

Chapter 2

An Historical Perspective of Ecological Hybridisation

Understanding human and environmental history is at the heart of an awareness of recombinant ecology. Unfortunately, since academics often work in disciplinary silos and many rarely step beyond the comfort zone of their core field, the connections and resulting conclusions are frequently missed. It is therefore necessary and helpful in this second chapter, to explore the roles of history in the making of ecology.

The concept of ‘ecological hybridisation’ or ‘eco-fusion’ is useful, and this chapter draws examples of the hybrid nature of much ecology occurring ‘naturally’ but often conveniently ignored or overlooked. Ecological hybridisation is taken to include species-level genetic hybrids but importantly too, the mixing of native and exotic in novel communities and ecosystems. In this emerging concept, these ideas are embedded in a longer-term view of the evolution and agricultural and forestry systems, and the impacts that these have had on landscapes and ecology. Plant collectors, gardeners, acclimatisation societies, and horticulturalists, particularly during the nineteenth century, took species into cultivation and deliberately hybridised species, and mixed and hybridised ecologies from around the world. These processes are explained with key examples. Stace et al. (2015), in their ‘Hybrid Flora of the British Isles’ detailed many of the hybrid outcomes of deliberate or accidental cross-fertilisations of plants, both native and exotic.

The garden examples include the so-called ‘wild rhododendron’, which is in fact a mix in varying proportions of the European *Rhododendron ponticum*, and the American *R. maximum* and *R. catawbiense*. The result is a highly adaptable and invasive hybrid. Other deliberate hybrids include the invader, montbretia, *Crocsmia x crocosmifolia*, a deliberate hybrid of *Crocsmia aurea* and *Crocsmia pottsii*. Variegated yellow archangel, *Lamium galeobdolon* var *argentatum*, is probably a naturally occurring hybrid through a doubling of its parental genes, but cultivated by Victorian gardeners for its striking variegated foliage.

However, the wider context of this issue is that many native ‘species’ in Britain are in fact largely hybrids or hybrid swarms, for example, the English oak and the Sessile oak occur as hybrid swarms of *Quercus petraea* x *robur*, in many

woodlands. This is complicated further by a significant proportion of the genes originating from European, especially Dutch stock in the 1700s and 1800s, and presenting quite distinctive phenotypes. In wet woods and moors, most willows, *Salix* sp. are hybrid complexes, and in wet grasslands, the marsh orchids form complex swarms of inter-breeding hybrids from a number of possible parents. This simply suggests that ‘nature’ is not as pure as it is often portrayed (see Stace et al. 2015 for a detailed account).

The Cultural Facilitation of Ecological Invasion

Throughout history, people have interacted with nature to modify and sometimes destroy environmental resources (Rackham 1986; Rotherham 2013a, 2014a). Human management has generated identifiable and distinctive ‘cultural’ landscapes, as fusions of natural and anthropogenic elements. Furthermore, many of these eco-cultural landscapes have been managed with customary and traditional mechanisms (e.g. Rotherham 2013b). In a pre-petrochemical age, such management created traditional landscapes frequently made up of diverse, species-rich habitats and maintained by long-established land-use applied continually over the years. It is argued (Rotherham 2014a), that such traditional, ‘unimproved’ lands provided habitats for biodiversity with direct links to habitat analogues in the ancient, primeval, ‘natural’ European landscape (Rotherham 2009b, 2013b, 2014a), the vision of Vera (2000). I suggest that the complex inter-relationships and ecologies of, for example, species-rich limestone grasslands, fens, peatlands, and ancient woods, result from such long-standing human-nature interactions and they are analogues of the ecological communities of the primeval landscape. This approach fits well with the ideas of Rackham (1980, 1986) for example. Furthermore, it is helpful to have these concepts in mind when we seek to understand the significance of recombination through time.

