CHAPTER 1

Dramatis personae: an introduction to the wild musteloids

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Why the musteloids?

When it comes to carnivores, the Romans understood the basic principle; there are those terrifying man-eaters that can rip a slave apart in the arena, and then there are all the rest. Today we revere these 'halo' species—lions, tigers, wolves, bears, maybe even hyaenas, and they serve as a reminder that humans hold dominion over the beasts only by their guile.

The musteloids do not share this dangerous allure (a point to which we return in the concluding synthesis of Chapter 30)—and although it proves wise to avoid direct conflict with a few of their membership (notably, wolverines [*Gulo gulo*], honey badgers [*Mellivora capensis*], and American badgers [*Taxidea taxus*]), this is because of their abject and disproportionate ferocity, rather than their intimidating size.

Due to their diminutive stature, and ubiquitous distribution, it is easy to overlook the familiar and unthreatening musteloids, and therefore to underestimate what they bring to the fields of ecology and conservation. Yet for almost every major paradigm they prove interesting and informative, even when contrasted against their more charismatic large-carnivore cousins.

First, habitat use: the felids, canids, and ursids all come up thin for the study of life in the tree-tops, with no analogues nearly so arboreal as kinkajous (*Potos flavus*, Brooks and Kays, Chapter 26, this volume), or even martens (*Martes* spp.). Aside from a few examples of natal den use, other larger carnivore families also provide few exemplars of fossoriality, and nothing so substantially subterranean as many polecats (*Mustela* spp.) and badgers (*Meles* spp., although a trait shared with small viverrids and mongooses; Noonan et al. 2015a). And the aquatic realm, both freshwater and marine, is the exclusive preserve of otters (sub-family Lutrinae) and mink (European [*Mustela lutreola*], and American [*Neovison vison*]), with no other carnivores getting close to this level of superlative adaptation, outside of their phocine sister clade. This diversity of habitat exploitation is reflected in musteloid evolution and taxonomy, where this most speciose of carnivore families has proven amongst the most challenging to classify (see Koepfli et al., Chapter 2, this volume), and, indeed, to study (Powell et al., Chapter 8, this volume).

Perhaps the ecological paradigm most central to the researcher's interest is diet; again the felids provide bland pickings, varying only in the size of prey they choose, and while many canids and ursids are omnivorous, only the giant panda (*Ailuropoda melanoleuca*) exhibits the type of extreme specialization rife among musteloids, and even here it is pegged by the red panda (*Ailurus fulgens*, Hu et al., Chapter 29, this volume). Certainly no other carnivore family exhibits the near exclusive piscivory of the lutrines, or the frugivory of kinkajous, and only a few small, versatile canids (foxes, jackals) get close to the opportunistic generalism typified by raccoons (*Procyon* spp., Zeveloff, Chapter 27, this volume), but falling well short of the extent of vermivory and insectivory seen in European badgers (*Meles meles*, Newman et al., Chapter 21, this volume) and skunks (*Mephitis* spp., Hass and Dragoo, Chapter 24, this volume;). The 'weasels', on the other hand, encompass a variety of diminutive species (most less than 500 g) that thrive wherever rodent prey can support them (Lambin et al., Chapter 4, this volume).

Social and mating systems among musteloids also vary more widely than those occurring in other carnivore families, deviating from the basic solitary carnivore polygynous format with myriad variations; variations that are not associated with the packing-power benefits of group hunting (as in wolves and lions), but with the more intricate mechanisms of resource dispersion leading to overlapping home ranges

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and, ultimately, promoting group formation (a theme that we develop further in Macdonald and Newman, Chapter 6, this volume). Indeed, while all group-living canids and felids are substantially social, even this is not a given for musteloids, with European badgers at high density seeming to operate as independent agents within their group-structured populations (Macdonald and Newman, Chapter 6, this volume; Macdonald et al. 2015b); while only the giant otters (*Pteronura brasiliensis*, Groenendijk et al., Chapter 22, this volume) exhibit a level of social group integration comparable to the social cats and dogs.

From pure ecology to the forum of conservation, despite the 'big' carnivores often bringing the 'big' questions, the small musteloids certainly pose many intriguing ones. Clearly human–wildlife conflict involving lions, tigers, bears, and wolves is a serious issue, but it is regionally localized compared with the widespread irritation caused by marauding urban raccoons, 'weasels' in poultry pens, or otters raiding fish farms (reviewed in Harrington et al., Chapter 7, this volume).

On introductions, musteloids also raise some of the most significant, if unwelcome, examples, and two cases in particular are discussed in detail in chapters in this book—the ferrets (*Mustela putorius furo*), stoats (*Mustela erminea*), and weasels in New Zealand in King et al. (Chapter 10, this volume), and the American mink in Europe, where it displaces native European ones, in Maran et al. (Chapter 17, this volume). And, in terms of disease epidemiology and zoonotics (reviewed by Newman and Byrne, Chapter 9, this volume), although the success of several endangered canid (e.g. Ethiopian wolf [*Canis simensis*], Laurenson et al. 1998) and felid (lion [*Panthera leo*], Packer et al. 1999) populations can be impacted severely by disease—and not to diminish the role played by foxes (*Vulpes vulpes*) in the maintenance of rabies in the developed world (Macdonald, 1980a)—it is raccoons and skunks that pose the biggest rabies threat throughout many parts of North America. Badgers also play a substantial role in rabies spread through China (Zhou et al., Chapter 13, this volume). And, of course, European badgers are a highly contentious wildlife host for bovine tuberculosis, necessitating costly management interventions in the UK and Ireland (Woodroffe and Donnelly, Chapter 20, this volume).

So, while the scale of issues caused by bigger carnivores relates to their physical size, the scale of nuisance caused by musteloids is a product of their very smallness. Our enthusiasm for sharing lands with grizzly bears (*Ursus arctos*) and tigers (*Panther tigris*) often leads to 'land sparing' as a prudent option, with national parks set aside to sustain the behemoth territorial needs of these mega-predators. Indeed, because large predatory felids (Macdonald and Loveridge 2010), canids (Macdonald and Sillero-Zubiri 2004), and ursids are (or are perceived to be) incompatible with people, they have been extensively extirpated. In contrast to the 'big' carnivores, we tolerate musteloids in suburbia from Tokyo to New York State. Because they are less directly threatening to us, we have not exterminated them so widely in the interests of self-preservation (although some have been, or are in danger of being, extirpated due to over-exploitation for their skins; Harrington et al., Chapter 7, this volume). Thus, solutions to the conservation and management issues raised by musteloids typically involve 'control', and exploitation strategies that are humane and sustainable, and a general philosophy of 'land sharing'.

In the remainder of this chapter, as prologue to the chapters that follow, we give a short overview of the biogeography and ecology of musteloids, their assemblages and communities, their conservation status, and the anthropogenic threats that they face, followed by the *dramatis personae* in which we briefly introduce each of the musteloid species.

Biogeography and ecology of musteloids

Global distribution, habitat, and diet

The musteloids (the Mustelidae, Mephitidae, Procyonidae, and Ailuridae) are amongst the most commonly encountered carnivores. Exhibiting a diversity of forms (described fully in Kitchener et al., Chapter 3, this volume), there are musteloid representatives across every continent, bar Antarctica (albeit only in Australasia by human introduction). Central America has the highest musteloid species richness, whilst Africa has the lowest (Figure 1.1, see also Figure 3.1, Chapter 3, this volume).

Mustelids are the most global of the musteloid families, and the *Mustela* (the weasels and polecats) the most speciose of musteloid genera, with at least 16 species that span the entire east–west range of the northern hemisphere through Eurasia and North America, as well as South America (where there are three neotropical species), Southeast Asia (five or six species), and North Africa (one). Martens (*Martes* spp.), collectively, also range across North America and Eurasia, and south into Southeast Asia; but do

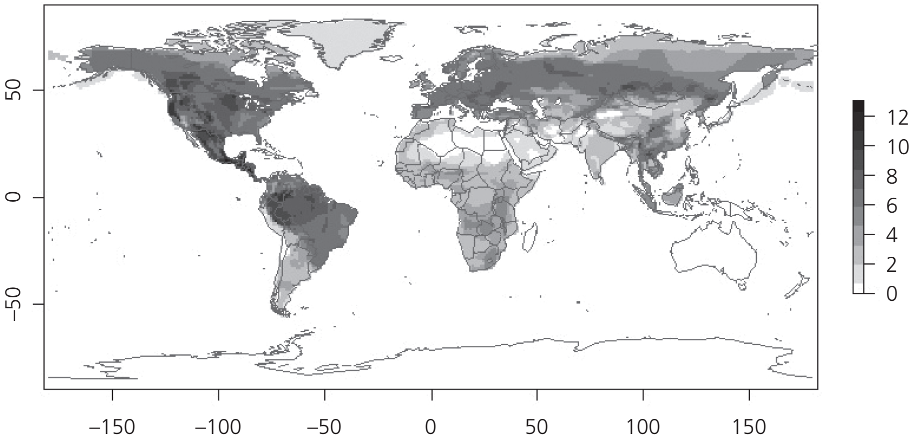


Figure 1.1 Global patterns of musteloid species richness (based on IUCN Red List range maps, version 2016.1, plotted at 1 degree scale). Includes only extant ranges and does not include introduced ranges with the exception of the reintroduced range of the black-footed ferret.

not occur in South America or Africa. Of the badgers, *Meles* species occur through Europe, Asia, and into Japan, hog badgers (*Arctonyx* spp.) and ferret badgers (*Melogale* spp.) through India, China, and Southeast Asia (Zhou et al., Chapter 13, this volume), and honey badgers through Africa and parts of Asia; American badgers (*Taxidea taxus*) are confined to North America (Weir et al., Chapter 19, this volume). Three other genera (*Gulo, Neovison*, and *Vormela*) add to the gamut of northern hemisphere mustelids, and three (*Galictis* and *Eira*, and *Ictonyx*) are confined to Central and South America, and Africa, respectively. Otters are also mustelids, and they occur almost everywhere in the world where there are aquatic habitats to support them, with the exception of Australasia, the frozen Antarctic, and islands they never colonized. There are four species in each of Africa, South America, and Southeast Asia, two in North America, and only one in Europe. Mephitids (with the exception of stink badgers, *Mydaus* spp., that are found in Southeast Asia) are restricted to the Americas—although, collectively, they range from southern Canada to Patagonia (Hass and Dragoo, Chapter 24, this volume). Procyonids also occur (as natives) only in North and South America, although introduced raccoon populations thrive in Japan and Germany. The only Ailuridae (the red panda) is confined to the Himalayas (Hu et al., Chapter 29, this volume).

The majority of musteloids are forest species (Figure 1.2) but there are also a number of grassland specialists (e.g. black-footed ferrets [*Mustela nigripes*], Biggins and Ead, Chapter 15, this volume) and even reputed forest specialists (such as the martens; e.g. American martens [*Martes americana*], Cushman and Wasserman, Chapter 12, this volume) can be relatively tolerant of alternative ‘open’ habitats (e.g. Moll et al. 2016). Few musteloids occur in deserts, but exceptions are the striped polecats (*Ictonyx* spp.) and honey badger, that all frequent the outskirts of the hot African deserts.

According with their extensive ranges, some of the musteloids occur across several climatic zones: least weasels, for example, are equally at home in the frozen tundra grasslands and boreal forests as they are in the dry subtropical grasslands of more southern climes (King and Powell 2007). Many of the non-carnivorous species occur in tropical regions, due to year-round plant productivity there (Vulla et al. 2009), while the strict carnivores are more common at high latitudes.

Brillat-Savarin’s (1825) ‘you are what you eat’ is particularly evident for the musteloids, where strictly carnivorous types include elongate predators able to squeeze into rodent burrows and sturdy, muscular forms able to excavate rodent prey. Sinuous otters with powerful tails have perfected the aquatic pursuit of fish, and martens are adept at hunting arboreal rodents through the tree tops, but also use this agility to exploit other tree-top foods, such as insects, bird eggs, and fruits (Zhou et al. 2011b). Generally less predatory are the omnivorous procyonids such as coatis (*Nasua* spp.) that forage mostly on the ground, using their long snouts to probe for invertebrates (Hirsch and Gompper, Chapter 28, this volume), and kinkajous that

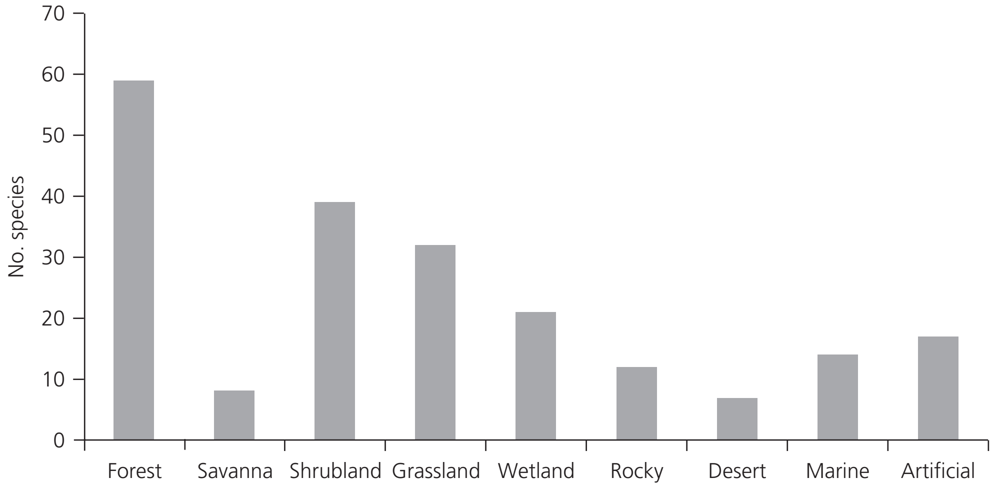


Figure 1.2 Suitable habitat types for musteloids based on IUCN Red List (version 2016.1) habitats classification scheme. The graph shows the total number of species for which each habitat category is listed as 'suitable'. Each species may occur in more than one habitat category, but habitat types listed only as 'marginal habitat' are not included. Marine habitats include coastal areas; artificial habitats include agricultural land, plantations, artificial ponds, rural gardens, urban areas, and introduced vegetation.

feed exclusively on fruit, using prehensile tails to keep them aloft and rarely ever coming to ground (Brooks and Kays, Chapter 26, this volume). Red pandas live life in the slow lane, mainly consuming bamboo (Hu et al., Chapter 29, this volume).

These dietary adaptations are, in turn, reflected by the range of dentitions found across the musteloids (see Table 3.4, Chapter 3, this volume). In general, the more carnivorous the species, the fewer and sharper its teeth (Van Valkenburgh 1989). While all canids have pronounced 'canines' and generally a full complement of 38–44 teeth packed into a long muzzle, and shorter-faced felids average 30 slicing sectoral teeth, to bite hard on flesh, the musteloids exhibit a much greater range of dental formulae. Mustelids have 28–38 teeth, while more omnivorous procyonids have 36–42. Red pandas have 36–38; and piscivory benefits from multiple gripping teeth, more so than terrestrial predation, thus otters typically have around 32–36 teeth. Teeth are not just for hunting, but also for defence against conspecifics and larger intraguild predators, and so musteloids retain formidable canines, able to inflict severe injuries (Macdonald et al. 2004b). Whilst a tiger can muster a Bite Force Quotient (bite force in newtons divided by body mass in kg) of 127 (lion 112 and leopard 94) and a grey wolf 137 (coyote 88), a least weasel can pinch with a BFQ of 164, a European badger with 109, and a wolverine 105 (Wroe et al. 2005; Christiansen and Wroe 2007).

The special case of urban musteloids

Many musteloid species use 'artificial' or human-modified habitats to some extent (Figure 1.2); at least 15 occur in urban areas and several (most notably the raccoons and skunks) thrive there.

Raccoons are believed to have lived in and around cities since the beginning of the twentieth century and are arguably one of the most common carnivores in modern North American cities (Hadidian et al. 2010). Records of stone martens (*Martes foina*) in towns date back to at least 1949 (Nicht 1969 cited in Bateman and Fleming 2012). Urban musteloids exploit a variety of anthropogenic food sources (waste food, 'pet' or bird food, crops, urban rodents or birds, domestic poultry, and road-kill). As a result of these human subsidies, some (but not all) urban carnivores live at higher densities than in rural areas (Šálek et al. 2015) and their ecology and behaviour can be quite different from that of 'natural' rural populations.

Raccoons, for example, typically occur at between one and 27 individuals per km^2 in rural areas (with home ranges of 50 to 300 ha) but in urban areas (usually open spaces or woodland fragments) there are reports of 100 or more per km^2, with home range sizes one tenth of the size of those in adjacent rural areas (reviewed in Gehrt 2004, and Hadidian et al. 2010; see also Gross et al. 2012). The diverse diet of raccoons, and their climbing ability and dexterity (see Kitchener et al., Chapter 3, this volume), has allowed them to exploit rubbish bins and dumps. Normally solitary, they are somewhat socially tolerant in suburban and urban situations, and feeding aggregations of three to seven individuals are common in picnic areas (Prange et al. 2004). Up to 23 raccoons have been recorded in the same den (Mech and Turkowski 1966 cited in Hadidian et al. 2010). In contrast, although skunks are also common inhabitants of urban parks and fields adjacent to industrial areas, they do not appear to be habitual refuse foragers (possibly because they are excluded by raccoons), instead they tend to forage for insects associated with mowed lawns, or eat fruit, pet food, or bird feed from gardens (Gehrt 2004; Rosatte et al. 2010; Theimer et al. 2015) and may be aggressive to other skunks feeding in gardens (Theimer et al. 2015). Skunk densities (although variable) do not appear to differ between urban and rural areas, and they seem to occupy similar-sized home ranges in both habitats, although comparative studies are limited (reviewed in Gehrt 2004, and Rosatte et al. 2010). Stone martens eat little in the way of human food, preferring wild free-ranging birds and wild fruit (Herr 2008), although they do eat cultivated fruit in villages (Hisano et al. 2016). Unlike skunks, (according to Herr et al.'s [2009] study in two Luxembourg towns) they occupy smaller home ranges in urban areas, allowing slightly higher population densities (6–8 individuals per km^2 compared with 1–2 adults per km^2 in rural areas) but they maintain a solitary lifestyle and defend intrasexual territories.

Only raccoons and stone martens are often found in city centres; others (including skunks and badgers) tend to be restricted to the suburbs (Bateman and Fleming 2012). Most urban badger populations in the UK, for example, are thought to be relicts that survived enclosure during development. They are found predominantly on patches of disused land, and in towns and cities only where they are abundant in the neighbouring countryside (Harris 1984). There is only one truly commensal musteloid—the Egyptian weasel (*Mustela subpalmata*; Rodrigues et al. 2016).

Domestication and farming

Despite the general intractability of musteloids, some have been domesticated to assist with human hunting practices. According to mitochondrial analyses, ferrets appear to have been domesticated from a North African lineage of the European polecat (*Mustela putorius*) around 2500 years ago (Sato et al. 2003). Certainly the Romans used ferrets extensively to hunt rabbits, and spread them throughout their Empire. Groups of captive bred, trained, smooth-coated otters (*Lutrogale perspicillata*) have been used for over 200 years to herd fish into nets in the Sundarbans region of Bangladesh, and today this fishing technique continues to be used by about 300 fishermen (Feeroz et al. 2011). Kinkajous (Harrington 2015; Brooks and Kays, Chapter 26, this volume) and skunks (Andrews 2011) are increasingly popular as pets in the USA, although ownership is prohibited in many states due to the risk of rabies. American mink are farmed for their fur in the US and across Eurasia (Macdonald et al., Chapter 30, this volume), as are sable (*Martes zibellina*), polecat, and common raccoon in Russia (www.sojuzpushnina.ru). We do not cover either domestic or farmed musteloids in this volume, but in a book on wild musteloids it is relevant to bear in mind that domesticated 'pets' are often illegally, or inappropriately, sourced from the wild with potential implications for conservation and animal welfare (e.g. Harrington et al., Chapter 7, this volume; Z-M. Zhou et al. 2015), and that both (domestication and farming) provide a route to invasion (the latter having played a key role in the spread of the American mink across two continents beyond its native range; Macdonald and Harrington 2003; Fraser et al., Chapter 16, this volume; Maran et al., Chapter 17, this volume).

Musteloid assemblages and communities

Interspecific interactions

Being the most speciose group of carnivores, often several musteloids inhabit a single locale. For example, the musteloid community in Nova Scotia, Canada, home of author CN, comprises common raccoons, North American river otters, fisher (*Pekania*, formerly *Martes, pennanti*), American mink, long-tailed weasels (*Mustela freneta*), stoats (or short-tailed weasels), least weasels, striped skunks, and rare American marten. Even the rural environment of Oxfordshire, UK (from where this book was produced), is home to Eurasian otters, European polecats, European badgers, stoats, and least weasels (and non-native American mink). Nevertheless, due to feeding and habitat specializations across a range of body sizes, direct intraguild competition is obviated by character displacement, resource partitioning, and niche differentiation (Meiri et al. 2005).

The classic example of stoat–weasel co-existence (King and Moors 1979) posits that smaller least weasels have an advantage under exploitation competition scenarios, because they are better able to reach small rodents in their burrows (even when they are scarce) and better able rapidly to respond numerically to a glut of rodents, whereas larger stoats have an advantage under interference competition, being able to take larger alternative prey when rodents are scarce and win in direct competition with weasels. Variation in the environment permits coexistence by constantly changing the balance of these advantages. Indeed, Powell and Zielinski (1983) suggest that coexistence between similar mustelids is never stable, but is temporary and fluctuates in response to fluctuations in prey. The balance of coexistence can be affected by the presence of larger intra-guild predators (Powell and Zielinski 1983; see Chapter 4 for a detailed discussion of the role of intraguild predators in predator–prey dynamics) and depends on geographic scale (King and Powell 2007). Ross et al. (Chapter 14, this volume) discuss coexistence among the many musteloid species that are found in Borneo.

In competition with other larger predators, musteloids have a tendency to punch above their weight (often advertised through aposematic pelage; see Buesching and Stankowich, Chapter 5, this volume). Honey badgers stand firm faced with a pride of 15 lions, wolverines take on wolves (*Canis lupus*) individually and in packs, and American badgers are more than a match for coyotes. Of course, however fierce a 70 g weasel might be, this is immaterial to, for example, the swooping talons of an owl, and, in Belarus, Vadim Sidorovich reports badger remains in wolf scat, believing these to be predated, not scavenged (Sidorovich 2011).

Musteloid introductions and conflict between native and invasive musteloids

Within musteloid communities, coexistence tends to break down when species are introduced into new regions, where they interact and compete with a different set of competitors. The best studied example is that of the American mink in Eurasia and its impact on European mink and other native musteloids (Sidorovich 2000; Sidorovich and Macdonald 2001; Sidorovich et al. 2008a; covered in detail in Maran et al., Chapter 17, this volume). The raccoon in Japan is another case. In 1977, Nippon Animation launched a TV series in Japan '*Araiguma Rasukaru*' or '*Rascal the raccoon*', depicting a cute and inquisitive raccoon accompanying a young boy on his adventure. The series spurred demand for 'pet raccoons' and around 1500 were imported into Japan, per year, thereafter. But if only they had finished the series first; in the end, the boy discovers that raccoons make terrible pets and releases Rascal back to the wild. Japanese raccoon owners did similarly (often at Shinto temples), until by 2004, 42 of 47 Prefectures had been invaded (Ikeda et al. 2004). Importation is now banned, but raccoons damage buildings and crops, and also compete with native Japanese badgers, which share a similar ecological niche. Coatis and raccoons, taken to Cozumel Island as pets, similarly represent a risk to native dwarf coatis (*Nasua narica nelsoni*; Hirsch and Gompper, Chapter 28, this volume) and pygmy raccoons (Cuarón et al. 2004, 2009; McFadden et al. 2010;), except in this case, the risk is due to interbreeding and hybridization.

In terms of impacts on other native (non-musteloid) fauna, the invasive New Zealand mustelids (discussed by King et al., Chapter 10, this volume) have undoubtedly been most damaging, but globally at least 10 musteloids are now established outside their native range where they are considered 'invasives' (see Table 1.1). Common raccoons, in addition to Japan, have been introduced in Russia and in a number of European countries—the largest population (estimated at about 700,000 individuals, Fischer et al. 2016) occurring in northern Germany. Like American mink, raccoons were brought to Europe for the fur industry and were either deliberately released or escaped into the wild from fur farms (Bartoszewicz 2011). In Germany, raccoons are spreading rapidly through a highly suitable mixed

Table 1.1 Musteloids beyond their native range.

Species	Native range	Introduced range
Japanese marten	Japan (Honshu, Kyushu, Shikoku)	Japan (Sado Island, Hokkaido)
Stone marten	Eurasia	United States (Wisconsin)
Stoat	Eurasia, North America	New Zealand
Japanese weasel	Japan (Honshu, Kyushu, Shikoku, Sado, and other islands)	Japan (Hokkaido)
Least weasel	Eurasia, North America, North Africa[1]	New Zealand
Siberian weasel	mainland Asia, islands of Taiwan and Jeju	Japan (Honshu, Kyushu, Shikoku)
American mink	North America	Eurasia, South America
Common raccoon	North America (including central America)	Eurasia, including Japan

Source: IUCN 2016; [1] least weasel populations in North Africa may have been introduced (Lebarbenchon et al. 2010) agricultural-forested landscape, such that the area occupied has increased from 26,515 km^2 in 2001 to 111,630 km^2 in 2011, and is predicted to expand to 252,940 km^2 (71% of the area of Germany) by 2061 (Fischer et al. 2016). In central Spain, between 2007 and 2010, raccoons colonized an estimated 100 km of rivers and streams (García et al. 2012). Believed to have originated from the release of unwanted pets (as in Japan), raccoons in Spain pose a potential predation risk to the native fauna (especially migratory birds at stopovers) and there is concern regarding spread of disease to humans, domestic animals, and other wildlife (Beltrán-Beck et al. 2012). Common raccoons are also present on the Balearic island of Mallorca (Pinya et al. 2009), and in the Canary Islands, where they kill breeding Cory's shearwaters (*Calonectris borealis*, García et al. 2012).

Conservation: status, population trends, and anthropogenic threats

Less than a quarter (21%) of all musteloids, 19 of the 90 musteloid species listed by the IUCN Red List of Threatened Species (hereafter the IUCN Red List), are considered threatened (classified as Critically Endangered, Endangered, or Vulnerable, Table 1.2), which

Table 1.2 Conservation status of musteloid species (Mustelidae, Mephitidae, Procyonidae, and Ailuridae) on the 2016 IUCN Red List of Threatened Species[1].

Critically Endangered *Extremely high extinction risk* European mink, *Mustela lutreola* Cozumel or Pygmy raccoon, *Procyon pygmaeus*	**Endangered** *Very high extinction risk* Sea otter, *Enhydra lutris* Southern river otter, *Lontra provocax* Marine otter, *Lontra felina* Hairy-nosed otter, *Lutra sumatrana* Giant otter, *Pteronura brasiliensis* Black-footed ferret, *Mustela nigripes* Bornean ferret badger, *Melogale everetti* Red panda, *Ailurus fulgens* Eastern mountain coati, *Nasuella meridensis*
Vulnerable *High extinction risk* Asian small-clawed otter, *Aonyx cinereus* Smooth-coated otter, *Lutrogale perspicillata* Greater hog badger, *Arctonyx collaris*[2] Nilgiri marten, *Martes gwatkinsii* Colombian weasel, *Mustela felipei* Marbled polecat, *Vormela peregusna* Pygmy spotted skunk, *Spilogale pygmaea* Eastern spotted skunk, *Spilogale putorius*	**Near Threatened** *Close to qualifying for a higher threat category* African clawless otter, *Aonyx capensis* Congo clawless otter, *Aonyx congicus* Spotted-necked otter, *Hydrictis maculicollis* Neotropical otter, *Lontra longicaudis* Eurasian otter, *Lutra lutra* Altai or Mountain weasel, *Mustela altaica* Japanese weasel, *Mustela itatsi* Olinguito, *Bassaricyon neblina* Western mountain coati, *Nasuella olivacea*
Least Concern *Relatively widespread and abundant* North American river otter, *Lontra canadensis* Northern hog badger, *Arctonyx albogularis*[2] Sumatran hog badger, *Arctonyx hoevenii*[2] Tayra, *Eira barbara* Lesser grison, *Galictis cuja* Greater grison, *Galictis vittata* Wolverine, *Gulo gulo* Saharan striped polecat or Libyan striped weasel, *Ictonyx libycus* Striped polecat or Zorilla, *Ictonyx striatus* Patagonian weasel, *Lyncodon patagonicus* American marten, *Martes americana* Yellow-throated marten, *Martes flavigula*	**Data Deficient**[3] *Inadequate information to assess extinction risk* Vietnamese or Cuc Phuong ferret badger, *Melogale cucphuongensis* Tonkin weasel, *Mustela tonkinensis* Sichuan weasel, *Mustela russelliana*

continued

Table 1.2 (*Continued*)

Stone or Beech marten, *Martes foina*	
European pine marten, *Martes martes*	
Japanese marten, *Martes melampus*	
Fisher, *Martes pennanti*	
Sable, *Martes zibellina*	
Japanese badger, *Meles anakuma*	
Asian badger, *Meles leucurus*	
European badger, *Meles meles*	
Honey badger, *Mellivora capensis*	
Chinese or Small-toothed ferret badger, *Melogale moschata*	
Javan ferret badger, *Melogale orientalis*	
Burmese or Large-toothed ferret badger, *Melogale personata*	
Amazon weasel, *Mustela africana*	
Ermine or stoat, *Mustela erminea*	
Steppe or Siberian polecat, *Mustela eversmanii*	
Long-tailed weasel, *Mustela frenata*	
Yellow-bellied weasel, *Mustela kathiah*	
Indonesian mountain weasel, *Mustela lutreolina*	
Least weasel, *Mustela nivalis*	
Malay weasel, *Mustela nudipes*	
European polecat, *Mustela putorius*	
Siberian weasel, *Mustela sibirica*	
Back-striped or stripe-backed weasel, *Mustela strigidorsa*	
Egyptian weasel, *Mustela subpalmata*	
American mink, *Neovison vison*	
African striped weasel, *Poecilogale albinucha*	
American badger, *Taxidea taxus*	
American hog-nosed skunk, *Conepatus leuconotus*	
Striped hog-nosed skunk, *Conepatus semistriatus*	
Molina’s hog-nosed skunk, *Conepatus chinga*	
Humboldt’s hog-nosed skunk, *Conepatus humboldtii*	
Hooded skunk, *Mephitis macroura*	
Striped skunk, *Mephitis mephitis*	
Indonesian or Sunda stink badger, *Mydaus javanensis*	
Palawan stink badger, *Mydaus marchei*	
Western spotted skunk, *Spilogale gracilis*	
Southern spotted skunk, *Spilogale augustifrons*	
Crab-eating raccoon, *Procyon cancrivorus*	
Common or Northern raccoon, *Procyon lotor*	
South American, ring-tailed or brown-nosed coati, *Nasua nasua*	
White-nosed coati or coatimundi, *Nasua narica*	
Ringtail, *Bassaricus astutus*	
Cacomistle, *Bassaricus sumichrasti*	
Kinkajou, *Potos flavus*	
Bushy-tailed or northern olingo, *Bassaricyon gabbii*	
Allen’s olingo, *Bassaricyon alleni*	
Western lowland olingo, *Bassaricyon medius*	

[1] Version 2016-2, downloaded November 2016.

[2] Hog badger formerly NT as single species, *Artonyx collaris*.

[3] This is not a category of threat; it is possible that future research will show that a threatened classification is appropriate.

is approximately comparable to carnivores and mammals in general (25% of both groups being threatened; Schipper et al. 2008) but considerably lower than felids (for which 44% are threatened, Macdonald et al. 2010a). Nevertheless, two musteloids are Critically Endangered, and nine are Endangered, compared with one and six, respectively, for felids (Macdonald et al. 2010a), and, considering otters alone, 54% (seven of 13) are threatened and all but one (the North American river otter) are at least Near Threatened. As for mammals generally (Schipper et al. 2008), threatened musteloid species are concentrated in south and Southeast Asia (Figure 1.3), although, in contrast with the large carnivores, threatened musteloid species occur everywhere across the globe except Africa.

Almost half (46.4%) of all musteloid species are believed to be declining, and population trends of a quarter (26.2%) remain unknown (with the procyonids particularly poorly known, Figure 1.4). Common raccoons and hooded skunks are the only species assessed as increasing at a global level (although Roper [2010] shows that national European badger populations are increasing throughout western Europe, see also Kranz et al. 2016; and American mink are increasing in their invaded range, Santulli Sanzo et al. 2014; MAGRAMA 2014; M. Põdra and A. Gómez, unpublished data;

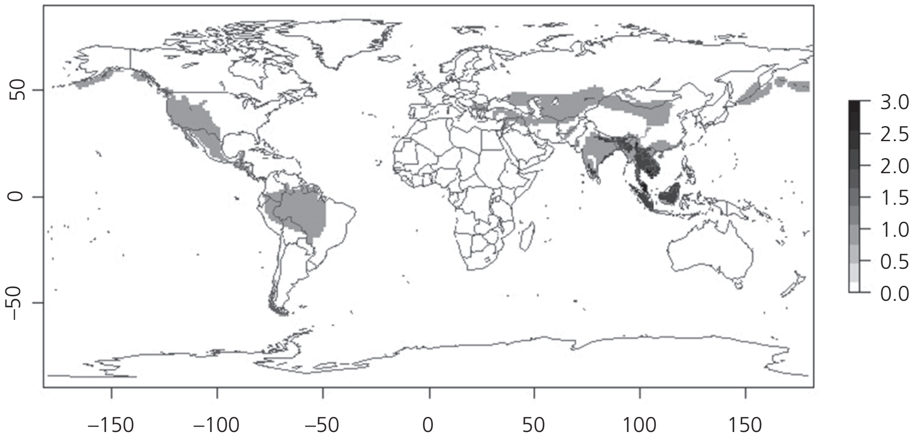


Figure 1.3 Global patterns of threatened musteloid species richness (based on IUCN Red List range maps, version 2016.1, plotted at 1 degree scale). Includes only extant (and reintroduced) ranges of Vulnerable, Endangered, and Critically Endangered species.

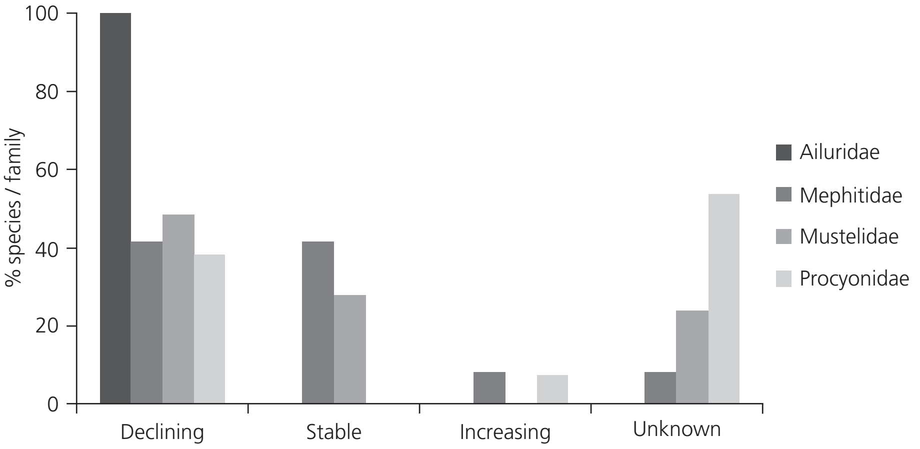


Figure 1.4 Population trends of musteloids, as assessed by the IUCN Red List (Version 2016.1). N = Ailuridae 1, Mephitidae 12, Mustelidae 58, Procyonidae 13.

Fraser et al., Chapter 16, this volume; Maran et al., Chapter 17, this volume).

Almost all musteloids and all otters (at least 56 species in total), are potentially threatened by hunting and trapping (either as target or non-target species, or both; Figure 1.5). Many are subject to legal, regulated harvest for the fur trade, which is still a multibillion dollar global business despite the slump in the market in the 1990s. However, many are hunted illegally, and poaching for pelts (and sometimes bushmeat or traditional medicine) is a serious problem for many of the otters (particularly the hairy-nosed otter [*Lutra sumatrana*]). For some species, even legal harvests are considered unsustainable, at least in parts of their range (Harrington et al. discuss contemporary exploitation of musteloids further in Chapter 7, this volume).

