

# Diversity, distribution, and conservation of endemic island rodents

Giovanni Amori<sup>a,\*</sup>, Spartaco Gippoliti<sup>b</sup>, Kristofer M. Helgen<sup>c,d</sup>

<sup>a</sup>*Institute of Ecosystem Studies, CNR-Institute of Ecosystem Studies, Via A. Borelli 50, 00161 Rome, Italy*

<sup>b</sup>*Conservation Unit, Pistoia Zoological Garden, Italy*

<sup>c</sup>*Division of Mammals, National Museum of Natural History, Smithsonian Institution, Washington, DC 20013-7012, USA*

<sup>d</sup>*Department of Biological Sciences, Division of Environmental and Life Sciences, Macquarie University, Sydney, New South Wales 2109, Australia*

Available online 8 June 2007

## Abstract

Rodents on islands are usually thought of by conservationists mainly in reference to invasive pest species, which have wrought considerable ecological damage on islands around the globe. However, almost one in five of the world's nearly 2300 rodent species is an island endemic, and insular rodents suffer from high rates of extinction and endangerment. Rates of Quaternary extinction and current threat are especially high in the West Indies and the species-rich archipelagos of Southeast Asia. Rodent endemism reaches its most striking levels on large or remote oceanic islands, such as Madagascar, the Caribbean, the Ryukyu Islands, the oceanic Philippines, Sulawesi, the Galapagos, and the Solomon Islands, as well as on very large land-bridge islands, especially New Guinea. While conservation efforts in the past and present have focused mainly on charismatic mammals (such as birds and large mammals), efforts specifically targeted toward less conspicuous animals (such as insular rodents) may be necessary to stem large numbers of extinctions in the near future.

© 2007 Elsevier Ltd and INQUA. All rights reserved.

## 1. Introduction

Conservation of biodiversity has been described as one of the principal environmental challenges for humanity (Wilson, 1992) and considerable scientific efforts are devoted to this issue. However, a gap exists between theory and practice in conservation activities. In reality, considerable attention and funds are directed toward a few species (or, more rarely, habitats) of high economic or emotional interest (Amori and Gippoliti, 2000), while vast portions of global biodiversity remain neglected or still unknown.

Here our attention is focused on island rodents, chosen especially because the dynamics of insular faunas are of high interest from an evolutionary and ecological standpoint. Animal populations on different islands, especially oceanic islands, are geographically and often genetically isolated, forming closed biological systems with reduced impacts from immigration. The combination of such

factors (genetic and ecological) has produced the high rates of endemism normally observed in island systems.

Impacts from human activities have caused the degradation of many habitats and the decline of many species, in some cases leading to their extinction. Particularly vulnerable are mammal populations on islands. Among insular mammals, rodents deserve special attention because of their relatively high degree of representation in insular faunas, high rates of endemism, general lack of information on insular rodent population status, and little attention paid hitherto to their conservation compared to birds, larger mammals, and some reptiles in insular contexts. Ironically, rodent species in island ecosystems are often considered only in a negative context, because of the well-known ecological damage wrought by a few widely introduced pest species (e.g. *Rattus rattus*, *R. norvegicus*, *R. exulans*, and *Mus musculus*), while the fate of endemic species is often overlooked. In fact, islands maintain an enormous and largely irreplaceable heritage of rodent biological diversity (Ceballos and Brown, 1995), and the aim of this paper is to highlight the diversity of island endemic rodents and provide some remarks on conservation priorities.

\*Corresponding author. Tel.: +39 06 49918013; fax: +39 06 4457516.

E-mail address: [giovanni.amori@uniroma1.it](mailto:giovanni.amori@uniroma1.it) (G. Amori).

## 2. Insular rodents: how many, and where?

For the purposes of this review, we compiled selected summary statistics on insular rodents worldwide. Rodents from all islands are included, with New Guinea considered as the largest island. Islands are grouped according to the major zoogeographical regions. Taxonomic judgements and distributional data are derived from Wilson and Reeder (2005), in many cases supplemented with information from newer publications on endemic island species (e.g. Goodman et al., 2005; Helgen, 2005a, b; Rickart et al., 2005; Cucchi et al., 2006). We include in our compilation only those species that are extant or that we regard as highly likely to be extant, and exclude those species that are well-established as extinct or that we regard as highly likely to be extinct (see below). Judgements regarding species extinctions rely largely on MacPhee and Fleming (1999), Amori and Clout (2003), and Wilson and Reeder (2005). Threatened genera were identified according to the criteria by Amori and Gippoliti (2001, 2003). We level a special focus on the genus rank in regional and other comparisons of rodents. When applied consistently and in a phylogenetic framework, as we feel is generally done appropriately across Rodentia, the genus represents a convenient means for measuring biodiversity (Williams and Gaston, 1994), and can be very useful in conservation planning aimed at establishing the most pressing priorities (Russell et al., 1998). Moreover, this taxonomic rank is useful in broad-scale comparisons because, though always dynamic (e.g. Weksler et al., 2006), it is usually more stable than taxonomy at the species level, especially for such a speciose group as Rodentia (Helgen, 2003a).

Rodent species restricted to islands include at least 388 extant species (17.5% of all extant rodent species), classified in 127 genera and 10 families. Species of Muridae (258 species) and Sciuridae (54 species) are most widespread on islands. There are 83 currently recognized rodent genera entirely endemic to islands (corresponding to 197 species in total), representing 17% of all rodent genera (Table 1). Only one rodent family, Capromyidae (the hutias), is found only on islands, being endemic to the Caribbean region.

It is well known that species richness typically scales according to island size (MacArthur and Wilson, 1967). Degree of endemism, on the other hand, is less closely linked to an island's size (Myers and De Grave, 2000; Fattorini, 2006) but rather to its remoteness and the duration of its isolation, and thus to its geological history. For example, Madagascar, isolated from all other landmasses for the last 85 million years, shows an index of 100% endemism in its native rodent fauna (owing apparently to the infrequency of dispersal to and from the island). Meanwhile, Borneo, which has been periodically connected during times of lowered sea levels in the late Quaternary with other land areas on the Sunda Shelf (including mainland Asia, Sumatra, and Java), has an index of only 12%. Islands or archipelagos with highest

