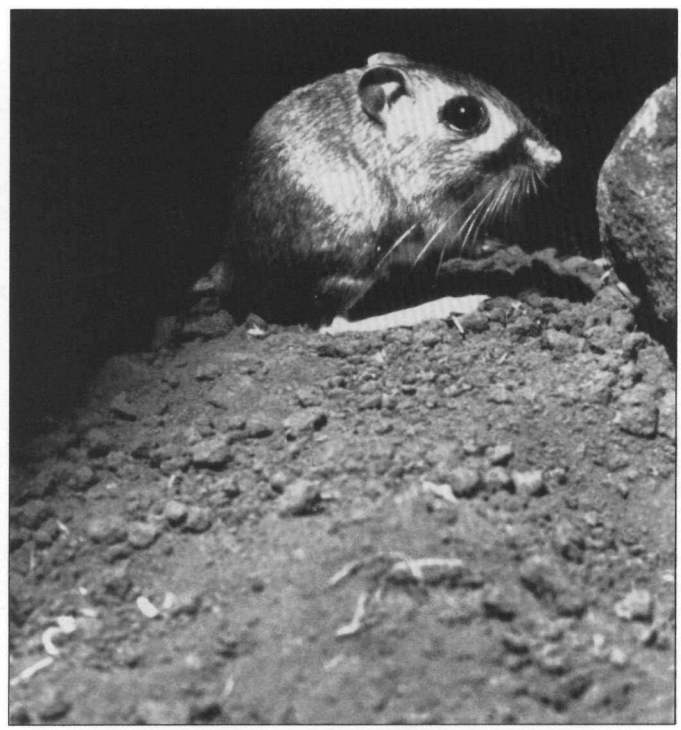
The kangaroo rats, genus *Dipodomys*, comprise the most threatened taxa of the region. At least seven forms are of conservation concern.

Perhaps the most critical example is the Morro Bay kangaroo rat, *Dipodomys heermanni morroensis*, listed as endangered by state and federal governments (California Department of Fish and Game, 1980) and now limited to less than 60 animals on a site of less than 20 hectares in San Luis Obispo County, California (Congdon, 1971; Congdon and Roest, 1975; Roest, 1977, pers. comm.). This kangaroo rat requires early seral stages of the soft chaparral community with low, sparse vegetation. The rapid decline of the population is thought to be due to habitat destruction by suburban housing development. A Recovery Plan has been underway since January 1985, and includes a program of captive breeding of both wild-caught and lab-reared animals. In June, 1985, the breeding colony consisted of 17 animals (Roest, pers. comm.), and the plan is to introduce kangaroo rats into an unpopulated reserve in another year or so. They will be gradually acclimated to living in the wild after the technique has been tried out on the most closely related form, *D. h. areni.* A potential problem of inbreeding exists since 14 of the 17 *D. h. morroensis* in the breeding stock are from a single site.

Dipodomys ingens, the giant kangaroo rat of west-central California, a species requiring annual grassland on sandy loam soil, is now restricted to an area of less than five square miles between the Carrizo Plain and Taft. It is listed by the state as endangered with federal status pending (D. C. Williams, pers. comm.), and is currently under intense study.

Stephens kangaroo rat, *Dipodomys stephensi* (I), occurs only in western Riverside County, California, and is listed as Rare by the state. More information is needed for assignment to a specific federal status.

The Fresno kangaroo rat, *Dipodomys nitratoides exilis*, and the Tipton kangaroo rat, *Dipodomys nitratoides nitratoides*, both occur in the southern half of the San Joaquin Valley in



Dipodomys heermanni, **Herrmann's Kangaroo rat. (Photo by R.H. Barrett, courtesy of the American Society of Mammalogists.)**

California. *D. n. exilis* is in upland areas, *D. n. nitratoides* is restricted to the valley floor of the Tulare Basin. Both are listed as endangered by the state and federal governments (California Department of Fish and Game, 1980).

The San Quintin kangaroo rat, *Dipodomys gravipes,* (E), is a monotypic species of serious concern (Best, 1978, 1983, pers. comm.; Best and Lackey, 1985). Occurring only in a 100 km coastal strip of low vegetation and little topographic relief in northern Baja California, Mexico, it was abundant "everywhere" in 1972, according to Best, but by 1980 its former habitat was plowed up except for an area 9 km north of El Rosario where he captured only 2 animals in 2,400 trap-nights. Best concludes that it has a strong affinity for flat land and does not tolerate cultivation of its habitat. More study is desperately needed.

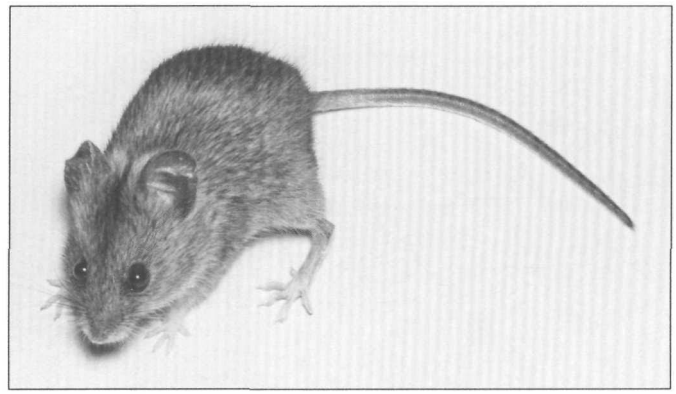
The Texas kangaroo rat, *Dipodomys elator,* found in north-central Texas and southwest Oklahoma, is listed as Rare in the Red Data Book and as "Protected" by the state of Texas. It is confined to mesquite brushlands on firm clay soils, almost entirely on private lands vulnerable to degradation, especially by brush-control chemicals (Martin and Matocha, 1972, Roberts and Packard, 1973, R. E. Martin, pers. comm.). Total numbers are not known and more study is urgently needed.

Family Cricetidae

The two subspecies of *Reithrodontomys raviventris* (E), the salt-marsh harvest mouse, are restricted to the marshes bordering San Francisco Bay, California (Fisler, 1965; Shellhammer, 1982). The southern race, *R. r. raviventris,* is more threatened than the northern one, *R. r. halicoetes,* although the entire species is considered endangered on both federal and state levels (Nat. Fish and Wildlife Lab., 1980; H. Shellhammer, pers. comm.). The major problem is that 80% of their original habitat has been destroyed. Pressure for housing developments and a new airport is threatening the remaining 20%. A Recovery Plan proposes to: a) acquire larger marsh units to combine with existing small, isolated ones; b) alter upper edges of most marshes to provide three species of plants as refugia for mice when they are stressed by flooding; and c) investigate long-term successional stages of the marsh vegetation. The northern subspecies, in least need of help, has received more, in terms of recent protection of habitat and mitigation of destructive activity. The proposed Recovery Plan (Shellhammer and Harvey, 1984) has been completed and will probably be approved.

D. C. Williams (pers. comm.) reports that the following Californian cricetids are in jeopardy: *Reithrodontomys megalotis limicola* (V), the southern marsh harvest mouse, occurring only in salt marshes from southern Ventura to Orange counties; *Sigmodon arizonae plenus* (E), the Colorado River cotton rat, known only from a single location on the Colorado River near Blythe; and *Neotoma fuscipes riparia* (V), the San Joaquin Valley woodrat, confined to riparian communities in the lower segments of the San Joaquin and Stanislaus rivers.

The Amargosa vole, *Microtus californicus scirpensis* (E), occurs in the northern end of Amargosa River Canyon and in the bullrush marshes near Tecopa in the southeastern corner of Inyo County, California. The major threat is reclamation of the marsh habitat for construction purposes, and the vole is listed as endangered by federal and state governments.



***Reithrodontomys raviventris,* Salt marsh harvest mouse. (Photo by T. Tutt and H. Shellhammer.)**

Family Zapodidae

The status of *Zapus trinotatus orarius* (I), the Pt. Reyes jumping mouse of Marin County, California, is precarious, according to D.F. Williams (pers. comm.). Almost nothing is known other than its preference for wet areas and that it occurs in confined, disjunct sites near Point Reyes.

Conclusions

This report gives the impression that California has a lion's share of problems with threatened rodent populations (Williams, in press). In part, this is an artifact of better communication with authorities in that state, but it may also demonstrate regional differences in attitude and concern about threatened species from state to state in southwestern North America. I am confident that the relative severity of the biological circumstances in the four-corner states of Utah, Colorado, Arizona, and New Mexico, for example, is greater than we now recognize, and efforts to compensate for sources of bias must be made in the future.

The common denominator that pervades all the situations discussed in this report—habitat destruction by burgeoning human populations—is the same one we are so keenly aware of in the reports from other regions of the world.

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Rodent Species of Concern in the Eastern North American Region

Garrett C. Clough

The Eastern North American Region covers the geographic area from about 62° N on the mainland of eastern Canada to about 25° N at the southern tip of Florida in the United States. The region extends from the Arctic Circle nearly to the Tropic of Cancer. This latitudinal spread includes biogeographic biomes from arctic tundra, taiga, northern coniferous forest, deciduous forest, southern evergreen forest, and subtropical scrub to tropical mangrove. Altitude within the region varies from sea level to mountains of 1,600 to 1,950 m. Habitats for rodents over this range of altitudes include coastal salt marshes, sand dunes, extensive freshwater marshes and bogs through mountain conifer and deciduous forests to alpine tundra. The region also includes a great number of continental islands along the entire coast of the Atlantic Ocean and the Gulf of Mexico. These islands vary in size from Newfoundland to small islets, and in nature from rocky northern subarctic islands to subtropical sandy barrier beach islands.

Almost all of the Eastern North American Region south of the national border between Canada and the United States is heavily populated and heavily developed and modified by humans. North of this national border, except for a narrow band of inhabited land along the coast and along the shores of the St. Lawrence River, the human population is quite sparse and the land is relatively undisturbed. All of the rodent taxa of concern in the Region are found south of the Canada-United States border.

The paramount problems facing rodents in this region are clearly related to human populations and human activities. The problems for rodents, as well as other mammals and plants in the region, are the shrinkage and deterioration of natural habitats. This loss occurs by outright elimination of habitats, through construction projects for housing, transportation, harbor development, and agricultural activities. Disturbance and alteration of habitats occurs by activities such as drainage of wetlands, excessive logging of forests, removal of topsoil, flooding by dam construction or river diversion, by increased sport and recreational use by humans, by use of pesticides in forestry and agriculture, and by pollution from many sources. As a result of all of these human impacts, rodent species are threatened by reduction in ranges, loss of specific resource requirements supplied by their natural habitat, genetic isolation from other populations, and by drastically reduced numbers in some cases.

A few categories of rodents stand out in particular in this Region as being under threat. One such group comprises the taxa which occupy island and coastal regions. Four taxa of the lower Florida Keys are on the list of threatened species, as well as more taxa which occupy southern coastal marshes and barrier islands along the southern Atlantic coast and in the Gulf of Mexico coastal area. Another group of rodents of concern are disjunct populations which inhabit isolated high altitude areas of the southern Appalachian Mountains.

The mammals of the Eastern North American Region are particularly well known to mammalogists. The Region has been under intensive study from the very start of scientific mammalogy in the first half of the nineteenth century. One result of this solid background of information is that subspecies of rodents in the Region are very well documented. The Region possesses a large number of outstanding collections of mammals, many of which were started over 100 years ago. These collections include the Royal Ontario Museum and the National Museum of Canada, and such large public and private museums in the United States as the U.S. National Museum of the Smithsonian Institution, the Field Museum of Natural History, American Museum of Natural History, Philadelphia Academy of Sciences, the Carnegie Museum, and such large university museums as those at the University of Michigan, Harvard Museum of Comparative Zoology, University of Florida, University of Illinois, and others. The Region, moreover, has a large number of active professional mammalogists.

Even though the distribution, taxonomy, and ecology of the rodents of this region have been studied so extensively in the past, much new information on rodents continues to be generated. Three factors are responsible for the changes in status and in our knowledge of rodents here. First, advances in taxonomic science have allowed for new determinations of subspecific status of some populations, and in one recent case, for the description of a new species. Second, there has been a continuous modification of habitats and environmental quality by human activity which modifies some rodent distributions and their numbers. Third, and associated with the second reason, are changes in the behavior, habitat use, and distribution of some of the associated species which interact with rodents.

Examples of some of these new findings include a population of the common and widespread *Microtus pennsylvanicus* which was discovered in 1982 as a disjunct population on the

Gulf coast of Florida. Chromosomal data and blood protein analysis by electrophoresis confirmed morphological data that this population was a new subspecies with a very limited distribution, and hence vulnerable to habitat loss. In 1978, a new species of rice rat, *Oryzomys argentatus,* was described from the lower Florida Keys based on specimens first collected in 1972-1973. An example of ecological changes which have caused a change in the status of rodents concerns the two subspecies of northern flying squirrel, *Glaucomys sabrinus,* which are endangered in the high mountains of the southern Appalachians. Their habitat has been restricted by logging operations and recreational development, as well as by encroachment of adjacent populations of the southern flying squirrel, *Glaucomys volans,* which is both a competitor and a carrier of a harmful parasite.

Continual study and monitoring of the rodents of this Region will be required to ensure their conservation and welfare for the future.

The following is a list of rodent taxa of conservation concern for the Eastern North American Region. It consists of 5 species and 26 subspecies, arranged according to their status.

Endangered

Endangered status of U.S. Fish and Wildlife Service.

Sciurus niger cinereus, Delmarva Peninsula fox squirrel
Neotoma floridana smalli, Key Largo wood rat
Peromyscus gossypinus allapaticola, Key Largo cotton mouse
Oryzomys argentatus, Silver rice rat
Peromyscus polionotus ammobates, Alabama beach mouse
Peromyscus polionotus trissyllepis, Perdido Key beach mouse
Peromyscus polionotus allophrys, Choctawhatchee beach mouse
Glaucomys sabrinus coloratus, North Carolina Northern flying squirrel
Glaucomys sabrinus fuscus, West Virginia Northern flying squirrel

Vulnerable

Presently under review by the U.S. Fish and Wildlife Service, Office of Endangered Species.

Sigmodon hispidus littoralis, Micco cotton rat
Sciurus niger shermani, Sherman's fox squirrel
Oryzomys palustris sanibelli, Sanibel Island rice rat
Oryzomys palustris planirostris, Pine Island rice rat
Peromyscus polionotus niveiventrus, Beach mouse
Peromyscus gossypinus anastase, Cotton mouse
Geomys pinetis goffi, Goff's pocket gopher

Rare

Range limited to one small island for each case; both were formerly on the U.S. Endangered list but have been removed; populations on the islands are adequate at present.

Microtus breweri, Muskeget Island meadow vole (beach vole)
Microtus pennsylvanicus provectus, Block Island meadow vole

***Sciurus niger avicennia,* Fox squirrel. (Photo by R. Palmer, Everglades City, Florida, courtesy of J.N. Layne.)**

Indeterminate

Peromyscus floridanus, Florida mouse
Peromyscus polionotus decoloratus, Pallid beach mouse (may be extinct)
Peromyscus polionotus leucocephalus, Santa Rosa Island beach mouse
Peromyscus polionotus peninsularis, Beach mouse
Peromyscus polionotus phasma, Beach mouse
Peromyscus gossypinus restrictus, Chadwick Beach cotton mouse
Sigmodon hispidus exsputus, Lower Keys cotton rat
Sigmodon hispidus insulicola, Insular cotton rat
Neotoma floridana haematoreia, South Appalachian wood rat
Microtus pennsylvanicus dukecampbelli, Salt marsh meadow vole
Geomys pinetis fontanelus, Sherman's pocket gopher
Geomys colonus, Colonial pocket gopher
Geomys cumberlandius, Cumberland pocket gopher

Extinct

Microtus nesophilus, Gull Island vole

Action Plans

Actions for the conservation of rodents and other mammals are being pursued vigorously by a number of groups in the Eastern North American Region. The primary group in this work is the U.S. Fish and Wildlife Service, Office of Endangered Species. This agency has prime responsibility for investigating the status of species of concern, for making decisions on listing new subspecies and species, and for developing action plans for recovery projects if needed. Critical habitat protection for species of concern is an integral part of the U.S. Fish and Wildlife Endangered Species Program. This national agency works closely with state agencies and with private university

mammalogists and independent experts. For example, the Recovery Plan for the Delmarva Fox Squirrel, *Sciurus niger cinereus,* was prepared by the U.S. Fish and Wildlife Service, together with the Maryland Department of Natural Resources and mammalogists from the University of Maryland. This recovery action has included releases of individual fox squirrels into areas suitable for re-establishment of the population. In 1985, the Fish and Wildlife Service captured live specimens of the endangered Perdido Key Beach Mouse, *Peromyscus polionotus trissyllepsis,* from habitat threatened by development, maintained them in captivity for a few months, and them released them in a new area of suitable natural habitat.

The Nature Conservancy, a private conservation organization, has initiated its own program, titled the Heritage Program, to gather information on species of concern. To accomplish this, the Nature Conservancy has enlisted its own corp of professional workers and volunteers to supply distributional data, other biological information, and to assess the nature and immediacy of threats facing each species of concern.

In addition to these two groups which cover all of the United States part of the Eastern North American Region, there are many groups which cover smaller areas within the Region. Many state agencies concerned with fish and wildlife, natural resources, or environmental protection have created special non-game or endangered species programs which deal with the animals and plants of concern within their own political region. These agencies seem to be receiving an increasing amount of interest and support. The Rodent Specialist Group of the IUCN can do well to cooperate openly and support, where possible, the conservation activities of such regional and local groups already active in the work of rodent conservation. Public educational efforts will always be important. Resolutions of support from professional organizations at times of critical legislation or litigation on behalf of conservation may be appropriate at times. A strength of the Rodent Specialist Group which can be of help to existing regional groups is its international perspective and wide base of knowledge about actions and programs in other parts of the world.

Endemic Rodents of the West Indies: The End of a Splendid Isolation

Charles A. Woods

Introduction

The objective of this paper is to summarize the status of endangered, vulnerable, or rare rodents in the Middle American Region. This region includes Mexico, all of Central America south to the Colombian border, and the West Indies. The West Indies are defined as the Bahamas, the Greater Antilles, and the Lesser Antilles. The islands of Trinidad and Tobago and the Dutch Antilles (Aruba, Curacao, and Bonaire) are not part of the West Indies and are not included in this report on the Middle American Region.

This report covers only the West Indies,[1] however, since the information available is the most complete and the problems faced by the endemic rodents the most acute. The status of the rodents of Mexico and Central America is less well documented, and apparently rodents from these areas have been less severely impacted by events during the last 10,000 years than have the endemic rodents of the island arc stretching from Cuba to Grenada.

Historical Background

Published accounts on the "original" rodents of the Caribbean Basin region are few in number, and in most cases are incomplete. The most complete early accounts of the natural history of the region are by Gonzalo Fernandez de Oviedo. In his Historia General y Natural de las Indias, Islas y Tierra-Firme del Mar Oceano, published in Seville in 1535 (and in various subsequent editions), Oviedo listed the animals of which he was aware based on the accounts of early explorers or on his own personal observations. The information is most reliable for the island of Hispaniola, where Oviedo reported the presence of four rodents: 1) the "Hutia", almost certainly *Plagiodontia aedium;* 2) the "Muhoy", which matches the description of a spiny rat and is most likely *Brotomys voratus;* 3) the "Querny", which he described as a large rodent, and which I believe was *Plagiodontia velozi* and not the large Hispaniolan heptaxodontid Miller went on to describe as *Quemisia gravis;* and 4) the "Cori", which most closely matches the description of the guinea pig (Miller, 1929), but which I recently have come to believe might well have been *Isolobodon portoricensis.*

The status of the endemic rodents within the past 20,000 years can be reconstructed based on an analysis of the remains of rodents found in Indian kitchen middens, cave deposits, and in the bottom of sinkholes, all of which are abundant in the West Indies. Based on data from these sources, Morgan and Woods (1986) were able to determine that 46 rodent species occurred in the West Indies during the past 30,000 years. Of this group, 35 species, or 77 percent, have become extinct. In this paper I have chosen to recognize all of the extant and extinct rodent species proposed from Cuba, which increases the number of species in the genus *Capromys* from 8 (Morgan and Woods, 1986) to 21. The rodents of the West Indies then total 59 species, 46 of which have become extinct. The extinction rate remains approximately the same, however, with 78% of the rodent species having become extinct.

In Cuba, at least four rodent species are known from archaeological sites. They are the echimyids *Boromys offella* and *B. torrei,* and the capromyids *Geocapromys columbianus* and *G. pleistocenicus.* All four of these taxa are now extinct. The surviving rodents of Cuba are all in the genus *Capromys.* These are:

C. angelcabrerai, Cabrera's hutia
*C. prehensilis,** Prehensile-tailed hutia
*C. nanus,** Dwarf hutia
C. auritus, Hutia rat
C. sanfelipensis, Land hutia
C. garridoi, Garrido's hutia
C. gundlachi, Chapman's prehensile-tailed hutia
*C. pilorides,** Desmarest's hutia
*C. melanurus,** Bushy-tailed hutia
C. meridionalis, Isla de la Juventud tree hutia

In Morgan and Woods (1986), only four taxa were considered valid species (the taxa designated above with an asterisk). All other taxa were considered to be subspecies of the four

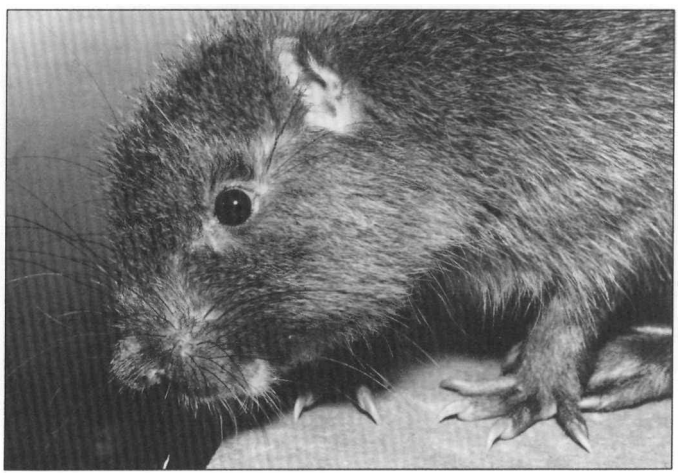
[1]A report on Mexican Rodents of conservation concern is now in press: Caballos, G. and Navarro, D. "Diversity and Conservation of Mexican Mammals." In *Latin American Mammalogy,* M.A. Mares and D. J. Schmidly, eds. University of Oklahoma Press: Norman.

primary taxa. *Capromys gundlachi* and *C. meridionalis* are new taxa at the species level (Varona, 1986), and are restricted to the Isla de la Juventud (formally known as the Isla de Pinos).

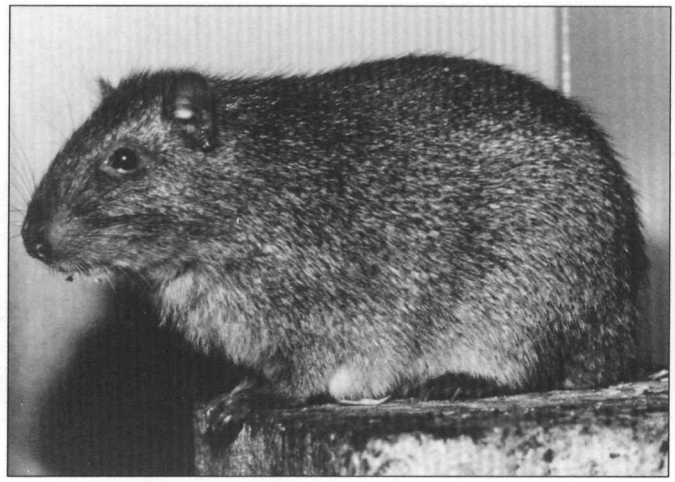
Of the 27 rodents known to have occurred on Cuba and its adjacent offshore islands during the past 10,000 years, 17 (63%) have become extinct (an average of one rodent extinction in the Cuban area every 370 years during the last 10,000 years). It is not possible to calculate the rate of rodent extinction after the arrival of Amerindians on Cuba based on the published data available.

