Chapter 10

Insects, Spiders, Snails and Empathy

Representing Invertebrate Extinctions in Natural History Museums

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Museums as Testimonies to Species Extinctions

The origin of natural history museums can probably be traced back to the 'cabinets of curiosities, rooms filled with remarkable objects' that emerged in the sixteenth century. In such collections, exotic or strange animals and other living beings from around the world, including humans, were displayed to visitors. There was no scientific context offered, and fact and myth were often intertwined.[1] In the not too distant past, as a legacy of these curious times, two-headed cows formed centrepieces in what were otherwise modern natural history museums.

Joseph Grinnell (1877–1939), a North American zoologist and museum director, was probably one of the first scientists to start recording field observation data, and he also contributed to changing the perception of what a natural history museum should be.[2] According to Grinnell, a museum must serve as a repository of specimens and data documenting the composition of communities across space and time. Modern natural history museums are now repositories of countless specimens, often dating as far back as the eighteenth century, or much earlier if we include fossils, each with a given scientific context in the form of, at least, location and date of collection. These specimens provide evidence of past populations of species that are often already extinct from the sites where they were captured, or even worldwide. It is a fact that if we start digging into old and not so old collections, we will find the only known individuals of many species that are long gone and that cannot be recovered, the so-called Cen-

tinelan extinctions.[3] Museum collections therefore provide some of the most important testimonies that exist of past population declines and species extinctions,[4] and potentially also furnish the data and tools needed to prevent future extinctions.[5]

In this chapter, I delve into some of the main challenges involved in representing human-driven extinctions, specifically invertebrate extinctions, in museums. I also discuss some possible solutions to these challenges. Although, in the popular imagination, extinctions are usually associated with large mammals and birds (of which some of the better-known examples include mammoths and the dodo respectively), the majority of extinctions are occurring among invertebrates, involving insects, spiders, snails and their kin. Our major challenge is to cultivate sensitivity towards the lives of such species, which are frequently forgotten, seeking to foster empathy for them among museum visitors.

Museum Exhibitions as Venues for Extinction Showcase

The role of natural history and other kinds of museums does not begin and end in collection management and research.[6] Museums are also ideal venues to showcase nature to the general public, this often being the single function visitors are aware of. Most natural history museums dedicate at least some of their exhibition space to dinosaurs or other fauna that went extinct for non-anthropogenic reasons. As extinct species constitute 99 per cent of all species that ever existed, everyone is familiar with the concept that the disappearance of living forms is part of the natural rhythm of our planet. Museum exhibitions, however, also present broader opportunities to connect increasingly urban populations with contemporary phenomena, and foreground how current human actions influence the natural world. This influence often leads to species extinctions at levels many times higher than in any past era.

Building on in-house expertise on conservation biology, many museums around the world often host permanent or temporary exhibitions, the main theme of which is anthropogenic species extinctions, their causes and their consequences. Given the gravity of such a theme, it may have been deliberately avoided in the past. More recently, radical approaches to the subject have gained global attention. In 2019, for example, Bristol Museum & Art Gallery (UK) made worldwide headlines with their 'Extinction Voices' intervention. By cloaking all the threatened and extinct animals in black translucent veils, this intervention highlighted the disappearance of their kin due to habitat loss, pollution, poaching, and a myriad of other threats that the species may have faced. Often extinctions are portrayed alongside a related theme, such as climate change (Fig. 10.1). Given the major atten-

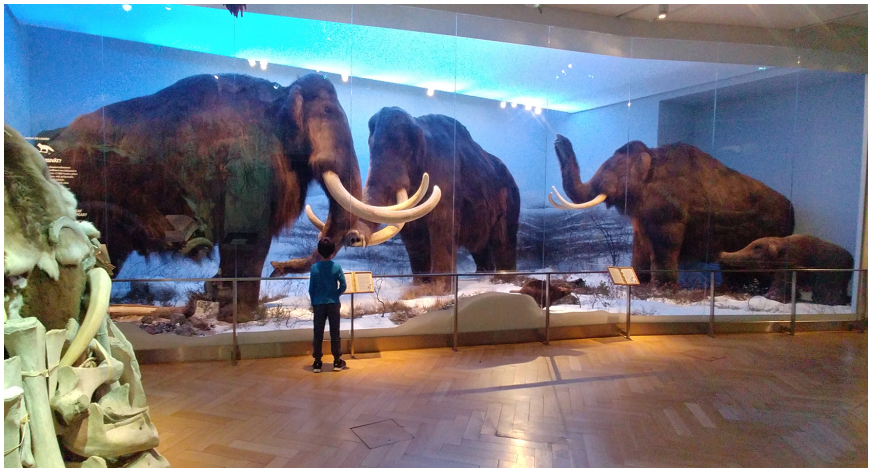

Illustration 10.1 Woolly mammoth exhibit, Finnish Museum of Natural History (Luomus), Helsinki, Finland. © Pedro Cardoso.

tion accorded to climate change by the public and in the media, an attention that is much greater than that given to species extinctions themselves, it serves as a way to connect us as visitors to the consequences of our own actions, and to the ecosystems of the millions of species that are affected by the current global warming crisis.

