WILDING

RETURNING NATURE TO OUR FARM

ISABELLA TREE

INTRODUCTION BY ERIC SCHLOSSER

In a story that is part personal memoir, part work of conservation, Tree reveals the capacity of the wild to reclaim the land—as long as humans step out of the way.

—Smithsonian

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Introduction to the American Edition

Lately the news about our relationship with nature has been grim and apocalyptic. Despite years of activism against climate change, the emission of greenhouse gases has roughly doubled since 1980. The level of carbon dioxide in the earth's atmosphere is higher today than it's been in about 3 million years, long before humans existed. The permafrost in Greenland is melting, the Antarctic ice shelf is cracking, and last winter snow fell in Las Vegas three times within one month. A recent United Nations report estimates that one million plant and animal species are now at risk of extinction—in part, because about 600 to 800 billion pounds of "heavy metals, solvents, toxic sludge, and other industrial wastes" are being dumped into seas, rivers, and lakes every year. Those numbers, although extraordinary, are dwarfed by the amount of trash that's already been dumped into the water. Perhaps 5 trillion pieces of plastic now float on the surface of the oceans, and a vast, unknown quantity has sunk to the bottom. A study this year of six deep ocean trenches in the Pacific discovered that 72 percent of the amphipods—tiny sea creatures that look like shrimp—had ingested microparticles of plastic. During an exploration of the Mariana Trench, at a depth of about 36,000 feet, almost seven miles beneath the surface, a submersible found candy wrappers and a plastic bag.

This book is a strong antidote to all the doom and gloom. For almost two decades, Isabella Tree and her husband, Charles Burrell, have been reversing the environmental harm

imposed on their land in England. They have worked hard at finding ways to let nature reclaim an authority abused for generations by hunters, farmers, and pastoralists. The English have long celebrated the countryside and the simple pleasures of rural life. They love to garden and to watch television shows about gardening. But as Tree reveals, the English countryside has been transformed since the end of the Second World War, without much protest or debate. Large-scale industrial agriculture and all it entails—the use of chemical pesticides and fertilizers, a reliance on monocultures, the need for highly mechanized equipment, an increase in farm size, a vulnerability to worldwide commodity prices, and dependence on government subsidies—have literally changed everything. The land looks different from how it appeared for centuries. The mix of plants and animals living upon it is different. And the amount of biodiversity, the amount of unfettered and uncontrolled wildness, has dwindled to insignificance.

The rewilding of Knepp Castle Estate suggests that all is not lost. By defying conventional opinion and local prejudice, Tree and Burrell have turned a failing industrial farm into an oasis of bats, birds, insects, trees, wildlife, and wildflowers, right beneath the flight path of Gatwick Airport. They have demonstrated what is still possible—and how swiftly it can be achieved. The Knepp estate isn't a model that every landowner can follow. Some land must be cultivated; people need to eat. But the principles that have been applied to the restoration of a few thousand acres in West Sussex must also be adopted in agriculture. The current industrial methods are not sustainable. Instead of attempting to conquer nature with chemicals and machines, we should acknowledge the complexity of ecosystems and work within them. Agricultural practices that are regenerative and organic improve the soil, produce healthier food, ensure biodiversity, and help to reverse global warming. They succeed by revering, not exploiting, nature.

The United States has preserved enormous tracts of wilderness, and most Americans feel a strong commitment to their

national parks. The lessons of *Wilding* may seem unnecessary here. And yet the United States has been largely responsible for the mentality driving climate change and mass extinctions. It is a mind-set that worships technology and a narrow measure of efficiency, that regards land as a commodity and livestock as units of production, that focuses only on the short term and cares most of all about profit. American attitudes toward nature are profoundly contradictory. Wolves have been restored to Yellowstone, bison are returning to the Great Plains, and the bald eagle is no longer at risk of becoming extinct. But American farmers apply about a billion pounds of pesticide to their land every year, with all sorts of unintended consequences.

Raindrops in the Midwest now contain glyphosate, one of the most widely used herbicides, the crucial ingredient in the weed killer Roundup—and a potential carcinogen. The same antibiotics and fungicides prescribed to cure human diseases are now being employed in American agriculture on a massive scale, threatening their effectiveness. Dangerous fungi and bacteria are developing resistance to them. This year about 650,000 pounds of streptomycin will be sprayed on citrus crops in the United States, despite strong opposition from the Centers for Disease Control and Prevention. Streptomycin is one of the World Health Organization's "essential medicines," an antibiotic used to treat tuberculosis, rat-bite fever, and bubonic plague. Its efficacy in preventing citrus blight remains unproven. This is madness.