Of the four known valid species of endemic Jamaican rodents, three have become extinct. Remains of the Jamaican hutia, *Geocapromys brownii,* are present in archaeological deposits from throughout the island, and the species continues to survive in several regions of the country (Oliver, 1982; Anderson et al., 1983). The small cricetid rodent, *Oryzomys antillarum,* was also present in archaeological deposits. It became extinct within the past 100 years, presumably from competition with *Rattus*. Until recently, the Jamaican heptaxodontids were considered to be represented by three distinct genera, but MacPhee (1984) has combined them into the single genus *Clidomys*. Remains of this taxon have been dated at 33,250 yBP, and are unknown from Holocene or recent deposits. These large rodents are one of the few groups to have become extinct on an island of the West Indies prior to the end of the Pleistocene, and for which the causes of the extinctions were not related to human activities.

Five species of endemic rodents are known to have occurred on Puerto Rico. Two of these have been found in archaeological sites, the large echimyid *Heteropsomys insulans*, and the capromyid *Isolobodon portoricensis*. The latter does not occur in pre-archaeological sites, however, and is presumed to have been transported to Puerto Rico from Hispaniola by Amerindians. The three remaining species are known only from pre-human fossil deposits. One taxon, *Proechimys corozalus,* an echimyid known only from a single dental fragment found in a rock crevice, is assumed to be much older than the remaining taxa, and probably became extinct before 20,000 yBP. Some



***Plagiodontia aedium,* Hispaniolan hutia or "zagouti," in captivity at the Animal Behavior Lab, Florida Museum of Natural History. (Photo by C.A. Woods.)**



***Geocapromys ingrahami,* Bahamian hutia, in captivity at the Animal Behavior Lab, Florida Museum of Natural History. (Photo by C.A. Woods.)**

reports indicate that *Isolobodon portoricensis,* introduced by Indians so many centuries ago, might still survive on Puerto Rico. An in-depth search in the winter of 1985 did not produce any evidence to confirm the continued presence of *Isolobodon* (Woods et al., 1986).

At least 13 rodent species from three families and six genera are known to have been present on Hispaniola. All of these taxa existed into the period when humans occupied the island during the past 4,500 years. Only one taxon continues to survive. This animal, *Plagiodontia aedium,* is called the "hutia" in the Dominican Republic and either the "zagouti" or "rat cayes" in Haiti. After the arrival of Amerindians on Hispaniola, 92% of the endemic rodents became extinct, an average loss of one endemic rodent every 375 years.

Only one native rodent, *Geocapromys ingrahami,* is known to have occurred on the Bahamas. The Bahamian hutia now survives only on tiny East Plana Cay in the southeast Bahamas, and on two islands in the Exuma Cays where it has been reintroduced (see below). The Bahamian hutia has been eliminated from most of its original range by a combination of habitat destruction, overhunting, and predation by dogs and cats. The remains of *Geocapromys ingrahami* are found on many of the islands of the Bahamas, and the species has been divided into three subspecies. The distribution of the subspecies reflects the past history of the archipelago. During times of low sea level, such as at the height of the Wisconsin glaciation 17,000 yBP, sea levels were as much as 120m below their present levels, and the Bahamas were composed of three main island masses. The largest of these was made up of all the region of the Great Bahama Bank. Remains of *G. ingrahami* have been recovered from Andros, New Providence, Eleuthera, Cat, Great Exuma, and Long islands, indicating that the Bahamian hutia was widely distributed on the single island formed by the Great Bahama Bank. The second largest island was formed by the islands of the Little Bahama Bank (Grand Bahama and Great Abaco islands and associated cays). Specimens collected on Great Abaco have been classified as *G.i. abaconis*. Another

large island of the Bahamian Archipelago that was prominent 17,000 yBP was formed by the Crooked-Acklins Bank. Specimens from Crooked Island have been named as a subspecies, *G. i. irrectus*. These specimens appear to be most closely related to hutias from the Great Bahamas Bank, and several authors have referred specimens collected on Eleuthera, Long, Great, and Little Exuma islands to this subspecies. The subspecies *G. i. ingrahami* is known only from East Plana Cay, which was never a part of any of the other main islands and is located east of the Crooked-Acklins Bank. Remains of the Bahamian hutia have also been reported from San Salvador Island north of the Crooked-Acklins Bank and east of the Great Bahama Bank.

On the Cayman Islands, both *Capromys* and *Geocapromys* are known to have occurred. Some deposits containing remains of these two hutias radiocarbon date as recently as 375 yBP, and some are associated with the remains of *Rattus* in surficial cave deposits on Grand Cayman and Cayman Brae. Both species became extinct sometime during the last 375 years.

On Little Swan Island, 175 km northeast of Honduras, one capromyid rodent is known to have occurred until the last few decades. *Geocapromys thoracatus*, a distinct species from *G. brownii*, became extinct following the effects of a damaging hurricane, and after cats were introduced on the island sometime after 1955 (Clough, 1976).

In the Lesser Antilles, no native non-volant mammals still occur, although at least seven endemic mammals once were present on these islands (Morgan and Woods, 1986). None of the species was of the Family Capromyidae, the dominant group of rodents in the Greater Antilles. The giant extinct heptaxodontid, *Amblyrhiza inundata*, which was almost the size of an American Black Bear, inhabited the tiny islands of Anguilla and St. Martin in the northernmost Lesser Antilles. Like the two species of *Clidomys* from Jamaica, it appears that *Amblyrhiza* became extinct before the end of the Pleistocene, and therefore its demise was not related to human activities. However, a recently extinct species of *Oryzomys* is known from St. Vincent. *Megalomys desmaresti* occurred on Martinique, and *M. luciae* was found on St. Lucia until early in this century. Museum specimens are known of all three forms. In addition, *M. audreyae* is known from a fossil deposit on Barbuda. A new, undescribed taxa of oryzomyine rodent is known from Barbados. A large undescribed genus and species of oryzomyine is known from Amerindian sites on Antigua, Guadeloupe, and Montserrat, and from prehistoric archaeological sites on Barbuda and Marie Galante. A smaller species of undescribed oryzomyine is known from archaeological sites on Montserrat, St. Kitts, Anguilla, and St. Eustatius. The distributions of all these taxa are discussed in more detail in Morgan and Woods (1986), but it is clear that at least seven species of rodents became extinct in the Lesser Antilles within the period of human occupation of the region.

Summarizing the data from the above discussion, it is clear that the impact of humans on the endemic rodents of the Antilles has been dramatic and negative. In most subregions of the Antilles, there has been a total loss of the endemic rodents, and in the few regions where endemic rodents do manage to coexist with humans and introduced forms such as rats, cats, dogs, and the mongoose, the percent of the remaining endemic species is very low. Only on the island of Cuba does a significant number of endemic rodents continue to exist, but even there over 50% of them are extinct. Most of the remaining endemic land mammals of Cuba are threatened. For the West Indies as a whole, 67 of the 76 species of endemic land mammals ever known to have occurred have become extinct. This figure of 88% is even higher than the 77% of endemic rodents known to have become extinct in the West Indies, and so as a group rodents have not been as badly hurt by the coming of humans to the region as have other groups, such as insectivores, primates, and ground sloths. In the West Indies, bats as a group have been the least damaged by the occupation of humans, with 14% of the 59 known species having disappeared during the same time period.

Summary of Regional Programs and Conditions

The West Indies are difficult to characterize as a region because they are so geographically and historically diverse. The geographical size of the individual islands ranges from 114,524 sq km for Cuba to 91 sq km for Anguilla. Population estimates range from a high of almost 10 million for Cuba and 6 million each for the Dominican Republic and Haiti (for a combined figure for Hispaniola of at least 12 million) downward to several hundred thousand for the main islands of the Lesser Antilles. The important figure is the density of population per sq km, however. These figures are some of the highest in the world. For Barbados it is 626, for Puerto Rico 439, for Martinique 296, Jamaica 205, Haiti 186, Dominican Republic 117, Cuba 85, and the Bahamas 16. These figures do not take into account the distribution of people or the amount of arable land. In Haiti, for example, much of the land is mountainous, and in the rain shadow of mountain ranges of the more easterly Dominican Republic. Much of the land is not suitable for agriculture because it is too dry, too steep, or too rocky. The population is very dispersed, and most people live on small peasant farms. I will make an attempt to summarize the major features of each of the island nations of the region, however, and to mention the major problems facing each country.

Cuba

There are active programs for natural resources and conservation in the country, such as the ones administered by the Instituto de Zoologiá of the Academia de Ciencias. There is also an established university system and several zoos. Efforts have been made to document the ecological and taxonomic status of the endemic mammals of the country. Articles are published each year on the status of various endemic animals in the journal *Poeyana* of the Instituto de Zoologiá, and many of these have covered endemic rodents. The Institute has also been active in promoting conservation, and has established the

Jaguani and Cupeyal Reserves in the eastern part of Oriente Province. The human population density is relatively low in some regions, such as Oriente Province, and there are still extensive areas where endemic mammals can survive. Legislation in Cuba protects all hutias, and all hunting is prohibited in many regions of Cuba where hutias are found. Resolution 21-79, passed in 1979, sets aside several important wildlife areas where hunting is restricted throughout the year (Varona, 1980). The regions protected by Resolution 21-79 include all of the Zapata Peninsula and Zapata Swamp, areas of Oriente Province, cays of the Sabana Archipelago, all cays in the Gulf of Ana Maria, and many cays in the Gulf of Batabano.

Jamaica

This country has most of the elements needed to form a strong conservation ethic. There is a well established zoo in the capital city of Kingston (Hope Zoological Gardens) that maintains a colony of the Jamaican hutia which seems to be flourishing. The director of the zoo received training at the Jersey Wildlife Preservation Trust (JWPT) in the UK, and a strong tie exists between the two institutions. The JWPT has maintained a large captive breeding colony of Jamaican hutias, and is currently working with several institutions in Jamaica in an effort to train personnel as part of a program to return many of their hutias to a carefully selected location in western Jamaica (see below). There is also an established natural history museum in Kingston (The Institute of Jamaica) and a strong university program (via the University of the West Indies). The Natural History Society of Jamaica is active. However, conservation of the endemic fauna has not been a high priority in the country. Although there is an official government organization charged with enforcing wildlife laws and promoting conservation issues and national parks, the Natural Resource and Conservation Department (NRCD) has been underfunded and shifted from one administrative unit to another. The NRCD has had minimal impact on the major conservation issues of the country, and in spite of the great potential for a strong conservation effort in Jamaica, the issues have been given a low priority by most governmental programs. The economy of the country has suffered during the recent economic downturn in the region.

Haiti

This country has the fewest institutions committed to conservation and the management of natural resources of any major country in the West Indies. There is no zoo and no natural history museum. The university system does not train individuals in biology, and the only educational programs in natural resources are designed to train agronomists. A natural history society has recently been formed, the Society Audubon d'Haiti pour la Protection de l'Environnment (SAHPE), but interest in the society is low. A new program in national parks has been established, but there has been bickering among the two agencies responsible for coordinating the program, and progress has been slow. The major problems in Haiti are a lack of public awareness of and support for conservation issues, and a lack of commitment by institutions within the country. A single, strong conservation agency is needed to supervise the programs and to be an advocate for the relationship between preservation of endemic species and the conservation of natural resources, water, and soil that will improve the quality of life for a large segment of the population. The major problems can be summarized as a poor economy, a lack of public awareness, a lack of interest at the governmental level, and a lack of any institutional infrastructure to provide jobs or educate people in the importance of the conservation of natural resources. The new national parks program (Pares Haiti) is the best hope in Haiti of initiating a program in conservation, education, and regulation that will take some steps to improve the chances of survival for the two remaining endemic mammals. No administrative structure has been established yet for Pares Haiti, however, and many regions of the two national parks of Haiti are dominated by secondary growth habitats and have people living within the park boundaries. Pares Haiti, therefore, can only be an effective conservation program if it receives support and attention in the near future from the new government of Haiti, and it is unclear if this will happen. Without this support, the future of the Hispaniolan hutia in Haiti is of concern.

Dominican Republic

Like Jamaica, the Dominican Republic has all the major institutions in place to promote the conservation of the two remaining endemic land mammals of Hispaniola (*Plagiodontia* and *Solenodon*). There is an excellent zoo (ZOODOM), a fine natural history museum, and several strong universities that have programs leading to a degree in biology. There is also a strong national parks program and several substantial national parks with staff and facilities in place. A number of people in the country care about wildlife conservation. Articles regularly appear in several newspapers of the country promoting wildlife conservation and discussing the flora and fauna of Hispaniola. With the addition of a new national park in the region of the Sierra de Baoruco, plus additional emphasis on the national parks program in the Dominican Republic, an increased environmental awareness is now spreading throughout the country. With these efforts the Dominican Republic has perhaps made more progress in wildlife conservation in the last two decades than any other country of the West Indies. There is a need in the country, however, to increase the enforcement of existing wildlife regulations and to increase the protection of habitats within the boundaries of the national parks. There is also a need for the various organizations concerned with natural resources of the Dominican Republic to work more effectively together.

Puerto Rico

There is a very strong conservation ethic in place within governmental programs in the commonwealth, and the necessary institutions are in place. However, there are no endemic rodents left to be protected by these programs.

Bahamas

There are several programs in place to protect the remaining endemic rodent of the subrcgion, *Geocapromys ingrahami.* The most significant of these is the Bahamas National Trust,

which promotes conservation and environmental education and manages the extensive national park program. The "Trust" is an advisory agency to the Ministry of Agriculture, Fisheries, and Local Government whose Department of Agriculture regulates activities that might impact on *Geocapromys*. There is also a substantial private zoological park in Nassau (Ardastra Gardens). A strong effort is being made to protect the Bahamian hutia and its natural habitat. The problem in the Bahamas is that the islands are spread over a wide geographic region, and regulations are difficult to enforce. Economic conditions in the outer islands are poor, and the major concern of the government is promoting jobs and development. However, on balance, the existing programs for conservation are effective, and in spite of economic problems and the lack of a strong conservation ethic among Bahamians living in remote regions, there is a good chance that current programs can succeed in protecting the existing populations of *Geocapromys ingrahami*.

Lesser Antilles

There are no remaining endemic rodents in this subregion of the West Indies, and so the major features of the various islands in the subregion will not be discussed.

List of Species of Concern

This list uses the Red Data Book categories as outlined and defined by IUCN. In each case I have examined the information available at the current time, and upgraded the status from the one reported in 1982. In each case I have indicated what the 1982 Red Data Book status was, and my reasons for changing the designation.

Cuba

Capromys nanus, Dwarf hutia. **Endangered.**

This is the smallest of the hutias. No specimens have been reported since 1937, but the animal probably still survives in the Zapata Swamp. The entire region of the Zapata Swamp is now protected by Resolution No. 21-79. The dwarf hutia was classified as Endangered in the 1982 Red Data Book.

Capromys angelcabrerai, Cabrera's hutia. **Endangered.**

This small hutia was discovered in 1974 and is restricted to the mangrove swamps of Cayos de Ana Maria off south-central Cuba, a region protected by Resolution No. 21-79. Cabrera's hutia was classified as Endangered in the 1982 Red Data Book and has recently been proposed as an endangered species by the U.S. Fish and Wildlife Service (USFWS, 1985).

Capromys auritus, Large-eared hutia. **Endangered.**

This large hutia was described in 1970 and only occurs in a mangrove swamp on Cayo Fragoso, a small, low island off the north-central coast of Cuba protected by Resolution No. 21-79. The large-eared hutia was classified as Endangered in the 1982 Red Data Book and has recently been proposed as an endangered species by the U.S. Fish and Wildlife Service (USFWS, 1985).

Capromys sanfelipensis, Little earth hutia. **Endangered.**

This hutia may be closely related to the one above and is found in the low dense vegetation of Cayo Juan Garcia and nearby Cayo Real off southwestern Cuba. This region is protected by Resolution No. 21-79. The little earth hutia was classified as Endangered in the 1982 Red Data Book and has recently been proposed as an endangered species by the U.S. Fish and Wildlife Service (USFWS, 1985).

Capromys garridoi, Garrido's hutia. **Endangered.**

This hutia was described in 1970 from a single specimen. It is believed to occur on small islands in the Banco de los Jardins y Jardinillos of the Archipelago de los Cannaroes south of the Zapata Peninsula and east of the Isle of Pines. This region is protected by Resolution No. 21-79. Garrido's hutia was classified as Endangered in the 1982 Red Data Book.

Capromys gundlachi, Chapman's prehensile-tailed hutia. **Insufficiently Known.**

This arboreal hutia is restricted to the Isla de la Juventud (formerly known as the Isla de Pinos). The taxon was originally described as a subspecies of *C. prehensilis* by Chapman in 1901 and proposed as a distinct species by Varona in 1986. The Isla de la Juventud is 3000 sq km in size, which makes it the sixth largest island in the West Indies and larger than all but one of the Bahama Islands. The mammalian fauna of this island is of great importance and should not just be lumped with Cuba. I recommend that this species receive immediate attention to determine the extent of its distribution and its current status on the Isla de la Juventud. This species was not discussed by the Red Data Book in 1982, and *C. prehensilis* previously has not been considered as a species of special concern.

Capromys melanurus, Bushy-tailed hutia. **Rare.**

This large, dark-colored hutia is arboreal and inhabits the humid montane forests of eastern Cuba. All hunting is now prohibited in certain parts of its range in Oriente Province by Resolution No. 21-79. It is not known if the species occurs in the areas set aside as reserves. The bushy-tailed hutia was designated as Indeterminate in the 1982 Red Data Book. I have chosen to upgrade its status to Rare, because the range of the species is so limited and its habitat requirements so specific to areas of dense mesic forest.

Capromys meridionalis, Isla de la Juventud tree hutia. **Insufficiently Known.**

This arboreal hutia was discovered in 1978 and described as a new species by Luis Varona in 1986. It is restricted to the southwestern region of the Isla de la Juventud. Because of the limited distribution of this species on the island, I recommend that immediate studies be undertaken to determine the status of this new taxon. This species was not discussed in the Red Data Book in 1982.

Haiti and the Dominican Republic (Hispaniola)

Plagiodontia aedium, Cuvier's hutia. **Vulnerable.**

This hutia is now very rare in most parts of its original range. Habitat destruction exposes the animal to predation by dogs and

other introduced predators. During the last decade, many areas of natural habitat have been destroyed in both Haiti and the Dominican Republic. The lowland swamp forest east of Sabana de la Mar in the Dominican Republic was recently cut down and turned into rice fields. It is possible that most or all of the *Plagiodontia aedium hylaeum*, a separate subspecies that inhabited this region, was eliminated. A captive breeding program for this subspecies is now underway. The captive colony is very inbred, however, and the gestation time of the Hispaniolan hutia is long. Only one young is usually born at a time, and a female usually has only one young each year, so the growth of the colony is slow. The long range goal for the captive breeding program is to establish a joint program between the Florida State Museum and Parque Zoologico Nacional (ZOODOM) with the objective of establishing a large viable colony and eventually to reintroduce surplus animals into suitable habitats of Hispaniola. Animals from the subspecies of the northeastern Dominican Republic will be maintained as a separate colony, and a special effort will be made to ensure the survival of this population. The Hispaniolan hutia was designated as Indeterminate in the Red Data Book. The status of the species has been upgraded to Vulnerable because recent studies suggest that the animal is rarely encountered in most of its previous range in the Dominican Republic (R. Sullivan, pers. comm.), and that many of the known populations of the species in Haiti have been significantly reduced in numbers since 1980 (Woods, 1986).

Jamaica

Geocapromys brownii, Jamaican hutia. **Rare.**

This hutia is still present in widespread regions of Jamaica but is rare or missing from many areas of suitable habitat, such as the Cockpit Country of central Jamaica. During the course of a three-month island-wide survey of Jamaica in 1982, William Oliver identified 16 separate population sites (Oliver, 1982). All these areas were in places where massive deposits of exposed limestone offer an abundance of hiding places for the animals in natural fissures and solution cavities (Oliver, 1985). The animal may be at risk over the next few decades unless some large areas of suitable habitat (karst regions with extensive forest cover) are set aside away from inhabited regions. However, the Jamaican hutia is so widespread in its distribution on the island that it is one of the most secure species of capromyid rodent surviving in the West Indies. Only *Capromys pitorides* of Cuba appears to be more widespread in distribution in its natural habitat and more resistant to the threats of extinction outlined in this report. There has also been a very successful captive breeding program for the Jamaican hutia at the Jersey Wildlife Preservation Trust. This captive breeding project has been so successful that more than 40 individuals were introduced into an area of western Jamaica in early 1986 by William Oliver and Laurie Wilkins in a joint project between the Jersey Wildlife Preservation Trust and the Florida State Museum. The Jamaican hutia was designated as Indeterminate in the Red Data Book. Its status has been upgraded to Rare because we now know that its present distribution does not include many areas previously occupied by the species nor many areas of potential habitat (Oliver, 1982; 1985; Anderson et al., 1983).

Bahamas

Geocapromys ingrahami, Bahamian hutia. **Rare.**

This small hutia is abundant on East Plana Cay, a small island of 1150 low-lying acres in the eastern Bahamas. Animals from East Plana Cay have been introduced onto two additional islands in the Exuma Cays Land and Sea Park: Little Wax Cay in 1973 and Warderick Wells Cay in 1981. These introduction efforts are known to be successful on Little Wax Cay, and although the status of the animal on Warderick Wells Cay is unknown, reports of tracks from a variety of locations on the island suggest that this introduction was also successful (Kevin Jordan, pers. comm.). The population of Bahamian hutias on Little Wax Cay has increased to the point that it is the subject of a year long study by Kevin Jordan, a doctoral student at the University of Florida. The status of the species is improving and should get better if efforts to introduce the Bahamian Hutia to other islands and cays are successful. These efforts should proceed cautiously so that the animals are not released onto islands where factors are not suitable for their survival, or where they will negatively impact other endemic plants or animals. From my discussions earlier in this paper, however, it is clear that the Bahamian hutia was once widespread throughout the Bahamas, and that the release of animals on suitable islands and cays is really a reintroduction program rather than an introduction effort. There are no known negative factors influencing the populations of Bahamian hutias on any of the three small islands where they now occur. Because the range of the species is limited to such small low-lying islands, however, the animals are "vulnerable" to a chance introduction of cats or dogs or to the disaster of a tropical storm with a large surge of water, high winds, and heavy rains. The combination of these problems eliminated *Geocapromys thoracatus* from Little Swan Island before anybody was aware that the problems were severe enough to cause the extinction of the species. Based on a series of recommendations by Kevin Jordan, I suggest that the Bahamian hutia be recognized as "Vulnerable". I have classified the Bahamian hutia as Rare because the status of the animal does not fit the technical definition of the term Vulnerable as used in the IUCN Red Data Book. The unique and very vulnerable status of the Bahamian hutia as a result of its very limited distribution should be taken into account by all individuals and organizations concerned with planning future programs that will affect the species. The Bahamian hutia was designated as Rare in the 1982 Red Data Book.