The human influences in these ecosystems include the hybridisation of species and ecology, through ‘eco-fusion’. This is most readily recognised in the world’s increasingly urban environments, but it clearly occurs more widely. Furthermore, whilst recombination as a process has only been recognised in recent decades, it has occurred on varying scales since humans first influenced the landscape. Today, huge areas of land are dominated by forestry and agriculture, and in these imposed environments plants, animals, and fungi move and mix beyond natural distributions and limits. This means that old, new, native, and exotic, are intertwined in novel, recombinant communities in hybrid ecosystems. Particularly now, in the rapidly expanding urban heartlands, this new ecology, of native and alien, is locked in a perpetual and dynamic struggle for dominance with the resulting formation of novel dependencies, interactions, and communities (Rotherham 2014a; Gilbert 1989, 1992a). Recognition of these processes and their consequences challenges many current debates in conservation ecology, particularly in relation to debates on alien species. The approach generates new paradigms and matters of perceptions,

**But the processes are not new – we can see them in
landscape-scale changes over centuries**

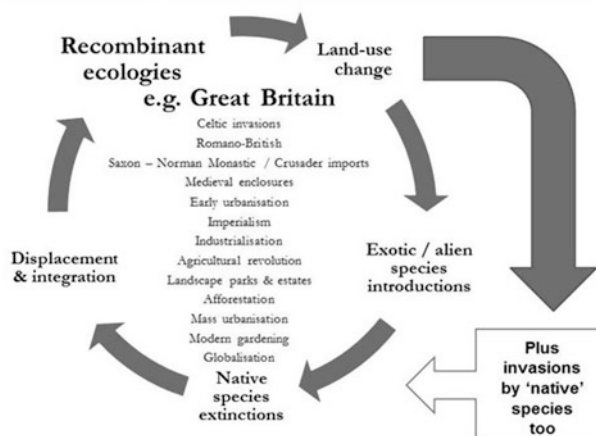


Fig. 2.1 The flow of recombinate ecology

judgements, and actions. These ideas of recombinate, hybrid ecologies and eco-fusion processes are new, and they have significant implications for future ecologies. Indeed, for discussions on ideas of ‘wilding’ and ‘re-wilding’, ecological fusion and hybrid ecology, are vital conceptual frameworks for debates on future landscapes and ecologies (Rotherham 2014a, b; Prins and Gordon 2014; Taylor 2005). The results of ‘re-wilding’ landscapes on a large scale (e.g. Monbiot 2013a; Taylor 2005; Carver 2014), will be determined by such processes acting within the contemporary environmental matrix. These areas will not reproduce some golden age past ecology, but reflecting their histories they will generate ‘futurescapes’ with novel hybrid ecologies. In the current debates on future ‘wild’ landscapes, these outcomes are neither recognised nor considered.

This historical precedence drives future change and is not new. Recombination has been a fundamental process driving and forging ecological systems for thousands of years; only today, its impacts are becoming more dominant, more obvious, and more rapid (Fig. 2.1).

Hybrid Ecologies

Over centuries, non-native, introduced species have altered landscapes and indigenous ecologies (Gilbert 1989; Rackham 1986; Rotherham and Lambert 2011a, b; Rotherham 2014a, b). Furthermore, these changes, such as by the rabbit introduced by the Normans to Britain, may be the fundamental determinants and keystone species in modern-day ecology. However, trends and changes need to be

assessed in the wider context of fluxing climate, land-use, and other human-nature interactions. A brief consideration of British landscapes shows there is little genuinely pure ‘natural’ or ‘native’. As noted earlier, most of our environment is dominated by ‘cultural’ or ‘eco-cultural’ landscapes and their ecological communities (Rotherham 2007, 2008a, 2009b, 2011, 2014a). This ecology results from centuries of interactions between people and nature, sometimes with ‘semi-natural’ components and some with regionally distinctive traditional countryside. However, significant proportions of today’s landscapes are highly modified; large areas of British farmland for example, are of modern origins and ecologically highly exotic in their make-up.

Whilst natural changes are influential, people are at the core, directly or indirectly, of most biological invasions (Johnson 2010; Rotherham and Lambert 2011b). There are two particular examples of invasion and fusion witnessed in Great Britain and which confirm the human component of the human-nature influence. The first example is the deliberate introduction of plants and animals around the recently discovered world, by the Victorian Acclimatisation Societies. The second example is the often-overlooked, case of the Victorian Wild Garden Movement (Rotherham 2005a, b, 2014a; Rotherham and Lambert 2011a, b). In these two nineteenth-century phenomena, we see the germ of many of contemporary issues and challenges for modern nature conservation and land management. There is also an interesting twist in terms of the changing perceptions, attitudes, and politics in relation to nature and the exotic. This is often overlooked, but hugely influential from the early nineteenth century to the early twenty-first century. Davis et al. (2001) wrote of how British attitudes to exotic species changed with the seminal writings and broadcasts of Charles Elton. However, despite this, the more general and pervading influences of fashion and taste with regard to exotic species have been ignored. Indeed, the often critical roles of accidental or even deliberate introductions of now invasive species have been overlooked (see Rotherham 2001, 2005a, b, 2011) or not recognised.