My favorite books on nature reveal something new about our relationship to it. In the wildlife chapters of *Mutual Aid* (1902), Peter Kropotkin observes the importance of cooperation within species, challenging the social Darwinism of his age and the prevailing faith in ruthless competition. Aldo Leopold's *A Sand County Almanac* (1949) stresses the necessity of wilderness for its own sake and the need for humility when tampering with things. *Desert Solitaire* (1968), by Edward Abbey, champions the absence of people and urges radical defiance of those

who despoil nature, while Wendell Berry's *The Unsettling of America* (1977) offers a more nuanced view of how culture and agriculture can find harmony. Each of these authors, inspired by a unique setting—the steppes of Siberia; rural Wisconsin; the desert of southern Utah; a small farm in Henry County, Kentucky—finds the universal in memorable, specific details. "If we are to be properly humble in our use of the world," Berry writes, "we need places that we do not use at all."

Wilding is a beautiful and important book. The descriptions of turtledoves and their near-extinction, the elaborate ecosystem sustained by an old oak tree, the importance of the lowly dung beetle, among other passages, vividly bring its larger themes to life. The poetic and the scientific are inextricable in these pages. The idea of "natural capital" has become increasingly popular, assigning a monetary value to things like forests, clean air, and coral reefs. There is a powerful, essential logic to making markets work more constructively and forcing corporations to assume the true costs of their behavior. But I instinctively rebel against the notion that everything has a dollar value. When I am in nature, that belief system seems irrelevant. The wild must be commonplace again, cherished again, not just sequestered in parks. No less than our survival is at stake. What we need most at the moment are two intangible, invaluable things that this book provides: hope and the willingness to act upon it.

—ERIC SCHLOSSER

Timeline

12th century	William de Braose (1144–1211), lord of the Rape of Bramber, builds the motte and bailey keep, now known as Old Knepp Castle.
1206–15	King John visits Knepp on several occasions to hunt fallow deer and wild boar.
1573–1752	Knepp Estate owned by the Caryll family, Sussex ironmasters.
1787	Sir Charles Raymond buys the Knepp estate and gives it to his daughter Sophia and son-in-law William Burrell.
1809–12	Sir Charles Merrik Burrell commissions John Nash to design Knepp Castle with a park in the style of Humphry Repton.
1939–45	Knepp Castle, requisitioned by the War Office, becomes HQ of the Canadian Infantry and Armoured Divisions during the Second World War.
1941–43	Widespread clearance of scrub and ploughing of permanent pasture at Knepp, including the Repton park, as part of the Second World War's 'Dig for Victory' campaign.
1947	Clement Atlee's government passes the Agriculture Act guaranteeing fixed market prices for farm produce in the UK in perpetuity.
1973	The UK joins the EEC and converts to farming subsidies under the Common Agricultural Policy (CAP).

1987	The author's husband, Charlie Burrell, inherits Knepp Estate from his grandparents. The farm is already losing money.
1987–99	Intensification of the farm, including amalgamating dairies, improving infrastructure, and diversifying into ice-cream, yoghurt and sheep's milk, fails to deliver profits.
2000	Sale of dairy herds and farm machinery; arable fields put out to contract.
2001	Restoration of the Repton park, with funding from Countryside Stewardship.
2002	*February* – Introduction of fallow deer from Petworth House to the restored Repton park. *December* – Charlie sends the Department for Environment, Food and Rural Affairs (DEFRA) a 'letter of intent to establish a biodiverse wilderness area in the Low Weald of Sussex'.
2003	First visit by scientists from English Nature to consider rewilding at Knepp. *June* – Introduction of twenty Old English longhorns to the Repton park. *June* – CAP reform, based on decoupled aid, allows farmers to take land out of production while still receiving subsidies, thus allowing Knepp to come out of conventional farming.
2003–6	The Southern Block of the Knepp Estate is left fallow, beginning with the worst fields and leaving the most productive fields to last.
2003	*August* – Neighbouring farmers and landowners invited to 'A Wild Wood Day' at Knepp, in an attempt to encourage them to support and/or join the rewilding project. *November* – Introduction of six Exmoor ponies to the Repton park.