Table 1

A basic summary of extant rodent genera endemic to islands

n species	Genus	Family	Zoogeographical region
2	<i>Capromys</i>	Capromyidae	Neotropical
2	<i>Geocapromys</i>	Capromyidae	Neotropical
5	<i>Mesocapromys</i>	Capromyidae	Neotropical
3	<i>Mysateles</i>	Capromyidae	Neotropical
1	<i>Plagiodontia</i>	Capromyidae	Neotropical
2	<i>Nesoryzomys</i>	Cricetidae	Neotropical
1	<i>Glirurus</i>	Gliridae	Palearctic
1	<i>Abeomelomys</i>	Muridae	Australian
1	<i>Anisomys</i>	Muridae	Australian
2	<i>Baiyankamys</i>	Muridae	Australian
3	<i>Chiruromys</i>	Muridae	Australian
2	<i>Coccymys</i>	Muridae	Australian
1	<i>Crossomys</i>	Muridae	Australian
2	<i>Hyomys</i>	Muridae	Australian
1	<i>Leporillus</i>	Muridae	Australian
3	<i>Leptomys</i>	Muridae	Australian
1	<i>Lorentzimys</i>	Muridae	Australian
2	<i>Macruromys</i>	Muridae	Australian
4	<i>Mallomys</i>	Muridae	Australian
2	<i>Mammelomys</i>	Muridae	Australian
2	<i>Microhydromys</i>	Muridae	Australian
1	<i>Parahydromys</i>	Muridae	Australian
2	<i>Paraleptomys</i>	Muridae	Australian
9	<i>Paramelomys</i>	Muridae	Australian
2	<i>Pogonomelomys</i>	Muridae	Australian
5	<i>Pogonomys</i>	Muridae	Australian
1	<i>Protochromys</i>	Muridae	Australian
5	<i>Pseudohydromys</i>	Muridae	Australian
4	<i>Solomys</i>	Muridae	Australian
1	<i>Xenuromys</i>	Muridae	Australian
1	<i>Abditomys</i>	Muridae	Oriental
1	<i>Anonymomys</i>	Muridae	Oriental
10	<i>Apomys</i>	Muridae	Oriental
2	<i>Archboldomys</i>	Muridae	Oriental
4	<i>Batomys</i>	Muridae	Oriental
3	<i>Bullimus</i>	Muridae	Oriental
6	<i>Bunomys</i>	Muridae	Oriental
2	<i>Carpomys</i>	Muridae	Oriental
5	<i>Chrotomys</i>	Muridae	Oriental
4	<i>Crateromys</i>	Muridae	Oriental
4	<i>Crunomys</i>	Muridae	Oriental
1	<i>Diplothrix</i>	Muridae	Oriental
2	<i>Echiothrix</i>	Muridae	Oriental
1	<i>Eropeplus</i>	Muridae	Oriental
3	<i>Haeromys</i>	Muridae	Oriental
1	<i>Kadarsanomys</i>	Muridae	Oriental
1	<i>Komodomys</i>	Muridae	Oriental
1	<i>Lenomys</i>	Muridae	Oriental
2	<i>Limnomys</i>	Muridae	Oriental
3	<i>Margaretamys</i>	Muridae	Oriental
1	<i>Melasmothrix</i>	Muridae	Oriental
1	<i>Nesoromys</i>	Muridae	Oriental
1	<i>Palawanomys</i>	Muridae	Oriental
1	<i>Papagomys</i>	Muridae	Oriental
1	<i>Paruromys</i>	Muridae	Oriental
1	<i>Paulamys</i>	Muridae	Oriental
2	<i>Phloeomys</i>	Muridae	Oriental
1	<i>Pithecheirops</i>	Muridae	Oriental
2	<i>Rhynchomys</i>	Muridae	Oriental
1	<i>Sommeromys</i>	Muridae	Oriental
1	<i>Srilankamys</i>	Muridae	Oriental
7	<i>Taeromys</i>	Muridae	Oriental

Table 1 (continued)

n species	Genus	Family	Zoogeographical region
2	<i>Tarsomys</i>	Muridae	Oriental
2	<i>Tateomys</i>	Muridae	Oriental
3	<i>Tokudaia</i>	Muridae	Oriental
1	<i>Tryphomys</i>	Muridae	Oriental
2	<i>Brachytarsomys</i>	Nesomyidae	Afrotropical
2	<i>Brachyuromys</i>	Nesomyidae	Afrotropical
10	<i>Eliurus</i>	Nesomyidae	Afrotropical
1	<i>Gymnuromys</i>	Nesomyidae	Afrotropical
1	<i>Hypogeomys</i>	Nesomyidae	Afrotropical
3	<i>Macrotarsomys</i>	Nesomyidae	Afrotropical
1	<i>Monticolomys</i>	Nesomyidae	Afrotropical
3	<i>Nesomys</i>	Nesomyidae	Afrotropical
2	<i>Voalavo</i>	Nesomyidae	Afrotropical
3	<i>Exilisciurus</i>	Sciuridae	Oriental
1	<i>Glyphotes</i>	Sciuridae	Oriental
2	<i>Hyosciurus</i>	Sciuridae	Oriental
1	<i>Nannosciurus</i>	Sciuridae	Oriental
5	<i>Prosciurillus</i>	Sciuridae	Oriental
1	<i>Rheithrosciurus</i>	Sciuridae	Oriental
1	<i>Rubrisciurus</i>	Sciuridae	Oriental

oceanic islands have an endemism index of >65%, while all land-bridge islands have an endemism index  $\leq$ 65%. Amongst oceanic islands, the Solomon Islands, Lesser Sundas, and Moluccas have unexpectedly low endemism indices, which we suggest can be explained in part by two factors—each of these archipelagos has poorly inventoried modern faunas, and they share an analogous history of considerable Holocene extinction (Musser, 1981; Flannery, 1995; Aplin and Helgen, in litt.). The low endemism index for the Galapagos derives in part from a history of Quaternary extinction events as well.

On land-bridge islands, such as Sri Lanka, Borneo, Java, Sumatra, Taiwan, Palawan, and New Guinea, endemism (especially generic-level endemism) is usually concentrated in highland areas, which retained discrete upland habitats even while lowland habitats on these islands were contiguous with larger areas across land bridges. On large oceanic islands, such as Madagascar, the West Indies, Sulawesi, and the oceanic Philippines, endemic species and genera can be found with similar frequency in lowland and upland habitats.

### 3. Island extinctions and pseudo-endemism

Extinct species are excluded from our calculations of modern rodent biodiversity on islands, but have much to teach us about the severity of extinction on islands in the face of ecological disturbances (Tables 2 and 3). Among mammals, Rodentia is the most diverse order and the order that has lost the most species in the modern era (MacPhee and Fleming, 1999). The total number of recorded insular rodent species extinctions, including those found by the first human settlers on oceanic islands, is at least 80 (Woods, 1989; Flannery, 1995; Alcover et al., 1998; Wilson and Reeder, 2005). Of these, at least 10 insular rodent species have become extinct during the last 150 years (Table 3). However, these estimates must be considered as highly preliminary. Many species, undoubtedly, disappeared without leaving any records, and many supposedly extant species are still known only from one or a few specimens (cf. Wilson and Reeder, 2005), often collected many years ago, and may be extinct (Table 3). All Quaternary endemic rodent species of Mediterranean islands went extinct in historical or prehistoric times (Palombo, 2005; Masini et al., this volume), the only clear exception being the recently described *Mus cypriacus* (Cucchi et al., 2006) (the systematic status of several other species, like *Dipodillus zakariai*, requires further clarification from genetic and paleontological investigations; Appendix A). The islands of the Neotropical region, particularly the West Indies, have suffered the highest losses during the last 7000 years at the genus level, with extinction of 14 insular rodent genera and at least 50 species (Woods, 1989; Alcover et al., 1998; MacPhee and Fleming, 2003; see Table 2). Indeed, an entire endemic West Indian family of the Late Quaternary, the relatively large-bodied Heptaxodontidae (represented by five