Invertebrate Extinctions around the World

When many of us think of extinctions, we imagine large mammals roaming across savannas and tropical forests. Most conservation biologists are as biased as the general public in this regard. But the truth is that these are just a diminutive part of the species in peril. Extinctions occur mainly among 'the little things that run the world'[7] – the invertebrates (animals without a backbone or bony skeleton), including insects, spiders, snails and their countless kin – and happen even on our doorsteps. Until recently, we were largely unaware that invertebrates could be imperilled to levels equivalent to, or even higher than, other taxa such as vertebrates, and that their loss would have consequences for our own well-being.

Given the lack of knowledge about, and monitoring of, invertebrates, relatively few extinctions are reported. Probably the best-known cases come from islands, where the evolution of unique and naturally rare species makes them particularly noticeable. Darwin himself was mainly inspired by island species to develop his evolution theory. The best documented

declines on islands and elsewhere are reported for snails, as they leave shells after death, in what often constitutes important evidence of past populations. The entire genus *Carelia* was made up of twelve large species (with shells over 85 mm long) that were endemic to the island of Kaua'i (Hawai'i). The last specimens were seen almost seventy years ago, and now all species are extinct.[8] Several endemic beetles[9] and spiders[10] are probably extinct in the Azores, and doubtless many other species suffering similar fates remain undetected. On Madeira Island, the Madeiran large white butterfly (*Pieris brassicae wollastoni*) was last seen in the 1970s.[11] A complete list would need an entire book, or maybe even an encyclopedia, and would include examples from all species groups and geographical regions.

Fuelled by the recognition of declining numbers from specific regions,[12] concern over the fate of invertebrates has recently begun to gain traction in the non-scientific realm. In total, at least one million species are facing extinction in the coming decades, the majority of them invertebrates.[13] It is not only their vast numbers, but the dependency of ecosystems and of humanity on them, that makes the conservation and diversity of insects and other invertebrates critical for future generations.[14] A major challenge for now and in coming years is to draw attention to the beneficial contributions of nature to all people. Insects and other invertebrates are irreplaceable components in this, as is biodiversity in general.

Human activity is responsible for almost all current population declines and extinctions. The precise trends and drivers, and their respective importance, are mostly unquantified, but it is clear that six main factors contribute synergistically to decline or extinction: habitat loss, or its degradation or fragmentation; pollution, including harmful pesticides; the spread of invasive species; global climate change; direct overexploitation; and the coextinction of species dependent on other species.[15] If habitat loss has long been regarded as a major extinction driver,[16] pesticides and climate change have also recently been linked to major declines, namely of the better-studied pollinators. Invasive species are particularly relevant in island contexts.[17] On the other hand, coextinction might be the most important factor for many parasite taxa.[18] Two recent studies, which collected the opinions of more than five hundred experts on insects and spiders worldwide, confirmed that experts are not only worried, but that they also believe multiple common pressures are driving species extinctions worldwide.[19]

Humanity Depends on Invertebrates

With invertebrate extinctions, we lose much more than species. We lose abundance and biomass, diversity across space and time, which conse-

quently causes homogenization, large parts of the tree of life, unique ecological functions and traits, and fundamental parts of extensive networks of biotic interactions. Such losses lead to the decline of key ecosystem services on which humanity depends. Insects and their kin contribute to provisioning services, supporting services, regulating services, and cultural services.[20] They change the structure, fertility, and spatial dynamics of soil, being a crucial element for maintaining biodiversity and food webs.[21] A large number of invertebrates provide medical or industrial products;[22] and in agroecosystems, invertebrates perform many different functions, such as pollination, nutrient and energy cycling, pest suppression, seed dispersal, and decomposition of organic matter, faeces and carrion.[23]

Despite their ubiquity, humanity's dependence on them, and the dire situation that many of them face, representations of invertebrate extinction intended for the general public are rare. Museums, science centres and similar venues have been laying the ground for such representations for some time, but not as systematically as for other groups. Probably more people are aware of what caused the end of the dinosaur era, even though it does not affect our lives, than of what is causing current invertebrate declines and extinctions. A quick online search for museum exhibitions specifically dedicated to extinctions will, in general, reveal multiple activities, but with few covering invertebrates in any meaningful way. This is not exclusive to museum exhibitions, but is common to conservation science in general, with these smaller animals being given only minimal attention and funding compared with other groups.[24]

Public Perceptions of Invertebrate Extinctions

Museums are now finally, albeit slowly, catching on to the importance of invertebrate extinctions, and beginning to represent some of the perils they face. The main difficulty that arises in such representations is probably one of creating empathy in a human audience for invertebrates. Being small, apparently insignificant, and often perceived as dangerous or as pests, insects, spiders, snails and others have a significant image problem that requires fixing. As a spider researcher, I regularly receive viral emails containing graphic pictures of a necrotic hand allegedly caused by a bite of the infamous brown recluse spider (*Loxosceles sp.*). Fortunately, these are fake, and, in fact, it is very rare for bites from this species to cause any kind of persistent harm.[25] And yet, such fake news definitely works against overturning the negative public perception surrounding spiders.

