

Biodiversity conservation and the extinction of experience

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Biodiversity loss is a matter of great concern among conservation scientists, but the wherewithal to reverse this trend is generally lacking. One reason is that nearly half of the world's people live in urban areas and are increasingly disconnected from nature. If there is to be broad-based public support for biodiversity conservation, the places where people live and work should be designed so as to provide opportunities for meaningful interactions with the natural world. Doing so has the potential not only to engender support for protecting native species, but also to enhance human well-being. Accomplishing these goals will necessitate conservation scientists forging new collaborations with design professionals, health practitioners and social scientists, as well as encouraging the participation of the general public.

Introduction

The magnitude of the current extinction crisis is widely appreciated in the scientific community, particularly among ecologists. The erosion of biodiversity is documented and potential strategies to reverse this trend are detailed in an ever-increasing number of journals and at the annual meetings of numerous professional societies. However, the wherewithal to reverse the degradation of our natural heritage in a meaningful way is still lacking. One reason for this is that conservationists have failed to convey the importance, wonder and relevance of biodiversity to the general public, preaching to the choir rather than reaching the unconverted [1,2].

This failure stems, in part, from the assumption that an 'educate-the-public' approach will be sufficient to motivate change [3]. Rather than fostering support for conservation, some forms of 'education' might have the opposite effect. Entrepreneur, environmentalist and author Paul Hawken observes that endlessly repeating the calculus of biotic impoverishment and the litany of environmental wrongs might eventually take on the ring of a 'the sky is falling' admonition, making the listener feel helpless or incredulous [4]. However compelling the evidence might appear to be, Hawken notes that fear of a future characterized by environmental degradation has rarely been an effective motivator [4].

Failure to engender broad-based support might also be a function of the estrangement of people from nature. This

possibility was driven home to me by an Australian radio report of the results of a survey of primary school children in Perth, many of whom were apparently unaware that milk is produced by cows and that the cotton in their clothes comes from plants. There are, of course, similar examples from other countries. In the USA, for instance, high-school students in Harris County, Texas, were given a multiple-choice test that comprised scaled black-line drawings of mammals that were either extant or historically present in the region, as well as basic questions regarding their natural history [5]. Results revealed that many students could not correctly identify common mammals with local distributions, incorrectly designated common species as extinct or never having existed in the area, and were generally ignorant about the relationship among urbanization, habitat loss and species declines [5]. The line that separates that which is deemed relevant by the public from that which is not is brought into sharp focus by the assertion that most Americans can identify hundreds of corporate logos, but fewer than ten native plant species [4], and that adolescents in south-central Los Angeles are more likely to identify correctly an automatic weapon by its report than they are a bird by its call [6].

Such examples suggest a widening gap between people and the natural world. As ecologist and author Robert Pyle points out [7], collective ignorance ultimately leads to collective indifference. To be successful in conserving biodiversity, the value and relevance of nature in the public mind must be made clear to raise awareness of the broader ecological realities that provide the context for human life. Here, I discuss some of the factors that have brought about this current state of affairs and then focus on the way forward. It is not my intention to argue that conservation biologists should abandon strategies aimed at protecting biodiversity or spend less time studying the ways that human activities impact native species. Rather, I suggest that more effort should be expended in making the natural world fundamental to people's lives.

The estrangement of people from nature

One factor responsible for the widening gap between humans and the natural world is straightforward; more people live in cities than ever before. Currently, >48% of people worldwide live in urban areas, a figure that is projected to exceed 60% by 2030 [8]. Some developed countries have already reached or exceeded this figure. In the USA, for example, half of the population lives in

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suburbs and an additional 30% live in urban centers [9]; nearly 90% of citizens of the UK live in cities [10]. More and more of us will soon live in highly modified, human-dominated environments where nature is too often considered expendable and the ecological processes that sustain us are hidden from view.

Urbanization has a homogenizing effect on biodiversity as native habitats are much reduced and relatively few species, often non-native, that thrive in human-dominated landscapes tend to predominate [11,12]. To make matters worse, the native species that remain in cities worldwide tend to be segregated from the neighborhoods where most human residents live [13]. Thus, a corollary of the exodus to urban areas is that most people encounter biological uniformity in their day-to-day lives. This serves as a constant reminder of the presumed unimportance of biodiversity among those designing and governing our metropolitan areas [14]. Expenditures on open spaces and greenways are too often viewed as a luxury, subordinated to more pressing socioeconomic concerns and typically the first items to be eliminated from municipal budgets.