Human cultural facilitation of invasions is very significant. Furthermore, perceptions and attitudes have influenced both the processes and the responses (e.g. Rotherham and Lambert 2011b). However, the research in this field is often lacking since the work inherently crosses the boundaries of ecological science and of history into a less well-trodden path of interdisciplinary study. Additionally, it is obvious that many if not most of the ecological invasions of the twentieth, and twenty-first centuries in Britain were culturally facilitated (e.g. Rotherham 2001, 2005a, b, 2009a; Rotherham and Lambert 2011b).

Furthermore, the problems associated with aggressive and invasive plants and animals are not new (consider for example, the spread of both black rats and brown rats, and their impacts on people and landscapes). Yet, the scale of impact, now combined with rapid climate change and other environmental influences, is spectacular. It is suggested that 15% of Europe’s 11,000 exotic species combine to generate environmental and economic damage valued at £2 bn *per annum* to the UK economy. However, behind the often-torrid newspaper headlines remain key questions about what is native and where, what is alien, and when. This applies

from Spanish bluebells, to eagle owls, Canada geese, ruddy ducks, ring-necked parakeets, Japanese knotweed, Himalayan balsam, to feral big cats, beavers and signal crayfish, and wild boar. With all these new arrivals, which ones get a '*free pass*' to be part of a new hybrid future and which do not (Rotherham 2009a, 2014b, 2016; Rotherham and Lambert 2011b)?

Examples of the Historic Cultural Drivers of Recombination

Considering the importance of history in ecological recombination, it is useful to consider very briefly some examples of the process at work.

Agriculture: Since people first settled in permanent farming communities, they have changed the landscape, the soil, the drainage, and the ecology. Furthermore, they cleared land, burnt vegetation, cultivated crops, which they modified by careful breeding and selection, and they domesticated animals that they bred into domesticated stock. These activities in turn transformed the environmental conditions and the landscape, and some species either escaped back into the wild or interbred with wild species. As humans then moved around the world, from the earliest times, they took with them their domesticated associated as a variety of other 'hangers-on' to be established into new terrain. Increasingly, especially from the Bronze Age onwards, people changed nature and this challenges many concepts of what is 'natural', 'native' or 'indigenous'. When you decide to 'stop the clock' becomes rather significant, since people have been mixing the species and genetic pools for countless centuries. Clearly, these impacts have grown exponentially in recent times, but the processes are ancient.

Forestry: It is important to distinguish between traditional 'woodland management' which has gone on in various forms, certainly since Roman times, but probably to some extent from much earlier still, and forestry. The latter was an invention of the French and German land managers in particular, and began in earnest during the 1700s and 1800s. This is 'high forestry' to produce 'timber' rather than the various forms of 'coppice' and 'coppice-with-standards' that applied traditional techniques to produce both 'wood' and 'timber'. As forestry developed, the approach was exported around the globe by Western European imperial powers. However, this was not one-way traffic since in return the imperial foresters brought back new species of trees to populate their high forest plantations. From the period around the late 1700s to the late 1900s, vast areas of Britain's heaths, moors, bogs, royal forests, and woods, were planted or converted to high forest with exotic species. Many areas were to be dominated by alien conifers, but others by broad-leaves such as sycamore, beech, and imported European oaks. The results today are large areas transformed in terms of landscapes, soils, and ecology, and many of the exotic trees now freely seeding themselves across the wider landscape. Of course,

as these often monocultures of alien trees have grown, one by one diseases and pests that thrive in the dense, single-species colonies have followed them.

With radically altered soils and light conditions, the associated ecologies have developed character and distinction, with many native birds, mammals and invertebrates now particularly associated with these exotic habitats. Some flowering plants and numerous fungi have strong associations with long-established conifer plantations.

Not all forestry and tree planting with exotic species was commercially driven, and major landowners, both public and private, undertook much establishment for reasons of ‘landscape improvement’ and beautification.

