THREATENED AND RECENTLY EXTINCT VERTEBRATES OF THE WORLD

A BIOGEOGRAPHIC APPROACH

MATTHEW RICHARDSON

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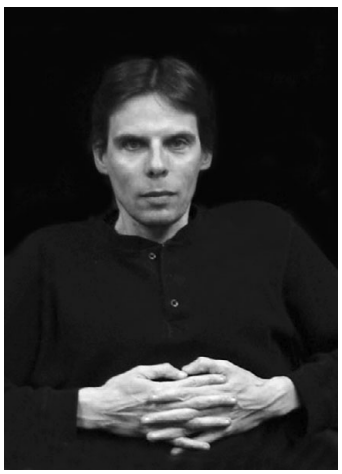
A Biogeographic Approach

Habitat loss and degradation are currently the main anthropogenic drivers of species extinctions. The main driver of this worldwide is agriculture, with urban sprawl, logging, mining, and some fishing practices close behind. The physical loss of habitat, such as deforestation for land development and the burning of fossil fuels, are examples of this. The root cause is human overpopulation.

This unique volume provides, for the very first time, a comprehensive overview of all threatened and recently extinct mammals, birds, reptiles, amphibians, and fishes within the context of their locations and habitats. The approach takes a systematic examination of each biogeographic realm and region of the world, both terrestrial and marine, but with a particular emphasis on geographic features such as mountains, islands, and coral reefs. It reveals patterns useful in biodiversity conservation, helps to put it all into perspective, and ultimately serves as both a baseline from which to compare subsequent developments as well as a standardization of the way threatened species are studied.



Matthew Richardson is a Canadian author known for such award-winning books as *Lemurs of Madagascar* (3rd edition, Conservation International, 2010). He has worked alongside some of the most high-profile conservationists in the world, and served as an active member of both the IUCN/SSC Primate Specialist Group and Conservation Planning Specialist Group. Passionate about both human and natural history, he has drawn extensively from these experiences to create what will surely become the foundational text on endangered and extinct species for decades to come.

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This book is dedicated to
my father
Charles Cruse Richardson
1928–2015

my mother
Dorothy May Richardson
née Lihou
1932–2017

and to my dearest friend
Douglas Arthur Sweetman
1964–2019

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Colour plates can be found between pages 356 and 357.

Foreword

Location, location, location: the geography of endangerment.

Everyone has images of endangered species – the iconic giant panda, or the tiger, or the blue whale. For those like me who are fanatic birdwatchers, one can easily add less familiar species. I so want to see a giant panda – the closest I've been is finding its fresh droppings of chewed bamboo. I also want to see a Chinese monal, a gorgeous pheasant that makes the same mountains its home. It, too, is endangered. Because bird tourism is such a major industry, I can quickly find a list of the bird species I must not miss while I'm there. Tour guides are there to help if needed.

Birding teaches me that there are unique places where hard-to-find species concentrate. They are typically those with small geographic ranges. About 90 per cent of threatened species have small ranges. (The rest, like tigers, have large ranges, but for which their ferocity is a threat to us and our livestock.) Simply, geography matters.

Matthew Richardson has taken this to heart. Because geography matters, we should look at endangered species from that perspective. No one has done this before so comprehensively, and his insights are vital.

First, iconic species excepted, I often do not know what species of mammals, reptiles, amphibians, and fish live in the places where I seek my rare birds. There aren't many tour guides for these species. It's not that I don't care; it's just that such knowledge is often hard to find. There may not be a guide to all the threatened species in an area. Even if there is, do I want to carry even more books into the field than I already do? This book tells me what else is there.

Second, the book is replete with examples of species that haven't been seen in an age – the Turkestanian salamander, the Balkan streber (a fish), the Sichuan dormouse, and the Sichuan pit viper. There is so much we don't know about many species – where to look for them is paramount. Some areas shout that they are poorly explored.

This comes at an exciting time. Crowd-sourced, citizen-science efforts have passed a billion bird observations on eBird. Other taxa lag, but iNaturalist logs a million observations in a good month. We are gaining knowledge of where species are at an unprecedented rate, and knowing where to look and what species to seek makes exploration ever more exciting. Parts of our own planet are the 'final frontier' when it comes to biodiversity.

Above all, this book is a guide for practical conservation. I direct a conservation NGO, Saving Nature (www.savingnature.org), which helps local conservation groups acquire land, restore their natural habitats, and reconnect the fragmented habitats that remain. Where do we choose to invest our limited funds? We care about all species, not just the charismatic large-bodied species. Saving tigers is important, certainly, but many thousands of species are equally interesting and desperately in need of our protection. I now know where to see if a river, a marsh, a cave, some special forest or desert house species for which our actions might help. Much of conservation is about protecting the right locations, and now we have an excellent guide as to where those are.

Stuart L. Pimm, Doris Duke Chair of Conservation, Duke University, and President, Saving Nature

Preface

This book is intended to provide a complete overview of all threatened and recently extinct mammals, birds, reptiles, amphibians, and fishes within the context of where they live in the world. My approach has been a systematic examination of each biogeographic realm and region, both terrestrial and marine, with a particular emphasis upon geographic features such as mountains and islands. All of the information within can more or less be found elsewhere. There is a myriad of sources on the subject, of course, not least of which being the IUCN Red List of Threatened Species upon which I primarily rely. It is this very wealth of data, however, that makes it so difficult for layman and expert alike to see, at a glance, the 'whole picture'. My goal has been to provide that picture, in the hope that it will reveal patterns useful in the preservation of both species and habitats, and thereby help to put it all into perspective. Towards that end, I have included summaries for each section and a general reckoning at the end of the book, which together provide the bare numbers needed to show the priority areas. I should perhaps add that the omission of invertebrates and plants is not meant to indicate that they are somehow of lesser importance, but one can only do so much and these, I'm afraid, will need to await further volumes, and perhaps different authors.

In terms of my own background, and my personal reasons for writing this book, they too are many and complicated. Simply put, I am an author and historian by training with a lifelong interest in wildlife conservation. Growing up in the town of Markham, in Ontario, Canada, I had the extraordinary privilege of living near one of the world's greatest zoos. I spent much of my childhood at the Toronto Zoo learning about animals. It was the ideal sort of education for a budding naturalist, particularly in its ambitious, zoogeographically arranged layout. Best of all, for me, were the series of sprawling pavilions, each dedicated to a particular region: Indo-Malaya, North America, Eurasia, and of course the incomparable African Pavilion, at the time the largest building in Canada. Beneath its vast glass and steel framework lay an entire rainforest, complete with all the sights and smells and wonders, along with areas representing caves, deserts, and rivers. Here I would dream of exploring these worlds for real one day, and vowed that at the very least I would one day work there as a zookeeper. Sadly, for whatever reason, I never did realize my ambition to work at the zoo that I loved, but it remains for me a magical place.

Another enormous advantage that I had growing up in Markham was the still-prevalent wilderness to be found there. The endless ravines and fields, now sadly fallen victim to rapacious property developers, gave me both scope for exploration as well as a sense of the growing reality of environmental destruction. So too the cottage on Lake Muskoka that my family visited each summer. Siamese cats were always there as well (and continue to be so today), and later, rather more exotic pets. But most of all it was books that gave me the escape I craved, especially those of the British author and zoologist Gerald Durrell, Bernhard Grzimek's *Animal Life Encyclopaedia*, James Fisher's *Zoos of the World*, and *Life Before Man* by Z. V. Spinar, with its extraordinarily evocative illustrations by Zdenek Burian. One particular book from my youth had an impact that, in some ways, led directly to the present volume. It was entitled *Let Them Live*, by the Swedish author Kai Curry-Lindahl. The latter was a sort of 'world tour' of rare and extinct animals, and I was immediately fascinated by the stories that it contained and the exotic places it evoked, so much so that I actually stole it from my local library.[*] Oddly enough, Prof. Curry-Lindahl is almost completely forgotten today, despite having been one of the early pioneers of conservation. Little did I know, incidentally, that at the time that I first found this book during the 1970s the author himself was actually teaching at Guelph University, a little more than an hour's drive from where I lived. I never had the honour to meet him, unfortunately, and until recently had never even managed to find a photo of him. He died in 1990.

[*] I make no apologies for this: if I hadn't done so, it would have long since been discarded, and my illicit copy appears to be the only one left in existence. I still treasure it to this day.

Figure A Kai Curry-Lindahl. (Credit: Kai Curry-Lindahl)

All of these early influences, along with my first serious travels, proved to be the ideal training for the writing career that I was about to fall into. My first published book, oddly enough, was not about animals, but rather, a history of the British royal family. While not an earth-shaking success, it did at least open some doors for me. And so it was that, at the beginning of the twenty-first century, I turned at last to natural history. I had already written a biography of my childhood hero Gerald Durrell, which despite gaining notice among agents and publishers never did see the light of day. My next project was an ambitious, four-volume book series entitled *Living Primates*. It was as a result of this that I had two very important breaks. The first was in making contact with the late Professor Colin Groves of the Australian National University, one of the most important taxonomists that ever lived. He advised and encouraged me, and never made me feel inferior despite the obvious fact that I was a complete amateur without so much as a degree to my name. He also introduced me to many other primatologists, most notably Dr Russell Mittermeiers, then President of Conservation International and himself one of the most respected scientific leaders in the world. Russ liked what I was doing and generously provided me with funding that enabled me to continue the work. Later, he brought me on board his own projects, which then included the second and third editions of *Lemurs of Madagascar* as well as the primate volume to the massive *Handbook of the Mammals of the World* series. It was a heady time, full of travel and excitement, and I was able to meet many other legends from the world of science and conservation, most notably the great wildlife artist Stephen Nash who remains a good friend to this day. It was during this period as well that I worked on a couple of occasions at Gerald Durrell's extraordinary zoo in Jersey, in the Channel Islands off the coast of France. There I got to know many of the people who had featured so prominently in making the Durrell Wildlife Conservation Trust so pivotally important. Living there, in an old French manor house on the zoo grounds, was eerily like stepping inside some of my favourite books. I will always be grateful for such opportunities.

So it was that, with the benefit of all these experiences and connections, I decided about 10 years ago that the time had come to take on the one book that I always wanted to write: an updated version of Prof. Curry-Lindahl's *Let Them Live*. More to the point, I wanted to copy his basic approach, but on a much more ambitious scale, and to take advantage of the more exacting scientific standards and greater wealth of information that the intervening half-century had provided. Moreover, I wanted the book to serve as a history of wildlife conservation as well as its destruction. The actual writing of it came at a time of deep personal crisis for me, and has been something of a solace over the long years that it has taken to complete it.

As mentioned at the beginning of this foreword, the present volume deals with all terrestrial, freshwater, and marine vertebrates that have become extinct during recent historic time (that is to say, since about the year 1500 A.D.), or which are currently threatened with extinction, or are so rare or specialized that even minor restrictions or alterations of their habitats may result in their extermination (i.e. Critically Endangered, Endangered, or Vulnerable according to the IUCN Red List). Also discussed are those forms that were formerly considered to be threatened but which have since been saved through wise conservation policy, as well as those about which little or nothing is known but, it seemed to me at least, are clearly at risk. All taxa are included (i.e. species as well as subspecies), along with any notable populations. While such an approach of necessity tends to focus on 'the rarest of the rare', it is important to keep in mind that it is all really just a matter of degree. We have seen, time and time again, how apparently common species can very quickly be wiped out for any number of reasons. Ultimately, all life on this planet is at risk. So it is that, in recent years, the tendency has been to shift the emphasis away from saving individual species to saving entire ecosystems. For my part I believe that both approaches are equally necessary and valid, and indeed it is often that, by putting an emphasis on a single 'flagship' species, an entire habitat may be saved.

Before proceeding, it would be helpful perhaps to take a closer look at the history of the IUCN and its Red List of Threatened Species. The International Union for the Conservation of Nature (and Natural Resources) was established in 1948, and is headquartered in Gland, Switzerland. As its name suggests, it is an international organization dedicated to both conservation and sustainability. As such, it gathers data and analysis, promotes research and field projects, and generally provides advocacy and education. It is best known, however, for compiling and publishing the Red List, which assesses the conservation status of fauna and flora the world over. The original Red List began in the 1950s as a simple card index of animals deemed threatened with extinction. This gradually evolved, over time, into the Red Data Books published during the 1960s and 1970s, by then covering all animals (as well as plants) regardless of their threat status. With this ever-growing number of species, however, it soon became difficult to keep up with the latest developments in a timely fashion, resulting

in a more committee-based approach to assessments and an emphasis on special reports. Eventually, with the advent of the Internet in the late 1990s, the Red List at last found a home online as Redlist.org, which had the advantages of greater access for people around the world as well as the ability, at least theoretically, to make updates as needed. It remains by far the most comprehensive and objective global approach for evaluating the extinction risk of plants and animals, providing conservation information for over 105,000 species of plants, animals, and fungi. In short, the IUCN Red List is regarded as the most influential source of information for species conservation in the world, and is used to inform and guide key national and international policy as well as on-the-ground conservation decisions. Over 15,000 scientists worldwide, most of them volunteers, currently contribute to the work, which is funded from a wide variety of donors.

Thus, the Red List has served as my primary source of conservation assessment information. For my purposes as an author as well as a researcher, however, there have been many occasions when I have disagreed with certain assessments, and have not been afraid to do so. Having worked on a few of them myself for the Global Mammal Assessment, I know first-hand how difficult the process can be, particularly when one has little or no information to work with. In some rare cases this has meant actually omitting a species or subspecies from the book that is accepted on the IUCN Red List and listed as threatened, but which my own research has convinced me is dubious. In most cases, however, I have erred on the side of caution, including taxa that were once common, perhaps, but have lately become threatened and have yet to have their status updated. So too with the countless forms listed as 'Data Deficient'. While I tend to agree that the majority in this category are either junior synonyms or at least valid forms although not in any immediate danger, all too often truly threatened species are simply dumped here and forgotten, usually due to a lack of follow-up research. For my part, if I find a valid species or subspecies known only, say, by a single museum specimen collected from a small patch of forest during the nineteenth century that has since been replaced with a large city, I am willing to make the leap that it is probably extinct, or at least extremely threatened. In dealing with species and subspecies it should be noted that mere 'rarity' is not always the best criterion for inclusion within a threat category. As noted, just as a common species may be wiped out very quickly for various reasons, so too a rare one may not necessary be threatened if sufficiently isolated or protected. Many types of deep-sea fishes, for instance, are naturally very rare, but are nevertheless stable and out of danger, at least for now. So too, many species or subspecies may have become extinct from a particular part of their former range (extirpated), or become regionally threatened by extinction, yet may still be relatively safe elsewhere. Very often, such threatened populations are vitally important to the health of its ecosystem.

Apart from the IUCN Red List, of course, I have also drawn from literally thousands of books and academic papers. The sheer size of this volume has made it impossible, for lack of space, to include every reference upon which the entries are based. I have, however, included a thorough bibliography and have always been careful to cite direct references. Modern technology has also made it very easy to rely upon the knowledge and criticism of experts around the world, many of whom have taken the time to provide personal reviews and corrections.

It may be useful to compare the present volume as well with its other primary influence, Kai Curry-Lindahl's *Let Them Live*. When the latter was writing his book during the late 1960s and early 1970s his approach had been almost entirely geographic, set within the biogeographic arrangement first formulated by Alfred Russel Wallace in the late nineteenth century. Wallace was a British naturalist, explorer, geographer, and biologist, best known for independently conceiving the theory of evolution through natural selection along with Charles Darwin. He undertook extensive fieldwork, first within the Amazon basin and then throughout the Malay Archipelago, where he identified the faunal divide now known as the Wallace Line which separates animals of largely Asian origin from those of what he termed 'Australasia'. The nineteenth century's leading expert on the geographical distribution of animal species, he is sometimes called the 'father of biogeography', and his 1876 two-volume work, *The Geographical Distribution of Animals*, would serve as the definitive text on the subject for the next 80 years. In it he laid out the basis for the same zoogeographic regions used by the Toronto Zoo in its layout of pavilions. Under his system, Earth's terrestrial regions were divided up into six biogeographical regions (i.e. the Nearctic, Neotropical, Palearctic, Ethiopian, Oriental, and Australian). The oceans were not divided at all, and while certain isolated islands were singled out as distinct areas they were not treated separately. Wallace's system has been amended slightly in the years since, but has remained essentially unchanged to this day.

Professor Curry-Lindahl naturally followed this basic arrangement in his own book, utilizing a more or less continental or oceanic division to his chapters, but within each continent or ocean the approach had been 'ecological' (i.e. coasts, deserts, savannas, etc.), rather than biogeographical. His sections included 'Africa', 'Eurasia', 'North America', 'Central and South America', 'New Guinea, Australia and New Zealand', 'Oceania', 'Isolated Islands in the Oceans', 'The Antarctic', and 'The Oceans'. All of his marine areas (e.g. islands, archipelagoes, and oceans) were, however, dealt with on a geographical basis alone. By this arrangement he endeavoured to connect environmental factors like man-made changes in various habitats to the disastrous effects that have often struck the animals living there. Then as now there were usually a number of factors behind the decrease of each species besides man's direct predation and habitat alterations.

In terms of species and subspecies, Prof. Curry-Lindahl's book also reflected a much simpler period of scientific knowledge. This was a time long before the present mania for taxonomic splitting, whereby a widespread species may be

reassessed as two or perhaps even several distinct forms, creating a new wealth of unexpected diversity along with considerable confusion. Oftentimes the split is an obvious one or involves some quite distinct subspecies being raised to species level, as for instance in the case of gorillas and orangutans. More recently, however, species are being 'created' based mainly upon tiny differences in their DNA, the animals themselves often looking very similar or even identical in appearance to one another. Many of these new taxa have very limited geographic ranges, and are as a result threatened. All of this has resulted in considerable disagreement among taxonomic experts, who fall broadly into two main schools: the 'lumpers' and the 'splitters'. It is not my place to make definitive statements regarding taxonomy. Indeed, as with Prof. Curry-Lindahl, I do not really care much whether a taxon is labelled a species, a subspecies, or merely a 'population of biological importance', so long as the full diversity of a given region is represented.

Thus, Prof. Curry-Lindahl had far fewer species and subspecies to deal with (just under 1400 in total), some of which have since proven to be invalid. But he also had far fewer data with which to work. That said, his book was an honest effort to include all species and subspecies of mammals, birds, reptiles, amphibians, and fishes that, in his day, were threatened with extinction, as well as those that had already become extinct during historic time (by his definition, around 1600 A.D.). His method of assessing them was logical and efficient. Threatened species, by definition, are usually quite localized in their distributions, and assigning them is usually relatively easy. Those occurring in various habitats or regions within a continent or marine area were mentioned only in connection with their characteristic habitat or primary range, and in general, geographical subspecies occurring on the same continent but frequenting different habitats received separate textual treatments. Those that occurred on multiple continents were, in general, treated where their main distribution range was located, although they might be mentioned more than once in the text. Where the range of such an animal was equally divided into more than one section, it was usually dealt with in connection with the section that appeared first in the text.

Taking into account the latest scientific thinking, my own volume has been arranged into 14 distinct biogeographic realms, six of which are further divided into two or more biogeographic regions. The terrestrial realms are as follows: the Arctic Realm, the Palearctic Realm (divided between the Eurasian, Sino-Himalayan, and Saharo-Arabian regions), the Afrotropical Realm (divided between the Guineo-Congolian and African regions), the Madagascan Realm, the Indo-Malaysian Realm (divided between the Oriental, Sundaic, and Wallacean regions), the Australian Realm, the Papua-Melanesian Realm, the Polynesian Realm (divided between the Micronesian, Novozelandic, and Polynesian regions), the Nearctic Realm, the Caribbean Realm, the Neotropical Realm (divided between the Mesoamerican and Amazonian regions), the Patagonian Realm, and the Antarctic Realm. Finally, the world's oceans are here considered to be a single interconnected whole, the Oceanic Realm, divided between the Temperate Northern Atlantic, Temperate Northern Pacific, Tropical Atlantic, Western Indo-Pacific, Central Indo-Pacific, Eastern Indo-Pacific, Tropical Eastern Pacific, Temperate South America, Temperate Southern Africa, and Temperate Australasia regions. It should be noted that the Arctic and Antarctic realms are really sort of transition zones between the terrestrial realms on the one hand and the Oceanic Realm on the other, having elements of both.

As with biogeography on a global scale, there has also been much work since Prof. Curry-Lindahl's day on how to delineate various types of habitat within them, as for instance rainforests and deserts. In recent years a number of different systems have been developed by various non-governmental organizations (NGOs). The best known of these is perhaps the World Wildlife Fund's system of biomes, ecoregions, and ecozones that, while comprehensive, remain incomplete and increasingly out of date. Conservation International favours a 'Hot Spots' approach; that is to say, one based on priority areas for biodiversity; while the Durrell Wildlife Conservation Trust uses one based on 'Islands and Highlands'. All are quite valid, even heroic. I myself experimented with all of these biogeographic arrangements, along with one based entirely on geography. As an author, however, I ultimately found that for the purposes of organization neither a purely geographic nor purely biogeographic system was entirely satisfactory. Bioregions (or ecoregions, depending on what you want to call them) work very well on a limited basis, particularly for lowland areas. Unfortunately, when combined together on a global scale the individual parts simply do not add up to a unified whole. Through many years of trial and error (mostly error) I gradually evolved a hybrid approach instead; one based largely upon geographical features such as mountains, islands and lakes, but combined with more generalized categories for the lowlands. The main advantage of this method is that it shows, at a glance, all the threatened and recently extinct taxa from a certain place. Where this system breaks down is with the marine regions. Unlike the terrestrial regions of the world, the global ocean cannot be so easily divided. Many highly threatened species within the latter are to be found worldwide, which is why I have opted to treat the oceans as a single realm, broken down more or less biogeographically and very broadly. The common element in all of this of course is elevation, with the oceans merely being the inverse of the terrestrial.

Set within this intricate framework are approximately 14,000 vertebrate taxa (i.e. species and subspecies). While it has been impossible to provide more than the most basic treatment for the vast majority owing to the limitations of space, a few are nevertheless dealt with at length and most receive at least a short comment. That said, biogeography is not an exact science, and it consequently hasn't always been clear where to assign certain forms within the text. Freshwater fishes are perhaps the most difficult of all. A type of fish confined to a mountain stream, a desert lake, or to seasonal

pools in the middle of a rainforest may reasonably be placed in any of half a dozen subsections. So, too, one living within a coastal mangrove in both brackish and fresh water. Amphibians can also be incredibly problematic and for much the same reason, particularly those living in isolated caves or rivers. In such cases I have been forced to make judgement calls based on what seems most appropriate.

Within each section and subsection of the book I have always endeavoured to work from general to specific, assigning animals to their most appropriate place in the text in order to highlight endemism wherever it exists. Each chapter therefore begins with those species that cannot easily be assigned within one single habitat. From there the organization takes on the additional aspect of elevation, starting with a general 'Mountains and Highlands' section and moving down to lowland forests of various sorts, grasslands, and deserts. Wetland areas are similarly treated with a general introductory section followed by lakes and rivers, the latter broken down by their tributaries and discussed from their upper reaches to their lower ones. This is followed by a section on coasts and major islands or islands groups, in which we normally navigate from north to south.

Precise geographical terms are obviously of the highest importance within such a system. With very few exceptions, all names for places and physical features in this book have been given in English, in an effort to standardize and thereby avoid a confusing Babel of languages. Wherever possible, however, I have also provided the local names as well. So too with species and subspecies names: English names and punctuation are used as opposed to local names, although exceptions are of course made in cases where the local name is widely known. I have always tried to provide both a common name as well as the scientific (Latin) one, even where it has meant having to coin one of the former myself. Common names for those species that are threatened or extinct are given in bold where we first encounter them in the text. The common names for subspecies, however, as well as for species that have already been discussed earlier or those that are not deemed threatened do not appear in bold.

Finally, in terms of illustrations, I have decided to include wherever possible actual photographs of now-extinct species and subspecies as are available, in the belief that they have immense historical importance as well as a powerful impact upon the reader. Sadly, far too many creatures have gone extinct without anyone ever having taken the trouble to photograph them. In such cases I have relied instead upon drawings and paintings. As with photographs I feel that older ones, rendered by those who actually saw the animal in life, are more compelling even if they are less scientifically accurate. In a few instances I have opted to also include images of notable, still extant forms.

What would Prof. Curry-Lindahl think about the current environmental situation, compared to his own era? Certainly, from his point of view, things were dire enough. In the mid-twentieth century threats to wildlife came mainly in the form of overhunting and overfishing, with loss of habitat and pollution usually only contributary causes. Sailors from Russia, Norway, and Japan were whaling indiscriminately, the American military was napalming forests in South East Asia, and the Chinese and others had begun to lay the foundations of the horrific mass trade in wildlife for use in what has since become known as 'traditional medicine' (despite being neither traditional, nor medicine). Several nations had already begun to tame great rivers with enormous hydroelectric projects. Most ominously of all, the mass destruction of the still vast tropical forests of South East Asia, Equatorial Africa, and South America had already started to have an impact. But it was past extinctions, rather than potential ones, that seemed to have preoccupied him and his contemporaries the most. To quote the very first lines from *Let Them Live*, 'Never in the realm of nature have so many been exterminated by so few in so short a time.' Prof. Curry-Lindahl knew better than anyone the damage wrought by hunting, but like most people of his day, still saw an important economic and even recreational role for it, and certainly didn't regard it as an evil in itself. Animals continued to be seen as little more than an unlimited, free resource to be exploited, and even the IUCN itself had been created mainly to ensure that this was done wisely, rather than for the preservation of biodiversity for its own sake. Indeed, the world's wilderness areas were still, by and large, pristine and indeed relatively unexplored. The growing human population, although already becoming a concern, was still half of what it is today. Moreover, mass awareness of human impact on the planet was only just beginning. Most people by then were familiar with the stories of the dodo and the American bison, and could see that overpopulation was a potential problem, but sustainability and their own role in that didn't enter into it. Nevertheless, an international environmental movement had begun, and Western nations were already enacting legislations to protect both species and habitats.

Yet from the standpoint of the early twenty-first century things appear very different indeed. In the half a century since Prof. Curry-Lindahl's book was published, many species and subspecies have been lost, although not as many as had been anticipated. Some have even made remarkable comebacks due to conservation action, while a few others, long feared lost, have been rediscovered. In terms of total biomass, however, the scale has been frightening. By one recent estimate some 60 per cent of all vertebrate populations have been destroyed since 1970, and vast areas of habitat are gone forever. Still worse, the core problem underpinning environmental destruction, that of human overpopulation, is arguably even more apocalyptic than had been predicted and continues to exponentiate far beyond what anyone could have imagined during the 1960s. Our numbers are increasing by over 200,000 each day, and we are now building the equivalent of a New York City every month. Earth has already far exceeded its maximum capacity. There are simply too many people. We don't just need to halt this; we must somehow find a way get back down to a truly sustainable level, which is to say a global population

of under two billion (roughly the level of the late nineteenth century). This is of course unlikely, particularly given the fact that the issue is no longer even talked about for the most part, either because of a feeling that there is nothing that can be done about it or that to do so is somehow politically incorrect. And yet it can be done, if only we all limit ourselves to having two children or less.

In what particular ways does human overpopulation manifest itself in terms of the environment? First and foremost, of course, is habitat destruction and degradation. The unprecedented and unrestrained growth of cities and suburbs, along with farming, mining operations, water extraction, logging, hydroelectric dams and the like, as well as pollution in all its forms, are leaving the planet's remaining wilderness areas fragmented and isolated. As people continue to push wildlife and wild places out often what remains must be strictly managed, like enormous, open-air zoos. Indeed, in the future, when speaking of a particular species' range, it will likely consist of a grim list of protected areas, of varying effectiveness. In recent years the concept of the national park has evolved, and we now have ones of considerable size, both terrestrial and marine, with some even crossing international borders. Sadly, it has been shown that protected areas, even in supposedly developed countries, are only protected until they aren't.

Another consequence brought about by humans has been the introduction of invasive species wherever they have settled. Such fellow travellers, in particular rats, mongooses, goats, feral cats, and dogs, either prey upon species directly or compete with them in such a way as to make their survival difficult or impossible. We shall see time and time again in this book how introduced species have devastated native fauna, often also resulting in a severe economic impact. It is a record that emphasizes as well how islands are particularly vulnerable.

Hunting continues to take its toll. Fortunately, thanks to improved legal protections, so-called sport hunting is less a threat to species as a whole. Gone are the days when individuals could kill rhinos and tigers indiscriminately, although a certain amount of 'trophy' hunting continues. It has been suggested by some that such activity can actually be an indirect aid to conservation, in that it brings in tourist dollars and gives an incentive to the local people to preserve certain species. Such ideas are of course spurious. Hunting simply has no role to play in conservation whatsoever, nor, indeed, any place in civilized society. But while sport hunting has diminished, so-called 'bushmeat hunting' and trapping have become pervasive throughout the tropical areas of the world, and are directly driving species into extinction. The overcollection of wildlife for use as food and other reasons also remains a serious threat to many species. In Asia, reptile and amphibian populations in particular have been devastated by a culture that consumes anything that moves. Sea turtles were once highly endangered by the collection of their eggs by the millions annually from their vulnerable nesting grounds. Such practices are perhaps, on some level, morally excusable. The greedy and nonsensical harvesting of wild animals for use in 'traditional medicine' certainly is not. As we have all seen in recent years, apart from the impact on species themselves, this practice is also putting human beings the world over at risk by means of devastating pandemics. Other forms of animal collection such as fishing are quite understandable, if undertaken sustainably. However, many areas of the oceans, not to mention certain freshwater lakes and rivers, have basically been emptied by intensive or industrialized practices. The global depletion of fish stocks such as cod, halibut, and salmon were an entirely preventable tragedy. The horrifying practice of 'shark finning' for shark fin soup, and the environmental toll of fisheries bycatch are corollaries.

Pollution in all its forms continues to plague both humans and animals. Plastics are a global blight. Sea turtles and other animals commonly confuse plastic bags with jellyfish and are killed, while microplastics fill our oceans and have created vast garbage patches in the middle of each ocean. Oil spills imperil our coasts. In some areas people are now forced to wear masks in order to endure high levels of air pollution. City lights have robbed us of the night sky, and the sounds of industry are omnipresent. We have literally trashed our world.

Apart from all of this there are also natural threats – stochastic events such as volcanic eruptions and hurricanes – that are particularly dangerous to those species living in vulnerable areas such as islands. Fires, both natural and man-made, are becoming more frequent and more devastating. Pathogens such as Ebola are affecting both humans and animals: indeed, the fungal disease Chytridiomycosis is literally wiping out scores of amphibians globally. Above all is the terrifying new threat of man-made climate change brought about by carbon emissions from fossil fuels. Sadly, our focus on voluntary carbon reductions was doomed from the start. Desertification and drought continue apace over wide areas and is just one example of its effects. The increased duration and frequency of El Niño warming events within the Eastern Tropical Pacific, which can cause severe and rapid declines for restricted-range, shallow water species, is another, as is the loss of coral reefs due to 'bleaching'. In the very near future rising sea levels due to melting polar ice will inundate coastlines globally and actually submerge certain low-lying Pacific islands. One of the most important breeding islands for green sea turtles (*Chelonia mydas*), located off the coast of Queensland in Australia, is a case in point. Once it's sunk, the turtles will nevertheless continue to be drawn there by some mysterious internal GPS. The planet is warming, and the root cause is overpopulation. Unless and until we reverse that, there really can be no hope.

Yet, in the face of all this negativity, it must be said that there have been some positive changes in the last half a century as well. First and foremost, people in general are much more aware about their impact on the environment, and more motivated to do something about it. Scientific knowledge and technology have also vastly improved. Action is being taken on national and international levels, with effective coordination in

the fight against wildlife smuggling for instance, and there is now a vast array of non-governmental conservation organizations. Zoos and aquaria, once places of mere entertainment, have become powerful weapons. Gerald Durrell and other pioneers showed just how effective captive breeding and reintroduction efforts can be in saving species from extinction, and the list of such species continues to grow.

What lessons have I myself learned in writing this book? I suppose the first thing that comes to mind is that I now see biodiversity conservation as not just one of many problems facing the world today, but as nothing less than a global war of annihilation. Moreover, it is a war that we are very close to losing. The enemy is numerous and varied: poachers, bushmeat and trophy hunters, developers, certain politicians, and above all practitioners of the illegal animal trade. Our allies are zoos, NGOs, and above all the people on the ground, all over the world, who have dedicated their lives to protecting and studying wildlife. Sadly, rangers and activists are all too often killed in the front lines. We must treat this war for what it is and begin to think in strategic terms. We need to understand as well that the aforementioned frontlines have shifted. Conservation is no longer simply about saving giant pandas or rhinos. Rather, it is about preserving those areas of the world that feature the highest biodiversity and which are most at threat. Islands and highlands are vital, of course, but it is overwhelmingly the tropical areas of the world that must be our priority. Half of Siberia, in terms of biodiversity, isn't worth a single province in Costa Rica or Sumatra. What I have tried to do with my emphasis on geography and maps is to highlight these far-flung battlefields. So, too, we must be smarter about where we allocate our all-too-limited conservation funds. Above all, we need to be very careful about the dissemination of information. The enemy reads academic papers as well, and watches with interest camera trap photos of endangered species posted online. We must not continue to provide them with precise locality data, however much that flies in the face of academic tradition. So it is that I never reveal such information in this book unless it is already widely known. Sadly, we have now reached a day where certain types of information must only be disseminated on a 'need to know' basis.

I believe that we are now quite literally living in that terrifying dystopia that Prof. Curry-Lindahl and others so feared, one of mass extinction and global environmental peril. For the first time in history people are seeing the actual effects of their own presence. The world is a much smaller place than it was just a few short decades ago, and we have gone beyond the fear of losing individual species – the 'rarest of the rare' – to that of losing whole ecosystems and perhaps, if we aren't careful, all life on Earth as well. Faced with all these problems it is easy to feel helpless, but everyone can at least do their bit. So it is that this book serves as my own small contribution. It is my fondest hope that it will at least make people aware of the sheer scope of the global environmental crisis, and perhaps help to set priorities in its preservation. In the end, perhaps the book's greatest value will be as an artefact for future generations. Another author, 50 years from now, will be able to use it in the same way that I have been able to use Prof. Curry-Lindahl's book; as a point of comparison and an inspiration. Maybe by then we will have all come to our senses at last, and there will be no need for books of this sort at all.