As with all mammals, many musteloids (over half of all musteloid species, and all but one of the otter species) are threatened by habitat loss that occurs as a result of agricultural practices and residential and/or commercial development, as well as habitat degradation due to logging and timber harvest (Figure 1.5). Road building destroys and fragments habitat (by creating barriers that animals cannot cross), facilitates access for hunting and other illegal activities, and is also a major cause of death for several non-threatened species worldwide. Road traffic accidents can represent a significant threat to small or fragmented populations that are otherwise already vulnerable.

For otters, all man-made changes to aquatic habitats (including canalization of rivers, water abstraction, wetland drainage, dam construction, and removal of bankside vegetation) tend to be unfavourable (e.g. Roos et al. 2015). Construction of hydroelectric dams is a major threat to several otter species (e.g. Palmeirim et al. 2014), and all otters (and mink) are impacted either directly or indirectly by aquatic pollution. Polychlorinated biphenyls (PCBs) impair reproductive success in American mink (Brunström et al. 2001), acidification of rivers and lakes (due to acid drainage from coal mines) eliminates otter prey (fish, e.g. Serfass et al. 2015), as does eutrophication caused by fertilizer runoff (e.g. Roos et al. 2015). Fisheries (both large- and small-scale) carry a risk of accidental death to otters due to getting caught in nets, and most otter species are subject to some level of illegal killing due to their (real or perceived) interference in fishing activities (see Harrington et al., Chapter 7, this volume).

Several terrestrial musteloid species are also persecuted or controlled due to various levels of conflict with humans (Figure 1.5)—the species affected are, for the most part, not threatened and persecution is in most cases considered to have a low impact on the population as a whole, but there are some exceptions. Some species are caught incidentally during predator control activities aimed at other non-musteloids: white-nosed coatis (*Nasua narica*), for example, disappeared from the Burro Mountains in New Mexico following a coyote poisoning campaign in 1971 (Kaufmann et al. 1976). Similarly, a number of rodent-eating species are placed at risk of secondary poisoning by the widespread and indiscriminate use of rodenticides (e.g. European polecat, Skumatov et al. 2016; marbled polecat, Abramov et al. 2016c; Sheffield and King 1994). Disturbance due to human recreation affects only a small number of musteloids—notably sea otters that can become energetically stressed while avoiding contact with kayakers (McKelvey 2015; see also Estes et al., Chapter 23, this volume) and occasionally suffer injury from boat strikes—but this may be an increasing issue given the increasing human population and increasing popularity of wildlife-watching activities (e.g. Y. Zhou et al. 2013a; Moorhouse et al. 2015c). Feral dogs and feral hogs present a threat to some species.

Overall, there seems to be little in the way of consistent patterns in the threats to musteloids. Some, for example many otter species (Foster-Turley et al. 1990), seem to be subject to a number of simultaneous interacting, compounding threats, such that each alone might not be crucial but all together might push the species over the edge. Some are vulnerable predominantly because of their tiny ranges. Most of the non-threatened species are exploited or persecuted (often both) for some reason, which is not a problem per se if carried out humanely and sustainably, but is often not well monitored (discussed further in Harrington et al., Chapter 7, this volume). Only eight musteloid species (six of them *Mustela* species) are considered to have no major threats (Figure 1.5).

Dramatis personae

The following species vignettes are based largely on the IUCN Red List species entries (all of which were updated in 2015 or 2016)—they are not exhaustive, but do provide a general ‘picture’ of each species, its ecology, and conservation status. In some cases,

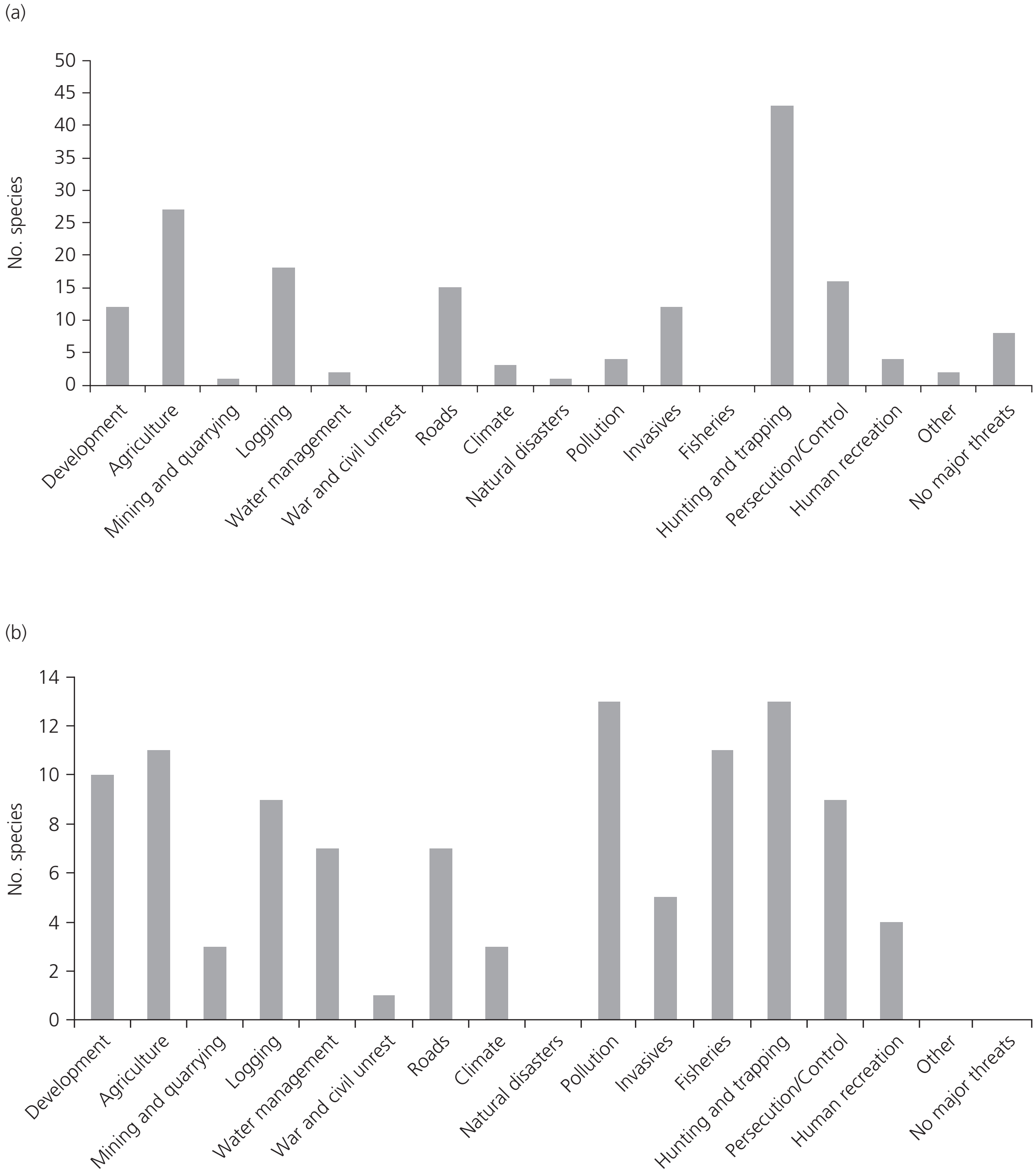


Figure 1.5 Number of (a) terrestrial musteloids, and (b) otters potentially affected by threats posed by people and their activities (based on IUCN Red List threats classification scheme, version 2015.4). Individual species were considered to be potentially impacted by between one and 10 of the threats as categorized here (e.g. the red panda and several of the otter species were considered to be subject to 10 or more threats). Includes all potential threats and does not take account of extent or severity (at the time of writing, this level of assessment had not been completed for the musteloids).

species are grouped to highlight potential community interactions, or where biology or threats are similar. Throughout, we follow Koepfli et al.'s (Chapter 2, this volume) classification of the four families (Mustelidae, Mephitidae, Procyonidae, and Ailuridae), but include notes on partially recognized additional species, if equivocal, such as Humboldt's Hog-nosed skunk (*Conepatus humboldtii*) and Congo clawless otter (*Aonyx congicus*). We do not include the sea mink (*Neovison macrodon*, Prentis, 1903) that formerly occurred along the eastern North American coast, but went extinct in the nineteenth century (last seen in New Brunswick in 1894, Campbell 1988), due to over exploitation for its fur, or the Japanese otter (*Lutra nippon*), that disappeared much more recently (perhaps in the early 1990s), and was only recognized as a distinct species after its disappearance (e.g. Suzuki et al. 1996; Koepfli et al., Chapter 2, this volume).

African otters

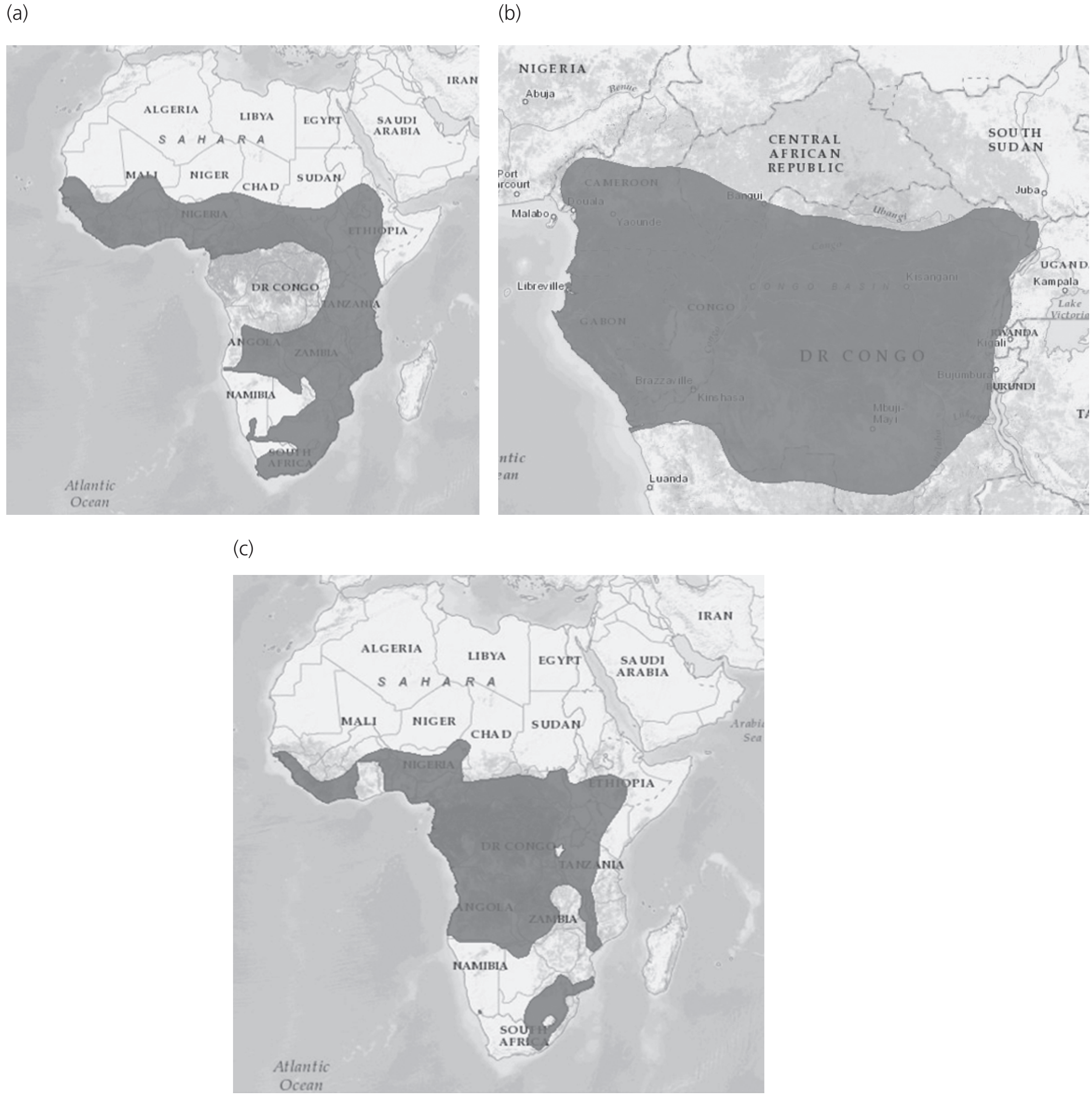
African clawless otter *Aonyx capensis* (Schinz, 1821), Congo clawless otter *Aonyx congicus* (Lönnberg, 1910) and spotted-necked otter *Hydrictis maculicollis* (Lichtenstein, 1835)

Otters in Africa comprise the *Aonyx* species—African (or Cape) clawless otters and Congo (or Cameroon) clawless otters (considered by some to be conspecific but listed by the IUCN as separate species, see Jacques et al. 2009), Eurasian otters (*Lutra lutra*), and spotted-necked otters (also known as spot-necked or speckle-throated otters). The latter are sometimes included in the genus *Lutra* but recent work places them in *Hydrictis* (Koepfli et al. 2008a; Sato et al. 2012; Koepfli et al., Chapter 2, this volume). Eurasian otters are limited to north of the Sahara, and are covered separately below. African clawless otters and spotted-necked otters are found near permanent freshwater across most of sub-Saharan Africa, whilst Congo clawless otters (known locally as 'swamp otters') are largely restricted to the rainforests and lowland wetlands of the Congo River basin. Both clawless otters are sympatric with spotted-necked otters across much of their range and there is some overlap between the two clawless otters in Uganda and Rwanda (Somers and Nel 2013; Jacques et al. 2004, 2015a, b). African clawless otters are often confused with spotted-necked otters, although the latter are considerably smaller and lack the characteristic pale face, throat, and chest of African clawless otters, and whilst the former is also found along rocky coasts and estuaries (provided there is freshwater nearby, Jacques et al. 2015b), spotted-necked otters do not occur in saltwater habitats (Reed-Smith et al. 2015).

Congo clawless otters are the least known of the African otters due to the remoteness of their range; they may be common in undisturbed rainforest locations, but otherwise are thought to be rare (Jacques et al. 2004, 2009). The other two species are widely distributed but there is little information on actual area occupied within their respective ranges (Reed-Smith et al. 2015; Jacques et al. 2015b). Home range length (measured as length of river occupied) of African clawless otters in the Western Cape, South Africa, was 35–54 km for males (n = 3, excluding one male that travelled only 4.9 km but fed predominantly from a floating rainbow trout tank 200 m from his resting site) and 14–18 km for females (n = 3, Somers and Nel 2004). Average home ranges of three male and three female spotted-necked otters along rivers in the Kwa-Zulu-Natal Drakensberg Park in South Africa were 23 and 8 km, respectively (Perrin et al. 2000). Reported densities of spotted-necked otters vary between one to two otters per kilometre of lake shore and one otter per 6–11 km of stream (Reed-Smith et al. 2015 and refs therein).

Clawless otters (*Aonyx* spp.) are often described as crab specialists (Kruuk 1995, 2006) and, unlike other otters, have un-webbed, clawless toes, adapted for searching for prey in the mud with their forepaws (Larivière 2001a, b; Jacques et al. 2009). Accordingly, they differ in diet from spotted-necked otters that eat mostly fish. For example, during drought conditions in South Africa (when trophic overlap might be expected to be high), the three most common prey items found in African clawless otter spraints were crab (*Potamonautes perlatus*, 51% relative frequency of occurrence), insect (19%) and fish (*Tilapia sparrmanii*, 18%), whereas for spotted-necked otter spraints, they were fish (47%), crab (38%), and frog (8%, Somers and Purves 1996). Spotted-necked otters appear to use freshwater streams and hunt in open water while clawless otters use brackish water streams and forage along the banks (Angelici et al. 2005; Jacques et al. 2009). Jacques et al. (2009) describes spotted-necked and Congo clawless otters feeding in the same area without conflict, with spotted-necked otters hunting in open water while Congo clawless otters foraged in soft mud banks for worms.

On Rubondu Island in Lake Victoria, Tanzania, Kruuk and Goudswaard (1990) observed spotted-necked otters foraging in groups of up to 10 individuals (mean group size 3.2 ± 1.3) and groups of up to 20 individuals have been seen (Rowe-Rowe and



Map 1 African otters, a) African clawless otter, b) Congo clawless otter, c) spotted-necked otter © IUCN 2016

Somers 1998). Reed-Smith et al. (2014) described the social system of foraging spotted-necked otters as one in which 'basic groups' (females with young or even singletons) coalesced into 'packs' which occasionally joined to form temporary larger 'schools' (of up to 12 individuals) that used the same stretch of river or lake bank (< 20 m) but did not engage in cooperative hunting. Similar to the fission/fusion groups of African clawless otters described by Kruuk (2006).

African clawless otters have been found in towns and cities, and can occupy rivers with high pollution and eutrophication levels (Somers and Nel 2013). All African otters are, nevertheless, threatened by habitat loss and degradation across their range, following widespread bush clearing, deforestation, overgrazing, and wetland drainage, exacerbated by a growing, poor population engaged in unsustainable agricultural activity and unsustainable fishing practices, poor sanitation infrastructure, and growing industrial waste pollution (Jacques et al. 2015a, b). All three species come into conflict with small-scale rural fisheries (e.g. Rowe-Rowe 1990; Akpona et al. 2015) and may be caught accidentally and drowned in gill nets and fish traps, or killed because they are perceived as competitors for fish. Fisheries managers of the Kairezi River Protected Area in Zimbabwe blamed trout declines on predation by African clawless otters and on competition between otters and trout for smaller food items, but scat analysis revealed that only 1% of otter faeces contained the remains of trout, and their diets overlapped only 17% (Butler 1994); subsequent studies revealed that trout ate small crabs because they were restricted by their mouth gape, whereas otters ate larger and more abundant crabs (Butler and Marshall 1996). In parts of their range, both clawless otters are also killed for food, skins, and other body parts (e.g. De Luca and Mpunga 2005; see also Harrington et al., Chapter 7, this volume), although Congo clawless otters have the reputation of being difficult to catch and are seldom recorded in bushmeat reports (Jacques et al. 2004, 2015b). Introduced Nile perch (*Lates niloticus*) and invasive non-native water hyacinth (*Eichhornia crassipes*) are also a problem for otters (Reed-Smith et al. 2015).

	Male mean (range)	Female mean (range)
Weight (kg)		
African clawless otters	14.1 (10–18) n = 16	11.7 (10–13.8) n = 9
Spotted-necked otters	5.7 (4.5–6.6) n = 5	4.3 (3.8–4.7) n = 4
Head/body length (mm)		
African clawless otters	1265 (1130–1380) n = 13	1233 (1140–1330) n = 7
Spotted-necked otters	698 (650–760) n = 5	588 (570–606) n = 4

Ref: African clawless otters, Somers and Nel 2013 based on data from South Africa; spotted-necked otters, d'Inzillo Carranza and Rowe-Rowe 2013.

Eurasian otters

Eurasian otter *Lutra lutra* (Linnaeus, 1758)

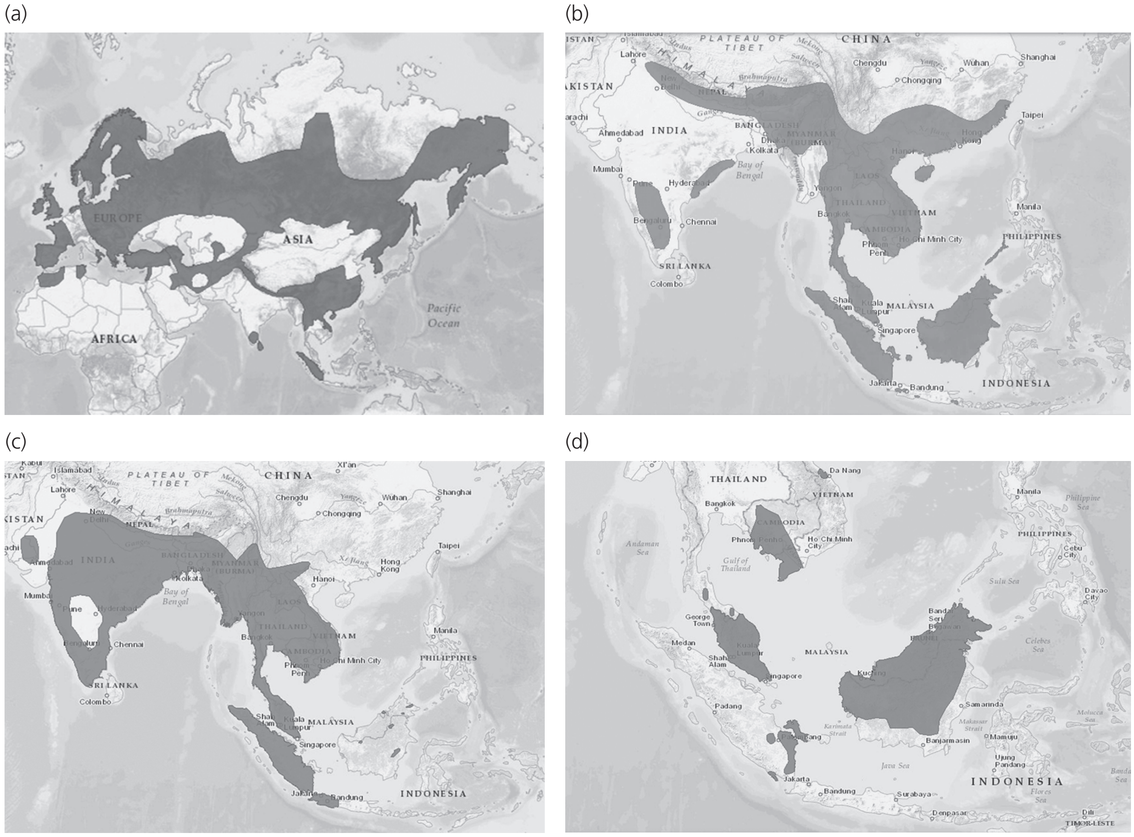
Eurasian otters have one of the widest distributions of all Palaearctic mammals, occurring over three continents: Europe, Asia, and Africa (albeit only in Morocco, Algeria, and Tunisia; Roos et al. 2015). Eurasian otters have increased in distribution in some parts of their range (e.g. the UK, Crawford 2010; and western mainland Europe, Kranz and Toman 2000), but are thought to be decreasing across their wider distribution (Roos et al. 2015) and have much reduced distributions in, for example, Italy (Prigioni et al. 2006) and northeast China (Zhang et al. 2016).

Eurasian otters live in highland and lowland lakes, rivers, streams, marshes, swamp forests, and coastal areas (Mason and Macdonald 2009), up to 1000 m in the Alps (Ruiz-Olmo and Gosalbez 1997) and > 4000 m in Tibet (Mason and Macdonald 2009). Density estimates are lacking for most parts of their range but, in coastal habitats in the UK, they averaged one per km of shore (each otter using several, overlapping kilometres of shoreline, with smaller exclusive core areas). In freshwater habitats, home ranges were 38.8 ± 23.4 km (n = 6 males) and 18.7 ± 3.5 km (n = 10 females, Kruuk 2006), and Harris et al. (1995) estimated density at one adult per 24–27 linear km of river. Like most *Lutra* species, fish may comprise over 80% of their diet (e.g. Erlinge 1969; Webb 1975; Ruiz-Olmo and Palazon 1997); but they also eat crustaceans, birds, amphibians, reptiles, aquatic insects, and small mammals (reviewed in Reid et al. 2013), depending on local availability and season. Eels (*Anguilla anguilla*) are often favoured (Kruuk 2006). In Sri Lanka, 81% of Eurasian otter diet was comprised of crabs (de Silva 1996). Most fish eaten are slow-swimming species less than 13 cm in length (Kruuk 2006; Grant and Harrington 2015), but otters can take fish up to 9 kg (Britton et al. 2005), and they come into conflict with fisheries when they take large specimen fish of valuable or stocked species (e.g. carp, discussed in Chapter 7). In parts of Southeast Asia, Eurasian otters occur in sympatry with smooth-coated and Asian small-clawed otters (Kruuk et al. 1994; see Smooth-coated otter).

Potential threats include exploitation and habitat loss (particularly in Asia, Roos et al. 2015), pollution (in parts of western and central Europe, e.g. Delibes et al. 2009; see also Delibes et al. 2012), declining eel populations (Kruuk 2014), road traffic accidents, and drowning or strangulation in underwater fish traps or nets (Roos et al. 2015).

	Male mean (range)	Female mean (range)
Weight (kg)	8.1 (4.4–12.0) n = 236	6.0 (2.1–8.0) n = 125
Head/body length (mm)	1120 (1000–1308) n = 213	1028 (880–1130) n = 118

Ref: Chadwick 2007 based on data from the UK



Map 2 Eurasian otters, a) Eurasian otter, b) Asian small-clawed otter, c) smooth-coated otter, d) hairy-nosed otter © IUCN 2016

Plate A Eurasian otter (*Lutra lutra*). © A.L. Harrington

Asian small-clawed otter *Aonyx cinereus* (Illiger, 1815) *Originally, but incorrectly, *Aonyx cinerea*

Asian (or Oriental) small-clawed otters are the smallest of the otters. Historically, they had an extensive distribution range, from India through Southeast Asia to Palawan (Philippines), Taiwan, and southern China (Hussain et al. 2011; Wright et al. 2015) but they are now believed to be extirpated or extremely rare throughout much of their range in southern China and recent surveys suggest that they have disappeared from the western Himalayan foothills (Hussain 2002; Hussain et al. 2011). Of all the otter species, small-clawed otters are the most commonly exhibited in zoos, but there are no reliable estimates of their population size in the wild (Wright et al. 2015).

Asian small-clawed otters occur in a range of aquatic habitats from coastal wetlands to mountain streams, wherever there is adequate shelter, although they appear to prefer slow-flowing and shallow water (Wright et al. 2015). As with other *Aonyx* species, they feed mainly on crabs, snails and other molluscs, insects, and small fish, but supplement their diet with rodents, snakes, and amphibians. Of 328 spraints examined in Malaysia, 80.8% consisted of crab remains, 77.8% fish, 12.5% insects, and 4.0% snails (Foster-Turley 1992 in Wright et al. 2015). In most of their range, they are sympatric with smooth-coated and Eurasian otters (see Smooth-coated otter).

	mean (range)
Weight (kg)	3.1 n = 20
Head/body length (mm)	406 (360–440) n = 8
Ref: Larivière 2003a	

Smooth-coated otter *Lutrogale perspicillata* (Geoffroy Saint-Hilaire, 1826)

Smooth-coated otters were once common in the lowlands and floodplains throughout south and Southeast Asia, from India and Pakistan to Indonesia, but are now restricted to a few protected areas (de Silva et al. 2015). They are usually seen in family groups of up to 10 individuals (Kruuk 2006). Population data are lacking, but, based on sightings, Nawab and Hussain (2012) estimated relative abundance at between 0.3 and 0.48 individuals per km^2 in the upper Gangetic plains in north India.

Smooth-coated otters move among habitat types seasonally in accordance with changes in prey availability—for example, in the upper Gangetic plains, otters occupy seasonally flooded swamps during the monsoon and in early winter, but move to permanent rivers when the swamps begin to dry in spring (Hussain and Choudhury 1997). Like Eurasian otters, smooth-coated otters eat mostly fish (which usually comprise 75–100% of their diet) but opportunistically supplement their diet with crustaceans and insects, and other vertebrates, such as frogs, birds, and rodents (Hussain and Choudhury 1998). In paddy fields in Malaysia, 23% of smooth-coated otter spraints contained rice field rats (*Rattus argentiventer*, Foster-Turley 1992).

In the Huai Kha Khaeng river valley, in Thailand, where Eurasian, Asian small-clawed, and smooth-coated otters occur in sympatry, the larger smooth-coated otters ate mostly fish, and took larger prey than Eurasian otters that ate predominantly amphibians. The rapid-flowing upper reaches of the river were dominated by Eurasian otters, and the dam and slow, meandering rivers near the dam were used by smooth-coated otters. The crab-eating Asian small-clawed otters used the middle sections of the river and, where they occurred at the same site, foraged further from the river than the other two species, between patches of reeds and river debris where crabs were likely to be found (Kruuk et al. 1994).

A sub-species of the smooth-coated otter (*L. p. maxwellii*, Maxwell's Otter) occurs as an isolated subpopulation in Iraq (de Silva et al. 2015). Despite wide-scale drainage of the marshes by the Iraqi political regime in the 1990s, smooth-coated otters are still present in at least five localities in four southern Iraqi provinces and have also been sighted in the Kurdistan region of northern Iraq (Al-Sheikhly and Nader 2013).

	range
Weight (kg)	7–11
Head/body length (mm)	590–749
Ref: Hwang and Lariviére 2005	

All otters in Asia face serious threats associated with increasing human populations and their activities—loss of habitat due to construction of hydro-electric dams, reclamation of wetlands for settlements and agriculture, overfishing, and contamination of waterways with pesticides (de Silva et al. 2015; Roos et al. 2015; Wright et al. 2015). Poaching for otter pelts has been reported from across the Western Ghats in south India (Prakash et al. 2012) and is a major threat in many parts of India and Southeast Asia (IOSF 2014).

Hairy-nosed otter *Lutra sumatrana* (Gray, 1865)

Hairy-nosed otters are endemic to Southeast Asia, where they live in inland or coastal tropical swamp or flooded forests (Aadrean et al. 2015), and eat mostly fish (e.g. three-spotted gourami [*Trichogaster trichopterus*], common climbing perch [*Anabas testudineus*] and snakeheads [*Channa* spp.] in Thailand, and farmed walking catfish [*Clarias microcephalus*] in Vietnam), and water snakes, but also frogs, lizards, crustaceans, birds, small mammals, and insects (Wright et al. 2008).

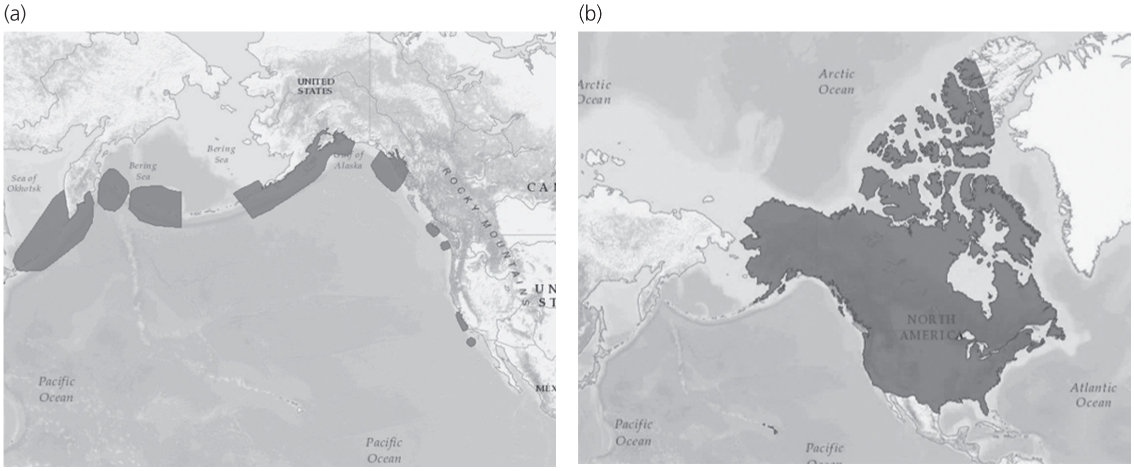
Hairy-nosed otter populations are declining rapidly across most of their range, due to habitat degradation (Aadrean et al. 2015) and hunting driven by the illegal trade in otter pelts (Yoxon and Yoxon 2007; Duckworth and Hills 2008, Shepherd and Nijman 2014). Tropical peat swamp forests (important habitat for hairy-nosed otters) are being cleared for oil palm plantations, food crops (rice, corn, and soya bean), and fish farming. In Vietnam, for example, about 80% of the Mekong Delta is used for rice production, reducing native habitats to a few pockets (Wassmann et al. 2004). Ultimately, the problem is the burgeoning human population in Southeast Asia, and resultant pressure on natural resources, but the naturally low density of hairy-nosed otters makes them vulnerable to extinction.

	mean (range)
Weight (kg)	7 (5–8)
Head/body length (mm)	652 (575–826)
Ref: Wright et al. 2008	

North American otters

Sea otter *Enhydra lutris* (Linnaeus, 1758)

The only exclusively marine otter, sea otters, historically occurred around the North Pacific Rim, from Hokkaido, Japan, to Baja California, Mexico (Doroff and Burdin 2015; Estes et al., Chapter 23, this volume). By the early twentieth century, commercial hunting for their skins had reduced them to about 2000 animals in 13 remnant colonies (Kenyon 1969) from which they have been recovering in recent decades. However, contemporary issues (oil spills, predation by killer whales *Orcinus orca*, Estes et al. 1998, shark bites and infectious disease, Conrad et al. 2005, Johnson et al. 2009, Newman and Byrne, Chapter 9, this volume, and illegal harvest of skins, IOSF 2014) have either prevented sea otter populations from thriving or have caused further population declines (Doroff and Burdin 2015). Three regional subspecies are currently recognized: *E. l. lutris* (Linnaeus, 1758) in the Kuril islands and the northwest Pacific, *E. l. kenyoni* in the Aleutian islands, Prince William Sound, Alaska and south along the North American Pacific coast to Oregon, and *E. l. nereis* in California,



Map 3 North American otters, a) sea otter, b) northern river otter © IUCN 2016

USA (Cronin et al. 1996). The total sea otter population is estimated at 125,831, with the largest sub-population in Alaska (Doroff and Burdin 2015).

Individuals occupy home ranges of a few kilometres long, and densities range between about one and five individuals per km^2, with highest densities where rocky bottom habitats support kelp forests (Laidre et al. 2001). Sea otters forage for marine invertebrates (sea urchins, bivalves such as clams and mussels, abalone, and snails, ranging in size from tiny limpets and crabs to giant octopuses, Estes 1980) on or near the ocean floor in water about 30 m deep, usually within a kilometre of the shore, although they can dive up to about 80 m (Bodkin et al. 2004; Estes et al., Chapter 23, this volume). They rarely come ashore. In high density populations, diet may comprise up to 50% fish (Estes et al. 1978). Severe weather can disrupt foraging, increase pup mortality, and potentially lead to malnutrition or starvation, and sea otters can become entangled in fishing gear and drown (Doroff and Burdin 2015). Oil spills are perhaps the greatest anthropogenic threat to sea otters (Geraci and Williams 1990; Doroff and Burdin 2015), causing hypothermia, gastrointestinal disorders, and lung damage. Approximately 3000 sea otters died following the Exxon Valdez spill in Prince William Sound in 1989 (Garrott et al. 1993).

	Male mean	Female mean
Weight (kg)		
– 1992–1997	32.3 n = 56	24.4 n = 142
– 1967–1971	28.1 n = 444	21.4 n = 1199
Head/body length (mm)		
– 1992–1997	1315 n = 56	1233 n = 142
– 1967–1971	1187 n = 444	1100 n = 1199

Ref: Laidre et al. 2006 based on data from low density declining population in 1992–1997 and population at carrying capacity in 1967–1971; males may weigh up to 45 kg (head/body length 1480 mm) and females 32.5 kg (head/body length 1400 mm) (Estes 1980).

Northern river otter *Lontra canadensis* (Schreber, 1777)

Both northern (or North American) and southern (or South American) river otters are distinct from Eurasian otters and belong in the genus *Lontra* (Van Zyll de Jong 1987; see Kruuk 2006) although they are often referred to as *Lutra* in the literature, and are ecologically and behaviourally very similar.

Northern river otters occupy lakes, reservoirs, ponds, rivers, streams, freshwater and salt water marshes, and swamp forest in North America. They consume predominantly medium-sized fish, amphibians (mostly frogs), crustaceans (mainly crayfish), and (opportunistically) small mammals, molluscs, reptiles, birds, and fruits (Serfass et al. 2015) and den in logjams and beaver (*Castor canadensis*) lodges (Melquist and Hornocker 1983; Reid et al. 1994b). Density estimates are usually about one otter per 3 to 4 km of waterway (e.g. Testa et al. 1994; Melquist and Hornocker 1983) but may be as high as one otter per km on the coast. They are predominantly solitary, with females exhibiting intrasexual territoriality, but in coastal regions groups of up to 18 individuals (mostly unrelated males) have been observed, with the largest groups seen during the seasonal migration of schooling pelagic fish (Blundell et al. 2002, 2004; Hansen et al. 2009).