Regional Priorities

Cuba

The status of the remaining endemic rodents of the mainland can be improved by strictly enforcing Resolution No. 21-79 and the other existing legislation protecting endemic rodents and by establishing additional reserves in critical habitats. These

actions are especially important in relation to the two new species of concern on the Isla de la Juventud. Areas of mangrove swamp near the Zapata Swamp and the swamp itself should be protected from fire. Access to the offshore cays where hutias occur should be restricted so that fishermen do not kill the animals found there or introduce cats or mongooses. A nationwide education program at the primary school level that would emphasize the uniqueness of the endemic mammals of Cuba could have beneficial effects in time to improve the chances of survival of the remaining endemic rodents. The taxonomic status of some of the forms that may not be distinct enough to be designated as full species, but which are currently recognized in the literature as such, should be investigated (*Capromys sanfelipensis, C. angelcabrerai, C. auritus, C. garridoi, C. gundlachi,* and *C. meridionalis*). High priority should be given to completing studies on the ecological status of the two possibly distinct endemic species of *Capromys* on the Isla de la Juventud. The ecological status of the three clearly distinct species of *Capromys* that are of special concern (C. *nanus, C. melanurus* and *C. prehensilis*) should be carefully reevaluated via an island wide survey by a team of investigators utilizing the same census techniques.

Jamaica

An educational program should be undertaken to point out the unique importance of Jamaica's one surviving non-volant endemic mammal. As some of the remaining populations of the hutia, or "Indian coney" as it is frequently called in the countryside, are in close proximity to areas of high use by humans, it is necessary for the general population to want to save the species if it is going to continue to survive in most regions of the island. All coney hunting should be prohibited. A special effort should be made to create some of the national parks that exist only on paper and to strengthen the role of the Natural Resource and Conservation Department. A previous director of this program believed that the animal was a pest and not worth saving, which is a widespread misconception that must be addressed at all levels. Since the remaining populations of the coney are still safe enough from immediate exploitation, a long-term educational program could have beneficial effects on the status of the animal in the coming decades as the human population of Jamaica further increases and remaining pockets of semi-natural habitat are further fragmented.

Haiti

Educational programs and strict laws will have little effect on the effort to keep *Plagiodontia aedium* from becoming extinct, because only a small percentage of the general population is able to read, and most people who live near the remaining areas of suitable hutia habitat are remote from any areas of authority. If the animal is to be saved in Haiti, suitable habitat must be set aside and protected from deforestation. The highest conservation priority in Haiti should be to finish the creation of a national parks program with a single administrative infrastructure, and to promote and protect the habitat within the boundaries of the two existing parks (Woods, 1986). Since these parks are in regions of significance for water and soil conservation, the emphasis should be on setting these areas aside to protect the habitat and improve the quality of life for people living below or near the parks. People living in the parks should be relocated outside the park boundaries. In Haiti *Plagiodontia* can only be saved as part of a package to save Haitians and ward off famine and disease. This can best be accomplished by linking the future of the animal with watershed and soil conservation (Woods and Harris, 1986).

Dominican Republic

As previously mentioned, all of the institutions are in place in the country to ensure that something can be done to save *Plagiodontia aedium* from extinction. High priority should be given to developing unified goals in wildlife conservation. All agencies with responsibilities in the area of managing and protecting the natural resources of the country should work together to develop a master plan that will take advantage of the substantial programs already in place. The endemic mammals can best be protected on a long-term basis by including measures to improve their status in plans that will improve the status of a large number of species, such as in existing national parks. An immediate survey of the status and distribution of *Plagiodontia aedium hylaeum* is needed to establish whether any animals or suitable habitat remain, so that a decision as to what to do about the preservation of this form can be a part of the joint planning of the major conservation agencies of the country. I also recommend that priority be given to the existing plans for a large captive breeding facility for endemic mammals to be established at ZOODOM.

Captive breeding programs for several species of threatened Hispaniolan reptiles, birds, and mammals have been high among the priorities of ZOODOM since it opened in 1975, and breeding success has been achieved for most species. At the initiative of ZOODOM, an agreement with wildlife authorities in the country was reached so that all reptiles, birds, and mammals confiscated by these officials are delivered to ZOODOM for rehabilitation, and either subsequent release into the wild or use in captive breeding programs. Reintroduction of captive-bred progeny into suitable natural habitats by ZOODOM was initiated in 1978 with the release of West Indian tree ducks, native *Epicrates,* and two species of iguanas *(Cyclura).* However, breeding success of species requiring special diets and/or breeding facilities not readily available were affected by the reduced budget of ZOODOM during recent years. Any serious effort for a successful breeding colony of native mammals at ZOODOM will depend on the efforts of the institution to increase the funds available for the program.

Bahamas

The status of *Geocapromys ingrahami* in the Bahamas is secure and improving. Unless a natural disaster or human error occurs, there is a reasonable chance that the animal can survive the threat of extinction in spite of a very limited distribution. To guard against the consequences of a natural disaster caused by weather or disease, or a chance introduction of dogs, cats, or the

mongoose on the three islands where the Bahamian hutia currently occurs, additional reintroductions on islands in different parts of the Bahamas should be encouraged. There are reports of Bahamian hutias having been seen on other islands and cays within the Bahamas. All these reports should be carefully investigated and documented. There should be a central location in the Bahamas where all information on the status of the Bahamian hutia is maintained and regularly updated. I recommend that this be with the Bahamas National Trust. The Trust should make a special effort to share all of this information and coordinate all of these activities with the Department of Agriculture so that members of this governmental organization will have access to all available information on *Geocapromys ingrahami* when making policy decisions, or acting on requests for permits. Before reintroductions of the Bahamian hutia on other islands are undertaken, a careful survey should be made of all the plants and animals on the proposed island or cay to ensure that no other endemic species are negatively impacted, and the files in the proposed database at the Bahamas National Trust should be carefully consulted. No reintroductions should be allowed without a permit issued by the Department of Agriculture.

Conservation Priorities

In an effort to rank the various endemic rodents discussed above in terms of the priority that should be placed on implementing a conservation program, I have developed a point scale. The maximum number of points that a species can receive is 50. There are four categories. Category A ranks taxonomic considerations, with an animal receiving 10 points if it is a distinct genus and restricted to an island, and another 10 points if a distinct species and restricted to an island. Category B evaluates the status of each species, with Endangered species receiving 10 points, Vulnerable species 8, Rare species 6, Indeterminate species 3 and Out-of-Danger species 1. Category C evaluates the prospects of a successful conservation effort, with a high probability receiving 10 points, a moderate 5, and a low probability 0. Category D evaluates the immediate threat faced by the species, with a high threat being assigned 10 points, a moderate threat 5 points and a low threat 0 points. I have attempted to apply the same criteria to all of the surviving endemic rodents of the West Indies based on an evaluation of the literature and discussions with as many authorities as possible. The list is presented as Table 1.

Table 1. Ranking of all endemic rodents from the West Indies in terms of their priority status in implementing a major conservation effort.

Taxon	Category A	B	C	D	Total Points	Rank
Capromys nanus	20	10	3	10	43	3A
C. angelcabrerai	20	10	3	10	43	3B
C. auritus	20	10	5	10	45	2A
C. sanfelipensis	20	10	5	10	45	2B
C. garridoi	20	10	5	10	45	2C
C. gundlachi	10	3	10	5	28	7A
C. melanurus	20	6	10	5	41	4
C. meridionalis	10	3	10	5	28	7B
C. prehensilis	20	3	10	3	36	5
C. pilorides	10	1	10	0	21	8
Geocapromys brownii	10	6	10	5	31	6
G. ingrahami	10	8	10	3	31	6
Plagiodontia aedium	20	8	10	10	48	1

A: Taxonomic considerations
B: Status
C: Prospects of conservation success
D: Immediate threat

Conclusions

The splendid isolation of the West Indies produced a remarkable radiation of endemic mammals. At the close of the Pleistocene, at least 77 endemic land mammals inhabited the West Indies, and some islands had over 20 species of endemic mammals filling a variety of niches. After the arrival of Amerindians about 4,500 years ago, a dramatic reduction in the numbers of these animals began, which accelerated at an alarming rate after the arrival of Europeans following the discovery of the islands by Columbus in 1492. Many smaller endemic mammals that had survived the effects of habitat alteration and overhunting by Indians and early settlers fell prey to the effects of predation and competition from introduced species such as black and Norway rats, feral dogs and cats, and finally, the mongoose, which was introduced into the region in the late 1800s. As a consequence of the end of the splendid isolation that produced and protected the 12 insectivores, 16 ground sloths, 3 primates, and 52 rodents known from the islands, conservationists and concerned governments are left with the difficult task of trying to save the remaining endemic mammals. These 13 rodents and 2 insectivores are surviving on just three main islands (Cuba, Jamaica, and Hispaniola), one lesser island (Isla de la Juventud, Cuba), and a series of small cays off the coast of Cuba and in the Bahamian archipelago. Accounts of additional animals that might still survive are frequently heard, but a serious effort to confirm any of these reports in Haiti, the Dominican Republic, and Puerto Rico (including offshore islands of all three countries) was not successful (Woods et al., 1986). As a consequence, we are left with the conclusion that only 15 endemic mammals continue to survive, and with the need to find a way to preserve these mammals in the face of rapidly expanding human populations on islands with serious economic and social problems. The rodents on some of these islands are considered to be pests by influential government

officials who are responsible for formulating policy on the conservation of natural resources, and by local residents. These misconceptions can only be corrected by strong programs in environmental education and by the implementation of single-minded programs with a clear mandate to identify, promote, and protect the national natural patrimony. In most countries of Latin America, these responsibilities are assigned to a Department of Agriculture or programs in natural resource management. These countries usually have substantial game, forestry, and mineral resources that create a need for strong programs around which a conservation ethic can be built. In many of the island nations of the Caribbean, however, there are not as many game, fish, or forest resources, and the organizations usually responsible for regulating these resources do not receive as much emphasis as they do in other parts of Latin America. This is especially true in Jamaica, Haiti, and the Bahamas. Therefore, I recommend that the major conservation effort in the West Indies be associated with programs concerned with protecting the national natural patrimony. The concept of promoting the importance of the endemic rodents as part of a package that includes a variety of endemic plants and animals found in selected regions is the method most likely to succeed in the face of all the other serious priorities that each country of the region must establish. If the concept of protecting "packages" of national natural patrimony can be coupled with an emphasis on the importance of certain regions (national parks) in the conservation of water and soil, then it is a package that has a good chance of being successful for many decades in spite of strong and compelling counter pressures for development and/or exploitation of natural resources.

Only so much time and money exist that can be used to promote the conservation of the remaining endemic rodents of the West Indies. Because the major forms left are scattered among five different countries, each of the efforts should be given a high priority, since each is a chance to save an endemic species of importance to that particular country. I believe that all of the 11 remaining endemic rodents can and should be saved from extinction. Table 1, however, ranks the species in terms of the priority that should be placed in committing funds and time if a decision has to be made as to what situation needs the most emphasis. The two species of the genus *Geocapromys* are in the best shape, and the continuation of existing programs should protect the species. The eight species of the genus *Capromys* include four species which inhabit extremely fragile and vulnerable habitats that will be difficult to protect. The latter four species are identified in Table 1 as priority 2 and 3 primarily because the chances of success of a long-range conservation effort are more limited. The animal for which there is a major concern for its future welfare, but for which there is a reasonable chance of success in preserving it over a long period of time, is *Plagiodontia aedium,* the Hispaniolan hutia. I recommend that the conservation of this animal be given the highest priority in the Middle American Region by the Rodent Specialist Group; however, I wish to emphasize that all of the endemic rodents of the West Indies, with the exception of *Capromys pilorides,* are of special concern and should be closely monitored.

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The Conservation Status of South American Rodents: Many Questions But Few Answers

Eduardo Gudynas

Introduction

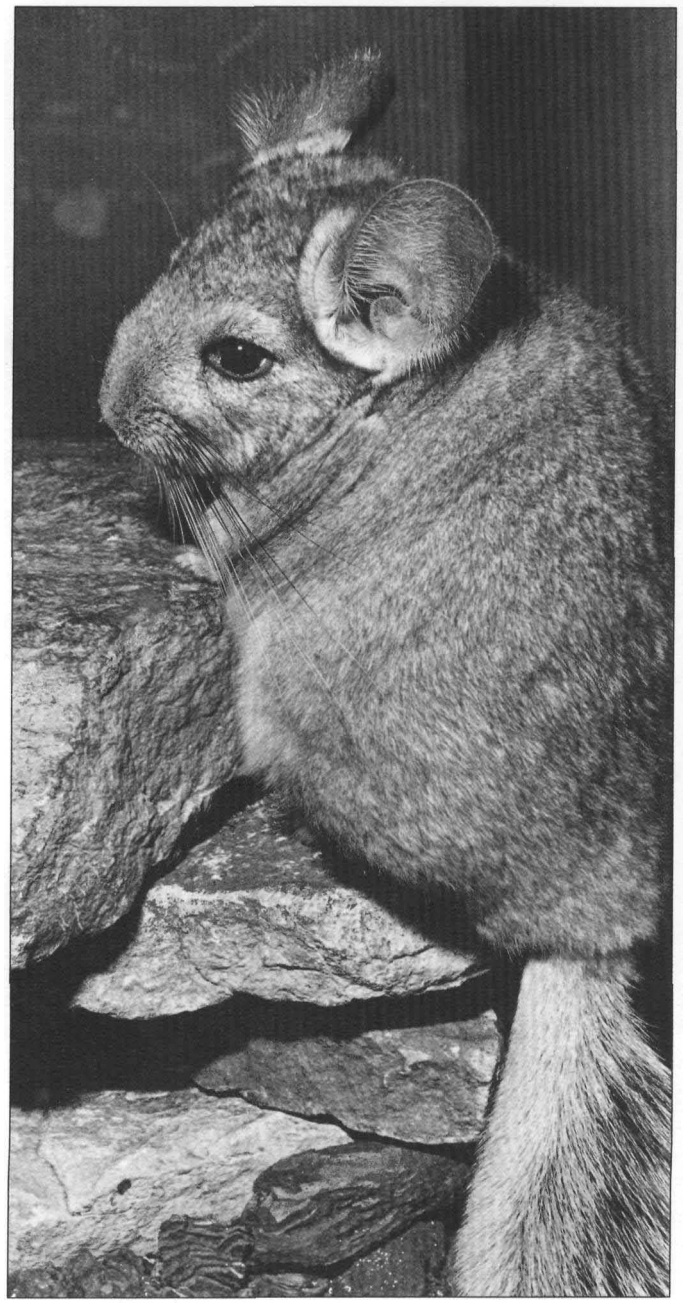
Two main problems were found when I started to prepare a report on the conservation status of rodents in South America. First, rodents represent the largest and most diverse group of South American mammals, and are the least known in all respects, including taxonomy (Pine, 1982). Second, rodents are found in all major areas of South America, which is a large continent with diverse environments ranging from still unexplored areas to heavily disturbed landscapes.

Thus, we are confronted with a very large mammalian group, poorly known and threatened by diverse causes; the conservation status of most species can hardly be estimated. This is a major limitation of this paper. Another limitation is that though there are many questions, few answers will result from them. At this time, I can provide only a framework for the conservation problems in South America. In this region these problems are particularly closely involved with socio-economic issues and scientific philosophy.

South American Rodents and Landscapes

Rodents are known from the early Oligocene (Deseadan Age) of South America (Carleton, 1984). Recent species are included in three groups: the Sciuromorpha, the Caviomorpha, and the myomorph Family Cricetidae. They are distributed in almost all areas of the continent, including its islands. They are the largest group of mammals, and comprise about 43% of the total number of species (Reig, 1981). This compares with 22% for the Chiroptera, 10% for the primates, 9% for the marsupials, and smaller numbers of other mammalian orders (Reig, 1981). New species are still being described, and so the number of known species of rodent in South America will surely increase in the future.

The rodent species are found in all major South American biogeographic regions, as defined by the floristic-based work of Cabrera and Willink (1973). Landscape diversity is very high in South America, ranging from deserts and semideserts, large steppes and savannas, to rain forests.



***Chinchilla lanigera*. (Photo by L. LaFrance, courtesy of the Chicago Zoological Society.)**

Human presence in these regions has depended on history and the resources available. Although European settlement started in coastal areas, it soon after reached other regions, mainly in the search for minerals. Today, there are large areas of the continent that still are poorly explored, but settlements have started within the past few years in all regions, with subsequent disturbance to the environment and its rodent fauna (see for example the case of Amazonia; Schmink and Woods, 1984).

Present Knowledge of Conservation Status

The IUCN Mammals Red Data Book, compiled by Thornback and Jenkins (1982), lists only three South American rodents:

1. *Chaetomys subspinosus,* a porcupine from the Atlantic forests of southeastern Brazil (Bahia and Espirito Santo states), which occurs in forest edges, and which is threatened by habitat loss due to forest clear-cutting.

2. *Chinchilla lanigera,* a chinchillid from the Cordillera de la Costa and rocky Andean slopes of Chile (400-2500 m), which is threatened by the fur trade and habitat loss to overgrazing, firewood collection, and mining.

3. *Chinchilla brevicaudata,* another chincillid from the central Andean region of Peru, Bolivia, Argentina, and Chile. It occurs at higher altitudes (over 3,000 m), and is also threatened by the fur trade. Although its actual status is poorly known, already it is extinct in Argentina and Peru (Ojedas and Mares, 1982; Pearson, 1982) and probably is facing extinction in other parts of its range.

The precarious conservation situation of the chinchillas has resulted from extremely heavy hunting pressure. The number of individuals exported to the United States and Europe has been immense. Although exports decreased late in the last century, they increased again early this century due to higher prices. Between 1862 and 1891, 872,953 were imported to the United States, and between 1895 and 1900, about 2 million were sent to Europe. The royal chinchilla, *C. brevicaudata,* attained U.S. $200 per pelt in European markets by 1930, and was considered "commercially extinct" by that time, even though some hunting continues in northern Chile and adjacent Bolivia (Nilsson et al., 1980).

The Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), lists in Appendix I all South American populations of *Chinchilla,* but no other rodents. Uruguay has listed *Sphiggurus* (or *Coendu) spinosus,* the spiny tree porcupine, in Appendix III. These listings by IUCN and CITES do not mean that the populations of most rodent species are in good health, but only that we know very little about them.

Knowledge about rodents seems inversely proportional to country size (and therefore to faunal size) and to the number of involved mammalogists (either native or foreign). Pine (1982) considered Chile, Uruguay, and (with doubts) Suriname to hold the best known mammal faunas. However, even in these countries, the rodent fauna is poorly known, and there are few data on their life histories and consequences of habitat disturbance. The paucity of knowledge is particularly severe in large countries, such as Brazil, that are undergoing extensive environmental destruction. Moreover, the time left for faunal exploration before massive habitat alteration is very short.

Another problem for international conservation efforts is that while some rodent species may be considered endangered in one country, the lack of data from other portions of their range has meant that they have been overlooked for inclusion in lists like the IUCN Red Data Book. This is the case of the coypu that will be discussed below.

Threats to the Rodent Fauna

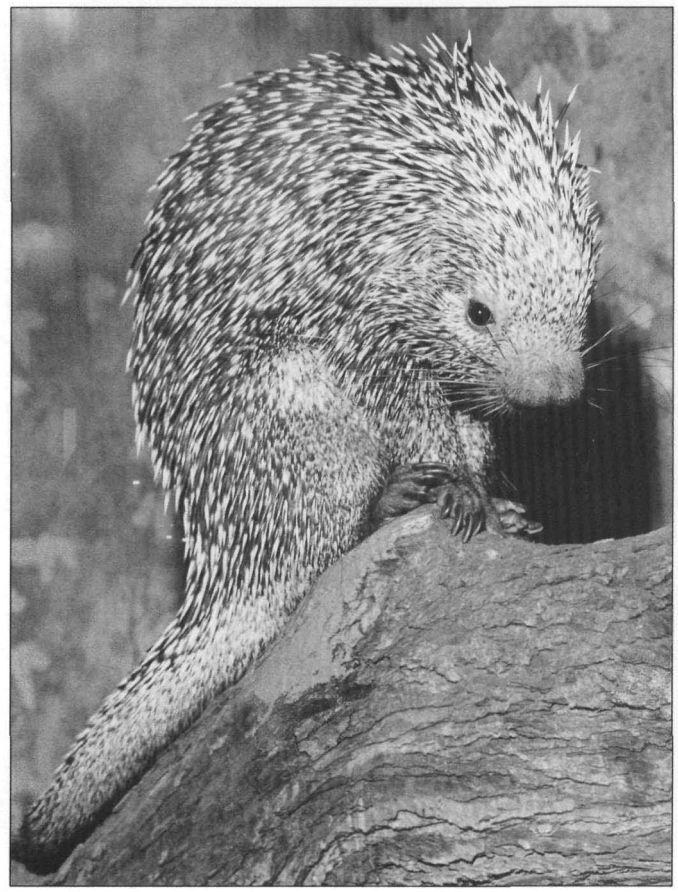
Population declines, which may end in species extinction, result from two main causes: first, natural processes, which are always very difficult to study, and second, and most importantly, human activities. In this document I briefly examine the second of these, particularly as it relates to hunting and habitat destruction or disturbance. Both may be caused by human settlement, agriculture, industry, extractive activities (timber, oil, minerals), and even by exotic species introduction.

Hunting may be legal or illegal, may be related to providing a human dietary supplement for very poor people, or be connected with the commercial fur trade. The coypu is a good example. The species, *Myocastor coypus,* an hystricognath rodent, has been introduced to large areas of North America and Eurasia, while its native populations are declining in South America. The populations of Argentina and Uruguay were common in small creeks and large marshes during the last century, but their exploitation for the fur trade is now very intense. The coypu constitutes 50% of the total exports of native mammal skins from Argentina. They have almost disappeared from northwestern Argentina, because of more than a century and a half of over-exploitation (Ojeda and Mares, 1982). Table 1 shows the export figures for some rodents from Argentina and Uruguay. Export of coypus is very important for Uruguay, but is confined to a few companies that receive large sums of money, while rural workers live at subsistence levels. Research carried out by C. R. Rodriguez, J. C. Rudolf, and others has shown that the number of reported captured individuals in Uruguay decreased from 610,008 in 1977 to 210,000 in 1983. The commercial value of furs and other derivates varied from U.S. $4,646,155 in 1975 to $4,102,432 in 1983. This exploitation has been carried out without any assessment of its ecological implications (Gambarotta et al., 1986).

Table 1. Numbers of selected rodents exported from Argentina and Uruguay.

Species	Number exported Argentina 1972-1979	Uruguay 1976-1979	Value per pelt (U.S.$)	Total value of exports Argentina 1979	Uruguay 1977
Coypu (*Myocastor coypus*)	25,107,545	1,885,366	5-18	63,234,922	4,666,155
Vizcacha (*Lagostomus maximus, Lagidium viscacia, L. wolffsohni*)	1,096,258		3-5	573,357	
Capybara (*Hydrochaerus hydrochaeris*)	102,789		4-11	227,256	

Data from Cajal (1986), FAO (1980), and Ojeda and Mares (1982).