2004 Countryside Stewardship funds extension of the park restoration to the 'Middle' and 'Northern Blocks'; boundary fences around the Middle and Northern Blocks erected.

July – Twenty-three old English longhorns introduced into the Northern Block.

December – Introduction of two Tamworth sows and eight piglets to the Middle Block.

2005 *July* – Duncan, an Exmoor colt, introduced to the Middle Block.

2006 *January* – 'An Holistic Management Plan for a naturalistic grazing project on the Knepp Castle Estate' drawn up for Natural England.

May – Inaugural meeting of Knepp Wildland Advisory Board.

2007 *Summer* – First turtle doves recorded at Knepp.

2008 The 1.5-mile River Adur restoration project at Knepp gets the go-ahead from the Environment Agency after eight years of consultations and feasibility studies.

February – Natural England scientists advise that Knepp is unlikely to receive backing for the foreseeable future.

June – Andrew Wood, founder of the Higher Level Stewardship agri-environment scheme, visits Knepp.

2009 Knepp receives notice of Higher Level Stewardship (HLS) funding for the whole estate (to start on 1 January 2010), so now the Southern Block, too, can be ring-fenced for free-roaming animals.

March – A nine-mile perimeter fence is built around the Southern Block.

March – First ravens nest at Knepp.

May – A mass migration of 11 million painted lady

butterflies from Africa descends on Britain; at Knepp, tens of thousands are attracted by an outbreak of creeping thistle.

May – Fifty-three longhorn cattle introduced into the Southern Block.

August – Twenty-three Exmoor ponies introduced into the Southern Block.

September – Twenty Tamworth pigs introduced into the Southern Block.

Scrapes created along three kilometres of River Adur tributary floodplains.

Five-year monitoring survey reveals astonishing wildlife successes, including breeding skylarks, woodlarks, jack snipe, ravens, redwings, fieldfares and lesser redpolls; thirteen out of the UK's seventeen bat species, and sixty invertebrate species of conservation importance, including the rare purple emperor butterfly.

2010 *February* – Forty-two fallow deer introduced into the Southern Block.

July – Beaver Advisory Committee for England set up, with Charlie as Chair.

Sir John Lawton's review *Making Space for Nature* submitted to government, with recommendations for 'more, bigger, better and joined up' areas of nature in Britain.

2012 A survey by Imperial College London identifies thirty-four nightingale territories at Knepp (from none in 2002), making it one of the most significant sites in the UK for this critically endangered bird.

2013 *April* – Red deer introduced to the Middle and Southern Blocks.

State of Nature report charting the continued cataclysmic decline of British species.

four hundred species identified in three transects at Knepp over one recording weekend, including thirteen birds on the International Union for Conservation of Nature (IUCN) Red List and nineteen on the Amber List; and several extremely rare butterflies and plants.

Studies by Imperial College identify nineteen species of earthworm at Knepp, indicating a marked improvement in soil structure and function compared with neighbouring farms.

2014 'Knepp Wildland' campsite and safari business opens.

Summer – Eleven male turtle doves recorded; first sightings of short-eared and long-eared owls. Knepp now has all five UK species of owl.

2015 Charlie becomes Chair of Rewilding Britain.

March – Official release of beavers into the River Otter in Devon—the first reintroduction of an extinct mammal in England.

July – Knepp is now the site of the UK's largest breeding population of purple emperor butterflies.

Knepp receives People. Environment. Achievement. Award for Nature (P.E.A.).

Knepp receives 2015 Innovative and Novel Project Award at the UK River Prize for the River Adur restoration project.

The United Nations Food and Agriculture Organisation warns that the world's agricultural land has only sixty harvests left, so depleted are its soils.

2015–16 Dave Goulson of Sussex University records sixty-two species of bee and thirty species of wasp at Knepp, including seven bee and four wasp species of national conservation importance.

2016 *December* – Thirty-four white storks from Poland

are introduced into a holding pen in the Southern Block as part of a joint project with Cotswold Wildlife Park, the Durrell Foundation, the Roy Denis Foundation and two other landowners in the southeast to reintroduce white storks to Britain after an absence of hundreds of years.