Originally occurring across North America, northern river otters suffered large-scale declines in the eighteenth century. In a scenario somewhat similar to that of Eurasian otters in Europe, improvements in water quality and furbearer management techniques, along with a number of reintroduction projects (Reasly 2001), have allowed northern river otters to recolonize parts of their former range (particularly in the Midwestern States), but they remain rare or absent in the southwestern United States (Serfass et al. 2015).

Most mortality is human-related and includes trapping. Additional (localized) threats include oil spills (in coastal areas, e.g. Ben-David et al. 2000; Bowyer et al. 2003), water pollution, and habitat degradation, which may limit their distribution (Serfass et al. 2015), illegal shooting, road kills, and accidental capture in fishing equipment (Melquist and Hornocker 1983).

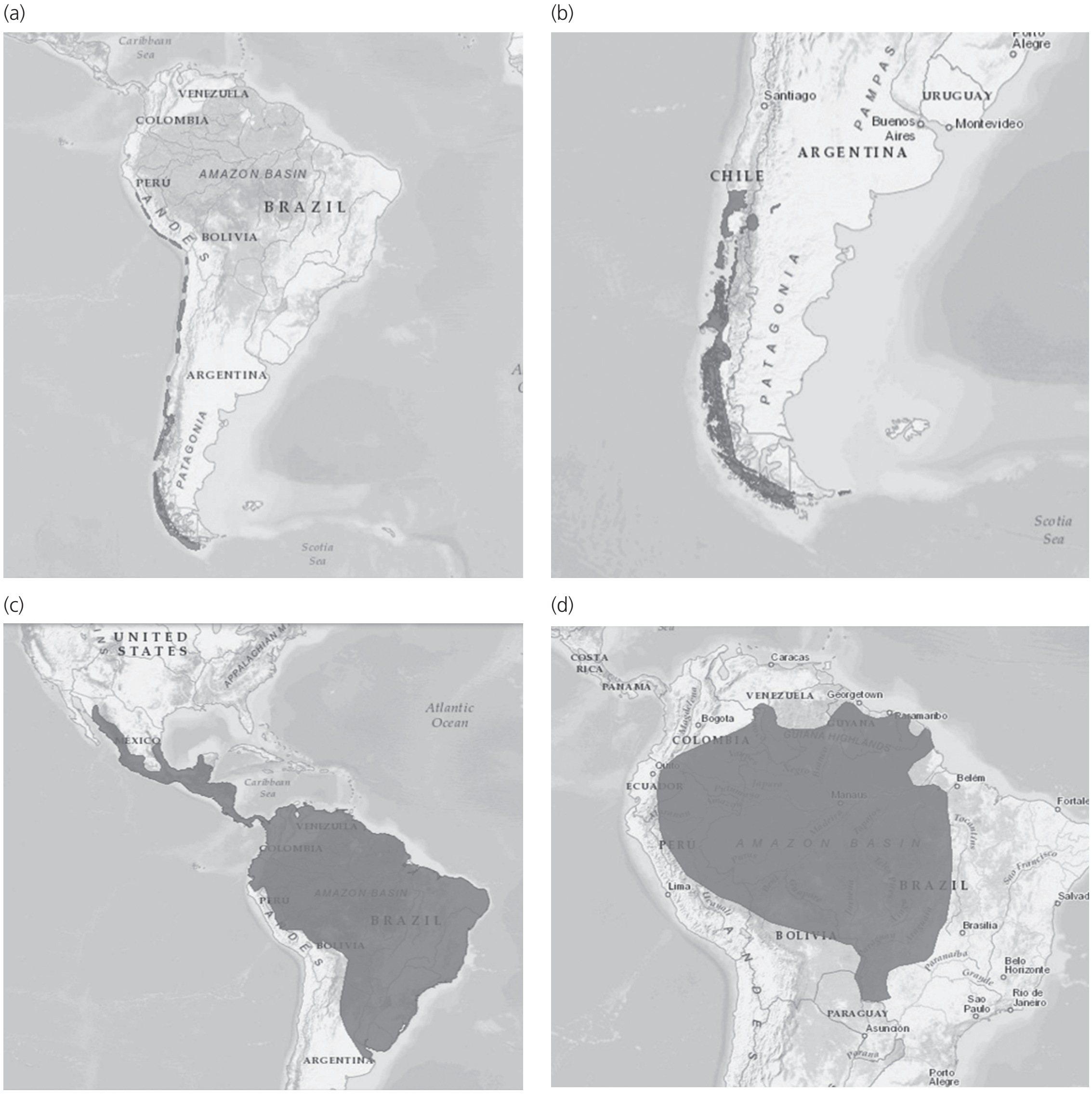
	Male mean	Female mean
Weight (kg)		
– Alberta, Canada	7.7 n = 20	7.3 n = 20
– Idaho	9.2 n = 4	7.9 n = 6
– Alaska	9.4 n = 2	8.4 n = 6
Head/body length (mm)	685 n = 3	620 n = 3

Ref: Larivière and Walton 1998

South American otters

Marine otter *Lontra felina* (Molina, 1782)

Sometimes known locally as 'sea cats' because of their diminutive size and bristly whiskers, marine otters feed exclusively in marine habitats but, unlike sea otters, they return to land to rest and care for their



Map 4 South American otters, a) marine otter, b) southern river otter, c) neotropical otter, d) giant otter © IUCN 2016

young. Generally restricted to within 30 m of steep, rocky coastlines, they have a naturally fragmented distribution (reflecting the heterogeneous distribution of suitable habitat, interspersed with unsuitable sandy beaches) along the Pacific coast from northern Peru to Cape Horn and east to Isla de Los Estados in Argentina (Valqui and Rheingantz 2015; although there are no contemporary records of marine otters in Argentina, Cassini 2008). Density estimates range from 0.04 to 10 individuals per km, but variation is probably at least partly due to differences in survey methods (Valqui 2012; Valqui and Rheingantz 2015); using direct observations of otters foraging on the shore, Medina-Vogel et al. (2006) estimated 1–5 (mean 3.8) otters per km of seashore. One study recorded home ranges of 1.4 to 4.1 km long (n = 3 males, n = 3 females, Medina-Vogel et al. 2007). Marine otters are solitary and diurnal; they can forage in heavy seas and strong winds (Valqui 2012) but wave-exposed coast is probably sub-optimal (Villegas et al. 2007). They feed on crustaceans (shrimps and crabs), molluscs (snails and bivalves), fish, and occasional birds and mammals, according to local availability (Medina-Vogel et al. 2004; Mangel et al. 2011), and several individuals may feed together on fisheries waste in fishing villages and ports (Medina-Vogel et al. 2007).

The major threat to marine otter persistence is the increasing development and urbanization of the Peruvian and Chilean coast (Mangel et al. 2011; Valqui 2012; Valqui and Rheingantz 2015). They are also killed to prevent perceived damage and predation at local fisheries (e.g. Pizarro Neyra 2008), accidental death by entanglement in fishing nets is a frequent problem in some areas (Valqui 2012), and poaching is prevalent in the south. Throughout their range there is little or no enforcement of protective legislation (Valqui and Rheingantz 2015).

	mean (range)
Weight (kg)	(3.2–5.8)
Head/body length (mm)	c. 560 (max. c. 800)

Ref: Larivière 1998; there is no sexual dimorphism

Southern river otter *Lontra provocax* (Thomas, 1908)

Southern river otters (known locally as 'huillin') are confined to the Andean-Patagonian region of southern Chile as well as some lakes and fjords of southern Argentina: the Limay river basin in the Nahuel Huapi National Park (Chehébar 1985, Cassini et al. 2010), Tierra del Fuego National Park in the Beagle Channel, and Isla de Los Estados (Valenzuela et al. 2013). Historically, their distribution extended from 34°S to the Magellan Region (53°S) in Chile but habitat loss (due predominantly to widespread floodplain drainage and canalization of watercourses for livestock farming and agriculture in the Central Valley and Coastal Range of Chile, Medina-Vogel et al. 2003) has reduced their populations in freshwater habitats to a few river basins between 39°S and 44°S (Medina 1996; Aued et al. 2003). Their disappearance from a number of Andean lakes is thought to be associated with urbanization and tourism (Medina 1996).

Southern river otters use lakes and rivers in temperate forests, where there is cover and where macrocrustaceans (*Aegla* spp. and *Sammastacus* spp.—their main prey) are abundant (Aued et al. 2003; Cassini et al. 2009; Chehébar et al. 1986; Medina-Vogel et al. 2003; Sepúlveda et al. 2009; Medina 1997; Medina-Vogel and Gonzalez-Lagos 2008; Fasola et al. 2009; Franco et al. 2013). They also use rocky coasts (where they are sympatric with marine otters), but prefer sheltered areas (Sepúlveda et al. 2015). Common prey items on the coast are cod icefish (*Patagonotothen* spp.), Patagonian blenny or rock cod (*Eleginops maclovinus*), and Antarctic spiny plunderfish (*Harpagifer bispinis*, Valenzuela et al. 2013). Radio-tracking six southern river otters in the Quele River, southern Chile, revealed average home range sizes of 11.3 ± 4.8 km of river, and population density of approximately 0.25 otters per km of river (Sepúlveda et al. 2007). Where southern river otters co-occur with invasive American mink (*Neovison vison*), mink eat more terrestrial prey (Valenzuela et al. 2013) and may alter their activity patterns to avoid the larger otters (Medina-Vogel et al. 2013), as has been found for American mink and Eurasian otters in the UK (see Harrington et al. 2009b).

	Male mean	Female mean
Weight (kg)	12.5 n = 7	9.4 n = 5
Total length (mm)	790 n = 3	710 n = 2

Ref: Reyes-Kuppers 2007

Neotropical otter *Lontra longicaudis* (Olfers, 1818)

Neotropical otters have an extensive distribution from northwest Mexico through the northern and eastern countries of South America to the Atlantic coast and as far south as northeastern Argentina, where they occur in a variety of habitats from rocky shorelines to deciduous and evergreen forests, rainforests, and coastal swamps (Rheingantz et al. 2014; Rheingantz and Trinca 2015). They occur on the Pacific coast only in Colombia, Ecuador, and northern Peru, and do not overlap with the southern river otter that occurs further south. They feed predominantly on fish, as well as crustaceans (crayfish and crabs), amphibians (particularly when they are abundant), and occasionally small mammals, birds, and reptiles (e.g. Rheingantz et al. 2011). Like Eurasian otters, they appear to prefer slower-swimming fish (Rheingantz et al. 2012). Neotropical otters are sympatric with giant otters in the Pantanal and in the Amazon region, but although both species consume fish, dietary overlap is low: in the Jaú National Park in the Amazon (Brazil), giant otters ate more active, larger fish, mostly 16–20 cm long, whereas neotropical otters searched for smaller (mostly 11–15 cm) fish around submerged leaves, rocks, and logs (Silva et al. 2014). Where there are human settlements near the river, Rheingantz et al. (2016) suggest that they alter their activity patterns to avoid human encounters.

Threats include habitat destruction due to deforestation, mining and pollution, and illegal hunting—all of which are probably increasing (Rheingantz and Trinca 2015).

	mean (range)
Weight (kg)	(5–15, usually < 12)
Head/body length (mm)	513 (360–660) n = 3

Ref: Larivière 1999a; male c. 25% bigger

Giant otter *Pteronura brasiliensis* (Gmelin, 1788)

The largest (but not the heaviest) of all extant musteloids, giant otters occur along rivers and lakes in the Peruvian-Amazonian basin, east of the Andes, between northern Venezuela and northeastern Argentina. Throughout their range they exist as small fragmented subpopulations that are extremely vulnerable to extinction due to the combined effects of their own natural history (e.g. late breeding age and small proportion of reproducing females), and the multitude of threats that face the habitat in which they live (gold mining, pollution, overfishing, persecution by fishermen, deforestation, human settlement, tourism, energy developments, and climate change; Groenendijk et al. 2015a, see also Chapter 22, this volume). The Brazilian Pantanal holds the largest population, which is estimated to number 2000–5000; they are considered extinct in Uruguay and probably extinct in Argentina (Groenendijk et al. 2015a).

Giant otters inhabit large, slow-moving rivers, streams, lakes, and swamps (Duplaix 1980; Carter and Rosas 1997), favouring lowland areas with oxbow lakes and high fish densities, where they maintain small stable family group territories of between 18.6 and 102.9 ha (Groenendijk et al. 2015b—or 2 to >20 km linear group ranges along rivers, extending into the flooded habitats adjacent to the river in the wet season, Leuchtenberger et al. 2013). Sometimes giant otters are seen in agricultural canals, reservoirs, and drainage channels (Ribas et al. 2012). They each eat about 3 kg of fish per day (usually slow-moving species, > 30 cm, Duplaix 1980; Kruuk 2006) and typically hunt in groups. Groenendijk and Hajek (2006) describe groups of otters surrounding schools of fish and ‘porpoising’ (performing a succession of leaping dives), which appears to confuse and exhaust the fish and increase capture rates. Giant otters rarely take alternative prey, but Ribas et al. (2012) observed giant otters eating caiman in the southern Pantanal.

	range (maximum)
Weight (kg)	22–26 (up to 32)
Total length (mm)	1500–1800 (up to 2000)

Ref: Duplaix 1980; Rosas et al. 2009b; Groenendijk et al., Chapter 22, this volume; no difference between sexes

Plate B Giant otters (*Pteronura brasiliensis*). © F. Hajek

Map 5 Hog badgers—northern hog badger (pale grey), greater hog badger (mid grey), Sumatran hog badger (dark grey) © Y. Zhou

Hog Badgers

Until recently hog badgers were considered to be monospecific, under the name, *Arctonyx collaris*. Helgen et al. (2008a) proposed three species: the Sumatran hog badger *A. hoevenii* (with a range disjunct from the rest of the genus), the northern hog badger *A. albogularis*, and the greater hog badger *A. collaris* (both of which occur in mainland Asia, with an unconfirmed zone of overlap). Of the three species, the northern hog badger (formerly *A. c.* subsp. *albogularis*) is the better known (see Zhou et al., Chapter 13, this volume) and is the largest of all extant modern badgers (based on skull and head/body length, Helgen et al. 2008a; European badgers are sometimes heavier).

Northern hog badger *Arctonyx albogularis* (Blyth, 1853) and greater hog badger *Arctonyx collaris* (Cuvier, 1825)

Northern hog badgers occur in Sikkim and elsewhere in northeast India (and presumably in intervening Bhutan), across southern and eastern China (Helgen et al. 2008a), and, as one isolated record, in eastern Mongolia (Stubbe et al. 1998). They are widespread and at least locally common in the central and northern provinces of China, and around Beijing (Helgen et al. 2008a), but are rare in the south (Helgen and Chan 2016). Greater hog badgers range from Bangladesh and northeast India east through Myanmar, Thailand, and Lao PDR to Vietnam and south to Cambodia and peninsular Thailand (Duckworth et al. 2016e). However, there is some uncertainty about the range of these two mainland species because both occur in some areas (e.g. in Bangladesh and northeast India where they overlap) and many records are simply identified as 'hog badger'—and while most hog badgers in China have been identified as the northern hog badger, two specimens from the Yunnan province were provisionally assigned by Helgen et al. (2008a) to greater hog badger. In Thailand, greater hog badgers are among the most commonly and widely photographed small carnivores in camera trap surveys, but in Vietnam they are only rarely found if at all (Duckworth et al. 2016e).

Hog badgers are solitary, live in burrows, and are active day and night across a range of habitats—dense deciduous and evergreen forest to non-forested grassland floodplains—from the extreme lowlands to the montane zone (northern hog badgers occur up to at least 4300 m, Helgen et al. 2008a). Northern hog badgers are opportunistic omnivores, with a diet that varies with habitat, region, and season. Wang and Fuller (2003a), for example, reported a diet of mostly mammals and gastropods in a rural agricultural area in southeast China; elsewhere they eat predominantly earthworms, roots, leaves, beetles, cicadas, lepidopteran larvae, and acorns (Helgen and Chan 2016). In a subtropical forest in China, they ate mostly earthworms in spring, and fruit when it was abundant in autumn (Y. Zhou et al. 2015b). Diet of greater hog badgers is poorly known but, based on morphology, assumed to be vermivorous (Helgen et al. 2008a); fruit is also likely to be important (Zhou et al., Chapter 13, this volume). Northern hog badgers hibernate in winter, from November to February or May, at least in northern China (Y. Zhou et al. 2015a, b).

The extent to which hog badgers are hunted as bushmeat varies across their collective mainland range and, in many places, they are probably not targeted but are taken opportunistically, or when other large-bodied wildlife is rare; nevertheless, their use as bushmeat (sometimes medicine) is prevalent and thought to be responsible for declines of northern hog badgers in south China (Lau et al. 2010; Helgen and Chan 2016) and greater hog badgers across much of their range (Duckworth et al. 2016e; see also Chen et al. 2015; Harrington et al., Chapter 7, this volume). Hog badgers are farmed for food in China (Lau et al. 2010). Only greater hog badgers are listed by the IUCN as a threatened species (Table 1.2).

	mean (range)
Weight (kg)	(7–14)
Head/body length (mm)	
– A. albogularis	623 (546–700) n = 7
– A. collaris	787 (650–1041) n = 11
Ref: Francis 2008; Helgen et al. 2008a; no sexual dimorphism	

Sumatran hog badger *Arctonyx hoevenii* (Hubrecht, 1891)

Sumatran hog badgers (head/body length mean 590 mm, range 510–710 mm, n = 14) are confined to Sumatra (Indonesia) where they occur along the length of the Bukit Barisan mountain chain, between 700 m and 3780 m, in mossy forests and subalpine meadows (Helgen et al. 2008a). Like other hog badgers they are active day and night, solitary, and live in burrows in the ground. Signs of foraging activity in montane meadows suggest that they eat ground-living invertebrates, predominantly earthworms, ants, and beetle larvae (Holden et al. 2016); Zhou et al. (Chapter 13, this volume) also suggest that fruit may be important, as for other species of hog badger. Threats are thought to be minimal (Holden et al. 2016) because they occur at elevations above where the majority of hunting takes place (Holden 2006) and above the main area of rapid deforestation (Gaveau et al. 2007).

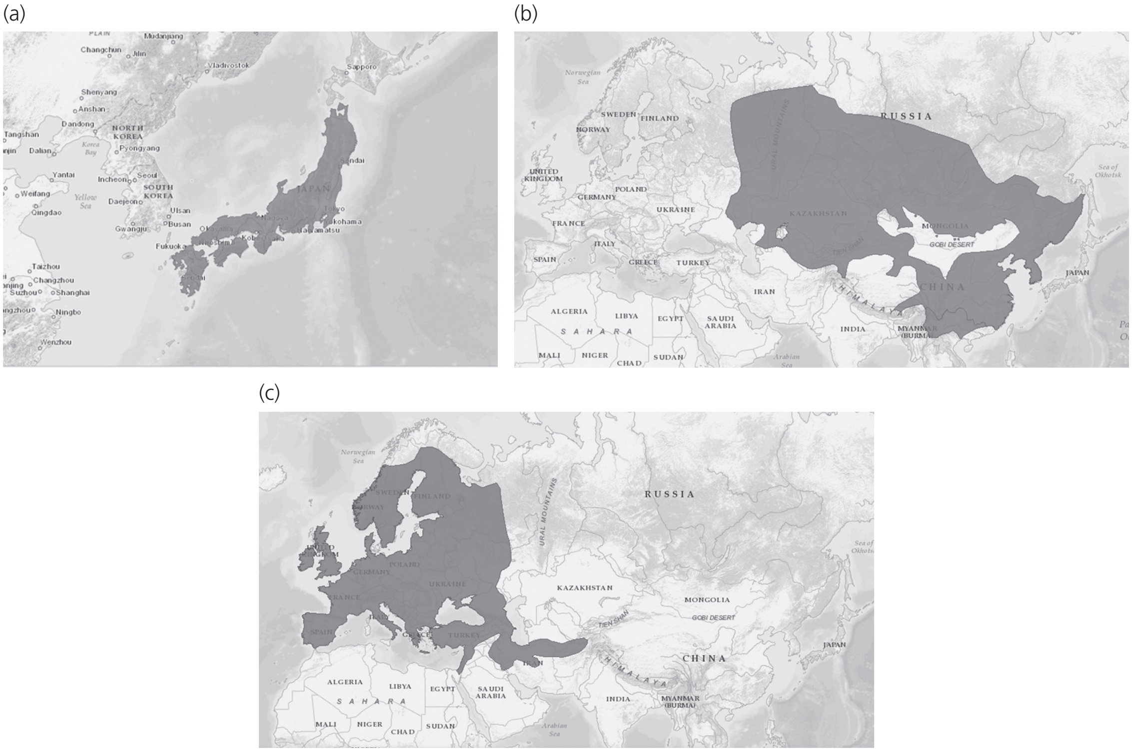
Old-world badgers

Among Old-World badgers (*Meles* spp.), regional species have increasingly been identified using nuclear and mitochondrial phylogenies, with the former Eurasian badger (*Meles meles*) split into three species (European, *M. meles*; Asian, *M. leucurus*; and Japanese, *M. anakuma*) established in 2005 (Wilson and Reeder 2005; Del Cerro et al. 2010; see Koepfli et al., Chapter 2, this volume; Zhou et al., Chapter 13, this volume). Subsequently, a fourth species has been recognized, *M. canescens*—the southwest Asian badger (Del Cerro et al. 2010; Abramov and Puzachenko 2013; *M. canescens* is included by Koepfli et al., Chapter 2, this volume, although the IUCN Red List currently only includes three *Meles* species).

Japanese badger *Meles anakuma* (Temminck, 1844)

Japanese badgers are endemic to Japan (found on Honshu, Kyushu, and Shikoku, but not on Hokkaido), where they inhabit broad-leaved forest and conifer plantations. They are also found in rural areas around Tokyo but nevertheless suffer habitat loss due to ongoing intensive development and increasing agriculture (Kaneko et al. 2016a). In 2003, they occupied about 29% of the country (*c*.126,000 km^2), an estimated 7% reduction since the late 1970s (Kaneko et al. 2016a). There are few data on population size or density but density in the Tokyo suburbs was estimated at four adults per km^2 (Kaneko et al. 2016a).

Smaller than European badgers, Japanese badgers eat similar foods—predominantly earthworms (Megascolecidae) but also berries (*Rubus* spp.), beetles, and persimmon (*Diospyros kaki*) during the summer and autumn months (Kaneko et al. 2006)—they are similarly nocturnal (Tanaka 2005), but maintain intrasexual territories more typical of other mustelids (Kaneko et al. 2014; Macdonald and Newman, Chapter 6, this volume; Zhou et al., Chapter 13, this volume). Home ranges in the Tokyo suburbs were approximately 30 – 40 ha for males (increasing during the mating season to 60 ha or more) and 10 – 15 ha for females (Kaneko et al. 2006, 2014). They are potentially threatened by the presence of introduced North American raccoons (Ikeda et al. 2004; Kaneko et al. 2016a).



Map 6 Old World badgers, a) Japanese badger, b) Asian badger, c) European badger © IUCN 2016

	Male mean (SD)	Female mean (SD)
Weight (kg)	7.7 (1.3) n = 20	5.4 (0.8) n = 10
Head/body length (mm)	648 (48.9) n = 33	585 (44.6) n = 11
Ref: Kaneko 2001		

Asian badger *Meles leucurus* (Hodgson, 1847) and Southwest Asian badger *Meles canescens*

Asian badgers (also known as sand badgers) are widely distributed in Russia (from the Volga River east through parts of Siberia to the coast of the Sea of Japan) and in central Asia (east of the Caspian Sea from Kazakstan to Mongolia, China and Korea, Abramov 2016b). Between the upper River Volga and the River Kama (a tributary of the River Volga in the southwestern Ural mountains), Asian badgers appear to be sympatric with European badgers to the west (Abramov et al. 2003). To the east of the Caspian Sea they are separated from southwest Asian badgers in the foothills of the western Tien Shan mountains by arid desert regions (the Kara Kum and Kyzyl Kum deserts). Asian and southwest Asian badgers co-occur in southeastern Uzbekistan, but differ in their habitat use: the former inhabiting plains and semi-deserts and the latter occupying mountains (Abramov 2016b). Asian badgers are found at a range of elevations from sea level to 2500 m in the Tien Shan mountains, and perhaps higher in the Tibetan Plateau (Abramov 2016b).

The ecology of Asian badgers is similar to that of their better studied former congeneric, the European badger. They use a range of habitats, including mixed and coniferous woodland, scrub, suburban areas, steppes, and semi-deserts, but appear to prefer mixed deciduous woodland–pastureland landscapes or woodlands with clearings (Abramov 2016b). They also have a diverse diet that varies regionally being generalist in some sites in the Urals and Western Siberia (incorporating wild berries, nuts, earthworms, beetles, frogs, toads and lizards, voles [*Microtus* or *Clethrionomys* spp.], molluscs and sometimes birds [Passeriformes]) but consuming predominantly Siberian pine nuts (99% occurrence) in the northern coniferous forests, and mostly insects and earthworms (both 100% occurrence) in the mountainous pine woods of the Southern Urals, most likely explained by local differences in food availability (Zagainova and Markov 2016; see also Chashchin 2002; Li et al. 2013; Murdoch and Buyandelger 2010; Zagainova and Markov 2011). In the northern parts of their range, Asian badgers hibernate in winter. They are hunted in some parts of their range for food and fur.

	Male mean (range)	**Female mean (range)**
Weight (kg)	6.8 (3.5–10.5) n = 11	5.6 (3.2–9.0) n = 13
Head/body length (mm)	618 (520–700) n = 12	570 (260–680) n = 14
Ref: Gao 1987; Wang 1990		

European badger *Meles meles* (Linnaeus, 1758)

European badgers are widespread throughout mainland Europe west of the Volga river, and are found on the Mediterranean islands of Crete and Rhodes, in Ireland, and in Britain (Kranz et al. 2016). To the east of the River Volga they are replaced by the Asian badger. They are abundant over much of their range, but densities vary (between 0.5 and 1.5 per km^2) with annual temperature variation (Johnson et al. 2002b). Densities in the UK can be much higher (see Newman et al. Chapter 21, this volume), generally around 4–7 badgers per km^2 in suitable habitat across southern England (Riordan et al. 2011; peaking at c. 50); although a national average of 1.4 is more typical (Wilson et al. 1997). Similarly, Ireland has badger densities of about 1–3 badgers per km^2 (Byrne et al. 2012a, b). Local badger densities and the northern boundaries of their regional distribution have benefited from recent climate warming (Newman et al., Chapter 21, this volume). In total, around 1.5 million European badgers are distributed across Europe, with the UK and Sweden having around 350,000 each, and around 142,000 in Germany (Roper 2010).

Habitats used by European badgers are broadly the same as those of Asian badgers, with a preference for deciduous woodlands with clearings or open pastureland with small patches of woodland (Kranz et al. 2016). In Mediterranean regions, the percentage of cork oak (*Quercus suber*) woodland is an important determinant of badger habitat quality (Rosalino et al. 2004; Santos and Beier 2008). They reach their highest densities when they have access to grazed pasture, rich in earthworm food (Macdonald et al. 2015b). They live in underground burrows (setts), and, in England, form groups with an average of about five adults, and up to 30 individuals in high-density populations (see Macdonald et al. 2015b); in other parts of Europe, group size may be only 2–3 (Roper 2010). They are opportunistic foragers with an omnivorous diet, but specialize on earthworms whenever these are available (Newman et al. Chapter 21, this volume; Macdonald et al. 2015b). Other food types include invertebrates (beetles and beetle grubs in dead wood, fruit, nuts, bulbs, tubers, and cereal crops, Roper 2010), as well as the contents of wasp and bee nests, birds' eggs, carrion, and live vertebrate prey such as hedgehogs and rabbits (Kranz et al. 2016). In drier parts of Mediterranean Europe, rabbits can comprise the major part of badger diets (e.g. Martín et al. 1995). Badgers gain weight prior to winter, to accumulate capital reserves to see them through variable extents of occasional torpor through to more complete hibernation, depending on climate and latitude. Mature weight is also influenced by local population density (and reductions below carrying capacity, for example, by culling) and by sex.

European badgers are vulnerable to road traffic accidents (e.g. Harris et al. 1995; see also Newman et al., Chapter 21, this volume). In Russia, European badgers are sometimes hunted for meat and other products, and in Germany and Finland they are hunted for sport (Kranz et al. 2016). Notably, European (and Asian, and hog-) badger fur is used to make traditional shaving brushes (Domingo-Roura et al. 2006), presenting another reason to hunt badgers, often illegally. In the UK, they are implicated in the spread of bovine TB to cattle, and subject to culling (Woodroffe and Donnelly, Chapter 20, this volume).

	Male mean (range)	**Female mean (range)**
Weight (kg)		
– Wytham woods, UK summer	8.5 n = 1316	7.5 n = 1495
– Wytham woods, UK winter	10.0 n = 451	9.0 n = 343
– England (southwest)	11.6 (9.1–16.7)	10.1 (6.5–13.9)
– Spain (Doñana)	7.3 (5.9–9.3)	6.9 (4.8–9.2)
– Scotland (west)	8.4	6.7
– Scotland (east)	10.4	9.6
– Denmark	11.3	9.6
– Germany	12.6 (10.9–14.1)	11.3 (8.7–12.8)
– Switzerland	12.6 (8.4–14.5)	10.7 (8.4–18)
– Netherlands	12.9 (9.7–17.1)	10.5 (8.0–12.9)

	Male mean (range)	Female mean (range)
Head/body length (mm)		
– Wytham woods, UK (season average)	707 n = 1088	683 n = 1356
– England (south)	753 (690–800)	720 (690–790)
– Spain	681 (580–750)	661 (590–750)
– Germany	813 (740–870)	785 (690–850)
– Switzerland	778 (740–800)	732 (650–780)

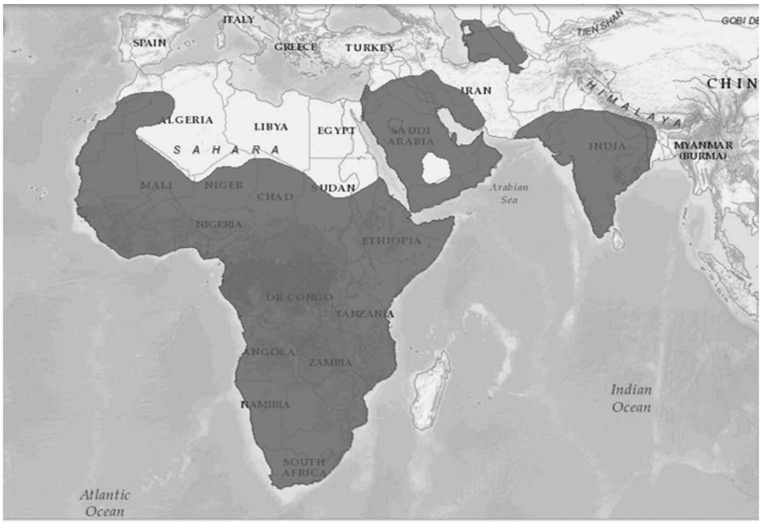
Ref: Wytham woods, UK, C. Newman and D.W. Macdonald, unpublished data; England (southwest), Neal and Cheeseman 1996; England (south), Neal 1977; Spain, Revilla et al. 1999; Scotland, Kruuk and Parish 1983; Denmark, Germany, Switzerland, Netherlands, Ûps and Wandler 1993

Honey badger

Honey badger *Mellivora capensis* (Schreber, 1776)

Historically, honey badgers (or ratels) ranged through most of sub-Saharan Africa from the Western Cape, South Africa, to southern Morocco, through Arabia, Iran, and western Asia to Turkmenistan, the Indian peninsula, and Nepal (Do Linh San et al. 2016). Their current distribution is largely undocumented but they appear to have disappeared from many places where they were once known (e.g. parts of Morocco, Israel, and South Africa), and their populations are becoming increasingly fragmented (Begg 2001 and references therein). Females occupy home ranges (mean 139 km^2, range 83–205, n = 10) that (with the exception of the wolverine) are at least five times larger than reported for other similarly sized musteloids (Begg et al. 2005b; see Macdonald and Newman, Chapter 6, this volume). Adult males in the Kgalagadi Transfrontier Park (KTP), in southern Africa, appeared to be somewhat nomadic, ranging over an area of at least 548 km^2 (range 229–844, n = 7) that overlapped extensively if not completely with other males, and encompassed the home ranges of young males (187 km^2) and several adult females (Begg et al. 2005b). Densities have been estimated at 0.1 individuals per km^2 in the Serengeti National Park in Tanzania (Waser 1980) and 0.03 individuals per km^2 in the KTP (Begg 2001).

Honey badgers occupy a range of habitat types from the dense rain forests of Zaire to the arid lands on the outskirts of the Sahara and pro-Namib deserts (Do Linh San et al. 2016), from sea level to the afro-alpine steppes in the Bale Mountains of Ethiopia (> 4000 m; Sillero-Zubiri 1996). They are generalist, opportunistic predators that take a wide variety of prey, ranging in size from small insect larvae to young ungulates (Begg et al. 2003a). They dig for their prey but are also accomplished climbers, able to raid raptor nests and bee hives and remove the bark from trees in search of lizards and skinks. In the KTP, barking geckos (*Ptenopus garrulus*), and hairy-footed gerbils (*Gerbillurus paeba*) were eaten most often; larger prey (such as springhares [*Pedetes capensis*], mole snakes [*Pseudaspis cana*], puff adder [*Bitis arietans*], and Cape cobra [*Naja nivea*]) were also eaten but less frequently, as were insects and scorpions, and Tsamma melons (*Citrullus lanatus*), the latter presumably as a source of moisture. Solitary bee larvae (*Parafidelia friesei*) are also eaten in large numbers and, on one occasion, Begg (2001) observed two male badgers digging at the same larval patch at the same time (although adult honey badgers were never observed to hunt cooperatively).



Map 7 Honey badger © IUCN 2016

Honey badgers disappear underground when digging out these larvae, and frequently sleep in the holes dug after a foraging bout. They forage every day and consume, on average, approximately 1 kg of meat per day (Begg 2001). Honey badgers come into conflict with beekeepers (Begg and Begg 2002; Do Linh San et al. 2016; see Harrington et al., Chapter 7, this volume) and outside of protected areas are persecuted by small livestock farmers (Begg 2001; Do Linh San et al. 2016) although their impact on livestock farming is considered to be negligible in comparison to caracal and jackal depredation. They are sometimes killed for traditional medicine (Do Linh San et al. 2016) or bushmeat (Colyn et al. 2004) and are killed incidentally in traps, or by poison, set for other medium-sized predators. Their low reproductive output (typically only a single cub raised [although twins may be born], late sexual maturity, and long inter-birth interval) means that they are particularly vulnerable to such losses.

	Male mean (range)	Female mean (range)
Weight (kg)	9.3 (8.0–11.2) n = 19	6.1 (5.2–7.1) n = 14
Head/body length (mm)	686 (580–790) n = 15	637 (580–690) n = 12
Ref: Begg et al. 2013		

American Badger

American badger *Taxidea taxus* (Schreber, 1777)

American badgers are relatively common in grasslands (prairie), brushlands, and mountain meadows across the western and central United States, southern Canada, and northern and central Mexico (Helgen and Reid 2016e). They occupy the underground burrows of fossorial rodents, but, with their stout forelimbs and long curved claws (see Kitchener et al., Chapter 3, this volume), are also powerful diggers themselves. They are solitary and nocturnal. Unlike other 'badgers', they are strictly carnivorous, and most food is obtained by excavating rodents (prairie dogs [*Cynomys* spp.] and ground squirrels [*Spermophilus* spp.]), although they also eat lagomorphs, deer mice (*Peromyscus maniculatus*), kangaroo rats (*Dipodomys* spp.) and other rodents, birds and birds' eggs, reptiles, and arthropods (Messick and Hornocker 1981). Home range sizes of American badgers living on a prairie dog colony in southeastern Wyoming were 3.4 ± 1.4 km^2 for females (n = 6) and 5.4 ± 1.7 km^2 for males (n = 7, Goodrich and Buskirk 1998) but may be 20 km^2 or more in fragmented landscapes (Duquette et al. 2014).