Coendu prehensilis. **(Photo courtesy of the Chicago Zoological Society.)**

Not only is the fur trade disturbing natural populations, but so is hunting for food. In Peru and other Amazonian regions, about 85% of the total protein in the human diet comes from hunting, of which rodents play an important role (Orejas-Miranda, 1972; Avila-Pires, 1977). Excessive hunting pressure for human food may result in local extinctions. The lapa, *Agouti paca*, has become extinct or much reduced in certain areas of Venezuela because of hunting for human consumption in restaurants. This has also happened with some *Dasyprocta* (i.e. *D. aguti* and *D. prymnolopha*). *Kerodon rupestris* is subject to intense hunting pressure for its meat and stomach, which is prized as a starter for cheese (Streilen, 1982). The capybara, *Hydrochaeris hydrochaeris*, is used in much of its range for this purpose. Venezuela has carried out a nationally managed exploitation of herds. In 1981, the utilization of 61,390 individuals hunted by 66 controlled exploiters, resulted in 491,120 kg of dried meat. Capybara products include both salted and dried meat for human food, and fur for gloves. Capybara are also hunted in various other areas, and their number is reduced in most parts of their range (Venezuela, Brazil, Argentina, Uruguay, Paraguay), particularly near human settlements. Species of the genus *Cavia* and *Kerodon*, and the paca (*Agouti* (or *Cuniculus*) *paca*) may also be important for human protein consumption (for example, the Peruvian organizations IDMA, SEPAS and CICCA are promoting the breeding and consumption of *Cavia porcellus;* and Lacher (1979) deals with *Kerodon* as a potential food source). Also, some rodent species have been persecuted by humans because they were considered pests of agricultural crops (particularly several cricetid rodents, the caviomorph *Ctenomys*, caviids, and vizcachas). The plains vizcacha has been heavily reduced for this reason, and has almost disappeared from Tucuman Province, Argentina (Ojeda and Mares, 1982).

Lastly, many rodents are sport hunted, including the lapas *Agouti paca* and *A toczanowski*, the agouti *Dasyprocta agouti*, the porcupines, *Coendu* spp., and both *Hydrochaeris* spp.

Habitat destruction is dramatic in the case of the extensive South American forests, particularly the tropical ones (Amazonian and Atlantic forests), but also in the temperate and subtropical ones. The tropical forest soils have been considered for many years to be almost infertile and fragile, and after forest clearing easily exhausted and eroded. Nevertheless, some recent findings show this picture to be an oversimplification. In fact, Amazonian soils are diverse, and many of them are fertile and able to support large plantations (Denevan, 1984). Now it seems that some profit can be obtained under present agricultural strategies, and so forest clear-cutting may be increased.

The case for conserving Amazonian rodents seems to be complex. Terrestrial mammal species diversity and population density apparently decrease from the western parts of the basin to the poor soils of the Guiana region. Thus, conservation measures will need to be different for these areas, as the western zones appear to hold the highest diversity (Emmons, 1984). Forest disturbance and second growth in tropical areas also seem to change community structure leading to decreased diversity and increasing dominance by fewer species (Eisenberg, 1983).

Studies of the cerrado formations in Brazil are also revealing the importance of gallery forests as habitats for species, many of them rodents. Fonseca and Redford (1984) found that 41% of a total of 23 species of mammals in a cerrado locality were trapped only in gallery forests, and that the most common species there were two rodents (*Rhipidomys* sp. and *Proechimys longicaudatus*). Cerrado habitats contain a low proportion of mammalian endemics; the highest figure among non-volant groups is 11 endemic species out of 100 species. Nine of them are rodents (and at least *Oryzomys lamia, Pseudoryzomys simplex,* and *Echimys braziliensis* appear to be restricted to gallery forests) (Redford & Fonseca, 1986). Most of the cerrado mammals are from mesic enclaves and gallery forests.

Many rodent species are adapted to forests (e.g. many erethizontids (*Coendu* and *Chaetomys*), some echimyids, sciurids; and many cricetid rodents, such as *Oryzomys, Oecomys,* and *Rhagomys*). The highest concentration of rodent genera (41) is found in forested areas (Olrog, 1980). The destruction of the forest environment would therefore cause the extinction of many rodent species.

A similar picture is found in Chacoan forests, and those of northwestern Argentina, southern Brazil, and northeastern Argentina, which have been heavily reduced for logging and firewood. The list of Chacoan endemic rodents includes: *Oryzomys chacoensis, Pseudoryzomys wavrini, Andalgalomys pearsoni, Graomys griseoflavus chacoensis, Akodon varius toba,* and *Ctenomys conoveri;* all these species may be actually or potentially threatened.

Each of these factors (fur trade, hunting, and environmental disturbance) are separately or collectively reducing drastically several rodent populations. Agouti populations (e.g. *D. agouti* and *D. prymnolopha*) are reduced, with local extinctions, not only through hunting but also by widespread habitat destruction. Evidence at hand is mainly available for the large species, such as those so far mentioned. Nevertheless there is incidental evidence of habitat loss affecting small rodents. Examples include *Zygodontomys* populations of Suriname that may be affected by the use of large savannas as airplane landing strips (Genoways et al., 1982), and *Reithrodon* populations of Uruguay which seem to be declining due to grassland alterations for cattle raising, and competition with introduced *Lepus.*

In poor countries, where little research for alternative development strategies or wildlife management has been done, the Flores Paradox becomes true most of the time: underdeveloped countries do not conserve their resources because they lack resources to conserve their natural resources!

Conclusion

We can safely conclude that many South American rodents are seriously threatened, mainly by environmental disturbance and intensive hunting.

Present day Latin American development strategies are a product of cultural dependence, and follow their northern counterparts. Few attempts have been made to utilize sustainably the local native mammals. Although there is potential for this, and even some experience (particularly in Venezuela with the capybara), the promotion of ecologically sound exploitation of rodents such as the coypu will be an important element in improving the conservation of these species.

Most South American conservation legislation lacks an adequate ecological basis. Also, it is not strictly enforced. Furthermore, strong economic interests surround the fur trade, despite the intervention of both the importer and exporter countries, as was clearly shown at the conference of the CITES parties at Buenos Aires, in April-May 1985.

The poor knowledge of both the composition and conservation status of the South American rodent fauna has limited any attempt to develop preservation or conservation efforts at the species level, either by captive breeding, protected wild areas, or effective legislation. Many species, some even unknown to science, may face extinction. CIPFE's team on Environment and Development has worked on the concept of "conservation significant units" (Con-SU). The concept is an extension of the "evolutionary significant units" (Evo-SU) (see Ryder, 1986). Con-SU has two main components: First, Evo-SU implies *a priori* recognition of the subject of the conservation effort (either species, subspecies or populations). The main objective of Evo-SU is to conserve diverse genetic pools, and is not limited to species. This may be done *in situ* or *ex situ* (i.e. captive breeding programs). Second, "ecologically significant units" (Eco-SU) are devoted not only to conserve the Evo-SU, but also to maintain ecological processes. Although the World Conservation Strategy called for the conservation of ecological processes, a definition of such processes was only later provided (see Ricklefs et al., 1984). Eco-SU permits conservation efforts not dependent on *a priori* identification of taxonomic subjects, but is directed to ecosystems. Eco-SU's are identified mainly by their representativeness of unique landscapes or processes, species richness, diversity, etc. As stated by Ricklefs et al. (1984), the conservation of ecological processes is crucial to the preservation of species and natural habitats.

The pathway for South American rodent conservation lies not only with specific taxa protection, but also with the Eco-SU approach. It is assumed that if major ecosystems are protected, their rodent faunas will be also protected, even if they are only partially known. Olrog (1980) pointed out the need to protect rodent habitats acknowledging their great taxonomic and habitat diversity. There is by now urgent need to delimit protected areas and start captive breeding programs for the highly endangered species *Chinchilla lanigera, C. brevicauda,* and *Chaetomys subspinosus.* The latter case is a good example of the Eco-SU approach. This porcupine is found in a restricted area of Atlantic forests in southeastern Brazil, and occurs in at least one national park and one reserve in Bahia, and three reserves in Espirito Santo. Conserving that forest ecosystem will also result in protection for other highly endangered species, such as the golden lion tamarin, *Leontopithecus chrysomelas,* and the woolly spider monkey, *Brachyteles arachnoides.* The case of the cerrado discussed above is similar, as there is a great need for protected areas which include the mesic enclaves which are of such importance to the ecological processes within the cerrado ecosystem. The Eco-SU approach is not restricted to highly diverse areas. For example, Pearson (1982) has shown

that in those Andean communities of Peru characterized by high bird species diversity, the mammals simply have increased numbers of just a few species. Thus, in this case, the relevant subject is not the mammals, but conserving the whole community.

Most of Mares's (Mares, 1982; Ojeda and Mares, 1982) comments on the status of South American mammals apply perfectly to the rodent species. I list his comments below and add some supplementary remarks of my own:

1. There are no South American research foundations which fund field studies or environmental evaluations.
2. There are few institutions that provide for the education of field biologists.
3. There are few popular works on South American mammals for the public at large, and most are of poor quality. Most people do not have a basic knowledge of their own mammal fauna, so they can hardly evaluate its loss.
4. Environmental education is poorly developed, both in the schools, the universities, and at the community level.
5. There is only a small number of South American mammalogists. Most of the knowledge on South American mammals resides with North American and European mammalogists.
6. There is poor dialogue between South American mammalogists and their northern counterparts. Foreign biologists spend a few months in our area, conduct research often strongly oriented to a North American context, and with minimal profit for the native population or scientific community. In contrast, Latin Americans are always facing problems in obtaining papers and books dealing with their fauna, but which are published in North America and Europe.

This situation has resulted in a poor knowledge of our rodents, which in turn leads to the poor knowledge of their conservation status and the lack of concrete conservation measures. Under these conditions, most of our questions will remain unanswered for a long time. Thus, several actions must be taken immediately, on a broad front, to increase our knowledge of this fauna. As part of this action, I again follow most of the suggestions made by Mares (1982):

1. North American and European mammalogists should start to disseminate their knowledge of South American mammals to South American biologists (increase literature exchange) and general public (participate in the preparation of popular papers).
2. Increase the number of field guides on South American mammals.
3. Promote basic research dealing with rodent species and including provision of adequate funding and research opportunities.
4. Increase the number of South American biologists training at North American and European universities and research centers. Moreover, South American students should be encouraged to conduct their research in South America.
5. Increase the number of foreign researchers in South America, but they should work with local scientists, and publish their results in South American journals.

These measures of course will not answer my initial questions about the number and diversity of South American rodents and threats to their survival, but they will be most helpful in increasing our understanding of such a complex mammal group.

Acknowledgments

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A Preliminary Report on Threatened Rodents in Europe

Zdzislaw Pucek

The purpose of this report is to analyze the present state of the European rodent fauna, highlighting threatened species, with the aim to select the top ten most endangered rodents. This is not the firstanalysis of this type, as in recent years a comprehensive study, "Threatened Mammals in Europe" by Smit and van Wijngaarden (1981), and a review of mammalian fauna and their protection in countries of the European Economic Community (Nowak, 1981) have been published. There is also an exhaustive literature on the mammals of this region as a whole (Corbet, 1978; 1980; Niethammer and Krapp, 1978; 1982), and also of different countries. In a number of countries, lists of endangered mammals or Red Data Books have either appeared or are currently being prepared, which contain descriptions of different taxa according to the category of threat (e.g., Ahlen, 1977; Glowacinski et al., 1980; Bauer & Spitzenberger, 1983; Blab et al., 1984). The relatively satisfactory state of knowledge of European mammals and the extensive relevant literature greatly facilitated this analysis. In order to avoid basing information solely on earlier published data, and to obtain the most up-to-date data possible, a circular letter containing a questionnaire was sent to mammalogists in nearly all European countries. Responses from 22 local consultants (1985-86) formed the basis for drawing up a list of all the rodents of Europe and selecting the most endangered species.

Area Surveyed and Criteria Used

The area of the European region accepted here was the one adopted by the Rodent Specialist Group. It contains all of Western and Eastern Europe up to the frontiers of the Soviet Union, except for the European part of Turkey. The European part of the Soviet Union, Turkey, and the Palearctic part of Africa are included with other regions.

Consultants were requested to give a full list of rodents occurring in different countries and to classify them according to the Red Data Book categories, and also to give information on their protection, population size and trends, and factors limiting (or stimulating) population growth. They were also requested to select up to 10 most endangered species in the given country. Geographic ranges of the different species were obtained from the monographic studies referred to above.

The following characteristics were analyzed for each species:

1. Geographic distribution

C—Continuous distribution in the whole country or at least in 2/3 of the country.

R—Continuous, but regional distribution, up to 2/3 of the total area of the country.

S—Discontinuous, fragmented or scattered distribution, restricted to small regions, local isolated populations or islands.

It was also noted whether the border (B) of the species' range occurred in the country, and which part of the country is inhabited by the given species.

2. Abundance

Endeavor was made, after G¢owaciæski et al (1980), to develop a quantitative scale of species abundance. The following classes were distinguished: **A**—absolute or **(A)** estimated numbers for the size of the population; **ER**—extremely rare, up to 100 individuals; **VR**—very rare, 100-1,000 individuals; **R**—rare, 1,000-10,000 individuals; **RN**—rather numerous, 10,000-100,000 individuals; **N**—numerous, 100,000-1,000,000 individuals; **VN**—very numerous, 1-10 millions individuals; **M**—abundant; **UK**—abundance unknown. It was found that this last category was the one most frequently applied, as exact or even approximate numbers were known for only a small number of species (e.g., *Castor fiber).* This scale is, however, capable of representing relative population size and as such was used for estimating the abundance of different species.

3. Population trends

I = increasing, **S** = stable, **D** = decreasing, **—** = no data. The same symbols in brackets were used to mark probable or weakly marked tendencies. For most species and countries there were no quantitative data on population trends for different species, and it was therefore necessary to go on the impressions of local consultants.

4. Category of protection

+ = totally protected, ± = partially protected, — = not protected, treated indifferently,! = treated as a pest.

5. Legal status

S = species protection, **G** = game protection, **R** = under reserve protection, **N** = no protection.

6. Red Data Book categories

Allocation of particular species to categories distinguished above leads to classifying them in one of the Red Data Book categories: **Ex** = Extinct, **E** = Endangered, **V** = Vulnerable, **R** = Rare, **I** = Indeterminate, **O** = Out of Danger, **K** = Insufficiently Known.

Statistics of the Rodent Fauna of Europe

This review of the rodent fauna of Europe shows that it is represented by 68 species in 10 families (Table 1). This number includes 60 indigenous and 8 introduced species. These figures differ slightly from those previously given. Smit and van Wijngaarden (1981) gave only 42 indigenous species and both Corbet (1981) and Niethammer and Krapp (1978, 1982) gave 52 indigenous plus 8 and 9 introduced species respectively. This difference is due to the different approaches used by taxonomists to giving the rank of species to forms, particularly within the subgenus *Pitymys* and genus *Mus.* For the purposes of this report, the number of taxa within Arvicolidae follows Niethammer and Krapp (1982), and the forms of house mice: *musculus, domesticus, hortulanus, abotti, spretus* and *poschiavinus* were treated separately, without decision as to their subspecies or species rank. Consultants from various countries followed the same philosophy after Marshall and Sage (1981) and Honacki et al. (1982). Only two species of the genus *Spalax* were distinguished, *S. leucodon* and *S. micropthalmus.*

Table 1. Summary of rodent fauna of Europe

Family	Number of Species				
	Indigenous	Introduced	Threatened		
			N	%	Top Ten
1. Sciuridae	6	2	5	62	1
2. Castoridae	1	1	1	50	1
3. Cricetidae	3	-	2	67	1
4. Arvicolidae	27	1	8	28	2
5. Spalacidae	2	-	-	-	-
6. Muridae	13	3	4	31	2
7. Gliridae	5	-	5	100	1
8. Zapodidae	2	-	2	100	1
9. Hystricidae	1	-	1	100	1
10. Capromyidae	-	1	-	-	-
Totals	**60**	**8**	**28**	**41**	**10**
Smit and Wijngaarden (1981)	42		5		
Corbet (1980)	52	8			
Niethammer and Krapp (1978, 1982)	52	9			

The Top Ten Threatened Rodents in Europe

Up to ten rodent species most endangered in particular countries were selected by local consultants. The combined list of these species contains as many as 28 species (i.e. 41% of all rodents living in Europe) endangered in at least one of the countries of the region surveyed. Table 2 shows the state of the threat to them in different countries according to RDB categories. Generally speaking there were no quantitative criteria of selection; in particular, a decrease in the range and abundance could not be quantified. Some consultants have adhered strictly to definitions of RDB categories when allocating particular species to different degrees of threat, while others have unfortunately resorted to more general formulations. No replies have been received up to the present from some countries (Greece, Netherlands). In those cases, I have made the classifications myself to the best of my knowledge. Despite these drawbacks, it would seem that no rodent which may be endangered in any part of its range in Europe has been omitted from the list of 28 species. The nutria and muskrat, although sometimes listed as rare species in a given country, have not been treated as endangered, as they are alien elements in the fauna of Europe.

The next stage of the work was to select the 10 most endangered species of rodent on the scale of the continent. Because of the subjectivity of this process, to which reference has been made above, the following criteria were taken into consideration: 1) type of distribution within the given range, 2) size of the range in Europe as a whole, 3) possible changes in range observed in recent years, 4) population size and trends in changes in population numbers, 5) category of threat, endeavoring to make sure that species classified in any particular country of Europe as extinct **(Ex)**, endangered **(E)**, or vulnerable **(V)** were included in this list, 6) character of anticipated habitat changes which might pose a threat to particular rodents. Detailed comments from colleagues in different countries and the listing of 5 of those species in *Threatened Mammals in Europe* (Smit and van Wijngaarden, 1981) have also been taken into consideration. In the majority of cases a combination of the criteria mentioned above led to the final result (Table 3), which represents almost all the families of the rodent fauna of Europe (cf. Table 1). This list may be flawed by the author's subjective input, but will serve as a basis for further consultation and refinement. It must certainly not be concluded that all other rodents, and especially the remaining 16 considered threatened (Table 2), are not in danger or in need of protection.

Table 2. The degree of endangerment of rodents in particular European countries (countries indicated by international letter-code)

Species	Red Data Book Categories					Remarks*	
	Ex	E	V	R	I	1	2
1. *Sciurus vulgaris*			E, GB, R			D7;	+/±15, -6
2. *Pteromys volans*				SF			-1
3. *Marmota marmota*		R	CS	I, PL, YU		S4, I3, Dl;	
4. *Spermophilus citellus*	?PL	A		CS, YU		D4;	+2,-6
5. *Spermophilus suslicus*				PL		Dl	+1
6. *Castor fiber*	B, CS, GB, NL, etc.	D		CH, F, SF		18;	+8
7. *Hystrix cristata*				I		D	
8. *Eliomys quercinus*		CS, PL, SF		D, DDR, YU	BG	D4;	+11,-4, !1
9. *Dyromys nitedula*		CS		CH, D, DDR, FL, GR, H, I, PL, R, YU		D3, S2;	+9,-2
10. *Glis glis*			CS, DDR, H	B, E,R	PL	D3, S5;	+11,-6
11. *Muscardinus avellararius*			DK, GB, S	B, BG, CS, DDR, F, GR, H, R, YU	PL	D4, S6;	+14, -3
12. *Myomimus roachi*				BG			+1
13. *Cricetus cricetus*	L	B,F		D, NL	A, BG, DDR	D4, S6;	+4, -7, !4
14. *Mesocricetus newtoni*				BG			+1,-1
15. *Dinaromys bogdanovi*				AL, YU			
16. *Microtus oeconomus*	D	CS, H	N, NL, S		A	D2;	+3,-7
17. *Microtus nivalis*		CS			BG, D, I		+2,-9
18. *Microtus cabrera*					E, P	Dl;	-2
19. *M. (Pitymys) bavaricus*	?D				A		+1,-1
20. *M. (Pitymys) felteni*				?AL, GR, YU			+0,-3
21. *M. (Pitymys) tatricus*				CS, PL		-	
22. *M. (Pitymys) thomasi*				AL, GR, YU		-	
23. *Micromys minutus*				A, CH, CS, E	BG, R	D2, S6?;	±3,-19
24. *Mus poschiavinus*				CH		-	
25. *Rattus rattus*	N, S, SF	B, DK, GB	D, E, L, NL	A, H, PL		-	
26. *Acomys spinosus*				GR (Crete)		-	
27. *Sicista subtilis*	A, ?H			BG,R	YU		+3,-2
28. *Sicista betulina*		CS	DK, PL	D,R, S		D3;	+7,-2

*Remarks:

1 (Population): **D** = decrease, **I** = increase, **S** = stable, followed by number of countries where observed

2 (Protection): + = totally protected, ± = partly protected, - = not protected,! = treated as a pest, followed by the number of countries

Country codes:

A = Austria; **AL** = Albania; **B** = Belgium; **BG** = Bulgaria; **CH** = Switzerland; **CS** = Czechoslovakia; **D** = Federal Republic of Germany; **DDR** = Democratic Republic of Germany; **DK** = Denmark; **E** = Spain; **F** = France; **FL** = Liechtenstein; **GB** = Great Britain; **GR** = Greece; **H** = Hungary; **I** = Italy; **L** = Luxembourg; **N** = Norway; **NL** = Netherlands; **P** = Portugal; **PL** = Poland; **R** = Romania; **S** = Sweden; **SF** = Finland; **YU** = Yugoslavia.

Descriptions of Selected Species

The following pages contain short descriptions of the 10 selected most endangered rodent species, and a discussion of the status of the remaining 16 threatened species. Descriptions are limited to describing the range, numbers and trend of changes in populations, and to the current state of their protection. Those interested in basic data on the biology of these rodents should refer to various comprehensive monographs available for most of them.

1. *Microtus (Pitymys) bavaricus* (König, 1962), Bavarian pine vole.

Larger than *M. subterraneus*, hitherto known only from the place of its description (district of Garmisch-Partenkirchen) in Bavaria and Biberwier in the Tyrol. Only 23 specimens are known. The status of the species is not clear. It is probably extinct at the type locality because its habitat (moist meadow) was destroyed by the construction of a hospital (Niethammer, in litt.). No specimen has been caught since 1962.

2. *Myomimus roachi* (Bate, 1937), Mouselike dormouse. Limited range in south-east Bulgaria and west Anatolia, from which it is known from several scattered localities. It

***Hystrix cristata,* North African crested porcupine. (Photo by A.H. Shoemaker, courtesy of the American Society of Mammalogists.)**

is very rare in Bulgaria where it has been specifically protected since 1962, and is classified as rare **(R)**.

3. *Acomys minous* (Bate, 1905), Spiny mouse of Crete.
Form solely inhabiting Crete. It differs in karyotype from the African *A. cahirinus*, with which it has been previously associated as a subspecies. It was probably carried to Crete by man since it is not known from Pleistocene sediments there. Its status is Indeterminate **(I)**.

4. *Hystrix cristata* (Linnaeus, 1758), Porcupine.
Northern African species, possibly introduced into Europe during the Roman Age. It occurs only on Sicily and in the southern part of mainland Italy, reaching its northern limit near Lucca. It was considered endangered because it was being over-hunted and its habitat (Mediterranean maquis) progressively destroyed. Following protection, starting in 1974, its range is expanding in central Italy, but it is still illegally hunted (Amori, in litt.). It could be classified as Rare **(R)**.