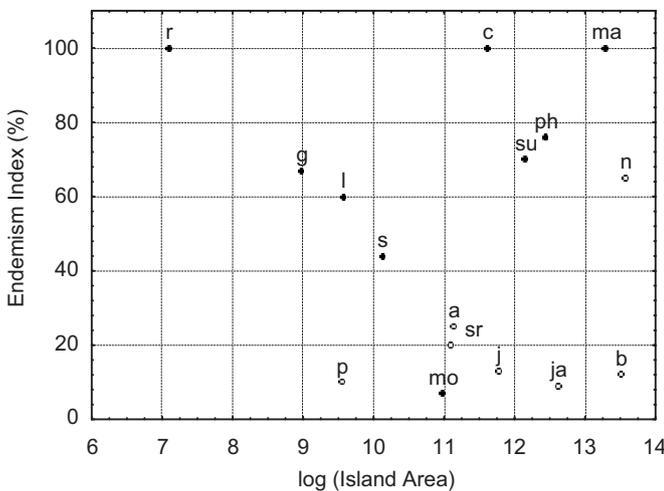


Fig. 1. Endemism indices for islands with endemic rodent genera. Degree of endemism (particular generic-level endemism) is only loosely related to island size, but instead largely dependent on relative isolation. Each island or archipelago in the plot is identified by an identifying descriptor; oceanic islands are labeled with a solid dot, land-bridge islands with an open dot. r = Ryukyus, c = Caribbean; ma = Madagascar; ph = oceanic Philippines; su = Sulawesi; g = Galapagos; l = Lesser Sundas; n = New Guinea; s = Solomons; sr = Sri Lanka; p = Palawan; mo = Moluccas; j = Java; ja = Japan; b = Borneo; a = Australian coastal islands.

indices of extant higher-taxonomic rodent endemism (calculated here as the proportion of endemic species also classified in endemic genera) are Madagascar, the Caribbean, the Ryukyu Islands, the oceanic Philippines, Sulawesi, the Galapagos, New Guinea, the Lesser Sundas, and the Solomon Islands, followed by Australia's coastal islands, Sri Lanka, Java, Borneo, Palawan, Japan, and the Moluccas (Fig. 1; Appendix A). (All remaining islands do not have endemic genera, only endemic species.) Most

Table 2  
Extinct late Pleistocene and Holocene rodent genera endemic to islands

Genus	Family	<i>n</i> spp.	Zoogeographical region and geographic range
<i>Rhagamys</i>	Muridae	1	Palearctic (Sardinia and Corsica, Mediterranean)
<i>Malpaisomys</i>	Muridae	1	Palearctic (Canary islands)
<i>Canariomys</i>	Muridae	2	Palearctic (Canary islands)
<i>Hypnomys</i> <sup>a</sup>	Gliridae	2	Palearctic (Balearic islands)
<i>Coryphomys</i>	Muridae	1	Oriental (Timor, Lesser Sundas)
<i>Spelaeomys</i>	Muridae	1	Oriental (Flores, Lesser Sundas)
<i>Noronhomys</i>	Muridae	1	Neotropical (Fernando da Noronha, Brazil)
<i>Megaoryzomys</i>	Cricetidae	1	Neotropical (Galapagos)
<i>Megalomys</i>	Cricetidae	4	Neotropical (Lesser Antilles, West Indies)
<i>Brotomys</i>	Echimyidae	2	Neotropical (Hispaniola, West Indies)
<i>Boromys</i>	Echimyidae	2	Neotropical (Cuba, West Indies)
<i>Heteropsomys</i>	Echimyidae	2	Neotropical (Puerto Rico, West Indies)
<i>Puertoricomys</i>	Echimyidae	1	Neotropical (Puerto Rico, West Indies)
<i>Hexolobodon</i>	Capromyidae	1	Neotropical (Hispaniola, West Indies)
<i>Isolobodon</i>	Capromyidae	2	Neotropical (Hispaniola, West Indies)
<i>Rhizoplagiodontia</i>	Capromyidae	1	Neotropical (Hispaniola, West Indies)
<i>Quemisia</i>	Heptaxodontidae	1	Neotropical (Hispaniola, West Indies)
<i>Elasmodontomys</i>	Heptaxodontidae	1	Neotropical (Puerto Rico, West Indies)
<i>Xaymaca</i>	Heptaxodontidae	1	Neotropical (Jamaica, West Indies)
<i>Amblyrhiza</i>	Heptaxodontidae	1	Neotropical (Anguilla and St Martin, West Indies)
<i>Clidomys</i>	Heptaxodontidae	1	Neotropical (Jamaica, West Indies)
<i>Tainotherium</i>	<i>Incerta sedis</i> <sup>b</sup>	1	Neotropical (Puerto Rico, West Indies)

<sup>a</sup>Considered by some authors as a synonym of *Eliomys*.

<sup>b</sup>See Turvey et al. (2006).

genera: Woods, 1989; MacPhee and Fleming, 2003; Woods and Kilpatrick, 2005), became extinct within recent millenia. Large size and inexperience with native mammalian predators are probably important correlates of extinction vulnerability in island rodents. Other correlates of extinction may be linked to habits. Of rodent species classified in genera that are wholly endemic to islands, 75 (38.1%) have arboreal/scansorial habits, while 122 (61.9%) are largely terrestrial (or semi-aquatic); there are no statistical differences in the breakdown of these basic habits between zoogeographical regions. There is some evidence that, to date, terrestrial rodents have suffered greater rates of insular extinction in the modern era (e.g. in the Solomon Islands; Flannery, 1995). However, it is evident that most of the arboreal/scansorial species of endemic insular genera are today restricted to areas where the rate of the deforestation is rapidly progressing (e.g. Brooks et al., 1997, 1999, 2002), such that further losses are to be expected without urgent conservation attention.

We highlight a particularly interesting category of rodents of grave conservation concern: those that must now be classified as “pseudo-endemic” to islands. Steadman (1997) developed the concept of pseudo-endemism in the Pacific avifauna to refer to species formerly widespread which today, after anthropogenic impacts, survive in a much restricted insular range, generally occurring on a single island or small archipelago (i.e. short-range “endemism” owing to anthropogenic rather than biogeographic determinants). Pseudo-endemism applies most obviously to two endangered Australian rodents, *Pseudomys fieldi* and

*Leporillus conditor*, which were formerly widespread across parts of the Australian continent but now survive only as small relictual populations on a handful of coastal islands that remain free of introduced mammalian predators and other disturbances (Johnson, 2006). In the future, without successful conservation initiatives, many other threatened species of rodents that are currently “continental” in distribution could follow this Australian path to become insular “pseudo-endemics” on small coastal islands. Rodent pseudo-endemism also applies to the Galapagos, where *Nesoryzomys indefessus* and *Oryzomys galapagoensis* were formerly distributed across multiple islands but today survive only on the islands of Fernandina and Santa Fe, respectively (Dowler et al., 2000; Musser and Carleton, 2005).

Another category of insular rodents that require urgent attention from biologists are those species which are rare, occur in areas of high threat, and have not been encountered by biologists in many years—species that have a high probability of already being extinct (see especially Table 3). These taxa, concentrated in Cuba and the Solomon Islands, are urgent priorities for detailed study. If not yet extinct, the critical time for research and conservation efforts on their behalf is at hand.