Map 8 American badger © IUCN 2016

Population density in southeastern Wyoming was 0.8–1.1. per km^2 (Goodrich and Buskirk 1998) but American badgers can reach densities of up to six individuals per km^2 (Messick and Hornocker 1981). The species has presumably declined where grassland has been converted into agriculture and colonial rodents eliminated (see also Black-footed ferrets), but decline of the species as a whole is not thought to be at a rate sufficient to qualify for threatened status. Total population in the United States was estimated at several hundred thousand (Helgen and Reid 2016e). American badgers in Ontario (*T. t. jacksoni*) and British Columbia (*T. t. jeffersonii*, Kyle et al. 2004; see Weir et al., Chapter 19, this volume), however, are recognized as distinct subspecies with estimated population sizes of 200 and 600 respectively (Helgen and Reid 2016e)—these two subspecies are Endangered in Canada. Road mortality is a major source of mortality for all American badgers (Hoodicoff et al. 2009).

	Male mean	Female mean
Weight (kg)		
– South Dakota	8.4	6.4
– northern Utah/Idaho	8.7	7.1
– southwestern Idaho	7.6	6.3
Head/body length (mm)		
– southwestern Idaho	599	578
Ref: Lindzey 2003		

Ferret Badgers

Chinese ferret badger *Melogale moschata* (Gray, 1831) and Burmese ferret badger *Melogale personata* (Geoffroy Saint-Hilaire, 1831)

The ranges of Chinese (or small-toothed) and Burmese (or large-toothed) ferret badgers, and areas of sympatry, are difficult to define because the two species cannot be distinguished on the basis of pelage alone, and therefore many records and observations are identified only to genus. Collectively, the two species occur from Nepal, through Southeast Asia, central and south-eastern China, to Japan in the west, and throughout Vietnam in the south, with the Chinese ferret badger broadly in the east (and further north), the Burmese ferret badger in the west (and further south), and an area of sympatry through Myanmar, Lao PDR, Vietnam, and southern China (Duckworth et al. 2016a, b). Chinese ferret badgers are apparently common in China (Lau et al. 2010) and Burmese ferret badgers appear to remain widespread (albeit rarely recorded) in mainland Southeast Asia (Gray et al. 2014). Home ranges of Chinese ferret badgers in alpine habitat in central China were between 51 and 472 ha (Zhang et al. 2010).

Chinese ferret badgers use tropical and sub-tropical forests (Zhou et al. 2008b) and farmland landscapes (where they often live in close proximity to humans, Storz and Wozencraft 1999; Wang and Fuller 2003b) in China. Both species occur in forests in Lao PDR and Vietnam (Abramov and Rozhnov 2014), but in Vietnam Burmese ferret badgers, and possibly Chinese ferret badgers, also occur widely in degraded habitats (Duckworth et al. 2016b).

Chinese ferret badgers are nocturnal, fossorial (using rodent burrows, firewood stacks, or piles of rocks for dens, Wang and Fuller 2003b), and appear to live in small groups of adults that share dens (Zhang et al. 2010). Analysis of 64 faeces collected in northern Taiwan (Chuang and Lee 1997) revealed that they consumed mainly earthworms, insects, and amphibians (with some seasonal variation in relative proportion of the three prey types), although elsewhere they are also reported to eat small birds, rodents, lizards, fruit, and berries (Storz and Wozencraft 1999). Their consumption of multi-seeded, fleshy fruit suggests that they play a role in seed dispersal, but Zhou et al. (2008b) found that seeds in faeces (although they were viable) were often deposited in sites not well suited for seed establishment and growth such as rocky outcrops—presumably selected for territory marking—so their role in forest recruitment and regeneration is not clear.

Both species appear to be tolerant to habitat modification, but are, nevertheless, potentially at risk because they occur in areas where hunting and habitat encroachment are widespread and heavy (Duckworth et al. 2016a, b). They are regularly seen for sale in wildlife markets (although many of these individuals may have been bred in captivity, Lau et al. 2010).

	Male mean (range)	Female mean (range)
Weight (kg)	1.42 (1.15–1.68) n = 8	1.15 (0.8–1.45) n = 12
Total length (mm)	(340–481)	(305–400)

Ref: data shown are for Chinese ferret badger, Wang and Fuller 2003b; Storz and Wozencraft 1999

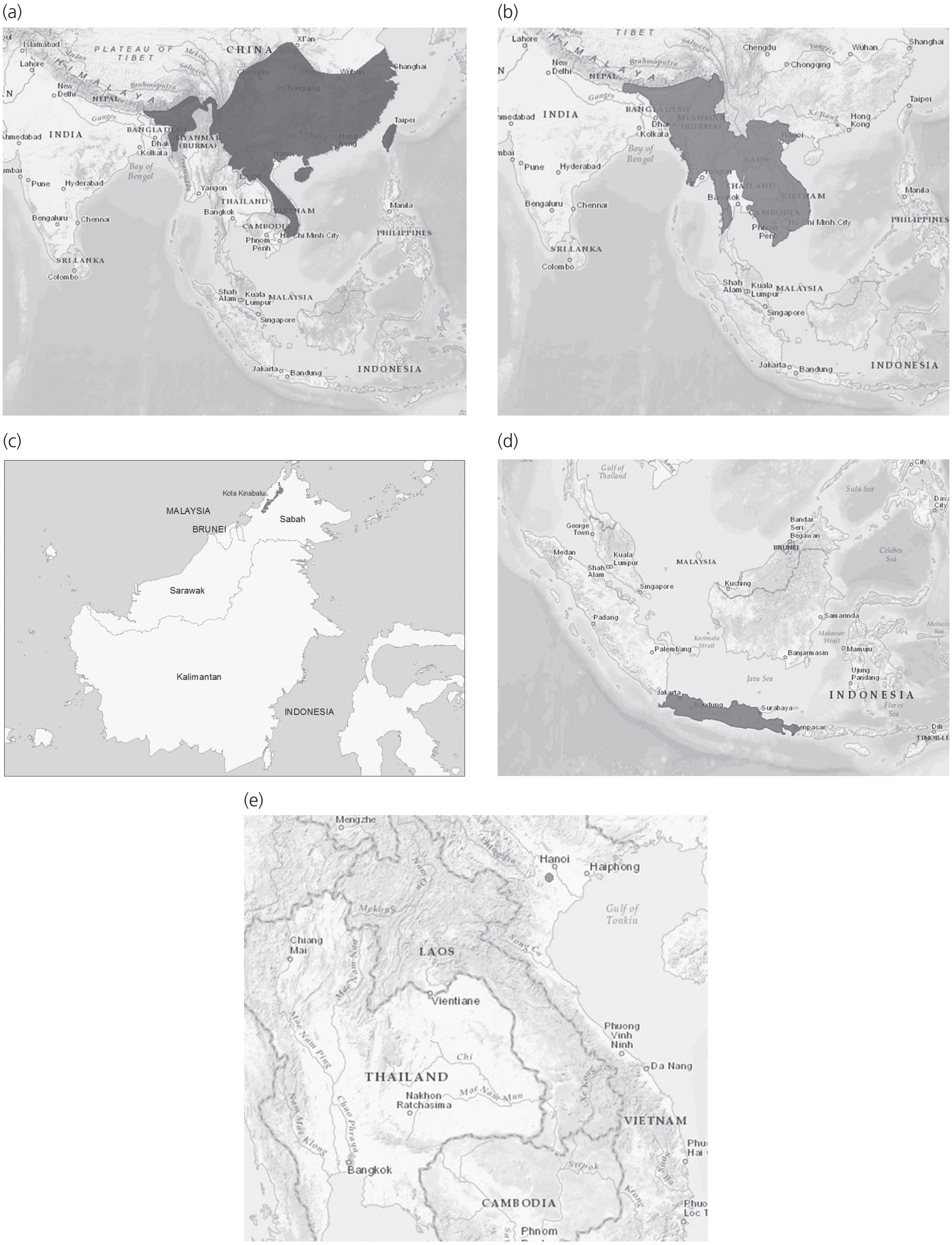
Bornean ferret badger *Melogale everetti* (Thomas, 1895)

Bornean ferret badgers are endemic to Borneo and thought to be restricted to Kinabalu and Crocker Range Parks and surrounding areas in Sabah (Wong et al. 2011), over an estimated extent of occurrence of 4200 km^2 (Wilting et al. 2015a, 2016). Camera trapping data (A. Hearn and J. Ross, pers. comm.) suggest that the species is rare and potentially occurs at low density. They appear to be restricted to high elevation primary forests (Ross et al., Chapter 14, this volume): all records are from evergreen or montane forests, or adjacent shrubland, at elevations between 500 and 3000 m (Wilting et al. 2015, 2016). They feed on earthworms and small vertebrates, and are believed to be nocturnal, ground-dwelling, and fossorial (Wilting et al. 2015).

The presumed small range of Bornean ferret badgers is fragmented by roads (Wilting et al. 2015) and the species is vulnerable to warming climates because upland range shifts would be impossible (Struebig et al. 2015). Targeted uses are unknown but they are undoubtedly at risk of incidental capture in non-selective traps, and may also be vulnerable to predation by feral dogs (Wilting et al. 2015).

Javan ferret badger *Melogale orientalis* (Horsfield, 1821)

Javan ferret badgers are confined to Java, where they are known from scattered localities in west, east, and central Java between c. 200 and > 2000 m (Duckworth et al. 2016c). Their abundance is unknown, as are their ecological habits, but recent records from lowland



Map 9 Ferret badgers, a) Chinese ferret badger, b) Burmese ferret badger, c) Bornean ferret badger, d) Javan ferret badger, e) location of Cuc Phuong ferret badger specimen © IUCN 2016, Bornean ferret badger © J. Ross (adapted from Wilting et al. 2016 with the inclusion of recent camera trap data [AJ Hearn, J Ross and DW Macdonald, unpublished data])

Plate C First known camera trap photo of a Bornean ferret badger (*Melogale everetti*). © A. Hearn

areas within highly anthropogenic landscapes (including secondary forest-rubber plantation mosaics, and crop fields interspersed with woodlots and villages) suggest that they exhibit broad habitat use and are not dependent on primary forest (Duckworth et al. 2016c). There are also records from deep within old-growth evergreen forest (Brickle 2007; Duckworth et al. 2008).

Small (but increasing) numbers of Javan ferret badgers are traded illegally at markets and online as novelty pets (Kim 2012; Shepherd 2012; Duckworth et al. 2016c). Other potential threats (e.g. hunting, predation by domestic dogs) appear to be low.

Cuc Phuong ferret badger *Melogale cucphuongenesis*

The Cuc Phuong ferret badger was discovered in the lowlands in northern Vietnam (Cuc Phuong National Park) in 2006 (Nadler et al. 2011). It was found in a region where both Chinese and Burmese ferret badgers occur, but is smaller than these two species and appears to differ in skull morphology (most notably an elongated snout, Anon 2011). The species was described on the basis of a single (male) museum specimen (body weight 0.8 kg, head/body length 360 mm, Nadler et al. 2011) and a photograph of a second individual. Threats are unknown but the area in which the specimen was found has been degraded and is heavily hunted (Helgen and Long 2016).

Martens and Fisher

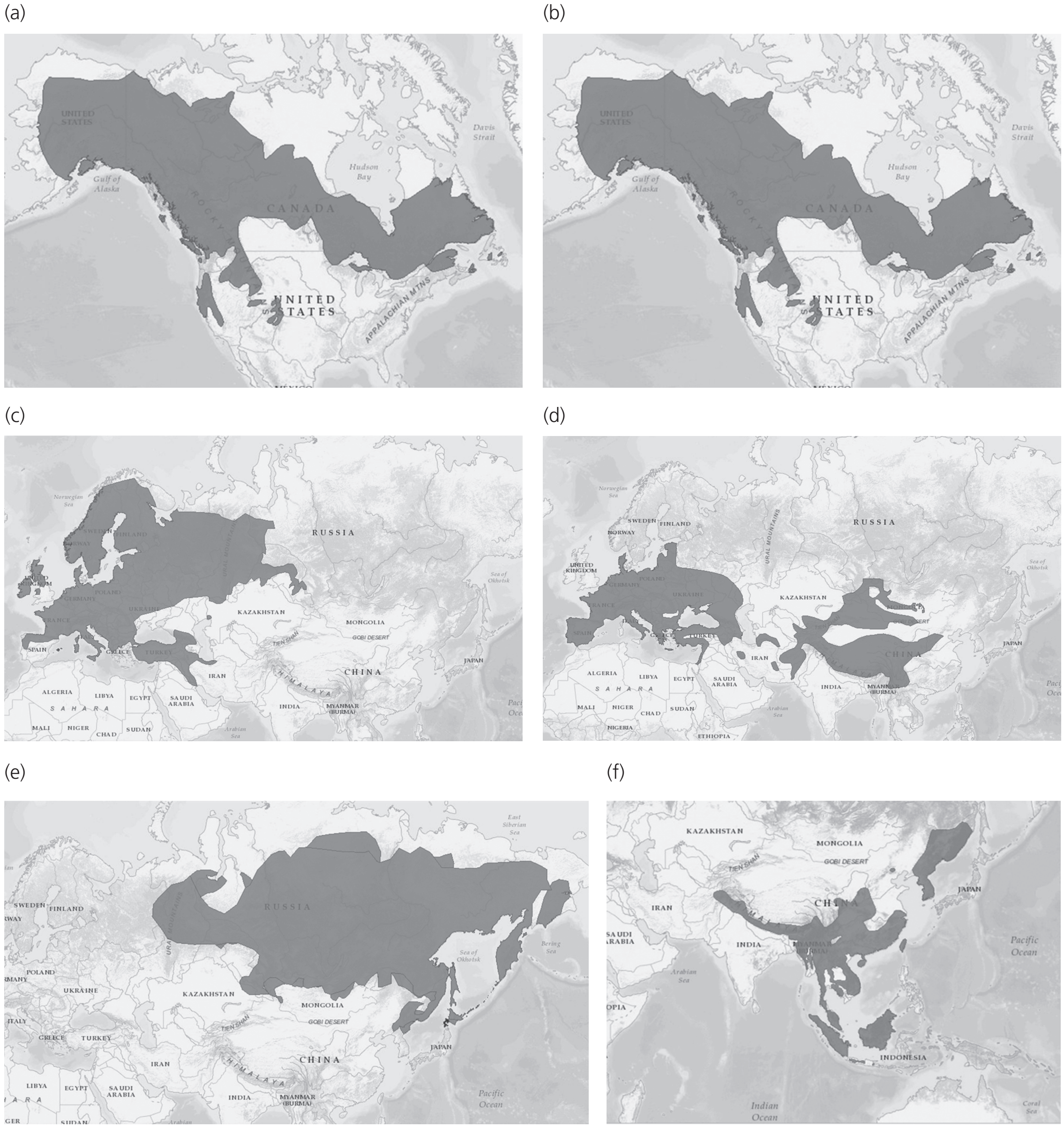
Martens are medium-sized carnivores that collectively (eight species) span the northern hemisphere. Compared with other mustelids, they are only moderately elongated, and have wedge-shaped faces and rounded ears. They hunt or forage terrestrially and arboreally, and are considered among the most agile and graceful of the musteloids, their arboreal adaptations contrasting with the heavyweight burrowing anatomy of badgers (explored revealingly in Newman et al. 2011). Generally described as frugivorous carnivores, the composition and trophic diversity of their diets varies with latitude, elevation, temperature, rainfall, snow cover, and primary productivity (Zhou et al. 2011b). American martens, for example, consume around 70% small mammals, while, on average, rodents comprise just 30% of the diet of Eurasian marten species; the rest is comprised of fruits, invertebrates, and birds (including eggs), in that ranking. Broadly, reliance on rodent prey is a function of climate zone, where cold conditions increase the need for protein (King and Murphy 1985; see also Zhou et al. 2013b). We include fishers here on the basis of their ecological similarities with martens but note that, although they were formerly included in the *Martes* genus, they are now placed in their own monospecific genus *Pekania* (Koepfli et al. 2008a; see Chapter 2, this volume).

American marten *Martes americana* (Turton, 1806) and Pacific marten *Martes caurina* (Merrian, 1890)

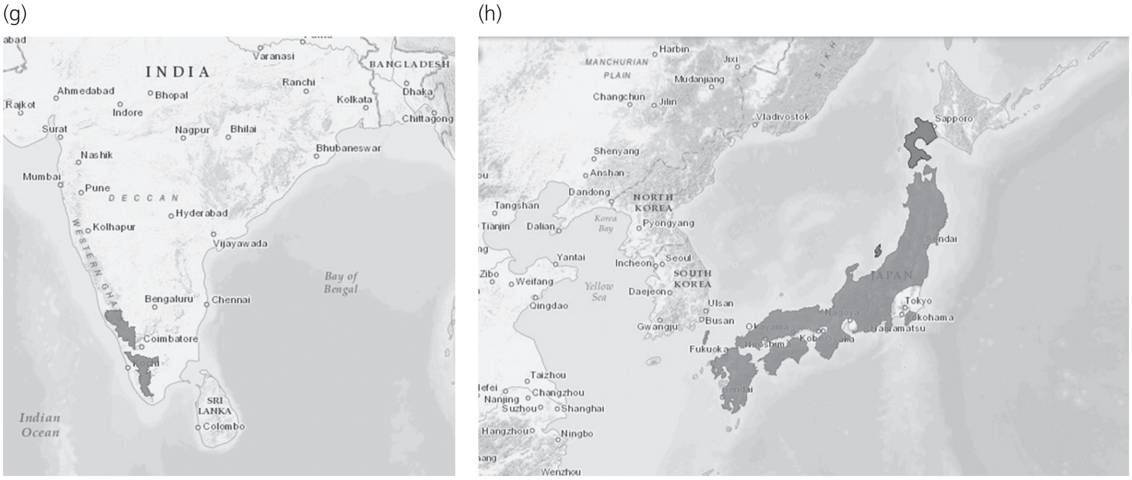
'American' marten comprises two species (but are currently listed in the IUCN Red List as one). American martens (*M. americana*) occur across much of Alaska and forested Canada, spreading into the northern United States, as far south (in the west) as northern New Mexico (Helgen and Reid 2016a). West of the Rocky Mountain crest they are replaced by Pacific marten (*M. caurina*, previously a subspecies, now considered distinct, Dawson and Cook 2012; USFWS 2015;

Koepfli et al., Chapter 2, this volume). American martens are absent from many eastern and southeastern States, having been extirpated due to loss of closed-canopy forest to logging, overexploitation, and climate change (Helgen and Reid 2016a; see Krohn 2012 for discussion of the role of climate); in a number of States and some Canadian provinces they have been re-established by translocations (Slough 1994; Proulx et al. 2004; Powell et al. 2012). In the coastal forests of the Pacific States, Pacific marten are restricted to isolated populations in northern California and southern Oregon, the central coast of Oregon, and the Olympic mountains of Washington (Zielinski et al. 2001; USFWS 2015; Moriarty et al. 2016a, b).

Mean home range sizes of 'American' marten are about 8.1 km^2 (range 2–27 km^2) for males and 2.3 km^2



Map 10 Martens and fisher, a) American marten, b) fisher, c) pine marten, d) stone marten, e) sable, f) yellow-throated marten, g) Nilgiri marten, h) Japanese marten (darker grey shows introduced range) © IUCN 2016



Map 10 Continued

for females (range 1–14 km^2, Powell 1994a; Powell et al. 2003). Home ranges of Pacific marten appear to be relatively small (e.g. in coastal Oregon 2.8 km^2 for males, n = 3, and 0.65 km^2 for females, n = 8, Moriarty et al. 2016a) but larger (> 10 km^2) in intensively logged landscapes (USFWS 2015 and references therein). Population densities of 'American' marten vary from 1.5 per km^2 in undisturbed forest to 0.4 per km^2 in commercial clear-cut forest (Powell et al. 2003). Total global population size (for the two species combined) are estimated to be in the region of at least several hundred thousand individuals (Helgen and Reid 2016a). Coastal populations of Pacific martens are estimated at a minimum of 28 individuals in Oregon (Moriarty et al. 2016a); and fewer than 100 in the northern California population, the latter having declined by an estimated 42% between surveys in 2000–2001 and 2008–2012 (perhaps as a result of bobcat predation accentuated by logging activities and reduced cover, USFWS 2015).

American martens are typically associated with late-seral coniferous forests characterized by closed canopies, large trees, and abundant standing and fallen woody material (Buskirk and Powell 1994). They also use managed woodland landscapes where sufficient cover and structural complexity are present (Thompson et al. 2012). Pacific martens also typically occur in montane and coastal coniferous forests (USFWS 2015) but in Oregon have been observed using coastal sand dunes adjacent to old-growth forest (where shrub cover and prey density is higher than in the old forest interior, Eriksson 2016). 'American' martens eat mostly small mammals, but also birds, insects, fruit, and carrion, and den in hollow trees or logs, in rocky crevices or in burrows (Powell et al. 2003). They are effective seed dispersers, moving ingested blueberry (*Vaccinium* spp.) and salmonberry (*Rubus spectabilis*) seeds an estimated average of 500 m (Hickey et al. 1999), and dense berry-producing shrubs (that provide food and cover) are important habitat for Pacific martens (Slauson et al. 2007). In parts of their range, 'American' martens are managed as furbearers. They are vulnerable to overharvest, and may be impacted by timber harvest, forest thinning to reduce fuel for wildfires (particularly in the Pacific coastal forests, Helgen and Reid 2016a, Moriarty et al. 2016c; see also Cushman and Wasserman, Chapter 12, this volume), and use of rodenticides at illegal marijuana plantations (USFWS 2015).

	Male range	**Female range**
Weight (kg)	0.78–1.47 n = 44	0.37–1.25 n = 36
Head/body length (mm)	360–450	320–400

Ref: weight, Buskirk and McDonald 1989; head/body length, Clark et al. 1987

Yellow-throated marten *Martes flavigula* (Boddaert, 1785)

Yellow-throated martens are widely distributed in South, Southeast, and East Asia, from Afghanistan and Pakistan in the west along the Himalayas and foothills east to southern and eastern China and Korea, as far north as the Russian Far East, and south throughout Southeast Asia and Indonesia (Chutipong et al. 2016).

They are the only marten species to extend into the southern hemisphere. They occupy mixed coniferous and broad-leaved forests, montane forest up to the tree line, and secondary (previously logged) forest (Chutipong et al. 2016), and have been recorded in heavily degraded areas and an oil palm plantation (Ross et al., Chapter 14, this volume), although it is not known if these habitats are permanently occupied or capable of supporting a population (Chutipong et al. 2016). Annual home range size in Thailand was 7.2 (±4.3) km^2 (Grassman et al. 2005). Population density in the Russian Far East was estimated at 1–5 individuals per 100 km^2 (Matyushkin 1993)—otherwise, there are few data on population size or densities but yellow-throated martens are believed to be common throughout their tropical range (Chutipong et al. 2016).

Predominantly diurnal, yellow-throated martens prey on squirrels, birds, snakes, and lizards on the ground and in trees, but also eat insects, eggs, frogs, human food waste, fruit, and nectar (Parr and Duckworth 2007; Zhou et al. 2008a, 2011a). Insects are eaten year-round and may comprise 10–30% of the diet, and wasp nests (Vespidae spp.) attached to tree branches may be an important food source in some places (e.g. Choi et al. 2015). In a sub-tropical forest in south China, in 'normal' mild years, yellow-throated martens clearly preferred fruit (and played an important role in seed dispersal, Zhou et al. 2008a), even when small mammals were also abundant (Zhou et al. 2011a) but switched to eating mostly rodents and small birds in an anomalous, extremely cold, snowy winter (presumably due to increased protein requirements, Y. Zhou et al. 2013b).

Yellow-throated martens may be sensitive to human disturbance (e.g. developments for ecotourism, Y. Zhou et al. 2013a) and trapping for fur may be a local threat (Chutipong et al. 2016).

	Male mean (range)	**Female mean (range)**
Weight (kg)		
– China	2.34 n = 5	1.95 n = 24
– Russia/Siberia	3.32 (2.46–5.75) n = 8	2.77 (1.16–3.83) n = 10
Head/body length (mm)		
– China	548 (420–630) n = 7	505 (325–540) n = 24
– Russia/Siberia	612 (500–719) n = 9	575 (500–620) n = 12

Ref: China, Gao 1987, and Y. Zhou, unpublished data; Russia, Heptner and Naumov 2002

Nilgiri marten *Martes gwatkinsii* (Horsfield, 1851)

Nilgiri martens (*c*.2 kg) are endemic to the Western Ghats of India, south of 13°N, where they occur mostly in medium to high elevation (800–2600 m) forests, but are also found in adjoining tea, coffee, and cardamom plantations (Mudappa et al. 2016). They are rarely seen and so assumed to occur at low density, and, on the basis of their restricted distribution, total population size is assumed to be small (*c*.1500, Mudappa et al. 2016). They prey opportunistically on small vertebrates (including Indian chevrotain [*Moschiola indica*], Indian giant squirrel [*Ratufa indica*], and Bengal monitor lizard [*Varanus bengalensis*]), probe logs for invertebrates, and raid bee-boxes for bee larvae (for which they are persecuted in some districts, Mudappa et al. 2016).

Japanese marten *Martes melampus* (Wagner, 1840)

Endemic to Japan, two subspecies of Japanese marten have been described (Masuda 2015): *M. m. melampus* on Honshu, Shikoku, and Kyushu (and as a non-native species, introduced via fur farms, on Sado Island and Hokkaido), and *M. m. tsuensis* on the Tsushima islands (see Kamada et al. 2012). They are found in deciduous and evergreen broad-leaved forests from sea level to 2200 m, and in suburban areas where there are sufficient trees, but avoid coniferous plantations (Tatara 1994; Hoshino et al. 2013; Abramov et al. 2015). Annual home range sizes on the Tsushima islands are about 0.8 km^2 for males and 0.7 km^2 for females, but may be larger (e.g. 2.3 km^2 on Honshu, Masuda 2015). On the Tsushima islands, they sometimes den in houses near the forest (Masuda 2015). They are usually nocturnal (Masuda 2015), and, like other *Martes* species, eat small vertebrates (including nesting birds, Barnett et al. 2013), insects, and fruit, relying more on small mammals and insects at higher elevations and consuming a greater proportion of fruit at lower elevations (Hisano et al. 2017). Like other fruit-eating musteloids, they play a key role in seed dispersal (Otani 2002), especially at lower elevations. Their habitat has been degraded by timber cutting (Tatara 1994), but they remain common throughout their range (and are increasing on Tsushima Island, Abramov et al. 2015). With the exception of the Tsushima population (which is protected), they are managed as a game species (Masuda 2015; Abramov et al. 2015).

	Male mean (range)	Female mean (range)
Weight (kg)		
– *M. m. tsuensis*	1.56 (SD 0.27) n = 50	1.01 (SD 0.19) n = 33
– *M. m. melampus*	1.63 (1.5–1.9) n = 6	0.92, 1.2 n = 2
Head/body length (mm)		
– *M. m. tsuensis*	469 (SD 24) n = 50	426 (SD 21) n = 33
– *M. m. melampus*	459 (448–480) n = 6	421, 456 n = 2

Ref: *M. m. tsuensis*, Masuda 2015; *M. m. melampus*, Y. Kaneko, unpublished data

Pine marten *Martes martes* (Linnaeus, 1758) and stone marten *Martes foina* (Erxleben, 1777)

Pine martens are distributed widely across most of Europe, south across Turkey and into Iran, and east across the Caucasus into western Siberia (Herrero et al. 2016), where they occupy diverse woodland habitats ranging from Scandinavian boreal forest to Mediterranean oak woodlands, but also sometimes open non-wooded habitats (such as grasslands and agricultural land, Moll et al. 2016; see also Clevenger 1994; Webster 2001; Pereboom et al. 2008; Manzo et al. 2012). In Russia, pine marten range appears to be spreading eastwards (Herrero et al. 2016) and they have recently been recorded for the first time in the lowland wetland forests of the Danube Delta (Kiss et al. 2012). In Spain, pine martens are restricted to the north (Barja 2005), but they occur further south on the Mediterranean islands of Corsica, Sardinia, Sicily, and Elba (e.g. Lombardini et al. 2015), and thrive on the Balearic islands of Minorca and Marjorca where they are assumed to have been introduced by man but are nevertheless now legally protected (Clevenger 1993a). In the UK, pine martens, historically, were widespread, but large-scale woodland clearance and predator control resulted in their populations being confined to the rocky, sparsely populated, upland areas of northwest Scotland by the early 1900s (Langley and Yalden 1977), with remnant populations in Wales and northern England (but see Jordan et al. 2012). Legal protection and reforestation have since allowed recovery of the Scottish population that is now widespread and occupies lowland areas with higher human population densities (Croose et al. 2013). In 2015, 20 pine martens were translocated from Scotland to mid-Wales to reinforce the population there, and the feasibility of reintroducing pine martens to southern England is being assessed (Vincent Wildlife Trust, vwt.org.uk).

Stone (or beech) martens also range across Europe from the Mediterranean region through central and eastern Europe into the Middle East and central Asia, as far east as the Tien Shan mountains and northwest China, and southeast as far as northern Myanmar (Abramov et al. 2016a). The two species thus overlap over much of their range, with the exception of the UK, Scandinavia, and the northern parts of European Russia where there are no stone martens, and the south of Spain where there are no pine martens. Where the two species co-occur, pine martens use more forested habitats and stone martens more non-forested and man-made habitats, and stone martens are often considered to be more of a habitat generalist, using open areas more often than other martens (Virgós et al. 2012 and references therein; see also Vergara et al. 2015). However, although, in the northern parts of their range

Plate D Pine marten (*Martes martes*). © K. Kilshaw (central and northeastern Europe), stone martens are common in agricultural, suburban, and urban areas (e.g. Herr et al. 2009), in the southern parts of their range they prefer more natural habitats, and in southern Spain they are most abundant in forests in high mountainous areas where there are few people (Virgós and Casanovas 1998). The original explanation for this geographic variation in habitat preferences was the co-occurrence of the pine marten in the north and the belief that pine martens out-compete stone martens and exclude them from preferred natural habitats (Delibes 1983). Alternative (non-mutually exclusive) explanations are higher behavioural plasticity in stone martens such that stone martens are able to utilize human-modified and natural habitats (Virgós et al. 2012), different colonization histories (Llorente-Rodríguez et al. 2016), and/or that the two species show different behavioural responses to cold climates, with stone martens seeking warm, sheltered resting sites in occupied buildings (Larroque et al. 2015; Wereszczuk and Zalewski 2015). However, interspecific interactions between stone martens and pine martens are still not well understood (e.g. Monterroso et al. 2016), and in Italy stone martens appear to have been displaced from an intensively cultivated area in the northwest by colonizing pine martens where previously pine martens were absent (e.g. Balestrieri et al. 2010; Remonti et al. 2012). Torretta et al. (2017) suggests that time partitioning may be key in community-level coexistence within the mesocarnivore guild in Europe, and that pine martens may be more adaptable than stone martens (and thus competitively superior) in this respect. An introduced stone marten population exists in Wisconsin, USA (Long 1995).

Across Europe, pine martens occupy home ranges of 2–29 km^2, with male (but not female) home range size increasing with decreasing forest cover, and female home range size decreasing with a greater abundance of rodents (Zalewski et al. 2006). Mean winter densities are between 0.1 and 8.9 per 10 km^2 (with maximum densities up to 17.5 per 10 km^2), lowest in regions with severe winters (Zalewski et al. 2006). In Poland, winter density varied twofold (3.6–7.6 individuals per 10 km^2) depending on winter density of rodents the year before (Zalewski et al. 2006). Stone marten home range sizes vary between about 30 and 300 or more hectares (Herr et al. 2009a and references therein), and population densities are relatively high at an estimated *c*.0.7–2.0 individuals per km^2 in rural environments (Herr et al. 2009). Pine martens are primarily (but not exclusively) nocturnal (Manzo et al. 2012). They are omnivorous, with exceptional climbing abilities, and a generalist diet that includes small mammals predominantly voles (*Myodes* formerly *Clethrionomys*, and *Microtus* spp., or mice, *Apodemus* or *Mus* spp; see Zhou et al. 2011b). Where voles are absent (e.g. on Mediterranean islands, Lombardini et al. 2015), they eat mostly berries, insects, and birds, as well as carrion and human food waste (De Marinis and Masseti 1993) and sometimes lagomorphs (e.g. Balestrieri et al. 2011). Stone marten diet is similar, comprising predominantly fruit, small mammals, birds, and lagomorphs (Zalewski 2007; Balestrieri et al. 2013), depending on local and seasonal availability (e.g. Czernik et al. 2016).

Pine martens suffer intraguild predation by red foxes (*Vulpes vulpes*) and a number of studies report an inverse correlation in the relative abundance of the two species (e.g. Lindström et al. 1995; see also Webster 2001); a pine marten was also seen killing fox cubs at their den (Brzeziński et al. 2014).

Pine martens and stone martens are hunted and trapped for their fur in some parts of their range (e.g. Helldin 2000; Ruette et al. 2015; Abramov et al. 2016a), and may be persecuted in response to conflict with humans (Virgós et al. 2012; Croose et al. 2013; Harrington et al., Chapter 7, this volume). Road traffic accidents are a major cause of mortality.

	Male mean (range)	**Female mean (range)**
Weight (kg)		
Pine marten		
– Poland	1.32 (0.95–1.65) n = 16	0.96 (0.79–1.12) n = 11
– UK (3+ years)	1.89 (1.6–2.15) n = 18	1.33 (1.1–1.45) n = 14
– UK (1–3 years)	1.7 (1.5–1.85) n = 11	1.23 (1.1–1.3) n = 5
– Italy	1.55 (0.90–1.97) n = 18	1.35 (1.01–1.70) n = 13
Stone marten		
– Poland	1.50 (1.22–1.78) n = 25	1.23 (1.08–1.42) n = 21
– Hungary	1.70 (1.41–2.31) n = 41	1.31 (1.01–1.51) n = 30
Head/body length (mm)		
Pine marten		
– Poland	461 (420–492) n = 16	417 (390–448) n = 11
– UK (3+ years)	494 (480–520) n = 18	440 (410–460) n = 14
– UK (1–3 years)	490 (485–520) n = 11	443 (425–450) n = 5
– Italy	493 (410–556) n = 18	465 (415–520) n = 14
Stone marten		
– Poland	445 (405–508) n = 25	420 (395–464) n = 21
– Hungary	450 (430–509) n = 39	419 (353–456) n = 30

Ref: Poland, Wereszczuk and Zalewski 2015; UK, Balharry et al. 2008; Italy, Bartolommei et al. 2014; Hungary, Lanszki and Valkár 2009

Sable *Martes zibellina* (Linnaeus, 1758)

Sable range widely over Eurasia, mainly in the mountain and lowland forests of Siberia, from the western foothills of the Urals to the Pacific Ocean, but also in the Altai mountain range in Kazakhstan, Mongolia, and parts of northern China, and in North (but not South) Korea (Monakhov 2016). In the Japanese archipelago, they are found on Hokkaido (Monakhov 2016). In Russia, the population is believed to be increasing and estimated to number over two million, over an occupied area of about 7 million km^2 (Monakhov 2016). There are an estimated 18,000 sable in China; there are no population estimates for Kazakhstan, North Korea, or Japan, and no recent estimates for Mongolia, but these comprise only a small part of the species' global range (Monakhov 2016).

Sable inhabit coniferous (taiga) and deciduous forests over a wide elevational range (20 –> 2000 m), using mainly the ground storey (Monakhov 2016), which is in contrast with the more arboreal pine martens, although diets are similar and comprise mostly small mammals, some birds, and berries, but also a large proportion of pine nuts (*Pinus sibirica* and *P. pumila*, Monakhov 2016). Sable also take larger mammals, including pika (*Ochotona* spp.), squirrels (*Sciurus* and *Pteromys* spp.), muskrat (*Ondatra* spp.), marmots (*Marmota* spp.), hare (*Lepus timidus*), and Siberian musk-deer (*Moschus moschiferus*). In some areas in China there is competition for food with humans harvesting pine nuts (Piao et al. 2011). L. Xu et al. (1997) reported home ranges in taiga in northeastern China of 7.2 km^2 for females and 13 km^2 for males; in cool-temperate mixed forests in Hokkaido (Japan), Miyoshi and Higashi (2005) recorded much smaller home ranges of 0.5–1.78 km^2. In the Ural mountains, sable are sympatric with pine martens and hybridization is common (although male offspring are sterile, Monakhov 2011). In the Altai mountains they are sympatric with yellow-throated marten, and on Hokkaido they occur alongside introduced Japanese marten, although the distributions of the latter two species appear to be separated there (Murakami and Ohtaishi 2000). In Russia, they are a valued furbearer, and in Russia and Finland they are farmed for their fur (Monakhov 2011).