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Chapter 1

The Arctic Realm

The Arctic Realm, as here defined, are those terrestrial areas where the average temperature for the warmest month is below 10°C. It therefore includes all of the Arctic Circle including almost all of Greenland, the northern coast of Siberia and northern Scandinavia, northern Alaska, and northern Canada including the high arctic islands. The focal point is of course the Arctic Ocean, the smallest, shallowest and coldest of the world's oceans and in many ways little more than an estuary of the North Atlantic. It consists of a roughly circular basin generally taken to include the Barents, Beaufort, Chuckchi, East Siberian, Greenland, Kara, Laptev and White seas, along with Hudson Bay and other tributary bodies of water. The latter is connected to the Pacific Ocean by the Bering Strait and to the Atlantic through the Greenland and Labrador seas. The Arctic Realm is bordered by the Nearctic and Palearctic realms to the south, and has affinities to both in terms of its fauna.

The Polar Ice Cap

The Earth's northern polar region is covered by floating pack ice (sea ice) over the Arctic Ocean, which for the purposes of this book are considered terrestrial. Portions of the ice that do not melt seasonally can become very thick, up to 3–4 m over large areas, with ridges of up to 20. One-year ice is usually around 1 m thick. With global warming, the extent of arctic ice has decreased about 4.2 per cent per decade since the 1980s.

The **polar bear** (*Ursus maritimus*) is the largest living bear species, as well as the world's largest land carnivore. It is distributed in low densities throughout the Arctic Circle. Although some occur in the permanent multi-year pack ice of the central Arctic basin, they are most common in the annual ice over the continental shelf and inter-island archipelagos that surround it. The southern limit of the range extends to the coast of Newfoundland in the north-western Atlantic, while the northernmost record is just 25 km from the geographic North Pole. At least some populations seem to be nomadic, moving on the ice from east to west in a large circumpolar loop that includes Greenland and Baffin Island and in the Old World runs chiefly inside the large islands of arctic Eurasia. Polar bears move south in winter and north in summer, following the food supply – mainly seals – as the ice breaks up and shifts. This movement helps to explain the failure until relatively recently of any country to take responsibility for the welfare of polar bear populations. The species has probably always been confined to arctic areas, although from time-to-time individuals have strayed to Iceland, the Norwegian mainland, Manchuria, and Japan. Those that have continuous access to sea ice are able to hunt throughout the year. However, those living in areas where the sea ice melts completely each summer are forced to spend several months on land, where they primarily fast on stored fat reserves until freeze-up. This use of land by polar bears during the ice-free season is increasing, at least in some areas. Intensive hunting of the species did not begin until the early seventeenth century, but then increased to such a degree that by 1850 it had been seriously depleted, particularly in the Spitsbergen area and on Novaya Zemlya. In addition, when most of the arctic whales had been exterminated men began to hunt the seals, which increased the hunting pressure on the polar bears as well. It soon became evident that polar bears were declining in number all over their range, including the New World. With increased protection populations began to recover, although 'subsistence harvesting' is still allowed in Alaska, Canada, and Greenland (but prohibited in Norway and Russia). Currently, it is the loss of arctic sea ice due to climate change that is the most serious threat.

Tundra

The vast arctic tundra is a circumpolar region in the far Northern Hemisphere, north of the boreal forest belt. It is here defined as comprising parts of northern coastal Scandinavia, northern coastal Russia, northern coastal Alaska, the Canadian High Arctic, and the islands of Greenland and Iceland.

The word 'tundra' usually refers only to areas where the subsoil is permanently frozen ('permafrost'). The lands within this region are typified by cold winters and cool summers, low precipitation, and an absence of trees. Biodiversity in the tundra is low, with the few plants and animals that manage to survive there being adapted to short growing seasons with long periods of sunlight, as well as to extreme cold, dark, snow and ice-covered winter conditions. Today they are essentially climax communities, with lichens serving as a basis for the existence of the large herds of reindeer or caribou (*Rangifer tarandus*), which in their turn are the staple winter food of the grey wolf (*Canis lupus*).

During prehistoric times the muskox (*Ovibos moschatus*) occurred throughout the Siberian and North American Arctic from the Urals east to Greenland and south as far as the ice sheets extended. It appears to have died out in Europe around 9000 years ago, and in Siberia around 2000 years ago. In the nineteenth century it was still to be found from Point Barrow, Alaska east across Canada to north-eastern Greenland and south to north-eastern Manitoba. By the early twentieth century it had been wiped out in Alaska by excessive hunting, but has made a considerable recovery in other areas. In the Canadian arctic they now inhabit most large islands (with the exception of Baffin Island) and the mainland tundra of the Northwest Territories and Nunavut from the coast of Hudson Bay west to almost the Mackenzie River, south to the tree line. They still occur naturally over the entire north of Greenland, in addition to several introduced populations further south. The species has also been reintroduced to parts of Alaska (beginning with Nunivak Island as early as 1935), Norway, and the Taimyr Peninsula and Wrangel Island in Russia. Taken together the species appears to be safe.

The reindeer (*Rangifer tarandus*), also known as the caribou in North America, is a type of deer found, as a species, both in the northernmost regions of North America and Greenland as well as in northern Eurasia. Despite this wide range many subspecies are threatened, and a few have already gone extinct. The Barren Ground caribou (*R. t. groenlandicus*) is found in the Canadian High Arctic islands (Nunavut and Northwest Territories) and western Greenland. The Peary caribou (*R. t. pearyi*) is found in the Canadian High Arctic islands (Nunavut and Northwest Territories). The Labrador caribou (*R. t. caboti*) occurs in the tundra regions of Quebec and Labrador. The Porcupine caribou (*R. t. granti*), so-named for the Porcupine River which runs through much of its range, lives in northern Alaska and adjacent north-western Canada (Yukon). The single herd of around 200,000 animals migrates some 2400 km each year between their winter range and their calving grounds near the Beaufort Sea, the longest land migration route of any mammal. It is highly vulnerable to climatic factors, and the population fluctuates greatly as a result. The Siberian tundra reindeer (*R. t. sibiricus*) is still found across much of northern Eurasia, but has been supplanted almost everywhere by domesticated reindeer. The largest remaining population of wild reindeer in the Old World lives in the Pyasina River drainage on the Taimyr Peninsula in north-central Siberia, where the number of individuals exceeds 100,000 as a result of partial protection.

The **snowy owl** (*Bubo scandiacus*) still has a considerable range across predominantly open tundra regions from western Scandinavia through northern Russia to Alaska, northern Canada, and Greenland. It has also bred occasionally in Iceland and in the United Kingdom. During the winter the birds move further south into the mainland United States, northern Europe, and northern Asia. The species appears to be undergoing a considerable decline in population, however, and is now thought to number less than 30,000.

The **Siberian crane** (*Leucogeranus leucogeranus*) is a large and spectacular snow-white species historically spread over an immense area from the Ural River in the south-east to the coast of the Arctic Ocean in north-eastern Siberia, where it favours bogs in conifer forests and steppes. Although long protected by law over most of its range, it was much persecuted and disturbed by hunters over its long migration routes and, like the more famous whooping crane (*Grus americana*) of North America, had difficulty maintaining its numbers. By the mid-twentieth century it was already reduced to two widely separated groups, known as the Eastern Flyway and Western/Central Flyway populations. The vast majority, the Eastern Flyway population, breed in the Yakutia region of north-eastern Arctic Russia between the Kolyma and Yana rivers and south to the Morma Mountains. Younger, non-breeding birds summer in Dauria on the border between Russia, Mongolia, and China, and occasionally in central Mongolia as well. The main wintering sites were formerly in the middle to lower reaches of the Yangtze River, although today almost all winter at or near Lake Poyang in China. The birds rely on a network of important wetlands along their migration route, which follows the Yana, Indigirka, and Kolyma rivers before continuing along the Aldan River and its tributaries and south into China. The other, remnant population of Siberian cranes (less than 20 birds) breeds in West Siberia and is divided into two further subpopulations, the Western Asian Flyway and Central Asian Flyway flocks. The Central Asian flock breeds in the Kunovat River drainage in Russia, and historically wintered in Keladeo National Park, north-western India. None have been seen at Keoladeo since the early 2000s, although unconfirmed but credible reports of passing birds continue from Russia, Uzbekistan, Kazakhstan, Pakistan, and India. The Western Asian flock breeds in the Konda and Alymka river drainages of West Siberia, and winters in Fereydoonkenar in Iran. It uses the Volga River delta as a migration stopover, and passes over Azerbaijan during its migration. Captive-breeding and reintroduction efforts have recently begun in Iran. Currently, the total population for the species as a whole is about 3750, up from less than 2000 in 1965.

The **red-breasted goose** (*Branta ruficollis*) breeds on the Taimyr, Gydan, and Yamal peninsulas of north-central Russia. Prior to the 1950s much of the population wintered along the western coast of the Caspian Sea, primarily in Azerbaijan, and in Iran and Iraq, although the wintering grounds thereafter rapidly shifted to the western Black Sea coast. The total number is small and prone to dramatic fluctuations for reasons that are not fully understood.

The **lesser white-fronted goose** (*Anser erythropus*) historically bred across much of subarctic Eurasia but is now confined to four main areas of northern Scandinavia and the northern coast of Siberia, from where it migrates in winter to Europe, the Middle East, and southern Asia. It has undergone a significant decline due to by-catch mortality in gillnets, oil pollution, disease, and hunting.

The **long-tailed duck** (*Clangula hyemalis*) has a circumpolar distribution, breeding along the arctic coasts of North America, Greenland, Iceland, Europe, and Asia, from where it winters in the north-eastern United States, north-western Europe, and in central and western coastal Asia. It is threatened by hunting, fisheries by-catch, pollution, and disease.

Steller's eider (*Polysticta stelleri*) is a small sea duck that breeds patchily along the northern coasts of Siberia and Alaska, from where it winters in Novaya Zemlya, Norway, south-western Alaska, and northern Japan. It has undergone a significant decline, particularly in Alaska, due to hunting, habitat destruction, and possibly the effects of climate change.

The **Eskimo curlew** (*Numenius borealis*) was historically abundant in its breeding grounds on the barren tundra of Canada north of the Arctic Circle, roughly between the Bathurst Peninsula and Point Lake and perhaps extending into Alaska. It migrated southward across Hudson Bay to Labrador and New England, whence it started its non-stop flight over the Atlantic Ocean and the Caribbean Sea to winter in southernmost South America. The spring flight followed a more westerly route, because there are records indicating a flyway passing over Yucatán, Texas, and west of the Great Lakes to north-western Canada. Hence, it flew twice a year across both Americas. Excessive shooting during the migration in eastern Canada and New England is thought to account for the tragic decline of this species. In 1863 over 7000 birds were killed in one day on Nantucket Island. As late as the period between 1856 and 1875 immense flocks used to rest in Texas, but by 1905 only three birds were seen there. Hecatombs of these curlews were shot as they migrated across the United States. Hunters sent wagonloads of birds back from the shooting grounds. They were very easy to kill, because they fed close together and were trustful of humans. In 1929 A. C. Bent, in his *Life Histories of North American Shore Birds*, declared of the curlew: 'It is now but a memory of the past.' However, in 1932 an individual was taken in Newfoundland, and a week later four were seen on Long Island. It was last confirmed from its wintering grounds in South America in 1939. Sporadic sight records followed elsewhere at long intervals: 1945, 1946, 1950, 1959, 1960, 1962, 1963, and 1970 on the coast of Texas and Louisiana as well as on the Atlantic coast. Some of these are doubtful, but in 1963 one bird was shot with certainty in Barbados. While there have been several unconfirmed reports in the decades since, with the latest alleged sighting occurring in Barbados as recently as 2012, the species is now almost certainly extinct.

A related species, the **bristle-thighed curlew** (*N. tahitiensis*), breeds in the tundra on the lower Yukon River and the central Seward Peninsula of western Alaska, wintering on various islands in the South Pacific. The total population is estimated at around 10,000.

Two migratory wading birds of the genus *Calidris* are threatened by coastal development in their wintering grounds. The **spoon-billed sandpiper** (*C. pygmaea*) breeds in north-eastern Russia and winters in South East Asia, where it has declined dramatically since the 1970s. The current total population is believed to be around 500. The **great knot** (*C. tenuirostris*) breeds in north-eastern Siberia and winters mainly in Australia, but also patchily throughout the coastal areas of South and South East Asia and the Arabian Peninsula.

Figure 1.1 One of four known photos of a living Eskimo curlew, taken on Galveston Island, Texas, in 1962. (Credit: Don Bleitz, courtesy of the archives of the Western Foundation of Vertebrate Zoology, Camarillo, California.)

Coasts and Satellite Islands

This section includes the coastal areas of northern Russia, northern Alaska, and northern Canada (along with the High Arctic islands), as well as Greenland, Iceland, and various smaller islands.

The **walrus** (*Odobenus rosmarus*) is a very large, flippered marine mammal characterized by its tusks and whiskers, which it uses to help obtain the molluscs upon which it feeds. It is still found across a large area of polar seas, although its distribution was much reduced as a result of the severe exploitation that began in the sixteenth century. It was not until the introduction of modern firearms and arctic transport, however, that the species began to be seriously threatened. It was considered an important natural resource, yielding oil, hides, and ivory. Now somewhat protected from hunting, it still faces an uncertain future due to habitat changes brought on by climate change. The Atlantic walrus (*O. r. rosmarus*) was historically common along the coasts of the North Atlantic and the Arctic Ocean southward to the Russian and Norwegian mainland and, in the Western Hemisphere, to the coast of Labrador, with vagrants being reported as far south as New England and the Bay of Biscay. Today it is found discontinuously from the eastern Canadian Arctic and Greenland to the western Kara Sea. The Pacific walrus (*O. r. divergens*) recovered remarkably from a seriously depleted state in the mid-twentieth century, and currently ranges from the Bering and Chukchi seas, which constitutes the core of its range, to

the Laptev Sea in the west and the Beaufort Sea in the east. Vagrants are occasionally reported in the North Pacific south to Japan and south-central Alaska.

The **hooded seal** (*Cystophora cristata*) is so-named for an inflatable sac found on the head of adult males. It lives on drifting pack ice in the Arctic Ocean and the central and western North Atlantic, ranging from Svalbard in the east to the Gulf of St. Lawrence. Prior to the 1940s adults were hunted extensively for their leather and oil, and the young for their distinctive blue and black pelts. The animals are also frequently killed for subsistence hunting. Numbers have increased in most areas with better protection in recent decades, which includes an allowable catch limit of 10,000 annually, but the species remains vulnerable to the effects of climate change.

The Ungava harbour seal (*Phoca vitulina mellonae*) is a freshwater species confined to a few lakes and rivers in northern Quebec, where the total population is thought to be less than 100.

The harp seal (*Pagophilus groenlandicus*) occurs in the northernmost parts of the Atlantic and throughout much of the Arctic Ocean. The species is strongly migratory, with the main breeding grounds in the White Sea, on the pack ice in Norwegian waters (particularly off Jan Mayen), off Labrador and northern Newfoundland, and in the Gulf of St. Lawrence. At the beginning of the twentieth century and even as late as the early 1940s the world population was estimated at about 10 million. Owing to reckless hunting this number had fallen to about 3 million within 20 years, where it has remained more or less stable ever since. A particularly cruel and barbaric form of commercial sealing, in which the pups are brutally bludgeoned for their fur, still takes place annually in Canada, Norway, Russia, and Greenland. The destruction is particularly marked in Newfoundland, where the small profit earned by seasonal hunters is far outweighed, economically, by the enormous damage done to Canada's international reputation.

The Arctic Archipelago

The Arctic Archipelago includes all of the high arctic islands lying to the north of the Canadian continental mainland, with the exception of Greenland.

Two subspecies of grey wolf (*Canis lupus*) historically inhabited the Arctic Archipelago. Bernard's grey wolf (*C. l. bernardi*) is known only from a few specimens collected from Banks and Victoria islands, where it died out around 1920. The Arctic wolf (*C. l. arctos*) is confined to the Queen Elizabeth Islands, but is not currently considered to be threatened.

Greenland

Greenland (Kalaallit Nunaat in Greenlandic; Grønland in Danish) is the world's largest island. It is almost entirely covered by a massive ice sheet, the weight of which has depressed the central land area to form a basin lying more than 300 m below sea level. Elevations along the more temperate coasts rise suddenly and steeply.

The East Greenland caribou (*Rangifer tarandus eogroenlandicus*) appears to have been confined to the tundra regions of eastern Greenland, where it went extinct around 1900.

Svalbard

Svalbard is an archipelago located about midway between Norway and the North Pole. Originally used as a whaling station during the seventeenth and eighteenth centuries, today the only permanently inhabited island is Spitsbergen.

The Svalbard reindeer (*Rangifer tarandus platyrhynchus*), the smallest of all the reindeer, is confined to the Svalbard Archipelago.

Novaya Zemlya

Novaya Zemlya is an archipelago in the Arctic Ocean of northern Russia and extreme north-eastern Europe. It is composed of two main islands, the northern Severny Island and the southern Yuzhny Island.

The Novaya Zemlya reindeer (*Rangifer tarandus pearsoni*) is confined to the archipelago. At the end of the nineteenth century there were about 20,000 reindeer on Novaya Zemlya. Heavily hunted both for local consumption as well as export, they would be reduced, only a few decades later, to just a handful of survivors on the northeastern part of Severny Island. Fortunately, a prohibition on hunting was put in place in time to save the subspecies, and it has since recovered.

Wrangel Island

Wrangel Island is located in the Arctic Ocean between the Chukchi and East Siberian seas.

The **Wrangel lemming** (*Lemmus portenkoi*) and **Wrangel collared lemming** (*Dicrostonyx vinogradovi*) are both confined to Wrangel Island, where they are considered intrinsically vulnerable due to their small range and marked population fluctuations.

Balance for the Arctic Realm

The Arctic Realm was among the last places on Earth to be permanently settled by humans. The first to live there arrived in Siberia around 20,000 years ago, from where they slowly migrated eastward across the Bering Strait land bridge to North America and, finally, Greenland. These prehistoric peoples were, and largely remain, nomadic hunter-gatherers, entirely dependent on the reindeer herds and marine mammals for sustenance. They ultimately developed into the Inuit, a group of culturally similar indigenous people that live throughout the region today.

Modern European exploration of the Arctic Realm also began relatively late. Greenland was first reached (and partially mapped) as early as 1499 by the Portuguese explorers Gaspar and Miguel Corte-Real. After that, exploration was undertaken either by land east from Russia, or by western Europeans seeking a Northwest Passage to the Old World. The latter

would result in the mapping of what is now the Canadian High Arctic, Alaska, and the islands of the northern Pacific. By the early twentieth century the focus was the North Pole. In 1908–09 the Americans Frederick Cook and Robert Peary each claimed to have reached it, although both are now widely doubted. In 1926 Roald Amundsen, Lincoln Ellsworth, and Umberto Nobile in the airship *Norge* became the first definitely known to have sighted the North Pole. With the coming of Europeans to the Arctic during the nineteenth and twentieth centuries, pollution and hunting began to take more of a toll, particularly on large animal populations. However, the latter were also responsible for the creation of the first national parks and environmental protections. The northern polar region remained relatively pristine up until very recently. Indeed, it still contains some of the last, and most extensive, wilderness areas remaining in the world. Today, however, the Arctic is being opened up at an increasing pace for exploitation of its vast wealth of natural resources, which include oil, natural gas, minerals, fish, and, to some extent, forests. Settlement and tourism will only increase as human populations continue to expand, perhaps encouraged by the Arctic's extraordinary abundance of freshwater (about one-fifth of the world's total). All of this will be to the detriment of its sensitive environment, fragmenting habitats, eroding ground cover and disturbing important breeding grounds. The primary threat, however, is now global warming, with the consequent shrinkage (and ultimately perhaps complete loss) of arctic sea ice and the Greenland ice sheet, as well as the thawing of permafrost.

In recent historical time (i.e. since A.D. 1500), the Arctic Realm has lost three subspecies of mammal and one species of bird. In addition, there are 14 species/9 subspecies currently threatened with extinction (that is to say, either Critically Endangered, Endangered or Vulnerable according to the IUCN Red List, as well as certain forms either listed as Data Deficient or Not Assessed but which are clearly at some risk of extinction). Of these, 5 species/9 subspecies are mammals, and 9 species are birds.

Vertebrate Class	Extinct	Possibly extinct	Extinct in the Wild	Threatened
Mammals	~ species	~ species	~ species	5 species
	3 subspecies	~ subspecies	~ subspecies	9 subspecies
	3 taxa	~ taxa	~ taxa	14 taxa
Birds	1 species	~ species	~ species	9 species
	~ subspecies	~ subspecies	~ subspecies	~ subspecies
	1 taxon	~ taxa	~ taxa	9 taxa
Total vertebrates	1 species	~ species	~ species	14 species
	3 subspecies	~ subspecies	~ subspecies	9 subspecies
	4 taxa	~ taxa	~ taxa	23 taxa

Note: ~, not applicable.

Chapter

2 The Palearctic Realm

The Palearctic Realm, as here defined, is divided into three zoogeographic regions (Eurasian, Saharo-Arabian, and Sino-Himalayan) that together comprise all the Old World terrestrial areas as far south as northern Africa, the Middle East, the mountains of Central Asia, and into southern China and the islands of Japan.

The **tiger** (*Panthera tigris*) is the largest cat species and, with its striped fur pattern, the most instantly recognizable. A number of subspecies once ranged collectively across much of Asia from the Black Sea in the west to the Indian Ocean in the south, and from the Russian Far East to Indonesia. Over the past century they have lost at least 93 per cent of their historic range and have been extirpated from Western and Central Asia, the islands of Java and Bali, and from large areas of south-eastern, southern, and eastern Asia due to habitat destruction and hunting (both for trophies as well as use in 'traditional medicine').

The **snow leopard** (*Panthera uncia*) has a wide but scattered distribution in the high mountains of Central and South Asia, with core areas including the Altai, Tian Shan, Kun Lun, Pamir, and Karakorum ranges. The species has declined everywhere owing to persistent illegal hunting for its beautiful and valuable fur and for its bones, which are used in 'traditional medicine'. The **leopard** (*P. pardus*) has, as a species, the largest distribution of all wild cats, occurring widely if patchily across most of Africa as well as eastern and southern Asia. Nevertheless, a number of subspecies have been largely or wholly wiped out.

Prehistoric fossil remains of the **Asiatic black bear** (*Ursus thibetanus*) have been discovered at various localities in Europe as far north as the Ural Mountains and in Germany and France, although in historic times the species has been limited to Asia, where it remains widespread, if patchily distributed, in a variety of forest types. Habitat loss combined with hunting for skins, paws and, increasingly, for gall bladders used in 'traditional medicine' have all contributed to declines, and several subspecies are considered threatened. The Indochinese black bear (*U. t. mupinensis*) is still found over a wide area of the Himalayas and Indochina. The Ussuri black bear (*U. t. ussuricus*) lives in southern Siberia, north-eastern China, and on the Korean Peninsula.

The grey or timber wolf (*Canis lupus*) was, historically, the world's most widely distributed animal species, being found across much of the Old and New Worlds. While the nominate form, the Eurasian grey wolf (*C. l. lupus*), is not considered threatened, a few other generally recognized subspecies do have limited distributions and will be discussed below. Another, the Ezo grey wolf (*C. l. hattai*), once ranged across Hokkaido, Sakhalin, the Kamchatka Peninsula, and the Kuril Islands, but appears to have gone extinct sometime during the late nineteenth century.

The **Asiatic wild dog** or **dhole** (*Cuon alpinus*) was historically found throughout much of central, eastern and southern Asia but has disappeared from most of these areas. Surviving populations are fragmented and continue to decline due to habitat destruction and depletion of their prey base. The Ussuri wild dog (*C. a. alpinus*) remains widespread on the Indian subcontinent and Indochina, but is most likely extirpated from China, Mongolia, and the Russian Far East.

The **aurochs** (*Bos primigenius*) was an impressive species of wild cattle that once inhabited the forests and grasslands of Europe, Asia, and North Africa. A large animal (modern bulls weighed around 700 kg), it was the ancestor of European domestic cattle and, it has been suggested, possibly of the European bison (*Bison bonasus*) as well. There were three subspecies. The North African aurochs (*B. p. africanus*) and the Indian aurochs (*B. p. namadicus*) were both extinct before about A.D. 1500 owing to the destruction of forests, competition from domestic animals, and hunting. The Eurasian aurochs (*B. p. primigenius*) survived somewhat longer. Historically it was found from the British Isles and Scandinavia in the north-west to the Mediterranean countries in the south and Siberia and Syria in the east; by the thirteenth century it was restricted to Russia, Poland, Lithuania, Moldova, Transylvania, and East Prussia. By 1409 only Poland and perhaps Russia seem to have possessed surviving populations. Efforts to preserve these magnificent animals were made in the former country, and a small herd persisted in the Jaktorów Forest near Warsaw until the beginning of the 1620s. In 1627 the last individual there, a female, died. Beginning in the 1920s, attempts were made to create look-alikes by means of selective breeding. More recently, a project to 'breed back' cattle that not only resemble aurochs but can fill their ecological role, through eventual reintroductions to the wild, have been explored.

The **Asiatic wild ass** (*Equus hemionus*) was originally found throughout the steppes and deserts of central Asia and

the Middle East, but has been almost entirely eliminated everywhere due to competition with livestock and overhunting. Five subspecies survive in isolated pockets, which will be discussed below. The **wild horse** (*E. ferus*), which once ranged across the steppes and grasslands of Europe and Asia, had three subspecies that survived into modern times: the domesticated horse (*E. f. caballus*), the undomesticated Eurasian wild horse or tarpan (*E. f. ferus*), now extinct, and the still-extant Mongolian wild horse (*E. f. przewalskii*). The latter two will be discussed below. The term 'wild horse', incidentally, is also used colloquially in reference to free-roaming herds of feral horses such as the mustang in the United States and the brumby in Australia, but these are all untamed members of the domestic horse subspecies, and not to be confused with true wild horse subspecies.

The **wild goat** (*Capra aegagrus*) is the ancestor of the domestic goat (*C. hircus*). Nominally widespread in the high rocky and mountainous areas of Europe, Asia Minor, the Middle East and Central Asia, it is everywhere rare and often absent in many parts of its former range. Threats include hunting (particularly for its majestic curved horns) and loss of habitat. The bezoar wild goat (*C. a. aegagrus*) is found sporadically in central Afghanistan, Armenia, Azerbaijan, Georgia, Turkmenistan, Iran, Turkey (Anatolia), and possibly extreme northern Iraq. It was extirpated from Syria and Lebanon in the early twentieth century.

The **marbled polecat** (*Vormela peregusna*) inhabits deserts, semi-deserts and steppe habitats from south-eastern Europe through central Asia to northern China and south to the Middle East. Although widespread, it has declined everywhere due primarily to loss of habitat.

The **Japanese sea lion** (*Zalophus japonicus*) was historically confined to the region of the Sea of Japan, more than 8000 km from the nearest colonies of its closest relative, the California sea lion (*Z. californianus*). It was known for certain from Kyushu, Shikoku, and on islands around Honshu. The last credible reports were from 1951, when 50 or 60 of these animals lived around Takeshima, a rocky islet in the open sea between Japan and Korea, but these soon disappeared after the island was occupied by soldiers. There have been no documented reports whatsoever since the late 1950s despite extensive search efforts. Individual sightings in 1974 and 1975 cannot be verified, nor can confusion with escaped California sea lions be ruled out.

The **Mediterranean monk seal** (*Monachus monachus*) was historically found continuously on the coasts and islands of the Black Sea and along those of the Mediterranean to North Africa and the major islands of the North Atlantic. Hunting, pollution, and disturbances in the caves where it breeds led to a severe decline during the twentieth century. It has been extinct in the Black Sea since the 1990s (although a few may still survive in the Sea of Marmara), and today only a few small, isolated colonies exist in the Mediterranean itself, mainly in the Ionian and Aegean seas, the coast of mainland Greece, Cyprus, and western and southern Turkey. An unknown number may still survive as well on the Mediterranean coasts of eastern Morocco and perhaps Algeria. It was formerly to be found in North Atlantic waters as well from Morocco to Cabo Blanco, including the Canary Islands, Madeira Islands, and the Azores. Vagrants have been reported as far south as Senegal, the Gambia and the Cape Verde Islands, and as far north as Portugal and the Atlantic coast of France. Today, only two Atlantic subpopulations are known to exist: one at Cabo Blanco on the Mauritania/Western Sahara border, and the other in the Madeira Islands. The total population is thought to be under 500.

The **Eurasian otter** (*Lutra lutra*) remains extremely widespread in the lakes, rivers, and coastal waters of Europe, Asia, and northern Africa. Nevertheless, the species has disappeared from many areas due mainly to chemical pollution in the water which is then absorbed by fish. The otters, which prey chiefly on fish, rapidly build up a fatal dosage of poisonous compounds. The species has recovered in many areas where water quality has improved, but continues to be threatened in others.

The sable (*Martes zibellina*) is a type of mustelid that historically ranged throughout the forests of Eurasia. Long hunted for its highly valued fur, the species has been extirpated from Europe but can still be found from the Urals to northern Japan, and is not currently considered to be threatened.

The **long-fingered mouse-eared bat** (*Myotis capaccinii*) is widespread across the Mediterranean region and the Middle East, but highly dependent upon wetlands for hunting and caves for roosting. While loss of habitat is the main threat, the species is additionally collected in northern Africa for use in 'traditional medicine'. **Felten's mouse-eared bat** (*M. punicus*) is found from Morocco to western Libya, with isolated populations on Corsica and Sardinia. It is threatened in northwestern Africa by destruction of its cave roosts by fire and vandalism, and by overcollection for 'traditional medicine'.

Mehely's horseshoe bat (*Rhinolophus mehelyi*) is found discontinuously around the Mediterranean Sea from northwestern Africa and the Iberian Peninsula through the Balearic Islands, southern France, Sardinia, Sicily, the Balkan Peninsula, and Asia Minor. A cave-roosting species, it is vulnerable to disturbance and destruction of its large colonies.

Steller's sea eagle (*Haliaeetus pelagicus*) breeds on the Kamchatka Peninsula and in the coastal area around the Sea of Okhotsk, as well as on the lower reaches of the Amur River and on northern Sakhalin. The majority winter in the southern Kuril Islands and on Hokkaido. In 2012 the total population was estimated at between 4600 and 5100 and continues to decline due to habitat degradation, pollution, poisoning, and overfishing. **Pallas' fish-eagle** (*H. leucoryphus*) has a peculiar, essentially land-locked distribution for a sea eagle, being found sporadically in wetland areas throughout central and southern Asia. The total population, estimated at less than 2500, is threatened by human persecution and loss of habitat.

The **eastern imperial eagle** (*Aquila heliaca*) has an extensive distribution, breeding in south-eastern Europe and through western and central Asia, from where many

populations migrate in winter to north-eastern Africa, the Middle East, and southern Asia. The total population is small, however, and sensitive to human influence. The **steppe eagle** (*A. nipalensis*) has a similarly large distribution, breeding across much of central Asia and migrating at other times over much of Africa and southern Asia. It has undergone particularly rapid declines in its European range and has been extirpated from many areas.

The **greater spotted eagle** (*Clanga clanga*) is an extremely widespread if nevertheless rare Palearctic species that favours boreal forests near wetlands for breeding, at other times migrating as far south as North Africa and South East Asia. It is threatened mainly by hybridization with lesser spotted eagles (*C. pomarina*) and habitat destruction.

The **Egyptian vulture** (*Neophron percnopterus*) is a small species still found over a wide area of southern Eurasia, Africa, and south-western Asia, where it is divided into three subspecies. The nominate form (*N. p. percnopterus*) is found from southern Europe and northern Africa to north-western India, where it has suffered significant declines due to poisoning, habitat destruction and disturbance, and collisions with wind turbines.

The osprey (*Pandion haliaetus*) is a large, fish-eating hawk with an unusual, nearly global distribution. The Palearctic osprey (*P. h. haliatus*) is still found over much of Europe, Africa, and Asia. During the late nineteenth and early twentieth centuries it was threatened by egg collectors and hunting. Later, during the 1950s and 1960s, it underwent a precipitous decline due to the toxic effects of insecticides such as DDT on its reproduction. It recovered quickly in many countries after the banning of DDT in the early 1970s, and is no longer considered threatened.

The **saker falcon** (*Falco cherrug*) breeds from central Europe east to Manchuria, migrating from there to Ethiopia, the Arabian Peninsula, northern Pakistan, and western China. It has declined rapidly in recent years, particularly in central Asia, mainly due to habitat destruction and illegal capture for use in Arab falconry. The peregrine falcon (*F. peregrinus*) is notable for being the fastest bird in the world and, indeed, the fastest member of the animal kingdom. Like the osprey, it too is found nearly globally, but was at one time threatened by pesticide spraying. It is no longer considered threatened.

The **great bustard** (*Otis tarda*), one of Eurasia's most spectacular birds, was originally a species of the steppes but has adapted somewhat to agricultural landscapes. Nevertheless, it has it has suffered serious declines owing to habitat fragmentation and hunting.

The **Asian houbara bustard** (*Chlamydotis macqueenii*) is found in desert and steppe regions from east of the Sinai Peninsula to Mongolia. Ruthlessly hunted across its wide range, it was considered great sport in colonial India in particular. However, it was not until the introduction of modern firearms and jeeps that the major population declines really got underway. In 1971, for example, one hunting party alone killed 2000 of the birds in Pakistan. The species was very nearly driven to extinction in the Middle East and other areas, and although better protected now both legal hunting as well as poaching continues in the Arab world, where the meat is unfortunately considered to be an aphrodisiac.

The **red-crowned crane** (*Grus japonensis*) is divided into two separate populations. The first breeds in south-eastern Russia, north-eastern China, and Mongolia, and winters mainly in the Yellow River delta, coastal China, and in the Korean demilitarized zone. The second lives and breeds in eastern Hokkaido, Japan, and is non-migratory. The latter population is stable or slightly increasing, while the continental one is severely declining owing to loss and degradation of wetlands through conversion to agriculture and industrial development. The total world population is estimated at around 3000. The **black-necked crane** (*G. nigricollis*) is a medium-sized species that breeds among the alpine bog meadows of the Tibetan Plateau and remote parts of Ladakh, India, with some populations wintering in Bhutan. The total population, around 10,000, is threatened mainly by loss of habitat.

The **white-naped crane** (*Antigone vipio*) breeds in far south-eastern Russia, Mongolia, and northern China, from where it migrates to eastern China, the Korean Peninsula, and southern Japan. It has undergone a considerable decline due to loss of wetlands.

The **oriental white stork** (*Ciconia boyciana*) was once common in eastern Siberia, China, the Korean Peninsula, and Japan, but declined to the point of extinction by the mid-twentieth century due to loss of habitat and heavy hunting. Today it breeds mainly in the Amur and Ussuri river drainages along the Russia/China border, with smaller numbers in the lower reaches of the Wuyuerhe River in Heilongjiangg province. The main wintering grounds are in the lower Yangtze drainage and in southern China as far south as Taiwan and Hong Kong. Small numbers are still found in the Koreas and Japan and irregularly in the Philippines, north-eastern India, Myanmar, and Bangladesh. The total population is thought to be around 3000.