The problem of biological impoverishment is compounded by the 'shifting baseline' syndrome [15], otherwise known as environmental generational amnesia [16,17]. The idea here is that the environment encountered during childhood becomes the baseline against which environmental degradation is measured later in life. The result is a continual ratcheting down of expectations regarding the quality and ecological function of natural areas closest to people's homes and workplaces.

The wedge between people and nature in human-dominated landscapes is driven deeper by another increasingly scarce resource, time. As the pace of life accelerates and time becomes commoditized, the rhythms of the human enterprise grow more and more distinct from those of the natural world [4,18]. This is true not only in the overscheduled lives of adults, but also of their children. Particularly in affluent societies, time spent out-of-doors by children tends to be structured in organized activities, which means that there is less time to explore on their own.

Even more problematic is the tendency for children to spend fewer hours outdoors and more time watching television or playing computer games. On a daily basis, the average child in the USA spends half the time outside (less than one hour) compared with just a few decades ago and watches more than four hours of television [19]. Such trends reflect the rise of virtual entertainment and more-sedentary lifestyles for people of all ages, with far-reaching consequences in terms of their mental and physical well-being.

Together, the factors described add up to what Pyle has termed the 'extinction of experience' [20,21]. He describes this phenomenon as a cycle of impoverishment that is initiated by the homogenization and reduction of local flora and fauna, followed by disaffection and apathy. This, in turn, begets more biologically depauperate environments and still deeper isolation from nature. If people no longer value nature or see it as relevant to their lives, will they be willing to invest in its protection?

Opportunities for reconnecting

Environmental psychologist Peter Kahn concludes that the genesis of estrangement from nature lies in childhood and it is there that we must begin to address the problem [17]. With increasingly mobile societies and the fragmentation of extended families, he warns that it is especially important to engage children in dialogues about elements of the natural environment that have been lost. He further suggests involving children in local conservation or restoration efforts.

Given the chance, a child will forge his or her own connections with the natural world if they are afforded appropriate places to do so. Formal parks and traditional playgrounds might be inadequate for this purpose [6]. Pyle [7] suggests that it is better to retain areas of undeveloped and unmanaged land, or 'second-hand lands and hand-me-down habitats', in urban settings if children are to realize their potential for self-teaching. Moreover, these areas must be located within a child's 'home range', easily reached on foot or by bicycle. Research indicates that children who play in wild environments show a greater affinity and appreciation for such places later in life [22]. However, as difficult as it is to retain a semblance of the wild in the face of development pressures, a greater challenge in many urban areas is to make these locations safe from adult predators without stifling playful exploration [7,23].

Even in the most developed areas, opportunities for contact with nature abound. A handful of city soil contains more biodiversity than is found on all the dead planets of the solar system [24] and ecological processes can be observed in a vacant lot, even though the players might lack the appeal of charismatic megafauna [25]. However, to engage a broad segment of the public might require natural areas with somewhat higher aesthetic and conservation value. Evidence shows that people who establish personal connections with natural areas are more highly motivated to protect such environments [26,27]. Fortunately, many cities retain substantial elements of biodiversity that are of relatively high quality, from patches of Atlantic rainforest in Rio de Janeiro [28] to bushland remnants in King's Park, Perth (Figure 1, [29]).

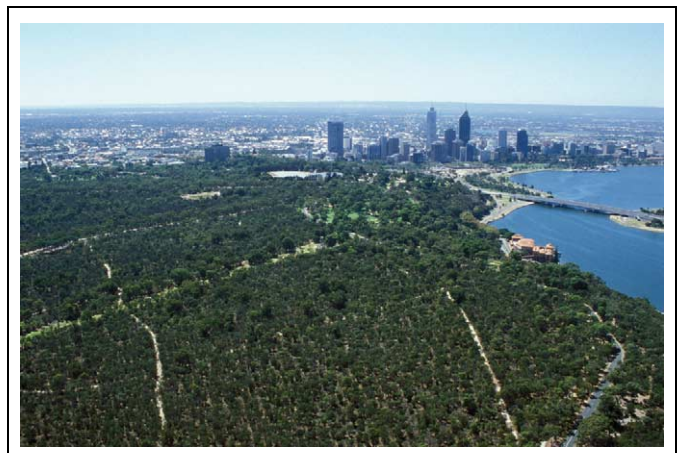


Figure 1. King's Park, Perth, Australia. The Park is located close to the city centre and covers ~430 ha, 300 of which consist of native vegetation (bushland). Reproduced with permission from Luke Sweedman.