2017 *Summer* – Sixteen male turtle doves recorded; peregrine falcons nest in a Scots pine; a red-backed shrike sets up a territory at Knepp for several weeks.

Knepp receives the Anders Wall Environment Award for contribution to creating a 'positive rural environment' in the European Union.

2018 *January* – Knepp Estate is singled out in DEFRA's 25 Year Environment Plan as an outstanding example of 'landscape-scale restoration in recovering nature'.

Summer – Twenty male turtle doves recorded.

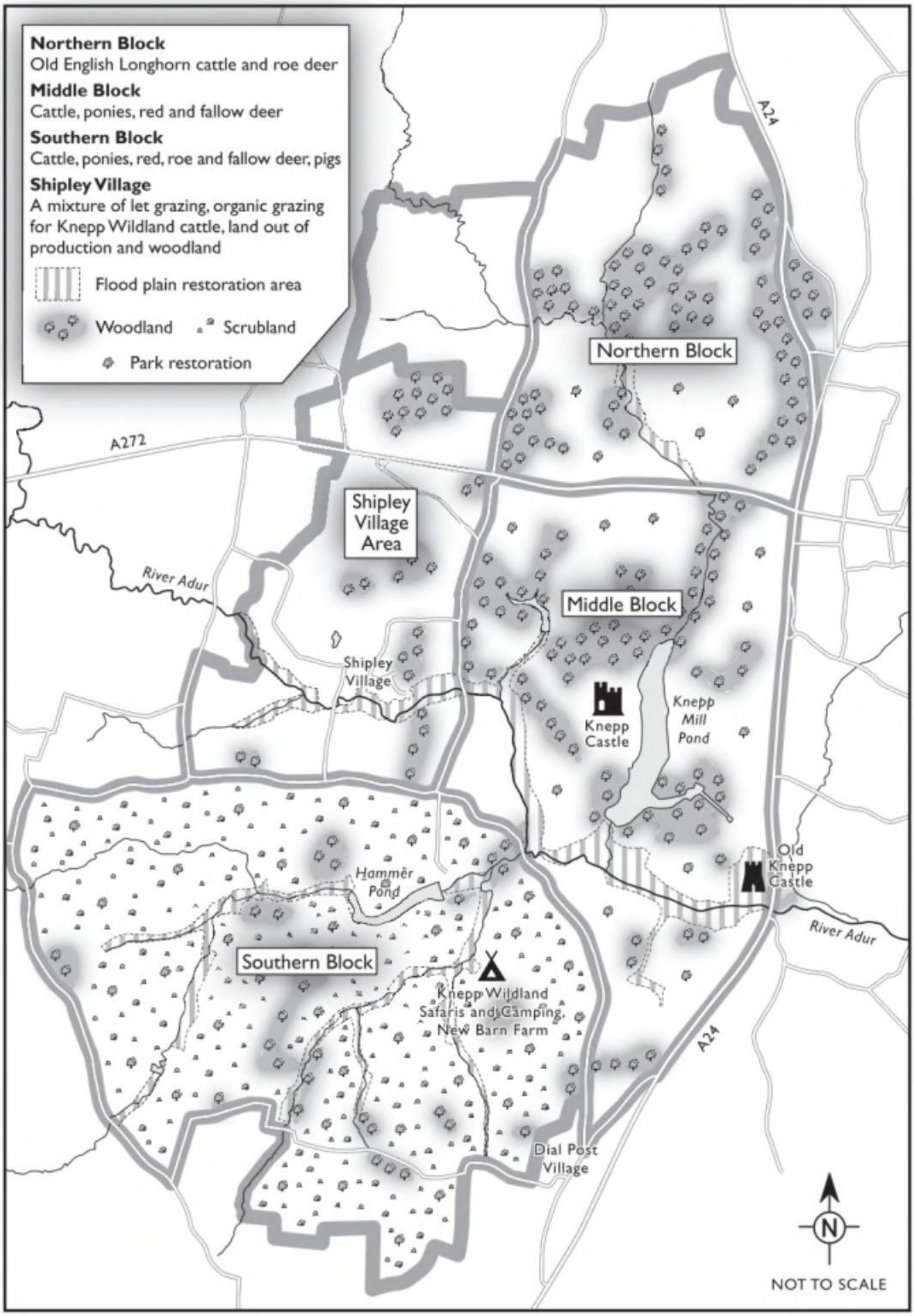
September – Soil research by Cranfield University finds that, under rewilding at Knepp, soil carbon, organic matter and microbial biomass has more than doubled, and fungal biomarkers (mycorrhizae) has more than tripled.