The **northern bald ibis** or **waldrapp** (*Geronticus eremita*) is a large, distinctive species that was historically widespread across the Middle East, northern Africa, and southern and central Europe. Fossil material has been found dating as far back as 1.8 million years, and the ancient Egyptians were sufficiently familiar with the bird to use it as a hieroglyph, so it must have been common in Egypt some thousands of years ago. Long persecuted by humans in their cliff-side breeding colonies, the species has also declined owing to a number of other factors including loss of habitat and pesticide poisoning. It disappeared from Europe over three centuries ago, and since the beginning of the twentieth century has been confined to disjunct populations that may ultimately be revealed to be distinct subspecies: a western one in North Africa, and an eastern one in the Middle East. In North Africa the species had colonies throughout the Atlas Mountains, from where it formerly migrated each year to Europe. It disappeared from

Algeria in the 1980s, but still has a stronghold in southern Morocco, with three breeding subcolonies in Souss-Massa National Park and another major one at nearby Tamri, totalling around 500 in all. The eastern population bred in Syria, where it was described as still fairly common as recently as the 1980s. From there it migrated south through Jordan, Saudi Arabia, and Yemen, wintered in central Ethiopia, then migrated back to Syria through Eritrea, Sudan, Saudi Arabia, and Jordan. Long believed to have died out; in 2002, however, a tiny colony consisting of just seven individuals was rediscovered at Palmyra. Unfortunately, as of 2015 it appears that these birds, too, have been extirpated. A semi-wild population numbering around 100 still exists at Birecik, southern Turkey. The species has long been established in captivity, and limited reintroduction programmes have been attempted at sites in Austria, Spain, and Morocco.

The **Asian crested ibis** (*Nipponia nippon*) historically nested in the Russian Far East, Japan, and mainland China, and was a non-breeding visitor to the Korean peninsula and Taiwan. It is now extinct over virtually all of its former range. There is a fairly successful captive breeding programme in Asia, but the only known remaining wild populations are in central China (Shaanxi), along with a reintroduced one on Sado Island in Japan.

The **Chinese egret** (*Egretta eulophotes*) breeds on small islands off the coasts of far-eastern Russia, the Korean Peninsula, and mainland China, and winters among the shallow tidal estuaries, mudflats, and bays of South East Asia. The species was almost brought to extinction during the nineteenth century by plume hunters. Despite this the persecution continued, and by the 1960s there were only scattered reports of its existence, mainly on the coast of the Yellow Sea. In recent years numbers have stabilized at between 2600 and 3400, although since the mid-1980s all breeding records have been from small, uninhabited offshore islands.

Saunder's gull (*Saundersilarus saundersi*) breeds mainly in eastern coastal China and sporadically at various sites on the south-western coast of South Korea, from where it migrates to eastern and southern China, Taiwan, western Japan, and Vietnam. It is threatened by the loss of tidal flats and salt marshes due to coastal development.

The **black-faced spoonbill** (*Platalea minor*) is a type of wading bird that breeds only on islets off the western coast of the Korean Peninsula and north-eastern China, from where they winter in parts of southern China (Taiwan, Macau, and Hong Kong), Japan, Vietnam, Cambodia, Thailand, and the Philippines. The species has long been rare and declining due to habitat destruction and pollution, reaching an all-time population low in the 1990s, but has since recovered somewhat.

One of the most shameful examples of mindless extermination is that of the **great auk** (*Pinguinus impennis*). This flightless, penguin-like bird at one time occurred widely in massive breeding colonies on the islands of the North Atlantic as well as on the western European, north-western African and eastern North American coasts. First discovered in 1534, its persecution began almost immediately. Vast numbers were slaughtered by ship's crews who drove them into stone pens where they were killed, or directly to their ships, where they were cooked to extract the fat bird's oily substances. Many ships also used the birds as fuel under pots in which other auks were being cooked. Finally, the nestlings were used as bait in fishing and eggs were collected for food. When the species became rare, museums and private collections hurried to get their share of any remaining specimens and eggs. The last two birds were killed on Eldey Island off Iceland in 1844. Two sailors had found a nesting pair, and proceeded to strangle them before smashing the last egg with a boot.

The **swan goose** (*Anser cygnoid*) has its key breeding grounds in south-eastern Russia, Mongolia, and northernmost China, with virtually the entire population wintering in the Yangtze floodplain of east-central China. While uncommon in the wild state the species has been domesticated, with introduced and feral populations occurring in many areas outside its natural range.

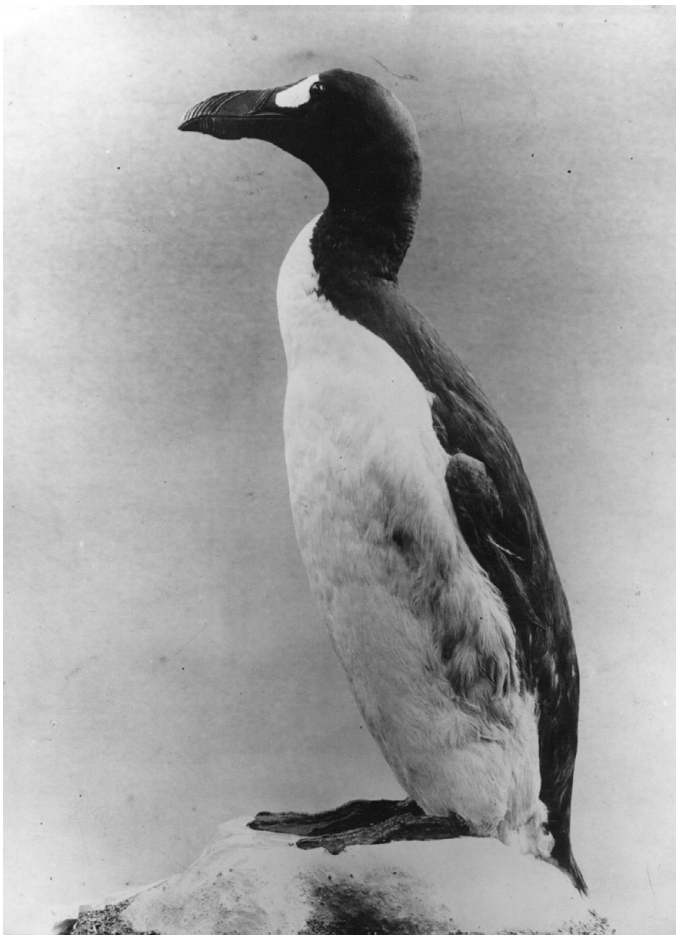

Figure 2.1 Great auk (mounted specimen). (Credit: Hulton Archive/Stringer/Getty Images.)

The **white-headed duck** (*Oxyura leucocephala*) breeds primarily in Russia and Kazakhstan as well as in smaller, more isolated areas of Spain, Algeria, Tunisia, and central Asia, from where it winters in the Middle East and south-central Asia. In the early twentieth century the total population likely exceeded 100,000, although this fell to an estimated 20,000 by 1996. The primary threat is competition and hybridization with introduced ruddy ducks (*O. jamaicensis*).

The **velvet scoter** (*Melanitta fusca*) is a type of duck that breeds in Scandinavia and western Siberia, from where it migrates to southern Europe and the Middle East. It has undergone considerable declines in recent decades, the reasons for which remain unclear.

The **northern pochard** (*Aythya ferina*) is a type of diving duck that still breeds across much of Eurasia, from where it winters in southern Asia and northern Africa. Another species, **Baer's pochard** (*A. baeri*), breeds in south-eastern Russia and northern China, from where it winters in southern Asia. Both are threatened by habitat destruction, hunting, the overcollection of eggs, and other factors.

The **scaly-sided merganser** (*Mergus squamatus*) is a type of sea duck that inhabits a variety of habitats in extreme south-eastern Russia, the Korean Peninsula, and north-eastern China, with most wintering in central and southern China. The species began to decline in the 1960s and 1970s due to deforestation, although in more recent decades illegal hunting has become the primary threat.

The **marbled teal** (*Marmaronetta angustirostris*) is a partially migrant species still found patchily across much of southern Europe, northern Africa, and western and central Asia, but has been significantly reduced due to loss of habitat and hunting.

The **crested shelduck** (*Tadorna cristata*) is known only from three museum specimens, one collected in Russia and the other two in South Korea. It was presumably familiar in Japan, as it was drawn by artists there during the nineteenth century. It was thought to be long extinct when a male and two females were sighted on islands south of Vladivostok in 1964. A further sighting of two males and four females was claimed in North Korea in 1971, although this seems unlikely. More recently there have been several unconfirmed reports from north-eastern China, leading to the theory that the species may breed in remote mountainous areas far inland, only travelling to the coasts at other times. In any case, if it still survives the total population must be quite small.

The **horned grebe** (*Podiceps auritus*) as a species is found over a wide area of the temperate Eurasia and North America. The Eurasian horned grebe (*P. a. auritus*) is everywhere declining due to the effects of human disturbance, loss of habitat due to deforestation around breeding lakes, and other factors.

The **slender-billed curlew** (*Numenius tenuirostris*) is only known to breed in a small area of south-central Russia, from where it winters in a few areas of northern Africa and the Arabian Peninsula. Last recorded in 2004, it may possibly be extinct.

The **sociable lapwing** (*Vanellus gregarius*) is a type of wading bird that breeds on the open grasslands of Russia and Kazakhstan, from where it migrates to certain key wintering sites in Israel, Syria, Eritrea, Sudan, and north-western India. It has undergone a serious decline since the mid-nineteenth century from hunting pressure and other, as yet poorly understood reasons.

The **European turtledove** (*Streptopelia turtur*) breeds over a wide area of the south-western Palearctic region, from where it migrates to sub-Saharan Africa to winter. Unfortunately, it has everywhere undergone a serious decline owing to a number of factors, including loss of foraging and nesting sites, disease, and hunting along its migration routes. Four subspecies are recognized. The northern turtledove (*S. t. turtur*) occurs from Europe (including the Madeira and Canary Islands) to western Siberia.

The **yellow-breasted bunting** (*Emberiza aureola*) was, historically, one of the most abundant passerine birds in Eurasia, breeding from northern and eastern Europe through Siberia, Kazakhstan, northern China and Mongolia to Far Eastern Russia, Korea, and northern Japan. During the autumn the birds would stop over in large numbers in the Yangtze Valley before continuing on to their wintering grounds in South and South East Asia. The species began to undergo a drastic decline during the early 1990s, most likely due to overcollection for food by mist net during migration, and has since disappeared from most or all of Finland, Belarus, Ukraine, and large areas of western Russia.

The **large-billed reed warbler** (*Acrocephalus orinus*), described as 'the world's least known bird', was long known only from a single specimen collected in north-western India (Himachal Pradesh) in 1867. The species was rediscovered in Thailand in 2006, and has since also been found in north-eastern Afghanistan, Tajikistan, and Bangladesh. It appears to be a rare long-distance migrant that breeds within the Palearctic Realm and winters in southern Asia. The **aquatic warbler** (*A. paludicola*) has a highly fragmented breeding range in the mires and marshes of Poland, Belarus, Ukraine, Germany, Lithuania, and western Russia, from where it migrates to western Europe and north-western Africa. The species suffered major declines in the second half of the nineteenth century due to habitat destruction, and further extirpations continue.

Pleske's grasshopper-warbler (*Locustella pleskei*) is a rare species that breeds on small islands in Peter the Great Bay of far-eastern Russia, the Izu Islands, and islands off Kyushu, Japan, the Korean Peninsula, and eastern China, from where it winters in southern China and Vietnam. It is threatened by habitat destruction.

Tristram's white-bellied woodpecker (*Dryocopus javensis richardsi*) is a large and spectacular subspecies historically found across the Korean Peninsula and on the Japanese island of Tsushima. It was extirpated from the latter due to intensive hunting and collection by museums, and became rare in Korea owing to deforestation. Despite being legally protected since

1952 it disappeared from South Korea by 1978, and today fewer than 50 still survive in a few areas of montane forest in North Korea.

The **spur-thighed tortoise** (*Testudo graeca*) occurs in a wide area of southern Europe, North Africa, and south-western Asia, in a varying number of subspecies. It is everywhere threatened by collection for use as pets.

Lataste's viper (*Vipera latastei*) is found patchily in both the Iberian Peninsula and north-western Africa, in a wide range of habitats and altitudes.

Sticklebacks (*Pungitius*) are freshwater, brackish or marine fish related to seahorses. The **Amur stickleback** (*P. sinensis*) remains relatively widespread through eastern Asia, but has disappeared from many areas due to pollution and the construction of flood control and dams, which can change the velocity of rivers and render them unsuitable for the species. The **short-spined ninespine stickleback** (*P. tymensis*) is confined to Sakhalin, the Kuril Islands, and Hokkaido (Japan), where it is threatened by loss of habitat and invasive species.

The Eurasian Region

The Eurasian Region spans half the Earth, including as it does virtually all of Scandinavia and Siberia (including the Kamchatka Peninsula, the Korean Peninsula, and islands of the northern Pacific), all of Europe (including most of the Mediterranean islands and the Anatolian and Balkan peninsulas), and much of central and western Asia. Although usually divided into two continents, Europe and Asia, this immense area is in fact a single physical complex that formed between 375 and 325 million years ago with the merging of three main landmasses. This in turn would be joined for a time to Laurentia (now North America) to form Euroamerica. Eurasia features a tremendous variety of topography, from Lake Baikal (the world's deepest lake) to some of the world's highest mountains. Its zones of climate range from subarctic through temperate to subtropical, and its vegetation from coniferous forest in the north through deciduous woodland, steppe, desert, and the Mediterranean maquis scrub in the central and south-western parts, to subtropical rainforests in the south-eastern parts. The great taiga is the world's largest forest, extending from the Scandinavian Mountains in the west to the Pacific Ocean in the east. Also, the steppes of Eurasia are larger than any other similar region. This extraordinary range of habitats within one continental block makes Eurasia very rich in animal species evolved over eons. The fact that this largest of continents was connected with Africa and America for long periods has also enriched the Eurasian fauna through animal migrations.

The history of the **European wood bison** or **wisent** (*Bison bonasus*) is almost as dramatic as that of its more famous American counterpart. A huge forest-dwelling animal, its disappearance is intimately connected with the retreat of the Eurasian deciduous forests. In prehistoric times it occurred over almost the whole of Europe east to the Lena and possibly existed in ancient Assyria, Mesopotamia, and Persia as well, which at that time were forested. Three subspecies are recognized, only one of which, the European lowland wood bison (*B. b. bonasus*), survives today. By the early twentieth century the latter had been reduced to a single herd of about 700 animals in the Bialowieza Forest of Poland, where they had long been protected. Because many of the animals there were tame, they became easy prey for invading troops during the First World War, who reduced the population to about 150. The last free individuals were shot in Bialowieza in 1921. Fortunately, some were preserved in zoos and their numbers were gradually built up again. But after World War II only 16 had survived in captivity at Bialowieza. They increased and in 1952 some were released back into the wild, the first to roam freely in one of Europe's last virgin forests for over 30 years. By the close of the 1960s there were over 1000 pure European bison, of which more than 215 lived in freedom in both Bialowieza and in the Zverevskoye Forest of north-western Ukraine. Since then they have been introduced into protected areas throughout western and eastern Europe with varying degrees of success, where today the total population is around 1500. There is a similar number in captivity worldwide.

The elk or wapiti (*Cervus canadensis*) is one of the largest species of deer. A number of subspecies are found across North America and north-eastern Asia, a few of which are threatened.

The reindeer (*Rangifer tarandus*), previously discussed in this volume, is a type of deer with a circumpolar distribution that has adapted itself to a number of different environments. While not threatened as a species a number of Eurasian subspecies are, and will be discussed below.

The Caspian tiger (*Panthera tigris virgata*) had at one time a wide range in the sparse forests south and east of the Black and Caspian seas, although the Pontic-Caspian steppe and into the deserts of central Asia. By the late 1960s intensive hunting and habitat destruction had wiped them out in most of these areas, and only a handful survived. It was last recorded in the early 1970s, and is now considered extinct.

The Siberian or Amur tiger (*P. t. altaica*), the largest of all the big cats, was formerly found throughout eastern Siberia, Mongolia, Manchuria, and the wooded parts of northern China, where it was adapted to the deep winter snows. Today it is confined to the Amur-Ussuri region in far-eastern Siberia, with the exception of a small population in Hunchun National Siberian Tiger Nature Reserve in north-eastern China, near the border with North Korea. In 2015 there was an estimated population of 480–540 in the Russian Far East.

The Amur leopard (*Panthera pardus orientalis*) is confined to cold regions of the Russian Far East and north-eastern China, having disappeared from its former range on the Korean Peninsula. Among the world's rarest animals, the total population is thought to be less than 100.

The Eurasian lynx (*Lynx lynx*) is found across most of Europe and Asia and is not considered threatened as a species,

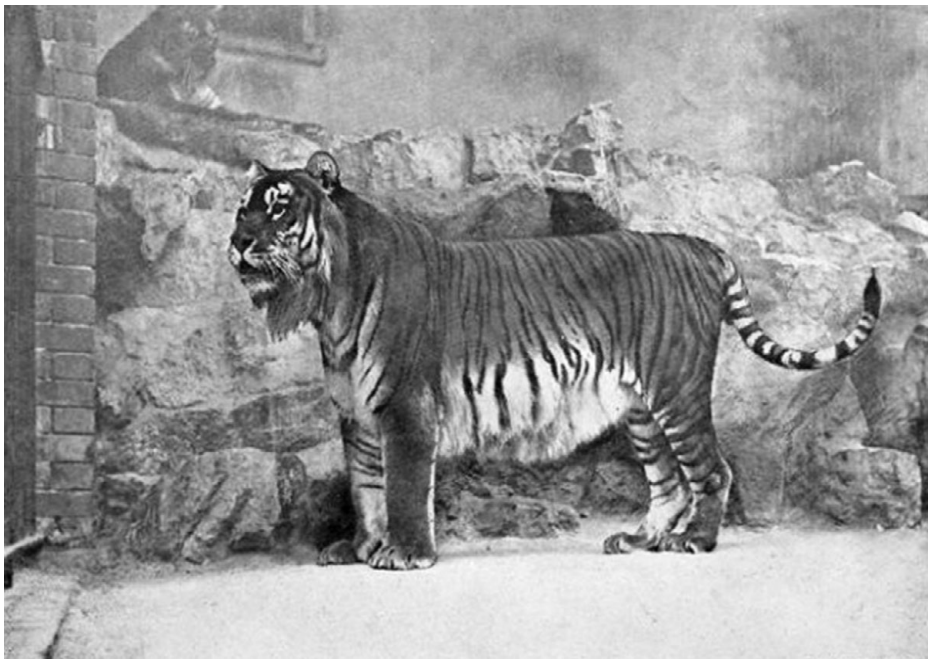

Figure 2.2 Caspian tiger in the Berlin Zoo, 1899. (Credit: Berlin Zoo.)

although many populations, particularly in southern areas, are isolated and at risk.

The European wildcat (*Felis silvestris silvestris*) inhabits forests across continental Europe from the Iberian Peninsula to Turkey and the Caucasus, but has become uncommon everywhere. A small number remain in the Scottish Highlands, but the species has otherwise been extirpated from the British Isles. While legally protected, they are frequently mistaken for feral cats and shot, and interbreeding with domestic cats is an additional threat.

The brown bear (*Ursus arctos*) is, as a species, found across much of North America and northern Eurasia, where it has manifested into a number of subspecies. A few will be discussed below.

The **Mongolian marmot** (*Marmota sibirica*), as a species, is found in a variety of habitats in east-central Asia. The steppe Mongolian marmot (*M. s. sibirica*) occurs in southern Russia, Mongolia, and northern China, while the montane Mongolian marmot (*M. s. caliginosus*) occurs in northern, western, and central Mongolia. Both are threatened by loss of habitat and hunting for their meat and pelts.

The **Spanish imperial eagle** (*Aquila adalberti*) is, at least in terms of breeding, entirely endemic to montane and lowland woodlands in the Iberian Peninsula of central and south-western Spain and adjacent parts of Portugal. Resident, non-breeding populations were at least historically to be found in Morocco and perhaps elsewhere in North Africa, although the species now appears to be largely a vagrant in these areas. It has recovered from a low of only 30 breeding pairs in the 1960s to an estimated 486 pairs by 2016, but remains particularly vulnerable to electrocution by poorly insulated powerlines, as well as by loss of habitat and persecution.

Blakiston's eagle-owl (*Bubo blakistoni*) is the largest living owl. There are two recognized subspecies, both of which are threatened by loss of their preferred riverine forest habitat. The mainland subspecies (*B. b. doerriesi*) is found in the forests and coastal mountain ranges of eastern Siberia, eastern China, and the Korean border area, including Sakhalin Island (although there has not been a verified record from there since 1974).

The **hooded crane** (*Grus monacha*) breeds in south-central and south-eastern Siberia, a small area of north-eastern China (Heilongjiang), and perhaps Mongolia. The majority of the population, estimated in 2015 at roughly 15,000, winters in southern Japan, with smaller numbers in south-eastern China and South Korea.

The **yellow-eyed pigeon** (*Columba eversmanni*) breeds in southern Kazakhstan, Uzbekistan, Turkmenistan, Tajikistan, Kyrgyzstan, Afghanistan, north-eastern Iran, and extreme north-western China, from where it migrates to Pakistan and north-western India. During the nineteenth and early twentieth centuries huge flocks were reported in its wintering grounds, particularly in the Punjab. The species declined rapidly thereafter due to loss of habitat and intensive hunting.

The **rustic bunting** (*Emberiza rustica*) has a massive distribution, breeding across the Palearctic from Norway to Kamchatka, from where it migrates south in winter to central and eastern Asia. Nevertheless, in recent decades the global population has declined dramatically, most likely due to increased logging in its breeding range and to large-scale

trapping combined with increasing agriculture in its non-breeding range.

The **streaked reed warbler** (*Acrocephalus sorghophilus*) is known from a few records originating within a small area of north-eastern China, and Taiwan, from where the species (at least historically) wintered on Luzon in the Philippines. Its breeding range remains unknown. The **white-browed reed warbler** (*A. tangorum*) breeds in south-eastern Russia and north-eastern China, from where it winters in southern Laos, Cambodia, Thailand, and Peninsular Malaysia. The species is everywhere threatened by loss of its swampy grassland habitat.

Carbonell's wall lizard (*Podarcis carbonelli*) is a rare species whose nominate subspecies (*P. c. carbonelli*) occurs in highly fragmented populations in western and central Portugal, extending slightly into west-central and south-western Spain.

The Iberian Lataste's viper (*Vipera latastei latastei*) occurs in both Spain and Portugal south of the Pyrenees, where it is threatened due to loss of habitat and direct persecution by humans.

Mountains and Highlands

With few exceptions, the great mountain chains of Eurasia run from west to east across the two continents. Many of them form massive barriers between well-distinguished biogeographic regions. They also serve as enormous refuges for plants and animals that have been exterminated elsewhere, or have been driven by advancing cultivation into remote montane areas.

The Balkan lynx (*Lynx lynx balcanicus*) is confined to the mountainous regions of eastern Albania and western North Macedonia, with smaller populations in Kosovo and Montenegro. Long threatened by illegal hunting, the total number is thought to be less than 50.

The **mouflon** (*Ovis gmelini*) and its many subspecies are a group wild sheep and the ancestors of all domestic sheep (*O. aries*). Today it inhabits steep mountainous woodlands of the Near and Middle East, although historically the range extended further to the Crimean Peninsula and the Balkans. Populations were long ago introduced to a number of islands in the Mediterranean, perhaps as feral domesticated animals, where they have naturalized to the hilly interiors and given rise to arguably distinct forms. Those from the islands of Corsica and Sardinia are commonly known as the European mouflon (*O. g. musimon*), having been subsequently introduced to parts of mainland Europe as well. Like all mouflon this subspecies has been heavily depleted by hunting for its meat and horns. The Transcaspian mouflon (*O. g. arkal*) is found in western Kazakhstan, Turkmenistan, Uzbekistan, and north-eastern Iran. In the mid-1970s the total population was estimated at over 20,000, of which around 15,000 lived in Golestan National Park in Iran. The Bukhara mouflon (*O. g. bocharensis*) is found in Tajikistan, Turkmenistan, and Uzbekistan. The Afghan mouflon (*O. g. cycloceros*) is found in southern Turkmenistan, eastern Iran, Afghanistan, and northern Pakistan. The Armenian mouflon (*O. g. gmelini*) is found in north-western Iran, Armenia, and Azerbaijan.

Another type of wild sheep is the **argali** (*Ovis ammon*). Several subspecies are found in the mountains and deserts of central Asia, where they are heavily hunted. The North China argali (*O. a. jubata*) is confined to a few pockets in northern China. Severtzov's argali (*O. a. severtzovi*) is known only from a small area of southern Uzbekistan. The Karaganda argali (*O. a. collium*) is confined to the low hills of central and eastern Kazakhstan. The Gobi argali (*O. a. darwini*) is confined to a few areas of northern China and Mongolia.

The **markhor** (*Capra falconeri*) is a large, typically screw-horned wild goat found patchily in the mountains of west-central Asia. Several subspecies are threatened by loss of habitat, domestic grazing herds and intensive hunting. The Astore markhor (*C. f. falconeri*) is confined to parts of north-eastern Afghanistan (Kunar and Nuristan), northern Pakistan, and northern India (Jammu and Kashmir). The Bukharan markhor (*C. f. heptneri*) occurs in parts of north-eastern Afghanistan, southern Tajikistan, Turkmenistan, and southern Uzbekistan. The straight-horned markhor (*C. f. megaceros*) survives in parts of north-eastern Afghanistan (Kabul, Parwan, and Paktia provinces) and central Pakistan (Baluchistan and Punjab provinces).

The Iberian ibex (*Capra pyrenaica*) is another species of wild goat that historically occurred throughout the mountainous areas of the Iberian Peninsula and south-western France. Of the four described subspecies, two are now extinct. The Portuguese ibex (*C. p. lusitanica*) was still abundant at the end of the eighteenth century, ranging in all the north-western mountains of Portugal, Galicia, Asturias, and western Cantabria. Thereafter its decline was rapid as hunting pressure increased for its meat, hides, horns, and bezoar stones, which local people erroneously believed to have medicinal properties. By 1870 it was rare. The last herd, about a dozen animals, was reported in 1886. An old female was captured alive in 1889, but only survived three days. Two more were found dead the following year in Galicia, victims of an avalanche. The last known individual in Spain died in 1890, and the last sighting was in the Serra do Gerês, Portugal, in 1892. A mounted specimen was on display in the Bocage Museum, Lisbon, until destroyed by fire in 1978.

The Pyrenean ibex (*C. p. pyrenaica*) was once abundant on both sides of the Pyrenees as well as in the Cantabrian Mountains of southern France. It too was severely persecuted by hunters and decreased rapidly during the nineteenth and twentieth centuries. Competition with domesticated sheep, goats, cattle, and horses also contributed to the decline. It was long thought to have gone extinct in the 1910s, until a small population of around 20 was discovered in Ordesa y Monte Perdido National Park, in the Spanish central Pyrenees. By 1989 only a dozen or so were left. The last individual, a female named 'Celia', was bizarrely killed by a fallen tree on 6 January 2000. In recent years there have been attempts made

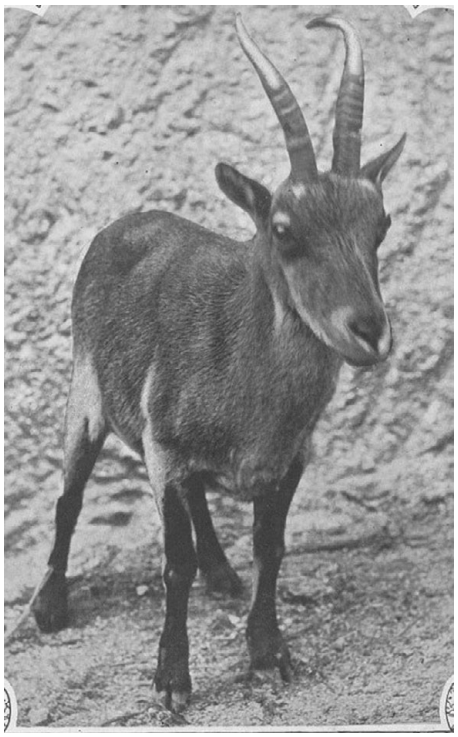

Figure 2.3 A nineteenth-century photo of a Portuguese ibex (*Capra pyrenaica lusitanica*). (Credit: unknown.)

to clone this individual and thereby make the Pyrenean ibex 'unextinct', although it would seem that modern scientific expertise cannot overcome the lack of a male cell donor.

Two species of chamois (*Rupicapra*), a kind of goat-antelope, inhabit the mountains of Eurasia. The southern chamois (*R. pyrenaica*) is divided into three subspecies inhabiting south-western Europe. The Pyrenean chamois (*R. p. pyrenaica*) and Cantabrian chamois (*R. p. parva*) were both nearly hunted to extinction by the 1940s, but have since recovered their numbers and are no longer considered threatened. A third remains highly endangered and is discussed elsewhere in this book. The northern chamois (*R. rupicapra*) is, as a species, common and widespread in the mountains of central and southern Europe and Asia Minor. However, several subspecies are considered to be highly threatened. The Balkan chamois (*R. r. balcanica*) inhabits most of the mountainous regions of Albania, as well as Bulgaria's four main massifs. In Greece it is confined to a few widely scattered populations.

The gorals (*Naemorhedus*) are a group of small goat-antelopes confined to the mountainous regions of Asia, where they have been much reduced by hunting. The **long-tailed goral** (*N. caudatus*) is found patchily in eastern Russia (Primorsky and Khabarovsk territories) and north-eastern China, with a small population living in the Demilitarized Zone on the Korean Peninsula.

The **Eurasian musk deer** (*Moschus moschiferus*) is still found over a wide area of north-eastern Asia in suitable montane taiga habitat, but has been much reduced by hunting. The Siberian musk deer (*M. m. moschiferus*) occurs in the Russian Far East, Mongolia, and northern China (Xinjiang, Heilongjiang, and Inner Mongolia). Turov's musk deer (*M. m. turovi*) is confined to an area of the Russian Far East. The Verkhoyansk Ridge musk deer (*M. m. arcticus*) is confined to the Verkhoyansk Range in the East Siberian Mountains. The Korean musk deer (*M. m. parvipes*) is found in north-western China and the Korean Peninsula.

Pikas (*Ochotona*) are small, mountain-dwelling relatives of rabbits. **Hoffmann's pika** (*O. hoffmanni*) is known only from two, widely separated localities (the Bayan-Ulan Ridge in northern Mongolia and the Erman Mountains of south-eastern Russia). The **Korean pika** (*O. coreana*) is confined to the mountains of north-eastern China (Jilin) and north-eastern North Korea.

The **woolly dormouse** (*Dryomys laniger*) is largely confined to the Taurus Mountains of southern Anatolia, Turkey, along with a few isolated localities in north-eastern Anatolia.

The **Balkan snow vole** (*Dinaromys bogdanovi*) is a 'living fossil' from isolated, mountainous regions of the Balkans, where it may be threatened by competition with the European snow vole (*Chionomys nivalis*).

Schaub's mouse-eared bat (*Myotis schaubi*) is a rare species known only from a few localities within the southern Caucasus Mountains of Armenia, and from the north-western Zagros Mountains of Iran. Fossils indicate that it historically ranged in Russia and Hungary as well.

The **Iberian rock lizard** (*Iberolacerta monticola*) is found patchily in the highlands of north-western Spain and central Portugal.

The **Spanish keeled lizard** (*Algyroides marchi*) is confined to a few isolated localities in the Alcaraz, Cazorla, and Segura ranges of south-eastern Spain.

Darevsky's viper (*Vipera darevskii*) is known only from Armenia and possibly two localities in eastern Turkey.

The **Kurdistan newt** (*Neurergus derjugini*) is known only from a small area of the Avroman Mountains in western Iran (Kermanshah province), but may occur in adjacent north-eastern Iraq as well. Its breeding streams have been seriously impacted by drought, water extraction and pollution, and the species is still collected for the international pet trade. The **Urmia newt** (*N. crocatus*) is confined to the mountains west of Lake Urmia in northern Iraq, south-eastern Turkey, and (at least historically) north-western Iran. It is threatened mainly by dam construction. The **Anatolian newt** (*N. strauchii*) is divided into two subspecies found in the mountains of eastern Turkey. Strauch's newt (*N. s. strauchii*) is confined to streams south and west of Lake Van, while Baran's newt (*N. s. barani*) is known from a few areas near the town of Pütürge.

The **golden-striped salamander** (*Chioglossa lusitanica*) is confined to the highlands of north-western Spain and northern and central Portugal, where it is dependent upon streams. Two subspecies have been described, the Lusitanian golden-striped salamander (*C. l. lusitanica*) and the long-footed golden-striped salamander (*C. l. longipes*).

The **Caucasian salamander** (*Mertensiella caucasica*) is found in north-western Anatolia (Turkey) and western Georgia, where it is threatened by loss of habitat.

Bejara's fire salamander (*Salamandra salamandra bejarae*) is confined to the mountains of north-central Spain.

The Alps

The Alps are the highest and most extensive mountain range lying entirely within Europe, stretching approximately 1200 km across eight countries (France, Switzerland, Italy, Monaco, Liechtenstein, Austria, Germany, and Slovenia). The mountains were formed over tens of millions of years as the African and Eurasian tectonic plates collided. At 4810 m Mont Blanc, which spans the French–Italian border, is the highest, but the alpine region contains around a hundred peaks higher than 4000 m. This extreme altitude and size greatly affect the climate of Europe. Generally speaking, they can be divided into two main subranges, the Eastern and Western Alps, separated in eastern Switzerland near the Splügen Pass. A series of lower ranges run parallel to the main chain of the Alps, including the French Prealps and the Jura Mountains.

The alpine ibex (*Capra ibex*) had been driven to the point of extinction in the early nineteenth century, but was saved thanks to conservation efforts chiefly by the Italians. The species is now considered safe in Italy, with populations reintroduced to Austria, France, Germany, and Switzerland and new ones established in Bulgaria and Slovenia.

Two subspecies of northern chamois (*Rupicapra rupicapra*), previously mentioned in the general section, are found within in this region. The alpine chamois (*R. r. rupicapra*) occurs in the Alps of Austria, Germany, and eastern France, where it is threatened mainly by poaching and overhunting. The Chartreuse chamois (*R. r. cartusiana*) is confined to the Chartreuse limestone massif near Grenoble, on the western edge of the French Alps.

The **Bavarian pine vole** (*Microtus bavaricus*) is known only from Rofan Mountain, in the northern Tyrol of Austria.