	Male mean (range)	Female mean (range)
Weight (kg)		
– Russia (January)	1.47 (1.10–1.81)	1.13 (0.82–1.56)
– Russia (July)	1.43 (1.20–1.81)	0.98 (0.87–1.30)
– China	0.87	0.64
– Hokkaido, Japan	0.89 n = 19	0.69 n = 8
Head/body length (mm)		
– Russia	(375–580)	(320–510)
– China	430	386

Ref: Russia, Heptner and Naumov 2002; China, Gao 1987; Japan, Miyoshi and Higashi 2005

Fisher *Pekania pennanti* (Gray, 1865) *formerly *Martes pennanti*

Fishers have an extensive northern North American range similar to (but not extending as far north as) that of American marten, from southeast Alaska, across boreal Canada to Quebec and New England in the west, and south into Idaho and Montana, and California (Lewis et al. 2012), where they occur primarily in dense coniferous or mixed forest, or early successional forest where there is dense overhead cover, and eat small to medium-sized mammals, birds, and carrion (Helgen and Reid 2016b; see Powell et al., Chapter 11, this volume). Powell (1993) describes how fishers prey on porcupines (*Erethizon dorsatum*) by attacking their unprotected face, before turning them over and eating them from the belly, much like a European badger eats a hedgehog (*Erinaceus europaeus*). Fishers are not dependent on old-growth conifer forests but are associated with complex vertical (large trees and snags) and horizontal (large logs and dense canopy) structure characteristic of late-seral forests (Raley et al. 2012; Powell et al., Chapter 11, this volume). Historically, they ranged as far south as Tennessee (see Lewis et al. 2012) but were extirpated from the southern states, due to habitat loss and excessive fur trapping (Helgen and Reid 2016b); although, as for American marten, climatic changes may also have played a role (Krohn 2012). Reduced harvest pressure (aided by translocations, Lewis et al. 2012; see also Powell et al., Chapter 11, this volume) has since allowed eastern and central populations to have expanded their range (by 119% and 46% respectively), but western populations have not had the same success (with range expansions of 15% and 18% in Pacific and northwestern populations)—a regional difference that LaPoint et al. (2015) suggest is due to a reduced predator community (and specifically the absence of mountain lions, *Felis concolor*) in the east. Powell (1994b) calculated mean home range sizes of 38 km^2 for male fishers and 15 km^2 for females but home range sizes are variable (Powell et al., Chapter 11, this volume). Very large home ranges (males 160–210 km^2, females 30–38 km^2), for example, were recorded in British Columbia (Weir et al. 2013 and references therein). Density estimates range from 0.5–0.1 individuals per km^2 in winter in Maine to 0.3 individuals per km^2 in California (Powell et al. 2003) but may be much lower where resource availability is low or spatially variable (e.g. in British Columbia, 9–17 individuals per 1000 km^2, Weir et al. [2013] and references therein). Total population size is unknown but it is probably in the low hundreds of thousands (Helgen and Reid 2016b).

Fishers are managed as a furbearer but may be vulnerable to overharvest (see Harrington et al., Chapter 7, this volume). As for American marten, habitat suitability is negatively impacted by forest management practices such as forest fuel reduction (mechanical removal of understorey trees, shrubs, and fallen logs) to reduce the risk of wildfires (Truex and Zielinski 2013) and Californian populations are at risk of rodenticide poisoning at illegal marijuana cultivation sites (Thompson et al. 2013; Gabriel et al. 2015). Range-wide, fishers are not threatened, but small populations of 'Pacific' fisher may be at risk of extinction (www.biologicaldiversity.org).

	Male mean (range)	**Female mean (range)**
Weight (kg)	(3.5–5.5)	(2.0–2.5)
Head/body length (mm)	600	510

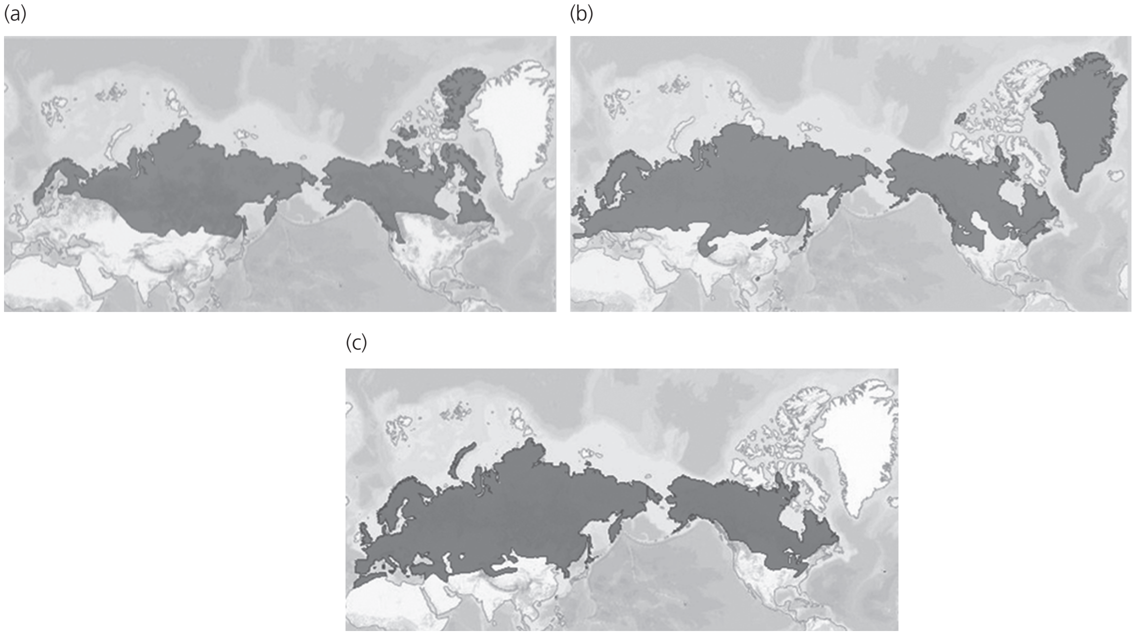
Refs: Powell 1993; Head/body length from Douglas and Strickland 1987

Circumboreal species

There are only three musteloid species that span the globe. All three are northern hemisphere species and they include the largest of the terrestrial musteloids (the rather bearlike wolverine) and the smallest (the tiny, skinny *Mustela*—stoats and least weasels).

Wolverine Gulo gulo (*Linnaeus, 1758*)

Wolverines are northern tundra and alpine region specialists. During the nineteenth and twentieth centuries, respectively, they disappeared from the southern extent of their range in Europe and North America, most likely due to persecution, over-hunting (for their fur), deforestation, and human development; protective legislation, hunting/trapping



Map 11 Circumboreal musteloids, a) wolverine, b) stoat, c) least weasel (showing native range only for stoat and least weasel) © IUCN 2016

regulations, and the cessation of wolf poisoning have since allowed re-establishment of the species in Scandinavia and recolonization of portions of their former range in North America (Aubry et al. 2007; Abramov 2016a). Currently, wolverines occur predominantly in Canada, Alaska, Scandinavia, and Siberia, although they persist at lower densities in northeast China and Mongolia, with a few in European Russia and the Baltic countries. In the US, wolverine populations have a patchy distribution in the northern Rocky Mountains in Washington, Idaho, Montana, and Wyoming (Aubry et al. 2007; Inman et al. 2013); in the mid-late 2000s, individual wolverines were reported as far south as Colorado, and the Sierra Nevada mountains in California, for the first time in almost a century (Jenkins 2015). Wolverines occupy extensive home ranges (*c*.100–300 km^2 for females, 500 –>1000 km^2 for males, Persson et al. 2010; Inman et al. 2012b) and occur at low population densities (between 6.2 per 1000 km^2 in high quality habitat in British Columbia, Lofroth and Krebs 2007, and an estimated 3.5 per 1000 km^2 in the Greater Yellowstone Ecosystem at the southern periphery of their US range, Inman et al. 2012b). In eastern Siberia and the Russian Far East, where there are few humans but many wild reindeer, wolverines are believed to number about 17,000 (Novikov 2005). Total population sizes elsewhere are: *c*.3500 in British Columbia (Lofroth and Krebs 2007), *c*.1100 in Scandinavia (Kaczensky et al. 2013), and only a few hundred in the entire United States (Inman et al. 2013).

Wolverines are largely nocturnal and although formerly considered to be solitary, Copeland et al. (Chapter 18, this volume) present evidence of a more complex social system, driven by resource availability, involving male parental association with young, and extended social tolerance of sub-adults. They occupy woodlands, open mountain, and tundra habitats (Abramov 2016a) but, at southern latitudes, favour high elevations (2200–2600 m in Central Idaho, Copeland et al. 2007), and are dependent on persistent spring snow cover for successful reproductive denning (Copeland et al. 2010) and probably dispersal corridors (Schwartz et al. 2009). They are primarily scavengers (of large ungulates killed by other carnivores, e.g. wolves and lynx), but also able predators of hares, small deer, domestic sheep, and even reindeer (in deep snow, where they have an advantage due to their heavily furred feet, Kitchener et al., Chapter 3, this volume).

Potential threats include overharvest (in the US and Russia; see Harrington et al., Chapter 7, this volume), climatic warming (McKelvey et al. 2011), conflict with livestock herders in Scandinavia (see Harrington et al., Chapter 7, this volume), and increased human use of mountain habitats (e.g. for winter recreation, Krebs et al. 2007; Stewart et al. 2016).

	Male **mean (range)**	**Female** **mean (range)**
Weight (kg)		
– Idaho	13.1 n = 11	8.2 n = 8
– Alaska	16.1 n = 7	11.2 n = 5
– Scandinavia	14.1 n=179	10.4 n=166
Head/body length (mm)		
– Russian Far East	904 n = 6	760 n = 5
– Idaho	797 (780–830) n = 10	698 (640–720) n = 6

Ref: Copeland and Whitman 2003; Scandinavia, Landa and Skogland 1995

Stoat Mustela erminea (Linnaeus, 1758)

Stoats (also known as short-tailed weasels, or 'ermine', referring to their white winter coats) range from Greenland and the Canadian and Siberian Arctic islands south to about 35°N (King 1983a—in the southern parts of their range, where winters are mild, they do not turn white, see King and Powell 2007). In North America, they range as far south as northern New Mexico; in Europe, to Portugal (but not the Mediterranean islands); and in China they reach the southern Xinjiang provinces. In Japan, stoats occur from the central mountains to the northern parts of Honshu and Hokkaido. They have been introduced to New Zealand (see King et al., Chapter 10, this volume). Through much of their range, they are common in suitable habitats, but in some areas they are only rarely recorded and may be scarce. Population sizes are influenced by prey availability and can fluctuate (or cycle) markedly, particularly at more northerly latitudes (discussed in Lambin et al., Chapter 4, this volume).

Stoats are found in a wide range of habitats, from sea level to 4000 m or more, where densities of small mammal prey (especially *Microtus* and *Clethrionomys* voles) are high, including successional or forest-edge habitats, scrub, alpine meadows, riparian woodlands, hedgerows, and riverbanks (King 1983a). They also eat birds, eggs, lizards, and larger mammals (e.g. rabbits and hares, King and Powell 2007), albeit with much regional variation. For example, in Greenland they eat almost exclusively lemmings, supplemented with ptarmigan (*Lagopus* spp.) and ptarmigan eggs when lemmings are scarce; in Ontario (where stoats are small), solely meadow voles, and in Britain (where stoats are large), they take a large proportion of rabbits, whereas in the Italian alps they were observed eating juniper berries when rodents were scarce (King and Powell 2007 and references therein). They may eat human food waste (fish and chicken bones, and meat scraps) where they occur near people (e.g. Piontek et al. 2015). McDonald et al. (2000) suggested that males take more large prey (lagomorphs) and females take more small rodents (see also King and Powell 2007, and King et al., Chapter 10, this volume, for further discussion of this topic); other studies (e.g. Piontek et al. 2015) have failed to find evidence of sexual trophic niche segregation. Stoats may be active day or night, and home ranges may be < 10 ha or > 200 ha (larger for males than females, and varying with both body size and prey density, King and Powell 2007). Stoats have no major threats but locally they may be vulnerable to unrestricted trapping, habitat loss, or declining prey (Reid et al. 2016a).

	Male **mean (range)**	**Female** **mean (range)**
Weight (g)		
– North America	59–81	45–54
– Sweden	207 n = 92	118 n = 31
– UK	367 (252–471) n = 191	242 (180–303) n = 69
– Siberia	179 (102–253) n = 13	(106–149) n = 4
– NZ	324 (284 – 356[1]) n = 395	207 (195 – 226[1]) n = 398
Head/body length (mm)		
– North America	166–279	153–204
– UK	291 (260–318) n = 188	262 (244–278) n = 69
– Siberia	259 (213–325) n = 32	216 (176–260)
– NZ	285	256

Ref: North America, King and Powell 2007; Sweden, Erlinge 1987; UK, McDonald and King 2008a; Siberia, Heptner et al. 1967; NZ ([1] range of local means), King 2005

Least weasel *Mustela nivalis* (Linnaeus, 1766)

Least (or common) weasels (the smallest of the confirmed *Mustela* species, and thus the smallest of all Carnivora) occur across Europe, including Britain (but not Ireland), ranging as far south (in Asia) as northern Iran, northern China, and northern Mongolia; and, in the United States, through the eastern States as far south as North Carolina and Tennessee (McDonald et al. 2016). They are found in Japan, and in North Africa (although they may have been introduced there, Lebarbenchon et al. 2010), and have been introduced to many Mediterranean Islands, and New Zealand (see King et al., Chapter 10, this volume). Least weasels in North America were formerly referred to as *M. rixosa* but are now generally accepted as belonging to the same species (King and Powell 2007). Two subspecies are recognized: *M. n. nivalis* (in North America, Asia and northern Europe) and *M. n. vulgaris* (in western and southern Europe and northern Africa)—distinguished by the white coat of *M. n. nivalis* in winter, and both distinguished from the larger stoat by the lack of a black tip at the end of the tail. Weasels in Taiwan (geographically separated from the rest of their range) may also warrant subspecific status (as *M. n. formosana*, Lin et al. 2010). In Eurasia, least weasels are relatively common but not often seen, and in North America they are considered rare (Sheffield and King 1994). Globally, their population is stable (McDonald et al. 2016). Population densities are highly dependent on prey availability (see Lambin et al., Chapter 4, this volume) and, locally, can reach 0.2–1.0 individual per ha when prey are abundant (Sheffield and King 1994).

Least/common weasels are found in a variety of habitats, from forest to alpine meadows and coastal dunes (Sheffield and King 1994), as well as cultivated farmland where they tend to use home ranges along intervening hedgerows (Macdonald et al. 2004c). They den in crevices among tree roots, hollow logs, and abandoned dens and burrows of other species. They are diurnal and a specialist rodent predator, although they also eat birds' eggs, lizards, frogs, and other alternative prey. They favour dense grassland where microtines (voles and lemmings) are abundant (McDonald et al. 2016) and tend to avoid open spaces because they are vulnerable to predation by raptors (Sheffield and King 1994).

They are trapped for their fur in North America. Potential threats elsewhere are persecution, and incidental poisoning with rodenticides.

	Male **mean (range)**	**Female** **mean (range)**
Weight (g)		
– UK	125 (81–195) n = 102	68 (48–107) n = 24
– Sweden	54, 73[1]	35, 36[1]
– NZ	127 n = 41	58 n = 4
– Russia	36–250	30–117

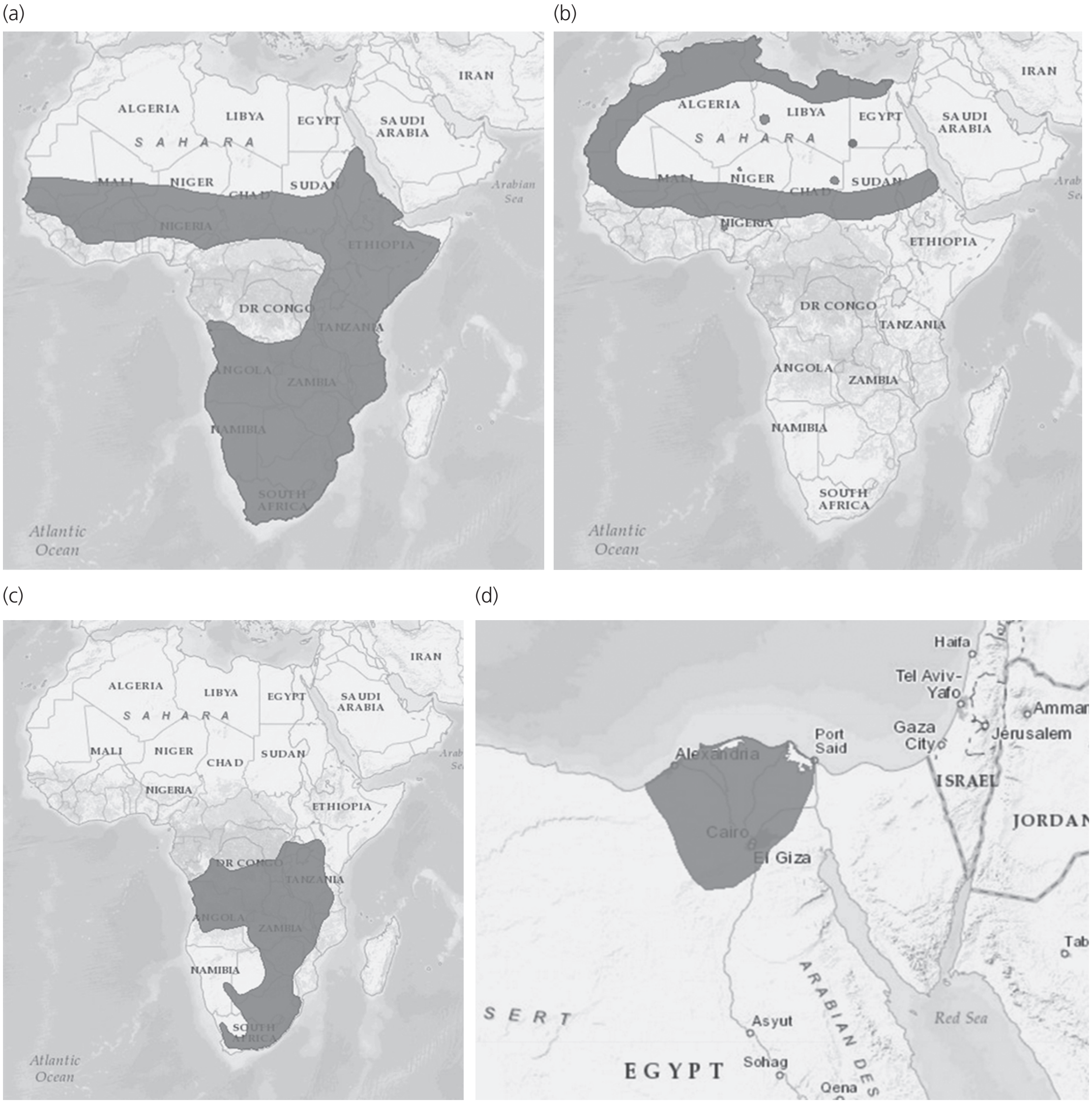
	Male mean (range)	Female mean (range)
Head/body length (mm)		
– UK	216 (195–248) n = 102	184 (175–194) n = 24
– Sweden	166, 189[1]	148, 154[1]
– NZ	217	183
– Russia	(130–260)	(114–204)
– North America	151–172	136–154

Refs: UK, McDonald and King 2008b; Sweden ([1] both sub-species present) and NZ, King and Powell 2007; Russia, Heptner et al. 1967; North America, King and Powell 2007

African 'polecats and weasels'

Striped polecat *Ictonyx striatus* (Perry, 1810) and Saharan striped polecat *Ictonyx libycus* (Hemprich and Ehrenberg, 1833)

Striped polecats (or zorilla) occur widely across sub-Saharan Africa, from Mauritania and Senegal in the west to Sudan, Ethiopia, and Somalia in the east, south to South Africa. They occupy acacia forest, woodland, thorn bush, savanna, open grassland, and even desert provided there is some shrub cover, between sea level and up to 4000 m (Stuart et al. 2015a), as well



Map 12 African 'polecats and weasels' a) striped polecat, b) Saharan striped polecat, c) African striped weasel, d) Egyptian weasel © IUCN 2016

as bamboo forests in Tanzania (DeLuca and Mpunga 2013) and pastoral areas in the Kenyan highlands (Stuart et al. 2015a). Saharan striped polecats (also known as Libyan striped weasels) occur across North Africa (from Morocco and Mauritania to Egypt and Sudan), overlapping with striped polecats at the southern and northern limits of their range respectively (in northern Nigeria and central and eastern Sudan, Ahmim and Do Linh San 2015). Saharan striped polecats favour sparse vegetation and only occur in desert fringes, mountains, and sub-desert habitats (Cuzin 2013). Little is known of the population status of either species; Ahmim and Do Linh San (2015) describe Saharan striped polecats as 'not uncommon'.

Striped polecats are solitary, nocturnal, and carnivorous, consuming mostly insects (predominantly ground-dwelling beetles, e.g. Saleh and Basuony 2005) and small rodents, but also reptiles, and birds and their eggs (Larivière 2002a). They also prey on domestic poultry (for which they are sometimes killed, DeLuca and Mpunga 2013; Stuart et al. 2015a). There are no known major threats for either species.

	Male mean (range)	Female mean (range)
Weight (g)		
Striped polecat		
– KwaZulu-Natal	990 (800–1200) n = 5	640 (420–750) n = 6
– Cape Province	790 (490–1200) n = 21	580 (430–700) n = 4
– Zimbabwe/Botswana	970 (680–1460) n = 27	710 (600–880) n = 8
– Botswana	900 (680–1360) n = 14	630 (480–790) n = 8
Saharan striped polecat	217[1] n = 3	
Head/body length (mm)		
Striped polecat		
– KwaZulu-Natal	365 (350–380) n = 3	331 (320–340) n = 3
– Cape Province	340 (280–380) n = 30	331 (290–365) n = 8
Saharan striped polecat	256 (231–279)[1] n = 7	

Ref: striped polecat, Larivière 2002a; Saharan striped polecat ([1] both sexes combined), Cuzin 2013

African striped weasel *Poecilogale albinucha* (Gray, 1864)

African striped weasels occur throughout much of southern Africa, from Angola in the west to Kenya in the east, and south to the Western Cape of South Africa (Stuart et al. 2015b). They are relatively uncommon (and elusive) but appear to be widely distributed in a variety of habitat types (mostly savanna habitats but also lowland rainforest, semi-desert grassland, fynbos, pine plantations, and agricultural land, Stuart et al. 2015b; Larivière 2001c). They eat a variety of animal prey but specialize on rodents (Larivière 2001c). They rest in hollow logs or rock crevices but are also powerful diggers and will excavate their own dens. Throughout much of their range, they are sympatric with the larger and more stocky striped polecats (Larivière 2001c; DeLuca and Mpunga 2013). Like striped polecats, they kill domestic chickens, but are considered by local people to be a blessing because they believe that they possess magical powers (DeLuca and Mpunga 2013). They are one of the most used species in traditional medicine but the level of use is considered to be low impact. Koepfli et al. (2008a; Chapter 2, this volume) suggest that African striped weasels should be incorporated within the genus *Ictonyx.*

	Male mean (range)	Female mean (range)
Weight (g)		
– Zimbabwe	260 (220–360) n = 6	170 (120–260) n = 11
– KwaZulu-Natal, SA	340 (280–380) n = 7	250 (230–290) n = 6
– Cape Province, SA	360 (330–380) n = 3	210, 220 n = 2
Head/body length (mm)		
– Zimbabwe	290 (286–345) n = 6	268 (264–299) n = 11
– KwaZulu-Natal, SA	313 (299–330) n = 7	298 (275–320) n = 3
– Cape Province, SA	314 (306–327) n = 3	280, 350 n = 2

Ref: Zimbabwe and KwaZulu-Natal, SA, Stuart and Stuart 2013; Cape Province, SA, Larivière 2001c

Egyptian weasel *Mustela subpalmata* (Hemprich and Ehrenberg, 1833) **probably an ecotype of Mustela nivalis*

Egyptian weasels are known only from five localities in the Nile Valley of Egypt, between Aswan in the South and Alexandria and the Nile Delta in the north (McDonald and Do Linh San 2016) where, unlike any other weasel, they live in cities as a human commensal. A recent genetic study by Rodrigues et al. (2016) found no evidence to support the view that Eygptian weasels are genetically distinct from least weasels (or even qualify as a subspecies), and, although it is not clear whether they are native to Egypt or were introduced (perhaps by the Romans), these authors suggest that they are most likely a relict of past range expansion of the least weasel from the eastern Mediterranean. They are nevertheless biologically unique.

Egyptian weasels are nocturnal (but are well known in Cairo), they hunt rats, mice, and lizards, and den in the basements of houses (Hope 2012). They are considered 'common' where they occur; densities may be 0.5–1.0 individuals per ha. They suffer no known major threats but they are potentially at risk from secondary poisoning from rodenticides, disease, or predation by feral dogs (McDonald and Do Linh San 2016).

	Male mean (range)	Female mean (range)
Weight (g)	390 (360–430) n = 6	210 (190–230) n = 5
Head/body length (mm)	289 (252–301) n = 9	242 (232–259) n = 5

Ref: McDonald 2013

Eurasian 'polecats, weasels, and mink'

European polecat *mustela putorius* (Linnaeus, 1758)

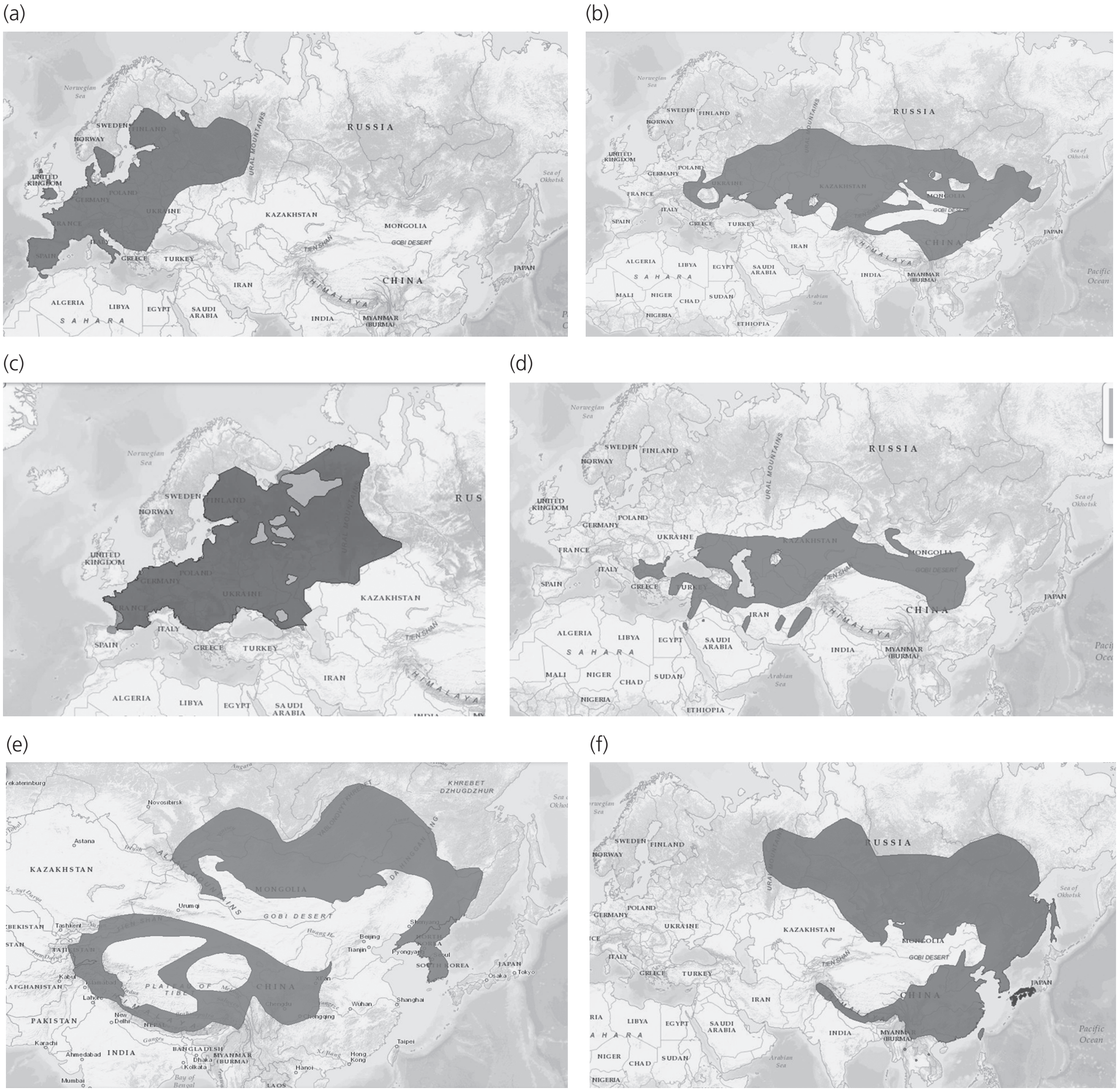
European polecats have a wide distribution, from Britain (but not Ireland) as far east as the Ukraine, the west slopes of the Middle and South Ural Mountains, and Arkhangelsk city in northwest Russia. Further north, east, and south of this eastern border, European polecats are replaced by Siberian polecats, although there is a broad area of overlap in this region where wild hybrids are known, and some evidence of northwards spread by European polecats (Skumatov et al. 2016). Current population size is assumed to be large, but there is little quantitative information on population trends (Skumatov et al. 2016). There is evidence of decline in a number of areas in western Europe (e.g. Portugal, Costa et al. 2014; Luxembourg, Baghli and Verhagen 2003; and France, where the area occupied fell from 11,263 to 3300 km^2 in the Alpine region and from 37,199 to 15,600 km^2 in the Mediterranean region between 2007 and 2013, attributed to loss of wetlands, and hedgerows in farmland, as well as declines in important prey species [e.g. rabbits in Mediterranean regions, and amphibians elsewhere], Berzins and Ruette 2014; Skumatov et al. 2016). In Britain, polecats are currently recovering from past declines in the early twentieth century (Birks and Kitchener 1999; Croose 2016). European polecats are also found in North Africa (Algeria and Morocco), but they are extremely rare (Griffiths and Cuzin 2013). There are feral populations of domestic ferrets within the European polecat's range (in Britain, Birks and Kitchener 1999) and outside it (in New Zealand, Clapperton 2001; King et al., Chapter 10, this volume).

European polecats live largely in landscapes dominated by farming, at elevations between sea level and 1600 m or more (Skumatov et al. 2016), but are found in a range of habitats including lowland woods, marshes and river valleys, and sand dunes (Birks 2016), often selecting areas of high structural diversity where resources are abundant (e.g. Zabala et al. 2005). Population densities in western Europe are typically about one individual per 10 km^2 (rarely exceeding 5–10 per 10 km^2), but in forested areas in European Russia are about 1 per km^2 (Skumatov et al. 2016). In farmed areas in lowland England, polecats use hedgerows and copses within home ranges of about 20–130 ha (e.g. Harrington and Macdonald 2008). They feed on rabbits, rodents, amphibians, and other vertebrates, but also sometimes invertebrates and carrion (Birks 2016). In some areas in mainland Europe, polecats are sympatric with European mink, but there is likely spatial segregation between them (e.g. Zabala et al. 2005; see also Sidorovich and Macdonald 2001) as there is between polecats and invasive American mink in the UK (Harrington and Macdonald 2008).

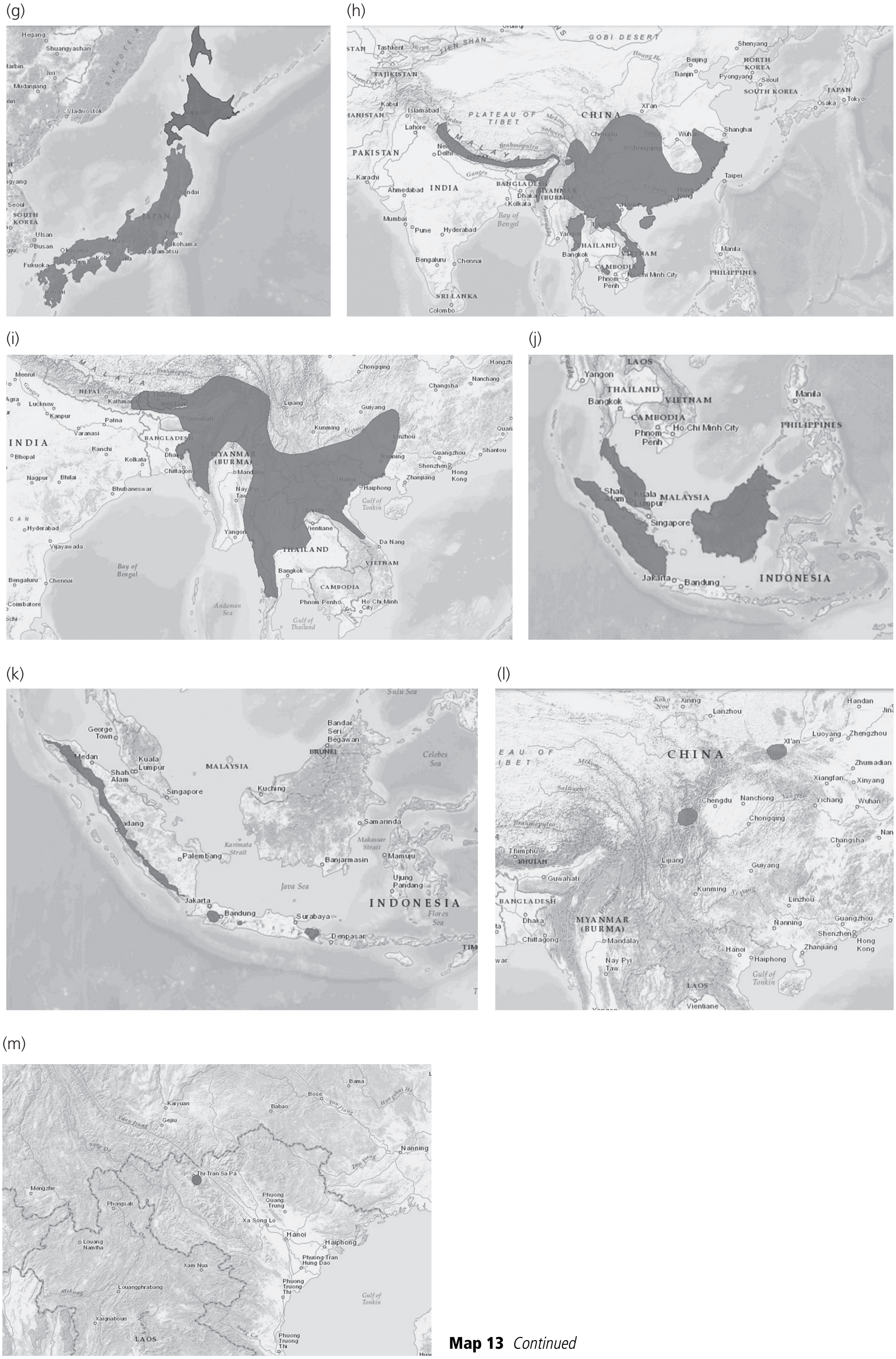
In Russia, European polecats are hunted for their fur (although they are not high value because of the variation in coloration of their pelts), and polecat-domestic ferret hybrids are farmed (Skumatov et al. 2016). Potential threats are non-selective trapping methods for other species (e.g. invasive American mink), pollution (which may reduce reproductive output, Weber 1989), rodenticide poisoning (Birks 1998), and road traffic accidents.