Maintaining high-quality natural areas in urbanizing regions will require many municipal government officials to reassess their assumption that socioeconomic growth must be predicated on development and the loss of open space. In fact, individuals, families and businesses alike often choose to locate in cities and towns with abundant natural amenities [14].

Preserving or restoring biodiversity in metropolitan areas will also require greater commitment on the part of conservation scientists. A range of issues must be addressed that will not easily lend themselves to extrapolation from studies conducted in more remote locations [2]. For example, planners often assume that linear greenways designed primarily for recreational purposes also serve as habitat for native species. However, empirical evaluations, such as the research conducted on the park-connector network in Singapore [30,31], are needed to understand which species will benefit and which will not. Successful conservation in cities will not only require input from scientists, but also a high level of interaction with planners, land managers, policy-makers and the general public. An excellent example can be found in the Chicago metropolitan area, where the efforts of such a coalition have resulted in a remarkable array of protected lands, known collectively as the Chicago Wilderness (<http://www.chicagowilderness.org>; Box 1).

It is also essential that conservation scientists pursue other avenues to make biodiversity more viable and more visible in urban areas. Some estimate that more buildings and infrastructure will be constructed in the next 50 years than have been built throughout human history [32]. By engaging with those who design the places where we live

and work, ecologists can help to modify human habitats so that they also provide for wild species, a form of conservation biology that Michael Rosenzweig calls 'reconciliation ecology' (Box 2 [33,34]). Such efforts can improve prospects for biodiversity in the very places that have the greatest potential for reconnecting people to the natural world.

Urban nature conservation and human quality of life

Greater integration of nature and the built environment not only has the potential to foster support for preserving biodiversity and to create opportunities for native species, but also to better the human condition. Throughout recorded history, people have gone to great lengths to incorporate nature in urban environments, suggesting a belief that contact with elements of the natural world would contribute to their well-being [35]. Indeed, conservation strategies that emphasize quality-of-life enhancement might be more effective than appeals from environmentalists for altruism or self-sacrifice [36].

Regardless of whether the affinity of humans for nature has a genetic basis [24], there is mounting evidence that biophilic responses extend far beyond aesthetic preferences [37]. Research has shown that exposure to natural systems, even relatively simple ones, hastens recovery from stress [38]. Moreover, natural settings foster more complete and more rapid recuperation than does exposure to the built environment [39].

Physical or visual contact with nature is also thought to promote high-order cognitive functioning, enhancing observational skills and the ability to reason [37]. This makes sense when one considers that, as E.O. Wilson has

Box 1. The Chicago Wilderness

The Chicago metropolitan area is the third largest in North America, with a population of over nine million people, sprawling over 13 counties in three states (Illinois, Indiana and Wisconsin) and comprising just under two million ha [47]. It is also home to one of the great success stories in urban nature conservation.

The Chicago Wilderness (<http://www.chicagowilderness.org>) is a regional nature reserve of epic proportions, totaling > 250 000 ha. This figure is especially impressive when one considers the highly fragmented nature of the Midwestern USA, a function of habitat loss to urbanization and intensive agriculture. Protected lands located throughout the metropolitan area include some of the most extensive tallgrass prairies and oak savannas in the region, as well as a collection of wetlands, woodlands and aquatic habitats. This network includes globally significant natural communities that harbor nearly 200 threatened or endangered species. A coalition was formed in 1996 to oversee these properties and involves over 175 organizations, including the US Forest Service; National Park Service; US Fish and Wildlife Service; a variety of state, county and municipal agencies; non-governmental institutions, such as The Nature Conservancy (<http://www.tnc.org>) and the National Audubon Society (<http://www.audubon.org>); and several colleges and universities.