Lanza's alpine salamander (*Salamandra lanzai*) is confined to a small area of the Western Alps on the border between Italy and France.

Mountains of Central Asia

The mountains of Central Asia, as here defined, are those ranges bordering the Tibetan Plateau to the north and west, spanning parts of Afghanistan, western China, Kazakhstan, Kyrgyzstan, Tajikistan, and Uzbekistan. Together they provide a diversity of habitats including montane grasslands, meadows, temperate coniferous forests, and alpine tundra.

The northern wild dog (*Cuon alpinus hesperius*) is known from the Altai and Tian Shan mountains, possibly extending to the Pamir Mountains and Kashmir. It was historically much more widespread.

Two subspecies of **Tarbagan marmot** (*Marmota sibirica*) are found in high-elevation steppe and alpine meadow areas of Central Asia. The Khentii marmot (*M. s. sibirica*) is confined to the Khentii Mountains of north-eastern Mongolia (Tuv and Khentii provinces). The Mongolian marmot (*S. s. caliginosus*) is still relatively widespread in south-western Russia (south-western Siberia, Tuva, and Transbaikalia), north-eastern China (Inner Mongolia and Heilongiiang), and western Mongolia, but is everywhere suffering massive declines.

The **white-throated bushchat** (*Saxicola insignis*) is a type of passerine bird that breeds very locally in the mountains of Mongolia and adjacent areas of south-central Russia, from where it migrates to the grasslands of northern India and Nepal. Formerly common, it is now rare in its wintering range due to loss of habitat.

The **Turkestanian salamander** (*Hynobius turkestanicus*) is known only from a few specimens collected in 1909 from an imprecise locality in central Asia, but thought to be somewhere in eastern Uzbekistan or southern Kyrgyzstan.

The Tian Shan Mountains

The Tian Shan Mountains is a large system of central Asian mountain ranges located in north-western China (Xinjiang), Kazakhstan, Kyrgyzstan, and Uzbekistan.

The Tian Shan argali (*Ovis ammon karelini*) is a type of wild sheep that, as here defined, is confined to the Tian Shan Mountains.

Menzbier's marmot (*Marmota menzbieri*) inhabits high-elevation meadows and steppe within the western Tian Shan Mountains, where its range is divided into two separate pockets separated by more than 100 km. It is threatened by habitat loss due to agriculture.

The **Ili pika** (*Ochotona iliensis*) is confined to a few high-elevation areas on two spurs of the Tian Shan Mountains in China, where the total population is thought to be less than 1000.

The **Central Asian salamander** (*Ranodon sibiricus*) is a rare species confined to the Dzungarian Alatau Ridge on the border between China and Kazakhstan. The range is extremely fragmented due to the scarcity of suitable habitat (i.e. flat, high-elevation plateaus with a dense network of permanent streams).

The Karakoram Range

The Karakoram is a large mountain range spanning the borders of northern Pakistan, western China, and north-eastern India, with the north-western extremity extending into north-eastern Afghanistan and Tajikistan. It includes K2, the second highest mountain in the world.

The **woolly flying squirrel** (*Eupetaurus cinereus*) was originally known from a few skins collected in extreme northern Pakistan, in the portion of Kashmir under Pakistani control, and from northern Sikkim (India). Thought to be extinct for 70 years, it was rediscovered in small numbers in 2004.

The Pamir Mountains

The Pamir Mountains are located at the junction of the Himalayas with the Tian Shan, Kunlun, Hindu Kush,

Figure 2.4 Caucasian wood bison photographed in 1889. (Credit: E. Demidoff.)

Suleman, and Hindu Raj ranges. They are among the world's highest.

The Marco Polo argali (*Ovis ammon polii*) is a type of wild sheep found mainly in the Pamir Mountains. It is threatened mainly by trophy hunters, who prize its large, spiralling horns.

The Alay Mountains

Also known as the Alai Mountains, this range runs roughly east to west in Kyrgyzstan and Tajikistan.

The **Alay mole vole** (*Ellobius alaicus*) is known only from a small area of high-elevation meadow steppe in the Alay Mountains, south Kyrgyzstan.

The Altai Mountains

The Altai Mountains are located in central and east East Asia where Russia, China, Mongolia, and Kazakhstan come together.

The Altai argali (*Ovis ammon ammon*) is the largest of all wild sheep and possesses the heaviest horns. It is confined to the higher elevations of the Altai Mountains, where not surprisingly it is heavily hunted.

The Caucasus Mountains

Located between the Caspian and Black seas, the Caucasus Mountains straddle south-eastern Europe and central Asia. They are comprised of the Greater Caucasus in the north and the Lesser Caucasus in the south.

The Caucasian wood bison (*Bison bonasus caucasicus*) was an inhabitant of the wooded slopes and valley meadows of the Caucasus. It will perhaps never be known how long this subspecies had been isolated from its relative, the European lowland wood bison (*B. b. bonasus*), which once roamed the forest steppes and woods of lowland Europe. What we know of the Caucasian wood bison goes back only as far as 150 years ago. In 1914 there were about 500 such animals in the Caucasus, but persecution drove them higher and higher up into unsuitable habitats, and by 1925 they were reported to be extinct in the wild. However, in 1940, some captive specimens that were at least partly of Caucasian ancestry were brought to a large enclosure on the northern, forested slopes of the Caucasus. In 1954 a small herd was set free and has been strictly protected since then. In the scientific sense, however, the pure Caucasian bison must be considered extinct.

The Caucasian lynx (*Lynx lynx dinniki*) was formerly distributed throughout much of south-western Asia, but is now confined to the northern Caucasus Mountains.

The Greater Caucasus

The Greater Caucasus Mountains are located in south-western Russia, northern Georgia, and northern Azerbaijan.

The **West Caucasian tur** (*Capra caucasica*) is a large, heavy-set goat confined to a few localities in the western part of the Greater Caucasus Mountains.

The Caucasian chamois (*Rupicapra rupicapra caucasica*) is confined to the Greater Caucasus.

Birch mice (*Sicista*) are a group of small, jumping rodents. The **Caucasian birch mouse** (*S. caucasica*) and the **Kazbeg birch mouse** (*S. kazbegica*) are both confined to the Greater Caucasus of Georgia and Russia.

The **subalpine meadow wall lizard** (*Darevskia alpina*) is confined to a narrow belt of subalpine meadows in the Greater Caucasus of Georgia and Russia.

Two species of viper (*Vipera*) are endemic to the Greater Caucasus, where they are threatened by habitat destruction and degradation, overcollection for the international pet trade,

and human persecution. The **magnificent viper** (*V. magnifica*) is confined to a small area of south-western Russia. The **Caucasus subalpine viper** (*V. dinniki*) is known from south-western Russia, northern Georgia and northern Azerbaijan.

The Lesser Caucasus

The Lesser Caucasus Mountains are located in southern Georgia, Armenia and Azerbaijan.

The **Armenian birch mouse** (*Sicista armenica*) is known only from a few subalpine meadows in north-central Armenia.

The **Armenian mouse-eared bat** (*Myotis hajastanicus*) is a rare and possibly extinct species known only from the Lake Sevan basin in Armenia.

Rostombekov's wall lizard (*Darevskia rostombekovi*) is known from a few isolated subpopulations in northern Armenia and western Azerbaijan.

The Armenian Plateau

The Armenian Plateau (also known as the Armenian Highlands) is located to the west of the Anatolian Plateau in Armenia, Azerbaijan, north-western Iran, and eastern Turkey (eastern Anatolia).

Uzzell's wall lizard (*Darevskia uzzelli*) and the **Bendimahi wall lizard** (*D. bendimahiensis*) are both confined to small areas of north-eastern Turkey.

Pleske's racerunner (*Eremias pleskei*) is a type of lizard confined to sandy, semi-desert areas of the Armenian Plateau. It is seriously threatened by habitat destruction.

The **Armenian steppe viper** (*Vipera eriwanensis*) is found patchily in north-eastern Turkey, Armenia, and Azerbaijan.

The Pontic Mountains

The Pontic Mountains are located in north-eastern Turkey and south-western Georgia.

Clarks' wall lizard (*Darevskia clarkorum*) is confined to the Pontic Mountains.

The **Black Sea viper** (*Vipera pontica*) is known only from the Coruh River valley in north-eastern Turkey (Artvin province) and from an additional specimen found in a tea plantation near the Turkish–Georgian border.

The Taurus Mountains

The Taurus Mountains are located in southern Turkey, where they separate the Mediterranean coastal region from the central Anatolian Plateau.

The **Anatolian meadow viper** (*Vipera anatolica*) is known only from a single locality in south-western Turkey.

The **Taurus frog** (*Rana holtzi*) is confined to a small area of high montane lakes in the Bolkar Range, where it is highly threatened by habitat disturbance and introduced carp.

The Apennine Mountains

The Apennines are a range consisting of smaller parallel chains extending some 1200 km along the length of peninsular Italy. Its system of national parks contains some of the best-preserved montane forests and grasslands on the continent.

The Apennine chamois (*Rupicapra pyrenaica ornata*) has probably been rare for centuries, its numbers only starting to increase in 1920s as a result of increased protection. They plummeted again to just a few dozen in Abruzzo National Park during World War II, but have slowly recovered since then. Today three small populations, numbering perhaps around 1100, survive in the Abruzzo, Majella, and Gran Sasso-Monti della Laga national parks.

The Pyrenees Mountains

The Pyrenees are a range of mountains in south-western Europe forming a natural boundary between Spain and France.

Two species of rock lizard (*Iberolacerta*) endemic to the Pyrenees are threatened by loss of habitat and collection for the international pet trade. The **Aran rock lizard** (*I. aranica*) was long thought to be confined to the Mauberme Massif in the central Pyrenees, but in 2006 a new population was discovered in Mont Valier (France). **Aurelio's rock lizard** (*I. aurelioi*) is restricted to a small part of the border area of Andorra, France, and Spain, with the majority of the population living in the latter country.

The **Pyrenean frog** (*Rana pyrenaica*) is largely confined to the southern slopes of the west-central Pyrenees, where it is threatened by loss of habitat and introduced species.

The Cantabrian Mountains

The Cantabrian Mountains stretch east to west for over 300 km across northern Spain.

The **broom hare** (*Lepus castroviejoi*) is confined to an area of the Cantabrian Mountains, where it occupies a small elevational range of between 1000 and 1900 m.

The Cantabrian capercaillie (*Tetrao urogallus cantabricus*) is a type of grouse that formerly ranged the length of the Cantabrian Mountains, but is now confined to a few areas of north-western Spain. In 2006 the total population was estimated at around 625.

The Carpathian Mountains

The second longest mountain range in Europe, the Carpathians form an arc roughly 1500 km in length across central and eastern Europe.

The Carpathian wood bison (*Bison bonasus hungarorum*) historically occurred in the Carpathian Mountains of Moldova and Romania, and perhaps Hungary and Ukraine as well. It began to die out in the eighteenth century due to overhunting, with the last known specimen being shot in 1852. There are currently plans to introduce European wood bison from Poland or the Caucasus into Transylvania.

The Carpathian lynx (*Lynx lynx carpathicus*) is found in the Carpathian Mountains of Romania, Slovakia, and Hungary, where it is threatened by poaching and loss of habitat. A further population was introduced into Croatia, Slovenia, and Bosnia during the 1970s.

The Carpathian chamois (*Rupicapra rupicapra carpatica*) occurs in many populations throughout the Carpathian Mountains and Transylvanian Alps, where there have been a number of successful reintroductions.

The Tatra Mountains

The Tatra Mountains are a subrange of the Carpathian Mountains forming a natural border between Poland and Slovakia.

The Tatra Mountains chamois (*Rupicapra rupicapra tatrica*) is confined to the Tatra Mountains.

Miscellaneous Mountains and Highlands

The *Scandinavian Mountains*, as their name suggests, are a range that run through the Scandinavian Peninsula. The mountains are ancient and not very high but steep in places, with the western slopes dropping precipitously into the North and Norwegian seas, forming fjords. By contrast, in the north-east they curve gradually towards Finland. The combination of northerly location and ocean moisture has resulted in numerous ice fields and glaciers. Vegetation is typically montane birch forests and grasslands. The mountain reindeer (*Rangifer tarandus tarandus*) is found only in the montane tundra regions of the Fennoscandian Peninsula, Norway.

The *Dinaric Alps* are located in southern Croatia, northern Albania, Bosnia-Herzegovina, and Montenegro. The **Mosor rock lizard** (*Dinarolacerta mosorensis*) is confined to a few isolated populations in the south-western Dinaric Mountains.

The *Pindus Mountains* are located in western Greece and southern Albania. The **Greek meadow viper** (*Vipera graeca*) is confined to the subalpine regions of the Hellenides mountain system of southern Albania and central Greece.

The *Catalan Pre-Coastal Range* is located in north-eastern Spain. The **Montseny brook newt** (*Calotriton arnoldi*) is confined to the El Montseny Massif, where it is only known in seven mountains streams within the boundaries of El Montseny Natural Park.

The *Central Cordillera* (Sistema Central in Spanish and Portuguese) is located in west-central Spain and east-central Portugal. **Cyrn's rock lizard** (*Iberolacerta cyreni*) and **Martinez-Rica's rock lizard** (*I. martinezricai*) are both confined to the Central Cordillera.

The *Sierra Nevada Mountains* are located in south-eastern Spain. The **Betic midwife toad** (*Alytes dickhilleni*) is confined to a few localities within the Sierra Nevada Mountains.

The *Penibaetic Mountains* are located in southern coastal Spain. The **long-snouted fire salamander** (*Salamandra longirostris*) is confined to a small area of southern Spain.

The *Karatau Mountains* are located in southern Kazakhstan. The Kara Tau argali (*Ovis ammon nigrimontana*) is a type of wild sheep confined to the Karatau Mountains.

The *Helan Mountains* (Helan Shan in Chinese, and formerly known as the Alashan Mountains) are an isolated, desert mountain range located in south-eastern Inner Mongolia. The **silver pika** (*Ochotona argentata*) is confined to a small area of the Helan Mountains.

The *Anatolian Plateau* rises from the lowland coast of the Aegean Sea and eventually converges with the Armenian Highlands to the east of Cappadocia. Its highest point is the dormant stratovolcano Mount Ararat. **Wagner's mountain viper** (*Montivipera wagneri*) is confined to eastern Turkey (Kars, Erzurum, and Agr provinces). The **central Turkish mountain viper** (*M. albizona*) is confined to two localities in central Anatolia (Sivas and Kahramanmaras provinces). Both are threatened by overcollection for the international exotic animal trade.

Lowland Boreal Forests

Boreal forests, also known as taiga, exist as a nearly continuous belt of mainly coniferous trees interspersed with lakes, bogs, and heaths stretching across both Eurasia and North America. In Eurasia it covers most of Sweden and Finland, much of Norway, some of the Scottish Highlands and the coastal lowlands of Iceland, much of Russia from Karelia in the west to the Pacific (including most of Siberia), and parts of northern Kazakhstan, northern Mongolia, and northern Japan (Hokkaido). Up until relatively recently these immense forests were largely untouched by humans, although in recent decades the southern areas in particular have begun to be conquered. Many animal species have been driven away as a result, retreating to montane regions or more remote areas of forest. On the other hand, some species have been favoured by the opening up of the coniferous forests and the replacement of parts of it by a secondary growth of mixed forests or cultivated areas.

The Kamchatka brown bear (*Ursus arctos beringianus*), the largest bear in Eurasia, is found in the Kamchatka region and a few offshore islands. While the population remains fairly intact the animals are heavily hunted, both legally and otherwise, for their fur and gallbladder as well as for 'sport'.

The Finnish forest reindeer (*Rangifer tarandus fennicus*) is today confined to north-western Russia (Karelia) and adjacent parts of Finland, where it migrates seasonally between the two countries. As late as 1750 it ranged over the greater part of the Finnish taiga eastward to the Ural Mountains. It was exterminated in Finland due to hunting and forest loss between 1880 and 1910, but returned spontaneously in small numbers during the mid-twentieth century after habitat disturbances in the Russian part of its range. In 1970 the total population was thought to number only a few hundred, although numbers have since increased to several thousand. Other Eurasian reindeer subspecies facing similar threats are the Busk reindeer (*R. t. buskensis*) from northern Russia, the Kamchatkan reindeer (*R. t. phylarchus*) from the Kamchatka Peninsula and regions bordering the Sea of Okhotsk and the Siberian forest reindeer (*R. t. valentinae*) from the forests of the Ural and Altai Mountains.

The **long-tailed birch mouse** (*Sicista caudata*) is a relatively widespread but naturally rare species from north-eastern China (Heilongjiang and Jilin), the Ussuri region of Far Eastern Russia and Sakhalin Island.

Lowland Broadleaf and Mixed Forests

Three or four thousand years ago, temperate deciduous and mixed forests covered a vast area from the British Isles and the northern Iberian Peninsula in the west across central Europe and eastward in a narrowing strip far into Siberia and the Korean Peninsula. Almost the same type of forest existed in China, Manchuria, and Japan. Stone Age men had burned and cut here and there, but it was not until farming spread in central Europe and Asia that the forests began to disappear. Industrialization combined with growing human populations caused them to retreat at an ever-accelerating rate. With the forests went many of the larger carnivores and also several hoofed animals. Several mammals belonging to forest regions of Eurasia have vanished forever.

Two highly threatened subspecies of Central Asian red deer (*Cervus hanglu*) inhabit forested river valleys in Central Asia. The Bactrian deer (*C. h. bactrianus*) is found in Kazakhstan, Uzbekistan, Tajikistan, Turkmenistan, and northern Afghanistan. Its range and numbers were much reduced during the 1960s due to persecution and the destruction of riverine vegetation, but conservation activities have succeeded in restoring it to much of its former range. The Yarkand deer (*C. h. yarkandensis*) shares a similar type of habitat in the valleys of the Tarim, Konqi, and Qarqan rivers of north-western China (Xinjiang). In the 1960s it was described as very rare, but precise information about its status continues to be lacking.

The **water deer** (*Hydropotes inermis*), so-named for its preference for riverine areas, is small with notably prominent canines and an absence of antlers. There are two subspecies. The Korean water deer (*H. i. argyropus*) was historically found along the western coast of the Korean Peninsula and into north-eastern China (Jilin and Liaoning). It has since been extirpated from the latter country.

The **Muisk vole** (*Microtus mujanensis*) is known only from the Muya Valley in east-central Siberia.

The **greater noctule bat** (*Nyctalus lasiopterus*) is found in scattered populations across central and southern Europe from the Iberian Peninsula to the Urals, where it favours deciduous forests. A tree-roosting species, it is threatened mainly by deforestation.

The **Charnali wall lizard** (*Darevskia dryada*) is confined to lowland forests of the Black Sea coastal region (north-eastern Turkey and possibly south-western Georgia), where it is threatened by deforestation.

Kaznakov's viper (*Vipera kaznakovi*) is confined to the Black Sea coast and forested foothills of the Caucasus Mountains, where is it threatened by overcollection for the international pet trade and loss of habitat.

Two species of Asian salamander (*Hynobius*) endemic to the Korean Peninsula are threatened by loss of habitat. The **Kori salamander** (*H. yangi*) is confined to forests in south-eastern South Korea (Gyeongsang province). The **Cheju salamander** (*H. quelpaertensis*) is known from the southern tip of South Korea, where it occurs on both the mainland as well as on the islands of Chindo and Cheju.

Lowland Mediterranean Forests, Woodlands, and Scrub

Areas of lowland Mediterranean forest, woodland, and scrub within the Eurasian region extend from the Iberian Peninsula to the Levant, and include the Mediterranean Islands.

The Anatolian leopard (*Panthera pardus tulliana*) was a little-known form native to south-western Turkey. It was last recorded in the mid-1970s, and is now considered extinct.

The **Iberian lynx** (*Lynx pardinus*) was historically distributed over large areas of the Iberian Peninsula and southern France, but habitat destruction, particularly deforestation, along with sharp declines in rabbit populations and human persecution reduced it to two separate regions. In 1950 the northern population still extended from the Mediterranean to Galicia and parts of northern Portugal, while the southern included suitable habitat in central and southern Spain. By the end of the twentieth century, however, it had been reduced to just two small subpopulations (in the mountains of south-central Spain and the coastal plains of the south-west, respectively), numbering perhaps around 100 animals in total. Since then, a range of conservation measures have been implemented in both Spain and Portugal including a captive breeding programme, habitat restorations, and limited translocations and reintroductions.

The **Italian hare** (*Lepus corsicanus*) occurs in southern Italy and on the islands of Elba, Sicily, and Corsica (where it was introduced by humans but has since been largely extirpated). It has declined due to habitat destruction, hunting, and competition from introduced species.

The **Mersin spiny mouse** (*Acomys cilicicus*) is known only from a small area of coastal rocky scrubland in southern Anatolia, Turkey.

Roach's mouse-tailed dormouse (*Myomimus roachi*) is known only from scattered records across western coastal Turkey, south-eastern Bulgaria, and possibly eastern Greece, although fossil material indicates that it was historically much more widespread.

Hermann's tortoise (*Testudo hermanni*) is confined to southern Europe, where it is divided into two subspecies. The western Hermann's tortoise (*T. h. hermanni*) is found in eastern Spain, southern France, central Italy, the Balearic Islands, Corsica, Sardinia, and Sicily. The eastern Hermann's tortoise (*T. h. boettgeri*) is found in Bosnia-Herzegovina, Croatia, Montenegro, Serbia, Kosovo, North Macedonia, Romania, Bulgaria, Albania, Turkey, and Greece. Both are threatened by overcollection for the international pet trade.

Orlov's viper (*Vipera orlovi*) is confined to a small area of the Black Sea coast in south-western Russia, where it is threatened by overcollection for the international pet trade.

The **bay Lycian salamander** (*Lyciasalamandra billae*), **Antalya Lycian salamander** (*L. antalyana*), **Marmaris Lycian**

Figure 2.5 Anatolian leopard (*Panthera pardus tulliana*). (Credit: unknown.)

salamander (*L. flavimembris*), and **Atif's Lycian salamander** (*L. atifi*) are all confined to small areas of coastal south-western Turkey, where they are threatened by habitat destruction and overcollection. **Fazila's Lycian salamander** (*L. fazilae*) is confined to south-western coastal Turkey and to the islands of Tersane and Domuz. **Luschan's Lycian salamander** (*L. luschani*) is divided into two subspecies, the nominate form of which (*L. l. luschani*) is confined to a small area of coastal south-western Turkey.

Eurasian Steppe

The Eurasian steppe consists of vast temperate plains stretching across much of central Asia from Eastern Europe to Manchuria. To the north they are bounded by boreal forests. There is no clear southern boundary, although the land becomes increasingly dry as one moves south. The steppe narrows at two points, thereby dividing it into three major parts. All are covered by more or less dense herbaceous vegetation, sometimes with bushes but usually with no trees except along rivers. In the past they were inhabited by wild herds of large mammals, mainly horses and asses, adapted to this special habitat, now mostly depleted by hunting. More recently steppes have come under increasing threat due to agricultural development.

The Eurasian wild horse or tarpan (*Equus ferus ferus*) historically ranged from Spain to central Russia. Its human-caused extinction began in southern Europe, possibly in antiquity. Humans had been hunting wild horses continually for meat since the Palaeolithic, just as areas of available habitat for these large herbivores were continually being lost due to the advent of civilization. The subspecies held out longest on the steppes of southern Russia and Ukraine, where it was still living as late as the nineteenth century. By then most 'tarpans' had become hybrids, having long interbred with domestic horses, and true wild horses were already very rare by 1880. After that only dubious sightings were documented. The last true tarpan mare was accidentally killed during an attempt to capture her, and the last known individual of all died in captivity on an estate near Poltava in 1909. The story did not end there, however. Beginning in the 1930s several attempts were made to develop horses that looked like tarpans by way of selective breeding. These 'bred back' animals do have a superficial resemblance to the extinct form, but cannot be said to be true Eurasian wild horses.

Western Steppe

The Western or Pontic–Caspian Steppe begins near the mouth of the Danube and extends north-east almost to Kazan and then south-east to the southern tip of the Ural Mountains. Its northern edge was a broad band of forest steppe (a mosaic of deciduous forests and grasslands) that has now been entirely destroyed by conversion to agriculture. Most of the original large animals have also long-since been exterminated.

The **European ground squirrel** (*Spermophilus citellus*) is found in central and south-eastern Europe where it is dependent upon short turf in order to construct its colonial tunnel systems. The species has adapted somewhat to artificial habitat such as pastures, golf courses, and parks, but has nevertheless been eliminated from many parts of its range.

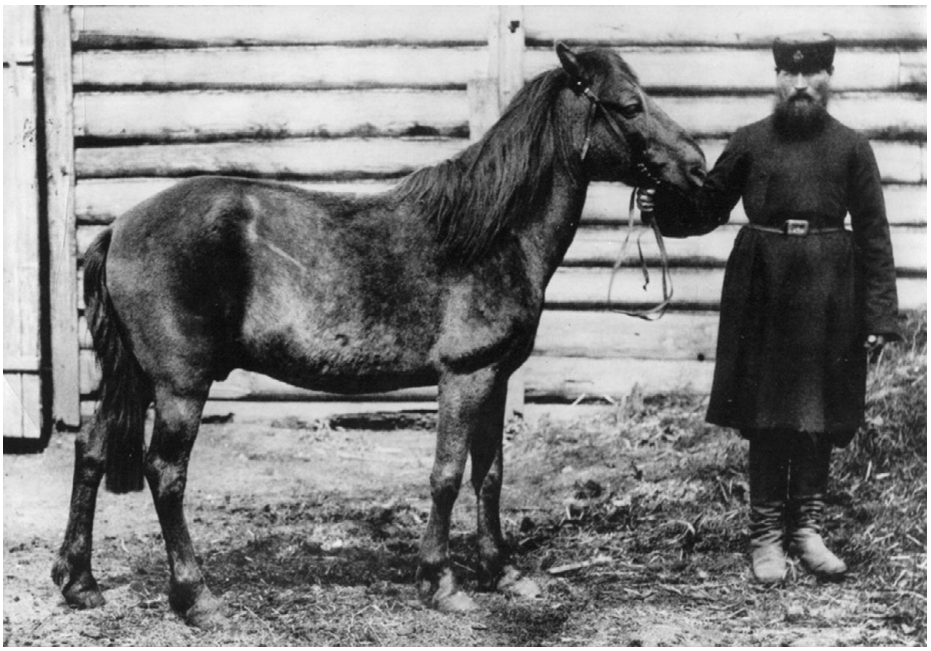

Figure 2.6 Only known photograph of an alleged living tarpan, taken at the Moscow Zoo in 1884. The animal is most likely a hybrid. (Credit: Moscow Zoo.)

The **Podolian mole-rat** (*Spalax zemni*) has a patchy distribution in Ukraine where it is threatened by habitat destruction.

The **Anatolian vole** (*Microtus anatolicus*) is confined to an isolated area of steppe in central-western Turkey (Konya province).

Pannonian Steppe

The Pannonian Steppe is an enclave separated from the main Eurasian Steppe by the mountains of Transylvania. It is located mainly in Hungary but also includes parts of Austria, Bulgaria, Romania, Serbia, Slovakia, and Croatia.

The Pannonian viviparous lizard (*Zootoca vivipara pannonica*) is confined to a small area of Austria and Hungary.

The Romanian meadow viper (*Vipera ursinii moldavica*) and Orsini's meadow viper (*V. u. rakosiensis*) are both rare and threatened by overcollection for the international pet trade.

Central Steppe

The greatest grass steppe in the world, the Central or Kazakh Steppe extends from the Urals to Dzungaria (north-western China), where it narrows between the Tian Shan and Altai Mountains. To the south it grades off into semi-desert and desert.

The **saiga antelope** (*Saiga tatarica*) historically inhabited a vast area of Eurasian steppe and semi-desert from the foothills of the Carpathian and Caucasus Mountains to Mongolia and north-western China. Two subspecies are recognized. The Russian saiga antelope (*S. t. tatarica*) is by far the more widespread, but its original range has been much reduced due to hunting and habitat destruction. Today only small pockets survive in Kazakhstan, Mongolia, Russia, Turkmenistan, and Uzbekistan.

The **Olkhon mountain vole** (*Alticola olchonensis*) is confined to rocky steppe areas on Olkhon and Ogoi islands, Lake Baikal.

The **Central Asian tortoise** (*Agrionemys horsfieldii*) is threatened by overcollection for the international pet trade.

Eastern Steppe

The Eastern Steppe extends from north-western China through Mongolia to Manchuria, where it very nearly reaches the Pacific Ocean.

The Mongolian wild horse (*Equus ferus przewalski*) is the last surviving subspecies of the now extinct wild horse. Until the eighteenth century, when it first became known to Western science, it ranged from the Russian steppes east to the semi-deserts of Kazakhstan, Mongolia, and northern China. Soon after it appears to have undergone a catastrophic decline. With the introduction of modern firearms Chinese and Mongolian hunters had become a serious threat to the survival of this species. Simultaneously, nomadic tribes with cattle occupied the areas where it lived and particularly the watering places, forcing the horses to retreat to less-favourable habitat in the mountains. It remained rare and little-known until reported again from Central Asia by the explorer, Colonel Nikolai Przewalski, at the end of the nineteenth century. European zoos quickly became interested in adding the animals to their collections, and several ambitious expeditions were mounted to their last known stronghold, the arid steppes in the corner between China, Mongolia, and Russia. In all, some 53 animals were captured and brought back successfully to Europe around

the turn of the century, with a few more collected in the 1930s and 1940s. The few remaining wild animals survived until the mid-twentieth century, where they were last seen in 1969 in the Dzungarian Gobi Desert. Fortunately, by then the captive population had grown to around 150. Since the 1990s reintroduction efforts have been undertaken in protected areas of Mongolia and China, with further projects planned for Kazakhstan and Russia.

The **Evoron vole** (*Microtus evoronensis*) is known only from a small area of far south-eastern Siberia within the lower Amur River floodplain.

Jankowski's bunting (*Emberiza jankowskii*) breeds in grassland areas of north-eastern China (Manchuria) and far north-eastern North Korea, where it is threatened by loss of habitat. It formerly also occurred in Russia (southern Primorye), but disappeared from there by the early 1970s.

The **Peking gecko** (*Gekko swinhonis*) still has a relatively wide distribution in the grasslands of north-eastern China, but is threatened by harvesting for 'traditional medicine' and habitat destruction.

Mongol Steppe

The Mongol Steppe includes both Mongolia as well as the Chinese province of Inner Mongolia, with the two being separated by the Gobi Desert. It is bordered on the south by the Tibetan Plateau.

The Mongolian saiga antelope (*Saiga tatarica mongolica*) is nowadays confined to western Mongolia north of the Altai Mountains, having been extirpated in China in the middle of the twentieth century due to hunting for its horns, which are highly valued in 'traditional medicine'. In recent years mass die-offs of entire herds have occurred in both subspecies as a result of disease.

Deserts and Semi-Deserts

Vast areas of central Asia consist of deserts or semi-deserts, the latter sometimes shading off into arid steppe. For the purposes of this book I have treated these habitats as one, because most of the larger mammals in these poor environments were driven into them from grasslands by man and his livestock. A surprising number of the larger animals have survived in the Eurasian deserts until the mid-twentieth century, when man, equipped with motorized vehicles and modern firearms, began to slaughter them recklessly.

The two-humped or Bactrian camel actually consists of two closely related species that, although similar in appearance, have nevertheless descended from distinct ancestors. The domesticated Bactrian camel (*Camelus bactrianus*) remains a common animal of the steppes and deserts of Iran, Afghanistan, Pakistan, Kazakhstan, Mongolia, and China. The **wild Bactrian camel** (*C. ferus*) historically ranged from about the great bend of the Yellow River, across the deserts of southern Mongolia and north-western China to central Kazakhstan. By the middle of the nineteenth century it had been extirpated from the western part of its range and survived only in remote areas of the Gobi and Taklimakan deserts, where populations are highly fragmented. Whether the latter descend from wild animals or their ancestors merely returned to the wild state from domestication is a matter of dispute, but in either case they have now long since been living as pure wild camels. During the 1920s the species could be met everywhere in the Gobi Desert, but during the following decades it declined rapidly. Heavy persecution and competition with domesticated animals for pasture and water probably caused the decline. Today, only about 1400 survive, mostly in the Lop Nur Reserve in China, with a smaller population in the Gobi Desert of Mongolia.

The Turkmenian wild ass (*Equus hemionus kulan*) was historically found in the semi-deserts of northern Afghanistan, western China, Kazakhstan, Kyrgyzstan, southern Siberia, Tajikistan, Turkmenistan, and Uzbekistan. By the 1940s a combination of hunting, competition with livestock and habitat destruction had reduced it to only one location, the Badkhyz Strictly Protected Area in southern Turkmenistan. Subsequent reintroduction efforts in Turkmenistan, Kazakhstan, and Uzbekistan have proven to be only temporarily effective owing mainly to high poaching pressure, and populations have declined to a current total of around 2500–3000.

The **goitered gazelle** (*Gazella subgutturosa*) is so-named for an enlargement of the neck and throat that males develop during mating season. Three subspecies are found throughout the arid and semi-arid regions of Central Asia and the Near East, where they have been historically slaughtered in great numbers and are still subject to illegal poaching. The Persian goitered gazelle (*G. s. subgutturosa*) still survives in Azerbaijan, Syria, Iran, southern Afghanistan, and western Pakistan, but has disappeared from much of its former range. The Turkmenian goitered gazelle (*G. s. gracilicornis*) lives in Kazakhstan, Uzbekistan, Turkmenistan, and Tajikistan, while the Yarkand goitered gazelle (*G. s. yarkandensis*) occurs in northern and north-western China and Mongolia.

The **pallid pygmy jerboa** (*Salpingotus pallidus*) is confined to a few localities in central and eastern Kazakhstan.

Dahl's jird (*Meriones dahli*) is confined to Armenia and eastern Turkey (Agri province).

The **desert dormouse** (*Selevinia betpakdalaensis*) is a rare species known only from a few localities over a relatively wide area of central Kazakhstan.

The **Bokhara mouse-eared bat** (*Myotis bucharensis*) is known only from a few specimens collected from three localities in Central Asia (Uzbekistan and Tajikistan).

Two lizards of the genus *Phrynocephalus* are threatened by loss of habitat. **Strauch's toad-headed agama** (*P. strauchi*) inhabits the Fergana Valley of Uzbekistan, Kyrgyzstan, and Tajikistan. **Horvath's toad-headed agama** (*P. horvathi*) is confined to a few isolated populations in the Araks River valley of Armenia, Azerbaijan, and eastern Turkey.

The Gobi Desert

The Gobi Desert is a large, cold expanse located in northern and north-western China and southern Mongolia. It is the fifth largest desert in the world and the second largest in Asia. Much of it is not actually sandy, but rather, exposed bare rock.