	Male mean	Female mean
Weight (kg)		
– Belarus	1.14 n = 27	0.64 n = 8
– lowland England	1.56 n = 2	0.98 n = 5
Head/body length (mm)		
– Belarus	409 n = 27	341 n = 8

Refs: Sidorovich et al. 1999; Harrington and Macdonald 2008



Map 13 Eurasian 'polecats, mink, weasels' a) European polecat, b) Siberian polecat, c) European mink (historical range shown in dark grey, estimated current range in light grey, see Chapter 17), d) marbled polecat, e) Altai mountain weasel, f) Siberian weasel (introduced range shown in dark grey), g) Japanese weasel (introduced range shown in dark grey), h) yellow-bellied weasel, i) stripe-backed weasel, j) Malayan weasel, k) Indonesian mountain weasel, l) location of Sichuan weasel specimen, m) location of Tonkin weasel specimen © IUCN 2016



Map 13 *Continued*

Plate E European polecat (*Mustela putorius*). © A.L. Harrington

Siberian polecat *Mustela eversmanii* (Lesson, 1827)

At the beginning of the twentieth century, Siberian (or steppe) polecats were widely distributed across the open steppe and agricultural landscapes of Central and Eastern Europe (Šálek et al. 2013), from Austria and the Czech Republic through southern Russia, to Mongolia and northern and western China (Maran et al. 2016a). Recent observations suggest that they occur as far south as Nepal (at > 5000 m, Chetri et al. 2014). They are believed to be common across their Russian and central Asian range (Maran et al. 2016a), but rapidly declining over much of their European range (Šálek et al. 2013), due to the widespread loss of steppe and grassland habitats, agricultural intensification (and the conversion of small-scale diverse farmlands to large intensively farmed monocultures), and the associated loss of important prey species, such as European ground squirrels (suslik, *Spermophilus*) and common hamsters (*Cricetus cricetus*). In Ukraine, for example, population densities in a reserve in the Donetsk-Priazovian steppe region in the 1970s were 100–150 individuals per 10 km^2, in 1995 11.5 individuals per 10 km^2, and only 1.9 by the late 1990s (Šálek et al. 2013). There do not appear to be any estimates of home range size but Siberian polecats in Asia are reported to move 10–15 km per day (see Biggins and Eads, Chapter 15, this volume and references therein).

In their European range, Siberian polecats overlap with European polecats everywhere except eastern Ukraine, southern Russia, and Georgia (Maran et al. 2016a; Skumatov et al. 2016). A study of the diet of the two species in the plains region east of the Danube River in Hungary recorded high trophic niche overlap (75.4%)—with both species' diets comprising high proportions of small birds (Passeriformes), voles (*Microtus* spp.), common hamster (*Cricetus cricetus*), and field mice (*Apodemus* sp.) but Siberian polecats having a narrower trophic niche than that of European polecats (Lanszki and Heltai 2007). Otherwise, little is known about interspecific interactions between these species. In China, Siberian polecats appeared to avoid periods when red foxes were active (Zhou et al. 1994 in Biggins et al. 2011a). They are hunted for their fur in Russia, and hunting is permitted in Austria (but nowhere else in the European Union) to protect small game.

	Male range	**Female range**
Weight (kg)	max 2.05	max 1.35
Head/body length (mm)	320–562	290–520
Ref: Heptner et al. 1967 (n = 1611)		

European mink *Mustela lutreola* (Linnaeus, 1761)

European mink are the only semi-aquatic *Mustela*, and one of only two extant semi-aquatic musteloids that is not an otter (the other being American mink). The European and American 'mink' species are so similar in appearance and ecology that they were originally considered to be subspecies (Ognev 1931; Heptner et al. 1967; reviewed in Novikov 1939; and Ternovskij 1977), but they are not closely related and European mink are, in fact, closely related to European polecats (Youngman 1982; Masuda and Yoshida 1994; Davison et al. 1999, 2000a, b). European mink inhabit densely vegetated banks of rivers, streams, and sometimes, lakes, where they hunt amphibians, crustaceans (crayfish), fish, small mammals, insects, and birds (Sidorovich et al. 1998; Maran et al. 1998b; Palazón et al. 2004, 2008). They are rarely found more than 100 m away from fresh water and there are no records of their presence on the sea coast. They are solitary, and usually occupy linear home ranges along river banks that are about 10 km in length, but may be between 2 km (Danilov and Tumanov 1976) and 17 km (Zuberogoitia and Zabala 2003). Densities may reach nine individuals per 10 km of water course on high quality rivers, or as low as two per 10 km on smaller streams (Sidorovich and Macdonald 2001). Historically, European mink ranged across Europe, from northern Spain (they never occurred in Britain) to the Ural Mountains, and from Finland to the Black Sea (Novikov 1939; Heptner et al. 1967). Their distribution apparently spread further west and south relatively late (first recorded in France in the 1830s, and in Spain in the 1950s, Youngman 1990; Michaux et al. 2005), but over the last 150 years it severely declined and European mink have been extirpated or greatly reduced over most of their former range (Maran 2007; Maran et al. 1998a, 2016b, and Chapter 17, this volume). Their current range consists of a few isolated fragments—in northern Spain and western France, the Danube delta in Romania and the Ukraine and in isolated habitat patches in Russia (Maran et al. 2016b, and Chapter 17, this volume). Almost 400 captive-bred European mink were introduced to the Kurile Islands in the Russian Far East in the 1980s but the population there did not establish (Maran et al. 2016b).

Early declines in European mink were probably due to habitat loss and over-exploitation, compounded through the mid-1990s by the arrival of the American mink (introduced for the fur trade, Maran et al., Chapter 17, this volume). American mink now occupy much of the European mink's native range and outcompete them everywhere they co-occur. In Romania, European mink seem to be widespread but over an area no more than 2500 km^2 (e.g. Kranz et al. 2006). In Spain, the population is estimated at 500–1000 individuals (Palazón et al. 2002, 2003), several hundred in France, and *c*.20,000 individuals in Russia (Tumanov 2003, 2006), although the latter is probably an overestimate (Maran et al. 2016b).

Reintroduction projects are on-going in Spain (initial trial in 2008–2010, with planning for future releases underway at the time of writing), Germany (in Saarland, since 2006, and at Steinhuder Meer, Lower Saxony, since 2010), and on the Estonian island of Hiiumaa (since 2000). The first wild-born mink in Germany for 150 years was recorded in 2015 (www.lutreola.eu), and a small core population exists on Hiiumaa Island, but it is not yet viable (see Maran et al., Chapter 17, this volume).

	Male mean (range)	**Female mean (range)**
Weight (g)		
– Belarus	854 n = 14	537 n = 8
– France	870 n = 7	543 n = 2
– Spain	813 (585–1065) n = 68	483 (340–675) n = 32
Head/body length (mm)	399 n = 14	358 n = 8

Ref: Belarus, Sidorovich et al. 1999; France, Youngman 1990; Spain, Palazón et al. 2006

Marbled polecat *Vormela peregusna* (Güldenstädt, 1770)

Marbled polecats range from southeast Europe, through Asia Minor, the Middle East, the Caucasus, and Central Asia, to northern China and Mongolia, where they inhabit desert, semi-desert, and steppe habitats, from sea level to 2000 m (up to 3000 m in the Tien Shan mountains), feed on desert and steppe rodents such as gerbils and ground squirrels (Abramov et al. 2016c), as well as other rodents, birds, lizards, frogs, and invertebrates, and inhabit the burrows of other fossorial mammals (Gorsuch and Larivière 2005). Distinguished from other mustelids by the stark white band across their dark brown heads, yellow mottled pelage, and long fluffy tail, marbled polecats are somewhat unique in appearance (and are the only Eurasian 'polecat/weasel' to be in a distinct genus, separate from the 'true weasels', the *Mustela*). They appear to be naturally rare throughout much of their range, but are thought to be declining in line with the widespread conversion of steppe habitat to cultivated farmland (and associated decline in key prey species), and both northern and southern range boundaries appear to be receding (Abramov et al. 2016c). In Serbia, marbled polecats sometimes occur near settlements and may take poultry but it is not clear whether this reflects adaptation to such human-occupied habitats (as seen in, for example, European polecats or stone martens) or whether such synanthropic behaviour simply brings additional risks (e.g. secondary poisoning by rodenticides, Milenković et al. 2000). Home ranges are 0.5–0.6 km^2 (Gorsuch and Larivière 2005). Hunting may be a threat in Israel (Werner 2012).

	Male mean	Female mean
Weight (g)		
– Bulgaria	330, 520 n = 2	317, 295 n = 2
– Siberia	610–715	450–600
– Israel	320–493	275–310
Head/body length (mm)		
– Bulgaria	320, 310 n = 2	292, 288 n = 2
– Israel	326 n = 6	308 n = 7
Ref: Gorsuch and Larivière 2005		

Altai mountain weasel *Mustela altaica* (Pallas, 1811)

Altai mountain weasels (or pale weasels) are found in central and east Asia from the plain river valleys in Kazakhstan (at about 340 m), up to 4700 m in the Tibetan plateau, and 4890 m in Nepal (Abramov 2016c). They occur mostly (but not exclusively) in mountain meadows—a threatened ecosystem subject to over-grazing by livestock (see e.g. Hornskov and Foggin 2007). They are also found in rocky areas, dry steppes and plains, river valleys with reeds and bushes, and often close to human settlements (Abramov 2016c). They appear to be mostly diurnal (Bischof et al. 2014), they prey mainly on pikas (Smith and Foggin 1999), but also eat rodents (voles, mice, hamsters), small birds, lizards, and insects (Pocock 1941). Altai weasels are believed to be declining due to the loss and degradation of mountain meadow habitat as well as widespread eradication of pikas (due to their perceived impact on vegetation and competition for forage with livestock, Hornskov and Foggin 2007). However, frequent sightings of this species (in China and in Nepal) suggest that they might still be common (Hornskov and Foggin 2007; Ghimirey and Acharya 2014).

In Nepal, and perhaps elsewhere, mummified bodies of Altai mountain weasels are hung in houses because this is believed to reduce deaths of newborn human babies. Across their range, they are sometimes hunted for their fur. Neither are likely to have an impact at the population level (Ghimirey and Acharya 2014; Abramov 2016c).

	Male mean (maximum)	Female mean (maximum)
Weight (g)	217–255 (350)	122–135 (220)
Head/body length (mm)	224–287	217–249
Ref: Heptner et al. 1967		

Siberian weasel *Mustela sibirica* (Pallas, 1773)

Siberian (or yellow) weasels range from the Ural Mountains in the west to the Pacific coast in the east, and southern China, northern Myanmar, and the Himalayas in the south (where, in the latter, they appear to occupy strictly montane habitats at elevations of 4000 m or more—in contrast to the northern parts of their range where they may be found at sea level, Abramov et al. 2016b). They are not found in the arid areas of north and west China, or southern Mongolia. In Japan, they are endemic to the Tsushima Islands, but have been introduced to Honshu, Shikoku, and Kyushu (Sasaki et al. 2014—see Japanese weasel). There are no data on population size, or density for this species, but it is frequently seen and so is assumed to be abundant (at least over its northern range—in southern Siberia, northern Mongolia, and China). In Japan, density in the Seburi mountains is estimated at approximately 0.1 individuals per ha (Sasaki et al. 2014) and home ranges vary depending on habitat, being smaller in villages (male 1.42 ± 1.62, n = 19; female 1.31 ± 1.12, n = 10) than in grassland (male 4.37 ± 3.87, n = 8; female 1.67 ± 0.91, n = 4; Sasaki and Ono 1994).

Siberian weasels are larger than most other species called ‘weasels’ and are only a little smaller than European mink. They live in a variety of forest habitats (deciduous, coniferous, and mixed) as well as open areas with patches of forest (and sometimes above the treeline in the mountains), along river valleys, and in farmland landscapes, and feed mostly on small mammals (97% frequency of occurrence [FO] in one study in alpine grasslands, Wu 1999), birds, reptiles, amphibians, and invertebrates. In villages in Japan, they scavenge for abandoned fish in the harbour and human waste food (Sasaki and Ono 1994; Sasaki et al. 2014). Siberian weasels were apparently released in cities in central and northern China for rat-control—and they appear to thrive there (Abramov et al. 2016b). In sub-tropical forests in Taiwan, Siberian weasels coexist with Chinese ferret badgers—both species are common but rodents are scarce so weasels eat mostly arthropods (69% FO) and shrews (41% FO) which results in dietary overlap with ferret badgers. Wu (1999) suggests that the two species are able to coexist because they forage for different groups of arthropods (weasels eat adult Coleoptera and centipedes, ferret badgers eat Coleopteran larvae and earthworms), and in different ways (weasels search in the forest litter on the ground and in caves and crevices, ferret badgers dig their prey from soil and rotten logs).

Siberian weasel tail hair is used for paint brushes (see Harrington et al., Chapter 7, this volume), and they may be persecuted for killing poultry (Abramov et al. 2016b).

	Male mean (range)	**Female mean (range)**
Weight (g)	802 (430–1150) n = 25	354 (338–390) n = 5
Head/body length (mm)	359 (310–400) n = 26	290 (270–306) n = 6

Ref: based on data from Japan where Siberian weasels are invasive, Sasaki et al. 2014

Japanese weasel *Mustela itatsi* (Temminck, 1844)

Japanese weasels are endemic to Japan but exist in a rather unusual situation whereby they occur naturally on the main islands of Honshu, Shikoku, and Kyushu (and several smaller islands), where they have disappeared from the western lowland areas that are now largely occupied by introduced Siberian weasels, but are themselves an invasive species on the Japanese island of Hokkaido and a different set of about 50 smaller islands (including the Izu and Nensei islands), where they were introduced in the 1880s for the control of rodents (Masuda and Watanabe 2009; Kaneko et al. 2016b). In the Seburi Mountains, Japanese weasels are found in grasslands and plantations at approximate densities of 0.05 individuals per ha. They look very similar to Siberian weasels but are slightly smaller, and have slightly shorter tails and different colouring (Sasaki et al. 2014). There are very few studies of the interactions between these two species, but Sasaki et al. (2014) suggests that the decline of Japanese weasels was associated with increasing urbanization rather than the presence of Siberian weasels per se. The particular species present in an area now seems to be dependent on the degree of urbanization, and, although there seems to be some level of co-occurrence around agricultural villages, the two species are not usually found in the same areas except during the juvenile dispersal period. Japanese weasels have a broader diet than other *Mustela* elsewhere: although small mammals are an important dietary item, they also eat large proportions of insects (Orthoptera, 21.5% frequency of occurrence; Coleoptera, 18.0%), crustaceans (20.3%), fruits (19.4%), fish (17.7%), and small mammals (23.6%, based on analysis of n = 237 faeces, Kaneko et al. 2009a, 2013). Small mammals appeared to be eaten most frequently in conifer plantations, fish in rice fields, and insects and fruit along riverbanks (Kaneko et al. 2009a; see also Okawara et al. 2014).

	Male mean (range)	**Female mean (range)**
Weight (g)	542 (200–929) n = 68	179 (100–262) n = 7
Head/body length (mm)	329 (268–400) n = 62	241 (222–265) n = 7

Ref: Sasaki et al. 2014

Yellow-bellied weasel *Mustela kathiah* (Hodgson, 1835)

Yellow-bellied weasels are found in hilly areas across the Indian Himalayas, through southern China and in Southeast Asia, where they occur in north and central Myanmar, north and central Thailand, Lao PDR, and Vietnam (Willcox et al. 2016), and have recently been recorded in Cambodia (in the Central Cardamom Protected Forest, 11°N, Phan et al. 2014). They are primarily an evergreen forest species, generally associated with elevations over 1000 m (Willcox et al. 2016), but have been sighted at 770 m in Thailand (Supparatvikorn et al. 2012). They appear to be common in forested areas in southern China; they are rarely recorded in the southern parts of their range, but Willcox et al. (2016) suggest that there is no reason to believe that they are actually rare. They are believed to be largely carnivorous (as other *Mustela*, although there are observations of one individual eating a non-fruiting medicinal plant, Wan 2014) and diurnal; in China, they regularly take poultry in villages. Many of the records of the species are from areas where the forest is heavily degraded and fragmented, and where there is intensive non-selective hunting (and where most other small carnivores are now rare), which suggests that they are largely tolerant of such pressures (Willcox et al. 2016).

Stripe-backed weasel *Mustela strigidorsa* (Gray, 1853), Malay weasel *Mustela nudipes* (Desmarest, 1822) and Indonesian mountain weasel *Mustela lutreolina* (Robinson and Thomas, 1917)

Much like the South American *Mustela*, little is known of these three Southeast Asian species. Stripe-backed (or back-striped) weasels (male head-body length 300–360 mm, n = 7, Abramov et al. 2008) are found in mainland Southeast Asia where they range from Sikkim, India, east through southern China, to Vietnam (Roberton et al. 2016), and as far south as Thailand (12°N, Chutipong et al. 2014). They are found mainly in evergreen forests in hills and mountains at high elevation (> 1000 m), but also in surrounding secondary forests, scrub areas, grassland, and farmland (Abramov et al. 2008; Roberton et al. 2016). Little is known about them, but they have been detected in almost all semi-evergreen and evergreen forests in Lao PDR that were surveyed for two weeks or more using appropriate methodology (Roberton et al. 2016), which suggests that they are not rare. Malay weasels (c. 350 g; see Ross et al., Chapter 14, this volume) are recorded from sea level to 1700 m, usually in forested habitats (lowland and upland mixed dipterocarp forest, tropical heath forest, swamp and montane forest, and montane scrub), on Sumatra, Borneo, and the Thai-Malay peninsula (the northernmost record being from Thailand at 10°N, Chutipong et al. 2014). They appear to be widespread (albeit probably at low density) in all three locations (Duckworth et al. 2006b, 2015; Ross et al. 2013). Indonesian mountain weasels are known from only 20 records. They are endemic to Sumatra and Java (Indonesia); existing records are mostly from forests, and all at high elevation (1400–3900 m) but it is not known if they are confined to these areas (Duckworth et al. 2016d).

Stripe-backed weasels are harvested for their skins and sold, at least occasionally, in Lao PDR, Vietnam, and China, but do not appear to be particularly sought after (Roberton et al. 2016).

Habitat availability for Malay weasels has undoubtedly been reduced in recent decades, due to deforestation and widespread conversion to plantations, particularly at lower elevations. They are recorded in deforested areas, plantations, and urban fringes, but it is not known whether these areas are permanently occupied or able to support sustainable populations. However, sufficient habitat remains and is now protected so further deforestation is not considered a threat to the species' long-term survival (Duckworth et al. 2015). No other major threats are known or suspected. Malay weasels are eaten in Sarawak, and possibly elsewhere, but this is not considered to be a population-level threat (Duckworth et al. 2006b, 2015). Indonesian mountain weasels live at elevations above the areas where mammal trapping and snaring is prevalent and above areas of heavy deforestation, and there are no obvious threats to this species (Duckworth et al. 2016d; see also Meiri et al. 2007).

Sichuan weasel *Mustela russelliana* (Thomas, 1911) and Tonkin weasel Mustela tonkinensis (Bjõrkegren, 1941) **taxonomy uncertain*

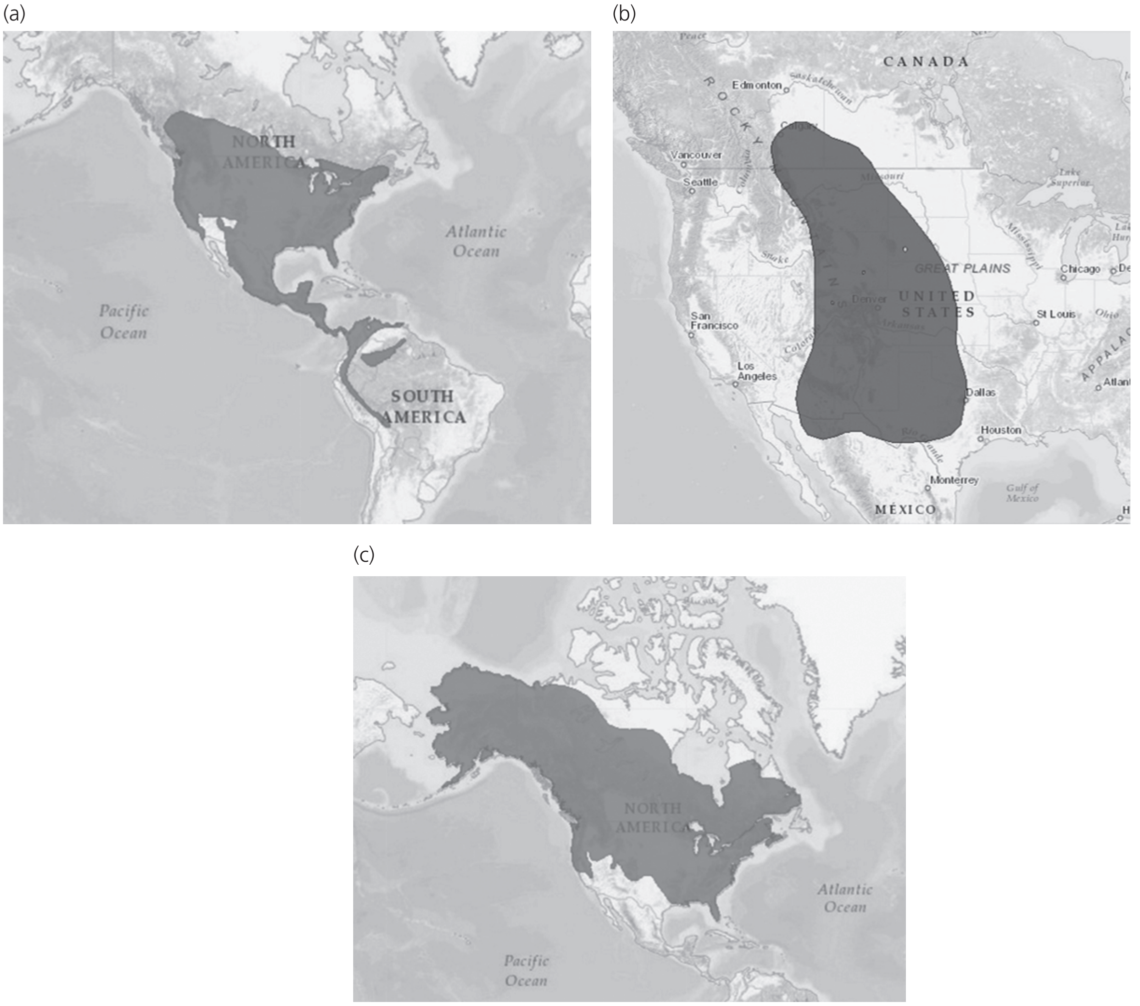
Previously considered subspecies of *M. nivalis*, Sichuan weasels and Tonkin weasels are (at the time of writing) listed by the IUCN Red List as separate species, although there remains debate regarding whether either warrant species status (see Koepfli et al., Chapter 2, this volume). The two male and two female putative Sichuan weasel specimens (male head/body length c. 137 mm, female head/body length c. 131 mm) are smaller than most *Mustela nivalis* (and, thus, potentially, the smallest of the weasels, and the Carnivora); their colouring resembles that of the yellow-bellied weasel (Groves 2007). They are known only from three collection records from a small area of China, all from montane sites (Abramov and Duckworth 2016). Tonkin weasels are known from only one specimen collected in northern Vietnam –the precise location of the specimen is unknown but it is assumed to be from the highlands of the Hoang Lien Son mountains (Abramov 2006; Timmins et al. 2016), in an area where hunting is intense and rates of habitat loss and degradation have been high (Timmins et al. 2016).

American 'Ferrets, Weasels, and Mink'

Long-tailed weasel *Mustela frenata* (Lichtenstein, 1831)

Long-tailed weasels have the widest distribution of all the mustelids in the Western hemisphere, extending from just north of the Canadian/North American border to Bolivia, South America (Helgen and Reid 2016d). They are fairly common throughout their range but densities vary according to habitat and prey availability (from about one per 2.6 ha to one per 260 ha, King and Powell 2007). Likewise, home ranges vary from 4 ha to 120 ha, and are usually larger for males than for females: Gehring and Swihart (2004) recorded home ranges of 39 ha for females and 137 for males in an agricultural landscape in Indiana. They are found in a wide variety of habitats, usually near water—including woodlands, field edges, grasslands, swamps, and marshes—and den in almost any small sheltered space—rock crevices, brush piles, tree stump hollows, and abandoned dens dug by other mammals (Helgen and Reid 2016d). Like stoats, their coat turns white in winter, but only in the northern parts of their range (King and Powell 2007), and, like most other *Mustela* spp., their diet consists mostly of rodents but they also eat other vertebrates. They appear to be tolerant to a moderate amount of land use change but 'corridor habitats' in agricultural landscapes are probably important (Gehring and Swihart 2004; Helgen and Reid 2016e)—radio-tracked weasels moved faster through crop fields than through corridors and forest patches, presumably reflecting their low prey availability and high predation risk. They may be impacted by pesticide use (Helgen and Reid 2016e).

	Male mean	Female mean
Weight (g)	195–256	102–122
Head/body length (mm)	220–270	209–245
Ref: King and Powell 2007		



Map 14 North American 'ferret, weasel mink' a) long-tailed weasel, b) black-footed ferret (showing historical range, see Chapter 15 for reintroduced range), c) American mink (showing native range) © IUCN 2016

Black-footed ferret *Mustela nigripes* (Audubon and Bachman, 1851)

Thought to be extinct in the wild in 1987, following widespread declines through the twentieth century as a result of prairie dog control and sylvatic plague, black-footed ferrets have since been the subject of massive reintroduction efforts in the United States (Belant et al. 2015; Biggins and Ead, Chapter 15, this volume). Historically, black-footed ferrets occurred wherever their prey (prairie dogs) were located, throughout the Great Plains, mountain basins, and semi-arid grasslands of west-central North America, from southern Canada to northern Mexico (Belant et al. 2015). Captive-bred individuals have been released in 24 sites in eight US States, Mexico, and Canada but only four sites are considered to have self-sustaining populations (two in South Dakota, one in Arizona, and one in Wyoming); these sites have a combined range of > 500 km^2. As of 2015, there were approximately 500 individuals in the wild (released and wild-born) and several hundred in *ex situ* captive breeding facilities.

Black-footed ferrets are nocturnal, prey predominantly on prairie dogs, and use their burrows for shelter (Hillman and Clark 1980). Approximately 40–60 ha of prairie dog colony are needed to support one black-footed ferret, but prairie dog densities are also important (see e.g. Biggins et al. 1993; 2006b; Eads et al. 2011a, 2014). Densities of 12 prairie dogs per ha appear to be sufficient for ferret reproduction (Ayers et al. 2014). Black-footed ferrets are killed by coyotes, great horned owls (*Bubo virginianus*), and American badgers—predation was the primary cause of mortality in a wild population (Forrest et al. 1988) and caused 95% of mortality of a reintroduced population (Biggins et al. 2006c; Breck et al. 2006). American badgers appear to dig selectively at burrows in areas recently occupied by ferrets, although it is not clear whether they are specifically hunting ferrets or stealing food from them—coexistence between these two species is presumably facilitated by the superiority of long, skinny ferrets (that can access prairie dog burrows without digging) in exploitative competition, and the superiority of larger, more powerful badgers (that kill, and sometimes eat, ferrets) in interference competition (Eads et al. 2013). Plague impacts black-footed ferrets directly (through infection and subsequent mortality) and indirectly (through mortality of prairie dogs and declines in their prey base) and is still a serious problem for black-footed ferret recovery (Eads and Biggins 2015; Biggins and Eads, Chapter 15, this volume). Loss and fragmentation of habitat due to the widespread conversion of grasslands to cropland and development is an additional threat, and potential inbreeding effects remain a concern (e.g. Wisely et al. 2008).

	Male mean	Female mean
Weight (g)	1034 n = 13	704 n = 31
Head/body length (mm)	430 n = 12	400 n = 21
Ref: Anderson et al. 1986		

American mink *Neovison vison* (Schreber, 1777)

The native range of American mink extends across North America from Alaska and Canada through much of the United States (except the dry southwest), where they are relatively common along densely vegetated streams and lakes as well as in swamps and marshes and along rocky coastlines (Reid et al. 2016d). They are an important

Plate F American mink (*Neovison vison*) on riverbank in the UK. © A.L. Harrington furbearer, and millions are produced annually in farms around the world (see Macdonald et al., Chapter 30, this volume). They are also well known as an invasive species in much of Eurasia, and in South America (reviewed in Macdonald and Harrington 2003; see also Fraser et al., Chapter 16, this volume, and Maran et al., Chapter 17, this volume). Ironically, even within their native range, feral escapees from fur farms are abundant (Bowman et al. 2007): in a study in southern Ontario, for example, 64% of mink trapped were of domestic origin or were hybrids (Kidd et al. 2009).

Nocturnal, solitary, and strictly carnivorous, American mink eat whatever is available—typically, muskrats, lagomorphs, small mammals, fish, crustaceans, amphibians, birds and their eggs, and even aquatic invertebrates (see Macdonald et al. 2015a). They are semiaquatic and are well adapted for hunting in water and on land (Dunstone 1993; Harrington et al. 2012b; Bagniewska et al. 2015). They occupy linear home ranges along the banks or coasts of waterways of between 1 and 9 km, larger for males (in lowland England: male mean = 3.4 km, female mean = 2.1 km) and densities in their invaded range vary between 0.2 and > 1 per km stretch of water bank (Macdonald et al. 2015a), but may be lower in their native range (Schooley et al. 2012). Home range sizes in a coastal marsh in the US were 6.91 ± 1.41 km^2 and 2.28 ± 0.89 km^2 (for males and females, respectively, Peeples et al. 2002). Mink populations in Canada exhibit periodic fluctuations that lag behind those of muskrats but with geographic variation in lag time (Shier and Boyce 2009)—mink–muskrat dynamics are not well understood, but are discussed further by Lambin (Chapter 4, this volume).

Aquatic pollution (particularly mercury and polychlorinated biphenyls, PCBs) may cause reproductive failure and high kit mortality (Aulerich and Ringer 1977)—as such, American mink have been proposed as a 'sentinel species' in environmental health (Basu et al. 2007; see also Bowman and Schulte-Hostedde 2009; Basu et al. 2009). Between the 1960s and 1990s, mink populations in some states (e.g. Georgia, North Carolina, and South Carolina) declined and virtually disappeared from some areas where previously they were abundant—mink kidney tissues from these areas had elevated mercury levels (at concentrations high enough to cause sub-lethal effects) and PCBs at levels that might cause reproductive problems (Osowski 1995). American mink have since been re-established in some areas by translocation (e.g. in South Carolina, Peeples et al. 2002) but, even in their native range, and at sites where they are a conservation priority, their management is controversial due to their predation on other species of conservation concern (Gorga 2012).

	Male range	Female range
Weight (kg)	0.6–2.0	0.38–0.96
Head/body length (mm)	305–510	300–440

Ref: data from several studies from invaded and native range sites, details in Macdonald et al. 2015a

South American Terrestrial Mustelids

Tayra *Eira barbara* (Linnaeus, 1758)

Tayra occur in tropical and subtropical forests, up to at least 2000 m, across the whole of Central America, as far north as Veracruz in Mexico (also in Trinidad), through most of South America east of the Andes (except for Uruguay and eastern Brazil), and as far south as northern Argentina. They are one of the most common medium-size predators throughout their range (Cuarón et al. 2016a). Tayra are solitary, diurnal (sometimes crepuscular, González-Maya et al. 2009) omnivores. In addition to a range of forest habitats (from tropical cloud forests to dry scrub forests), they are also found in plantations, agricultural areas, and gardens near human settlements. They are active on the ground and in the trees, and feed on fruits, carrion, small vertebrates, insects, and honey (Cuarón et al. 2016a). They are hunted for their fur in many South American countries and are killed by road traffic, but these seem to be only local or low-level threats.

	Range
Weight (kg)	2.7–7
Head/body length (mm)	559–712

Ref: Presley 2000; adult males are 30% larger than females

Grison *Galictis* spp.

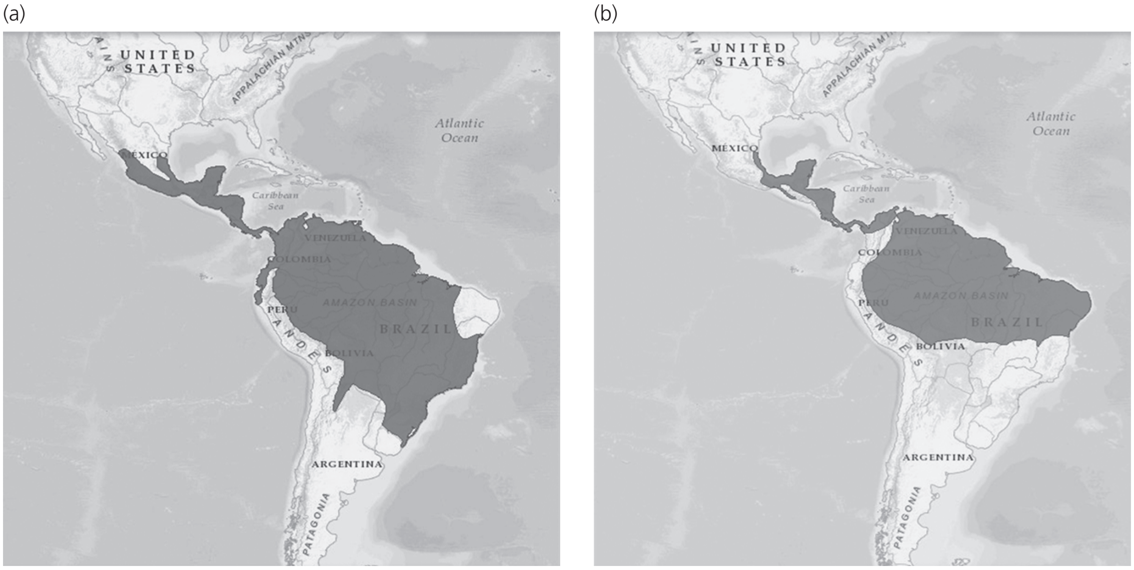
Greater grison (G. *vittata*, Schreber, 1776) live in tropical forests and savanna grasslands (often associated with rivers and streams) below 1200 m throughout Central America from eastern Mexico, east of the Andes, as far south as Bolivia, and Santa Catarina, Brazil (Cuarón et al. 2016g). P. Smith et al. (2013) also report their presence in Paraguay. Lesser grison (*Galictis cuja,* Molina, 1782) are slightly smaller and are found further south, in similar habitats, but also in mountainous regions up to 4200 m (Yensen and Tarifa 2003b). Lesser grison range from eastern Brazil and southern Bolivia, through southeastern Peru, central Chile, Paraguay, and Uruguay, as far south as Santa Cruz province, Argentina, where they occupy cold, arid Patagonian steppe habitats (Prevosti and Travaini 2005; Zapata et al. 2005; Helgen and Schiaffini 2016). Both also occur in agricultural areas.

Grison are diurnal and terrestrial (Yensen and Tarifa 2003a, b; Tellaeche et al. 2014); they are solitary and live in hollow trees, crevices, rock piles, and burrows dug by other mammals (Yensen and Tarifa 2003b). Lesser grison diet consists primarily of small and medium-sized vertebrates (and they feed heavily on introduced lagomorphs—3 kg European hare [*Lepus europaeus*] and European rabbit [*Oryctolagus cuniculus*]) but grison, generally, also eat birds and their eggs, lizards, and amphibians (e.g. Diuk-Wasser and Cassini 1998; Delibes et al. 2003; Zapata et al. 2005). Greater grison density has been estimated at 1–2.4 individuals per km^2 (Eisenberg et al. 1979). Home range, measured for a single individual of each species, was approximately 400 ha for both (Yensen and Tarifa 2003a; Luengos Vidal et al. 2016). In southern Patagonia, lesser grison are sympatric with Humboldt's hog-nosed skunks—the two species have different diets, but the presence of Humboldt hog-nosed skunk remains in lesser grison scats (Zapata et al. 2005) suggest that they occasionally come into direct contact and that lesser grison are dominant.