Wetland drainage: As described for the Yorkshire region and for the whole of the east of England lowlands (Rotherham 2010, 2013a), widespread land drainage since Roman times, but especially since the medieval, has transformed vast areas. Entire landscapes, particularly of lowland wet woodland, of riverine forest, of lowland fen, marsh and wet heath and bog, have been entirely removed. In their place, we have the modern farming landscapes and especially intensive arable prairies. Whilst some vestiges of the native fauna and flora may hold out in small areas, and especially in nature reserves, this transformation is mostly complete with over huge areas landscapes dominated by alien, hybrid or intensively bred crops. Whilst roadside verges for example, in some areas hold remnants of native communities from the medieval landscape, many are populated by invasive aliens, by highly competitive natives, and by opportunistic species such as roadside halophytes spreading from native saltmarshes inland along linear corridors because of road-salt pollution. Even the linear waterways of field drains and ditches or the larger canals, will have a mix of native and exotic waterweeds, and the alien brown rat will rub shoulders with native water voles. Within the arable fields, ‘weed’ species both native and long-term aliens formerly did very well. However, adversely affected by modern farming methods and especially herbicides, the diversity of native and archaeophyte arable weeds has collapsed. Today’s arable fields do still support floras of weed flowers and associated invertebrates and birds, but again a recombinant mix of natives and aliens.

Urban development: The development of urban centres has happened around the world for thousands of years. However, it was only in the early twenty-first century that humans became predominantly ‘urban’ with over half the global population now in towns and cities. Where urban settlement occurs, the landscape and its ecologies are transformed. Furthermore, towns and cities act as growth-poles for recombinant ecology as species and people intertwine in a melting pot of urban sprawl and human impacts. Urban development draws into itself people and resources such as animals, plants, and the products from both. People establish gardens and parks with exotic species of plants but often of animal too. The impacts of towns and cities rebound back into the wider environment as pollution as a naturalising fauna and flora.

Additionally, towns and cities change the local environment and particularly the local microclimate, which may trigger potential establishment and invasion by exotic species. This can range from alien ants in buildings, to parakeets in gardens,

and Mediterranean figs along watercourses. The urban impact may also create opportunities for invasion by removing established natives and creating vacant or new niches for exotic fauna and flora. The urban footprint extends out beyond the town or city as exploitation of the hinterland triggers transformations of the wider landscape to support the expanding communities. Into this extensive landscape, exotic species such as Himalayan balsam, Japanese knotweed and others, find abundant opportunities.

Trade: A major part of the processes of human colonisation and urbanisation is trade in goods, products, and species – both plants and animals. Not only did people move species with them, but also as Europeans for example, discovered new worlds, they traded and brought back exotic plants and animals from around the planet. Many of these imports perished but some survived, and others did remarkably well to become familiar, often invasive species today. These processes continue today, accelerating as the fashion for gardening has become a national obsession in Britain. New and exotic plants are imported and sold on into gardens via gardening retail outlets and many of these can leap the garden fence. The numbers that actually establish and survive in the ‘wild’ are limited but with climate change and other environmental perturbations, they are growing. Over time, many of these invaders, such as the medieval imports like snowdrop and sweet cicely for example, tend to settle into the native ecology and to become accepted as ‘honorary natives’.

Throughout history, many species of both animals and plants have travelled as unofficial baggage alongside trade to become naturalised into our established ecologies. Some of these, like both black rat and then brown rat, have had profound impacts on both people and native ecology. Specific weed species are associated with for example, cotton cargoes imported from North America, though these are frequently limited in occurrence. Unseen fauna brought in with exotic plants for glasshouse and garden collections, include the micro-arthropod springtails or collembolan. Some species from as far away as New Zealand and Australia can now be found in horticultural collections and spreading into the wider landscape. They are joined by a range of exotic fungi and other taxa, many largely unseen and unnoticed, unless like the New Zealand flatworm they achieve a higher public awareness and profile.

Human migration and colonisation: Finally, one of the major triggers of ecological recombination throughout history has been the movement of people and cultures across the landscape and around the planet. This process continues today but in Britain, probably began in earnest with the arrival of European settlers the Celts. They changed the way that the land looked though farming impacts and technological innovations, and they brought crops, weeds and animals like the brown hare and fallow deer for example, with them. Each wave of colonists since then has marked their arrival with a diversity of new species and ways of using the land that have merged into what was ‘natural’ as the long-term process of ecological recombination has played out. We can see ecological markers in the landscape of these various waves of cultural integration from the Roman and later Norman introductions of brown hares, of fallow deer, and then the monastic and

crusader importations, to the black rat and bubonic plague. Each arrived, established, transformed and merged into the national ecology. The more recent impacts of gardening and of forestry are simply modern manifestations of this established process.

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Photograph: Massive flower-heads of giant hogweed are another Victorian garden import, this time from the Caucasus

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