5. *Spermophilus dtellus* (Linnaeus, 1766), European souslik.
Its range extends from the southern Ukrainian steppes, Asia Minor and Palestine, northwestward as far as Czechoslovakia, Austria, Poland and the German Democratic Republic (Saxony). The range is cut into smaller isolated parts, and especially the eastern Carpathians divide the northwestern and southeastern ranges. Particular colonies could also be isolated from each other, and easily become extinct as agriculture intensifies. For instance, in the early 19th century, there was a considerable expansion of the souslik in Silesia (Poland), after which its range became greatly reduced in the 1960's (Surdacki, 1965). It has recently become extinct in this part of Poland (Meczynski, in litt.). It shows a decreasing trend in edge populations, but is protected only in Hungary and Poland. The species is classified as vulnerable **(V)** in Austria and rare **(R)** in Czechoslovakia and Yugoslavia. In general, category **V** is accepted by Smit and Wijngaarden (1981).

6. *Microtus oeconomus* (Pallas, 1776), Root vole.
Occupies an extensive range from Alaska through northern Asia as far as China, Mongolia and the steppe zone in the south. In the west it reaches Norway and the northern regions of the German Democratic Republic. Along the western boundary of the species' range, isolated populations exist in Holland, in southern Norway and Sweden, along the Finnish Baltic coast, on the boundary between Czechoslova-

***Cricetus cricetus,* Common hamster. (Photo by M. Andcra, courtesy of the American Society of Mammalogists.)**

kia and Austria, and in Hungary. This pattern is evidence for the shrinkage of the species' range from the west. Studies by Reichstein (1970) indicate that this species still occurred in Schleswig-Holstein within historical times. In these isolated parts of its range it is not numerous, showing decreasing or stable population trends. However, in Sweden and Norway during peak vole years, both in Northern (continuous) and southern (isolated) parts of the range it reaches pest abundance and so cannot be considered as endangered (Hansson, in litt.; Stenseth, in litt.) It is protected in the Federal Republic of Germany, Hungary, and Norway, but not in other parts of its range, and is classified as endangered **(E)** in Czechoslovakia and Hungary, vulnerable **(V)** in Norway, the Netherlands, and Sweden, and indeterminate **(I)** in Austria. Although rare in western and central Europe (except for Poland), it cannot be endangered throughout its extensive range in northern Europe and Asia. The status of a rare **(R)** or vulnerable **(V)** rodent could only be accepted for southern subspecies—*M. o. stimmingi, M. o. mehelyi*—living in isolated populations (Sulkava, in litt.).

7. *Cricetus cricetus,* Common hamster (Linnaeus, 1758).
Primarily inhabits the steppes of eastern Europe and extends up to the Yenisei. In western Europe it extends as far as Belgium, the Netherlands, and the extreme east of France, including isolated populations in the Federal Republic of Germany. It also occurs in Austria, Romania, northern Bulgaria, and Yugoslavia, except for the mountain chains of the Sudetes and Carpathians. It is fairly common and even

treated as a pest in the southeastern part of its range, but **Endangered** (Belgium, France) or **Rare** (Federal Republic of Germany, the Netherlands) in isolated populations along the western border, where it is under specific protection (Table 3).

8. *Rattus rattus* (Linnaeus, 1758), Ship (black) rat.
Distributed worldwide, but in Europe has a compact range only in the Mediterranean region. In northern and central Europe its range is discontinuous. Scattered populations are mainly confined to seaports. In this region it has been recently reported as very rare or rare and showing a decreasing tendency, which is well documented, e.g. in the Netherlands by Wijngaarden et al. (1971). Nowhere is it protected, but is already extinct in Norway, Sweden, and Finland, where it can only sporadically be observed in seaports. It is classified as **Endangered, Vulnerable,** or **Rare** in other north European countries (Table 3). There are some data indicating that the number of black rats increases during great wars and decreases after them, when human life becomes stabilized and its activities are more regulated. This points to the close dependence of this species on man, with whom it came to Europe from India in early historical times. It could only be treated as endangered locally, in northern and central Europe, but not over the whole of the species' range. In southern Europe it could be abundant and could occur also in the wild in habitats away from humans (Petrov, in litt.).

9. *Castor fiber* (Linnaeus, 1758), European beaver.
It had been almost completely exterminated by the end of the 19th century. Indigenous populations persisted only in the lower reaches of the Rhone, in southern Norway, in the middle reaches of the Elbe and the river basins of the Niemen, Prypec, Berezyna, Sosh, Voronesh, and two other localities in Asia (Konda-Sosva and Pelyn rivers, in the Urals and Upper Yenisei), and also in Western Siberia and Outer Mongolia—in all twelve residual populations. Owing to the successful introductions from these residues of its former range, the European beaver's range has been greatly extended during recent years, particularly in Norway, Sweden, Finland, France, the German Democratic Republic and Poland. Its populations in Europe are still scattered and to a great extent isolated, but the total number of colonies and animals is slowly increasing. It is protected everywhere, treated as **Endangered** in the Federal Republic of Germany and **Rare** in France, but **Out of Danger** in the remaining countries (Table 3). The European beaver can only be considered **Out of Danger** when suitable habitats are left in the form of non-regulated rivers and lakes and undrained marshy land. A special danger has been created by the introduction of *Castor canadensis* to Finland (from which it may may reach Sweden and the Soviet Karelia) and also the recent introduction of this species to France. Observations have shown that the American beaver takes over space more rapidly than its European cousin, particularly as the former has on average larger litters (respectively 4.7 and 3.0) (Lahti and Helminen, 1974). Under these circumstances efforts should be made for the total extermination of the Canadian beaver in Europe.

10. *Sicista subtilis* (Pallas, 1773), Southern birch mouse.
Inhabits the steppe zone of the southern European and Asian parts of the Soviet Union as far as Lake Baikal. The range extends westward as far as Hungary and eastern Austria, where isolated populations existed but are now probably extinct. The surveyed area includes the western fragmented range of the species, in which it is decreasing and rare (Bulgaria, Romania, Yugoslavia) (see Table 3). It is protected in all European countries where it occurs and is treated as rare **(R)**. This species would not appear to be threatened in the eastern part of its range.

In summing up it may be said that only two of these species are fully in danger of extinction, namely, *Microtus bavaricus* and *Myomimus roachi.* Both of these and *Acomys minous* and *Hystrix cristata* have very restricted ranges. Other species occupy sufficiently large and continuous regions so as not to be endangered in their worldwide existence, but the western parts of their ranges in Europe are of a relict character. Their numbers are usually smaller in these isolated and scattered populations. Progress in agriculture creates a special threat to *Spermophilus citellus, Cricetus cricetus,* and *Sicista subtilis.* Carelessly considered draining of marshy areas has led to a limitation of habitats suitable for *Microtus oeconomus* and *Castor fiber.* Due to long-lasting strict protection in many countries and well-planned reintroductions, the European beaver has been successfully restored to numbers which may permit their being used for hunting purposes again. Perhaps the most controversial is the inclusion in this list of *Rattus rattus,* which is threatened by local extinction over a larger part of its range in northern and central Europe. It is surely premature to suggest protection for this species, but local reduction of its control would permit preserving it as a possible competitor of the common *Rattus norvegicus.*

Among the remaining 18 species given as endangered it is possible to distinguish the following groups:

1. Mountain species. *Marmota marmota, Dinaromys bogdanowi, Microtus nivalis*, Microtus cabrerae, M. tatricus. M. felteni,* and *M. thomasi,* occupying very restricted ranges or limited to isolated and scattered populations in mountains. They are sometimes known only from a small number of localities (e.g., *M. tatricus, M. felteni*). Most often they are classified as **Rare** (Table 2). *Marmota marmota* has been under species protection in many countries for a long time, and in the Alps under partial protection

*According to Petrov (in litt.) not threatened at all.

Table 3. The top ten endangered rodents in Europe.

Species	Distribution Category	Abundance	Population Trend	Protection	RDB Category
1. *Microtus bavaricus*	S	VR	D	D+; A-	(?) Ex
2. *Myomimus roachi*	S	? VR	? S	BG + ('62)	R
3. *Acomys minous*	R	R/RN	? S	—	I
4. *Hystrix cristata*	R	? R	D - I	I + ('74)	R (R)
5. *Spermophilus citellus*	S or R	RN	D	H, PL +; others-	Ex-PL, V-A, R-CS, YU(V)
6. *Microtus oeconomus*	S or C	R (loc. VN)	D(or S)	D, H, N +; others-	Ex-D; E-CS, H; V-, N, S, NL; I-A (R)
7. *Cricetus cricetus*	S or R	VR (loc. N)	D(or S)	B, D, NL+; others-	Ex-L; E-B, F; R-D, NL; I-A, BG, DDR (R)
8. *Rattus rattus*	S	VR/R	D	—	Ex-N, S, SF; E-B, DK, GB; V-D, L, NL, R-A, H, PL
9. *Castor fiber*	S	VR/R	I	+	Ex-B, CS, GB, NL; E-D; R-CH; O-DDR, PL, S, N (O)
10. *Sicista subtilis*	S or C	ER/R	S or D	+	Ex-A, H; R-BG, R, YU

Explanation of symbols: ?=data uncertain, /=category varies, depending on the part of the species range
Protection: capital letters indicate countries; + = protected, followed by the year of pertinent legislation; - = not protected.
RDB categories in parentheses are those generally accepted for species listed by Smit and Wijngaarden (1981). For details of RDB codes, see Appendix 1. For details of country codes, see Table 2. Note that in right-handed column, RDB codes are underlined to distinguish them from country codes. See pages 26 and 27 for details of other symbols.

as a game animal. *Dinaromys* is protected in Yugoslavia and the remaining representatives of the genus *Microtus* are not protected species, although this status should be recommended as necessary.

Since mountain habitats are in less danger of transformation by human activities, the above species are not directly threatened and should belong to the Rare **(R)** category.

2. Gliridae. Four species of this family, *Eliomys quercinus*, *Dyromys nitedula*, *Glis glis*, and *Muscardinus avellanarius*, have extensive ranges in Europe, although they are almost everywhere regarded as rare or very rare, particularly in the northern parts of their ranges. They are included in national red lists or in local Red Data Books, and in the majority of countries are under species protection. Intensive utilization of old-growth forest stands causes shrinkage of their habitats, and they should be classified as Rare **(R)**.

3. Peripheral relict populations. *Sicista betulina* occurs in a small number of isolated localities in the western part of its European range, and further to the east, as far as regions east of Lake Baikal and the Ussuri River, it has a more continuous range. It is protected in most of the European countries, being classified as **Endangered** (Czechoslovakia), **Vulnerable** (Denmark, Poland), or **Rare** (West Germany, Romania, Sweden). It should be treated as Rare **(R)** on the European scale. *Spermophilus citellus suslicus* enters into the region surveyed only on its western fringe. Peripheral and isolated populations merit protection, and this species possesses this status in Poland. Reserves should also be established for its benefit.

Table 4. List of rodents introduced into Europe

Intentional Introductions

1. *Sciurus carolinensis* (Gmelin, 1788) Grey squirrel
2. *Tamias sibiricus* (Laxmann, 1769) Siberian chipmunk
3. *Castor canadensis* (Kuhl, 1820) American beaver
4. *Ondatra zibethicus* (Linnaeus, 1766) Muskrat
5. *Myocastor coypus* (Molina, 1782) Coypu, nutria

Commensal Introductions

7. *Rattus rattus* (Linnaeus, 1758) Ship (Black) rat
8. *Mus musculus* (Linnaeus, 1758) Eastern house mouse
9. *Mus domesticus* (Rutty, 1772) Western house mouse

4. Widespread, but rare in some countries. In some countries *Sciurus vulgaris*, *Pteromys volans*, and *Micromys minutus* are considered rare species, classified in categories **R** or **V**. In the northern parts of its range (exclusive Finland—Sulkava, in litt.), *S. vulgaris* is decreasing in numbers, even though it is under partial game protection (Finland). The western fringe of the range of *P. volans* is in Europe. *Micromys minutus* has a wide range in Europe, but is relatively rare in some countries, and is classified in the category of **Rare** (Austria, Switzerland, Czechoslovakia) or **Indeterminate** (Bulgaria, Romania).

5. Local endemic. *Musposchiavinus,* distinguished by its karyotype and pelage coloration, occurs only in a restricted area (Val Poschiavo) of the Swiss Alps, where it is protected as a **Rare** species. *Mesocricetus neurtone* occurs only in easternmost Bulgaria and Romania.

Further Action Plans

The analysis presented here is of a preliminary character only and is based mainly on data in the literature. The list of most threatened rodent species in Europe should be discussed by experts in the various countries and given a more precise form. The maximally inclusive approach presented here may be justified by the need for considering problems of threats to rodents on the scale of particular countries. By selecting the 10 most endangered species, an attempt has been made to look for priorities on the continental scale. Every effort should be made to ensure that this list incorporates the opinions of local experts. In order to achieve this it is essential to collect more data on many of the threatened species, including an analysis of the causes of concern, the protective measures so far undertaken, and suggestions for further protection. Material accumulated in this way, after consultation with the Rodent Specialist Group SSC/IUCN, will then form a basis for international propaganda on behalf of rodent species endangered in Europe. It will also be useful in the compilation of national red lists and Red Data Books. By bringing to the attention of the international community the threats to particular rodent species, it should be possible to stimulate greater activity aimed at their protection.

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African Rodents of Special Concern: A Preliminary Assessment

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Abstract

A preliminary assessment of the species of African, including Malagasy, rodents that are of special concern was done by a regional committee of 23 specialists on African rodents. Sixty-seven species in eight families were considered to be of special concern by the committee. The list contains four species of Sciuridae, two species of Anomaluridae, one species of Arvicolidae, 24 species of Cricetidae, 31 species of Muridae, one species of Dipodidae, three species of Bathyergidae, and one species of Ctenodactylidae. A single species, *Leimacomys buettneri,* is probably extinct based on the 50-year definition of extinction of IUCN and CITES. It has not been found since it was described in 1893. Of the remaining species, 21 are too poorly known to determine their status at this time. An overview of the 67 species of rodents in this preliminary list is presented.

Introduction

There are 15 families of rodents currently known from Africa if the Cricetidae are regarded as being distinct from the Muridae. Of these families, species of special concern are known for eight families. The list of species considered to be of special concern is still very preliminary. Concurrence of opinions is not possible yet between the specialists of this mammalian group. But the list is a beginning of an attempt at reaching a final list of species of special concern.

Family Sciuridae

Epixerus ebii. This African palm squirrel closely resembles the African giant squirrel, *Protoxerus stangeri.* It ranges in the lowland forests from Sierra Leone to Ghana and from Cameroon to western Zaire and Gabon, an area within the greater geographic distribution of the African giant squirrel. Within this range, *Epixerus ebii* seems to be rare (Rosevear, 1969), as less than a couple dozen records in museums seem to exist. Emmons (1978) found it solitary, and it seems to spend much time on the ground. It is classified as **Insufficiently Known.** It may be that it is more common than suspected as few ecological studies of squirrels have been done in western tropical Africa.

Myosciurus pumilio. The African pygmy squirrel occurs from northwestern Cameroon to Gabon. Emmons (1978, 1979) reported some new ecological information on this poorly-known species, apparently the smallest squirrel in the world at a little over 16 grams in average body weight. Emmons (1979) observed this species to pull small chips of outer bark from trunks and branches of trees while apparently foraging for fungi. Although occurring over a fairly wide area in all kinds of forest, populations are low in number. Widespread deforestation could quickly affect this species. It is classified as **Vulnerable.**

Funisciurus carruthersi. Carruther's mountain squirrel occurs in the chain of mountains west of Lake Tanganyika as far north as Mount Ruwenzori on the Zaire-Uganda border. It generally lives in forests between 1500 and 2800 m, especially in moist montane forests predominated by *Pygeum africanum* (Kingdon, 1974). It does not adapt well to areas of cultivation, but rather prefers well-established forests. Due to the seemingly low population numbers and its predeliction for established forests, this species is listed as **Vulnerable.**

Paraxerus vexillarius. This rare squirrel occurs exclusively on the Usambara Mountains of northeastern Tanzania. Its taxonomic status is unclear; Kingdon (1974) considers it to be a hybrid between *Paraxerus lucifer* and *P. palliatus.* The natural forests in which this taxon occurs are diminishing as cardamom spice production increases. It is classified as **Rare.**

Family Anomaluridae

Zenkerella insignis. The flightless scaly-tailed squirrel occurs from southern Cameroon and southwestern Central African Republic to northern Gabon. It is poorly known and few specimens are represented in museums even though it was discovered in the last century. Superficially, this species closely resembles the largest species of African dormice (G. *hueti*) with which it seems to share hollow trees. Little is known of its life history but some speculate it may be a diurnal animal because of the presence of a rudimentary gliding membrane. It is **Insufficiently Known** to classify otherwise.

Idiurus zenkeri. The smallest species of pygmy scaly-tailed flying squirrel occurs from West Africa to eastern Zaire. Both *I. zenkeri* and its congener *I, macrotis* dwell in hollow trees in the forests. Kingdon (1974) reports the occurrence of from a dozen or less to over a hundred in a single hollow tree but

qualifies these numbers by adding that the larger number might include both species of *Idiurus*. This species deserves attention because it prefers mature forests with hollow trees. Land use and lumbering might swiftly impact on this species. It is classified as **Insufficiently Known.**

Family Arvicolidae

Microtus guentheri mustersi. Only a single vole occurs in Africa. This is a relict population in the Jabel Al-Akdar or Cyrenaica Plateau and coastal plain of northeastern Libya. The Cyrenaica vole has been proposed as a separate species as well as being placed as a subspecies of *M. guentheri* of the Middle East and the more widespread *M. socialis* of Eurasia. Clearly its affinities are to these nominal taxa regardless of the hierarchical level at which it is recognized.

The Cyrenaica vole has been obtained in open burrows in cornfields, from among mosses on a rocky north-facing slope, and from beneath perennials mixed with tamarix, sedges, and grasses on the coastal plain adjacent to the beach (Ranck, 1968). The region of occurrence of this vole is the only suitable area of habitat in northern Africa. Nothing is known of the population size nor the biology of this vole. It is classified as **Vulnerable.**

Family Cricetidae

Subfamily Nesomyinae

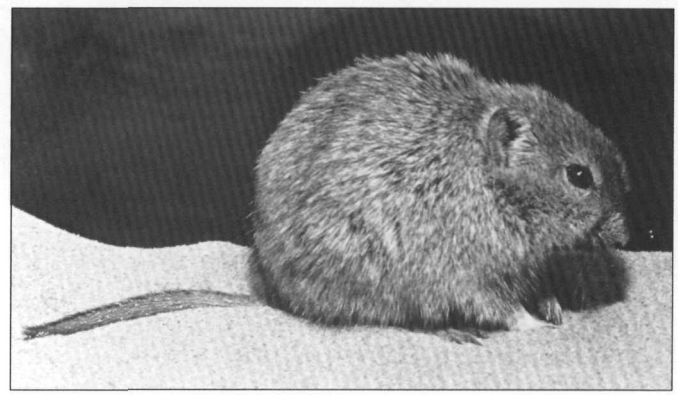
This is an endemic subfamily of Madagascar rodents which presently includes 10 species (Petter, 1975a). None of the species are exceptionally well studied but four are worthy of mention here. Of these four, three may be Endangered, Vulnerable, or Rare but are too little known to make a firm designation while one species is considered Rare.

Macrotarsomys ingens. This small species of Malagasy rodent resembles a gerbil externally. It is fawn-colored with a long, penicillate tail. It was described by Francis Petter in 1959 and to date is known only from the type locality, between Tananarive and Majunga in the forest of Ankarafansika in northwestern Madagascar. This is a nocturnal species that appears to be primarily arboreal, although burrows in the ground were also observed. To date the species is **Insufficiently Known.**

Eliurus minor. This species, the smaller of the two species of *Eliurus* occurring on Madagascar, is known from over six scattered localities in the eastern rain forest and eastern plateau. Ellerman (1949) reported 16 specimens from five localities in addition to the type locality. This is a nocturnal and arboreal species, apparently receiving some competitive pressure from the introduced *Rattus rattus.* Unlike its congener *E. myoxinus*, this species apparently does not burrow in the forest floor (Ellerman, 1949), although Grzimek (1975) reports that it does. However, the species is **Insufficiently Known** at present to classify it properly.

Gymnuromys roberti. This slender rodent with a long, essentially naked tail is referred to by Petter (1972) as rare, with less than a dozen specimens known since its description in 1896. It is known from five localities in the forests of eastern Madagascar. Little life history knowledge exists for the species. It is classified as **Rare.**

Hypogeomys antimena. This giant rat of Madagascar is known from three localities in western Madagascar. Petter (1972) states that it lives in sandy coastal forest and is a nocturnal jumping and running rat. Ellerman (1949) likens it to a European rabbit and mentions its long burrows. It is **Insufficiently Known** at present to classify it properly.



***Olomys* sp., Swamp rat. (Photo by J. Visser, courtesy of the American Society of Mammalogists.)**

Subfamily Otomyinae

Otomys tropicalis. This groove-toothed rat occurs on high mountains in Cameroon and East Africa from eastern Zaire to central Kenya. It is found in a wide variety of habitats from marshes to high altitude savannah and areas of cultivation (Misonne, 1963). Yet its distribution is very fragmentary in the areas where these habitats can be found. This species is **Insufficiently Known** to classify it properly at this time.

Otomys denti. O. denti is found in the high mountains of eastern Zaire, southwestern Uganda, and Rwanda, northeastern Tanzania, and northern Malawi. It occurs in a patchy distribution, usually in dense secondary growth associated with forests (Rahm, 1967). This species, and the previous one, are not well understood taxonomically. Until more is known of this species, it is classified as **Vulnerable** because of the geographic limitations of suitable areas for them.

Subfamily Gerbillinae

Gerbillus mauritaniae. This species is currently known from the holotype only which originated from southern Mauritania. Other unreported specimens appear to be extant from various sub-Saharan countries of West Africa (Cockrum, pers. comm.). The status of this species is affected by two factors. The first is that the taxonomic confusion surrounding the generic and specific distinctiveness of the taxon must be worked out. Secondly, nothing is known about the life history of the species. It is classified here as **Insufficiently Known.**

Gerbillus muriculus. This species is one of a number of poorly known, small gerbils found in Sudan. It is only known from two specimens from western Sudan in the British Museum (Natural History). It has been recognized as a distinct species as well as a synonym of *G. nanus*, an extremely widespread species of naked-footed gerbil. It is classified as **Insufficiently Known.**

Gerbillus nancillus. This is the smallest species of hairy-footed gerbil. It is known only from seven specimens, three of which are in the British Museum (Natural History), from three localities in western Sudan. It is classified as **Insufficiently Known,** as no data are available on its reproductive biology, habitat requirements, or population size.

Gerbillus rosalinda. This dark-colored gerbil was described in 1929 from seven specimens originating from west-central Sudan. Four of these were retained at the British Museum (Natural History) and the remainder were returned to the Natural History Museum in Khartoum. More recently, Roche (1978) reported this species from central Somalia. This species is known only from these two localities. It is classified as **Rare,** as these two localities are far apart and the species has been known for over 50 years.

Gerbillus acticola. This species is known only from northern Somalia. Its taxonomic status is in doubt. It has been considered a subspecies of *G. pyramidum* (Petter, 1975b). It is poorly known in this region and nothing is known of its life history. It is classified as **Insufficiently Known.**

Dipodillus maghrebi. This species is known from only seven specimens from the type locality in northern Morocco. It is among the largest of the species of *Dipodillus* if this genus is considered distinct. Nothing is known of the population status nor the biology of this species. It is classified as **Insufficiently Known** at this time.