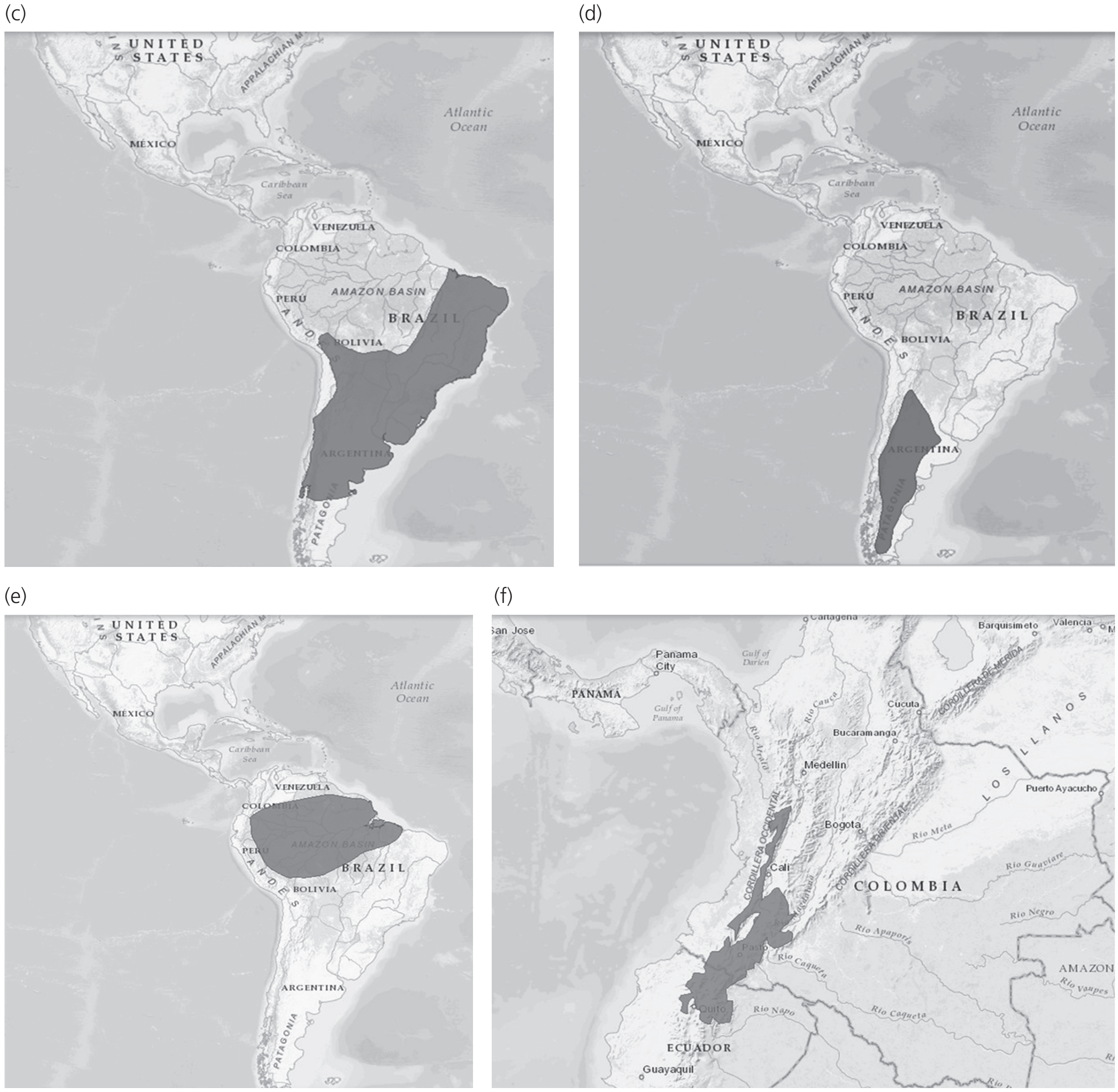
Lesser grison are valued by farmers in some areas because of their role in rodent control, and, historically, they were tamed and used to hunt chinchillas (much like modern 'ferreting' in the UK; Yensen and Tarifa 2003b). Potential (but probably low-level) threats are persecution for eating poultry (Brooks 1991), road traffic accidents (Vieira 1996), and hunting for the pet trade (Cuarón et al. 2016b; Helgen and Schiaffini 2016).

	Male mean (range)	**Female mean (range)**
Weight (kg)		
Greater grison	2.35 (1.48–3.8)[1] n = 6	
Lesser grison	2.12 (1.3–2.8) n = 15	1.03 (0.8–1.3) n = 6
Head/body length (mm)		
Greater grison	518.8 (450–600)[1] n = 19	
Lesser grison	c. 543 n = 15	c. 489 n = 6

Ref: greater grison ([1] both sexes combined), Yensen and Tarifa 2003a, b; lesser grison, females are smaller, more slender and lighter, Luengos Vidal et al. 2016



Map 15 South American terrestrial mustelids a) tayra, b) greater grison, c) lesser grison, d) Patagonian weasel, e) Amazon weasel, f) Colombian weasel © IUCN 2016



Map 15 *Continued*

Patagonian weasel *Lyncodon patagonicus* (de Blainville, 1842)

Patagonian weasels (head body length c. 250 mm, Prevosti et al. 2009) are found from sea level to 2000 m, in temperate, arid, and semi-arid areas, in Argentina and southern Chile, from the Salta province in northern Argentina to Santa Cruz province in the south, and into Chile along the southern Argentine border (Prevosti et al. 2009; Schiaffini et al. 2013a; Kelt et al. 2016). They are rarely seen (many records are more than 10 years old) and are assumed to occur at low densities. They are found in herbaceous and shrub steppes and xerophytic woodlands, and, like other 'weasels', are thought to be nocturnal or crepuscular and to prey on fossorial rodents (probably *Ctenomys* spp., tuco-tucos) and birds (Prevosti et al. 2009; Kelt et al. 2016). In the northern part of their range, they are sympatric with the larger lesser grison (skull morphology suggests both are hypercarnivorous, Schiaffini and Prevosti 2014).

There is no reason to consider the species to be under serious threat, but it is subject to habitat degradation (due to sheep grazing) and occasional killing by ranchers (Prevosti et al. 2009).

Amazon weasel *Mustela africana* (Desmarest, 1818) and Colombian weasel *Mustela felipei* (Izor and de la Torre, 1978)

Including the long-tailed weasel (a North American species that also occurs in parts of northern South America) there are three *Mustela* species in South America. The two endemic species—the Amazon and the Colombian (or Felipe's) weasels are among the least known of the musteloids. Despite their potentially misleading Latin name (*Mustela africana*), Amazon weasels (the largest of the South American weasels, c. 250 mm head/body length, Ramírez-Chaves et al. 2014) occur in humid riparian forests and in the drainages of several of the Amazon tributaries, across the northern regions of South America in Brazil, Ecuador, Peru, and northern Bolivia, and perhaps southern Colombia (Emmons and Helgen 2016a). In western Colombia and northern Ecuador they are replaced by Colombian weasels (the smallest of the three species, c. 220 mm head/body length based on measurements of total and tail length in Ramírez-Chaves and Patterson 2014), but the latter are known from only six specimens in five localities (Ramírez-Chaves et al. 2012; González-Maya et al. 2016a) and the range limits of both are somewhat unclear. Colombian weasels are known to occupy an approximately 5600 km^2 area of western Colombia and northern Ecuador (González-Maya et al. 2016a); it is suspected that the species' true distribution is larger (Burneo et al. 2009) but this has not yet been confirmed. Almost nothing is known of Colombian weasels' habitat preferences; their naked foot soles with extensive interdigital webbing have led some authors to suggest adaptation to riparian or water-edge habitats (e.g. Ramírez-Chaves and Patterson 2014) but others purport that they are more likely a forest animal (e.g. Tirira and González-Maya 2009). Specimens have been obtained from between 1525 and 2700 m, where cloud forests predominate (González-Maya et al. 2016a).

Both species are rarely seen. Colombian weasels are easily confused with long-tailed weasels (that are relatively common, and local names for the two species are the same, Ramírez-Chaves and Patterson 2014).

Because of the extensive nature of the Amazon basin, Amazon weasels are assumed not to be under any major threat (Oliviera 2009). Colombian weasels may be subject to persecution (Tirira and González-Maya 2009) and may be impacted by forest loss (which is taking place at a at a rapid rate within the species' known extent of occurrence, González-Maya et al. 2016a).

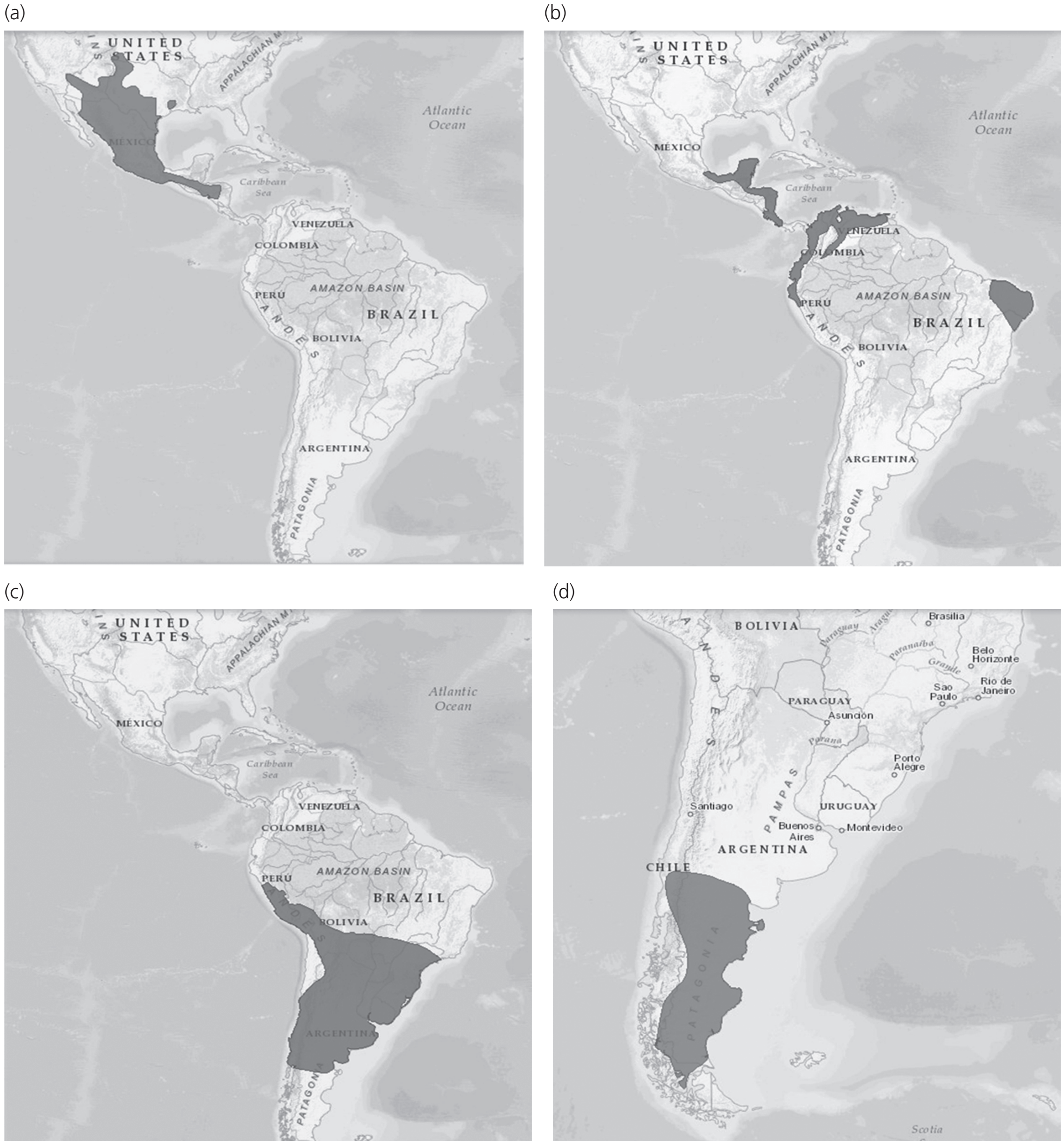
Hog-Nosed Skunks

Hog-nosed skunks are solitary, nocturnal species that feed on insects (larvae and beetles), fruit, and small vertebrates (Dragoo and Sheffield 2009; Helgen 2016). They search for their prey by digging or rooting in the ground, or forage under rocks and logs that they overturn with their claws or snout. Being adapted for digging, they resemble badgers more so than skunks and Zapata et al. (2001) describe them as 'harvesters' rather than 'hunters'. Collectively, hog-nosed skunks range from the southern US to Argentina (Dragoo et al. 2003) and they are the only mephitid genus with species in both North and South America, but little is known of these species compared with the much better known *Mephitis* and *Spilogale* spp. in North America (Kasper et al. 2009).

Here we list four species, in keeping with the IUCN Red List, but note that there is debate regarding whether or not Humboldt's and Molina's hog-nosed skunks are distinct species. Schiaffini et al. (2013b) failed to find either morphological or molecular differences between these two species and proposed that they should be considered conspecific, suggesting that any differences observed were more likely due to environmental variation. Koepfli et al. (Chapter 2, this volume) refer to three species.

American hog-nosed skunk *Conepatus leuconotus* (Lichtenstein, 1832)

American (or white-backed) hog-nosed skunks (generally considered the largest of all skunk [mephitid] species, although striped skunks are also often large, particularly in the north of their range—see Striped skunks) have the most extensive range of the *Conepatus* species, occurring from the southern United States to Nicaragua and northern Costa Rica in Central America. They are found in a variety of habitats (including woodlands, grasslands, bushy areas, and rocky canyons, Dragoo and Sheffield 2009; Helgen 2016). They den in rock crevices, hollow logs, in caves, or under buildings, and may share these dens with other sympatric skunk species, which, over much of their range, may include *Mephitis mephitis*, *M. macroura*, *Spilogale putorius*, or *S. gracilis* (see Hass and Dragoo, Chapter 24, this volume). Density in one study (in a grassland area in Mexico) was measured as 0.6 individuals per km^2 in the wet season and 1.3 individuals per km^2 in the dry season (Cervantes et al. 2002). In west-central Texas where density was considerably higher (2.6 skunks per



Map 16 Hog-nosed skunks a) American hog-nosed skunk, b) striped hog-nosed skunk, c) Molina's hog-nosed skunk, d) Humboldt's hog-nosed skunk © IUCN 2016

km^2), home ranges were 1.9 km^2 for males (n = 5) and 0.64 km^2 for females (n = 9, Brashear et al. 2015).

American hog-nosed skunks are believed to be experiencing range-wide decline in the United States (Meaney et al. 2006) and have disappeared from a number of states in the north of their range (Helgen 2016), which may be due to loss of habitat to agriculture, declining prey due to the use of agricultural pesticides, or competition with feral hogs (Helgen 2016; Dragoo and Sheffield 2009).

	Male range	Female range
Weight (kg)	2–4	
Head/body length (mm)	c. 257–524 n = 123	c. 330–400 n = 88
Refs: Dragoo and Sheffield 2009; males c. 10% larger		

Striped hog-nosed skunk *Conepatus semistriatus* (Boddaert, 1785)

Striped (or Amazonian) hog-nosed skunks are a neotropical species, locally common in suitable habitats but with a disjunct distribution (Cuarón et al. 2016b) such that they occur in southern Mexico, through Central America to northern (but not southern) Panama, in the llanos of Colombia, east across northern Venezuela, along the western Andes and as far south as northern Peru, and with a third isolated population segment in eastern Brazil. Recent records from central Panama may represent a single wandering individual, but might provide evidence of a connection between the Central and South American populations (Esser et al. 2012). Home ranges of three individuals in Brazil were measured as 1.4 km^2 (Cavalcanti et al. 2014).

Striped hog-nosed skunks occur along the edges and in the gaps of evergreen forest, in transitional regions between the Cerrado and the Atlantic Forest where there are open vegetation areas (Kasper et al. 2009) and in some human-modified environments (e.g. agroforestry, clearings adjacent to agricultural land, coffee plantations), but may be restricted to higher elevation habitats (mostly deciduous woodlands) during the wet season (Sunquist et al. 1989). Diet is broad and opportunistic and includes insects, lizards, and birds (and perhaps rodents and toads [*Bufo* spp.] in some regions, Kasper et al. 2009). A study in Emas National Park (Cavalcanti et al. 2014) revealed frequent use of the areas around the administrative headquarters where individuals were regularly seen consuming avocado and mulberry (two invasive species common in intensively used areas).

Striped hog-nosed skunks were likely historically isolated from Molina's hog-nosed skunk by the Atlantic Forest, although there are uncertainties regarding the extent of geographical and reproductive isolation between the two species—and the distributional limits of both in Brazil, Bolivia, and Paraguay are unclear. Striped hog-nosed skunks occur in sympatry with crab-eating fox and maned wolf but there is no evidence of intraguild predation between skunks and canids, and skunks are occasionally seen chasing canids away (Kasper et al. 2009). Potential threats are road traffic accidents and hunting for their skins, but the population-level impacts of either are unknown or thought to be minor (Kasper et al. 2009; Cuarón et al. 2016b).

Molina's hog-nosed skunk *Conepatus chinga* (Molina, 1782) and Humboldt's hog-nosed skunk Conepatus humboldtii (Gray, 1837) **both may be conspecific as C. chinga*

Molina's (or Andean) and Humboldt's (or Patagonian) hog-nosed skunk are confined to South America. Molina's hog-nosed skunks have a wide distribution from southern Peru, across southern Bolivia reaching as far south as northern Argentina and central Chile, a region where extensive habitat remains intact (Emmons et al. 2016). Further south, Humboldt's hog-nosed skunks occur in the Patagonian grasslands of southern Argentina and adjacent parts of Chile (Emmons and Helgen 2016b), but, unlike between striped and Molina's hog-nosed skunks, there are no apparent ecological barriers between these two species (Kasper et al. 2009). Both species are locally common. In Pampas grassland in Argentina and Brazil, Molina's hog-nosed skunk are among the most common of the carnivores (Kasper et al. 2009); densities range from 0.68 to 3.8 individuals per km² (Castillo et al. 2011a; Kasper et al. 2012b; similar to densities estimated for other mephitids in North America).

Both species forage for beetles and lizards under bushes and clumps of grass, in open-vegetation grassland habitats—predominantly steppe but also canyon meadows (Donadio et al. 2001). They eat mostly invertebrates (which, for Molina's hog-nosed skunk, comprised 74–85% of food items in one study, Donadio et al. 2004). They favour Coleoptera larvae, but also eat wasps, grasshoppers, scorpions and spiders, earthworms, vertebrates (lizards, rodents, birds, and eggs), some berries and carrion. In southeastern Brazil, Kasper et al. (2009) reports individual Molina's hog-nosed skunks feeding on fish, amphibians, and eggs of freshwater turtles and ground-nesting birds. Humboldt's hog-nosed skunks were observed to eat more vertebrates in winter when invertebrates were scarce (Zapata et al. 2001). Both species live near urban areas (Kasper et al. 2012a). Humboldt's hog-nosed skunk was found around human dwellings at rubbish sites or in vegetable gardens most often in winter, when they seemed to shift habitat use from open grassland in summer, to shrub, forest and suburban areas in winter

(Fuller et al. 1987). Home range sizes of Molina's hog-nosed skunks differ between the sexes and vary among areas but are approximately 240–250 ha for males and 100–120 ha for females (Castillo et al. 2011a; Kasper et al. 2012b), they occur in sympatry with crab-eating fox and Pampas fox but do not appear to avoid them (Kasper et al. 2009).

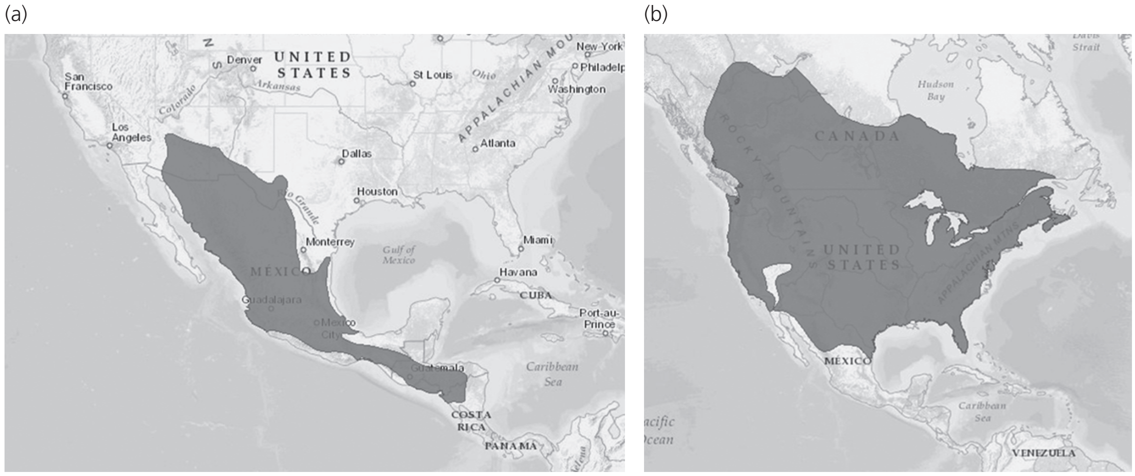
Potential threats are habitat loss to agriculture and livestock grazing (although Molina's hog-nosed skunks appear to thrive in fragmented habitats, Kasper et al. 2012a), and road traffic accidents (especially given the increasing number of roads in the Pampas region; Peters et al. 2011; see also Castillo et al. 2011b, 2012).

	Male mean (SD)	Female mean (SD)
Weight (kg)	2.32 (0.3) n = 7	1.62 (0.4) n = 11
Head/body length (mm)	430 (26.5) n = 7	401 (28.9) n = 11
Ref: Kasper et al. 2012a		

Hooded and striped skunks

Hooded skunk *Mephitis macroura* (Lichtenstein, 1832)

Hooded skunks range from the southern United States (southern Texas, New Mexico, and Arizona) through Mexico and Central America, as far south as Costa Rica (Cuarón et al. 2016c). They are common in Costa Rica and abundant in Mexico and Arizona but there are no recent records from Texas. Hooded skunks are most common in the arid lowlands but also occur in deciduous or ponderosa forest, forest edge, pastures, rocky canyons, and riparian habitats, from sea level to > 2000 m, where they consume mostly insects (e.g. Coleopteran beetles and grasshoppers), some fruit, and occasionally (and opportunistically) small mammals, and birds' eggs (Hwang and Larivière 2001; Cuarón et al. 2016c and references therein). In the Huachuca mountains in southeast Arizona, Hass (2003) found insects in 90% of 49 scats, fruits in 67%, reptiles in 10% and mammals in 8%. Densities in Oaxaca, Mexico, were between 0 and 9 individuals per km^2 (Cervantes et al. 2002) and in Arizona were estimated at between 1.3 and 3.9 per km^2 (Hass 2003). Hooded skunks seem to benefit from human-disturbed areas and can be abundant in human-altered habitats such as cultivated fields, pastures, and suburban areas (Hwang and Larivière 2001). Like striped skunks, they den in dirt holes, crevices in rocks, holes in logs, and sometimes under buildings, piles of debris or in thick clumps of vines or shrub branches (Hass 2003). There appear to be few estimates of home range size for this species but denning ranges (the area encompassing all of the dens used by an individual), in Arizona, were approximately 3 and 5 km^2 for females and males, respectively (Hass 2003). In parts of the southern United States, hooded skunks are sympatric with striped skunks and diet overlap may be high (70% in Hass [2003]'s study)—but competition between the two appears to be minimal (see Hass and Dragoo, Chapter 24, this volume).



Map 17 a) hooded skunk, b) striped skunk © IUCN 2016

	Male mean (range)	Female mean (range)
Weight (kg)	1.06 (0.6–1.6) n = 22	0.77 (0.6–0.9) n = 15
Head/body length (mm)	c. 375 (330–420) n = 37	646 (628–678) n = 4

Ref: data shown are for animals from Arizona, Hass 2003 (head/body length based on total length and body:tail ratio, and no difference between the sexes); maximum species body weight is 2.7 kg, and animals in Central America appear to be smaller than those from the southern United States (Hwang and Larivière 2001).

Striped skunk *Mephitis mephitis* (Schreber, 1776)

Striped skunks may be one of the most common carnivores in North America. They are widely distributed in a variety of habitats (woods, plains, deserts, and agricultural, suburban, and urban areas) throughout most of southern Canada, the United States, and into northern Mexico (Helgen and Reid 2016c), where their generalist nature has allowed them to adapt to (and thrive in) modern fragmented landscapes (Kuehl and Clark 2002). In most areas, they feed extensively on insects (grasshoppers and beetles) associated with grasslands, but when insects are not available they eat small mammals, ground-nesting birds and their eggs, fruit (windfall apples, blueberries, black cherries, and ground cherries), or other vegetation (such as corn crops, Wade-Smith and Verts 1982; see also Hass 2003). In agricultural areas, they prefer to forage along field edges, in surrounding grasslands and wetlands. They are capable of digging their own dens but usually use underground dens dug by other large semi-fossorial species, or above-ground shelters (Wade-Smith and Verts 1982), and they commonly seek den sites in farmyards (Larivière and Messier 1998a). In the urban environment of Bakersfield, California, striped skunks were aggressive to endangered San Joaquin kit foxes at feeding sites, but 30% of 130 den sites were occupied by both species (S.W.R. Harrison et al. 2011). Densities are highly variable, usually between approximately 2 and 7 individuals per km^2, but may be up to 36 per km^2, or as low as 0.1 per km^2 (reviewed in Rosatte et al. 2010). Home ranges in the Great Smoky Mountain National Park in Tennessee were approximately 1 km^2 (range 0.3–1.4 km^2 for females and 0.6–2.7 km^2 for males, Bixler and Gittleman 2000).

Striped skunks are one of the most important terrestrial reservoirs of rabies virus in North America, but the disease in this species has been largely unmanaged and oral vaccination campaigns inefficiently targeted (Raghavan et al. 2016). Overall, their population is considered stable (Helgen and Reid 2016c), but they have increased locally in many regions during recent years.

	Male range	Female range
Weight (kg)		
– Tenessee	1.4–2.5 n = 9	1.2–2.6 n = 6
– Minnesota	1.75–5.20 n = 21	1.35–3.50 n = 26
Head/body length (mm)		
– Minnesota	c. 401–460 n = 35	c. 400–425 n = 31

Ref: Tennessee, Bixler and Gittleman 2000; Minnesota, Fuller et al. 1985; body weight increases with latitude, maximum body weight of 6 kg or more recorded for males in Canada (Schowalter and Gunson 1982), maximum body weight (n = 38) recorded by Hass 2003 in Arizona was a 2.4 kg female.

Stink Badgers **actually skunks not 'badgers'*

Indonesian stink badger *Mydaus javanensis* (Desmarest, 1820)

Indonesian (or Sunda) stink badgers (also known as Malay badgers) occur on Sumatra, Borneo, Java, and the Natuna Islands in Indonesia. On Borneo, they are frequently captured in camera-trap surveys between the lowlands and up to 2000 m, where they occur in a wide range of habitat types including primary and secondary forest and open areas (e.g. gardens adjacent to forest), as well as disturbed areas and palm oil plantations (Wilting et al. 2015a; see also Ross et al., Chapter 14, this volume). They are nocturnal (Ross et al., Chapter 14, this volume) and apparently solitary, spending the day in dens in hollow logs or burrows dug by porcupines. Like hog-nosed skunks, stink badgers use their snouts to root in the soil for worms and insects, and dig into soft soil using their long claws; they also eat birds' eggs, carrion, and plants (Hwang and Larivière 2003). They can cause damage in plantations by digging up seedlings. In some areas they are eaten by people but the lack of commercial demand, in addition to the persistence of the species in many areas close to human habitation, suggest that hunting is not a threat (Wilting et al. 2015a).

	range
Weight (kg)	1.4–3.6
Head/Body length (mm)	375–510

Ref: Hwang and Larivière 2003

Map 18 Indonesian and Palawan stink badgers © Y. Zhou

Palawan stink badger *Mydaus marchei* (Huet, 1887)

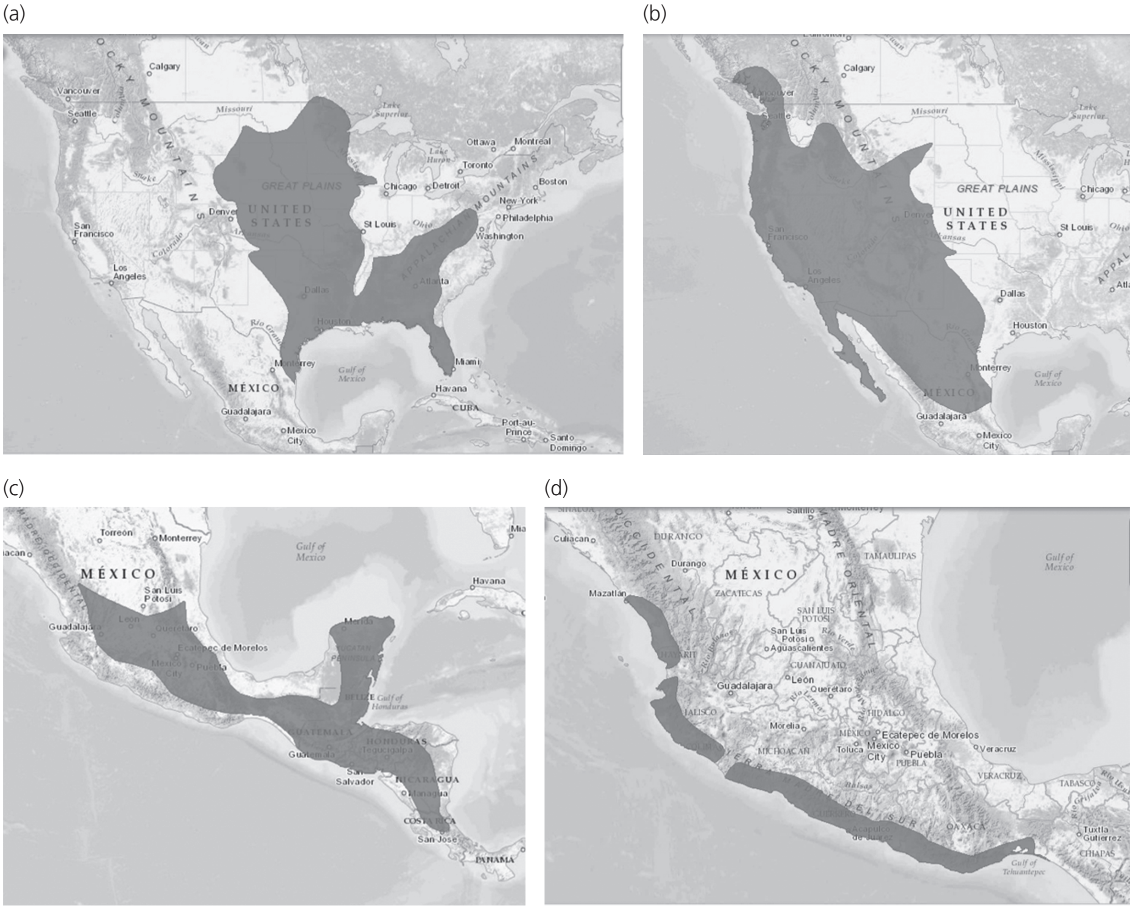
Palawan stink badgers (known locally as pantots) are endemic to the Palawan island group, situated between Borneo and the Philippines (Widmann and Widmann 2004), where they occur up to at least 300 m (their occurrence at higher elevations has not been assessed) on Palawan Island, Busuang, and Calauit, but not on the smaller outlying coral islands (Widmann 2015). They are reportedly common in forest, secondary growth, and low-intensity agricultural areas in the lowlands (Widmann and Widmann 2004), where they forage in damp soil along streams and in rice paddies (usually where these are close to shrub areas), for worms, insects (e.g. mole crickets [*Grillotalpa* spp.] and beetles), and small freshwater crabs (Kruuk 2000; Hwang and Larivière 2004). They dig their own dens and like honey badgers can dig a temporary resting site rapidly—Kruuk (2000) observed one individual digging a den in a dam between two paddy fields deep enough to be out of sight in less than five minutes. Like Indonesian stink badgers, Palawan stink badgers appear to be tolerant of deforestation and human presence (Widmann 2015). Indeed, Kruuk (2000) suggests that they have benefited from expanding rice cultures in the same way that European badgers have benefitted from man-made pastures in western Europe.

Spotted skunks

Spotted skunks are not truly spotted but have a series of broken strips running down their back and sides (dragoo.org). They are quicker, more alert, and more agile than other North American skunks (Kinlaw 1995). They are nocturnal, mainly terrestrial, and omnivorous—feeding on insects, small mammals, fruit, birds and birds' eggs, seeds, and sometimes carrion (rabbits, chickens, and pheasants, Cuarón et al. 2016d; Gompper and Jachowski 2016; Helgen et al. 2016a, f; Medellín et al. 1998; Verts et al. 2001). They den in logs or hollow trees, wood piles, straw piles, hen houses, barns, in the burrows of other species (e.g. rodents), or under dense vegetation (Medellín et al. 1998).

Eastern spotted skunk *Spilogale putorius* (Linnaeus, 1758)

Ranging across the eastern United States from the Canadian border to Mexico, eastern spotted skunks were once common (and harvested for their pelts in many regions), but are now declining across their range, and are considered rare or even absent from some states where they once occurred (e.g. Minnesota and Iowa; Gompper and Hackett 2005; Gompper and Jachowski 2016; see Gompper, Chapter 25, this volume). Gompper and Hackett (2005) estimate that numbers have declined by over 90% since the 1950s. The cause of the decline is not well understood, but Gompper and Jachowski (2016) suggest that several factors probably acted simultaneously and may have included overharvest, wide-scale use of pesticides, landscape changes associated with agricultural or forestry practices, and recovery of larger predators (spotted skunks are vulnerable to predation where there is no cover, Lesmeister et al. 2010) or disease



Map 19 Spotted skunks—a) eastern, b) western, c) southern, d) pygmy © IUCN 2016

(see Gompper, Chapter 25, this volume).There are few estimates of population density but one early study in an agricultural area in Iowa reported a density of between 8.8 and 20 individuals per km^2 (depending on the method of calculation, Crabb 1948) and Kinlaw et al. (1995) estimated density of skunks on Canaveral National Seashore in Florida to be 40 skunks per km^2. Male home ranges in the Ouachita Mountains in western Arkansas were between 76 and 175 ha in the non-mating season, and female home ranges between 54 and 135 ha (Lesmeister et al. 2009).

Three subspecies of Eastern spotted skunk are recognized (Gompper, Chapter 25, this volume). Two (the midwestern *S. p. interrupta* and Appalachian *S. p. putorius*) prefer forested habitats with dense understorey and overhead cover—the Appalachian eastern spotted skunk is seen most often at high elevations—and the Florida subspecies (*S. p. abarvalis*) is often encountered in and near human habitation (Gompper and Hackett 2005).

	Male mean (SD)	Female mean (SD)
Weight (g)	399 (112) n = 94	283 (39) n = 38

Ref: body weights are from animals in Florida, Kinlaw 1995; individuals in the south are smaller (total length, both sexes: 311–421 mm) than those in the north (453–610 mm)

Western spotted skunk *Spilogale gracilis* (Merriam, 1890)

Western spotted skunks range along the west coast of North America from British Columbia to the Baja California peninsula and Mexico (Cuarón et al. 2016d). They occur in a variety of habitats from open lowlands to mountainous areas, streams, rocky riparian

Plate G Eastern spotted skunk (*Spilogale putorius*). © D. Lesmeister

areas, beaches, farmland, and other disturbed areas, at elevations up to 2500 m (Verts et al. 2001; Cuarón et al. 2016d). Over much of their range they are sympatric with striped skunks and there is some evidence that they avoid striped skunks by being active mostly after midnight, whereas striped skunks tend to be active earlier in the night (Neiswenter et al. 2010). An endemic subspecies of the western spotted skunk (*S. g. amphiala*) occurs on the Californian Channel Islands (Santa Cruz and Santa Rosa Islands), where they coexist with the (also endemic) island fox (*Urocyon littoralis*), apparently facilitated by subtle differences in use of space, activity, and diet (Crooks and Van Vuren 1995).

One early study reported home ranges of 64.8 ha and densities of 2.2 individuals per km^2 in farmland in Iowa (Crabb 1948). Home ranges of island skunks were 29.6 ha in the wet season and 61.1 ha in the dry season (Crooks and Van Vuren 1995). There are no data on mainland population sizes but, as of 2011, there were an estimated 3000 island spotted skunks on Santa Rosa Island (www.nps.gov). Potential threats are road traffic accidents and pesticides (Cuarón et al. 2016d).

	Male mean (range)	**Female mean (range)**
Weight (kg)		
– Texas	(336–734)	(227–482)
– Santa Cruz Island		
*Dry season	600 n = 79	401 n = 28
*Wet season	540 n = 14	429 n = 6
Head/body length (mm)		
– Texas	c. 260 n = 14	c.230 n = 8

Ref: Texas, Verts et al. 2001; Santa Cruz Island, Jones et al. 2008

Southern spotted skunk *Spilogale angustifrons* (Howell, 1902)

Southern spotted skunks range from central Mexico, south through much of Central America, to central Costa Rica, where they are ‘uncommon but widespread’ in farmland, open wood and brush, and dry, rocky areas, from the lowlands to 3000 m (Helgen et al. 2016f). Originally considered a subspecies of the eastern spotted skunk (*S. p. tropicalis*), there is little published information on this southern species, but they are thought to be adaptable to human disturbances.