#### 4. Conservation priorities and surrogate species

At least 28 rodent genera endemic to islands are threatened with extinction, according to the criteria by Amori and Gippoliti (2001) (Table 4). The highest number

Table 3  
Recent rodent extinctions (documented and potential)

Documented insular rodent species extinctions in the last 150 years (excluded from Appendix A)	
Cricetidae	
<i>Megalomys desmarestii</i> (Fischer, 1829)	Lesser Antilles, Caribbean
<i>Megalomys luciae</i> (Major, 1901)	Lesser Antilles, Caribbean
<i>Oligoryzomys victus</i> (Thomas, 1897)	Lesser Antilles, Caribbean
<i>Nesoryzomys darwini</i> Osgood, 1929	Galapagos (Ecuador)
<i>Oryzomys nelsoni</i> Merriam, 1898	Tres Marias (Mexico)
<i>Neotoma bunkerii</i> Burt, 1932	Gulf of California (Mexico)
<i>Peromyscus pembertoni</i> Burt, 1932	Gulf of California (Mexico)
Muridae	
<i>Rattus macleari</i> (Thomas, 1887)	Christmas Island (Australia)
<i>Rattus nativitatis</i> (Thomas, 1889)	Christmas Island (Australia)
Capromyidae	
<i>Geocapromys thoracatus</i> (True, 1888)	Little Swan Island (Honduras)
Insular rodent species possibly extinct, but in need of further verifying study (included in Appendix A)	
Muridae	
<i>Crateromys paulus</i> Musser and Gordon, 1981	Philippines
<i>Melomys spechti</i> Flannery and Wickler, 1990	Solomon Archipelago (Papua New Guinea)
<i>Solomys salamonis</i> (Ramsay, 1883)	Solomon Archipelago (Solomon Islands)
<i>Uromys imperator</i> (Thomas, 1888)	Solomon Archipelago (Solomon Islands)
<i>Uromys porculus</i> Thomas, 1904	Solomon Archipelago (Solomon Islands)
Capromyidae	
<i>Mesocapromys nanus</i> (G.M. Allen, 1917)	Greater Antilles (Cuba)
<i>Mesocapromys sanfelipensis</i> (Varona and Garrido, 1970)	Greater Antilles (Cuba)
<i>Mysateles garridoi</i> (Varona, 1970)	Greater Antilles (Cuba)

of threatened genera is found within the Oriental region: 17 of the 27 threatened genera (63.0%), representing 27 species. However, great interest is also raised by the last survivors of the endemic Caribbean capromyoid radiation, as so many species, including all members of a whole family, have been lost already (Morgan and Woods, 1986; Woods and Kilpatrick, 2005). The remaining survivors of major Holocene extinction events, such as those that swept through the Caribbean, Lesser Sunda, and Galapagos archipelagos, must be considered high priorities for conservationists.

In a previous paper, Amori and Gippoliti (2001) identified the following insular regions as the most urgent conservation priorities for rodent conservation at the ecoregional level: the Philippines (especially Luzon), New Guinea, Sulawesi, and the Caribbean (especially Hispaniola). As in many other regions, recent surveys and taxonomic revisions continue to increase the number of rodent genera and species recognized in Madagascar (Goodman et al., 2005; Carleton and Goodman, 2007), revealing the island as an emerging priority in the context of global rodent conservation efforts.

Conservation strategies are usually centered on flagship species such as large mammals or charismatic birds (Caro et al., 2004; Helgen and Groves, 2005). On larger islands, such mammals and birds may act as “umbrella” taxa for the conservation of large tracts of forest (i.e. Philippine eagle *Pithecopogon jefferyi*, New Guinean tree kangaroos *Dendrolagus* spp., Javan gibbon *Hylobates moloch*, rhinoceros *Rhinoceros sondaicus*, etc.). However, reliance on flagship taxa is not always an effective path to conservation of less charismatic species in the same areas. Conservationists should remember the cases of rodents like *Hypogeomys* on Madagascar and *Nesoryzomys* on Galapagos, which are declining even while some targeted flagship species are flourishing or stable in these areas (Dowler et al., 2000; Sommer and Hommen, 2000). Further, on smaller and more remote islands, large mammals and birds may be absent. Here, endemic rodents may serve as useful indicator species for overall island biodiversity conservation. In some of these cases (e.g. Solomon Islands, Ryukyu Islands, and Lesser Sundas) species-specific strategies are absolutely necessary. The recent extirpation of an island rodent population (*Peromyscus guardia*) owing to a single feral cat (Vásquez-Domínguez et al., 2004) highlights the susceptibility of island rodents to stochastic factors that may be species-specific and can be addressed only by specific conservation plans.

## 5. Conclusion

The picture developed in this review must naturally be recognized as a provisional one. Changes in our understanding of the systematics, distribution, and threats facing island rodents can be expected owing to new fossil and zooarchaeological discoveries, taxonomic revisions, and new and better “on the ground” information from field surveys. As stressed by Helgen (2003b), the modern faunas of many islands, such as the large island Buru in the Moluccas, have still received surprisingly little survey attention from mammalogists, and even more remains to be learned of insular zooarchaeological records worldwide. Incredibly, new living species are still described even from seemingly well-known areas, such as the Mediterranean island of Cyprus (Cucchi et al., 2006).

Whittaker (1998) and Simberloff (2000) reported that islands, which comprise only about 3% of the global land area, host over 15% of the global biodiversity of plants, land snails, and birds. The magnitude of global rodent biodiversity represented by extant endemic island species (17.5%) reveals a similarly disproportionate wealth of rodent diversity on islands. Up to now, conservation efforts have largely emphasized the status of relatively few charismatic endemic island animals worldwide. The islands of the Galápagos stand as an emblematic example, with birds, pinnipeds, marine iguanas, and tortoises receiving the “lion’s share” of interest and investment, while the fate of the archipelago’s endemic mice has received scanty

Table 4  
Threatened (or potentially threatened) rodent island genera according to Amori and Gippoliti (2001)

Genus	Zoogeographic region	Range	# Species	Family
<i>Hyosciurus</i>	Oriental	Sulawesi	2	Sciuridae
<i>Eropleplus</i>	Oriental	Sulawesi	1	Muridae
<i>Melasmothrix</i>	Oriental	Sulawesi	1	Muridae
<i>Sommeromys</i>	Oriental	Sulawesi	1	Muridae
<i>Tateomys</i>	Oriental	Sulawesi	2	Muridae
<i>Abditomys</i>	Oriental	Philippines (Luzon)	1	Muridae
<i>Anonymomys</i>	Oriental	Philippines (Mindoro)	1	Muridae
<i>Archboldomys</i>	Oriental	Philippines (Luzon)	2	Muridae
<i>Crateromys</i>	Oriental	Philippines	4	Muridae
<i>Limnomys</i>	Oriental	Philippines (Mindanao)	1	Muridae
<i>Palawanomys</i>	Oriental	Philippines (Palawan)	1	Muridae
<i>Tryphomys</i>	Oriental	Philippines (Luzon)	1	Muridae
<i>Komodomys</i>	Oriental	Lesser Sundas	1	Muridae
<i>Tokudaia</i>	Oriental	Nansei Shoto	3	Muridae
<i>Glirulus</i>	Oriental	Nansei Shoto	1	Gliridae
<i>Papagomys</i>	Oriental	Flores	3	Muridae
<i>Paulamys</i>	Oriental	Flores	1	Muridae
<i>Macruromys</i>	Australian	New Guinea	1	Muridae
<i>Pseudohydromys</i>	Australian	New Guinea	5	Muridae
<i>Leporillus</i>	Australian	Australian coastal islands	1	Muridae
<i>Solomys</i>	Australian	Solomons	4	Muridae
<i>Gymnuromys</i>	Afrotropical	Madagascar	1	Muridae
<i>Hypogeomys</i>	Afrotropical	Madagascar	1	Muridae
<i>Nesoryzomys</i>	Neotropical	Galapagos	2	Muridae
<i>Geocapromys</i>	Neotropical	Jamaica, Bahamas	2	Capromyidae
<i>Plagiodontia</i>	Neotropical	Hispaniola	1	Capromyidae
<i>Mesocapromys</i>	Neotropical	Cuba	4	Capromyidae

attention so far. We suggest that increased attention to less conspicuous components of insular faunas, such as endemic rodents, may be necessary to stem considerable numbers of insular extinctions in the near future.