Many of the remnants in the Chicago Wilderness have been severely degraded since European settlement during the 19th century, but have served, in recent decades, as natural laboratories for developing techniques in ecological restoration. Much of this restoration work would not have been possible without the participation of volunteers (Figure 1). Indeed, one of the great strengths of this regional nature reserve is its large volunteer base. Member organizations have trained thousands of individuals to assist in restoration activities, resource inventories and monitoring. The educational and outreach programs



Figure 1. Volunteers restoring wetland vegetation along the Middle Fork of the North Branch of the Chicago River. Reproduced with permission from Will Fletcher.

have been invaluable in raising awareness of conservation issues and local biodiversity.

Given all of the above, it is not surprising that The Chicago Wilderness is nationally and internationally recognized for its contribution to the protection of native species. Moreover, the Biodiversity Recovery Plan of the coalition (<http://www.chicagowilderness.org/pubprod/brp/index.cfm>) serves as an excellent model for conservation in highly urbanized regions.

Box 2. Reconciliation ecology

Rosenzweig [33,34] has observed that nature reserves worldwide encompass <5% of the surface of the Earth and are unlikely to increase by a substantial amount. Even less land is available for ecological restoration. He therefore proposes that strategies based on reserves and restoration ecology be complemented by a new form of conservation science called 'reconciliation ecology' [33,34]. Here, the goal is not necessarily to produce a semblance of previously existing habitats, but rather to modify the places dedicated to human activities so as to provide for the needs of a wider variety of native species.

Rosenzweig offers several examples: avian habitats in the form of constructed ponds and meadows in Golden Gate Park in San Francisco, an ecologically friendly restaurant situated among coral reefs off the Israeli coast, the pine forests of Eglin Air Force Base in Florida, and the green rooftops of Berlin [34]. He also underscores the potential of reconciliation ecology to meet the habitat needs of species on the brink, such as the use of constructed ponds by the endangered natterjack toad *Bufo calamita* in the UK and the successful reproduction of endangered American crocodiles *Crocodylus acutus* in the cooling canals of a power plant in South Florida.

Reconciliation ecology is an appealing concept. It offers a framework for developing a wider focus in conservation that highlights the necessity of engaging a much larger group of stakeholders and moves beyond the dichotomy of pristine habitats and spoiled habitats. Achieving success will be, in many instances, a matter of trial and error as techniques gradually evolve. The green roofs of Berlin, for example, were primarily designed to increase energy efficiency; the City of Chicago has expanded this concept by varying the depth and structure of the substrate on the roof of its City Hall, and by incorporating greater plant diversity (including many natives), thereby supporting a much wider variety of invertebrate and bird species (Figure 1, [48]).

Many challenges still remain. Particularly vexing is the issue of habitat extent and connectivity in areas of high human density. The cooperation and coordination needed to make urban habitats functional is non-trivial for many native species, such as those with limited dispersal ability or large area requirements. Still, even in cities, much can be accomplished given appropriate conservation targets [49] and there is enormous potential for raising the public's awareness of biodiversity in the process.



Figure 1. An example of reconciliation ecology in action. The green roof atop City Hall in Chicago comprises 20 000 individual plants of >150 species over a 2000-m² area and has been colonized by a wide variety of native invertebrate and bird species. Reproduced with permission from Antonio Dickey.

noted [24], the natural world is the most information-rich environment that people will ever encounter. Of particular interest, there is an increasing body of research indicating that children's emotional and intellectual development, as well as value formation, are greatly enhanced by direct contact with nature in familiar settings, and that

vicarious or indirect experience are inadequate substitutes [40]. These observations lend credence to Kahn's assertion [17] that childhood is a logical starting point in the search for long-term solutions to species loss and habitat degradation.

The built environment has tremendous potential for improving human health, but it is largely untapped [41]. In realizing this potential, there is much opportunity to also improve conditions for biodiversity; doing so will require that conservation scientists recognize the synergies that exist between biodiversity, environmental degradation, human well-being, social cohesion and sense of place [42].