The Mongolian wild ass or khulan (*Equus hemionus hemionus*) is today largely confined to arid and semi-arid regions of the Gobi Desert in northern China and southern Mongolia. It formerly also occurred in eastern Kazakhstan and southern Siberia, but has been extirpated there due to overhunting. While the population remains large, it continues to be threatened by poaching and loss of habitat.

Miscellaneous Deserts

The *Karakum Desert* ('Black Sand') is located east of the Caspian Sea and covers much of Turkmenistan. **Golubew's toad-headed agama** (*Phrynocephalus golubewii*) is an extremely rare species confined to a small area of salt flats near Bami Station in southern Turkmenistan.

The *Kyzylkum Desert* ('Red Sand') is a large desert located in Central Asia between the rivers Amu Darya and Syr Darya, a region historically known as Transoxania or Sogdiana. Today it is divided between Kazakhstan, Uzbekistan, and Turkmenistan. **Heptner's pygmy jerboa** (*Salpingotus heptneri*) is confined to the Kyzylkum Desert, where it is known only from a few specimens.

The *Taklamakan Desert* is located in north-western China (south-western Xinjiang). **Vaurie's nightjar** (*Caprimulgus centralasicus*) is known only from a single specimen collected in the mid-twentieth century. Subsequent surveys have failed to locate it, and it is thought that the species may be migratory and either breed or winter elsewhere.

Isolated Caves, Springs and Pools

Within the Eurasian Region the most notable karstic region occurs in the Balkans.

The **olm** or **proteus** (*Proteus anguinus*) is an entirely aquatic salamander that inhabits subterranean caves within the Dinaric Alps. The nominotypical form (*P. p. anguinus*) ranges from southern Slovenia and adjoining north-eastern Italy through coastal Croatia and the karst regions of Bosnia-Herzegovina. It likely occurs in western Montenegro as well. The black olm (*P. p. parkelj*), first discovered in 1986, is endemic to the underground waters of the Doblicica karst spring near Crnomelj, Slovenia. Both subspecies are extremely vulnerable to changes in their habitat, in particular pollution.

The **Petzea rudd** (*Scardinius racovitzai*) is a type of freshwater fish confined to a single small hot spring in north-western Romania, where it is threatened by pollution and water extraction.

The **Almiri toothcarp** (*Aphanius almiriensis*) is known from two springs in western Greece, one near Almiri (where it has not been recorded since 2003 and is probably extirpated), and the other at Meligou in the Peloponnese. The latter locality was unfortunately transformed into a bathing area, but the species is still thought to survive in surrounding lagoon habitat.

Two minnows of the genus *Delminichthys* are threatened by water extraction and pollution. The **Modro Oko minnow** (*D. krbavensis*) is confined to a single karstic spring in western Croatia. **Ghetaldi's minnow** (*D. ghetaldii*) is confined to karstic streams and springs in southern Dalmatia.

Three species of spring minnow (*Pseudophoxinus*) are highly restricted in distribution. The **Akstafa spring minnow** (*P. sojuchbulagi*) is known only from springs in Azerbaijan, where it was last recorded in 1948. None have been found in subsequent searches. The **Antalya spring minnow** (*P. antalyae*) is confined to two springs and a stream flowing to the Bay of Antalya in south-western Turkey. The **Turianchi spring minnow** (*P. atropatenus*) is confined to two small but very deep springs in Azerbaijan.

The **Timavo Spring sculpin** (*Cottus scaturigo*) is confined to Timavo Spring in north-western Italy, a resurgence of the partially subterranean Reka River.

The **Greek ninespine stickleback** (*Pungitius hellenicus*) is confined to three localities in the Spercheios Valley of central Greece, specifically the Aghia Paraskevi spring, a number of drainage channels, and three natural wells.

Stefanidis' spined loach (*Cobitis stephanidisi*) has been extirpated from its original range in the Kefalovriso karstic spring, within the former Lake Karla basin of central Greece. However, it was subsequently found in the nearby Chasambali spring, where it is seriously threatened by water extraction, pollution, and drought.

Starostin's stone loach (*Troglocobitis starostini*) is confined to a single cave in the Kugitang Hills of eastern Turkmenistan, where it is highly susceptible to human disturbance and pollution.

The **cave stone loach** (*Barbatula* sp.) is an as-yet undescribed species first discovered by cave divers in southern Germany in 2015.

The Sultan Sazligi Marshes

The Sultan Sazligi marshes are located in south-central Turkey. At one time a very important wetland area, they were unfortunately drained and largely dried out in the early twenty-first century. All remaining springs are fed from a single aquifer.

The **Sultan Sazligi toothcarp** (*Aphanius danfordii*) and the **Sultan Sazligi spring minnow** (*Pseudophoxinus elizavetae*) are both confined to two small spring fields about 15 km apart along with a few canals within the Sultan Sazligi marshes.

Lakes, Rivers, and Marshes

The Eurasian Region is rich in freshwater wetlands, being crossed by a number of large river systems and dotted by mainly smaller lakes. Most of the latter were produced by the great ice sheets that covered the northern part of this portmanteau continent for long periods. Northern Eurasia is therefore

much richer in lakes than is the southern part. A high proportion of the original shallow lakes and marshes of northern Europe have long since been drained for agricultural purposes. Long regarded as a step towards effective land use and prosperity, during the nineteenth and twentieth centuries draining had become a sort of mania. Oftentimes these efforts proved to be less than successful. Economically they failed to produce the expected agricultural harvests, biologically the productivity of the areas was greatly reduced, and hydrologically the surrounding lands suffered owing to the sinking ground-water level. These unanticipated consequences of draining resulted from a complete failure to appreciate the intimate relationship between aquatic resources and the long-term productivity of the soil. In more recent years hydroelectric systems, including reservoirs with continuously changing volumes, as well as serious pollution have also affected lakes and rivers, interfering with natural food chains, biotic productivity, and the reproduction of waterfowl and economically important fishes such as salmon and trout. With the disappearance or poisoning of many marshes, lakes, and deltas, the habitats of aquatic animals have been greatly reduced and many species have gone extinct or become seriously threatened.

The Eurasian beaver (*Castor fiber*) was once widespread in Europe and Asia, but was hunted to near-extinction both for its fur and castoreum (a yellowish secretion used as a tincture in perfumes). By 1900, only 1200 survived in 8 relict populations. Reintroduced throughout much of its former range, it now occurs from Great Britain to Mongolia and China, although it remains absent from southern Europe and the Middle East.

The **European mink** (*Mustela lutreola*) is a semi-aquatic mustelid that was historically found from Finland to east of the Ural Mountains and south as far as northern Spain and the Caucasus. Heavily hunted for its luxuriant fur, it is now reduced to a few isolated pockets across this vast range. Habitat destruction and the introduction of American mink (*Neovison vison*) are additional threats.

The **Russian desman** (*Desmana moschata*) is a small, long-snouted, semi-aquatic insectivore that inhabits wetlands of the Volga, Don, and Ural river drainages in Russia, Ukraine, and Kazakhstan. Long hunted for their rich, thick fur, the main threats now are habitat destruction and degradation and competition with introduced muskrats (*Ondatra zibethicus*).

The **Pyrenean desman** (*Galemys pyrenaicus*) occurs in the northern and central parts of Spain and Portugal, the French Pyrenees, and Andorra, but has experienced extreme range contractions across its range.

The **southern water vole** (*Arvicola sapidus*) is confined to isolated wetland areas of France, Spain, and Portugal, where it is threatened mainly by loss of habitat.

The **relict gull** (*Ichthyaetus relictus*) breeds in a small number of saline lakes in the arid steppe regions of Mongolia, eastern Kazakhstan, south-central Russia, and northern China, from where it migrates to South Korea and perhaps north-eastern China as well. It is threatened mainly by coastal development in its non-breeding range.

The **Far Eastern curlew** (*Numenius madagascariensis*) breeds in eastern Russia and north-eastern Mongolia, from where it winters as far south as Australia and New Zealand. It is threatened mainly by loss of habitat.

Swinhoe's rail (*Coturnicops exquisitus*), the world's smallest rail species, was long known only from two small breeding areas separated by more than 1000 km in north-eastern China and south-eastern Siberia. A new breeding population situated between the two was discovered in the Amur region in 2018, and more recently in Japan. The species is everywhere rare and declining due to loss of habitat.

The **large-headed water snake** (*Natrix megalocephala*) is found in western Transcaucasia in south-western Russia, western Georgia, and far north-eastern Turkey, where it prefers fast-flowing mountain streams as well as lower-elevation woodlands. It is threatened by loss of habitat and introduced racoons (*Procyon lotor*).

The **Italian yellow-bellied toad** (*Bombina pachypus*) ranges through much of the Italian Peninsula south of the Po River, where it is nevertheless threatened by the loss of its wetland habitat.

The **Suweon tree frog** (*Dryophytes suweonensis*) is confined to wetlands areas in the lowlands of the north-western South Korea, where it is threatened by loss of habitat.

The **Tavas frog** (*Rana tavasensis*) is confined to two areas of south-western Turkey. The **Italian agile frog** (*R. latastei*) is confined to a few localities in northern Italy and (marginally) southern Switzerland. Both are threatened by loss of habitat.

Three species of Eurasian water frog (*Pelophylax*) are threatened by loss of habitat, pollution, and overcollection. The **Epirus water frog** (*P. epeiroticus*) is confined to small pockets of suitable habitat in southern Albania and western Greece (including the island of Corfu). The **Albanian water frog** (*P. shqipericus*) is confined to western Albania and southern Montenegro. The **Korean water frog** (*P. chosenicus*) is confined to the western Korean Peninsula.

The **European sturgeon** or **beluga** (*Huso huso*) is the largest freshwater fish in the world, with the all-time accepted record being a 7.2-m individual taken from the Volga estuary in 1827 that weighed 1571 kg. It is an anadromous species historically known from the Caspian, Black, Azov, and Adriatic basins, but has been extirpated from the Adriatic and Azov seas due to overfishing and loss of spawning sites due to dams. It has long been in heavy demand for the female's valuable roe – better known as beluga caviar – and although governments have attempted for decades to restrict the trade, poaching continues.

Sturgeons of the genus *Acipenser* are widespread across Eurasia and North America, where they are anadromous (i.e. able to live in both fresh and salt water). Many species are highly threatened by overfishing, damming of their spawning rivers, and the international trade in caviar. The **Atlantic sturgeon** (*A. sturio*) was historically found throughout the

North and Baltic seas, the English Channel, the European and Icelandic coast of the Atlantic, the northern Mediterranean, and parts of the Black Sea. Today only a single small population remains, in the Garonne River of south-western France, where it last spawned in 1994. The **starry sturgeon** (*A. stellatus*) was historically found throughout the Caspian, Black, Azov, and Aegean sea basins, but has been extirpated from the latter and it is predicted that the remaining natural population will soon follow. The **Siberian sturgeon** (*A. baerii*) is normally divided into two subspecies, the nominate form of which (*A. b. baerii*) historically inhabited all the Siberian rivers draining into the Kara, Laptev, and East Siberian seas as well as the Irtysh River in north-western China (Xinjiang). The latter wild population was extirpated in the 1950s, although small numbers continue to be artificially restocked. The **sterlet** (*A. ruthenus*) inhabits the large rivers flowing into the Black, Azov, and Caspian seas, as well as a few others in Siberia. Populations migrating between fresh and salt water have all been extirpated. The **diamond sturgeon** (*A. gueldenstaedtii*) was historically found in the Caspian, Black and Azov sea basins, although aquaculture has resulted in both intentional and accidental introductions throughout Europe. It is currently known only from the Caspian Sea, where it spawns in the Ural and Volga rivers, and from the Black Sea where spawning occurs in the lower Danube and Rioni rivers. There is no native spawning population remaining in the Sea of Azov, only introduced (stocked) individuals. The **ship sturgeon** (*A. nudiventris*) was historically abundant in the Black, Aral, and Caspian sea basins, with possible relict populations in the Rioni River of Georgia and the Safid Rud in Iran. The healthiest population is in Lake Balkhash in Kazakhstan, well outside its natural range, where the species was introduced in the 1960s for commercial purposes. It has also been introduced to the upper Illi River in China and to the Syr-Darya River in the Aral Sea basin. The **Adriatic sturgeon** (*A. naccarii*) was historically confined to the rivers and lagoons of northern Italy and the eastern coasts of the Adriatic Sea. All wild populations are now most likely extirpated, with the species now totally dependent upon stocking from aquaculture.

The **lavaret whitefish** (*Coregonus lavaretus*) was historically confined to Lake Bourget in France and to Lake Geneva, with an additional population having been introduced to Lake Aiguebelette in France centuries ago. The Lake Geneva population was extirpated in the early twentieth century, although the reason is unknown. The **pfärrit whitefish** (*C. confusus*) was historically known from lakes Morat and Bienne in Switzerland, although it may occur in Lake Neuchâtel as well. The Lake Morat population was extirpated in the 1960s due to eutrophication and water level management. **Trybom's whitefish** (*C. trybomi*) was historically known for certain only from a few lakes in southern Sweden. Only the population in Lake Fegen survives today, the other populations having been extirpated in the 1970s and 1980s due to acid rain and the stocking of introduced species.

The **Siberian taimen** (*Hucho taimen*) is a salmon-like game fish with a wide geographic range within Eurasia, including parts of the Caspian and Arctic drainages as well as portions of the Pacific drainages. It is everywhere threatened by overfishing, pollution, and loss of habitat.

The **Yessey char** (*Salvelinus tolmachoffi*) is confined to lakes Yessey, Siltak, and Bezymannoye in the Khatanga River drainage of north-central Siberia, and to Khantaiskoye Lake in the Yenisey drainage. It may also be present in a few lakes of the Gydanskiy Bay basin on the Taimyr Peninsula. It is threatened by pollution from heavy metal mining and by overfishing.

The **common carp** (*Cyprinus carpio*) has been domesticated since the Middle Ages, and cultivated stocks are assumed to have been derived from the wild European carp (*C. c. carpio*) which is native to the Black, Caspian, and Aral sea basins. This subspecies has been introduced to other parts of Europe as well as to the Middle East and north-western Africa, and has also been established worldwide in large quantities for use as food. Unfortunately, hybridization with domesticated introduced stocks has become a seriously threat to genetically pure populations. Another subspecies, the Deniz carp (*C. c. yilmaz*), is confined to Anatolian Turkey.

The **Austrian lakes trout** (*Salmo schiefermuelleri*) is known historically from three subalpine lakes (Attersee, Traunsee, and Fuschlersee). It is most likely extinct. The **Adriatic trout** (*S. obtusirostris*) is confined to a few rivers in Croatia, Bosnia-Herzegovina, and Montenegro. The **Pelagos trout** (*S. pelagonicus*) is confined to a few rivers in North Macedonia and northern Greece. The **flathead trout** (*S. platycephalus*) is known only from three mountain streams in central Turkey. There is some question, however, as to the validity of the species.

The **Valencia toothcarp** (*Valencia hispanica*) is confined to coastal areas of east-central Spain. The species appears to have formerly ranged as far as southern France. **Letourneux's toothcarp** (*V. letourneuxi*) is confined to Lake Butrint in southern Albania and to a few areas of coastal western Greece. The species is believed to have been extirpated from the islands of Corfu and Lefkas.

Kemal's golden barb (*Garra kemali*) is confined to central Anatolia, where it is known from the Eregli Marshes, Lake Meyil, and the Lake Beysehir basin.

Four barbels of the genus *Barbus* are threatened by habitat degradation, water extraction, and introduced species. The **brook barbel** (*B. caninus*) was historically confined to the Po and Isonzo rivers of northern Italy, southern Austria, and southern Switzerland. It is not clear whether it still survives in the Isonzo River. The **Crimean barbel** (*B. tauricus*) is confined to a few streams on the southern tip of the Crimean Peninsula. The **Macedonian barbel** (*B. macedonicus*) is confined to a few rivers in northern Greece and North Macedonia. The **Catalan barbel** (*B. haasi*) is confined to the Ebro River drainage and a few coastal rivers in north-eastern Spain.

The **Greek barbel** (*Luciobarbus graecus*) is confined to the Sperchios River drainage and Lake Yliki in eastern Greece. It formerly occurred in Lake Paralimni as well, which has since

been drained. The **Bulatmai barbel** (*L. capito*) is found in the Caspian and Aral seas along with their inflowing rivers. It has been extirpated over much of its range due to expanding hydropower development, overfishing, and pollution. The **Iberian barbel** (*L. comizo*), **Valencia barbel** (*L. guiraonis*), and **Steindachner's barbel** (*L. steindachneri*) are all confined to the Tagus and Guadiana river drainages of south-western Spain and southern Portugal, where they have declined considerably since the 1990s.

The **Dalmatian barbelgudgeon** (*Aulopyge huegelii*) inhabits both above-ground and subterranean karst rivers as well as lakes in Croatia and Bosnia-Herzegovina, but is everywhere threatened by pollution and invasive species.

Two species of scraper (*Capoeta*) are endemic to Turkey, where they are threatened by water extraction, drought, and introduced species. The **longsnout scraper** (*C. mauricii*) appears to have been historically widespread in central Turkey, but is two confined to the south-eastern Lake Beysehir basin and few other isolated streams. The **Pamphylian scraper** (*C. antalyensis*) is confined to the Aksu and Koprucay river drainages of south-western Turkey.

The **pike-asp** (*Aspiolucius esocinus*) is found in the Amu Darya and Syr Darya rivers and a few lakes in Tajikistan, Kazakhstan, Turkmenistan, and Uzbekistan.

The **Antalya bleak** (*Alburnus baliki*) is known only from four streams draining to the Gulf of Antalya in south-central Turkey. The **Manyas bleak** (*A. carinatus*) is confined to Lake Kus (Lake Manyas) and Lake Uluabat (Lake Apalyont) in north-western Turkey, from where they ascend a handful of tributaries to spawn. The **eastern Aegean bleak** (*A. demiri*) is confined to a few river drainages in south-western Turkey. The **Gediz bleak** (*A. battalgilae*) is confined to the lower Gediz and Koca drainages of east-central Turkey, where it has been extirpated from a number of localities. The **Italian bleak** (*A. albidus*) is confined to the rivers of southern Italy. **Nasreddin's bleak** (*A. nasreddini*) was historically found in Lake Eber and Lake Aksehir and their tributaries. Massive water extraction and pollution have destroyed most of its habitat, and the species is currently known only from a single tributary of Lake Aksehir, the Ortakoy River.

Members of the genus *Telestes* are small cyprinid fish that live in the karstic rivers and lakes of the Balkan region. Many are threatened by habitat loss due to water extraction and drought. The **spring dace** (*T. fontinalis*) is confined to intermittent rivers and karsts in Croatia. The **Boeotian dace** (*T. beoticus*) is confined to the Kifissos and Asopos river drainages of south-eastern Greece. It was historically also found in the catchment rivers for lakes Yliki and Paralimni, which are now totally drained. The **Croatian dace** (*T. croaticus*) is confined to a few river systems in central Croatia. The **striped dace** (*T. metohiensis*) is confined to a few streams in southern Croatia, Bosnia-Herzegovina, and Montenegro.

Four species of nase of the genus *Chondrostoma* are threatened by water extraction, introduced species, and pollution. The **eastern Aegean nase** (*C. holmwoodii*) was historically known from the Kucuk Menderes, Izmir, Gediz, and Bakir river drainages of western Turkey. It has apparently been extirpated from the Kucuk Menderes. The **Tefenni nase** (*C. fahirae*) is historically known from Kirkpinar spring near Tefenni in south-western Turkey, where it was extirpated and had to be reintroduced, with unknown success. Populations are found in Lake Karatash and a stream within the Lake Burdur basin as well. The **Italian nase** (*C. soetta*) was historically confined to northern Italy, Slovenia, and southern Switzerland, from where it has been introduced into a few lakes in west-central Italy. It has been extirpated from Slovenia and the Isonzo River drainage. The **minnow nase** (*C. phoxinus*) is known only from a few freshwater karst localities in Croatia and Bosnia-Herzegovina.

Coelho's nase (*Pseudochondrostoma duriense*) is confined to a few river drainages in north-western Spain and northern Portugal. **Willkomm's nase** (*P. willkommii*) is confined to southern Spain and southern Portugal. Both are threatened mainly by habitat destruction.

The **south-west European nase** (*Parachondrostoma toxostoma*) is confined to the Rhône drainage of France and Switzerland and to coastal rivers in France. It is threatened by dam construction and introduced species. The **Turia nase** (*P. turiense*) is confined to the Turia and Mijares river drainages of east-central coastal Spain, where it is threatened by pollution and introduced species.

Three species of nase of the genus *Iberochondrostoma* endemic to the Iberian Peninsula are threatened by habitat destruction, pollution, and predation and competition from introduced fish species. **Almaca's arch-mouthed nase** (*I. almacai*) is confined to the Mira, Arade, and Bensafrim river drainages of southern Portugal. The **Lusitanian arch-mouthed nase** (*I. lusitanicum*) is confined to a few rivers in south-western Portugal. **Lemming's arch-mouthed nase** (*I. lemmingii*) is confined to the Tagus, Guadiana, Odiel, and Guadalquivir river drainages of south-western Spain and southern Portugal.

The **Aegean minnow** (*Phoxinus strymonicus*) is known only from the Aggitis (Strymon) River in northern Greece, although the species may also occur in the Loudias and Filiouris drainages. **Strandja's minnow** (*P. strandjae*) is confined to the Veleka and Resowska river drainages of Bulgaria and Turkey.

The **Dinaric minnow** (*Phoxinellus alepidotus*) is confined to a few river drainages in southern Croatia and Bosnia-Herzegovina.

A great number of spring minnows of the genus *Pseudophoxinus* are endemic to Anatolian Turkey, where they are threatened by water extraction and drought. The **giant spring minnow** (*P. anatolicus*) is still found in a number of lakes and streams in central Turkey and their tributaries and in the Eregli marshes. It has been extirpated from Lake Beysehir. The **Sandikli spring minnow** (*P. maeandricus*) is known from Karadirek stream near Sandikli in west-central Turkey, an isolated basin which flows underground to Isikli spring, and to the Lake Hotamis basin in south-central Turkey where it

was extirpated some time ago due to the draining of the marshes. The **Pamphylian spring minnow** (*P. alii*) is known from the Ilica and Kormurculer streams as well as a section of the Aksu River, all of which flow into the Bay of Antalya in south-central Turkey. The **Lycian spring minnow** (*P. evliyae*) is known from the Lake Avlan basin, which drains through the Akçay River to the Mediterranean, and to the Lake Söğüt basin, both in south-western Turkey. Lake Avlan has become a seasonal lake, making three springs the only refuge sites for the species, while Lake Sogut was drained many years ago and the species only survives in a few canals fed by a single spring. The **central Anatolian spring minnow** (*P. burduricus*) is confined to the Lake Burdur and Lake Salda drainages and to a few other isolated springs and streams. The **fat spring minnow** (*P. crassus*) is known from a few lakes and streams in west-central Turkey. The species most likely occurred in Lake Samsam, which was entirely drained in the 1970s. The **Apamean spring minnow** (*P. maeandri*) is confined to an undefined locality in Turkey.

The **Izmir minnow** (*Ladigesocypris mermere*) is known only from a few specimens collected from south-western Anatolia.

The **spotted minnow** (*Delminichthys adspersus*) and **Ghetaldi's minnow** (*D. ghetaldii*) are both confined to a few rivers and lakes in Croatia and Bosnia-Herzegovina.

The **Peloponnese minnow** (*Pelasgus laconicus*) is confined to fragmented populations within the Eurotas and Alfeiós rivers in southern Greece.

The **Estremadura minnow** (*Achondrostoma occidentale*) is known from the Alcabrichel, Sizandro, and Safarujo drainages of west-central Portugal, although it is believed that the Safarujo population was extirpated when the stream dried up. **Arcas' minnow** (*A. arcasii*) is confined to a few rivers in northern Portugal and northern Spain. Both are threatened by habitat destruction, pollution, and predation and competition from introduced fish species.

The **Crimean riffle minnow** (*Alburnoides maculatus*) is confined to small streams of the Crimean Peninsula, where it is threatened by water extraction and drought.

The **European mudminnow** (*Umbra krameri*) has a scattered distribution in the Danube and Dniestr River drainages of south-central Europe, where it is threatened by the disappearance of its backwater habitat. It has been extirpated from many locations.

The **Spartan minnowroach** (*Tropidophoxinellus spartiaticus*) is confined to a few small rivers and streams in the southern Peloponnese of Greece.

Steindachner's chub (*Iberocypris alburnoides*) is still fairly widespread in lakes and rivers within the southern Iberian Peninsula of Spain and Portugal, but is everywhere under threat by loss of habitat and introduced species.

The **Aksehir chub** (*Squalius recurvirostris*) is known from at least three stream catchments, one each flowing to lakes Ilgin, Eber, and Aksehir in west-central Turkey. The species historically occurred in lakes Eber and Aksehi themselves, but have been extirpated due to desiccation and pollution, although it still survives in Lake Ilgin. The **thick-lipped chub** (*S. cephaloides*) is known only from the Tesvikiye and (formerly) Armutlu streams in north-western Turkey. The **Toscana chub** (*S. lucumonis*) is confined to a few populations with the Tiber, Arno, Ombrone, and Serchio river drainages of central-west Italy. The **Málaga chub** (*S. malacitanus*) is confined to the Guadalmina and Guadiaro rivers of southern coastal Spain. The **Valencia chub** (*S. valentinus*) is confined to a few coastal rivers in south-eastern Spain. The **Arade chub** (*S. aradensis*) is confined to the Arade, Algibre, and Bordeira river drainages of southern Portugal. The **Stymphalia chub** (*S. moreoticus*) is known only from Lake Stymphalia and Vouraikos river drainage of south-central Greece. The **Neretva chub** (*S. svallize*) is confined to the Neretva and Trebisnjica river drainages in Bosnia-Herzegovina, southern Croatia, and Montenegro. The **Livno chub** (*S. tenellus*) is confined to a few karstic streams in Bosnia-Herzegovina and southern Croatia, and may have been introduced to Lake Blidinje more than a century ago.

The **Elmali rudd** (*Scardinius elmaliensis*) is confined to a few streams and springs in south-western Turkey. The **Tiber rudd** (*S. scardafa*) was formerly found throughout the Tiber River drainage, but is now entirely confined to Lake Scano, a locality outside its natural range, where it was introduced in the late nineteenth century.

Meidinger's roach (*Rutilus meidingeri*) is currently known from lakes Attersee, Mondsee, and Wolfgangsee in northern Austria, with an additional small population in an Austrian stretch of Danube. The species has been extirpated from Lake Traunsee in Austria and from Lake Chiemsee in south-eastern Germany (although it continues to be stocked there).

Panos' roach (*Leucos panosi*) is confined to lakes Trichonis and Ambrakia and to the Achelous and Louros river drainages of western Greece. The **Yliki roach** (*L. ylikiensis*) was historically known from the Kifissos River drainage, including lakes Yliki and Paralimni (the latter now dry) in central Greece.

Duran's sculpin (*Cottus duranii*) is only known from a few specimens collected from the upper Loire and Dordogne drainages of south-central France.

The **Eber gudgeon** (*Gobio intermedius*) historically occurred in lakes Eber and Aksehir in west-central Turkey, but are now confined to a few inflowing streams due to drought and pollution. The **Salgir gudgeon** (*G. krymensis*) is confined to a few rivers at the southern tip of the Crimean Peninsula, where it is threatened by water extraction.

The **Benacus gudgeon** (*Romanogobio benacensis*) was historically confined to the Po River drainage and coastal rivers in northern Italy, where it has disappeared from many areas. The species has been introduced into the Arno and Ombrone rivers, and to the Isonzo and Reka rivers of Slovenia.

The **Arno goby** (*Neogobius nigricans*) is confined to streams and lakes within the Tyrrhenian catchment of north-central Italy. It is threatened by habitat degradation and introduced species.

Brauner's goby (*Benthophiloides brauneri*) is a rarely recorded freshwater and brackish water species from the surrounding rivers, lakes, and estuaries of the Black and Caspian sea basins. It is threatened by loss of habitat due to water extraction and drought.

The **Iyidere goby** (*Ponticola rizensis*) is confined to three streams in north-eastern Turkey, where it is threatened by dam construction.

The **Gediz dwarf goby** (*Knipowitschia mermere*) is known from Lake Marmara and the lower Gediz and Madra river drainages of western Turkey. The **Croatian dwarf goby** (*K. croatica*) is found in clear karstic springs, lakes, and smaller rivers within the Neretva and Matica drainages of Croatia and Bosnia-Herzegovina. It is threatened by eutrophication, pollution, and water extraction.

The **Baetic toothcarp** (*Aphanius baeticus*) is confined to the lower Guadalquivir River and a few streams in south-western Spain. While protected within Doñana National Park it remains threatened by habitat destruction, pollution, repeated drought, and the introduction of exotic species.

Aristotle's catfish (*Silurus aristotelis*) was historically confined to Lake Trichonida, Lake Lysimachia, and Lake Amvrakia in western Greece. The species is of considerable commercial interest to local fisheries and was introduced to Lake Pahvotis as well as to Lake Volvi in northern Greece.

The **Kashmir mountain catfish** (*Glyptothorax kashmirensis*) is known from the Jhelum River within the Indus River drainage of Pakistan, as well as from northern India (Jammu and Kashmir). An additional record from the Ganges River drainage in Nepal requires confirmation. It is thought to be seriously threatened by damming.

The **Carian sportive loach** (*Oxynoemacheilus germencicus*) is known only from the Buyuk Menderes and lower Gediz drainages in western Anatolia. It likely also occurred in the Kucuk Menderes River, which lies between the two known rivers, but is now extirpated there due to pollution and water extraction.

Two pond loaches of the genus *Seminemacheilus* are endemic to west-central Turkey, where they are threatened by water extraction and drought. **Lendli's pond loach** (*S. lendlii*) was historically widespread across central Anatolia but is now known only from a few isolated springs and tributaries of Lake Tuz and Lake Beysehir. The **Ispart pond loach** (*S. ispartensis*) is confined to the Egirdir, Aksehir, and Eber lake basins.

Stephanidis' spined loach (*Cobitis trichonica*) is confined to lakes Trichonis, Lysimachia, Ozeros, and Amvrakia, and to the Acheloos River drainage in western Greece. The **brown spined loach** (*C. puncticulata*) is confined to a few rivers and lakes in north-eastern Greece and north-western Turkey. The **Phrygian spined loach** (*C. phrygica*) is confined to a few lakes, springs, and streams in south-western Turkey. The **Bithynian spined loach** (*C. splendens*) is confined to a single small stream on the Black Sea coast of north-western Turkey. **Calderon's spined loach** (*C. calderoni*) is confined to the Douro, Ebro, and Tagus river drainages of northern Portugal and northern Spain. The **Illyrian spined loach** (*C. illyrica*) is confined to a small area of southern Croatia. **De Buen's spined loach** (*C. paludica*) is confined to the rivers of the central and southern Iberian Peninsula. **Zanandrea's spined loach** (*C. zanandreai*) was historically confined to the Volturno River drainage of south-central Italy. It is also present in Lake Fondi and a few associated lagoons, where it was most likely introduced.

The **Turkish brook lamprey** (*Lampetra lanceolata*) is confined to widely separated streams in northern Turkey, one flowing into the Black Sea at Trabzon and another running to Lake Sapanca in Western Anatolia.

The **Greek brook lamprey** (*Eudontomyzon hellenicus*) is today known only from two brooks within the Struma River drainage of north-eastern Greece. It was historically found in the Louros River drainage in western Greece as well, but appears to have extirpated.

The Caspian Sea

The Caspian Sea is the largest enclosed inland body of water on Earth by area, although shrinking rapidly due to climate change and human activity along the Volga River. Its fauna is poor but extremely varied owing to its former connections with other seas from the Arctic to the Mediterranean.

The **Caspian seal** (*Pusa caspica*) is a small, ice-breeding species endemic to the Caspian Sea. Unsustainable commercial hunting has been responsible for a dramatic decline in population.

The **Persian sturgeon** (*Acipenser persicus*) is confined to the Caspian Sea, where it is most abundant in the southern part. Historically it ascended all the rivers of the basin to spawn, but is now restricted to the lower courses of a few rivers in Iran. The species is heavily fished for its meat and roe, and continues to be stocked from aquaculture.

The **Volga shad** (*Alosa volgensis*) is an anadromous species of commercial fishing importance which historically ascending from the Caspian Sea up the Volga, Terek, and Ural rivers to spawn. It has been extirpated from the latter two rivers, and the construction of the Volgograd Dam has severely curtailed its migration in the Volga.

The **beloribitsa whitefish** (*Stenodus leucichthys*) has lost all of its spawning grounds along the Volga River due to the construction of dams. It is now extinct in the wild, but survives in cultured stocks.

The **Caspian kutum** (*Rutilus kutum*) was historically common, but appears to have declined dramatically in recent years owing to marine pollution and overfishing.

The **Khvalyn spined loach** (*Cobitis amphilekta*) is known for certain only from Kyzylagach Bay and the lower Kumbashi River in Azerbaijan.

The Aral Sea

The Aral Sea was an endorheic lake (i.e. one with no outflow) lying between Kazakhstan in the north and Uzbekistan in the south. Formerly the fourth largest lake in the world, it began to shrink in the 1960s after the rivers that fed it were diverted by

Soviet irrigation projects. By 1997 it had declined to just 10 per cent of its original size, in the process splitting into four separate lakes. By 2009 the south-eastern lake had disappeared, and the south-western lake had been reduced to a thin strip. Satellite images taken by NASA in 2014 revealed that the eastern basin had completely dried up (it is now known as the Aralkum Desert). The shrinking of the Aral Sea has been called one of the worst environmental disasters in modern history. The region's once-prosperous fishing industry has been essentially destroyed.

The **Aral barbel** (*Luciobarbus brachycephalus*) was historically found throughout the Aral Sea basin, along with the Chu River drainage and the western Caspian Sea. Today it survives only in a few reservoirs of the Amu Darya and Syr Darya (tributaries of the Aral Sea) and the Karakum Canal, where it is invasive. In the western Caspian Sea the landlocked population in the Kura River is thought to be stable, as are those in the southern tributaries, but migrating populations have declined due to a lack of spawning sites and poaching.

The Amu Darya and Syr Darya Rivers

The Amu Darya (historically the Oxus) and Syr Darya (historically the Jaxartes) rivers are the primary tributaries of the Aral Sea.

The **sharpray** (*Capoetobrama kuschakewitschi*) is a type of cyprinid fish confined to the Aral Sea basin. Kuschakewitsch's sharpray (*C. k. kuschakewitschi*) is confined to the Amu Darya and Syr Darya river systems.