### Acknowledgments

We would like to thank F. Masini and M.R. Palombo for providing us with unpublished data. We are also indebted to K.P. Aplin and D.E. Wilson for useful suggestions on earlier versions of this paper.

### Appendix A. List of the endemic island rodent taxa (see text)

(ex?) = possibly extinct, in need of verifying study. Excluded from our list and calculations are species that we regard as conclusively extinct, including most species known only from insular subfossil records, and a number of species reasonably well documented as succumbing to extinction in the modern era (Table 3). Higher-level endemism index = (number of endemic species in endemic genera)/(total number of endemic species). Only non-zero endemism indices are shown

### ORIENTAL REGION

**Japan (main islands) (300,000 kmq)**

**Endemism index 9%**

1 genus: *Glirulus* (Gliridae). 11 species: *Petaurista leucogenys*, *Pteromys momonga*, *Sciurus lis* (Sciuridae); *Glirulus japonicus* (Gliridae); *Apodemus argenteus*, *Apodemus speciosus* (Muridae); *Microtus montebelli*, *Myodes andersoni*, *Myodes imaizumii*, *Myodes rex*, *Myodes smithii* (Cricetidae).

**Ryukyu (Nansei Shoto: Japan) (1200 kmq) Endemism index 100%**

2 genera: *Diplothrix*, *Tokudaia* (Muridae). 4 species: *Diplothrix legata*, *Tokudaia muenninki*, *Tokudaia osimensis*, *Tokudaia tokunoshimensis* (Muridae).

**Taiwan (36,000 kmq)**

4 species: *Apodemus semotus*, *Microtus kikuchii*, *Niviventer coninga*, *Niviventer culturatus* (Muridae).

**Sri Lanka (66,000 kmq)**

**Endemism index 20%**

1 genus: *Srilankamys* (Muridae). 5 species: *Mus fernandoni*, *Mus mayeri*, *Rattus montanus*, *Srilankamys ohiensis*, *Vandeleuria nolthenii* (Muridae).

**Borneo (Malaysia, Brunei, Indonesia) (736,000 kmq)**

**Endemism index 12%**

3 genera: *Glyphotes*, *Rheithrosciurus* (Sciuridae), *Pithecheirops* (Muridae). 25 species: *Aeromys thomasi*, *Callosciurus adamsi*, *Callosciurus baluensis*, *Callosciurus orestes*, *Dremomys everetti*, *Exilisciurus exilis*, *Exilisciurus whiteheadi*, *Glyphotes simus*, *Lariscus hosei*, *Petaurillus*

*emiliae*, *Petaurillus hosei*, *Rheithrosciurus macrotis*, *Sundasciurus brookei*, *Sundasciurus jentinki* (Sciuridae); *Chiropodomys major*, *Chiropodomys muroides*, *Chiropodomys pusillus*, *Haeromys margarettae*, *Maxomys alticola*, *Maxomys baeodon*, *Maxomys ochraceiventer*, *Niviventer rapit*, *Pithecheirops otion*, *Rattus baluensis* (Muridae); *Hystrix crassispinis* (Hystricidae).

**Java (Indonesia) (130,000 kmq) Endemism index 13%**

1 genus: *Kadarsanomys* (Muridae). 8 species: *Hylopetes bartlesi*, *Petinomys sagitta* (Sciuridae); *Kadarsanomys sodyi*, *Maxomys bartelsii*, *Mus vulcani*, *Niviventer lepturus*, *Pithecheir melanurus*, *Sundamys maxi* (Muridae).

**Sumatra (Indonesia) (473,600 kmq)**

10 species: *Callosciurus albescens*, *Hylopetes winstoni* (Sciuridae); *Maxomys hylomyoides*, *Maxomys inflatus*, *Mus crociduroides*, *Niviventer fraternus*, *Rattus blangorum*, *Rattus hoogerwerfi*, *Rattus korinchi* (Muridae); *Hystrix sumatrae* (Hystricidae).

**Palawan (and adjacent islands: Philippines) Endemism index 10% (14,000 kmq)**

1 genus: *Palawanomys* (Muridae). 10 species: *Hylopetes nigripes*, *Sundasciurus hoogstraali*, *Sundasciurus juvenus*, *Sundasciurus moellendorffi*, *Sundasciurus rabori*, *Sundasciurus steerii* (Sciuridae); *Chiropodomys calamianensis*, *Maxomys panglima*, *Palawanomys furvus* (Muridae); *Hystrix pumila* (Hystricidae).

**Nicobar and Andaman Islands (India) (8500 kmq)**

3 species: *Rattus burrus*, *Rattus palmarum*, *Rattus stoicus* (Muridae).

**West Sumatran Islands (Mentawai, Enggano, Simalur: Indonesia) (6000 kmq)**

13 species: *Callosciurus melanogaster*, *Hylopetes sipora*, *Iomys sipora*, *Lariscus obscurus*, *Petinomys lugens*, *Sundasciurus fraterculus* (Sciuridae); *Chiropodomys karlkoopmani*, *Leopoldamys siporanus*, *Maxomys pagensis*, *Rattus adustus*, *Rattus enganus*, *Rattus lugens*, *Rattus simalurensis* (Muridae).

**Lesser Sundas (Indonesia) (14,300 kmq) Endemism index 60%**

3 genera: *Komodomys*, *Papagomys*, *Paulamys* (Muridae). 5 species: *Komodomys rintjanus*, *Papagomys armandvillei*, *Paulamys naso*, *Rattus hainaldi*, *Rattus timorensis* (Muridae).

**Sulawesi (Indonesia) (190,000 kmq) Endemism index 70%**

13 genera: *Hyosciurus*, *Prosciurillus*, *Rubrisciurus* (Sciuridae); *Bunomys*, *Echiothrix*, *Eropeplus*, *Lenomys*, *Margaretamys*, *Melasmothrix*, *Paruromys*, *Sommeromys*, *Taeromys*, *Tateomys* (Muridae). 47 species: *Hyosciurus heinrichi*, *Hyosciurus ileile*, *Prosciurillus abstrusus*, *Prosciurillus leucomus*, *Prosciurillus murinus*, *Prosciurillus rosenbergii*, *Prosciurillus weberi*, *Rubrisciurus rubriventer*

(Sciuridae); *Bunomys andrewsi*, *Bunomys chrysocomus*, *Bunomys coelestis*, *Bunomys fratrorum*, *Bunomys penitus*, *Bunomys prolatus*, *Crunomys celebensis*, *Echiothrix centrosoa*, *Echiothrix leucura*, *Eropeplus canus*, *Haeromys minahassae*, *Lenomys meyeri*, *Margaretamys beccarii*, *Margaretamys elegans*, *Margaretamys parvus*, *Maxomys dollmani*, *Maxomys hellwaldii*, *Maxomys musschenbroekii*, *Maxomys wattsi*, *Melasmothrix naso*, *Paruromys dominator*, *Rattus bontanus*, *Rattus hoffmani*, *Rattus koopmani*, *Rattus marmosurus*, *Rattus mollicomulus*, *Rattus pelurus*, *Rattus salocco*, *Rattus xanthurus*, *Sommeromys macrorhinos*, *Taeromys arcuatus*, *Taeromys callitrichus*, *Taeromys celebensis*, *Taeromys hamatus*, *Taeromys microbullatus*, *Taeromys punicans*, *Taeromys taerae*, *Tateomys macrocercus*, *Tateomys rhinogradoides* (Muridae).