Microdillus peeli. This gerbil is known from three localities in northern and central Somalia (Roche and Petter, 1968) where it occurs in sub-desert steppe. Nothing is known about population levels nor the life history of this species although Roche and Petter (op. cit.) believe it to be more common than results of trapping indicate. It is classified as **Insufficiently Known.**

Tatera minuscula. This species is known from two localities, the type locality of Sheik Hussein in eastern Ethiopia (Osgood, 1936) and the lower Omo Valley, Ethiopia (Hubert, 1978). It had been considered a synonym of *T. robusta* (Davis, 1975). Subsequently Bates (1985) has suggested it is a subspecies of *Tatera phillipsi* from northern Somalia. It is poorly known taxonomically and distributionally. However, it seems to be rare within its area of occurrence so it is classified here as **Rare.**

Ammodillus imbellis. This unique gerbil is known from seven localities in eastern Ethiopia and northern and central Somalia (Roche and Petter, 1968). It occurs in the same subdesert steppe as *Microdillus peeli.* Nothing is known about the population levels nor the life history of this species. It is classified as **Insufficiently Known.**

Subfamily Cricetomyinae

Beamys hindei. The lesser hamster rat is known from scattered localities in southwestern coastal Kenya and northeastern Tanzania. Kingdon (1974) considered this and the next species to be relicts of the "southern forests" of eastern Africa. It occurs in forests and moist woodlands. It requires water and soft sandy soil for burrowing. This species is classified as **Vulnerable** in view of its dependence on the dwindling forests in the area of its occurrence.

Beamys major. The greater hamster rat has at times been regarded as a large subspecies of the above species *(B. hindei)* but is probably distinct (Carlton, pers. comm.). It occurs in southwestern Tanzania, Malawi, and northeastern Zambia where it is found at middle and high altitudes in evergreen forests (Hanney, 1965). This species is also classified as **Vulnerable** because of its dependence on dwindling forests in the area of its occurrence.

Subfamily Dendromurinae

Delanymys brooksi. Delany's mouse is a small nocturnal mouse known from the marshes between 1,700 and 2,625 m in eastern Zaire, western Uganda, and northern Rwanda. It is rarely obtained in the region of its occurrence because it is trap shy. Dieterlen (1969) obtained 26 individuals by fencing plots and clearing away all undergrowth. He found it most common in sedges and grasses bordering the marshes. Kingdon (1974) thought this species very rare as he could find no skulls in pellets of the grass owl (*Tyto capensis*) which hunted extensively in the swamp edges of the Kigezi Forest. It is classified as **Rare** at this time.

Dendromus kahuziensis. This long-tailed species is known only from 2,100 m on Mt. Kahuzi in eastern Zaire. It occurs in montane bamboo forest with extensive fern ground cover. It is a very distinct species in what is otherwise a taxonomically difficult genus. It is classified as **Rare.**

Dendroprionomys rousseloti. This monotypic genus is known from only four specimens from the type locality, Brazzaville in Congo. Petter (1966) speculated that it was at least partially arboreal and, from the nature of its dentition, at least partially insectivorous. No additional studies have been published nor is anything known of population levels. It is classified as **Rare.**

Leimacomys buettneri. This monotypic genus is known from only two specimens from the type locality, Bismarkburg in Togo. The two specimens were collected in 1890 and reported by Matschie in 1893. Two mammal surveys in Togo during the 1960s failed to obtain additional specimens. This species resembles the African fat mice (genus *Steatomys*) externally but anatomically resembles the harsh-furred mice (genus *Lophuromys*) (Misonne, 1966; Dieterlen, 1976a). It is probably a terrestrial species and could be at least partially insectivorous, but only speculation on its biology exists in the literature. Because it has not been found for 95 years, this species is classified as **Extinct.**

Megadendromus nikolousi. This monotypic genus is known only from the montane forest on the south slope of the Bale Mountain south of Dinshu, Ethiopia, at an elevation of 3,000 to 4,000 m (Dieterlen and Rupp, 1978). Grasses and shrubs form the ground cover at this locality. The species seems to be nocturnal and is probably less arboreal than species of the closely related genus *Dendromus.* Nothing is known of the life history or population status of this species. It is classified as **Rare.**

Steatomys jacksoni. This large species of African fat mouse is known from two localities in Ghana and southwestern Nigeria (Swanepoel and Schlitter, 1978; Anadu, 1979). Although little is known of the life history of this species, it probably is typical of the other species of *Steatomys.* All seem to be trap shy. They occur in most habitats within their geographic ranges so this species is probably not habitat specific. They are terrestrial and nocturnal, and construct burrows. Because of their ability to accumulate large fat stores in their bodies, these mice are sought by local people for food. This species might be affected by such hunting as it occurs in a region of Africa where the local people especially favor eating these mice. This species is classified as **Rare.**

Prionomys batesi. Dollman's tree mouse constitutes a monotypic genus. It is known from southern Cameroon and southern Central African Republic. It is nocturnal, and is probably partially arboreal. Arecently captured individual from Cameroon was taken by completely clearing a grass and shrub covered tract. Nothing is known of its life history or population status. It is classified as **Rare.**

Family Muridae

Pelomys hopkinsi. This small species of creek rat is known from only a few specimens from northern Rwanda and southern Uganda where it occurs in the edge vegetation of papyrus swamps. Its taxonomic status is uncertain; Delany (1975) believed it might be conspecific with *Pelomys isseli.* No information on population levels is known. It is classified as **Vulnerable** because of the tenuous nature of its preferred habitat and the small area of occurrence.

Pelomys isseli. This small species of creek rat occurs only on islands in Lake Victoria. It is presently known from Bugala, Bunyama, and Kome Islands, Uganda (Delany, 1975). Other islands have been sampled but no *P. isseli* were obtained. Delany (1975) reports that this species was found in scrub vegetation and forest edge some distance from the nearest swamp on Bugala Island. He reported two lactating females in April and a single female with four placental scars on Bugala Island. This species is classified as **Vulnerable** because of its occurrence only on islands in Lake Victoria.

Hylomyscus baeri. This white-bellied species of African climbing wood mouse occurs in southern Ivory Coast and Ghana (Guatan and Bellier, 1970; Robbins and Setzer, 1979). It is presently known from about 21 specimens even though extensive collecting of rodents has occurred in both countries in the last two decades. This is an arboreal species and more specimens may be obtained with studies utilizing arboreal trapping techniques. This species is classified **Rare** at this time.

Hylomyscus fumosus. This species of African climbing wood mouse is known from a few specimens from southern Cameroon, northern Gabon, and southwestern Central African Republic (Misonne, 1974; Robbins et al., 1980). It is a very distinct species although its generic allocation is still unclear. Based upon external appearances, namely its shortened tail, this species is probably less arboreal than other species of *Hylomyscus.* This species is classified as **Rare.**

Hylomyscus denniae. This species is a relict inhabiting forests on most of the mountains of East Africa. It occurs from the Ruwenzori mountains of eastern Zaire and southwestern Uganda southward to Mt. Rungwe, Tanzania, and adjacent high elevations of eastern Zambia, and eastward to Mt. Kenya, Kenya. It is poorly known in spite of its wide distribution throughout the mountains of this region. Delany (1975) reports up to six embryos in Zaire and lactating females in January. This species is classified as **Vulnerable.** The status of the montane forest will determine the future of this species.

Hylomyscus parvus. This pygmy species of African climbing wood mouse is known from a few localities in southern Cameroon, northern Gabon and Republic of Congo (Robbins et al., 1980; Missone, 1974). Ten were obtained from a single locality (Eseka) in Cameroon over a period of nearly two years so the species does not seem to be very rare. But it is **Insufficiently Known** at this time to classify it properly.

Praomys hartwigi. This species is known from a few specimens from the mountains of western Cameroon. It is a large species with large molars. Nothing is known about its life history. Extensive field work in this region of Cameroon during the past 20 years has not resulted in additional specimens of this montane *Praomys.* It is classified as **Rare** at this time.

Praomys morio. This species was described from Mt. Cameroon but the genus *Praomys* is taxonomically difficult. Consequently, lowland specimens from adjacent areas of Africa have been identified as *P. morio* but their identification as this species is suspect. If this species is only the montane form, it deserves some consideration. Rosevear (1969) reports that from collection records, it becomes more abundant at higher elevations. Degradation of these montane habitats in Cameroon is occurring, but this species is **Insufficiently Known** to determine with certainty what its status is at this time.

Praomys ruppi. This recently described species of African soft-furred rat (Van der Straeten and Dieterlen, 1983) occurs in the highlands of southwestern and central Ethiopia. It is a large species and is similar to the extremely common and widespread *P. albipes.* Nothing is known of its population biology. It is **Insufficiently Known** to classify otherwise at this time.

Mastomys pernanus. This pygmy species of multimammate mouse occurs in Tanzania and Kenya adjacent to Lake Victoria and in Rwanda (Kingdon, 1974). It may not belong in the genus *Mastomys* but the species itself is quite distinct. Because its area of occurrence is not well studied for small mammals, this species is classified as **Insufficiently Known.**

Malacomys verschureni. This pygmy species of long-footed rat is known from five specimens from three localities in northeastern and northwestern Zaire (Robbins and van der Straeten, 1982; Dieterlen and van der Straeten, 1984). The second specimen was taken in 1979 in an area along the edge of the Congo Basin forest block. These two localities are more than 1,000 km apart. The species is distinct from others in the genus. Nothing is known about its population levels or life history features. It is classified as **Insufficiently Known** at this time. With its wide distribution, other records may exist in unstudied collections in museums.

Zelotomys woosnami. Woosnam's desert rat occurs at widely scattered localities in northern Cape Province, South Africa, Botswana, and northern and eastern Namibia (De Graaff, 1981). It occurs primarily in the semi-arid environs of the Kalahari, especially in riparian *Acacia* areas. The species seems to be omnivorous. Although found only rarely, it has been studied extensively both in nature and in the laboratory. Smithers (1983) and De Graaff (1981) review the biology of the species. Numerous field studies of rodents and surveys have been carried out in Botswana, yet the species is found only rarely. It is classified as **Rare.**

Aethomys silindensis. The Selinda veld rat has been taken twice on Mt. Selinda, a mountain on the eastern border of Zimbabwe, and northwestern Mozambique. The original series of two was taken in 1938 and additional specimens were captured in the late 1960s (Smithers, 1983). They appear to occur in rocky areas with vegetation or with *Brachystegia* cover at an altitude between 700 and 800 m. Nothing is known of its population biology. The species is classified as **Rare.**

Lemniscomys mittendorfi. This montane species of African striped grass rat occurs in the mountains of western Cameroon. It is known only from the type locality near Lake Oku at about 2,300 m. It was originally described as a subspecies of the widespread *L. striatus* but is now thought to be a distinct species (van der Straeten and Verheyen, 1980). Nothing is known of its life history. It is classified as **Rare.**

Colomys goslingi. This species of African aquatic rodent is very distinct. It has a pelage of charcoal gray on the dorsum and pure white on the venter. It occurs throughout the Congo Basin forest block and central highlands of Ethiopia but is rarely taken at any given location. Its life history was reviewed by Kingdon (1974) and more recently by Dieterlen and Statzner (1981). The latter believed that this species is an active predator in limnetic ecosystems. Its distributional area, although generally broad, is restricted to the central African forest region along streams of running water in mainly primary forest. They considered the population levels to be quite low in any given area and the species to be rare. Only about 150-200 specimens exist in museums. The species is classified as **Rare.**

Thamnomys venustus. This large species of *Thamnomys* is known from eastern Zaire, southwestern Uganda, and Rwanda. It is arboreal and nocturnal, occurring in montane and bamboo forests. Delany (1975) reported the species up to 3 m in trees but also living in burrows. He reports an herbivorous diet. Rahm (1968) reported only 15 specimens taken at Lake Kivu, Zaire, in several years of trapping, or only 0.64% of the murids and insectivores captured. Kingdon (1974) considers it more common than these data indicate. It is still **Insufficiently Known** to classify properly at this time.

Grammomys comestes. This East African species of woodland mouse occurs generally in dense evergreen forest or forest edges and thickets in the woodland zone from southern Tanzania to Natal province of South Africa. It is very localized and difficult to tell apart from *G. dolichurus,* with which it has been recognized at times as a subspecies. Many literature records therefore may be misidentified *G. dolichurus*. De Graaff (1981) and Smithers (1983) have reviewed the biology of the species. Because of its predeliction for evergreen forests, the species is classified as **Vulnerable.**

Mylomys dybowskii. This species, commonly called the mill rat, occurs from Ivory Coast to western Kenya and south to western Tanzania along the northern edge of the Congo Basin forest block. It occurs in moist grasslands but not marshes up to 2,400 m. It seems to be trap shy and extremely localized. Kingdon (1974) believes that it might be a dominant species in these localized pockets. It is herbivorous, primarily diurnal, and nests on the ground surface. It is found primarily in sword grass, *Imperata cylindrica.* In spite of its wide distribution, it is poorly known. It is classified as **Insufficiently Known.**

Lophuromys cinereus. This species of harsh-furred rat is known only from the type locality in eastern Zaire. Nothing else is known of the species, but it is doubtful if this or the following species are ecologically similar to the common *L. sikapusi* orL. *flavopunctatus* (Dieterlen, 1976b). This species is **Insufficiently Known.**

Lophuromys medicaudatus. This species of harsh-furred rat occurs in the montane forests of eastern Zaire and western Rwanda, at about 2,000 m. The area of occurrence has been studied by a number of people but few specimens of this species have been obtained (Dieterlen, 1976b). Nothing is known of its life history. It is classified as **Rare.**

Lophuromys rahmi. This species is known from eastern Zaire and adjacent Rwanda at an altitude of about 2,000 m in disturbed forests. It seems to be rarely taken relative to the amount of trapping (Dieterlen, 1976b). Little is known about its population biology (Dieterlen, 1986b). It is classified as **Rare.**

Lophuromys melanonyx. This species of harsh-furred rat occurs at high altitudes in central and south central Ethiopia (Yalden et al., 1986). It inhabits the grasslands and moors at elevations around 3,000 m and higher. It is diurnal and a burrower. Nothing is known of population levels. It is classified as **Rare**.

Muriculus imberbis. This small mouse is endemic to the highlands of Ethiopia between 1,900 and 3,400 m on both sides of the Rift Valley (Yalden et al., 1976). This species is considered by Yalden et al. (1976) to have been declining since 1940

because of conversion of land to agricultural use. I took a single specimen near Addis Ababa in 1976 in agricultural land. If conversion of land is critical, this species must be classified as **Vulnerable**. Nothing is known of population levels of this species.

Mus. Eight species of this taxonomically very difficult group of African pygmy mice are considered to be **Insufficiently Known**. Five of these are known essentially only from the type localities. They are as follows: *Mus goundae:* northern Central African Republic; *Mus pasha:* northeastern Zaire; *Mus kasaicus:* southcentral Zaire; *Mus acholi:* northwestern Uganda; and *Mus wamae:* southeastern Kenya. All of these are poorly known so no information on population levels is available. An additional three species are somewhat more widespread in distribution, but still poorly known. These are as follows: *Mus callewaerti:* from southern and southeastern Zaire to central Angola; *Mus neavei:* from two localities in southeastern Zambia (Ansell, 1978); and *Mus oubanguii:* from southern Central African Republic. *M. callewaerti* is the largest for the genus and so is fairly readily identifiable (Petter and Matthey, 1975). *M. neavei* and *oubanguii* are similar to each other as well as to *Mus sorella* (Petter and Matthey, 1975).

Family Dipodidae

Allactaga tetradactyla. This African jerboa inhabits salt marshes and adjacent areas in coastal valleys of the western desert of Egypt. Inland, it is found on flat, clay desert in the vicinity of Bedouin barley fields and in areas where the bush *Anabasis articutata* predominates. Hoogstraal (1963) commented on the reduced numbers of this jerboa and its ecological restrictions. He noted that it had disappeared from some coastal valleys near Alexandria and that continued desert reclamation threatened it with extinction. It is presently classified as **Vulnerable.**

Family Bathyergidae

The African mole rats are endemic, fossorial rodents occurring from Ghana to Ethiopia and Kenya and thence southward to South Africa.

Cryptomys zechi. This West African representative of what is primarily a southern African genus is noted for its limited geographic distribution. The Togo mole rat occurs in a triangle between the Oti and Volta rivers on the Togo-Ghana border in a zone 100 km by 80 km (Rosevear, 1969). Based on museum specimens the species is probably common locally in spite of its limited distribution. It is classified as **Insufficiently Known** at this time.

Heliophobius spalax. This species has been included under *H. argenteocinereus,* a widespread species of mole rat in East and Central Africa. But the shape of the palate seems to indicate that it is a distinct species. It is known only from the slopes of Mount Kilimanjaro in Tanzania and adjacent Kenya. It is classified as **Rare** since the population may be small. Only single individuals occupy the tunnel systems of its congener *H. argenteocinereus.* However, a status survey may show that this taxon is only a variant of the latter or that it is locally very abundant.

Bathyergus janetta. The Namaqua dune mole rat occurs only in extreme northwestern Cape Province, South Africa, and across the Orange River in adjacent Namibia. It has a limited distribution in suitable soft sand dunes, its favored habitat. It does occur in certain inland valleys where suitable sand dunes occur. Until more data on its status are available, it is listed as **Vulnerable** since portions of both the South African and Namibian parts of its range are undergoing marked economic development in the form of mining and housing development. Meester (1976) listed it as **Rare** in the South African Red Data book.

Family Ctenodactylidae

Gundis comprise a group of four genera and five species of African rodents occurring only in northern Africa in the arid and semi-arid zones.

Felovia vae. This gundi occurs in southern Mauritania, eastern Senegal and western Mali. George (1974) studied a colony in Mali that has been known since 1885. Although not arboreal, this species seems to prefer rocky areas adjacent to dry tropical forest. It has been kept and bred in captivity. It is classified as **Insufficiently Known** but deserves attention because of its limited geographic range. With the deforestation and desertification of the Sahel, species such as this gundi may be affected rapidly before action can be taken. It is classified as **Vulnerable** until more information becomes available.

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Rodents of Conservation Concern in the Soviet Union Region

Viktor N. Orlov

Incorporating the most recent taxonomic treatments, there are 169 species of rodents living in the Soviet Union Region. This diverse assemblage includes 53 genera in 10 families. Of these, 71 species or 42% fall into Red Data Book categories of threat. In addition, two subspecies of the beaver *Castor fiber,* out of the three occurring in the Region, are listed as Endangered. These 73 taxa are listed below along with their Red Data Book categories.

Only 13 rodent taxa are currently listed in the Red Data Book of the Soviet Union, and one additional species is listed in the Red Data Book of the Ukraine. Three families have more than the average of 42% of their included species listed. These are the Dipodidae (13 of 30 species listed), Seleviniidae (1 out of 1), and the Spalacidae (7 of 7 species). A total of 17 species among the 73 taxa (23.3%) are categorized as Insufficiently Known.

List of taxa of concern

*Listed in the Red Data Book of the Soviet Union
**Listed in the Red Data Book of the Ukraine

Sciuridae

Spermophilus citellus (L., 1766)—**Rare**
Spermophilus xanthoprymnus (Bennet, 1835)—**Rare**
Spermophilus dauricus Brandt, 1843—**Rare**
Spermophilus musicus Men., 1832—**Rare**
Marmota sibirica (Radde, 1862)—**Rare**
Marmota menzbieri (Kasch., 1925)—**Vulnerable***

Castoridae

Castor fiber pohlei (Sen, 1929)—**Endangered***
Castor fiber tuvinicus (Lavrov, 1969)—**Endangered***

Gliridae

Eliomys quercinus (L., 1766)—**Insufficiently Known**
Myomimus personatus Ognev, 1924—**Insufficiently Known***

Seleviniidae

Selevinia betpakdalensis Bel. et Baz., 1938—**Rare***

Zapodidae

Sicista severtzovi Ognev, 1935—**Insufficiently Known**
Sicista betulina Pall., 1778 (2n = 44)—**Rare**
Sicista caucasica Vin., 1925—**Insufficiently Known**
Sicista kluchorica Sokolov, Baskev., Koval., 1981—**Insufficiently Known**
Sicista kasbegika Sokolov, Baskev., Koval., 1985—**Rare**
Sicista pseudonapaea Straut, 1949—**Rare**
Sicista caudata Thos., 1907—**Insufficiently Known**

Dipodidae

Cardiocranius paradoxus Sat., 1903—**Insufficiently Known***
Salpingotus crassicauda Vin., 1924—**Insufficiently Known***
Salpingotus heptneri Voron. et Smir., 1969—**Insufficiently Known***
Salpingotus pallidus Vor. et Shenb., 1984—**Insufficiently Known**
Pygerethmus vinogradovi (Vor., 1958)—**Rare**
Jaculus blandfordi (Mur., 1884)—**Rare***

Spalacidae

Nannospalax nehringi (Sat., 1898)—**Insufficiently Known**
Nannospalax leucodon (Nord., 1840)—**Rare****
Spalax giganteus Nehr., 1897—**Rare***
Spalax arenarius Rech., 1939—**Rare***
Spalax microphtalmus Guld., 1770—**Insufficiently Known**
Spalax polonicus Meh., 1909—**Rare**
Spalax graecus Nehr., 1898—**Rare***

Muridae

Apodemus speciosus (Temm., 1845)—**Rare**
Apodemus mystacinus (Danf. et Alst., 1877)—**Insufficiently Known**
Mus domesticus Rutty, 1772—**Rare**
Mus abbotti Wat., 1837—**Rare**

Cricetidae

Ellobius lutescens Thos., 1897—**Insufficiently Known**
Ellobius alaicus Vor., Lyap., Zak., et Ivan., 1969—**Rare**

Allocricetulus curtatus (Allen, 1925)—**Rare**
Cricetulus pseudogriseus Orlov et Iskh., **1974**—**Rare**
Phodopus roborovskii Sat., 1903—**Rare**
Mesocricetus raddei (Nehr., 1894)—**Rare**
Mesocricetus nigriculus (Nehr., 1898)—**Rare**
Mesocricetus brandti (Nehr., 1898)—**Rare**
Mesocricetus auratus (Wath., 1839)—**Rare**
Calomyscus mystax Kasch., 1925—**Rare***
Calomyscus urartensis Vor. et Kart., 1979—**Rare***
Meriones unguiculatus (Milne-Edw., 1867)—**Rare**
Myospalax myospalax (Laxm., 1773)—**Insufficiently Known**
Myospalax aspalax (Pall., 1776)—**Rare**
Myospalax psilurus (Milne-Edw., 1874)—**Rare**
Prometheomys shaposchnikovi Sat., 1901—**Rare**
Alticola tuvinicus Ogn., 1952—**Rare**
Alticola semicanus Allen, 1924—**Rare**
Alticola barakschin Bann., 1947—**Rare**
Clethrionomys sikotanensis (Tokuda, 1935)—**Rare**
Clethrionomys ponticus (Thos., 1908)—**Rare or Endangered**
Eolagurus luteus (Eversm., 1840)—**Endangered**
Dicrostonyx vinogradovi Ogn., 1948—**Rare**
Microtus dagestanicus Schidl., 1919—**Rare**
Microtus schelkovnikovi Sat., 1907—**Rare**
Microtus nasarovi Schidl, 1938—**Rare**
Microtus schidlowskii Arg., 1937—**Rare**
Microtus mujanensis Orlov. et Kow., 1975—**Rare**
Microtus sachalinensis Vas., 1955—**Rare**
Microtus evoronensis Kov. et Sokolov, 1980—**Insufficiently Known**

Meriones unguiculatus. **(Photo by L. LaFrance, courtesy of the Chicago Zoological Society.)**

Microtus transcaspicus Sat., 1905—**Rare**
Microtus mongolicus (Radde, 1861)—**Rare**
Lasiopodomys brandti (Radde, 1861)—**Rare**
Lasiopodomys mandarinus (Milne-Edw., 1871)—**Rare**
Chionomys gud (Sat., 1909)—**Rare**
Chionomys roberti (Thos., 1906)—**Insufficiently Known**

A Tentative List of Threatened Rodents in China and Japan with Notes on their Distribution, Habitat, and Status

Wang Sung, Zheng Changlin, and Tsuneaki Kobayashi

This tentative list of threatened rodents in China and Japan is prepared based on our recent investigation and assessment of the current situation of these species. It attempts to provide a brief account of the distribution, habitat, status, and causes of threat for each rodent species. The Order Rodentia, as a whole, is the most diversified group of mammals in China, including 10 families, 66 genera and 188 species, but comparatively speaking, much less attention has been paid to its conservation than the large mammals either in China, Japan, or elsewhere. Little information has been available in IUCN's *Red Data Book* or the CITES Appendices. Furthermore, there is a lot of confusion with rodent classification and nomenclature, causing additional difficulty in preparing such a list. It is hoped, however, that this preliminary and tentative list can be regarded as the first stage of the report of the Eastern Asian Region to the Rodent Specialist Group of SSC, and that it will promote further studies of rodent biology and related conservation measures to be taken in the future. In Japan, there are some 22 or so species in four families. For the remaining parts of the East Asian Region, data are still being solicited from local experts.