Fedtschenko's false shovelnose sturgeon (*Pseudoscaphirhynchus fedtschenkoi*) was historically found in the Aral Sea as well as the Syr Darya and the middle and lower reaches from the Kara Darya River. Last recorded in 1960, it is most likely extinct. The **dwarf false shovelnose sturgeon** (*P. hermanni*) and **Kaufmann's false shovelnose sturgeon** (*P. kaufmanni*) are both confined to a few localities within the Amu Darya River.

The Chu River

The Chu River is located in northern Kyrgyzstan and southern Kazakhstan.

The Chu sharpray (*Capoetobrama kuschakewitschi orientalisi*) is confined to the Chu River.

Lake Urmia

Lake Urmia (Daryace Orumiye in Persian) is an endorheic salt lake located in north-western Iran. At its greatest extent it was the largest lake in the Middle East, but has shrunk to a fraction of its former size owing to damming of the rivers that flow into it and groundwater pumping in the surrounding area.

The **Urmia bream** (*Acanthalburnus urmianus*) is confined to southern and western tributaries of the Lake Urmia basin.

Lake Baikal

Lake Baikal is a rift lake located in southern Siberia near the Mongolian border. So large that it is often mistaken for a sea, it is the deepest and oldest lake in the world, and the largest freshwater lake by volume. Famous for its crystal-clear waters and unique wildlife, the lake is nevertheless under threat by pollution, poaching and development.

The Baikal seal (*Pusa sibirica*) is the only entirely landlocked seal species in the world and one of the smallest. Endemic to the lake and its tributary rivers, it remains quite common despite hunting and pollution, but could be at risk in the future owing to climate change.

The Baikal sturgeon (*Acipenser baerii baikalensis*) is confined primarily to the northern end of the lake, migrating up the Selenga River to spawn. Long a target for fishermen due to its enormous size (specimens up to 125 kg were once common), it is now officially protected but remains threatened.

The Baikal whitefish or omul (*Coregonus migratorius*), one of the lake's most economically important fish, was once overfished to such an extent that by the 1960s its survival, also imperilled by other environmental disturbances, was threatened. It has since recovered.

Lake Saimaa

Lake Saimaa is located in south-eastern Finland. One of the largest natural freshwater lakes in Europe, it was formerly connected to the Gulf of Finland and the Baltic Sea, but has been landlocked since the last Ice Age.

The Saimaa ringed seal (*Pusa hispida saimensis*) is endemic to the lake, where the total population is estimated at around 200–250 individuals. It has been fully protected since 1958, but pollution and complaining fishermen constitute a threat to its existence.

Lake Geneva

Lake Geneva (Lac Léman in French) is located on the northern side of the Alps between France and Switzerland. It is one of the largest lakes in western Europe.

Two species of economically important whitefish (*Coregonus*) endemic to Lake Geneva have been driven to extinction due to a combination of eutrophication and overfishing. The **gravenche whitefish** (*C. hiemalis*) appears to have disappeared in the early 1900s, while the **fera whitefish** (*C. fera*) was last recorded in 1920.

The Prespa Lakes

The Prespa Lakes are two connected freshwater lakes located high in the Balkan Mountains of south-eastern Europe. Great Prespa Lake is shared between Greece, Albania, and North Macedonia, while Small Prespa Lake is shared only between Greece and Albania. The area contains three national parks.

The **Prespa bleak** (*Alburnus belvica*) is confined to the Prespa Lakes.

The **Prespa trout** (*Salmo peristericus*) is known for certain only from Agios Germanos stream in the Prespa Lakes region of north-western Greece, although it may be present as well in one or two streams in North Macedonia.

The **Prespa minnow** (*Pelasgus prespensis*) is confined to the Prespa Lakes, where it is threatened by water extraction, pollution, disease, and the introduction of exotic fish species.

The **Prespa riffle minnow** (*Alburnoides prespensis*) is confined to the Prespa Lakes.

The **Prespa nase** (*Chondrostoma prespense*) is confined to the Prespa Lakes.

The **Prespa roach** (*Rutilus prespensis*) is confined to shallow nearshore and swampy areas of the Prespa Lakes.

The **Prespa spined loach** (*Cobitis meridionalis*) is a rare nearshore species from the Prespa Lakes.

Lake Ohrid

Lake Ohrid straddles the mountainous border between south-western Macedonia and eastern Albania. One of Europe's deepest and oldest lakes, it features a unique aquatic ecosystem of global importance and many endemics.

The **Belushka trout** (*Salmo ohridanus*), **Struga trout** (*S. balcanicus*), **Ohrid summer trout** (*S. aphelios*), and **Lumi trout** (*S. lumi*) are all endemic to Lake Ohrid, where they are threatened by artificial hybridization with the more common Pestani trout (*S. letnica*) as well as by overfishing, poaching, and degradation of the lake's water quality.

The **Ohrid minnow** (*Pelasgus minutus*) was historically confined to swampy areas of the Lake Ohrid basin. It has not been collected since 1973, and may be extinct.

The **Ohrid riffle minnow** (*Alburnoides ohridanus*) is confined to the surf zone along the lake's shoreline. Interbreeding with introduced species is a possible threat.

The **Ohrid gudgeon** (*Gobio ohridanus*) is naturally endemic to Lake Ohrid, although it has been introduced to France and perhaps other countries.

Lake Van

Lake Van (Van Golu in Turkish) is a large endorheic lake located in eastern Turkey.

The **Karasu Sha bleak** (*Alburnus timarensis*) is confined to the lower part of Karasu stream in the Lake Van basin.

The **Van scraper** (*Capoeta kosswigi*) is confined to the Lake Van basin.

The **Van sportive loach** (*Oxynoemacheilus ercisianus*) is confined to a few streams flowing into Lake Van, where it is threatened by sand mining and dam construction.

Lake Neuchâtel

Lake Neuchâtel (Lac de Neuchâtel in French/Neuenburgersee in German) is a large lake located in western Switzerland.

The **Neuchâtel deepwater char** (*Salvelinus neocomensis*) is known only from three specimens collected in 1896, 1902, and 1904. Research undertaken in the 1950s and in 2003 appear to confirm its extinction.

The **Neuchâtel whitefish** (*Coregonus candidus*) is naturally confined to the lake, where eutrophication caused a population decline in the 1970s. It has since somewhat recovered. An introduced (possibly hybridized) population lives in Lake Maggiore.

Lake Beysehir

Lake Beysehir (Beysehir Golu in Turkish) is a large freshwater lake located in south-central Turkey.

The **Beysehir bleak** (*Alburnus akili*) was endemic to Lake Beysehir, where it became extinct soon after the introduction of pike-perch (*Sander lucioperca*) in 1955.

The **Beysehir nase** (*Chondrostoma beysehirense*) is confined to part of Lake Beysehir and three adjacent streams.

Two species of gudgeon (*Gobio*) are endemic to the Lake Beysehir basin. The **Beysehir gudgeon** (*G. microlepidotus*) is known only from a few streams flowing into Lake Beysehir, although it may occur in the lake itself. The **Eyilikler gudgeon** (*G. battalgilae*) is known only from Eyilik stream in the northern Lake Beysehir basin.

The **Hittitic spring minnow** (*Pseudophoxinus hittitorum*) is known only from a spring at Eflatunpınar, east of Lake Beysehir, and Bakaran stream, which drains from the south of the lake.

Two spined loaches (*Cobitis*) are confined to the Lake Beysehir basin. The **Beysehir spined loach** (*C. battalgili*) is known only from three streams in the Lake Beysehir basin, and in the Manavgat stream that flows to the Mediterranean. **Bilsel's spined loach** (*C. bilseli*) is confined to a few streams in the Lake Beysehir basin.

Lake Egirdir

Lake Egirdir (Egirdir Golu in Turkish) is a large freshwater lake located in south-western Anatolia. The introduction of the predatory pike-perch (*Sander lucioperca*) has had a decimating impact upon the native fish species.

Hanlirsch's spring minnow (*Pseudophoxinus handlirschi*) has not been recorded since the 1980s despite intensive fieldwork, and is thought to be extinct. The **Egirdir spring minnow** (*P. egridiri*) is restricted to two densely vegetated tributaries and one large shoreline spring in the Lake Egirdir basin. At one time feared extinct, it was rediscovered in 1993.

The **Egirdir longsnout scraper** (*Capoeta pestai*) was formerly found throughout Lake Egirdir, but is now confined to a single inflowing stream (Caykoy Creek) along with a small area of adjacent lake where it is considered highly threatened.

Lake Burdur

Lake Burdur (Burdur Golu in Turkish) is a large, deep saline lake located in south-western Turkey.

The **Sureyan toothcarp** (*Aphanius sureyanus*) and the **Burdur toothcarp** (*A. burduricus*) are both confined to Lake Burdur, where they are threatened by water extraction, damming of the lake's sources, and drought.

The **Burdur sportive loach** (*Oxynoemacheilus anatolicus*) is confined to three separate, short, spring-fed streams that used to drain into Lake Burdur.

Lake Tuz

Lake Tuz (Tuz Golu in Turkish) is located in central Turkey. It is the second largest lake in the country and one of the largest hypersaline lakes in the world.

The **Cappadocian chub** (*Squalius cappadocicus*) is known only from the Melendiz River, a small inflow of Lake Tuz.

The **Cappadocian gudgeon** (*Gobio gymnostethus*), **Taurus gudgeon** (*G. hettitorum*), and **Cihanbeyli gudgeon** (*G. insuyanus*) are all confined to streams and marshes within the Lake Tuz basin.

The **Tuz sportive loach** (*Oxynoemacheilus eregliensis*) is confined to streams and springs within the Lake Tuz basin.

The **Tuz spined loach** (*Cobitis turcica*) is confined to a few springs and streams in the Lake Tuz basin.

Lake Vistonis

Lake Vistonis is a shallow coastal lagoon located in north-eastern Greece. General threats include damming, pollution, and water extraction for irrigation.

The **Vistonis bleak** (*Alburnus vistonicus*) is confined to the Lake Vistonis drainage.

The **Thracian shad** (*Alosa vistonica*) is confined to the Lake Vistonis drainage.

Lake Trichonida

Lake Trichonida is a large lake located within the Acheloos River drainage of western Greece. It is connected to the smaller Lake Lysimachia.

The **Trichonida dwarf goby** (*Economidichthys trichonis*) is confined to Lake Trichonida and Lake Lyssimachia.

The **Trichonida combtooth blenny** (*Salaria economidisi*) is confined to Lake Trichonida. It is threatened by loss of habitat.

Lake Skadar

Lake Skadar is located on the border between Albania and Montenegro. It is the largest lake in southern Europe.

The **Skadar nase** (*Chondrostoma scodrense*) is known only from nine specimens collected in the late nineteenth century from the Lake Skadar basin. Surveys in recent decades have failed to find the species, and it is now considered to be extinct.

The **Skadar gudgeon** (*Gobio skadarensis*) is known only from Zeta stream and the lower Moraca River, within the Lake Skadar basin.

Lake Ammer

Lake Ammer (Ammersee in German) is a large lake located in the upper Danube basin of southern Germany (Bavaria).

The **Ammersee char** (*Salvelinus evasus*) is confined to deep waters in Lake Ammer.

The **Ammersee ruffe** (*Gymnocephalus ambriaelacus*) is a type of perch confined to Lake Ammer, where it is threatened mainly by introduced species.

The **Ammersee whitefish** (*Coregonus bavaricus*) is confined to deep waters in Lake Ammer.

Lake Ladoga

Lake Ladoga is a freshwater lake located in north-western Russia near Saint Petersburg. It is the largest lake in Europe.

The Ladoga ringed seal (*Pusa hispida ladogensis*) is confined to Lake Ladoga, where it is threatened by human disturbance.

The **Ladoga whitefish** (*Coregonus baerii*) is threatened by overfishing and damning of its spawning rivers.

The Tagus River

The Tagus River (Rio Tajo in Spanish/Río Tejo in Portuguese) is the longest river on the Iberian Peninsula. It has its origins in east-central Spain and flows directly west through Portugal to the Atlantic Ocean.

The **Lisbon arch-mouthed nase** (*Iberochondrostoma olisiponensis*) is confined to three small tributaries within the lower Tagus River drainage of Portugal.

The Arrago River

The Arrago River is located in western Spain.

The **Alagón spined loach** (*Cobitis vettonica*) is confined to the Arrago River.

The Gallo River

The Gallo River is located in central Spain.

The **Gallo chub** (*Squalius castellanus*) is known from specimens collected from the Gallo River and its main tributaries, the Bullones and Arandilla rivers. It is threatened mainly by pollution from the city of Molina de Aragon.

The Guadiana River

The Guadiana River flows through central Spain before turning south along a southern stretch of the Portugal–Spain border and emptying into the Atlantic.

The **small-headed barbel** (*Luciobarbus microcephalus*) is largely confined to the Guadiana River drainage, where it is threatened by dam construction, pollution, water extraction, and introduced species. It occurs as well in a small stretch of the Tajo River, where it was most likely introduced.

The **Iberian minnowcarp** (*Anaecypris hispanica*) is confined to the Guadiana River drainage.

The Guadalquivir River

The Guadalquivir River is located in south-central Spain.

The **Guadalquivir chub** (*Iberocypris palaciosi*) is confined to the Guadalquivir River drainage.

The Jándula River

The Jándula River is a tributary of the Guadalquivir River.

The **Jándula arch-mouthed nase** (*Iberochondrostoma oretanum*) is confined to the Robledillo and Fresnada rivers, small tributaries of the Jándula River.

The Danube River

The Danube is Europe's second largest river drainage, being roughly twice the size of California. The river flows over 2857 km from Germany's Black Forest to the shores of the Black Sea.

The **Danube salmon** (*Hucho hucho*) is found patchily throughout the Danube River drainage, with very few self-sustaining populations. The species has been locally introduced to Lake Constance in Germany, the Vistula River in Poland, the Tagus River in Spain, the Rhône River in France, and most likely other drainages where it apparently maintains only through stocking.

The Arges River

The Arges River is located in southern Romania.

The **sculpin-perch** (*Romanichthys valsanicola*) was formerly known from the upper Arges River and its tributaries, the Vâlsan and Râul Doamnei. It is now known only from a single 1-km stretch of the upper Vâlsan, where the population is entirely reliant upon the amount of water released by a reservoir immediately upstream.

The **Arges sculpin** (*Cottus transsilvaniae*) is known only from its original collection from the upper Arges River in 1998.

The Beli Vit River

The Beli Vit River is located in north-western Bulgaria.

The **Beli Vit sculpin** (*Cottus haemusi*) is known only from its original collection from the Beli Vit River in the 1980s.

The Danube Delta

The Danube delta is located in south-western Romania and south-eastern Ukraine.

Antipa's gudgeon (*Romanogobio antipai*) was historically found in the Danube delta. Last recorded in the 1960s, it is now considered to be extinct although the reason for this remains unknown.

The **Danube delta dwarf goby** (*Knipowitschia cameliae*) is known only from a single small, brackish lagoon south of the Danube delta in Romania. Last recorded in 1994, it is possibly extinct.

The Rhine River

The Rhine is the second longest river in central and western Europe (after the Danube). It runs from Switzerland to the North Sea.

Lake Constance

Lake Constance (Bodensee in German) is a lake on the Rhine at the northern foot of the Alps in Germany, Switzerland, and Austria. It consists of three bodies of water: Upper Lake Constance, Lower Lake Constance, and a connecting stretch of river.

Gmelin's whitefish (*Coregonus gutturosus*) was historically endemic to the deeper waters of Lake Constance. An important commercial species in the 1960s, it is thought to have become extinct in the 1970s when eutrophication of the lake reached its peak. **Kottelat's whitefish** (*C. arenicolus*) still survives in the lake, where it is threatened by hybridization with a more common species.

The **Lake Constance deepwater char** (*Salvelinus profundus*) is confined to the deeper waters of Lake Constance. It was thought to have gone extinct during the 1970s due to eutrophication, but was unexpectedly rediscovered in 2016.

The Rhône River

One of the major rivers of Europe, the Rhône rises in the Swiss Alps. After passing through Lake Geneva, it runs down through south-eastern France before dividing near its mouth with the Mediterranean at Arles. The resulting delta constitutes the Camargue wetland region.

The **Rhône streber** (*Zingel asper*) is confined to four fragmented subpopulations in the rivers Durance and Beaume, Rhône River drainage, with no hope of connectivity between them owing to dam construction. It is threatened by pollution.

The Neretva River

The Neretva River is located in Bosnia-Herzegovina and Croatia.

The **Neretva nase** (*Chondrostoma knerii*) is confined to the main channel of the Neretva River.

The **Imotski chub** (*Squalius microlepis*) is confined to two lakes and a few small karstic streams within the Neretva River drainage.

The **Mostar minnow** (*Phoxinellus pseudalepidotus*) is known only from a single stream within the Neretva River drainage of Bosnia-Herzegovina.

The **Neretva spined loach** (*Cobitis narentana*) is confined to the Neretva River drainage.

The Norin River

The Norin River is a small karstic stream located in southern Croatia.

The **Norin dwarf goby** (*Knipowitschia radovici*) is confined to the Norin River.

The Pinios River

The Pinios River is located in east-central Greece.

The **Thessaly gudgeon** (*Gobio feraeensis*) was historically found in the Pinios and Karla lakes within the Pinios River drainage, but has been extirpated from the latter when it was largely drained for agriculture.

The **Thessaly dwarf goby** (*Knipowitschia thessala*) is confined to the Pinios River catchment.

The Krka River

The Krka River is located in coastal Croatia.

Tursky's dace (*Telestes turskyi*) is confined to Lake Busko Blato in Bosnia-Herzegovina and to the Cikola River, a tributary of the Krka River in southern Croatia. It was thought to be extinct until rediscovered in 2002.

The **Vrba minnow** (*Phoxinellus dalmaticus*) is confined to Vrba Creek, on the Cikola tributary of the upper Krka River drainage.

Lake Visovac

Lake Visovac is located in the lower Krka River drainage.

Mrakovcic's dwarf goby (*Knipowitschia mrakovcici*) is confined to Lake Visovac.

The Cikola River

The Cikola River is located in north-western Croatia.

The **Cikola dace** (*Telestes polylepis*) is today confined to a single karstic stream within the Cikola River drainage, but was formerly more widespread.

The Cetina River

The Cetina River is located in southern Croatia and western Bosnia-Herzegovina.

The **Cetina dace** (*Telestes ukliva*) is confined to the Cetina River drainage in Croatia, where it was thought to have gone extinct in the 1980s. It was rediscovered in 1997.

The **Cetina spined loach** (*Cobitis dalmatina*) is confined to the Cetina River drainage.

The Ceyhan River

The Ceyhan River (historically known as the Pyramus) is located in south-central Turkey.

The **Ceyhan spring minnow** (*Pseudophoxinus zekayi*) is confined to streams, springs, and lakes within the middle Ceyhan River drainage.

The **Ceyhan chub** (*Squalius seyhanensis*) is known only from two localities within the upper Ceyhan River drainage.

The **Ceyhan spined loach** (*Cobitis evreni*) is known only from three stream catchments of the middle Ceyhan River drainage.

The **Cilician sportive loach** (*Oxynoemacheilus seyhanicola*) and the **Elbistan stone loach** (*O. ceyhanensis*) are both endemic to the Ceyhan River drainage.

The Zamanti River

The Zamanti River is a headwater stream in the Ceyhan River watershed.

The **Zamanti sportive loach** (*Oxynoemacheilus seyhanensis*) and the **Zamanti stone loach** (*Barbatula samantica*) are confined to the Zamanti River, where they are threatened by water extraction, pollution, and drought.

The Caysuyu River

The Caysuyu River is a tributary stream of the Ceyhan River located in Kayseri province.

The **Caysuyu stone loach** (*Barbatula tschaiyssuensis*) is confined to the Caysuyu River, where it is threatened by water extraction, pollution, and drought.

The Buyuk Menderes River

The Buyuk Menderes River (Büyük Menderes Irmagi in Turkish, and historically known as the Maeander) is located in south-western Turkey. General threats include pollution, water extraction, and dam construction.

The **Menderes barbel** (*Luciobarbus kottelati*) is confined to the Buyuk Menderes drainage.

The **Isikli nase** (*Chondrostoma meandrense*) is confined to the Buyuk Menderes drainage, where it is most abundant in Lake Isikli.

The **Apamean spring minnow** (*Pseudophoxinus maeandri*) is confined to two springs within the upper Buyuk Menderes drainage.

The **Isikli gudgeon** (*Gobio maeandricus*) appears to be absent from Lake Isikli itself, but is known from two separate inflowing spring systems and some additional spring-fed streams elsewhere.

The **Isparta algae-eater** (*Crossocheilus klatti*) is known from the Kopu River drainage and Lake Isikli basin in the upper Buyuk Menderes drainage. It formerly inhabited lakes Egirdir and Golcuk, but is now believed to have been extirpated there.

The **Menderes sportive loach** (*Oxynoemacheilus cinicus*) is known only from a single imprecise type locality, most likely within the Buyuk Menderes drainage.

Lake Isikli

Lake Isikli (Isikli Golu in Turkish) is located within the upper Buyuk Menderes drainage.

The **chocolate chub** (*Squalius carinus*) is confined to the Lake Isikli basin, where it appears to be absent from the lake itself but is known from two separate inflowing spring systems and some spring-fed streams near Dinar.

The **Isikli sportive loach** (*Oxynoemacheilus mesudae*) is known from four springs and spring-fed streams within the Lake Isikli basin. While still abundant, the water level is declining steadily due mainly to extraction, and several small springs where it presumably once occurred have already dried out.

The Upper Euphrates River

The Euphrates is the longest river in western Asia. It originates on the Armenian Plateau of Armenia, Azerbaijan, north-western Iran, and eastern Turkey, from where it flows south through Syria and Iraq to the Persian Gulf.

Firat's spring minnow (*Pseudophoxinus firati*) is known only from two widely separated localities in central and eastern Turkey.

The **Erzurum sportive loach** (*Oxynoemacheilus araxensis*) and the **Mancilik stone loach** (*O. paucilepis*) are each confined to a few streams within the upper Euphrates drainage of Turkey.

The Upper Tigris River

The upper Tigris is located primarily within the Taurus Mountains of south-eastern Turkey.

The *Yuksekova River* is an endorheic basin nested within the upper Tigris River catchment of south-eastern Turkey (Hakkari province).

The **Yuksekova chub** (*Petroleuciscus kurui*) is confined to the Yüksekova River drainage.

The *Batman River* is a major tributary of the upper Tigris River located in south-eastern Turkey.

The **Diyarbakir loach** (*Paraschistura chrysicristinae*) is known from two localities within the Batman River, but has not been recorded since the 1970s. It is possibly extinct, though the reason for its disappearance is unknown.

The **Göksu spined loach** (*Cobitis kellei*) is known only from its original collection from the Göksu stream in 1974. Not recorded during more recent surveys, it is thought that the construction of a dam may have driven it extinct.

The *Queiq River* (also known as the Aleppo River) is located in south-eastern Turkey and northern Syria. It has been largely desiccated by drought and water extraction.

The **Halap sportive loach** (*Oxynoemacheilus tigris*) was historically found throughout the Quieq River drainage but is now known only from a single stream, only a few hundred metres long between two reservoirs, in south-eastern Turkey.

The Chornaya River

The Chornaya River is a small river on the Crimean Peninsula.

The **Chornaya tubenose goby** (*Proterorhinus tataricus*), **Chornaya gudgeon** (*Gobio delyamurei*) and **Chornaya spined loach** (*Cobitis taurica*) are all confined to a very limited stretch (about 1 km in length) of this drainage, below the Chornaya Gorge. Water extraction and drought threaten to dry up their habitat entirely.

The Amur River

The Amur River flows for nearly 3000 km from the mountains of northern China and south-eastern Russia before finally emptying into the North Pacific. During the summer monsoon rains flood parts of the river, although for six months in the winter and spring large portions are frozen.

The **kaluga** (*Huso dauricus*), a type of sturgeon, is one of the largest freshwater fishes in the world and capable of attaining a length of 5.6 m and at least 1000 kg in weight. Still found in small numbers throughout the Amur River drainage and perhaps in coastal waters, it has been fished to near extinction for its valuable roe.

The **Amur sturgeon** (*Acipenser schrenckii*) is another enormous freshwater fish species that often reaches a length of up to 3 m and a weight of over 190 kg. Still found throughout the entire Amur River drainage from its estuary to the upper tributaries, it has nevertheless declined steadily since the end of the nineteenth century due to overfishing and is now considered to be seriously threatened.

Miscellaneous Lakes, Rivers, and Marshes

Lake Bourget (Lac du Bourget in French) is a large, deep lake located in the southernmost end of the Jura Mountains in France. The **Bourget whitefish** (*Coregonus bezola*) was a deep-water species that went extinct in the 1960s according to local fishermen.

Lake Morat (Lac de Morat in French/Murtensee in German) is located in western Switzerland. The **Morat whitefish** (*Coregonus restrictus*) was last recorded in 1890. Surveys in the 1950s found no whitefish at all, and in recent years a related species has been introduced to the lake.

Lake Breiter Luzin (Breiter Luzin in German) is located in northern Germany. The **Breiter Luzin whitefish** (*Coregonus lucinensis*) is confined to the lake. During the 1970s the population declined heavily due to eutrophication, but has since improved along with the water quality.

Lake Cheim (Cheimsee in German) is a glacial, pre-alpine lake located in southern Germany. The **Cheimsee whitefish** (*Coregonus hoferi*) was last recorded in the 1940s, although fishermen indicated its presence in the lake up until the late 1980s. It is likely extinct.

Lake Atter (Attersee in German) is a large lake located in northern Austria. The **Attersee whitefish** (*Coregonus atterensis*) is historically confined to the lake, with an additional introduced population in nearby Lake Mond. It is threatened by competition from introduced fish species.

Lake Traun (Traunsee in German) is located in northern Austria. The **Traunsee whitefish** (*Coregonus danneri*) is confined to the lake, where it is threatened by competition from introduced fish species.

Lake Garda (Lago di Garda in Italian) is a large glacial lake in northern Italy. The **Garda trout** (*Salmo carpio*) is historically endemic to the lake, where it is seriously threatened by introduced species. It has, however, been introduced into a number of other lakes both in Italy and elsewhere.

Lake Posta Fibreno (Lago di Posta Fibreno in Italian) is located in central Italy. It is an elongated karstic lake rich in underground springs and caves. The **Fibreno trout** (*Salmo fibreni*) is confined to the lake and its tributaries.

Lake Doiran (Límni Dhoiráni in Greek) is located on the Greece/North Macedonia border. The **Doiran bleak** (*Alburnus macedonicus*) is confined to Lake Doiran.

Lake Pamvotida is a large lake located in north-western Greece. The **Pamvotida minnow** (*Pelasgus epiroticus*) is confined to Lake Pamvotida, where it has declined considerably in recent decades due to overfishing, pollution, and introduced species.

Lake Yliki (Limni Yliki in Greek) is located in central Greece. The **Greek rudd** (*Scardinius graecus*) is confined to the lake, where it is threatened by large fluctuations in water level.

Lake Volvi (Límni Vólvi in Greek) is located in north-eastern Greece. Ongoing threats include introduced species, water extraction for irrigation, and eutrophication. Two species, the **Macedonian shad** (*Alosa macedonica*) and the **Volvi bleak** (*Alburnus volvitticus*), are nowadays endemic to the lake. Formerly both were also found in Lake Koronia, but in 1995 the latter dried up, killing all the fish.

Lake Techirghiol is a hypersaline lake located in coastal south-eastern Romania. The **Techirghiol stickleback** (*Gasterosteus crenobiontus*) was historically confined to freshwater springs of Lake Techirghiol. Hybridization with the three-spined stickleback (*G. aculeatus*) led to its extinction in the 1960s.

Lake Mandras (Mandrensko ezero in Bulgarian) is located in eastern Bulgaria. The **Mandras bleak** (*Alburnus mandrensis*) is confined to the Lake Mandras basin, where it is threatened by pollution and the impoundment of its spawning streams.

Lake Iznik (Iznik Golu in Turkish) is located in north-western Turkey (Bursa province). The **Iznik bleak** (*Alburnus nicaeensis*) was known only from the Lake Iznik basin. Alien species stocked into the lake to improve fisheries yields likely led to its extinction. It has not been reported since the late twentieth century despite several intensive searches. The **Iznik sportive loach** (*Oxynoemacheilus phoxinoides*) is confined to just one small stream in the Lake Iznik basin.

Lake Acigol (Acigol Golu in Turkish) is a located in west-central Anatolia, Turkey. The **Acigol toothcarp** (*Aphanius transgrediens*) was, prior to the 1970s, found throughout Lake Acigol and its catchment basin. The lake has since dried up, and today the species is confined to a single small spring field and a few short feeder streams.

Lake Apolyond (Apolyond Golu in Turkish) is located in western Anatolia, Turkey, within the Sea of Marmara basin. The **Apolyond sprat** (*Clupeonella muhlisi*) is confined to Lake Apolyond.

Lake Golcuk (Golcuk Golu in Turkish) is a small mountain lake in east-central Turkey (Izmir province). The **Golcuk toothcarp** (*Aphanius splendens*) was known only from Lake Golcuk. The year of its extinction is unknown, but it had already disappeared by the 1980s.

Lake Kezenoi-am is located in the Caucasus Mountains of south-western Russia (Chechnya). The **Kezenoi-am trout** (*Salmo ezenami*) was historically endemic to Lake Kezenoi-am, although it appears to have been introduced into Lake Mochokh (Daghestan) in the early 1960s.

Lake Abrau is a small karst lake located near the Black Sea coast of south-western Russia. The **Abrau sprat** (*Clupeonella abrau*) is confined to Lake Abrau, where it is threatened by water extraction and introduced species.

Lake Balkhash is located mainly in south-eastern Kazakhstan. One of the largest lakes in Asia, like the Aral Sea it is shrinking owing to the diversion of water from the rivers that feed it. It used to have a rich fish fauna with a number of endemic species, but since the 1970s biodiversity has been declining. The **Balkhash perch** (*Perca schrenkii*) occurs in Lake Balkhash and the Alakol lake group, where it is threatened by the introduction of a predatory fish.

Lake Elgygytgyn is an impact crater lake located in the Chukchi region of north-eastern Siberia. The **long-finned char** (*Salvethymus svetovidovi*) and the **Elgygtgyn char** (*S. elgyticus*) are confined to the lake.

The *Mira River* (Rio Mira in Portuguese) is located is southern Portugal. The **Torgal chub** (*Squalius torgalensis*) is confined to the Torgal tributary of the Mira River.

The *Douro River* (Rio Doero in Spanish/Rio Douro in Portuguese) is located in north-western Spain and northern Portugal. The **Sarda minnow** (*Achondrostoma salmantinum*) is confined to the Águeda, Yeltes, Turones, and Uces tributaries of the Douro River drainage of western Spain (Salamanca province).

The *Júcar River* (Rio Jucar in Spanish) is located in east-central Spain. The **Júcar nase** (*Parachondrostoma arrigonis*) is confined to the Júcar River drainage.

The *Lez River* (Le Lez in French) is located in southern France near Montpellier. The **Lez sculpin** (*Cottus petiti*) is confined to a short (3 km) stretch of this coastal river, from its karstic springs source to the Lirou tributary.

The *Hérault River* (L'Hérault in French) is a small coastal drainage in southern France. **Rondelet's sculpin** (*Cottus rondeleti*) is confined to three stretches of stream (each only a few hundred metres long) within the Hérault River.

The *Jadova River* is located in western Croatia. The **Jadova minnow** (*Delminichthys jadovensis*) and the **Jadova spined loach** (*Cobitis jadovaensis*) are both confined to a single ephemeral stream within the Jadova River drainage.

The *Dragonja River* is located in Slovenia and Croatia. The **Istrian chub** (*Squalius janae*) is confined to the upper Dragonja River.

The *Vardar River* (historically known as the Axios River) is located in Greece and North Macedonia. The **Balkan streber** (*Zingel balcanicus*) is known only from a few specimens collected in the Vardar River drainage. The **Macedonian trout** (*Salmo macedonicus*) is confined to the upper Vardar River drainage.

The *Moraca River* is located in Montenegro, where it arises in the mountains of the north-east and empties into Lake Skadar. The **Zeta trout** (*Salmo taleri*) is confined to the upper Moraca drainage and its tributary, the Zeta River. It is threatened by hybridization with introduced brown trout (*S. trutta*).

The *Provadiskaya River* is located in Bulgaria. The **Varna gudgeon** (*Gobio kovatschevi*) is confined to the Provadiskaya River.

The *Struma River* is located in Bulgaria and Greece. The **Struma spined loach** (*Cobitis punctilineata*) is confined to the Aggitis stream, a tributary of the Struma River in northern Greece.

The *Aoös River* is located in north-western Greece and south-western Albania. The **Pindus sportive loach** (*Oxynoemacheilus pindus*) is confined to the Aoös River drainage.

The *Arachthos River* is located in north-western Greece. The **Arachthos spined loach** (*Cobitis arachthosensis*) is confined to the Arachthos River drainage.

The *Louros River* is located in north-western Greece. The **Louros spined loach** (*Cobitis hellenica*) is confined to the Louros River drainage.

The *Acheron River* is located in western Greece. The **Acheron dwarf goby** (*Knipowitschia milleri*) is confined to the Acheron River delta.

The *Eurotas River* (also known as the Evrotas) is located on the Peloponnese Peninsula of southern Greece. The

Eurotas chub (*Squalius keadicus*) is confined to the Eurotas River. It is threatened by pollution and the seasonal drying of the river.

The *Kucuk Menderes River* is located in western Turkey. It is heavily desiccated in its upper reaches and heavily polluted in the lower ones. The **Ephesus dwarf goby** (*Knipowitschia ephesi*) is confined to the delta and marshes of the lowermost Kucuk Menderes.

The *Bakircay River* is located in western Turkey. The **Bakircay bleak** (*Alburnus attalus*) is confined to a few tributaries of the Bakircay River, where it is threatened by water extraction and pollution.

The *Tahtali River* is located in western coastal Turkey. **Kosswig's chub** (*Squalius kosswigi*) is nowadays confined to the Tahtali River, although it may have formerly occurred (or still occur) in the Kucuk Menderes River drainage as well.

The *Onaç River* is located in south-western Turkey. The **Onaç spring minnow** (*Pseudophoxinus ninae*) is confined to the Onaç stream drainage.

The *Gediz River* (Gediz Nehri in Turkish) is located in south-western Turkey. The **Simav sportive loach** (*Oxynoemacheilus simavica*) is confined to Simav stream, a tributary of the Gediz River.

The *Koprucay River* is located in south-central Turkey, where it drains into the Bay of Antalya. The **Pisidian spring minnow** (*Pseudophoxinus fahrettini*) is confined to some headwater tributaries and a spring within the Koprucay River drainage.