**Moluccas (Indonesia) (58,000 kmq) Endemism index 7%**

1 genus: *Nesoromys* (Muridae). 15 species: *Melomys aerosus*, *Melomys bannisteri*, *Melomys caurinus*, *Melomys cooperae*, *Melomys fraterculus*, *Melomys fulgens*, *Melomys howi*, *Melomys obiensis*, *Melomys paveli*, *Melomys talaudium*, *Nesoromys ceramicus*, *Rattus elaphinus*, *Rattus feliceus*, *Rattus morotaiensis*, *Uromys siebersi* (Muridae).

**Philippines (oceanic, i.e. minus Palawan faunal region) (250,000 kmq) Endemism index 76%**

14 genera: *Abditomys*, *Anonymomys*, *Apomys*, *Archboldomys*, *Batomys*, *Bullimus*, *Carpomys*, *Chrotomys*, *Crateromys*, *Limnomys*, *Phloeomys*, *Rhynchomys*, *Tarsomys*, *Tryphomys* (Muridae). 54 species: *Exilisciurus concinnus*, *Petinomys crinitus*, *Petinomys mindanensis*, *Sundasciurus davensis*, *Sundasciurus mindanensis*, *Sundasciurus philippinensis*, *Sundasciurus samarensis* (Sciuridae); *Abditomys latidens*, *Anonymomys mindorensis*, *Apomys abrae*, *Apomys camiguinensis*, *Apomys datae*, *Apomys gracilirostris*, *Apomys hylocetes*, *Apomys insignis*, *Apomys littoralis*, *Apomys microdon*, *Apomys musculus*, *Apomys sacobianus*, *Archboldomys luzonensis*, *Archboldomys musseri*, *Batomys dentatus*, *Batomys granti*, *Batomys russatus*, *Batomys salomonseni*, *Bullimus bagobus*, *Bullimus gamay*, *Bullimus luzonicus*, *Carpomys melanurus*, *Carpomys phaeurus*, *Chrotomys gonzalesi*, *Chrotomys mindorensis*, *Chrotomys sibuyanensis*, *Chrotomys silaceus*, *Chrotomys whiteheadi*, *Crateromys australis*, *Crateromys heaneyi*, *Crateromys paulus*, *Crateromys schadenbergi*, *Crunomys fallax*, *Crunomys melanius*, *Crunomys suncooides*, *Limnomys bryophilus*, *Limnomys sibuanus*, *Phloeomys cumingi*, *Phloeomys pallidus*, *Rattus everetti*, *Rattus mindorensis*, *Rattus tawitawiensis*, *Rhynchomys isarogensis*, *Rhynchomys soricooides*, *Tarsomys apoensis*, *Tarsomys echinatus*, *Tryphomys adustus* (Muridae).

**Taxa endemic to multiple South-east Asian islands (Malaysia, Indonesia, Philippines)**

5 genera: *Exilisciurus*, *Nannosciurus*, *Sundasciurus* (Sciuridae); *Crunomys*, *Haeromys* (Muridae). 7 species: *Hylopetes lepidus*, *Lariscus niobe*, *Nannosciurus melanotis*,

*Petinomys hageni* (Sciuridae); *Haeromys pusillus*, *Sundamys infraluteus* (Muridae); *Hystrix javanica* (Hystricidae).

#### AUSTRALIAN REGION

**New Guinea, satellite islands, and Bismarck Archipelago (Indonesia and Papua New Guinea) (785,000 kmq)** **Endemism index 65%**

21 genera: *Abeomelomys*, *Anisomys*, *Baiyankamys*, *Chiruromys*, *Coccymys*, *Crossomys*, *Hyomys*, *Leptomys*, *Lorentzimys*, *Macruromys*, *Mallomys*, *Mammelomys*, *Microhydromys*, *Parahydromys*, *Paraleptomys*, *Paramelomys*, *Pogonomelomys*, *Pogonomys*, *Protochromys*, *Pseudohydromys*, *Xenuromys*. 80 species: *Abeomelomys sevia*, *Anisomys imitator*, *Baiyankamys habbema*, *Baiyankamys shawmayeri*, *Chiruromys forbesi*, *Chiruromys lamia*, *Chiruromys vates*, *Coccymys albidens*, *Coccymys ruemmleri*, *Crossomys moncktoni*, *Hydromys hussoni*, *Hydromys neobritannicus*, *Hydromys ziegleri*, *Hyomys dammermani*, *Hyomys goliath*, *Leptomys elegans*, *Leptomys ernstmayri*, *Leptomys signatus*, *Lorentzimys nouhuysi*, *Macruromys elegans*, *Macruromys major*, *Mallomys aroensis*, *Mallomys gunung*, *Mallomys istapantap*, *Mallomys rothschildi*, *Mammelomys lanosus*, *Mammelomys rattoides*, *Melomys arcium*, *Melomys dollmani*, *Melomys frigicola*, *Melomys leucogaster*, *Melomys lutillus*, *Melomys matambuai*, *Melomys rufescens*, *Microhydromys musseri*, *Microhydromys richardsoni*, *Parahydromys asper*, *Paraleptomys rufilatus*, *Paraleptomys wilhelmina*, *Paramelomys gressitti*, *Paramelomys levipes*, *Paramelomys lorentzii*, *Paramelomys mollis*, *Paramelomys moncktoni*, *Paramelomys naso*, *Paramelomys platyops*, *Paramelomys rubex*, *Paramelomys steini*, *Pogonomelomys bruijnii*, *Pogonomelomys mayeri*, *Pogonomys championi*, *Pogonomys fergussoniensis*, *Pogonomys loriae*, *Pogonomys macrourus*, *Pogonomys sylvestris*, *Protochromys fellowsii*, *Pseudohydromys ellermani*, *Pseudohydromys fuscus*, *Pseudohydromys germani*, *Pseudohydromys murinus*, *Pseudohydromys occidentalis*, *Rattus arfakiensis*, *Rattus arrogans*, *Rattus giluwensis*, *Rattus jobiensis*, *Rattus mordax*, *Rattus niobe*, *Rattus novaeguineae*, *Rattus omichlodes*, *Rattus pococki*, *Rattus praetor*, *Rattus richardsoni*, *Rattus steini*, *Rattus vandeuseni*, *Rattus verecundus*, *Uromys anak*, *Uromys boeadii*, *Uromys emmae*, *Uromys neobritannicus*, *Xenuromys barbatus* (Muridae).

**Solomon Archipelago (Papua New Guinea and Solomon Islands) (25,000 kmq)** **Endemism index 44%**

1 genus: *Solomys* (Muridae). 9 species: *Melomys bougainville*, *Melomys spechti* (ex?), *Solomys ponceteti*, *Solomys salamonis* (ex?), *Solomys salebrosus*, *Solomys sapientis*, *Uromys imperator* (ex?), *Uromys porculus* (ex?), *Uromys rex* (Muridae).

**Australian islands (Australia) (68,500 kmq)** **Endemism index 25%**

1 genus: *Leporillus* (Muridae). 4 species: *Leporillus conditor*, *Melomys rubicola*, *Pseudomys fieldi*, *Pseudomys higginsii* (Muridae).