There are exceptions to the generally negative public perception of invertebrates though, with butterflies and bees viewed positively due to their

perceived beauty and utility respectively.[26] Butterflies, with their often colourful wings, have always been regarded as symbols of beauty, and are valued for it. Their close cousins, dull brown moths, on the other hand, have always been feared, even though both groups are very similar. It is a tough break being sombre, coloured and an invertebrate.

Bees, as well as being colourful, have also accrued a positive perception due to their utility as pollinators. The bulk of our food depends on bees and other pollinators to enable reproduction and fruit production. There is growing awareness in the general public about this reality. Maybe in the future, dung beetles (which help to keep us in a dung-free world), earthworms (which prepare the soil for crops), spiders (which eat insect pests) and many other invertebrates will also be seen through a similarly positive lens.

Taking advantage of such optics, invertebrate extinctions are now often represented in ways that emphasize their utility. At Manchester Museum (UK), the exhibition 'After the bees' (2016–17) focused on bees as pollinators, and foregrounded how crucial they are to our own well-being. Another approach is to represent invertebrates as unique to a given neighbourhood, as was the case in the exhibition 'Azorean for millions of years', which depicted endemic Azorean insects for the public using large outdoor macrophotography. This use of extreme close-ups renders otherwise easily overlooked invertebrates highly visible and therefore difficult to ignore. Another way of nurturing a sense of connection between humans and invertebrates is by attributing common names to species, so that people can associate some characteristic of the species with a familiar concept.[27] The use of common names, along with other strategies to encourage empathy, form some of the best ways to raise invertebrate extinction awareness. People can name specific species of mammals and birds, but rarely can they name invertebrates. The use of carefully selected flagship species of invertebrates, the fates of which are foregrounded, could potentially help to draw attention to the bigger picture. Exhibitions with live specimens in recreated habitats, giant models that allow their intricate body structures to be viewed, and interaction with the scientists who study them and with their work, are some of the new ways being used to showcase invertebrates, their extinction, and why and how they should be saved.

Exhibitions involving the depiction of extinction are not the sole preserve of natural history museums. Art museums also frequently engage with extinction, often employing works of art in ways that leave more room for use of the imagination and for interpretation. When framed by a strong message, subjectivity and emotion can potentially play a central role in changing perceptions and attitudes. The Finnish Museum of Contemporary Art (Kiasma) recently (2019–20) showcased two exhibitions depicting global change and extinctions. 'Weather Report: Forecasting Future' was themed

around the complex and varied relations that exist between the human and non-human in an age when climate change and mass extinction are threatening the future of life on Earth. 'Coexistence' dealt specifically with the question of the coexistence of humans, animals and nature. In a cooperation between Kiasma and Luomus, conservation biologists provided guided visits in which art pieces were interpreted through the prism of conservation science.[28] If it is difficult for the invertebrates themselves to engage the public, artists and scientists can give them a helping hand.

Moving Forward

The depiction of invertebrate extinctions in museums or similar venues is a work in progress. Even when they are known, invertebrates often endure an image problem; but usually unknown, most simply pass under the radar. Both reason and emotion must be mobilized if we are to improve the current situation. We can use an array of psychological tools[29] in an effort to overcome the 'public dilemma',[30] which is that invertebrates and their ecological services remain largely unknown to the general public.

Introducing museum visitors to those of us working with invertebrates gives a human dimension to a specific exhibition. There are many, including myself, who have first-hand experience of species extinctions and conservation. We may have lived in a tropical forest for many months identifying bugs and trying to learn a little bit more about them and their behaviour. I can share memories of expeditions to places including Brazil, Nicaragua, Tanzania and Ghana, where it is believed 80 per cent of invertebrates are still undescribed, waiting to be discovered; or memories of a recent project concerning one of the largest spiders in Europe, the Desertas Wolf Spider (Fig. 10.2), which only lives in a small valley of a small islet close to the island of Madeira, and under small rocks.[31] Thanks to an initiative led by Madeira Natural Park and Bristol Zoo (where you can visit it), this spider, which was on the brink of extinction ten years ago, is now recovering both in its native habitat and in a number of zoos across Europe. To save it we have had to swim (not voluntarily), climb cliffs and sleep in the remotest of places while doing scientific work to support its recovery, using our knowledge and expertise. Fieldwork does not always involve remote areas, however, and it is equally possible that a scientist may have been collecting specimens in the fields or forests near your own home, without even being noticed. During an exhibition at the Finnish Museum of Natural History titled 'See spider researchers in action', myself, my colleagues and some of our students had the opportunity to talk about activities such as these to anyone willing to listen and find out more about our work. Our talks