The *Akgol-Eregli Marshes* are located in south-central Turkey. The **Akgol-Eregli stone loach** (*Barbatula eregliensis*) is confined to the Akgol-Eregli marshes.

The *Aksu River* is located in north-eastern Turkey. The **Aksu goby** (*Ponticola turani*) is confined to a few streams within the Aksu drainage.

The *Lenkoran River* is located within the Caspian Sea basin of Azerbaijan. The **Lenkoran sportive loach** (*Oxynoemacheilus lenkoranensis*) is confined to the Lenkoran River.

The *Lena River* is located in eastern Siberia. One of the longest rivers in the world, it rises west of Lake Baikal in southern Russia and flows north for some 4400 km before finally emptying into the Arctic Ocean. At its mouth into the Laptev Sea in northern Siberia, the river forms a huge delta of 32,000 km^2, which is the largest Arctic delta and the most extensive protected wilderness area in Russia. Baunt's whitefish (*Coregonus sardinella baunti*) is confined to the Vitim River, a tributary of the Lena River.

The *Penzhina River* is located in Kamchatka, Russia. The **Penzhina whitefish** (*Coregonus subautumnalis*) lives in the Sea of Okhotsk, from where it migrates up the Penzhina River to spawn. It is threatened by overfishing.

Coasts and Satellite Islands

This section includes the coastal areas and islands of western and north-western Europe, the Russian Far East, the Mediterranean shore of southern Europe, and the majority of the islands within the Mediterranean Sea.

The **sandy mole-rat** (*Spalax arenarius*) is found only along the lower Dnepr River sands in southern Ukraine, with the main part of the population lying within the Black Sea Biosphere Reserve.

The **Atlantic puffin** (*Fratercula arctica*) is a type of seabird that can still be found throughout the northern Atlantic on rocky coasts and offshore islands, but has experienced rapid declines across its range.

The **spotted greenshank** (*Tringa guttifer*) is a type of wading bird that breeds along the south-western and northern coasts of the Sea of Okhotsk, and possibly along western Kamchatka and Sakhalin. At other times the species migrates south across south and South East Asia as far as Sri Lanka and Australia. The total population is very small, however, and threatened by development of coastal wetlands throughout its range.

The **Yelkouan shearwater** (*Puffinus yelkouan*) is a type of seabird that breeds on islands and coastal cliffs along the central and eastern Mediterranean coast. It is threatened by habitat destruction, fisheries by-catch, and introduced species.

Audouin's gull (*Larus audouinii*) is found patchily in breeding colonies along the coasts and islands of the Mediterranean, where it was at one time threatened by egg-robbing fishermen. Numbers have since recovered to safe levels.

The Azores

The Azores are a remote archipelago located in the North Atlantic some 1360 km west of Portugal. Like so many other volcanic islands, they appear to rise directly from the ocean floor. First discovered by the Portuguese in 1431 and long colonized, the unique laurel forests that once covered them have been almost completely destroyed.

The **Azores noctule** (*Nyctalus azoreum*) is a type of bat confined to the Azores, where it is still relatively abundant although vulnerable owing to its small range.

Monteiro's storm petrel (*Hydrobates monteiroi*) is only known to breed on a few small islets in the Azores. It is thought to remain in the vicinity of these islands during the non-breeding season.

The Azores wood pigeon (*Columba palumbus azorica*) is rare but still occurs on a number of islands.

São Miguel

São Miguel is the largest and most populous island in the Azores.

The **São Miguel scops owl** (*Otus frutuosoi*) probably became extinct after European settlement due to habitat destruction and the introduction of alien species.

The **Azores bullfinch** (*Pyrrhula murina*) is confined to one small area of remnant cloud forest in the mountains of São Miguel, where it is considered stable. The total population is around 250.

The British Isles

The British Isles are an archipelago in the northern Atlantic consisting of the islands of Great Britain, Ireland, the Isle of Man, and thousands of smaller ones. Animal and plant life are similar to that of the north-western Europe.

Great Britain

Great Britain is the largest of the British Isles and indeed the largest island in Europe. Threatened vertebrate species consist almost entirely of freshwater fishes.

The chars (*Salvelinus*) are a group of salmonid fish with a circumpolar distribution. Most are typically cold-water fish that primarily inhabit freshwater, though some also migrate to the sea. The following species have very localized distributions and are considered threatened. The **golden char** (*S. youngeri*) is known from Loch Eck and possibly a few other lakes in Scotland. The **haddy char** (*S. killinensis*) is confined to Loch Killin, Loch Doine, possibly Loch Builg, and a few other Scottish lakes. **Malloch's char** (*S. mallochi*) is confined to Loch Scourie and Loch Shin, Scotland. The **Ben Hope char** (*S. maxillaris*) was long known only from its original description, but has since been found in several lakes in northern Scotland. **Peris' char** (*S. perisii*) is known from six locations in northern Wales. The **Struan char** (*S. struanensis*) is confined to Loch Rannoch and Loch Ericht in Scotland. **Lonsdal's char** (*S. lonsdalii*) is confined to Haweswater in north-western England. **Willoughby's char** (*S. willoughbii*) is known from Lake Windermere and possibly Ennerdale Water in north-western England.

A number of whitefish (*Coregonus*) are similarly restricted in distribution. The **powan** (*C. clupeoides*) was historically confined to Loch Lomond and Lock Eck in west-central Scotland. It has since been introduced into two reservoirs in the Loch Lomond basin. The **gwyniad** (*C. pennantii*) was historically confined to Llyn Tegid (Lake Bala) in northern Wales, where it is threatened by declining water quality and introduced species. It has been introduced into nearby Llyn Arenig. The **vendace** (*C. vandesius*) was historically found in lakes Derwentwater and Bassenthwaite in north-western England, and Castle Loch and Mill Loch in south-western Scotland. The two Scottish populations have since been extirpated, although another has been introduced into Loch Skene. The **schelly** (*C. stigmaticus*) is confined to four lakes in north-western England (Haweswater, Ullswater, Brotherswater, and Red Tarn).

The *Shetland Islands* are a subarctic archipelago located north-east of Scotland.

The **Shetland char** (*Salvelinus gracillimus*) was long known only from Loch of Girlsta in Shetland, but may occur in Loch More and possibly other lakes in northern Scotland.

The *Inner Hebrides* are a small archipelago located off the western coast of Scotland.

The **Orkney char** (*Salvelinus inframundus*) is nowadays confined to Loch Mealt on the Isle of Skye. It formerly occurred in Heldale Water on Hoy Island, in the Orkney Islands, but has not been recorded there since 1908.

The *St. Kilda Islands* are an isolated archipelago located 64 km west of the Outer Hebrides.

The St. Kilda house mouse (*Mus musculus muralis*) evolved on the tiny island of Hirta, where it was entirely dependent upon the presence of humans. It died out soon after all the people were evacuated from Hirta in 1930.

The St Kilda wren (*Troglodytes troglodytes hirtensis*) is confined to the St. Kilda Islands, where the total population is around 500.

Fair Isle is a tiny island located between the main Shetland Islands and Orkney. It is the most remote inhabited island in the United Kingdom.

The Fair Isle wren (*Troglodytes troglodytes fridariensis*) has a breeding population of from 10 to 50 pairs adapted to life on boulder beaches. The slightest environmental interference would likely prove to be devastating.

Ireland

Ireland is located west of Great Britain and is the second largest of the British Isles. As with Great Britain all of the threatened vertebrate species are freshwater fishes.

The **pollan** (*Coregonus pollan*) is a type of whitefish confined to just five lakes (Lough Neagh, lower Lough Erne, Lough Ree, Lough Derg, and Lough Allen) in central Eire and Northern Ireland. However, the only remaining sustainable populations are those of Lough Neagh and Lough Allen, the rest relying upon continued restocking.

The **blunt-snouted char** (*Salvelinus obtusus*) was historically found in a number of lakes in eastern and south-western Eire, but has disappeared from most if not all of them due to eutrophication and pollution. It was last recorded from Lough Muckross in 1904, Lough Tay in 1908, Lough Dan in 1988, and Lough Leane in 1999. Surveys in Lough Accose in 1983, meanwhile, failed to find any char.

Lough Melvin is located in north-western Ireland, on the border between Eire and Northern Ireland.

Gray's char (*Salvelinus grayi*) is confined to Lough Melvin, where it has been declining for decades due to eutrophication and introduced species.

Two species of trout, the **gillaroo** (*Salmo stomachicus*), and the **sonaghen** (*S. nigripinnis*) are also endemic to Lough Melvin.

Lough Coomasaharn is a small oligotrophic lake located in south-western Ireland (Eire).

The **Coomsahar char** (*Salvelinus fimbriatus*) is confined to Lough Coomasaharn.

Lough Leane is located in south-western Ireland (Eire).

The **Killarney shad** (*Alosa killarnensis*) is confined to Lough Leane, where it is seriously threatened by eutrophication and introduced species.

Sakhalin

Sakhalin is a large island located in the northern Pacific off the eastern coast of Russia and north of Japan.

The Sakhalin musk deer (*Moschus moschiferus sachalinensis*) is confined to Sakhalin.

The **Sakhalin vole** (*Microtus sachalinensis*) is confined to northern and central parts of the island, where it may be potentially affected by oil infrastructure development projects.

Bering Island

Bering Island is located in the Bering Sea off the Kamchatka Peninsula.

The **spectacled cormorant** (*Phalacrocorax perspicillatus*), the largest known species of cormorant, was almost flightless and therefore easy prey for hunters. It was exterminated by about 1852.

Sicily

Located south of the Italian Peninsula, Sicily (Sicilia in Italian) is the largest island in the Mediterranean Sea. It is an often-quoted example of man-made deforestation, which has occurred since Roman times when the island was turned into an agricultural region. This gradually dried the climate, leading in turn to a decline in rainfall and the drying up of rivers. The central and western parts are practically devoid of forest. Not surprisingly, there is little in the way of endemic fauna remaining.

Figure 2.7 Spectacled cormorant. (Credit: Joseph Wolf.) (A black and white version of this figure will appear in some formats. For the colour version, please refer to the plate section.)

The Sicilian grey wolf (*Canis lupus cristaldii*) was a slender, short-legged subspecies that was likely driven extinct due to human persecution in the 1920s, although there were several possible sightings up until the 1970s.

The **Sicilian pond turtle** (*Emys trinacris*) is confined to the remaining wetlands of Sicily, where it appears to be relatively abundant.

Corsica and Sardinia

The islands of Corsica and Sardinia and here considered together, as they are geographically close and share much of the same fauna.

The Corsican red deer (*Cervus elaphus corsicanus*) is a small subspecies that is thought to have been introduced to Corsica and Sardinia by humans around 8000 years ago. It underwent a dramatic decline on Corsica and was extirpated there in 1969, after which the only remaining population (around 100) lived on Sardinia. Captive breeding and better protection enabled the animals to slowly recover on the latter island and, eventually, to be successfully reintroduced to Corsica.

The **Sardinian pika** (*Prolagus sardus*), a type of small, tailless mammal, historically occurred on Corsica, Sardinia, and a few satellite islands. Last seen in 1774, it is considered to be extinct.

Bedriaga's rock lizard (*Archaeolacerta bedriagae*) has a highly fragmented distribution on Corsica, Sardinia, and a few satellite islands.

Corsica

Corsica (Corse in French) is located south-east of France and west of Italy. Roughly two-thirds of this large island is comprised of a single mountain chain.

The **Corsican nuthatch** (*Sitta whiteheadi*) is confined to areas of Corsican pine, which occurs in fragments on the island's mountain ridges.

The **Corsican painted frog** (*Discoglossus montalentii*) is endemic to the central mountains.

Sardinia

Sardinia (Sardegna in Italian) is located south of Corsica. It is the second largest island in the Mediterranean Sea.

The **Sardinian long-eared bat** (*Plecotus sardus*) is confined to forest fragments on Sardinia.

The Sardinian barred grass snake (*Natrix helvetica cetti*) is confined to Sardinia.

The **Sardinian brook salamander** (*Euproctus platycephalus*) is a rare species found only in eastern Sardinia between the Limbara Mountains in the north and the Sette Fratelli Mountains in the south.

Several species of European cave salamander (*Speleomantes*) are endemic to various areas of Sardinia, where they are threatened by loss of habitat and illegal collection for the international pet trade. The **Supramonte cave salamander** (*S. supramontis*) is confined to central-eastern Sardinia. **Gene's cave salamander** (*S. genei*) occurs in south-western Sardinia.

The **imperial cave salamander** (*S. imperialis*) is confined to central and eastern Sardinia. The **Monte Albo cave salamander** (*S. flavus*) is found within the Monte Albo Mountains of north-eastern Sardinia. The **Sarrabus cave salamander** (*S. sarrabusensis*) is found around Monte dei Sette Fratelli in extreme south-eastern Sardinia.

The Aegean Islands

The Aegean Islands are located in the Aegean Sea between Greece and Turkey. They are traditionally comprised of seven different island groups.

Euboea

Euboea (Evvoia in Greek) is the second largest island in Greece, after Crete.

The **Manikiotikos barbel** (*Barbus euboicus*) is a type of freshwater fish confined to a single stream on the southern part of Euboea, where during the dry season it is often reduced to only a few intermittent pools.

The Sporades Islands

The Sporades (Vóries Sporádhes in Greek) are an archipelago along the eastern coast of Greece, north-east of the island of Euboea in the Aegean Sea. They consist of 24 islands, only 4 of which are permanently inhabited.

Two subspecies of **Sporades wall lizard** (*Podarcis gaigeae*) are endemic to a few of the Sporades Islands. The Skyros wall lizard (*P. g. gaigeae*) is confined to Skyros and associated islets, while Weigand's wall lizard (*P. g. weigandi*) is confined to the island of Piperi.

Crete

Crete (Kríti in Greek) is located in the southern part of the Aegean Sea and is the largest of the Greek islands. It is elongated in shape and mountainous, with a large number of islets surrounding the coast. The island has long been isolated from mainland Europe, Asia, and Africa, and this is reflected in the diversity of its fauna. Dwarf forms of elephant, mammoth, hippopotamus, and deer, along with giant flightless owls, were all native here during the Pleistocene Period.

The **Cretan shrew** (*Crocidura zimmermanni*) is known from a few localities in the mountains.

Two species of wall lizard (*Podarcis*) are endemic to Crete and its satellite islands. The **Cretan wall lizard** (*P. cretensis*) is found on western Crete and a few small islets. The **Leventis wall lizard** (*P. levendis*) is confined to the uninhabited islets of Pori and Lagouvardos, north of the island of Antikythira, where its total population is presumably very small.

The **Cretan water frog** (*Pelophylax cretensis*) is patchily distributed in the lowlands and not particularly abundant.

The Cyclades

The Cyclades (Kiklaoes in Greek) are a group of some 220 small islands in the Aegean Sea, south-east of mainland Greece.

Three subspecies of **Cyclades wall lizard** (*Podarcis milensis*) are endemic to various islands. The Milos wall lizard (*P. m. milensis*) is confined to Milos. Adolf Jordans' wall lizard (*P. m. adolfjordansi*) is confined to Ananes Island west of Milos. The Gerakunia wall lizard (*P. m. gerakuniae*) is confined to Gerakunia (Falconera) and Velopoula.

Schweizer's blunt-nosed viper (*Macrovipera schweizeri*) is confined to the western Cycladic islands of Milos, Kimolos, Polyaigos, and Syphnos.

The Dodecanese Islands

The Dodecanese (Dodekánisa in Greek) are a group of 15 larger plus 150 smaller islands located in the south-eastern Aegean Sea, off the coast of Turkey.

Helversen's Lycian salamander (*Lyciasalamandra helverseni*) is confined to the islands of Karpathos, Kasos, and Saria, where it is still fairly common within its restricted range.

Rhodes (Ródos in Greek) is the largest of the Dodecanese Islands.

The **Rhodes minnow** (*Ladigesocypris ghigii*) is endemic to freshwater streams, springs, marshes, reservoirs, and pools on Rhodes, where it is threatened by habitat destruction.

Karpathos is located about 47 km south-west of Rhodes.

The **Karpathos water frog** (*Pelophylax cerigensis*) is only known with certainty from a single river in the mountains of Karpathos.

Kastellorizo lies roughly 2 km off the south coast of Turkey and some 125 km east of Rhodes.

The Kastellorizo Lycian salamander (*Lyciasalamandra luschani basoglui*) is confined to Kastellorizo.

The Balearic Islands

The Balearic Islands (Islas Baleares in Spanish) are an archipelago of around 50 islands in the western Mediterranean near the eastern coast of the Iberian Peninsula. The larger islands (Mallorca, Menorca, Ibiza, and Formentera) are popular tourist destinations, although many of the smaller islands and islets are uninhabited.

The **Balearic shearwater** (*Puffinus mauretanicus*) is a type of seabird that breeds exclusively in the Balearic Islands.

Lilford's wall lizard (*Podarcis lilfordi*) was historically found on the larger islands of Mallorca, Menorca, and Ibiza, as well as in the Cabrera Archipelago. It is believed that the introduction of cats and other predators was responsible for the extirpation of the species from the main islands, but a number of subspecies still survive on various rocky islets. These will be discussed below.

Mallorca

Mallorca (also known as Majorca) is the largest of the Balearic Islands.

The Sargantana wall lizard (*Podarcis lilfordi sargantanae*) is confined to four islets off the northern coast of Mallorca (Sargantana, Ravells, Bledes, and Tusqueta).

The **Mallorcan midwife toad** (*Alytes muletensis*) is confined to the Sierra Tramuntana in northern Mallorca.

Dragonera is an islet off the northern coast of Mallorca. The Dragonera wall lizard (*Podarcis lilfordi gigliolii*) is confined to Dragonera.

Toro is an islet off the coast of Mallorca. The Toro wall lizard (*Podarcis lilfordi toronis*) is confined to Toro.

La Guardia is an islet off the coast of Majorca. The La Guardia wall lizard (*Podarcis lilfordi jordansi*) is confined to La Guardia.

Malgrats is an islet off the south-western coast of Mallorca. The Malgrats wall lizard (*Podarcis lilfordi hartmanni*) is confined to Malgrats.

Menorca

Menorca (also known as Minorca) is located north-east of Mallorca.

Ratas was a tiny, rocky islet within the bay of Mahón, Menorca. The Ratas wall lizard (*Podarcis lilfordi rodriquezi*) was confined to Ratas Island. It went extinct in 1950 after the island was destroyed during harbour reconstruction.

Rey is another tiny islet located within the bay of Mahón, Menorca. The Rey wall lizard (*Podarcis lilfordi hospitalis*) is confined to Rey Island. Another subspecies, Bedriaga's wall lizard (*P. l. balearica*), was historically endemic to Rey Island but has been introduced to Minorca.

Addaya is an islet off the eastern coast of Menorca. The Addaya wall lizard (*P. l. addayae*) is confined to Addaya.

Aire is an islet off the south-eastern coast of Menorca. The Aire wall lizard (*P. l. lilfordi*) is confined to Aire.

Colom is an islet off Menorca. The Colom wall lizard (*P. l. brauni*) is confined to Colom.

Carbonera is an islet off Menorca. The Carbonera wall lizard (*Podarcis l. carbonerae*) is confined to Carbonera.

Colomer is an islet off the north-eastern coast of Menorca. The Colomer wall lizard (*P. l. colomi*) is confined to Colomer.

Binicondrell is an islet off the southern coast of Menorca. The Binicondrell wall lizard (*P. l. codrellensis*) is confined to Binicondrell.

Sanitja is an islet off northern Menorca. The Sanitja wall lizard (*P. l. fenni*) is confined to Sanitja.

Porros is an islet off the northern coast Menorca. The Porros wall lizard (*P. l. porrosicola*) is confined to Porros.

Ibiza

Ibiza is the third largest of the Balearic Islands.

The Ibiza wall lizard (*P. l. zenonis*) was historically confined to Ibiza, where it went extinct at some unknown date after the introduction of invasive predators.

The Cabrera Archipelago

The Cabrera Archipelago is located south of Majorca.

The Cabrera wall lizard (*P. l. kuligae*) is confined to Cabrera, Fonoi Gros, Fonoi Petit, and Ses Rates. The Na Redonda wall lizard (*P. l. conejerae*) is confined to Na Rodonda. The Xapat Gros wall lizard (*P. l. xapaticola*) is confined to Xapat Gros, Xapat Petit, and La Teula islands. The L'Esponge wall lizard (*P. l. espongicola*) is confined to L'Esponge. The Na Pobra wall lizard (*P. l. pobrae*) is confined to Na Pobra. The L'Imperial wall lizard (*P. l. imperialensis*) is confined to L'Imperial. The Na Plana wall lizard (*P. l. planae*) is confined to Na Plana. The Sas Bledas wall lizard (*P. l. nigerrima*) is confined to Sas Bledas. The Horadada wall lizard (*P. l. fahrae*) is confined to Horadada. The Estel de Fora wall lizard (*P. l. estelicola*) is confined to Estel de Fora.

The Aeolian Islands

The Aeolian Islands (Isole Eolie in Italian) are a volcanic archipelago in the Tyrrhenian Sea, north of Sicily.

The **Aeolian wall lizard** (*Podarcis raffonei*) is confined to a few isolated areas on Volcano Island, along with a few small rocky islets (Strombolicchio, La Canna, and Scoglio Faraglione).

Miscellaneous Islands

Santo Stefano Island (Isola di Santo Stefano in Italian) is located off the western coast of Italy. The Santo Stefano wall lizard (*Podarcis siculus sanctistephani*) was confined to Santo Stefano, where it became extinct in 1965 most likely due to predation by feral cats and other factors.

Corfu (Kerkyra in Greek) is located off the north-western coast of Greece. The **Corfu dwarf goby** (*Knipowitschia goerneri*) was long known only from a single freshwater spring, where it was last recorded in 1983. Surveys in the 1990s failed to find any there. In 2014 nine specimens were collected from Korission Lagoon in southern Corfu.

The *Berlengas Archipelago* is a group of small islands off the coast of western Portugal. The Berlengas wall lizard (*Podarcis carbonelli berlengensis*) is confined to the Berlenga Islands.

Shedao Island is located off the coast of Liaotung, north-eastern China. The **Shedao pit viper** (*Gloydius shedaoensis*) is confined to Shedao Island.

Paramushir Island is located in the northern Kuril Islands off the Kamchatka Peninsula. The **Paramushir shrew** (*Sorex leucogaster*) is confined to Paramushir Island.

Balance for the Eurasian Region

Widely dispersed, isolated finds of fossils and stone artefacts suggest that *Homo erectus* had migrated across Eurasia from Africa by around three million years ago, but he and his eventual successor Heidelberg Man (*H. heidelbergensis*) apparently remained quite rare. Between 600,000 and 350,000 years ago Neanderthals (*H. neanderthalensis*) first emerged, and are considered to be the first modern Europeans and the first to leave behind a substantial tradition, as evidenced by their cave paintings and burial practices. Modern humans (*H. sapiens*) arrived in Mediterranean Europe and southern Siberia from

the Levant between 45,000 and 43,000 years ago, whereupon both species coexisted for several thousand years until the assimilation or extinction of the Neanderthals between 40,000 and 28,000 years ago. Humans subsequently proceeded to populate the entire continent and advanced north, following the retreating ice sheets of an ice age which spanned from 26,500 to 19,000 years ago and surviving as hunter-gatherers. After the last ice age ended around 12,500 B.C. temperatures and sea levels began to rise, changing the environment and creating the British Isles. Finally, about 8000 years ago a wave of 'farmers' arrived from the Near East and permanent settlement began.

Despite this long human settlement, particularly in western Eurasia, there had been relatively little environmental destruction within the Eurasian Region up until the modern era. While it is true that the Mediterranean countries had suffered almost complete forest loss and later soil erosion due to goats, an ecological balance was more or less maintained. Beginning in the late sixteenth century, Russian explorers began to probe ever further into the vast Siberian wilderness, reaching the Lena River by the 1620s, Lake Baikal and Sakhalin by 1643, and the Kuril Islands by 1706. However, it was not until the nineteenth century that we begin to see a major human impact. Indeed, it was primarily in Europe that the concept of conservation first originated. In 1810, the English poet William Wordsworth described the Lake District as 'a sort of national property, in which every man has a right and interest who has an eye to perceive and a heart to enjoy'. Even earlier, the Naples government had undertaken laws to protect natural areas, which could be used as a game reserve by the royal family. Over the past few decades there has been an ever-growing awareness of environmental issues throughout Europe and ambitious attempts at rewilding more remote areas.

In recent historical time (i.e. since A.D. 1500), the Eurasian Region has lost at least 18 species/12 subspecies of vertebrates. Among the extinct forms 1 species/9 subspecies are mammals, 2 species are birds, 3 subspecies are reptiles, and 15 species are freshwater fishes. Another 6 species are possibly extinct.

In addition, there are 459 species/94 subspecies currently threatened with extinction (that is to say, either Critically Endangered, Endangered, or Vulnerable according to the IUCN Red List, as well as certain forms either listed as Data Deficient or Not Assessed but which are clearly at some risk of extinction). Of these, 55 species/47 subspecies are mammals, 19 species/5 subspecies are birds, 42 species/33 subspecies are reptiles, 38 species/7 subspecies are amphibians and 305 species/2 subspecies are freshwater fishes.

Vertebrate Class	Extinct	Possibly Extinct	Extinct in the Wild	Threatened
Mammals	1 species	~ species	~ species	55 species
	9 subspecies	~ subspecies	~ subspecies	47 subspecies
	10 taxa	~ taxa	~ taxa	104 taxa
Birds	2 species	~ species	~ species	19 species
	~ subspecies	~ subspecies	~ subspecies	5 subspecies
	2 taxa	~ taxa	~ taxa	24 taxa
Reptiles	~ species	~ species	~ species	42 species
	3 subspecies	~ subspecies	~ subspecies	33 subspecies
	3 taxa	~ taxa	~ taxa	75 taxa
Amphibians	~ species	~ species	~ species	38 species
	~ subspecies	~ subspecies	~ subspecies	7 subspecies
	~ taxa	~ taxa	~ taxa	45 taxa
Freshwater fishes	15 species	6 species	~ species	305 species
	~ subspecies	~ subspecies	~ subspecies	2 subspecies
	15 taxa	6 taxa	~ taxa	307 taxa
Total vertebrates	18 species	6 species	~ species	459 species
	12 subspecies	~ subspecies	~ subspecies	94 subspecies
	30 taxa	6 taxa	~ taxa	553 taxa

Note: ~, not applicable.

The Sino-Himalayan Region

The Sino-Himalayan Region extends from the Tibetan Plateau and the Himalayas through the temperate and subtropical, mostly mountainous areas of northern India, China, and northern Indochina to the Japanese Archipelago and Taiwan. It is bordered on the north by the drier parts of the Eurasian Region and on the south by the lowland rainforests and grasslands of the Indo-Malaysian Realm.

The South China tiger (*Panthera tigris amoyensis*) was formerly distributed in a large part of eastern and central China northward to 38–40° N. latitude. Heavily hunted for decades, it is now the most critically endangered subspecies of tiger and, indeed, one of the most threatened animals in the world. Despite unconfirmed reports and some evidence of footprints, there have been no confirmed sightings since the 1970s, leading experts to consider it already functionally extinct in the wild. The entire known population of roughly 65 individuals is currently held in captivity.

The Himalayan wild dog (*Cuon alpinus laniger*) occurs in southern Tibet, Nepal, Sikkim, Bhutan, and Kashmir. The thin-tailed wild dog (*C. a. lepturus*) is found in China south of the Yangtze River. Both are threatened by loss of habitat, depletion of their prey base and human persecution.

The **Indochinese clouded leopard** (*Neofelis nebulosa*) is a medium-sized wild cat found patchily over much of southern and eastern Asia, where it has long been hunted for its beautiful fur.

The **western black crested gibbon** (*Nomascus concolor*) lives primarily in the mountainous areas of southern China, northern Vietnam, and northern Laos, and is seriously threatened by habitat destruction and hunting. The Tonkin black crested gibbon (*N. c. concolor*) is found in southern China (south-western Yunnan) and northern Vietnam (Lao Cai, Yen Bai, Son La, and Lai Chau provinces), roughly between the Black and Red rivers.

The **Tonkin snub-nosed monkey** (*Rhinopithecus avunculus*) has long been confined to areas east of the Red River in far north-eastern Vietnam. Since the mid-twentieth century it has suffered a serious decline due to loss of habitat and hunting, and is now confined to a few areas of steep, karstic forest in Tuyen Quang, Bac Kan, Ha Giang, and Thai Nguyen provinces. In 2008 fewer than 250 were thought to exist.

The **white-headed langur** (*Trachypithecus leucocephalus*) is a type of leaf-eating monkey found patchily within a small area of south-western China (Guangxi), where the total population is thought to be less than 250. **Shortridge's langur** (*T. shortridgei*) occurs in south-western China (Yunnan) and north-eastern Myanmar. Both are threatened by loss of habitat and hunting for food as well as use in 'traditional medicine'.

Perhaps the most dramatic history of any animal faced with extinction is that of **Père David's deer** (*Elaphurus davidianus*). In ancient times this deer had a wide range in China and occurred in Japan as well, but as early as the Shang dynasty (1766–1122 B.C.) it seems to have been exterminated in the wild. Like so many other deer in China, however, it survived in parks. It was in one of these reserves, the imperial hunting park near Peking (present-day Beijing), that a French missionary, Father David, came upon the last remaining herd. Father David managed to send a number of the animals to European zoos, so that by about 1870 there were small herds at several zoological gardens. This came none too soon, because when floods broke through the imperial walls of the hunting park in 1894, many deer escaped and were killed by peasants. And in 1900 foreign troops sent to Peking during the Boxer Rebellion killed almost all the deer. The few that remained were sent to the Peking Zoo, but by 1921 these, too, were dead. After the events of 1900, the eleventh Duke of Bedford at Woburn Abbey in Bedfordshire, England undertook to help the deer by collecting a herd of 16 animals from European zoos. Today, all survivors derive from this herd. By the early 1960s there were some 400 deer in over 40 zoos all over the world, including Beijing. In the mid-1980s the species was reintroduced into semi-captive facilities in China, prior to being established in protected areas of intact coastal grassland.

The **sambar deer** (*Rusa unicolor*) is a large species found over a wide area of southern and south-eastern Asia, where it is divided into a number of subspecies. Dejean's sambar deer (*R. u. dejeani*) is confined to southern and south-western China.

The **Chinese goral** (*Naemorhedus griseus*) is a small, goat-like ungulate found in the mountainous regions of China,

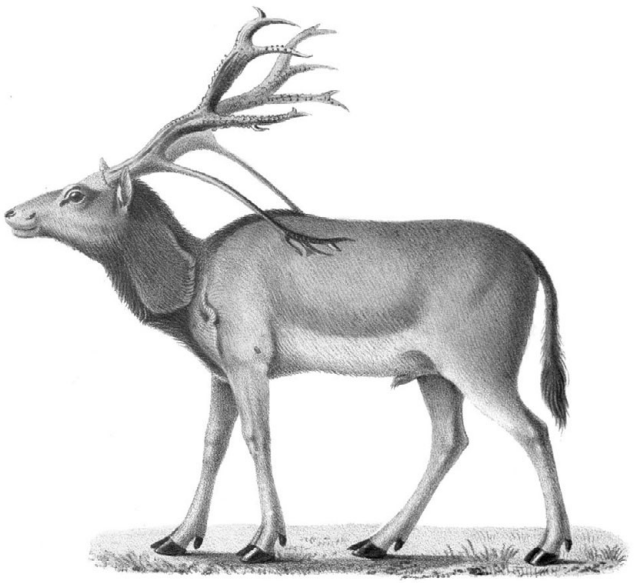

Figure 2.8 Père David's deer. (Credit: Josèphe Huët.) (A black and white version of this figure will appear in some formats. For the colour version, please refer to the plate section.)

Myanmar, India, Thailand, Vietnam, and possibly Laos. It is threatened by overhunting.

Milne-Edwards' serow (*Capricornis milneedwardsii*) is a goat-like species found widely but patchily in forests and rocky areas throughout Central and South East Asia, where it is threatened by habitat destruction and hunting.

The pangolins or scaly anteaters are a group found throughout the tropical and subtropical regions of Africa and southern Asia. They are among the most illegally traded animals in the world today, as their protective scales and other body parts are highly valued for use in 'traditional medicine'. The **Chinese pangolin** (*Manis pentadactyla*) is still found over much of the northern Indian subcontinent, northern South East Asia and southern China (including Taiwan and Hainan), but has been extirpated from many areas.

Reeves' pheasant (*Syrmaticus reevesii*) is endemic to temperate forest fragments in central and north-eastern China, where it is threatened by habitat destruction, hunting, and overcollection of its eggs. The species has been successfully introduced to various parts of Europe and to Hawaii. **Elliot's pheasant** (*S. ellioti*) is endemic to south-eastern China (Guizhou, Hubei, Anhui, Zhejiang, Fujian, Jiangxi, Hunan, Guangxi, and Guangdong), where it lives in both lowland and montane forests. While not immediately threatened, habitat destruction is a concern, as is hunting for food.

The **brown-chested jungle flycatcher** (*Cyornis brunneatus*) is a rare species that breeds in the lowland forests of south-eastern China and winters in the southern Malay Peninsula.

The **fairy pitta** (*Pitta nympha*) is a brightly coloured passerine bird that breeds in Japan, South Korea, south-eastern China and Taiwan, from where it migrates in winter mainly to the island of Borneo. The total population is very small and seriously threatened by loss of habitat and trapping for the cage-bird trade.

The **Naung Mung wren-babbler** (*Rimator naungmungensis*) is known only from a small area of far northern Myanmar (Kachin state).

The **Chinese grass-babbler** (*Graminicola striatus*) is found disjunctly in wetland areas across much of South and South East Asia, with small resident populations in central and south-eastern China (Guangxi, Guangdong, Hainan, and Hong Kong) and central Myanmar. Vagrants have been found in Thailand, Vietnam, and Cambodia. It is everywhere under threat by loss of habitat.

The **beautiful nuthatch** (*Sitta formosa*) is a rare species found patchily over a wide area of north-eastern India (Arunachal Pradesh, Assam, Nagaland, and West Bengal), Bhutan, northern and eastern Myanmar, south-western China (Yunnan), and extreme north-western Thailand. It is threatened by the loss of large trees upon which it depends.