Of the 188 species of Chinese rodents, 43 are assessed to be in danger of extinction to some extent, and are listed below together with brief notes on their status, distribution and habitat. The main cause of threat is habitat destruction, while overexploitation and chemical control of rodent pests are endangering some species in different areas. The 43 species of concern represent 9 families and 34 genera and include 12 species of Sciuridae, 1 of Castoridae, 5 of Cricetidae, 9 of Arvicolidae, 8 of Muridae, 1 of Gliridae, 3 of Zapodidae, 5 of Dipodidae, and 1 of Hystricidae. Among them, the giant squirrel and various species of flying squirrels and other forest-dwellers are considered to be threatened with extinction due to the pressures of deforestation and uncontrolled hunting for their fur or traditional medicinal usage. Estimates of the numbers of these endangered species are not available. We believe that it is urgent to conduct a series of surveys on their status and life history features in order to develop and implement proper conservation strategies. We are grateful to Dr. Wang Youzhi for his kind assistance in sending information and advice for the preparation of the China list.

Ratufa bicolor. **(Photo by L. LaFrance, courtesy of the Chicago Zoological Society.)**

In Japan, 11 species are considered to be threatened, including 6 species of Sciuridae, 4 of Muridae, and 1 of Gliridae.

China

Sciuridae

Aeretes melanopterus. **Rare.** Hepei, Sichuan; Temperate forest.

Belomys pearsoni. **Rare.** Guangxi, Guangdong, Yunnan, Hainan, Guizhou, Sichuan, Henan; Tropical monsoon forest.

Hylopetes alboniger. **Endangered.** Sichuan, Guizhou, Yunnan, Hainan; Tropical and subtropical forest.

Hylopetes electilis. **Rare.** Fujian, Hainan; Subtropical and tropical monsoon forest.

Petaurista magnificus. **Rare.** South Tibet; Subtropical forest.

Petaurista pectoralis. **Indeterminate.** Taiwan; Subtropical forest.

Petaurista hainana. **Endangered**. Hainan; Tropical monsoon forest.
Trogopterus xanthipes. **Endangered.** Shanxi, Hepei, Sichuan, Yunnan, Tibet; Temperate and subtropical forest.
Callosciurus pygerythrus. **Vulnerable.** South Tibet, West Yunnan; Subtropical forest.
Callosciurus quinquestriatus. **Vulnerable.** West Yunnan; Subtropical forest.
Ratufa bicolor. **Endangered**. South Yunnan, South Guangxi, Hainan; Tropical rain and monsoon forest.
Sciurotamiasforresti. **Vulnerable.** West Yunnan; Subtropical forest.

Castoridae

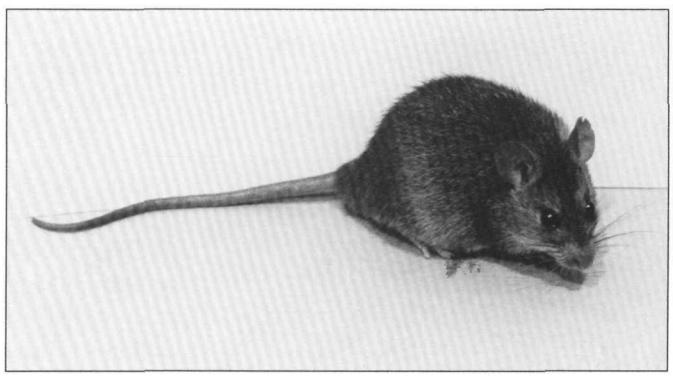
Castor fiber. **Endangered.** North Xinjiang; Northern coniferous forest.

Cricetidae

Brachiones przewalskii. **Rare.** Xinjiang; Desert and semi-desert.
Meriones chengi. **Rare.** Southeast Xinjiang; Desert and semi-desert.
Myospalax rothschildi. **Rare.** Hubei, Gansu; Forest and steppe.
Myospalax smithi. **Rare.** Ningxia, Gansu; Forest and steppe.
Typhlomys cinereus. **Rare.** Yunnan, Zhejiang, Anhui, Hunan, Guizhou, Guangxi, Fujian; Forest.

Arvicolidae

Arvicola terrestris. **Rare.** Xinjiang; Swamp.
Eothenomys olitor. **Rare.** Yunnan; Forest and steppe.
Eothenomys proditor. **Rare.** Sichuan, Yunnan; Forest and meadow.



Rattus exulans, **Polynesian rat. (Photo by E.J. Taylor, courtesy of the American Society of Mammalogists.)**

Eothenomys shanseius. **Rare.** Hebei, Shanxi; Forest and meadow.
Lagurus luteus przewalskii. **Indeterminate.** Inner Mongolia, Gansu, Qinghai, Xinjiang; Desert and steppe.
Microtus clarkei. **Indeterminate.** Tibet, Yunnan; Forest and steppe.
Microtus fuscus. **Rare.** Qinghai; Meadow and steppe.
Microtus mellicens. **Indeterminate.** Tibet, West Sichuan; Forest and steppe.
Proedromys bedfordi. **Rare.** Sichuan, Gansu; Forest and steppe.

Muridae

Chiropodomys gliroides. **Rare.** Yunnan; Tropical forest.
Hadromys humei. **Indeterminate.** West Yunnan; Tropical forest.
Hapalomys delacouri. **Endangered.** Hainan, Guangxi; Tropical forest.
Maxomys rajah. **Indeterminate.** West Yunnan; Subtropical forest.
Niviventer excelsior. **Indeterminate.** Sichuan; Forest.
Rattus exulans. **Indeterminate.** Xisha Islands; Forest.
Vandeleuria oleracea. **Rare.** West Yunnan; Forest.
Vernaya fulva. **Rare.** Sichuan, South Yunnan; Forest.

Gliridae

Dryomys nitedula. **Indeterminate.** North Xinjiang; Forest.

Zapodidae

Eozapus setchuanus. **Endangered.** Shaanxi, Gansu, Qinghai, Sichuan, Yunnan; Forest and steppe.
Sicista concolor. **Rare.** Gansu, Qinghai, Sichuan, Yunnan; Forest and meadow.
Sicista betulina. **Rare.** Heilongjiang; Forest and meadow.

Dipodidae

Allactaga bullata. **Rare.** Inner Mongolia, Ningxia, Gansu, Xinjiang; Desert-steppe.
Cardiocranius paradoxus. **Rare.** Inner Mongolia, Gansu, Xinjiang; Desert and steppe.
Euchoreutes naso. **Endangered.** Inner Mongolia, Gansu, Xinjiang; Desert and steppe.
Salpingotus crassicauda. **Rare.** Inner Mongolia, Gansu, Xinjiang; Desert and steppe.
Salpingotus kozlovi. **Rare.** North Shaanxi, Inner Mongolia, Ningxia, Gansu, Xinjiang; Desert and steppe.

Hystricidae

Hystrix brachyura yunnanensis. **Vulnerable.** Yunnan; Forest.

Japan

Explanation for status symbols:
* Rare or scarce in Kyushu and Shikoku.
** Protected by "Natural Monument Protection," which means that the species is listed in the "Cultural Properties Protection Act."
I—Population maintaining itself but at a very low level.
II—Habitat contracting by deforestation.
III—Endemic and very low in numbers.

Sciuridae

Petaurista leucogenis. Honshu, Kyushu, Shikoku; Coniferous or mixed forest. **II**
Pteromys volans. Hokkiado; Coniferous forest. **I**
Pteromys momonga. Honshu, Kyushu; Montane forest. **I**
Sciurus lis. Honshu, Kyushu, Shikoku; Montane forest. **I***
Sciurus vulgaris. Hokkaido; Mixed forest. **I**
Eutamias sibiricus. Hokkaido; Deciduous forest. **I**

Muridae

Micromys minutus. Western Honshu, Kyushu, Shikoku, Tsushima; Marsh bush or tall-grass. **II-III**
Tokudaia osimensis. Amami-Oshima, Tokuno-Shima, Okinawa; Forest. **III****
Lenothrix (Rattus) legata. Amami-Oshima, Tokuno-Shima, Okinawa; Mountain regions. **III****
Rattus rattus tanezumi. Northern Honshu; Rural cultivation. **III**

Gliridae

Glirulus japonicus. Honshu, Kyushu, Shikoku; Montane forest. **III****

The Status of Rodents in the Western Asian Region

Iyad A. Nader

Eighty-seven species belonging to seven families of rodents are known to occur in the Western Asian Region, and fifteen of them are endemic. Some of the species, including some of the endemic ones, are rare and quite restricted in their distribution. With habitat destruction, some of the local populations including some endemic subspecies may become rarer or be eliminated.

Eighteen taxa are treated in this report as being of conservation concern. One species in this Region is regarded as Endangered (E) and seventeen species and subspecies as Rare (R). It should be borne in mind that this list is provisional. Additions and deletions are likely to take place as additional information becomes available.

***Petaurista petaurista,* Giant flying squirrel. (Photo courtesy of the Chicago Zoological Society.)**

Family Sciuridae

Sdurus anomalus pallescens, (Gray, 1867) Persian squirrel. **R**. Iraq and Iran

Known from a few localities in northern Iraq, northwestern and western Iran (Harrison, 1972; Lay, 1967). Habitat destruction and deforestation are important factors in reducing the population.

Petaurista petaurista albiventer Gray 1834, Common giant flying squirrel (Gray, 1834). **R**. Afghanistan

Known from one locality in eastern Afghanistan (Hassinger, 1973: Sensa-Nuristan).

Family Hystricidae

Hystrixi. indica Kerr, 1792, Indian crested porcupine. **R**. Saudi Arabia

Known from a few scattered localities in Saudi Arabia (Harrison, 1972; Buttiker and Harrison, 1982). These animals are killed whenever they are seen, especially by farmers in the western and southwestern regions.

Family Dipodidae

Allactaga e. euphratica Thomas, 1881, Euphrates jerboa. **R**. Saudi Arabia

Known from one locality in northern and one in central Saudi Arabia (Lewis, et al., 1965: near Qaisumah; Saleh and Khan, 1984: Al Zulfi).

Jaculus o. orientalis, Erxleben, 1777, Greater Egyptian jerboa. **R**. Sinai and Palestine

Known from two localities, one in Sinai (Setzer, 1958: Ras Abu Rudies) and one in Palestine (Harrison, 1972: Tel Arad, Negev desert).

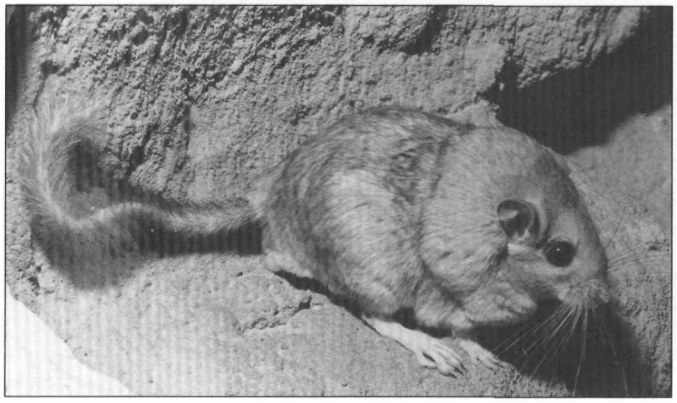
Family Muscardinidae

Eliomys melanurus (Wagner, 1839) Southwest Asian garden dormouse. **R**. Saudi Arabia

Known from two localities in Saudi Arabia (Vesey-Fitzgerald, 1953: near Madin Salih; Nader, et al., 1983: Wadi Dalaghan, 35 km southeast of Abha).

Dryomys nitedula phrygius Thomas, 1907, Forest dormouse. **R**. Syria

Known from two localities in northwestern Syria (Lehmann, 1965: Kastel Maaf and Slenfe). It is also known from several localities in Upper Galilee, Palestine (Harrison, 1972) and one locality in northwestern Iraq (Jawdet, 1977).



***Sekeetamys calurus,* Bushy-tailed jird. (Photo courtesy of the Chicago Zoological Society.)**

Dryomys laniger Felten and Storch, 1968. **R**. Turkey

Endemic to Turkey. Known from a few localities in southwestern Turkey (Felten, et al., 1973).

Family Muridae

Praomys fumatus yemeni, (Sanborn and Hoogstraal 1953), Yemen rock rat. **R**. Saudi Arabia and North Yemen

Known from three localities in North Yemen and three localities in southwestern Saudi Arabia (Sanborn and Hoogstraal, 1953; Buttiker and Harrison, 1982; Nader, et al., 1983).

Acomys whitei Harrison 1980. **R**. Dhofar/Oman

Endemic to Oman. Known only from three specimens collected from the type locality (Harrison, 1980: Khadrafi).

Erythronesokia bunnii Khajuria 1980. **E**. Iraq

Endemic to the marsh lands of southern Iraq. Known only from the type locality (Al Qurna/S. Iraq) and the Basra area with one specimen from each locality (Khajuria, 1980).

Family Cricetidae

Mesocricetus a. auratus (Waterhouse, 1839), Golden hamster. **R**. Syria

Known from a few localities in northwestern Syria (Harrison, 1972).

Gerbillus poecilops Yerbury and Thomas, 1895, Large Aden gerbil. **R**. Saudi Arabia

Endemic to Arabia. Known from two localities in Saudi Arabia (Morrison-Scott, 1939: Hadda near Taif; Harrison and Bates, 1984: 50 km north of Muhayl).

Gerbillus allenbyi Thomas 1918, Allenby's Gerbil. **R**. Palestine

Endemic to Palestine. Known from several localities in the coastal strip of Palestine (Harrison, 1972).

Meriones sacramenti Thomas, 1922, Buxton's jird. **R**. Palestine

Endemic to Palestine. Known from a few localities in the coastal plain of southern Palestine (Harrison, 1972).

Meriones meridianus (Pallas, 1773), Midday gerbil. **R**. Afghanistan

Known from two localities in northern Afghanistan (Gaisler, et al., 1967:25 km northwest of Kunduz; Hassinger, 1973: near Darkat on the Amu Darya, from owl pellets).

Sekeetamys calurus (Thomas, 1892), Bushy-tailed jird. **R**. Saudi Arabia

Known from three localities in central Saudi Arabia (Nader, 1974: about 36 km southwest of Riyadh; Buttiker and Harrison, 1982: Jebel Banban; Wadi Khumra).

Arvicola terrestris hintoni Aharoni, 1932, Water vole. **R**. Syria and Palestine

Known from the type locality (Antioch Lake, Syria—now Turkey) and from owl pellets in northern Palestine (Harrison, 1972).

Comments

In an area torn by wars and internal unrest, it is extremely difficult and quite unrealistic to put forth any recommendation to save the threatened rodent populations of this region since human life itself is endangered. However, the following comments might help to focus attention on some of the rare species in the region.

The new genus and species of the *Nesokia-like* taxon, *Erythronesokia bunnii*, is in grave danger of becoming extinct as a result of habitat destruction if the war resumes in its restricted habitat. A complete protection of the marshland of southern Iraq is needed to save this interesting rat once the threat of war is over.

The Persian squirrel, *Sciurus anomalus pallescens*, is threatened by habitat destruction and deforestation. The discontinous distribution of the species in northern Iraq and northwestern and western Iran is due to the isolated forest stands.

Allenby's gerbil, *Gerbillus allenbyi*, and Buxton's jird, *Meriones sacramenti*, may become threatened by the continous development of the coastal areas of Palestine.

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Rodent Conservation in the Indian Sub-continent

Ishwar Prakash

The diversity of rodent species in the Indian sub-continent is remarkable; 46 genera, 135 species and about 300 subspecies have been reported (Ellerman, 1961). Every bioclimatic zone of the region has some typical rodent taxon: marmots (*Marmota*) and hamsters (*Cricetulus*) in the Himalayas; bamboo rats (*Cannomys, Rhizomys*) in northern-eastern India to the Malayan archipelago; *Bandicota, Rattus,* and *Mus* in the plains; the porcupine (*Hystrix*) in rocky habitats; and the gerbils (*Gerbillus, Tatera, Meriones*) in the northwestern desert. Two peculiar genera of Murinae (*Diomys* and *Hadromys*) are practically confined to Manipur in northeast India. The woolly flying squirrel, *Eupetaurus,* and a microtine genus *Hyperacrius* (a vole) are endemic to Kashmir.

With the increasing human as well as livestock populations, more and more land has been falling under the plough in an effort to produce more food and fodder crops. As a result, a continuous food supply is available to rodents and, therefore, they are observed to be more abundant in the croplands as compared to habitats with natural vegetation. Availability of irrigation water has further helped the rodents to maintain a high population density (Prakash, 1978). As a result, the rodents in the Indian sub-continent are considered to be serious pests of agricultural crops, grassland, and forests, and not as being worthy of conservation. Most of the research being carried out in this tropical and subtropical zone is to control the rodent pests with a view to minimize losses to standing crops, stored foodgrains, and forage.

In recent years, with the human intervention which has altered the ecological scenario, the rodents are creating new problems: *Bandicota bengalensis,* a field rodent, has almost replaced the house rat *Rattus rattus* in the urban environment of the two metropolitan cities of Bombay and Calcutta (Deoras 1966, Seal and Banerji, 1966). *Tatera indica,* the Indian gerbil, (a reservoir of plague bacillus) has entered the desert towns (Prakash, 1981a, 1981b) and now occurs in close association with *Rattus rattus,* enhancing the spread of cutaneous leishmaniasis (Prakash, 1978). *Mus musculus,* the house mouse, which occurs mostly in residential premises, has come out into irrigated agricultural fields on a grand scale (Prakash, 1974) in the Punjab, possibly a case of atavism of habitat preference. In the northeastern hill region of India and northern Burma, the outbreaks of *Rattus rattus brunneusculus* are known to be associated with bamboo flowering having a 25 year cycle (Chauhan, 1981).

The region has been a venue of intense work on taxonomy of mammals (Blanford, 1888-91; Ellerman, 1961; Harrison, 1948; Hinton, 1915-22; Moore, 1960; Murray, 1884; Phillips, 1935; Roberts, 1977; Roonwal, 1950; Wroughton, 1918-1921). In recent years, however, rodent research in India and adjoining countries is more aimed towards rodent control (Barnett and Prakash, 1975; Bindra and Sagar, 1975; Deoras, 1966; Fernando, 1967; Fall, 1977; Fitzwater and Prakash, 1978; Greaves and Khan, 1978; Pingale et al., 1967; Posamentier and Elsen, 1984; Prakash, 1976, 1981b; Prakash and Ghosh, 1975; Sood and Guraya, 1976; Spillett, 1968; Srivastava, 1968; Wood, 1984).

In spite of all this work, information on the rodents of this region is not adequate to adjudge the status of poorly-known species, whether they are on the verge of extinction or are rare and should be considered for protection. In Sri Lanka, Santiapillai (pers. comm., 1984) considers *Mus fernandoni* a candidate for some kind of protected status. Likewise Tikader (1983) regards the crestless Himalayan porcupine (*Hystrix hodgsoni*) and the grizzled giant squirrel *Ratufa macroura dandolena* as vulnerable to extinction mainly due to shrinkage of their habitat.

There is, however, an urgent need to strengthen research work on the distribution and taxonomy of the rodents in the region, especially in the Himalayan ranges and mountain tracts in northern Burma to evaluate the status of these species on a quantitative basis.

Selected Rodent Species of Conservation Concern

A complete list of threatened rodents in the Indian sub-continent is not yet available. The following three species are known to be of conservation concern.

Ratufa macroura dandolena, Grizzled giant squirrel.

The following account is taken from Tikader (1983). The grizzled giant squirrel is of large size and measures 29-41 cm in head and body length. The tail is slightly longer than the body. Dorsally, it is brownish, grizzled with white; its underparts, cheeks, a patch on the neck, arms and legs are buff white, and

the top of the head, shoulder and the toes are blackish brown. Its tail varies from brown to dark brown and is edged with white hair throughout its length, sometimes tending to be wholly pale terminally.

Distribution
The grizzled giant squirrel occurs in the hill forests of Tamil Nadu and Sri Lanka.

Habits and habitat
This species inhabits high trees in dry deciduous and moist evergreen forests, rarely coming to the ground. It is diurnal in habit. Its diet consists of fruits, nuts, insects, etc. The young are born in a large, globular nest of twigs and leaves, constructed on a branch of a tree; the litter-size is one to two.

Status
The status of the Indian population of this squirrel is vulnerable, mainly due to the shrinkage of its habitat.

Hystrix hodgsoni, Crestless Himalayan porcupine.

The following account is taken from Tikader (1983). This porcupine is normally crestless, but occasionally possesses a few bristles, slightly longer than the neighboring spines on the back of the neck. It is a fairly large rodent, the head and body length being about 47 cm and the tail 27 cm or so. It has powerful feet with sharp claws. Its body and limbs are covered with short and grooved spines; intermixed with them are also a few longer spines of 20-25 cm on the loins and rump. The color of its body is dark brown, but blackish on the limbs. A narrow band of white-tipped spines forms a collar in front of its neck. The medial portion of its quills are dark brown; the tip or the base or both are whitish.

Distribution
Within the Indian sub-continental limits, it is known from the central and eastern Himalayas at elevations up to about 1,500 m, ranging from Nepal through Sikkim to Nagaland and Manipur. It is said to occur in lower Bengal also. It also occurs in Burma and other countries of southeastern Asia including China.

Habits and habitats
The crestless porcupine lives in burrows dug by itself in hill slopes or in flat ground among bushes. It is nocturnal and seclusive in habits. Its foraging hours are early and late quarters of the night and it feeds mainly on vegetative matter, such as roots, tubers, bulbs, etc. It is monogamous, breeds in spring, and the litter size is usually two.

Status
This species has greatly declined, mainly due to indiscriminate killing for its much esteemed meat and quills. At present, it is considered a rare animal.

Mus fernandoni, Ceylon spiny mouse.

This is an endemic species to Sri Lanka, confined to scrub, forest, and grasslands below 300 m, where it is rare (Santiapillai pers. comm., 1984).