#### NEARTIC REGION

**Alaskan islands (USA) (1500 kmq)**

2 species: *Dicrostonyx unalascensis*, *Microtus abbreviatus* (Cricetidae).

**Muskeget Island (USA) (0,0012 kmq)**

1 species: *Microtus breweri* (Cricetidae).

**Mexican islands (Gulf of California, Cozumel, Tres Marias: Mexico) (7000 kmq)**

13 species: *Ammospermophilus insularis* (Sciuridae); *Neotoma anthonyi*, *Neotoma bryanti*, *Neotoma martinensis*, *Peromyscus caniceps*, *Peromyscus dickeyi*, *Peromyscus interparietalis*, *Peromyscus madrensis*, *Peromyscus pseudocrinitus*, *Peromyscus sejugis*, *Peromyscus slevini*, *Peromyscus stephani*, *Reithrodontomys spectabilis* (Cricetidae).

**Vancouver (Canada) (32,100 kmq)**

1 species: *Marmota vancouverensis* (Sciuridae).

#### PALEARCTIC REGION

**Mediterranean islands (Greece, Cyprus, Tunisia) (17,800 kmq)**

4 species: *Acomys minous*,<sup>1</sup> *Acomys nesiotis*,<sup>1</sup> *Dipodillus zakariai*,<sup>1</sup> *Mus cypriacus* (Muridae).

**Russian islands (Russia) (77,000 kmq)**

3 species: *Dicrostonyx vinogradovi*, *Lemmus portenkoi*, *Microtus sachalinensis* (Cricetidae).

#### AFROTROPICAL REGION

**Madagascar (587,000 kmq)**

**Endemism index 100%**

9 genera: *Brachytarsomys*, *Brachyuromys*, *Eliurus*, *Gymnuromys*, *Hypogeomys*, *Macrotarsomys*, *Monticolomys*, *Nesomys*, *Voalavo* (Nesomyidae). 25 species: *Brachytarsomys albicauda*, *Brachytarsomys villosa*, *Brachyuromys betsileonsis*, *Brachyuromys ramirohitra*, *Eliurus antsingy*, *Eliurus ellermani*, *Eliurus grandidieri*, *Eliurus majori*, *Eliurus minor*, *Eliurus myoxinus*, *Eliurus penicillatus*, *Eliurus petteri*, *Eliurus tanala*, *Eliurus webbi*, *Gymnuromys roberti*, *Hypogeomys antimena*, *Macrotarsomys bastardi*, *Macrotarsomys ingens*, *Macrotarsomys petteri*, *Monticolomys koopmani*, *Nesomys audeberti*, *Nesomys lambertoni*, *Nesomys rufus*, *Voalavo antsahabensis*, *Voalavo gymnocaudus* (Nesomyidae).

**Bioko (Equatorial Guinea) (2000 kmq)**

1 species: *Hybomys basillii* (Muridae).

**Lake Victoria islands (Uganda)**

1 species: *Pelomys isseli* (Muridae).

<sup>1</sup>Several endemic species of the Mediterranean islands, although accepted by Carleton and Musser (2005), are the result of ancient human-mediated introductions (i.e. Barome et al., 2001). Consequently, accordance of species status to these populations is unwarranted and may have negative consequences for conservation policies.

## NEOTROPICAL REGION

### Caribbean Islands (Cuba, Dominican Republic, Haiti, Bahamas) (110,000 kmq) **Endemism index 100%**

5 genera: *Capromys*, *Geocapromys*, *Mesocapromys*, *Mysateles*, *Plagiodontia* (Capromyidae). 13 species: *Capromys gundlachianus*, *Capromys pilorides*, *Geocapromys brownii*, *Geocapromys ingrahami*, *Mesocapromys angelcabrerai*, *Mesocapromys auritus*, *Mesocapromys melanurus*, *Mesocapromys nanus* (ex?), *Mesocapromys sanfelipensis* (ex?), *Mysateles garridoi* (ex?), *Mysateles meridionalis*, *Mysateles prehensilis*, *Plagiodontia aedium* (Capromyidae).

### Galapagos (Ecuador) (7900 Km<sup>2</sup>) **Endemism index 67%**

1 genus: *Nesoryzomys* (Cricetidae). 3 species: *Nesoryzomys fernandinae*, *Nesoryzomys indefessus*, *Oryzomys galapagoensis* (Cricetidae).

### Coiba (Panama) (500 kmq)

1 species: *Dasyprocta coibae* (Dasyproctidae).

### Roatan (Honduras) (160 kmq)

1 species: *Dasyprocta ruatanica* (Dasyproctidae).

### Trinidad and Tobago (4800 kmq)

1 species: *Proechimys trinitatus* (Echimyidae).

### Isla de San Sebastiao (Brazil) (400 kmq)

1 species: *Phyllomys thomasi* (Echimyidae).

### Chilean islands (Chile) (2500 kmq)

3 species: *Abrothrix hershkovitzi*, *Abrothrix markhami* (Cricetidae); *Octodon pacificus* (Octodontidae).