Illustration 10.2 The Desertas Wolf Spider (*Hogna ingens*), a critically endangered species with an ongoing recovery project. © Pedro Cardoso.

included looking under the microscope at many of the spiders we had collected and researched.

Sensory experiences that allow us to perceive reality at an appropriate scale bring small invertebrates into our world, even if we must use technological aids to supplement the limitations of our senses. New technologies, such as robotics and virtual or augmented reality (VR and AR respectively), are still underused in museums. Given their capacity to emphasize what cannot be seen by the naked eye, or to allow the stimulation of multiple senses simultaneously,[32] VR and AR can potentially show us invertebrates in new ways, giving them a more human dimension and, through this, fostering greater empathy for their fate. A system could be envisioned, for instance, where a visitor to the museum would be embedded in the world as it is seen through the lens of an insect, with gigantic grasses and even more gigantic humans walking around. A game might be developed in which the goal would be to survive the many perils an invertebrate could face, from destruction of habitat (which might be someone's backyard) to pesticides and unbearable heat. Maybe that visitor/player would have to

help other insects to survive too, emphasizing the interconnection in an ecosystem. Through a judicious use of new tools and technologies, we can better grow empathy towards invertebrates, and thereby foster a collective will towards species preservation.

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Notes

1. Farrington, 'The Rise of Natural History Museums'.
2. Grinnell, 'Methods and Uses of a Research Museum'.
3. Wilson, 'The Little Things That Run the World'.
4. Shaffer, Fisher and Davidson, 'The Role of Natural History Collections'; Lister and Climate Change Research Group, 'Natural History Collections as Sources'.
5. Krishtalka and Humphrey, 'Can Natural History Museums Capture the Future?'
6. Miller et al., 'Evaluating the Conservation Mission'.
7. Wilson, 'The Little Things That Run the World'.
8. Solem, 'How Many Hawaiian Land Snail Species'.
9. Terzopoulou et al., 'Drivers of Extinction'.
10. Cardoso et al., 'Drivers of Diversity in Macaronesian Spiders'.
11. Gardiner, 'The Possible Cause of Extinction'.
12. Hallmann et al., 'More than 75 Percent'; Hallmann et al., 'Declining Abundance of Beetles'; Powney et al., 'Widespread Losses of Pollinating Insects'; Seibold et al., 'Arthropod Decline'; and many other studies.
13. Díaz et al., *Summary for Policymakers*.
14. Cardoso et al., 'Scientists' Warning to Humanity'; Samways et al., 'Solutions for Humanity'.
15. Cardoso et al., 'Scientists' Warning to Humanity'.
16. Foley et al., 'Global Consequences of Land Use'; Dirzo et al., 'Defaunation in the Anthropocene'; Habel, Samways and Schmitt, 'Mitigating the Precipitous Decline'.
17. Borges et al., 'Increase of Insular Exotic Arthropod Diversity'.
18. Dunn, 'Modern Insect Extinctions'; Dunn et al., 'The Sixth Mass Coextinction'.
19. Branco and Cardoso, 'An Expert-Based Assessment of Global Threats'; Milicic et al., 'Insect Threats and Conservation'.
20. Noriega et al., 'Research Trends in Ecosystem Services'.
21. Schowalter, Noriega and Tscharntke, 'Insect Effects on Ecosystem Services'.
22. Ratcliffe et al., 'Insect Natural Products and Processes'.

23. Schowalter, Noriega and Tscharntke, 'Insect Effects on Ecosystem Services'.
24. Cardoso et al., 'The Seven Impediments'; Mammola et al., 'Towards a Taxonomically Unbiased EU Biodiversity Strategy'.
25. Vetter, 'Spiders of the Genus *Loxosceles*'.
26. Sumner, Law and Cini, 'Why We Love Bees and Hate Wasps'.
27. Arroz et al., 'Bugs and Society I'.
28. Luomus is a contraction of *Luonnontieteellinen keskusmuseo* (Finnish Museum of Natural History). The museum is located in Helsinki.
29. Simaika and Samways, 'Insect Conservation Psychology'.
30. Cardoso et al., 'The Seven Impediments'.
31. Crespo et al., 'Assessing the Conservation Status'.
32. Rodrigues et al., 'An Initial Framework'.

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