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Rodents of Conservation Concern in the Southeast Asian Region

Illar Muul

For the majority of species of rodents in the Southeastern Asian Region, the conservation status is unknown. However, based on limited information, the rodent species can be roughly divided into groups that seem to be dependent, to various degrees, on the types of habitats in which they live. As these habitats are impacted by activities of humans, the effects on the rodent species may be positive or negative, depending on the type of activity. Partial cutting of a primary forest, for example, may result in an increase in some species of squirrels and a reduction in others.

In general, species associated with agricultural activities are those that are often scarce in primary forests and are therefore restricted to areas of natural or man-created disturbances. Further use of land for agricultural purposes encourages population growth of such species. Examples are: *Rattus exulans, R. tiomanicus, R. argentiventer, Bandicota indica,* and some species of *Mus.*

Plantations of coconut trees and fruit trees that characteristically grow in the midst of small villages give rise to population densities of some species of squirrels far beyond those found in undisturbed forests. Examples are: flying squirrels: *Hylopetes lepidus* (Java, Sumatra, Malay Peninsula), *Hylopetes phayrei* (Thailand, Laos), *Petaurista petaurista* (Java, Sumatra, Malay Peninsula, Thailand, Sri Lanka, Laos); and squirrels: *Callosciurus notatus* (Sunda region), *Callosciurus finlaysoni* (Indochinese region).

The species in greatest danger seem to be those that are obligatorily dependent on diminishing habitats, such as primary forests, and habitats restricted to islands that are being destroyed for agricultural development. The latter is particularly pertinent to some of the smaller Philippine islands and the smaller islands of Indonesia, some of which, such as the Mentawi Islands, have specialized endemic species. Some restricted montane species may also be susceptible since their habitats are also "islands". Primary forest species in some cases cannot tolerate much alteration of their habitats. The best example of this is *Pteromyscus pulverulentus,* a flying squirrel.

Because of these relationships, it is meaningless to discuss the preservation of certain species without also considering the preservation of sufficiently large areas of habitats in order to support viable populations. If habitat preservation is accomplished, no special efforts need to be made to preserve the rodent species living in them.

Callosciurus finlaysoni. **(Photo courtesy of the Chicago Zoological Society.)**

Research is required to establish the minimum area of habitat needed to support viable populations of threatened rodents in southeast Asia. These areas need to be sufficiently large to buffer the effects of floods, droughts, fire, and genetic and demographic problems that are characteristic of small populations.

It is clear, therefore, that habitat conservation is the highest priority for rodent conservation in southeast Asia, especially in centres of rodent diversity and endemism. Specifically, Borneo, especially Sabah, has many endemic species, in addition to species that are widespread throughout the Sunda region. Therefore, Sabah should be given a high priority for habitat preservation for the benefit both of endemic species and of more widespread species. Islands such as Sulawesi and the Philippine Islands are also of particular importance for unique endemic species.

For national parks and protected areas to be viable in the long-term, strategies must be developed to make them financially self-sufficient and able to compete on an economic basis with potential alternative uses of such lands. Unless such an economic basis is established, conservationists will often be fighting a losing battle with economic developers.

Selected Examples of Threatened Rodents in Southeast Asia

A complete list of the threatened rodents of southeast Asia is not yet available, and the following is a very preliminary account from just four countries.

Thailand

Several species appear to be relicts associated with specific habitats or islands. If these habitats are not preserved, the species are likely to perish.

Pteromyscus pulverulentus, smoky flying squirrel. Undisturbed lowland, primary forest.

Eothenomys melanogaster, Pere David's vole. Known only from the summit of Doi Inthanon.

Hapalomys longicaudatus, marmoset rat. Stands of bamboo (*Gigantochloa*).

Rattus remotus, island rat. Koh Samui, Koh Phangngan, Koh Tao (Islands), Gulf of Thailand.

Rattus neilli, Neill's rat. Limestone cliffs, Saraburi and Kanchanaburi.

Rattus hinpoon, limestone rat. Limestone cliffs, Saraburi and Lopburi.

Malaysia

One species appears to be associated only with primary lowland forests. Unchecked exploitation of these forests may cause the loss of this species. The remainder of rodent species have been collected in selectively cut forests or secondary forests.

Pteromyscus pulverulentus, smoky flying squirrel. Undisturbed lowland primary forest—not yet collected in Sarawak.

Malaysia has a good system of forest reserves (periodic selective cutting) and forest preserves (no cutting). A number of national parks have been established where wildlife is totally protected.

A few species are restricted to specialized habitats and are therefore vulnerable:

Hapalomys longicaudatus. Stands of bamboo (*Gigantochloa);* collected only in two localities: Kelantan and Pahang.

Haeromys margarettae, ranee mouse and *Haeromys pusillus.* These two species have been collected only on Mt. Kinabalu and in Sarawak, Borneo. They are extremely small (56-74 mm head and body length) and may have been missed by use of standard live-traps.

Indonesia

A number of insular species are of concern. The Mentawi Islands have several unique species that do not exist elsewhere, including one rodent:

Petinomys sipora, Small Sipora flying squirrel (misidentified as *Hylopetes,* Chasen, 1940). Only one specimen has been collected on Sipora Island.

The island of Sulawesi has a large number of endemic species, which, according to Dr. Guy Musser, are closely associated with, and probably dependent on, undisturbed forests. The montane species are particularly vulnerable as agriculture spreads in Sulawesi. Strong measures need to be taken to set aside forest preserves representing various habitat types on Sulawesi. Too little is known about the various species' individual dependence on undisturbed forest to predict which are the most threatened. At this point, it may be assumed that most of the native rodent species would disappear if the forests were destroyed.

Philippines

Many of the Philippine rodents have adapted to secondary forests during the course of human activities on these islands. According to Dr. Laurence Heaney, species unique to some of the small islands are vulnerable because of habitat destruction. The following are examples:

Crateromys paulus. Ilin Island (only one specimen collected).

Crateromys australis. Dingat Island (only one specimen collected).

Batomys spp. Dingat Island (two specimens collected).

Petinomys spp. Basilan Island (only one specimen collected).

The Rare and Endangered Rodents of the Australasian Region

J. H. Calaby and A. K. Lee

This report is concerned with the rodents of Australia (including Tasmania) and the main island of New Guinea, with some mention of the faunas of other island groups in the New Guinea area.

As is well known, the native land mammalian fauna of this region consists of only four Orders (if one considers the Marsupialia as a single order for convenience). These are monotremes, marsupials, bats, and rodents. Australia has a native land mammal fauna of approximately 260 species, 145 of which are marsupials and 56 (22%) are rodents. New Guinea, on the other hand, with only about one-tenth of the land area, has 175 native land mammals, including 55 marsupials and the same number (32%) of rodents. While the monotremes and marsupials are Gondwanan in origin, the ancestors of the rodents arrived later, over sea barriers, presumably from southeast Asia where the greatest diversity of their family, the Muridae, is found. The earliest fossil rodents in both Australia and New Guinea have been found in Pliocene sediments, the oldest being an Australian deposit radiometrically dated at about 4.5 mya (Hand, 1984).

In general, the Australian and New Guinean rodents have had separate evolutionary histories or adaptive radiations and there are few species in common. The majority of Australian species are adapted to the drier forests, woodlands and arid or semi-arid communities while those of New Guinea have proliferated in rain forest and montane habitats.

In both lands there has been a radiation of indigenous *Rattus*, the ancestors of which are generally believed to have arrived in the early Pleistocene. Further enquiry is needed on this matter, and also on the relationships of Australian and New Guinean *Rattus* to other *Rattus* in southeast Asia. Like the old endemic rodents, most Australian *Rattus* are adapted to grasslands and generally drier habitats while those of New Guinea are mostly rain forest and montane forms.

Although all Australian and New Guinean rodents belong to a single family, there is a great diversity among the genera and species. There are terrestrial, arboreal and amphibious forms, various groups being the ecological (or morphological, behavioral, or any combination of these) equivalents of other families of rodents in other zoogeographical regions, e.g. "ordinary" rats and mice, voles, squirrels, pack rats, jerboas, etc. They range in size from 10 g or less in the small Australian terrestrial mice, e.g. *Pseudomys delicatulus*, to the very large arboreal *Mallomys rothschildi* of New Guinea, may weigh up to 2 kg.

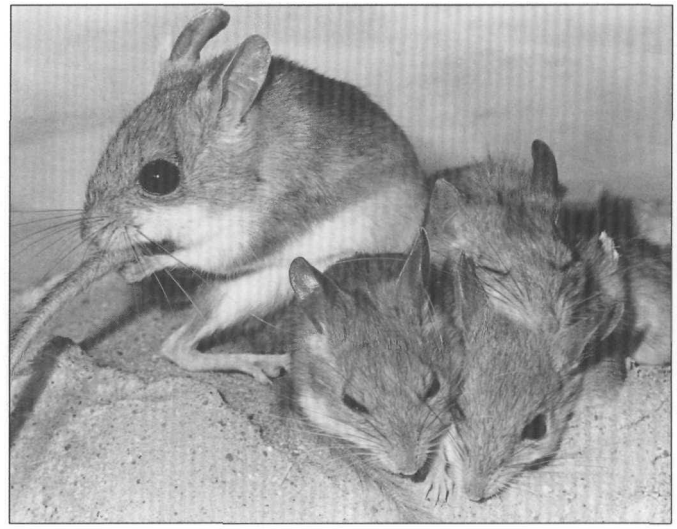
The older endemic rodents of Australia have low reproductive rates. They have small litters of precocious young, and long gestation and weaning periods. All have only 4 teats. In indigenous *Rattus*, teat numbers range from 6 to 12; however these species have lower reproductive rates than the species of *Rattus* introduced by Europeans (Yom-Tov, 1985). Little is known of reproductive rates of New Guinean species; however they appear to be generally similar to those of Australia. Older endemic rodents of New Guinea have 4 or 6 teats, but at least one has only 2.

Table 1. Genera and numbers of species of Australian and New Guinean native rodents.

Genus	Numbers of Species	
	Australia	New Guinea
Hydromys	1	3
Xeromys	1	
Crossomys		1
Parahydromys		1
Leptomys		1
Paraleptomys		2
Mayermys		1
Microhydromys		1
Neohydromys		1
Pseudohydromys		1
Notomys	9	
Mesembriomys	2	
Conilurus	2	1
Zyzomys	3	
Leporillus	2	
Pseudomys	ca 20	1
Leggadina	2	
Mastacomys	1	
Uromys	1	2
Melomys	4	10
Pogonomelomys		4
Xenuromys		1
Pogonomys	1	3
Chiruromys		4
Anisomys		1
Lorentzimys		1
Hyomys		1
Macruromys		2
Mallomys		1
Rattus	7	11

A list of genera and numbers of species of Australian and New Guinean rodents is given in Table 1. Although the two areas were connected by land for long periods down to less than 10,000 years ago, they have surprisingly few species in common. One species each of *Hydromys, Uromys, Pogonomys,* and *Rattus* have crossed from New Guinea to Australia, while one each of *Pseudomys, Conilurus,* and *Rattus* have gone in the reverse direction. *Melomys* is represented by four species in Australia and ten in New Guinea.

Modern general works on the Australian rodents and their natural history are Watts and Aslin (1981) and Strahan (1983), while the New Guinean species are dealt with by Menzies and Dennis (1979). The rare and endangered Australian forms have been discussed by Watts (1979) and Ride and Wilson (1982). George (1979) has given some information on those of New Guinea and comments on status are given by Menzies and Dennis (1979) and Ziegler (1982). Species on the official Australian list for the purposes of the Convention on International Trade in Endangered Species of Wild Flora and Fauna (CITES) are discussed by Burbridge and Jenkins (1984).



Notomys alexis. **(Photo by L. LaFrance, courtesy of the Chicago Zoological Society.)**

Rare and Endangered Species in Australia

The codes for the IUCN Red Data Book categories follow the species names (See Appendix 1).

Xeromys myoides, false water-rat. **K.**

Known from less than 20 specimens collected in vegetated swamps or tidal mangroves in the Northern Territory and Queensland. The majority were collected within the past fifteen years.

Notomys aquilo, northern hopping-mouse. **K.**

The only known stable population is on Groote Eylandt, Northern Territory, where the species burrows among stabilized dunes covered with scrub and *Triodia* hummocks. The type specimen was collected on Cape York prior to 1867 and is the only record for Queensland. A specimen was collected in 1973 in the Northern Territory about 70 km or so from the north coast in a rocky area with sandy soils vegetated with some *Triodia* hummocks and shrubs.

Notomys amplus, short-tailed hopping-mouse. **Ex.**

Presumed extinct. Known from only two specimens collected in the Northern Territory near its southern border, in 1896. Jaws and other skull fragments have been found in cave deposits in the central parts of Australia.

Notomys longicaudatus, long-tailed hopping-mouse. **Ex.**

Presumed extinct. The last specimens were collected in central Australia in 1901. A few other specimens were collected over a wide area of inland Australia during the previous sixty years.

Notomys macrotis, big-eared hopping-mouse. **Ex.**

Presumed extinct. Known from only two specimens, one from Moore River about 100 km north of Perth, collected in 1843, and the other unlocalized. It is closely related to the fawn hopping-mouse (*N. cervinus)* of eastern central Australia and may be no more than subspecifically distinct from that form (Mahoney, 1975).

Notomys mordax, Darling Downs hopping-mouse. **Ex.**

Presumed extinct, if it ever existed! The species was described in 1922 from a single damaged skull said to have been collected on the Darling Downs, Queensland, some time prior to 1846. Mahoney(1977) concluded that *N. mordax* was closest to Mitchell's hopping-mouse (*N. mitchellii*) but had larger teeth. Adequate series of the latter or indeed any other species *of Notomys* have not been examined for variation in morphometric characters.

Notomys fuscus, dusky hopping-mouse. **V.**

Found among dune systems in far southeastern Queensland and the adjacent part of South Australia where it burrows in the tops of dunes. This is only a fraction of its former distribution in inland Australia.

Conilurus albipes, white-footed tree-rat. **Ex.**

Presumed extinct. The species has not been recorded for more than a century. It formerly inhabited woodland communities in inland south-eastern Australia.

Zyzomys pedunculatus, central rock-rat. **I.**

Known from relatively few specimens collected in rocky parts of the central Australian ranges. It was last collected in 1960.

Leporillus conditor, greater sticknest rat. **R.**

This species formerly occupied a large area of inland southern Australia but has not been recorded on the mainland since 1933. A population estimated to be about 750 is found on the Franklin Islands, off South Australia. The islands are uninhabited by humans and have no exotic predators. The *Leporillus* are preyed on by owls and snakes but the population appears to be stable. The main danger to its survival may be the introduced ice-plant *Mesembryanthemum crystallinum,* which appears to

suppress the natural vegetation (Read, 1984). Research on the Franklin Islands population is continuing.

Leporillus apicalis, lesser sticknest rat. **Ex.**

Presumed extinct. Like its congener, this species also had a very large distribution in southern and central inland Australia. There have been no records since 1933.

Pseudomys gouldii, Gould's mouse. **Ex.**

Presumed extinct. Formerly widespread in the southern half of Australia. Last collected about 1930 in Western Australia. This and the next two species form a closely related trio and may eventually prove to be one species (A. Baynes, 1979; and pers. comm.).

Pseudomys praeconis, Shark Bay mouse. **R.**

Found only on Bernier Island off the central Western Australian coast in dune areas vegetated with dense *Triodia* hummocks and heathy shrubs. A specimen was collected on the adjacent mainland in 1858.

Pseudomys fieldi, Field's mouse. **Ex.**

Presumed extinct. Known only from a single damaged specimen collected at Alice Springs in central Australia in 1895. Jaws and skull fragments are common in cave deposits in the area.

Pseudomys shortridgei, heath rat. **V.**

The species was first collected in Western Australia in 1906 but is now presumed to be extinct there. In 1961 it was found in heathlands in southwestern Victoria and has been well studied in recent years. It colonizes suitable patches of heathlands that are regenerating after fire and flourishes until its food plants decline with advancing succession. Hence its continued existence requires a mosaic of heathlands of differing maturity following fires. Clearing of its habitats for agriculture and suppression of wild fire since European occupation have increasingly restricted its geographical range.

***Leporillus conditor,* Sticknest rat. (Photo by H. J. Aslin, courtesy of the Americal Society of Mammalogists.)**

Pseudomys occidentalis, western mouse. **R.**

A rare Western Australian species known from few specimens. Since 1971 it has been collected in five more or less isolated small nature reserves mostly surrounded by cleared farming land. The species occurs in shrublands and woodlands on sandy soils.

Pseudomys fumeus, smoky mouse. **R.**

This species still has a reasonably wide distribution in heathlands and dry forest in Victoria. Its optimum habitat is dominated by legumes, a result of regeneration following fires. The species is not endangered at the present time but unfortunately none of its known range is located within any existing protected area.

Pseudomys oralis, Hastings River mouse. **I.**

P. oralis was described in 1921 from two specimens collected in the 1840s, one labelled "Australia" and the other "Hastings River, New South Wales". No further specimens were collected until 1969 when a living example was trapped in south-eastern Queensland. A number of populations are now known in that region and in the adjacent northeastern part of New South Wales. The preferred habitat appears to be open *Eucalyptus* forest, with grass and bracken in the ground vegetation.

Pseudomys pilligaensis, Pilliga mouse. **I.**

This species was described in 1980 from a handful of specimens from the Pilliga Scrub, an area of low-nutrient sandy country carrying cypress pine (*Callitris*) forest and *Eucalyptus* with a sparse understory of heathy shrubs. Even in this limited area it appears to be sparsely distributed.

Leggadina lakedownensis, Lakeland Downs mouse. **R.**

Described in 1976 from a few specimens taken in northeastern Queensland when this species was said to be in large numbers in irrigated grassland and sorghum fields. A specimen collected in 1933 on the opposite side of Cape York Peninsula was recently recorded (Thomson, 1985). These specimens differ little morphologically from the widely distributed *L. forresti,* and it is debatable whether the karyological and electrophoretic characters that distinguish the two forms are of specific value (Baverstock et al., 1976). The specimens of these two forms used in these investigations were collected at localities 1,100-1,500 km from each other.

Melomys hadrourus, Thornton Peak melomys. **V.**

This distinctive species was described in 1984 from six specimens collected in upland tropical rain forest at two localities less than 10 km from each other in north Queensland. Rain forest in Australia occurs in discontinuous blocks, and it is probable that the species is restricted to one of these. Fortunately, one of the localities is in a national park.

Pogonomys sp., prehensile-tailed rat. **R.**

This species is another recent discovery in the north Queensland rain forest, the original specimen collected in 1974 and most of the subsequent ones being victims of house cats. It is now known from four localities spanning a distance of 600 km. In spite of a great deal of live-trapping, no specimen has so far been trapped. All specimens were collected by house cats, were shot in a spotlight beam, or came from owl pellets. Further study may show that the species is not endangered. The genus is of New Guinean origin. The Australian specimens have been identified as members of the New Guinean species (*P. mollipilosus*) but this is not yet certain.

Many reasons have been advanced for the decline or extinction of the various species. There is no doubt that long term climatic change is one of these. Studies of dated cave fossils have shown that there have been great changes in geographical distribution and declines in some species over many thousands of years from late Pleistocene into historical times. A few species, e.g. *Notomys macrotis* and *Conilurus albipes,* apparently disappeared relatively early in European times and possibly before the European impact had advanced very far. This suggests that they were declining before European interference. Usually the reasons suggested for the decline of species have to do with European activities, e.g. introduced predators (fox and cat), drastic habitat alteration caused by the introduced rabbit and domestic livestock, clearing of native vegetation for agriculture, and changes in the nature of fire regimes coincident with the change to European land management from the apparently less destructive Aboriginal one. There is little evidence one way or the other for these suggestions, and most of them are little more than speculations after the event.

There is little that can be done for those species for which no known population exists except to continue the search for possible remnant occurrences. For those species still known to be with us, detailed ecological studies of the animals in relation to the dynamics of their habitats are an urgent necessity, e.g. Cockburn's (1978, 1981) recent work on *Pseudomys shortridgei* and *P. fumeus.* Unfortunately, research on rodents is at a disadvantage in competition for funds with the supposedly more glamorous marsupials.

Rare and Endangered Species of New Guinea

While much more information is needed on the Australian forms, a great deal less is known of the rodents of New Guinea. The study of the mammalian fauna of this remarkable island is still in the exploratory phase. Many species are known from a small number of specimens from few localities. They may be rare or endangered, but it would be pointless to list them formally or give details of the occurrences. The many small species are not actively hunted by local people.

A few large species that have been known for a long time are collected only rarely and they may be actually rare. One example is *Xenuromys barbatus,* described in 1900. The species is known from a few specimens from widely scattered localities. However, a party of zoologists recently (1984) obtained a complete specimen and the jaws of six other individuals that had been collected by local hunters. The jaws of large rats are kept by those people for use as engraving tools (Flannery et al., 1985). The species may be more common than previously believed.

Some species may have restricted ranges as a result of habitat constraints. An example is the alpine *Rattus giluwensis.* This occurs in alpine grassland and in the fringes of moss forest immediately below, at altitudes ranging between 2,195 and 3,660 m on Mt. Giluwe and an adjacent range (Taylor et al., 1982). The species cannot be considered endangered as its cold mountain peak environment is not inhabited by people and it is visited only rarely by local hunters.

To the northeast and east of the mainland of New Guinea are a number of large islands and island groups; Admiralty Islands, Bismarck Archipelago (chiefly New Britain, New Hanover, and New Ireland), and the Solomon Islands. Compared with New Guinea these have impoverished rodent faunas but they do have endemic species. Of special interest is a minor secondary radiation of giant rats in the Solomon Islands (three species of *Uromys* and three of *Solomys*). There has been no recent work in these island groups and virtually the only data available on these rats are the original descriptions. We cannot even guess at their status.

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Appendix 1: IUCN Red Data Book Categories

Extinct (Ex)

Species not definitely located in the wild during the past 50 years (criterion as used by CITES).

Endangered (E)

Taxa in danger of extinction and whose survival is unlikely if the causal factors continue operating.

Included are taxa whose numbers have been reduced to a critical level or whose habitats have been so drastically reduced that they are deemed to be in immediate danger of extinction. Also included are taxa that are possibly already extinct but have definitely been seen in the wild in the past 50 years.

Vulnerable (V)

Taxa believed likely to move into the "Endangered" category in the near future if the causal factors continue operating.

Included are taxa of which most or all the populations are decreasing because of over-exploitation, extensive destruction of habitat or other environmental disturbance; taxa with populations that have been seriously depleted and whose ultimate security has not yet been assured; and taxa with populations that are still abundant but are under threat from severe adverse factors throughout their range.

Rare (R)

Taxa with small world populations that are not at present "Endangered" or "Vulnerable", but are at risk.

These taxa are usually localized within restricted geographical areas or habitats or are thinly scattered over a more extensive range.

Indeterminate (I)

Taxa known to be "Endangered", "Vulnerable" or "Rare" but where there is not enough information to say which of the three categories is appropriate.

Out of Danger (O)

Taxa formerly included in one of the above categories, but which are now considered relatively secure because effective conservation measures have been taken or the previous threat to their survival has been removed.

Insufficiently Known (K)

Taxa that are suspected but not definitely known to belong to any of the above categories, because of lack of information.

N.B. In practice, "Endangered" and "Vulnerable" categories may include, temporarily, taxa whose populations are beginning to recover as a result of remedial action, but whose recovery is insufficient to justify their transfer to another category.

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