## References

- Alcover, J.A., Campillo, X., Macias, M., Sans, A., 1998. Mammal species of the world: additional data on insular mammals. *American Museum Novitates* 3248, 1–29.
- Amori, G., Clout, M., 2003. Rodents on islands: a conservation challenge. In: Singleton, G.R., Hinds, L.H., Krebs, C.J., Spratt, D.M. (Eds.), *Rats, Mice and People: Rodent Biology and Management*. ACIAR Monograph No. 96, pp. 63–68.
- Amori, G., Gippoliti, S., 2000. What do mammalogists want to save? Ten years of mammalian conservation biology. *Biodiversity and Conservation* 9, 785–793.
- Amori, G., Gippoliti, S., 2001. Identifying priority ecoregions for rodent conservation at the genus level. *Oryx* 35 (2), 158–165.
- Amori, G., Gippoliti, S., 2003. An higher-taxon approach to rodent conservation priorities for the XXI Century. *Animal Biodiversity and Conservation* 26 (2), 1–18.
- Barome, P.O., Lymberakis, P., Monnerot, M., Gautun, J.-C., 2001. Cytochrome b sequences reveal *Acomys minous* (Rodentia, Muridae) paraphyly and answer the question about the ancestral karyotype of *Acomys dimidiatus*. *Molecular Phylogenetics and Evolution* 18, 37–46.
- Brooks, T.M., Pimm, S.L., Collar, N.J., 1997. Deforestation predicts the number of threatened birds in insular Southeast Asia. *Conservation Biology* 11, 382–394.
- Brooks, T.M., Pimm, S.L., Kapos, V., Ravilious, C., 1999. Threat from deforestation to montane and lowland birds and mammals in insular South-east Asia. *Journal of Animal Ecology* 68, 1061–1078.
- Brooks, T.M., Mittermeier, R.A., Mittermeier, C.G., da Fonseca, G.A.B., Rylands, A.B., Konstant, W.R., Pilgrim, J., Oldfield, S., Magin, G., Hilton-Taylor, C., 2002. Habitat loss and extinction in the hotspots of biodiversity. *Conservation Biology* 16, 909–923.
- Carleton, M.D., Goodman, S.M., 2007. A new species of the *Eliurus majori* complex (Rodentia: Muroidea: Nesomyidae) from south-central Madagascar, with remarks on emergent species groupings in the genus *Eliurus*. *American Museum Novitates* 3547, 1–21.
- Caro, T., Engilis, A., Fitzhebert, E., Gardner, T., 2004. Preliminary assessment of the flagship species concept at a small scale. *Animal Conservation* 7, 63–70.
- Ceballos, G., Brown, J.H., 1995. Global patterns of mammalian diversity, endemism and endangerment. *Conservation Biology* 9, 559–568.
- Cucchi, T., Orth, A., Auffray, J.C., Renauld, S., Fabre, L., Catalan, J., Hadjisterkotis, E., Bonhomme, F., Vigne, J.D., 2006. A new endemic species of the subgenus *Mus* (Rodentia, Mammalia) on the island of Cyprus. *Zootaxa* 1241, 1–36.
- Dowler, R.C., Carroll, D.S., Edwards, C.W., 2000. Rediscovery of rodents (genus *Nesoryzomys*) considered extinct in the Galápagos Islands. *Oryx* 34, 109–117.
- Fattorini, S., 2006. Detecting biodiversity hotspots by species-area relationships: a case study of Mediterranean beetles. *Conservation Biology* 20 (4), 1169–1180.
- Flannery, T., 1995. *Mammals of the South-West Pacific and Moluccan Islands*. Comstock/Cornell University Press, Ithaca, New York, pp. 1–464.
- Goodman, S.M., Rakotondravony, D., Randriamanantsoa, H.N., Rakotomalala-Razanahoera, M., 2005. A new species of rodent from the montane forest of central eastern Madagascar (Muridae: Nesomyinae: *Voalavo*). *Proceedings of the Biological Society of Washington* 118, 863–873.
- Helgen, K.M., 2003a. Major mammalian clades: a review under consideration of molecular and palaeontological evidence. *Mammalian Biology* 68, 1–15.
- Helgen, K.M., 2003b. A review of the rodent fauna of Seram, Moluccas, with the description of a new subspecies of mosaic-tailed rat, *Melomys rufescens paveli*. *Journal of Zoology (London)* 261, 165–172.
- Helgen, K.M., 2005a. A new species of murid rodent (genus *Mayermys*) from south-eastern New Guinea. *Mammalian Biology* 70, 61–67.
- Helgen, K.M., 2005b. The amphibious murines of New Guinea (Rodentia, Muridae): the generic status of *Baiyankamys* and description of a new species of *Hydromys*. *Zootaxa* 913, 1–20.
- Helgen, K.M., Groves, C.P., 2005. Biodiversity in Sri Lanka and the Western Ghats. *Science* 308, 199.
- Johnson, C., 2006. *Australia's Mammal Extinctions: a 50,000 Year History*. Cambridge University Press, Cambridge, UK, pp. 1–278.
- MacArthur, R.H., Wilson, E.O., 1967. *The Theory of Island Biogeography*. Princeton University Press, Princeton, NJ, pp. 1–203.
- MacPhee, R.D.E., Fleming, C., 1999. *Requiem Aeternam*. The last five hundred years of mammalian species extinctions. In: MacPhee, R.D.E. (Ed.), *Extinctions in Near Time*. Kluwer Academic/Plenum, New York, pp. 333–371.
- MacPhee, R.D.E., Fleming, C., 2003. A possible heptaxodontine and other caiviian rodents from the Quaternary of Jamaica. *American Museum Novitates* 3422, 1–42.
- Masini, F., Petruso, D., Bonfiglio, F., Mangano, G., this volume. Origination and extinction patterns of Mammals in three Central Western Mediterranean islands in the Late Miocene to Quaternary. *Quaternary International*.
- Morgan, G.S., Woods, C.A., 1986. Extinction and zoogeography of West Indian land mammals. *Biological Journal of Linnean Society* 28, 167–203.
- Musser, G.G., 1981. The giant rat of Flores and its relatives east of Borneo and Bali. *Bulletin of the American Museum of Natural History* 169, 67–176.
- Musser, G.G., Carleton, M.D., 2005. Superfamily Muroidea. In: Wilson, D.E., Reeder, D.M. (Eds.), *Mammal Species of the World: A Taxonomic and Geographic Reference*, third ed., Vol. 2. Johns Hopkins University Press, Baltimore, pp. 894–1531.
- Myers, A.A., De Grave, S., 2000. Endemism: origins and implications. *Vie et Milieu* 50, 195–204.

- Palombo, M.R., 2005. Biochronology of the Plio-Pleistocene terrestrial mammals of Sardinia: the state of the art. *Hellenic Journal of Geosciences* 41, 47–66.
- Rickart, E.A., Heaney, L.R., Goodman, S.M., Jansa, S., 2005. Review of the Philippine genera *Chrotomys* and *Celaenomys* (Murinae) and description of a new species. *Journal of Mammalogy* 86 (2), 415–428.
- Russell, G.J., Brooks, T.M., McKinney, M.M., Anderson, C.G., 1998. Present and future taxonomic selectivity in bird and mammal extinction. *Conservation Biology* 12, 1365–1376.
- Simberloff, D., 2000. Extinction proneness of island species: causes and management implications. *Raffles Bulletin of Zoology* 48, 1–9.
- Sommer, S., Hommen, U., 2000. Modelling the effects of life history traits and changing ecological conditions on the population dynamics and persistence of the endangered Malagasy giant jumping rat (*Hypogeomys antimena*). *Animal Conservation* 3, 333–343.
- Steadman, D.W., 1997. The historic biogeography and community ecology of Polynesian pigeons and doves. *Journal of Biogeography* 24, 737–753.
- Turvey, S.T., Grady, F.V., Rye, P., 2006. A new genus and species of ‘giant hutia’ (*Tainotherium valei*) from the Quaternary of Puerto Rico: an extinct arboreal quadruped? *Journal of Zoology* 270 (4), 585–594.
- Vásquez-Domínguez, E., Ceballos, G., Cruzado, J., 2004. Extirpation of an insular subspecies by a single introduced cat: the case of the endemic deer mouse *Peromyscus guardia* on Estanque Island, Mexico. *Oryx* 38, 347–350.
- Weksler, M., Percequillo, A.R., Voss, R.S., 2006. Ten new genera of oryzomyine rodents (Cricetidae: Sigmodontinae). *American Museum Novitates* 3537, 1–29.
- Whittaker, R.J., 1998. *Island Biodiversity: Ecology, Evolution, and Conservation*. Oxford University Press, Oxford, pp. 1–285.
- Williams, P.H., Gaston, K., 1994. Measuring more biodiversity: can higher-taxon richness predict wholesale species richness? *Biological Conservation* 67, 211–217.
- Wilson, D.E., Reeder, D.M. (Eds.), 2005. *Mammal Species of the World: A Taxonomic and Geographic Reference*, third ed., Vol. 2. John Hopkins University Press, Baltimore, pp. 745–2142.
- Wilson, E.O., 1992. *The Diversity of Life*. Norton W.W. & Company, New York, pp. 1–424.
- Woods, C.A., 1989. The biogeography of West Indian rodents. In: Woods, C.A. (Ed.), *Biogeography of the West Indies: Past, Present, and Future*. Sandhill Crane Press, Gainesville, FL, pp. 741–798.
- Woods, C.A., Kilpatrick, C.M., 2005. Infraorder Hystricognathi. In: Wilson, D.E., Reeder, D.M. (Eds.), *Mammal Species of the World: A Taxonomic and Geographic Reference*, third ed., Vol. 2. John Hopkins University Press, Baltimore, pp. 1538–1600.