Conclusion

Landscape ecologists and conservation biologists alike have emphasized the vital role of habitat connectivity in maintaining viable populations of native species [43–46]. More attention must also be paid to restoring human connections with the natural world by affording the possibility of meaningful interaction with nature in close proximity to the places where people live and work. The same emphasis placed on spatial and temporal scale in conservation circles must also be extended to the scale of human experience. Ethnobotanist and author Gary Nabhan argues that the case for preserving biodiversity must be made more compelling and appealing to a wider audience [1]. To do this will require that conservation scientists participate in broad-based partnerships with planners, architects, health professionals, natural resource managers and local citizens. We need to explore ways to convey conservation principles in a manner that draws people together rather than fostering an attitude of confrontation. There must be opportunities for the public, young and old, to explore and apply these principles in a variety of contexts, both formal and informal. By engaging in dialogues with local policy-makers, ecologists can help to make such opportunities more widely available in the places where they live and work. The potential benefits for humans and wild species alike are too great to continue to ignore.

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References

- 1 Nabhan, G.P. (1995) The dangers of reductionism in biodiversity conservation. *Conserv. Biol.* 9, 479–481
- 2 Miller, J.R. and Hobbs, R.J. (2002) Conservation where people live and work. *Conserv. Biol.* 16, 330–337
- 3 Kaplan, R. *et al.* (1998) *With People in Mind: Design and Management of Everyday Nature*, Island Press
- 4 Hawken, P. (1993) *The Ecology of Commerce*, HarperCollins
- 5 Adams, C.E. *et al.* (1987) Urban high school students' knowledge of wildlife. In *Integrating Man and Nature in the Metropolitan Environment: Proceedings of a National Symposium on Urban Wildlife* (Adams, L.W. and Leedy, D.L., eds), pp. 83–86, National Institute for Urban Wildlife
- 6 Nabhan, G.P. and Trimble, S. (1994) *The Geography of Childhood*, Beacon Press
- 7 Pyle, R.M. (2002) Eden in a vacant lot: special places, species, and kids