Several species and subspecies of Asian box turtle (*Cuora*) number among the most heavily trafficked and seriously threatened in the world, being much sought after both by the international pet trade and for use in 'traditional medicine'. **Zhou's box turtle** (*C. zhoui*) is known only from Chinese food market specimens and from a relatively small number of captive individuals in Germany and the United States. The species appears most likely to originate from a very small area of extreme northern Vietnam and possibly adjacent southern China (south-eastern Yunnan or western Guangxi), although it has never been scientifically recorded in the wild. The **Chinese yellow-headed box turtle** (*C. aurocapitata*) is known only from a small area of central-eastern China (Anhui). **McCord's box turtle** (*C. mccordi*) was originally described in 1988 from a single specimen obtained from the Chinese pet trade. It was unknown from the wild until 2007, when a small population was discovered in southern China (central Guangxi). **Pan's box turtle** (*C. pani*) is confined to central China (Shaanxi, Sichuan, and Hubei). The **Chinese three-striped box turtle** (*C. trifasciata*) was historically widespread and common in southern China (Guangxi, Guangdong, and Fujian) as well as on the islands of Hainan, Macau, and Hong Kong (the latter two populations most likely having been introduced). The species has been extirpated from mainland China, and now survives only on the aforementioned islands. The **Vietnamese three-striped box turtle** (*C. cyclornata*) was historically found in southern China (Guangxi), northern Vietnam, and northern Laos. Nearly extinct in the wild, it is well-established on Chinese turtle farms. The **yellow-margined box turtle** (*C. flavomarginata*) as a species is widespread in central and eastern China (Hunan, Henan, Anhui, Hubei, Chongging, Sichuan, Zhejiang, and Jiangsu) as well as Taiwan and southern Japan. The Chinese yellow-margined box turtle (*C. f. flavomarginata*) is the subspecies found over the majority of this range, but is everywhere seriously threatened.

Bourret's skink (*Sphenomorphus tritaeniatus*) is known only from two localities within the Red River delta region of northern Vietnam.

The **Chinese cobra** (*Naja atra*) is still found over a relatively wide area of south-eastern China (including the islands of Hainan, Hong Kong, and Macao), northern Vietnam, and northern Laos. It is threatened by human persecution and overcollection for use in 'traditional medicine'.

The **Assamese bug-eyed tree frog** (*Theloderma moloch*) is known only from a few localities in north-eastern India (Arunachal Pradesh and Assam).

Khare's gliding frog (*Pterorana khare*) in known only from a few disjunct localities in north-eastern India (Assam and Nagaland).

Mountains and Highlands

Mountains and highlands within the Sino-Himalayan Region include the Himalayas along with certain of the southern foothills, as well as the Tibetan and Yunnan-Guizhou plateaus and various smaller mountain ranges and plateaus in China, northern Myanmar, and northern Vietnam.

The **golden snub-nosed monkey** (*Rhinopithecus roxellana*) is found in the temperate mountainous forests of central China, where it is divided into three subspecies. The Moupin golden

snub-nosed monkey (*R. r. roxellana*) is confined to western Sichuan, southern Gansu, and southern Shaanxi. The **Myanmar snub-nosed monkey** (*R. strykeri*) was unexpectedly discovered in 2010 in high-altitude forest in northern Myanmar (Kachin State), and has since been found in the Gaoligong Mountains of neighbouring south-western China (Yunnan). The species is seriously threatened by loss of habitat and hunting.

The iconic **giant panda** (*Ailuropoda melanoleuca*) was historically widespread throughout central and south-eastern China, being found as far north as Beijing and south into parts of South East Asia. The better-known black and white form (*A. m. melanoleuca*) now has a very restricted and fragmented range in the high mountains of Sichuan, Shaanxi, and Gansu provinces, where it exists exclusively in middle-elevation forests with a dense understory of bamboo. The largest populations are currently found in the Min and Qionglai ranges, with smaller, more isolated ones remaining in the Liangshan, Daxiangling, and Xiaoxiangling mountains.

The **takin** (*Budorcas taxicolor*) is a muskox-like goat-antelope found in heavily forested montane areas of north-eastern India (Arunachal Pradesh and Sikkim), Bhutan, western China (Gansu, Sichuan, Shannxi, Tibet, and Yunnan), and northern Myanmar. Several subspecies are threatened by hunting and habitat destruction. The Mishmi takin (*B. t. taxicolor*) is found in western China (Tibet and Yunnan) and northern Myanmar. The Sichuan takin (*B. t. tibetana*) is found in Tibet and western China (Yunnan).

The Tibetan argali (*Ovis ammon hodgsoni*) is a type of wild sheep found in western and central China. It is threatened by poaching and competition with introduced livestock.

The **red goral** (*Naemorhedus baileyi*) is a type of goat-antelope confined to the temperate mountains of south-western China (Tibet and Yunnan), north-eastern India (Arunachal Pradesh), and northern Myanmar. It is threatened by habitat destruction and illegal hunting.

Two subspecies of elk or wapiti (*Cervus canadensis*) occurring on the Tibetan Plateau and nearby regions are also threatened. MacNeil's deer (*C. c. macneilli*) has long been intensively hunted for its antler velvet, which is believed to have aphrodisiac properties. The Tibetan deer (*C. c. wallichi*) of south-eastern Tibet and Bhutan was thought to be extinct until its rediscovery in 1995.

The South China sika deer (*Cervus nippon kopschi*) was historically found throughout the Yangtze River drainage east to the coast and as far south as the border with Vietnam. Today, the surviving population of around 300 is widely scattered across its former range in remote mountains isolated by heavily populated lowlands. About 30 exist in the Tianmu Mountains of northern Zhejiang, 70–100 in southern Anhui, and 150 in northern Jiangxi. The population size in southern Guangxi is unknown, and a tiny number may still exist in northern Guangdong as well. Ongoing poaching as well as inbreeding are the main threats.

The **tufted deer** (*Elaphodus cephalophus*) is a small, muntjac-like species historically found widely within central and southern China and northern Myanmar, where it has suffered significant declines due to hunting. The south-western tufted deer (*E. c. cephalophus*) is found in south-western China and (at least historically) northern Myanmar, although it has perhaps been extirpated from the latter country. The south-eastern tufted deer (*E. c. michianus*) is confined to south-eastern China. The central tufted deer (*E. c. ichangensis*) is found in central China.

The **black muntjac** (*Muntiacus crinifrons*) is a type of deer confined to the montane forests of Zhejiang, Anhui, Jiangxi, and Fujian in south-eastern China. Up until 1975 it was known only from a few specimens and was considered the rarest deer in the world. It has since been shown to be more populous than previously thought but nevertheless threatened. Heavily harvested throughout the twentieth century (at least 2000 were killed in 1978 alone), the current population is estimated at between 5000 and 10,000.

Several species and subspecies of musk deer (*Moschus*) are seriously threatened by hunting for use in 'traditional medicine', as well as loss of habitat. The **black musk deer** (*M. fuscus*) is found in south-western China (Yunnan and Tibet), northern Myanmar, Bhutan, north-eastern India (Arunachal Pradesh), and eastern Nepal. The **dwarf musk deer** (*M. berezovskii*) is found widely in the mountains of central and southern China, northern Vietnam, and possibly northern Laos. A number of ill-defined subspecies have been described, including Berezovski's dwarf musk deer (*M. b. berezovskii*), the Bijang dwarf musk deer (*M. b. bijanensis*), the Cao Bang dwarf musk deer (*M. b. caobangis*), and the Yunnan-Guizhou dwarf musk deer (*M. b. yanguiensis*). The **alpine musk deer** (*M. chrysogaster*) is found in the mountains of northern and central China.

The **red panda** (*Ailurus fulgens*) is a racoon-like species that, despite its name, is not closely related to the giant panda. It is native to the eastern Himalayas and the mountains of south-western China, where it is usually divided into two subspecies. The Himalayan red panda (*A. f. fulgens*) is found in north-eastern India (Sikkim, Assam, West Bengal, and Arunachal Pradesh), Nepal, and Bhutan, while Styan's red panda (*A. f. styani*) is found in northern Myanmar (Kachin State) and south-western China (Sichuan, Yunnan, and Tibet). Both are threatened by habitat destruction.

The **Sichuan weasel** (*Mustela russelliana*) is known only from three collection records within a small area of north-central China (Sichuan).

The **Muong Bang stripe-bellied rat** (*Pseudoberylmys muongbangensis*) is known only from a single locality in northern Vietnam (Son La province).

The **Sichuan dormouse** (*Chaetocauda sichuanensis*) is known only from five specimens collected from the mountains of central China (northern Sichuan).

Crump's mouse (*Diomys crumpi*) is known only from a few widely separated localities in northern India (Bihar and Manipur), southern Nepal, and northern Myanmar.

The **Duke of Bedford's vole** (*Proedromys bedfordi*) is known only from a small area in the mountains of central China (southern Gansu and northern Sichuan).

The **dusky shrew** (*Sorex sinalis*) is known only from a few mountaintop localities spread over a relatively wide area of central China (Gansu, Sichuan, and Shaanxi). The **Gansu shrew** (*S. cansulus*) is known only from a few areas of Gansu, Qinghai, and Tibet.

The **dusky tube-nosed bat** (*Murina fusca*) is known only from a single locality in north-eastern China (Heilongjiang).

Anthony's pipistrelle bat (*Hypsugo anthonyi*) is known only from a single specimen collected in the 1940s in north-eastern Myanmar.

Several species and subspecies of eared pheasant (*Crossoptilon*) are endemic to small areas of China. The **brown-eared pheasant** (*C. mantchuricum*) is confined to a few scattered areas of montane forest in northern central China (Shanxi, Hebei, and Shaanxi). Those populations outside of protected areas are threatened by habitat destruction. The **white-eared pheasant** (*C. crossoptilon*) is found in west-central and south-western China, where it is divided into three subspecies. The Sichuan white-eared pheasant (*C. c. crossoptilon*) is confined to Sichuan. The Yunnan white-eared pheasant (*C. c. lichiangnse*) is confined to Yunnan. Drouyn's white-eared pheasant (*C. c. drouyni*) is found in Tibet and Qinghai. All are threatened by deforestation and hunting for food.

Cabot's tragopan (*Tragopan caboti*) is a type of pheasant found patchily in the montane forests of south-eastern China, where it is divided into two subspecies. The eastern Cabot's tragopan (*T. c. caboti*) occurs in Fujian, Jiangxi, Zhejiang, and Guangdong, while the western Cabot's tragopan (*T. c. guangxiensis*) is confined to north-eastern Guangxi and southern Hunan. The **grey-bellied tragopan** (*T. blythii*) is divided into two subspecies. Blyth's grey-bellied tragopan (*T. b. blythii*) occurs in the Himalayas of north-eastern India through south-western China and north-western Myanmar. All are threatened by loss of habitat and high hunting and snaring pressure.

Sclater's monal (*Lophophorus sclateri*) is a type of pheasant divided into two subspecies. The eastern Sclater's monal (*L. s. sclateri*) is found in the Himalayas of north-eastern India, northern Myanmar, and south-western China (Tibet and Yunnan). The western Sclater's monal (*L. s. arunachalensis*) is confined to north-eastern India (Arunachal Pradesh).

The **Sichuan partridge** (*Arborophila rufipectus*) is confined to a few montane forest fragments in central China (south-central Sichuan and possibly north-eastern Yunnan). It is threatened by hunting and habitat destruction.

The **grey-sided thrush** (*Turdus feae*) breeds in a small mountainous area of north-eastern China (Shanxi, Hebei, and Beijing), from where it migrates in winter to north-eastern India, Bangladesh, Myanmar, Thailand, and Laos. It is threatened by deforestation.

The **white-spotted laughingthrush** (*Garrulax bieti*) is confined to the mountains of central China (north-western Yunnan and south-western Sichuan).

The **rufous-headed robin** (*Larvivora ruficeps*) breeds only in a few areas of northern China (north-central Sichuan and southern Shaanxi), from where it migrates to the Malay Peninsula and Cambodia. It is threatened by forest loss and overcollection for use as cage birds.

The **black-throated blue robin** (*Calliope obscura*) was first discovered in 1891 in the mountains of north-central China (Sichuan, Gansu, and Shaanxi). Only a handful of individuals were seen again until 2011, when its breeding grounds were discovered in the Qinling Mountains. The species is thought to migrate to southern China and northern Thailand.

The **grey-hooded parrotbill** (*Sinosuthora zappeyi*) is confined to the mountains of central China (south-central Sichuan and western Guizhou).

The **Emei liocichla** (*Liocichla omeiensis*) is a type of passerine bird known from the mountains of central China (south-central Sichuan and extreme north-eastern Yunnan).

The **golden-fronted fulvetta** (*Schoeniparus variegaticeps*) is a type of passerine bird known only from a few localities in the mountains of south-central China (Sichuan and Guangxi).

The **giant nuthatch** (*Sitta magna*) was historically found throughout the mountains of south-western China (Yunnan), north-western Thailand, and central and eastern Myanmar, but may now be extirpated from the latter country. It is threatened by the loss of large trees upon which it depends.

The **Yunnan gecko** (*Gekko scabridus*) is a poorly known species from the mountains of south-western China (Sichuan and Yunnan).

The **Sichuan pit viper** (*Sinovipera sichuanensis*) is known only from two specimens collected in western China (southern Sichuan).

The **Sichuan rat snake** (*Euprepiophis perlacea*) is known only from a few mountainous areas of western China (western Sichuan).

Angel's keelback (*Rhabdophis angeli*) is a type of snake known only from a few specimens collected in the 1930s from a small area of northern Vietnam (Thai Nguyen and Vinh Phuc provinces).

The **Sichuan hot-spring keelback** (*Thermophis zhaoermii*) is confined to a small area of central China (Sichuan).

The **Chapa flat-nosed keelback** (*Hebius chapaensis*) is known only from a small area of montane forest in northern Vietnam, where it was last reported in the early twentieth century. The **Wa keelback** (*H. metusium*) is known only from two localities in central China (Sichuan).

The **Yunnan mountain snake** (*Plagiopholis unipostocularis*) is known only from a single specimen collected from an imprecise locality in southern China (Yunnan).

The **Ningshan kukri snake** (*Stichophanes ningshaanensis*) is known only from a single locality in central China (Shaanxi).

Lacroix's kukri snake (*Oligodon lacroixi*) is known only from three localities across a relatively wide area of south-western China (Yunnan and Sichuan) and northern Vietnam.

Blyth's reticulated snake (*Blythia reticulata*) appears to have been found historically across a wide area of north-

eastern India (Arunachal Pradesh, Assam, Manipur, and Meghalaya), northern Myanmar, and possibly southern China (Tibet), although in recent decades it has only been recorded from Myanmar (Chin State).

The **Tam Dao stream snake** (*Opisthotropis tamdaoensis*) is known only from Tam Dao National Park in northern Vietnam (Vinh Phuc province).

The **Lichuan bell toad** (*Bombina lichuanensis*) is known only from two localities in northern China (Hubei and Sichuan). It probably occurs more widely, especially in area between the two known sites, but is nevertheless thought to be threatened by loss of habitat.

Several lazy toads of the genus *Oreolalax* are endemic to small areas of China and Indochina. **The Liangbei lazy toad** (*O. liangbeiensis*) is known only from a single small stream in central China (southern Sichuan). **Weigold's lazy toad** (*O. weigoldi*) is known only from a single specimen collected in the 1920s from an imprecise locality in central China (Sichuan). The **Chuanbei lazy toad** (*O. chuanbeiensis*) is known only from a small area of central China (northern Sichuan). The **Puxiong lazy toad** (*O. puxiongensis*) is known only from a single locality in west-central China (Sichuan). The **dotted lazy toad** (*O. multipunctatus*) and the **Emei lazy toad** (*O. omeimontis*) are both confined to a small area of central China (south-western Sichuan).

Several lazy toads of the genus *Scutiger* are threatened by habitat destruction and degradation. The **Chinting lazy toad** (*S. chintingensis*) is known only from a small area of central China (Sichuan). The **Ningshan lazy toad** (*S. ningshanensis*) is known only from two specimens collected from a single locality in central China (southern Shaanxi). The **Muli lazy toad** (*S. muliensis*) is known only from a single locality in central China (south-western Sichuan). The **Jiulong lazy toad** (*S. jiulongensis*) is known only from a single locality in central China (southern Sichuan). The **spotted lazy toad** (*S. maculatus*) is known only from two localities in western China (north-western Sichuan and eastern Tibet). The **Pingwu lazy toad** (*S. pingwuensis*) is known only from two localities in central China (north-eastern Sichuan and southern Gansu). The **Liupan lazy toad** (*S. liupanensis*) is confined to a few localities in central China (Gansu province and Ningxia Autonomous Region). The **bumpy lazy toad** (*S. tuberculatus*) is confined to a small area of central China (southern Sichuan). The **Adung lazy toad** (*S. adungensis*) is known for certain only from two specimens collected from the Adung Valley in northern Myanmar in 1931.

The **Chapa bug-eyed tree frog** (*Theloderma bicolor*) occurs in south-western China (Yunnan) and north-western Vietnam (Quang Tri province), where it is threatened by loss of habitat.

Hu's gliding tree frog (*Rhacophorus hui*) is known only from two, relatively distant montane areas of central China (Sichuan and Hubei), but presumably occurs more widely. The **Hoanglien gliding tree frog** (*R. hoanglienensis*) is known from two localities in northern Vietnam (Lao Cai and Ha Giang provinces).

Dubois' gliding tree frog (*Zhangixalus duboisi*) is known only from two localities in northern Vietnam and south-western China (Yunnan).

The **Jinxiu foam-nest tree frog** (*Gracixalus jinxiuensis*) is known only from a few widely scattered montane localities in southern China (south-eastern Yunnan, north-eastern Guangxi, and southern Hunan) and northern Vietnam (Mount Fan Si Pan). It likely represents a cluster of species, some as yet undescribed.

The **Htingnan shrub frog** (*Philautus tytthus*) is known only from its original collection in northern Myanmar in 1940. The **Darjeeling shrub frog** (*P. dubius*) is known only from its original collection during the late nineteenth century from an undefined locality in north-eastern India (West Bengal or Meghalaya).

Several odorous frogs of the genus *Odorrana* are threatened by habitat destruction and overcollection for food. The **Jingdong odorous frog** (*O. jingdongensis*) occurs over a relatively wide area of south-western China (Yunnan and Guangxi) and northern Vietnam. The **geminated odorous frog** (*O. geminata*) is known from a few localities in south-western China (south-eastern Yunnan) and north-eastern Vietnam (Ha Giang and Cao Bang provinces). The **Trankien odorous frog** (*O. trankieni*) is known only from a single locality in north-eastern Vietnam (Son La province). **Ahl's odorous frog** (*O. sinica*) is known only from a single specimen collected in the early twentieth century from an undefined locality in China. The **Tay Yen Tu odorous frog** (*O. yentuensis*) is known only from the Tay Yen Tu Nature Reserve in north-eastern Vietnam (Bac Giang province). The **Guangwu odorous frog** (*O. kuangwuensis*) is known from a few localities in central China (Sichuan and Hubei).

The **Nanjiang odorous frog** (*Oreolalax nanjiangensis*) is confined to a few isolated localities in central China (Sichuan, Gansu, and Shaanxi), where it is threatened by loss of habitat.

Three species of horned frog (*Megophrys*) are endemic to small areas of central China, where they are threatened by loss of habitat. The **Nankiang horned frog** (*M. nankiangensis*) is known only from a few localities in Sichuan and Gansu. The **convex-tailed horned frog** (*M. caudoprocta*) is confined to parts of Hunan and Hubei. The **Shuicheng horned frog** (*M. shuichengensis*) is known only from a single locality in western Guizhou.

The **Kambaiti cascade frog** (*Amolops longimanus*) is known only from its original collection in 1939 from northern Myanmar. The **vitreous cascade frog** (*A. vitreus*) is known only from northern Laos (Phongsaly province) and northern Vietnam (Dien Bien and Son La provinces). The **Assamese cascade frog** (*A. assamensis*) is known only from the Mayeng Hill Reserve Forest in north-eastern India (Assam). The **Lolokou cascade frog** (*A. loloensis*) is confined to a small area of central China (Sichuan and Yunnan). The **minute cascade frog** (*A. minutus*) is known only from Mu Ham Mountain in north-western Vietnam (Lai Chau province), but likely ranges as well into south-western China (Yunnan). The **splendid**

cascade frog (*A. splendissimus*) is known only from a small area of north-western Vietnam (Lai Chau province).

Boring's large-eyed litter frog (*Leptobrachium boringii*) is known from a few localities in central China (Sichuan, Guizhou, and Hunan), where it is threatened by overcollection for human consumption and the international pet trade, as well as by habitat destruction. The **Dawei large-eyed litter frog** (*L. promustache*) is confined to a small area of southern China (Yunnan) and adjacent north-western Vietnam (Lào Cai province).

Two species of spiny frog (*Quasipaa*) are threatened by habitat destruction and overcollection for human consumption. The **Jiulong spiny frog** (*Q. jiulongensis*) is known from a few localities in east-central China (Zhejiang and Fujian). **Shin's spiny frog** (*Q. shini*) occurs in central China (Sichuan, Guizhou, Hunan and Guangxi).

Two species of tiny frog (*Nanorana*) are threatened by overcollection for food and subsistence wood extraction outside of protected areas. **Anderson's tiny frog** (*N. yunnanensis*) occurs over a wide area of central and south-western China (Sichuan, Yunnan, Guizhou, Hunan, and possibly Hubei), northern Myanmar, and northern Vietnam. The **Tonkin tiny frog** (*N. unculuanus*) occurs in south-western China (Yunnan), northern Vietnam, and possibly northern Laos.

The **Chuanan short-legged litter frog** (*Brachytarsophrys chuannanensis*) is confined to a small area of central China (southern Sichuan).

Liu's wart frog (*Limnonectes liui*) is known only from a small area of south-western China (southern Yunnan), but may extend into adjacent areas of Myanmar and Laos.

The **Tsinpa salamander** (*Liua tsinpaensis*) is known only from three localities in the mountains of central China (southern Shaanxi and north-eastern Sichuan).

The **Yichang salamander** (*Hynobius chinensis*) is known only from a single locality in central China (Hubei province).

Three salamanders of the genus *Pseudohynobius* are threatened by loss of habitat and overcollection for food and the international pet trade. The **Schuicheng salamander** (*P. shuichengensis*) is known only from a single locality in south-western China (Guizhou). The **Kuankuoshui salamander** (*P. kuankuoshuiensis*) is known only from the Puchang-Kuankuoshui Nature Reserve in Guizhou. The **yellow-spotted salamander** (*P. flavomaculatus*) is confined to two localities in central China (Hubei and Hunan).

Three species of mountain stream salamander (*Batrachuperus*) are threatened by overcollection for food and 'traditional medicine'. **Schmidt's mountain stream salamander** (*B. tibetanus*) occurs in central China (Sichuan, Shaanxi, Qinghai, Gansu, and Tibet). **Pinchon's mountain stream salamander** (*B. pinchonii*) is currently found in western Sichuan and north-western Yunnan, having been extirpated from south-eastern Guizhou many decades ago. The **Yenyuan mountain stream salamander** (*B. yenyuanensis*) is known from the Daliang, Daxue, and Xiaoxianglin mountain ranges of south-western Sichuan.

The **red-tailed knobby newt** (*Tylototriton kweichowensis*) is confined to the mountains of central China (western Guizhou and north-eastern Yunnan).

The Tibetan Plateau

The Tibetan Plateau (also known as the Qinghai-Tibet Plateau or Himalayan Plateau) is located in Central and East Asia. It covers much of western China (Tibet Autonomous Region, southern Xinjiang, northern Yunnan, western Sichuan, western Gansu, and Qinghai), as well as parts of northern India (Ladakh and Himachal Pradesh), Pakistan (Gilgit-Baltistan), northern Nepal, Bhutan, eastern Afghanistan, eastern Tajikistan, and southern Kyrgyzstan. The world's highest and largest plateau, it stretches approximately 1000 km from north to south, some 2500 km from east to west and averages over 4500 m in elevation. Often referred to as the 'Roof of the World' or the 'Third Pole', it is essentially a vast, high-altitude arid steppe interspersed with mountain ranges and large, brackish lakes. It is from here that several major rivers (including the Yangtze, Mekong, and Indus) begin their long journeys to the sea. Owing to its remoteness much of the environment remains intact, with species and subspecies like the Tibetan wild ass (*Equus kiang*), Tibetan gazelle (*Procapra picticaudata*), and Tibetan grey wolf (*Canis lupus filchneri*) all still relatively common.

The **wild yak** (*Bos mutus*) is a large, shaggy bovid and the ancestor of the domestic yak (*B. grunniens*). Today it is primarily found in the cold treeless uplands of northern Tibet and western Qinghai, with a few populations extending into the southernmost parts of Xinjiang, China, and Ladakh, India. Further small, isolated populations are also found in western Tibet and eastern Qinghai. Historically the species was also found in central China, Nepal, Sikkim and Bhutan, but has been extirpated there due to hunting.

The **white-lipped** or **Thorold's deer** (*Cervus albirostris*), one of the largest of all deer, formerly ranged across much of the eastern Tibetan Plateau but has been much reduced by intensive hunting, both for meat as well as 'traditional medicine'. It now occurs only in fragmented populations in remote mountainous areas of eastern Tibet, Gansu, Qinghai, Sichuan, and Yunnan. The total population is estimated at around 7000.

The Tibetan brown bear (*Ursus arctos pruinosus*) is a little-known subspecies with long, bluish fur found on the eastern Tibetan Plateau. Rarely sighted in the wild, it is threatened mainly by hunting for use in Chinese 'traditional medicine' and loss of habitat.

The **Chinese mountain cat** (*Felis bieti*) is a small, rare species found only on the north-eastern edge of the Tibetan Plateau. It is threatened by the organized poisoning of pikas (*Ochotona* sp.), which both diminishes prey and kills the cats unintentionally.

Przewalski's gazelle (*Procapra przewalskii*) was formerly widespread across the high plateaus of north-western China, from the area around Lake Qinhai through Gansu to Ningxia, possibly Shanxi and Inner Mongolia. It underwent a significant

decline in the 1950s due to hunting, and today is confined to around a dozen sites within five isolated areas around Lake Qinhai.

Kozlov's pika (*Ochotona koslowi*) is known only from three localities in northern Tibet.

Kozlov's shrew (*Sorex kozlovi*) is known only from a single locality in eastern Tibet.

The **Linzhi mountain vole** (*Neodon linzhiensis*) is known only from the Gongbu Nature Reserve in south-eastern Tibet.

The **Chinese monal** (*Lophophorus lhuysii*) is a type of pheasant confined to the mountains of central China (western Sichuan, eastern Tibet, south-eastern Qinghai, southern Gansu, and possibly north-western Yunnan). In 2000 the total population was estimated to be around 12,000 and declining.

The **giant babax** (*Pterohinus waddelli*) is a rare, thrush-like bird confined to southern Tibet and extreme north-eastern India (Sikkim).

The **Sichuan jay** (*Perisoreus internigrans*) is a rare species confined to the mountains of central China (western Sichuan, eastern Tibet, south-eastern Qinghai, and southern Gansu).

Sillem's rosefinch (*Carpodacus sillemi*) was long known only from two specimens collected in 1929 from southern Xinjiang, China. In 2012 it was photographed at another locality some 1500 km away in western Qinghai province.

The **Medog forest lizard** (*Calotes medogensis*) is only known from a single locality in south-eastern Tibet.

Kaulback's lance-headed pit viper (*Protobothrops kaulbacki*) is known only from Medog County (south-eastern Tibet) and from northern Myanmar.

The **Zamda toad** (*Bufotes zamdaensis*) is known only from a single high-elevation wetland locality on the south-western Tibetan Plateau.

The **Medog gliding tree frog** (*Rhacophorus verrucopus*) is known only from a single locality on the south-eastern Tibetan Plateau, but may occur more widely.

The **Medog foam-nest tree frog** (*Gracixalus medogensis*) is only known from a single specimen collected in south-eastern Tibet.

The **Medog frog** (*Liurana medogensis*), **Xizang frog** (*L. xizangensis*), and the **alpine frog** (*L. alpina*) are all known only from small areas of south-eastern Tibet.

The **reticulated frog** (*Ingerana reticulata*) is known only from a small area of south-eastern Tibet.

Two species of cascade frog (*Amolops*) endemic to the Tibetan Plateau are threatened by loss of habitat. The **Medog cascade frog** (*A. medogensis*) and the **Aniqiao cascade frog** (*A. aniqiaoensis*) are each known only from a single locality in Medog County, on the south-eastern edge of the Tibetan Plateau.

The **Medog tiny frog** (*Nanorana medogensis*) is known only from a small area of south-eastern Tibet.

The **Medog horned frog** (*Megophrys medogensis*) is known only from a small area of south-eastern Tibet, where it is threatened by loss of habitat due to road construction and urbanization.

The Himalayan Mountains

Located in Central Asia, the Himalayas include many of the Earth's highest peaks and separate the plains of Indian subcontinent from the Tibetan Plateau. As here defined, they are spread across Bhutan, south-western China, northern India, Nepal, and northern Pakistan and are divided into two main subranges.

The Himalayan brown bear (*Ursus arctos isabellinus*) is a relatively small subspecies that lives in high-altitude forests and alpine meadows in northern Nepal, northern and north-western India, and northern Pakistan. It is threatened by loss of habitat. The Himalayan black bear (*U. thibetanus laniger*) is a long-furred subspecies that, during the summer, can be found at high altitudes of the Himalayas and surrounding areas. In winter it tends to descend to warmer lower-elevation forests.

The Himalayan Pallas' cat (*Otocolobus manul nigripectus*) is a rare subspecies that occurs in the Himalayas from Kashmir to Bhutan.

The **Himalayan tahr** (*Hemitragus jemlahicus*) is a large wild goat native to the Himalayas of southern Tibet, northern India, and Nepal, where it is threatened by hunting and habitat destruction. The species has been widely introduced to Argentina, New Zealand, South Africa, and the United States.

The **Himalayan musk deer** (*Moschus leucogaster*) occurs in parts of Afghanistan, Pakistan, Tibet, Nepal, Bhutan, and northern India. It is ruthlessly hunted for use in 'traditional medicine' and has suffered a considerable decline.

The **satyr tragopan** (*Tragopan satyra*) is a type of pheasant found patchily in the Himalayas of northern India, southern Tibet, Nepal, and Bhutan, where it is threatened by hunting and habitat destruction.

The **wood snipe** (*Gallinago nemoricola*) occurs as a vagrant throughout a wide area of Indochina and South Asia, but breeds only in the high alpine meadows of the Himalayas of northern India, Nepal, Bhutan, and southern China. It declined drastically during the early twentieth century due to hunting, which continues to be a threat in some areas.

The Western Himalayas

The Western Himalayas stretch from Badakhshan in north-eastern Afghanistan/southern Tajikistan, through India (Jammu and Kashmir, Himachal Pradesh and Uttarakhand) to central Nepal. The Himalayas capture moisture from the monsoons that sweep in from the Bay of Bengal, and most of this rainfall is expended in the eastern Himalayas. Therefore, the western Himalayas are drier, a trend reflected in the timberline that declines from 4000 m in the east to about 3500 m in the west.

The **Chamba sacred langur** (*Semnopithecus ajax*) is confined to a small area of north-western India, primarily in the Chamba Valley of Himachal Pradesh but extending somewhat into Jammu and Kashmir.

The Kashmir markhor (*Capra falconeri cashmiriensis*) is a type of wild goat confined to a small area of north-western India (Jammu and Kashmir) and north-eastern Pakistan, where it is threatened by military activity and competition from introduced livestock.

Two subspecies of mouflon (*Ovis gmelini*), a type of wild sheep previously discussed in this volume, are endemic to the Western Himalayas. The Punjab mouflon (*O. g. punjabensis*) is confined to the foothill forests of eastern Pakistan (Punjab). The Ladakh mouflon (*O. g. vignei*) is found in Ladakh and northern Pakistan, including Kashmir.

The Kashmir stag (*Cervus hanglu hanglu*) is confined to dense riverine forests in the Kashmir Valley and northern Chambra district of Himachal Pradesh. Up until 1947 the total population of between 3000 and 5000 was regarded as the personal property of the Maharaja of Kashmir, which gave it adequate protection. In the years after Indian independence, however, it was heavily poached and much of its habitat destroyed by domestic livestock. By 1970 the population had been reduced to just 140–170 living in the Dachigam Sanctuary (now a national park) in Kashmir, with a few small groups in Himachal Pradesh. An international conservation project helped to increase this number to over 340 by 1980, but since then the animals have been under renewed threat from local shepherds and their dogs. As of 2018 only 186 were known to survive.

The **Kashmir musk deer** (*Moschus cupreus*) is found sporadically in extreme north-western India (Jammu and Kashmir), northern Pakistan, and perhaps north-eastern Afghanistan (Nuristan province). It is seriously threatened by poaching for its prized scent glands.

The **Himalayan goral** (*Naemorhedus goral*) is a type of goat-antelope divided into two subspecies. Hodgson's Himalayan goral (*N. g. goral*) is found in southern Tibet, Bhutan, eastern Nepal, and north-eastern India (Sikkim and Arunachal Pradesh). Bedford's Himalayan goral (*N. g. bedfordi*) is confined to northern India (Jammu and Kashmir, Himachal Pradesh and Uttaranchal) and western Nepal. Both are threatened by loss of habitat and hunting for their meat.

The **central Kashmir vole** (*Alticola montosa*) is known only from two localities in north-western India and northern Pakistan.

The **pale grey shrew** (*Crocidura pergrisea*) is known only from a single locality in Pakistan-administered Kashmir.

Peters' tube-nosed bat (*Harpiola grisea*) is known only from a small area of northern India (Uttarakhand).

The **cheer pheasant** (*Catreus wallichi*) occurs patchily in the western Himalayas from northern Pakistan through Kashmir and northern India to central Nepal. Widely shot for sport during the early twentieth century, it continues to be hunted and trapped for food and its eggs collected for local consumption.

The **western tragopan** (*Tragopan melanocephalus*) has a disjunct distribution in the western Himalayas from the Indus-Kohistan district of Pakistan, east through Kashmir and Himachal Pradesh to Uttarakhand in north-western India. Although historically considered to be rare, a mid-1980s population estimate of 1600–4800 was revised in the mid-1990s to around 5000 birds following the discovery of several significant populations in northern Pakistan. It is threatened by habitat destruction and hunting.

The **Himalayan quail** (*Ophrysia superciliosa*) is known only from the western Himalayas in north-western India (Uttaranchal), where about a dozen were collected near Mussooree and Naini Tal prior to 1877. It has not been recorded with certainty since then, despite numerous searches. However, quail are naturally difficult to observe and the species probably remains extant, although in small numbers.

The **Kashmir flycatcher** (*Ficedula subrubra*) breeds in the Western Himalayas of north-western India and north-eastern Pakistan, from where it migrates south to winter primarily in

Figure 2.9 Himalayan quail painted by John Gould in 1883. (Credit: John Gould.) (A black and white version of this figure will appear in some formats. For the colour version, please refer to the plate section.)