Pygmy spotted skunk *Spilogale pygmaea* (Thomas, 1898)

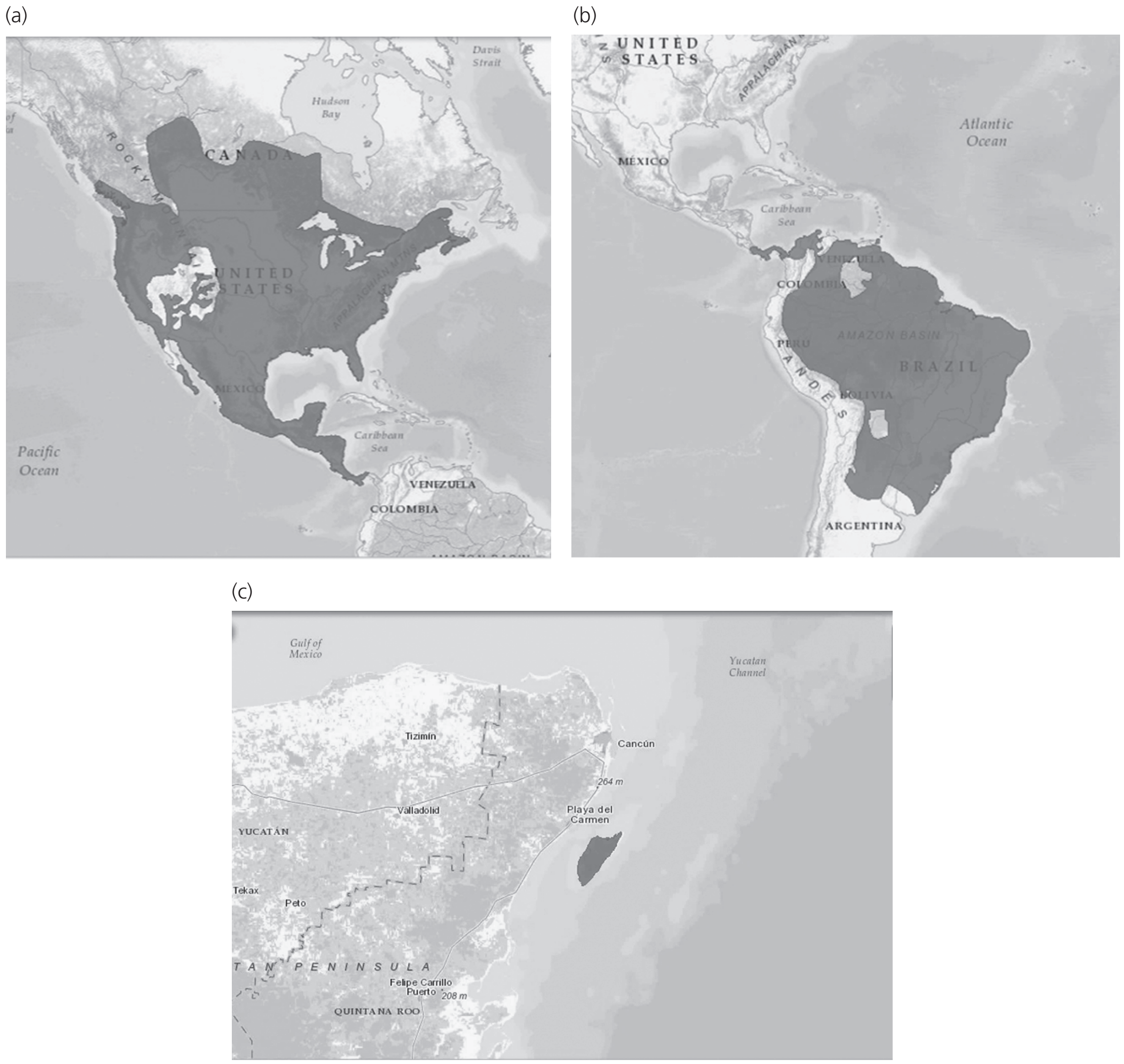
Pygmy spotted skunks are endemic to the tropical Pacific coast of Mexico but occur in very few localities and appear to be restricted to dry coastal forests (Cantú-Salazar et al. 2009) in an area where tourist developments are expanding rapidly (Helgen et al. 2016a). Although they have been recorded up to 1630 m, they are most common below 350 m (Helgen et al. 2016a). They occupy home ranges of about 20 ha (Cantú-Salazar et al. 2009). In human-occupied areas they are killed by domestic cats and dogs (Helgen et al. 2016a).

	Male **mean (range)**	**Female** **mean (range)**
Weight (g)	186 (145–230) n = 27	156 (130–173) n = 13
Head/body length (mm)	c. 200 n = 27	c. 185 n = 13
Ref: Cantú-Salazar et al. 2009		

Raccoons

Common raccoon *Procyon lotor* (Linnaeus, 1758)

Common (or northern) raccoons, with their characteristic facial mask, are probably the most widely known (and readily recognized) of the musteloids, and the many issues that they raise are discussed elsewhere in this book: urban populations (p. 6), wildlife management (Gehrt 2004; Harrington et al., Chapter 7), exploitation (Zeveloff, Chapter 27, this volume), and invasive species (p. 8). Their superior



Map 20 Raccoons—a) common, b) crab-eating, c) pygmy © IUCN 2016

dexterity is referred to in Kitchener et al. (Chapter 4, this volume); indeed, the name 'raccoon' comes from the Algonquin word arakun, which means 'he who scratches with his hands'. They are a North and Central American species, occurring from the Canadian prairies southwards across the United States of America (except for parts of the Rocky Mountains and the deserts) through Central America down to northern Panama (although the precise southern limit of their range is not clear, Timm et al. 2016). They have been introduced to Russia, Germany, Spain, and Japan (Ikeda et al. 2004; Frantz et al. 2005). They are extremely adaptable and are generally common wherever they occur. They are often associated with habitats near water (along streams and shorelines), such as hardwood swamps, mangrove forests, and marshes, but are also found in human-modified environments, both agricultural and urban (Lotze and Anderson 1979; Hadidan et al. 2010; Timms et al. 2016). Raccoon densities at rural sites range between one and 28 individuals per km^2 (Gehrt 2004). They are typically solitary, but socially tolerant at artificial food sources such as rubbish bins in urban parks (Hadidian et al. 2010), where densities of > 200 raccoons per km^2 have been recorded (Smith and Engeman 2002). Raccoons den under logs or rocks, in hollow trees, and in burrows—they do not hibernate in winter, but may stay in insulated dens for extended periods during exceptionally cold weather, relying on fat reserves accumulated through the autumn (Lotze and Anderson 1979). They eat a range of plant and animal food, including berries, nuts, crayfish, crabs, insects, waterfowl and other ground-nesting birds, turtles and their eggs, muskrats, and corn crops (Lotze and Anderson 1979 and references therein; Harrington et al., Chapter 7, this volume). Raccoons foraging for clams in an intertidal zone in British Columbia, Canada, appeared to select larger clams (more profitable), of species with less shell mass (easier to get into), to maximize energetic profit (Simmons et al. 2014). A raccoon foraging in this manner in the intertidal zone at low tide is estimated to be able to obtain up to 8.4% of their daily metabolic requirements in 10 minutes.

Common raccoons are one of the few musteloid species whose populations currently increasing at a range-wide level, and, although there are local or regional threats (trapping, poisoning, road traffic accidents), there are no threats to the population as a whole (Timm et al. 2016).

	Male mean	Female mean
Weight (kg)		
– Missouri	6.76 n = 5371	5.94 n = 2809
– Illinois	7.0–8.3 n = 2115	5.1–7.1 n = 2809
– S Florida	2.4	2.0
– S Texas	9.0	6.7

Ref: Missouri, Lotze and Anderson 1979; others, Gehrt 2003; raccoons can be larger in the north (e.g. up to 12 kg in Minnesota, Mech et al. 1968) and have been recorded at over 20 kg (Zeveloff 2002).

Crab-eating raccoon *Procyon cancrivorus* (Cuvier, 1798)

Crab-eating raccoons are a coastal or riverbank species residing on Trinidad, possibly some other Caribbean islands, and the mainland of Central and South America from Costa Rica to northern Argentina (Reid et al. 2016b), including the Colombian Amazon (where their presence has recently been confirmed, Noguero-Urbano and Ramírez-Chaves 2015). They are sometimes seen in llanos, evergreen forest, and in Andean forests, but rarely deep in the rainforest. Smaller and sleeker (but with the same 'bandit' face-mask and striped, bushy tail), they are easily confused with the better known common raccoon, with which they are sympatric in Central America, although they are not as well adapted to human activity as the common raccoon is (Reid et al. 2016b).

Crab-eating raccoons presumably got their name from being seen eating crabs and other crustaceans on riverbanks and seashores—but all raccoon species are well adapted to consuming hard-shelled prey (Kitchener et al., Chapter 3, this volume), and all eat a variety of prey. Several studies have shown, for example, large proportions of fruit in their diet (> 60% FO queen [or cocos] palm [*Syagrus romanzoffiana*], Aguiar et al. 2011; Quintela et al. 2014; 80% FO seashore palm [*Allagoptera arenaria*], Gatti et al. 2006; 44% FO 'wild banana' [*Bromelia antiacantha*], Quintela et al. 2014), as well as insects and small vertebrates (mostly small rodents, Quintela et al. 2014). In a study in Brazil, they ate more birds, rodents, and other small mammals in winter and spring, which may reflect increasing need for protein, associated with reduced ambient temperatures and production of cubs (Pellanda et al. 2010—as has been proposed for fruit-eating martens, Zhou et al. 2011a).

Using camera-trap capture rates, Arispe et al. (2008) estimated density in a dry forest in Bolivia to be between 19 and 40 individuals per 100 km^2, and, generally, crab-eating raccoons are considered to be naturally rare (Reid et al. 2016b). Potential threats are hunting for pelts, the pet trade, and coastal development (Reid et al. 2016b).

Pygmy raccoon *Procyon pygmaeus* (Merriam, 1901)

Pygmy (or Cozumel) raccoons are found only on the Mexican island of Cozumel (486 km^2) in the Caribbean; they are considered a true dwarf (at approximately half the weight of common raccoons), and recognized as a distinct species (McFadden and Meiri 2013; Cuarón et al. 2016e). Like other raccoons, they are nocturnal, solitary, opportunistic generalists—but it is not uncommon to see them during the day, and they are sometimes seen in temporary aggregations at 'share-able' (usually human-related) food sources (de Villa-Meza et al. 2011). They prefer mangrove forests, coastal wetlands, and sandy areas, but are also found in forests and agricultural areas, and (like their northern cousin) are often found near human settlements and roads (Cuarón et al. 2004). They prefer crabs (which constitute over 50% of their diet), but also eat fruit, insects, crayfish, and small vertebrates (McFadden et al. 2006; de Villa-Meza et al. 2011). Density varies between 12.4 and 112 individuals per km^2, and total population size is estimated to be between about 200 and 570 mature individuals, but numbers are rapidly declining due predominantly to recent and ongoing human encroachment (development and road building associated with urban growth and an increasing tourism industry)—an effect that is accentuated by the fact that both raccoons and development are concentrated in coastal areas (Cuarón et al. 2016e). Hurricanes (apparently increasing in frequency, magnitude, and duration, Goldenberg et al. 2001) can reduce numbers at a site by up to 60%, which can have devastating effects on an already severely depressed population, and it is increasingly difficult for the species to recover following these natural disasters (de Villa-Meza et al. 2011; Cuarón et al. 2016e). They are also vulnerable to introduced pathogens and diseases (e.g. mange, rabies, and canine distemper) from common raccoons brought to the island as pets and other domestic animals, and may be killed by introduced boa constrictors and feral dogs (Cuarón et al. 2004).

	Male mean (SD)	Female mean (SD)
Weight (kg)	3.68 (0.52) n = 20	3.28 (0.18) n = 12
Head/body length (mm)	512 n = 20	514 n = 12
Ref: McFadden and Meiri 2013		

Coatis

White-nosed coati *Nasua narica* (Linnaeus, 1766)

White-nosed coatis (or coatimundis) have a wide distribution that extends from Arizona through Central America to Panama, and as far south as Colombia, Ecuador, and northern Peru, west of the Andes (Gompper 1995; Cuarón et al. 2016f). Reported densities from neotropical sites, where they are one of the most numerous carnivores, range from 15 to 33 individuals per km^2 (and even higher on Barro Colorado Island, Panama, where densities reach an estimated 55.6 individuals per km^2, Gompper 1997—perhaps due to the absence of either [or both] large predators and human hunting). In contrast, white-nosed coatis in the United States are relatively rare (Cuarón et al. 2016f) and densities may be as low as 1–2 individuals per km^2 (Gompper 1995). Home range estimates vary and appear to be smaller in the south of their range than in the north: average 0.4 km^2 on Barro Colorado Island, Panama (n = 6 bands, Gompper 1997), 3.8 km^2 in southern Mexico (n = 17, Valenzuela and Ceballos 2000) and 13.6 km^2 for female groups (n = 9), and 6.1 km^2 for solitary males (n = 7), in Arizona (Hass 2002b).

White-nosed coatis are adaptable omnivores that forage on the ground and in the forest canopy (mostly during the day) for fruit and invertebrates, although vertebrates make up a significant proportion of their diet in some regions (Gompper 1995; Valenzuela 1998). They are found in woodland habitats, often at high (up to *c.*2800 m) elevation—they are rarely seen in open grassland or desert. They exhibit an unusual social system among carnivores in that females and juveniles form large stable groups ('bands' of up to 30 or more individuals, typically 12–15), while males (outside the breeding season) are solitary from the age of 2–3 years (Gompper 1997; Hirsch and Gompper, Chapter 28, this volume). In the southern parts of their range, white-nosed coatis compete with white-faced monkeys (*Cebus capucinus*) for fruit—coatis are sometimes harassed and chased from trees by monkeys, but will remain under a tree where monkeys

Map 21 Coatis—a) white-nosed coati, b) South American coati, c) western mountain coati, d) eastern mountain coati © IUCN 2016

are eating, and feed on the dropped fruit (Gompper 1995). Habitat loss and hunting for skins or for food are a potential threat (Cuarón et al. 2016f).

	Male mean (range)	**Female mean (range)**
Weight (kg)		
– Mexico	5.4 n = 24	4.2 n = 42
– Panama	5.1 (3.7–6.8) n = 51	3.7 (3.1–4.8) n = 37
Head/body length (mm)		
– Panama	*c.*608 n = 51	*c.*570 n = 32
– Cozumel Island	*c.*437 n = 3	*c.*416 n = 4

Ref: Mexico, Valenzuela 1998; Panama, Gompper 1996; Cozumel Island, Gompper 1995; note that individuals on Cozumel Island are slightly smaller than mainland individuals, and may warrant designation as a separate species (see Gompper and Hirsch, Chapter 28, this volume) but are currently considered to be a sub-species *N. n. nelsoni* (or dwarf coati).

Ring-tailed coati *Nasua nasua* (Linnaeus, 1766)

Ring-tailed (South American, or brown-nosed) coatis are common (and are the most numerous carnivore in most of the places they occur); they are found in all South American countries except Chile, although they were introduced (accidently, due to the escape of two pregnant females) to Robinson Crusoe island, one of the Juan Fernández Islands off Chile, where the population in 1972 was estimated to number 4000 (Gompper and Decker 1998; Emmons and Helgen 2016c). Population densities are variable, ranging from 6.2 individuals per km^2 (in a low-lying deciduous forest) to 13 individuals per km^2 (in a taller gallery forest, Gompper and Decker 1998). Home range size in a tropical Atlantic forest, in Brazil, was measured as approximately 5 km^2 (Beisiegel and Mantovani 2006).

Like white-nosed coatis, ring-tailed coatis are omnivorous forest dwellers, found over a wide range of

Plate H Young ring-tailed coati *Nasua nasua*. © B. Hirsch

elevations (up to 2500 m in the Andes) with a social system in which females and juveniles occur in groups and males are solitary (Emmons and Helgen 2016c). They eat predominantly invertebrates (mostly millipedes and spiders) and fruit (which is particularly important when it is dry and invertebrate prey are scarce, Alves-Costa et al. 2004). They eat tarantulas after rolling them to remove urticating setae (irritating hairs), but may avoid other invertebrates (e.g. ants and termites) that emit noxious fluids or odours. South American coatis are an important predator of Paraguayan caiman (*Caiman yacare*, Gompper and Decker 1998). They are also an important seed disperser: in an Atlantic forest fragment in southeast Brazil, coatis were observed to ingest and defecate intact seeds of 49 plants species (Alves-Costa et al. 2004), which Alves-Costa and Eterovick (2007) suggest may promote gene flow among forest patches and facilitate the regeneration of disturbed sites.

Like white-nosed coatis, they are hunted for their meat by local people (Emmons and Helgen 2016c)—and are often kept as pets by local people, although the impact of this activity on wild populations is not known (Brooks 1993).

	Male mean (range)	**Female mean (range)**
Weight (kg)		
– Suriname	3.86 n = 4	3 n = 1
– Bolivia	4.6 (1.5–6.5) n = 12	4.1 (2.7–5.0) n = 13
Head/body length (mm)		
– Suriname	532 n = 4	525 n = 1
– Brazil	640 n = 7	531 n = 3
Ref: Gompper and Decker 1998		

Mountain coatis *Nasuella* spp. (Gray, 1865)

Mountain coatis live at high elevations (> 1800 m) in the cloud forests and páramo (tropical montane vegetation above the continuous treeline) of the Andes, in Colombia and Ecuador (the western mountain coati, *N. olivacea*), and Venezuela (the eastern mountain coati, *N. meridensis*, González-Maya and Arias-Alzate 2016; González-Maya et al. 2016b; Helgen et al. 2009, known only from five localities within an area of 770 km^2). They are the only procyonids to occur at such high elevations.

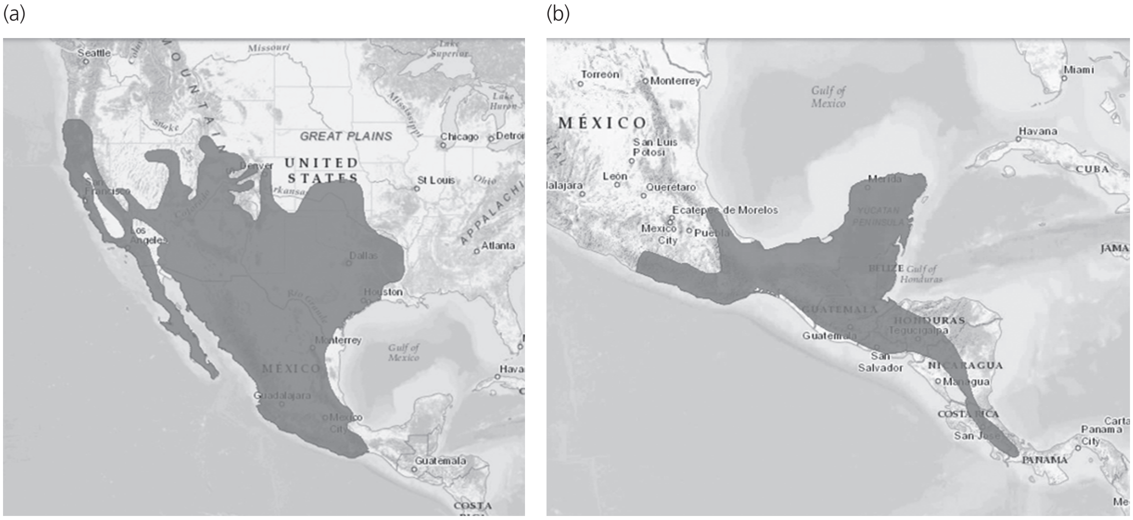
Population sizes are unknown but they are believed to be uncommon. Little is known of their biology or ecology—indeed, Helgen et al. (2009) suggest that they are the least studied procyonid and perhaps the least studied carnivore genus globally (although Koepfli et al. [Chapter 2, this volume] suggests that they should be reclassified in the genus *Nasua*, which are relatively well studied). Mountain coatis appear to be specialist consumers of small soil and subsoil animals, that dig in the ground looking for insects, and feed predominantly on arthropods (that are abundant in the humid soils of the Andes), but also vertebrates (frogs) and fruit (which is generally less available in the mountains, Rodríguez-Bolaños et al. 2000; Belaguera-Reina et al. 2009). They, thus, have a narrower trophic niche than that of other coati species that live in warmer areas, and they exhibit morphological adaptations for digging; for example, they have a more elongated snout and sharper claws. Most female 'groups' seem to consist of 6–8 individuals but up to 80 have been observed (Belaguera-Reina et al. 2009). In some areas, mountain coatis are sympatric with *Nasua nasua*.

Over the last 20 years, an estimated 20% of suitable habitat for western mountain coatis has been converted to other land uses (crops or cattle-grazing) or degraded (González-Maya and Arias-Alzate 2016), although the fact that they are still found in forest fragments surrounding a number of cities in Colombia suggests that they are tolerant to some level of habitat fragmentation.

Ringtails And Cacomistles

Ringtail *Bassariscus astutus* (Lichtenstein, 1830)

Ringtails (the smallest of the procyonids, Harrison 2012) are one of only two members of the genus *Bassariscus*—the other being the cacomistle, with which they co-occur in the southern-most parts of their range. Both are morphologically and ecologically very similar (with their



Map 22 a) Ringtail, b) cacomistle © IUCN 2016

long legs, lithe bodies, long bushy ringed tails, fox-like faces, and relatively large ears)—but the ringtail differs in that it is frequently found near human habitation (while the cacomistle is not). Popular information sources seem to confuse the two species—both are sometimes referred to as the 'ringtail cat', and both may be known as the cacomistle. Ringtails are the better known of the two species.

Ringtails are distributed across the southern North American states (from southern Oregon and California, southwest to Texas), occur on three islands in the Sea of Cortez, and are common and widely distributed from northern to central Mexico (Reid et al. 2016c). Reported home range estimates, from different studies across their range, vary hugely from 9 to 560 ha (Harrison 2012), although it is not clear to what extent differences are due to habitat differences, or to monitoring duration or methods. Population density estimates are similarly variable, ranging from <1 to 20 individuals per km^2 (Reid et al. 2016c).

Ringtails occur in forest habitats (including semi-arid oak forests, pinyon pine and juniper woodland, and montane forest) and desert and rocky areas (Poglayen-Neuwall and Toweill 1988), and consume a wide variety of prey (arthropods [including some venomous species], fruit, mammals, birds, and reptiles, Harrison 2012; Poglayen-Neuwall and Toweill 1988). They den in rocks, trees, shrubs, and holes in the ground, and are excellent climbers. Their fruit-eating habits mean that ringtails function as seed dispersers, and their use of disturbed or urbanized areas means that they may be dispersing native vegetation seeds to disturbed areas and thus may be able to play a role in the regeneration and/or maintenance of native vegetation in peri-urban areas (Solalinde-Vargas and Valenzuela-Galván 2013).

Predation by both mammalian and avian predators seems to be the major cause of death for this species (Harrison 2012), primarily great horned owls (*Bubo virginianus*), but also coyotes (*Canis latrans*), bobcats (*Felis rufus*), and raccoons (Poglayen-Neuwall and Toweill 1988).

	Male mean (SD)	Female mean (SD)
Weight (kg)	1.0 (0.1) n = 9	0.9 (0.1) n = 9
Head/body length (mm)	394 (15) n = 9	378 (15) n = 9
Ref: Harrison 2012		

Cacomistle *Bassariscus sumichrasti* (Saussure, 1860)

Cacomistles are a Central American species, occurring further south than their congener, the ringtail, in a range of forested habitats (including montane and lowland rain forest and wet evergreen forest, as well as seasonally dry forest and scrub), from southern Mexico to Panama (Pino et al. 2016). Like ringtails, cacomistles are nocturnal, arboreal, and solitary. They den, often high up, in tree hollows (Vaughan et al. 1994), but descend to the ground to cross clearings They, feed on a wide range of fruits (e.g. wild figs), but also eat some insects and small vertebrates, and, although they are solitary, up to eight individuals have been observed feeding at the same time in a fruit-bearing tree (Poglayen-Neuwall 1992). Home ranges appear to be about 20–30 ha and they travel an average of 2.5 km per night within their home range (Vaughan et al. 1994; García et al. 2002). They have characteristic calls, and in 'high density' areas, in the mating season, can be heard from all directions through the night (Poglayen-Neuwall 1992). Like ringtails, they probably function as seed dispersers (Coates-Estrada and Estrada 1986a).

Cacomistles are variably reported to be 'uncommon', 'locally common', and 'common' in different parts of their range (Pino et al. 2016), and their forest-dwelling habits suggest that may be vulnerable to the high levels of forest clearance in the area. Densities generally are not known (Poglayen-Neuwall 1992). Poglayen-Neuwall (1992) suggested that alleged raids on poultry are unlikely (because they rarely occur near humans and only eat small vertebrates).

	mean (range)
Weight (kg)	1.3 (1–1.55) n = 5
Head/body length (mm)	410 (370–450) n = 5

Ref: Vaughan et al. 1994

Kinkajous And Olingos

Kinkajou *Potos flavus* (Schreber, 1774)

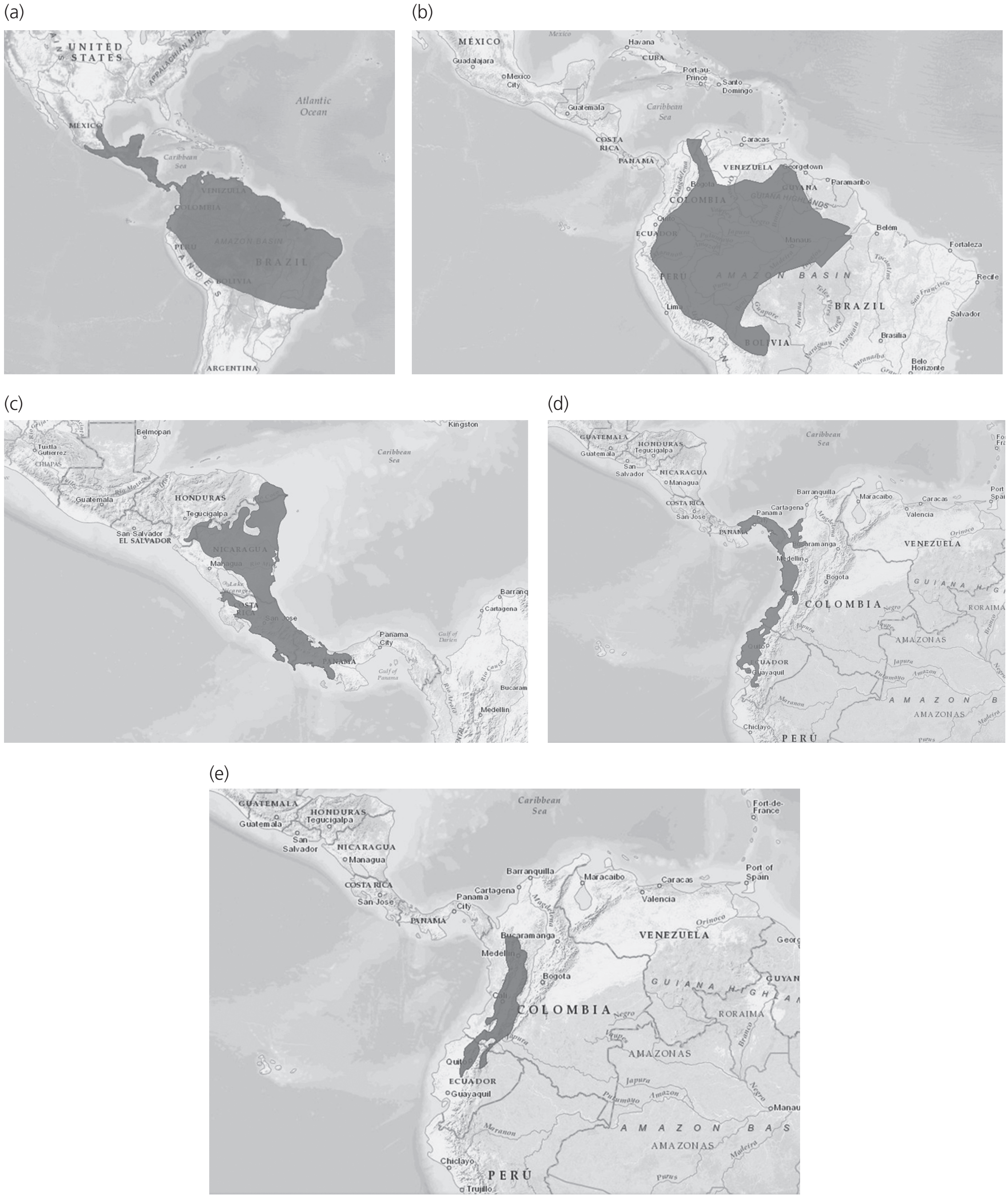
Another procyonid common in suitable habitat through South America is the frugivorous kinkajou, which occurs in closed-canopy tropical forests (up to 2500 m) from the Sierra Madres in Mexico to south-eastern Brazil, east of the Andes. Kinkajous (also known as honey bears or night apes, Ford and Hoffmann 1988) are medium-sized members of the procyonids that live almost exclusively in the tree canopy (Brooks and Kays, Chapter 26, this volume), where they feed primarily on fruit, supplemented with flowers and leaves (Kays 1999b). Kinkajous, together with olingos, differ somewhat from other procyonids in their appearance, with their large, round eyes and rather 'teddy-bear'-like faces—because of this, their prehensile tail, and arboreal behaviour, they have, in the past, been likened with primates (Ford and Hoffmann 1988). They occur at relatively high densities of 12 to 30 individuals per km^2 (Ford and Hoffmann 1988), are generally solitary, but congregate at large fruit trees where resources are sufficient to allow simultaneous feeding (this slightly unusual social system, facilitated by resource dispersion, is described by Brooks and Kays in Chapter 26). Estrada and Coates-Estrada (1985) estimated that a single individual consumes 3 kg fruit per month. Kinkajous have a long, narrow, extensible tongue that they use to feed on nectar (of, for example, large *Quararibea cordata* flowers, Janson et al. 1981), and thus, potentially, have a role in cross-pollination (Ford and Hoffmann 1988). They may be affected locally by deforestation, or hunting (Brooks and Kays, Chapter 26, this volume), but they are not considered to be a threatened species (Helgen et al. 2016e).

	Male range	**Female range**
Weight (kg)	2.7–3.7 n = 8	2.2–3.6 n = 6
Head/body length (mm)	*c.*440–660	*c.* 410–525

Ref: weight based on a single study in Panama, Kays and Gittleman 2001 (rangewide body weight may be between 1.4 and 4.6 kg, Brooks and Kays, Chapter 26, this volume); head/body length, Ford and Hoffmann 1988

Olingos *Bassaricyon* spp.

Olingos comprise four species, the taxonomy of which has recently undergone significant revision (Helgen et al. 2013) and now includes eastern lowland (or Allen's) olingos (*B. alleni* Thomas, 1880), northern (or bushy-tailed) olingos (*B. gabbii* Allen, 1876), western lowland olingos (*B. medius* Thomas, 1909), and newly described olinguitos (*B. neblina* Helgen et al., 2013), discovered in 2013 in the cloud forests of Ecuador and Colombia. Broadly resembling the closely related kinkajou (with the exception of their longer muzzles and non-prehensile tails), olingos also occupy Neotropical forests. Collectively they range from Nicaragua to Bolivia: the northern olingo confined to Central America (Helgen et al. 2016b), the two lowland species on the eastern and western slopes (respectively) of the Andes (Helgen et al. 2016c, d—the eastern species extending into the lowland forests east of the Andes as far as western Brazil), and the olinguito in the high elevation (> 1500 m) regions of the northern Andes (with some spatial overlap between *neblina* and *medius* on the western slopes of the Ecuadorian Andes, Helgen et al. 2013). Like kinkajous, olingos



Map 23 a) Kinkajou,b) eastern lowland olingo, c) northern olingo, d) western lowland olingo, e) olinguito © IUCN 2016

are nocturnal, arboreal, and probably largely solitary (Helgen et al. 2013), but otherwise little is known of their ecology, or behaviour. They feed on fruit and nectar (Kays 2000; González-Maya and Belant 2010), but few details of their diet have been published; eastern lowland olingos are known to supplement their diet with small rodents, lizards, nestling birds, insects, and eggs (Poglayen-Neuwall 1973 in Helgen et al. 2013). They spend the day resting in tree holes; one western lowland olingo had a home range of 37 ha (Kays 2000).

Deforestation is a potential threat to all olingos, but olinguitos are especially vulnerable due to their dependence on limited cloud forest (Helgen et al. 2013, 2016d).

	mean (range)
Weight (kg)	
– *B. alleni*	1.34 (1.10–1.50) n = 27
– *B. gabbii*	1.32 (1.14–1.58) n = 13
– *B. medius*	1.08 (0.92–1.20) n = 36
– *B. neblina*	0.87 (0.75–1.07) n = 19
Head/body length (mm)	
– *B. alleni*	391 (304–455) n = 27
– *B. gabbii*	428 (373–470) n = 13
– *B. medius*	379 (310–415) n = 36
– *B. neblina*	355 (325–400) n = 19
Ref: Helgen et al. 2013	

Ailuridae

Red panda *Ailurus fulgens* (Cuvier, 1825)

Formerly classified with both the bear and the raccoon families, the taxonomy of the red panda is now established as being the only extant member of the Ailuridae, within the Musteloidea superfamily (see Koepfli et al. Chapter 2, this volume).

Predominantly arboreal, highly specialized bamboo-eaters, red pandas are endemic to the eastern Himalayas, where they are found in temperate broadleaf and conifer forests with dense understories of bamboo, typically between 2500 and 4000 m elevation, where annual temperatures are cool and range between 10 and 25 °C (Glatston et al. 2015). They are distributed from Nepal (the westernmost confirmed records at about 81°E) to China, including northern Bhutan, India (Sikkim, West Bengal, and Arunachal Pradesh), and the northern mountains of Myanmar. In China they are found in Tibet, Yunnan, and Sichuan (the easternmost records at about 104°E) but are believed to be extinct in the rest of their historical range in China (e.g. Guizhou, Gansu, Shaanxi, and Qinghai provinces, Wei et al. 1999b; Hu et al., Chapter 29, this volume). There is also a disjunct population reported from tropical forests on the Meghalaya Plateau in northeastern India (Choudhury 2001).

In Bhutan, red pandas were strongly associated with old growth Bhutan fir (*Abies densa*) forest (containing

Map 24 Red panda © IUCN 2016

mature trees that provide safe resting and denning sites), tall bamboo species, a high density of fallen logs and tree stumps at ground level to provide structural access to bamboo leaves, and locations close to water (presumably to supplement the low water content of bamboo leaves, Dorji et al. 2011). In one study in Nepal, a single species of bamboo comprised 54–100% of the pandas' diet (depending on season, Yonzon and Hunter 1991). Elsewhere, fruit (e.g. rowan berries *Sorbus* spp.) may provide an important dietary supplement, especially for lactating females (Dorji et al. 2011). Red pandas are generally diurnal, with frequent activity periods (peaking in the morning and early evening) interspersed with periods of rest lasting two or more hours (Zhang et al. 2011). Density estimates in Nepal vary between one panda per 2.09 km^2 and one per 5.5 km^2 but there is considerable uncertainty in existing population estimates for all occupied areas (Glatston et al. 2015); the global population is estimated at less than 10,000 mature individuals. The main threats are habitat loss and fragmentation (associated with logging and logging roads), habitat degradation associated with encroaching human populations (including bamboo harvesting and livestock grazing, as well as risk of canine distemper from peoples' dogs, see Sharma et al. 2014), and poaching (for meat and pets, which seems to be increasing, see Harrington et al., Chapter 7, this volume), all of which are compounded by increasing numbers of people in the region, climate change, and natural disasters (Glatston et al. 2015).

	mean (range)
Weight (kg)	5.0 (2.5–7.5)
Head/body length (mm)	(510–730)

Ref: data based on captive populations, AZA Small Carnivore TAG 2012; Roberts and Gittleman 1984; Smith and Xie 2008; no sexual dimorphism in size recorded

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