- in the neighborhood of life. In *Children and Nature: Psychological, Sociocultural, and Evolutionary Investigations* (Kahn, P.H., Jr. and Kellert, S.R., eds), pp. 305–327, MIT Press
- 8 United Nations Population Division (2004) *Urban and Rural Areas 2003*, United Nations
 - 9 U.S. Census Bureau (2003) *Statistical Abstract of the United States*, U.S. Government Printing Office
 - 10 United Nations Population Division (2003) *World Population Prospects: The 2002 Revision*, United Nations
 - 11 McKinney, M.L. and Lockwood, J.L. (1999) Biotic homogenization: a few winners replacing many losers in the next mass extinction. *Trends Ecol. Evol.* 14, 450–453
 - 12 McKinney, M.L. (2002) Urbanization, biodiversity, and conservation. *Bioscience* 52, 883–890
 - 13 Turner, W.R. *et al.* (2004) Global urbanization and the separation of humans from nature. *Bioscience* 54, 585–590
 - 14 Kellert, S.R. (1996) *The Value of Life: Biological Diversity and Human Society*, Island Press
 - 15 Pauly, D. (1995) Anecdotes and the shifting baseline syndrome of fisheries. *Trends Ecol. Evol.* 10, 430
 - 16 Kahn, P.H., Jr. and Friedman, B. (1995) Environmental views and values of children in an inner-city black community. *Child Dev.* 66, 1403–1417
 - 17 Kahn, P.H., Jr. (2002) Children's affiliations with nature: structure, development, and the problem of environmental generational amnesia. In *Children and Nature: Psychological, Sociocultural, and Evolutionary Investigations* (Kahn, P.H., Jr. and Kellert, S.R., eds), pp. 93–116, MIT Press
 - 18 Gleick, J. (1999) *Faster: The Acceleration of Just About Everything*, Pantheon Books
 - 19 Orr, D.W. (2002) Political economy and the ecology of childhood. In *Children and Nature: Psychological, Sociocultural, and Evolutionary Investigations* (Kahn, P.H. and Kellert, S.R., eds), pp. 279–303, MIT Press
 - 20 Pyle, R.M. (1978) The extinction of experience. *Horticulture* 56, 64–67
 - 21 Pyle, R.M. (1993) *The Thunder Tree: Lessons From an Urban Wildland*, Houghton Mifflin
 - 22 Bixler, R.D. *et al.* (2002) Environmental socialization – quantitative tests of the childhood play hypothesis. *Environ. Behav.* 34, 795–818
 - 23 Luymes, D.T. and Tamminga, K. (1995) Integrating public safety and use into planning urban greenways. *Land. Urb. Plan.* 33, 391–400
 - 24 Wilson, E.O. (1984) *Biophilia*, Harvard University Press
 - 25 Leopold, A. (1949) *A Sand County Almanac*, Oxford University Press
 - 26 Schultz, P.W. (2000) Empathizing with nature: the effects of perspective taking on concern for environmental issues. *J. Soc. Issues* 56, 391–406
 - 27 Williams, K.J.H. and Cary, J. (2002) Landscape preferences, ecological quality, and biodiversity protection. *Environ. Behav.* 34, 257–274
 - 28 Monteiro, S. and Kaz, L. (1992) *The Atlantic Rainforest*, Edicoes Alumbamento
 - 29 Recher, H.F. and Serventy, D.L. (1991) Long term changes in the relative abundances of birds in Kings Park, Perth, Western Australia. *Conserv. Biol.* 5, 90–102
 - 30 Briffett, C. *et al.* (2000) The planning and ecology of green corridor networks in tropical urban settlements: a case study. In *Nature Conservation 5: Managing the Matrix* (Craig, J. *et al.*, eds), pp. 411–426, Surrey Beatty and Sons
 - 31 Sodhi, N.S. *et al.* (1999) Bird use of linear areas of a tropical city: implications for park connector design and management. *Land. Urb. Plan.* 45, 123–130
 - 32 Orr, D.W. (2002) *The Nature of Design: Ecology, Culture, and Human Intention*, Oxford University Press
 - 33 Rosenzweig, M.L. (2001) Loss of speciation rate will impoverish future diversity. *Proc. Natl. Acad. Sci. U. S. A.* 98, 5403–5410
 - 34 Rosenzweig, M.L. (2003) *Win-Win Ecology: How the Earth's Species Can Survive in the Midst of the Human Enterprise*, Oxford University Press
 - 35 Shepard, P. (1967) *Man in the Landscape*, Knopf
 - 36 Kaplan, S. (2000) Human nature and environmentally responsible behavior. *J. Soc. Issues* 56, 491–508
 - 37 Ulrich, R.S. (1993) Biophilia, biophobia, and natural landscapes. In *The Biophilia Hypothesis* (Kellert, S.R. and Wilson, E.O., eds), pp. 74–137, Island Press
 - 38 Kaplan, R. and Kaplan, S. (1989) *The Experience of Nature: A Psychological Perspective*, Cambridge University Press
 - 39 Ulrich, R.S. *et al.* (1991) Stress recovery during exposure to natural and urban environments. *Environ. Psychol.* 11, 201–230
 - 40 Kellert, S.R. (2002) Experiencing nature: affective, cognitive, and evaluative development in children. In *Children and Nature: Psychological, Sociocultural, and Evolutionary Investigations* (Kahn, P.H. and Kellert, S.R., eds), pp. 117–151, MIT Press
 - 41 Jackson, L.E. (2003) The relationship of urban design to human health and condition. *Land. Urb. Plan.* 64, 191–200
 - 42 Horwitz, P. *et al.* (2001) Biodiversity, endemism, sense of place, and public health: inter-relationships for Australian inland aquatic systems. *Ecosyst. Health* 7, 253–265
 - 43 Fahrig, L. and Merriam, G. (1985) Habitat patch connectivity and population survival. *Ecology* 66, 1762–1768
 - 44 Hansson, L. and Angelstam, P. (1991) Landscape ecology as a theoretical basis for nature conservation. *Lands. Ecol.* 5, 191–201
 - 45 Tewksbury, J.J. *et al.* (2002) Corridors affect plants, animals, and their interactions in fragmented landscapes. *Proc. Natl. Acad. Sci. U. S. A.* 99, 12923–12926
 - 46 Wiens, J.A. (1997) The emerging role of patchiness in conservation biology. In *The Ecological Basis of Conservation* (Pickett, S.T.A. *et al.*, eds), pp. 93–107, Chapman & Hall
 - 47 Openlands Project (1999) *Under Pressure: Land Consumption in the Chicago Region, 1998–2028*, Openlands Project
 - 48 Millett, K. (2004) Birds on a cool green roof. *Chicago Wilderness* 7, 6–9
 - 49 Gaston, K.J. *et al.* (2005) Urban domestic gardens (II): experimental tests of methods for increasing biodiversity. *Biodiv. Conserv.* 14, 395–413