Land managers owning, in total, a million acres visit Knepp to investigate the possibilities of rewilding.

2019 *May* – UN report warns that one million species are at risk of extinction in the next few years, with serious consequences for human beings as well as the rest of life on Earth.

May – A pair of white storks nest in the top of an oak tree in the Southern Block; quite possibly the first free-flying white storks to nest successfully in Britain since they were persecuted to extinction after the English Civil War.

June – Application submitted to DEFRA for a license to release beavers at Knepp (decision is pending).



Introduction

> 'Flowers appear on the earth; the time of the singing of birds is come, and the voice of the Turtle is heard in our land.'
>
> Song of Solomon 2:12

It's a still June day on Knepp Castle Estate in West Sussex. We can call it summer now. This is a moment we've been waiting for, not sure if we dare expect it. But there it is – from the thicket that was once a hedgerow, that unmistakable purring: soothing, inviting, softly melancholic. We tread quietly past an eruption of saplings of oak and alder, billowing with skirts of blackthorn, hawthorn, dog rose and bramble. The thrill of recognition is tinged with relief and, though neither of us tempts fate by expressing it, a hint of triumph. Our turtle doves have returned.

For my husband Charlie, their gentle burbling takes him back to the African bush, to his infancy running around on his parents' farm. This is where the doves have come from – their tiny flight muscles pumping 3,000 miles from deep in West Africa, from Mali, Niger and Senegal, across the epic landscapes of the Sahara Desert, the Atlas Mountains and the Gulf of Cadiz; over the Mediterranean, up the Iberian Peninsula, through France and across the English Channel. They mostly fly under the cover of darkness, covering between 300 and 450 miles every night at a maximum speed of 40 miles an hour,

usually making landfall in England around May or early June. Like their fellow African migrant, the nightingale, they are famously timid. It is their call that tells us they are here. Like the cuckoo and the nightingale – who generally arrive here first – they have come to breed, to raise their young far from the predators and competitors of Africa and to take advantage of the long daylight feeding hours of the European summer.

For most people our age, born in the 1960s, who have grown up in the English countryside, turtle doves are the sound of summer. Their companionable crooning is lodged for ever, somewhere deep in my subconscious. But this nostalgia, I realize, is lost to generations younger than ours. In the 1960s there were an estimated 250,000 turtle doves in Britain. Today there are fewer than 5,000. At the present rate of decline, by 2050 there could be fewer than 50 pairs, and from there it would be a hair's breadth to extinction as a breeding species in Britain. Now, at Christmas, when we sing of the gifts my true love gave to me, few carollers have ever heard a turtle dove, let alone seen one. The significance of its name, derived from the lovely Latin *turtur* (nothing to do with the reptile; all to do with its seductive purring), is lost to us. The symbolism of 'turtles', their pair-bonding an allegory of marital tenderness and devotion, their mournful *turr-turr*-ing the song of love lost, the stuff of Chaucer, Shakespeare and Spenser, is vanishing into the kingdom of phoenixes and unicorns.

As its territory shrinks to the south-east corner of England, Sussex is one of the turtle's final redoubts. Even so, numbers for our county are reckoned to be at best 200 pairs. Trouble on the migration route is undoubtedly partly responsible: periodic droughts, changes in land use, the loss of roosting sites, increasing desertification and hunting in Africa – and the stupendous challenge of crossing the firing squads of the hunters of the Mediterranean. In Malta alone the slaughter claims 100,000 turtle doves every season. Around 800,000 a year are killed in Spain.

Yet these impacts, considerable though they are, are not

enough to explain the almost complete collapse of the population in Britain. In France, where hunters still shoot the birds on their return passage to Africa after the breeding season, numbers have decreased 40 per cent since 1989 – a significant loss, but nothing compared with ours, where, in recent times at least, we have opted not to shoot them. Across Europe, turtle-dove numbers have declined by a third over the past sixteen years to fewer than 6 million pairs – leading, in 2015, to a change in the bird's status on the International Union for Conservation of Nature (IUCN) Red List of Endangered Species from 'Least Concern' to 'Vulnerable', the start of a worrying downward slide.

But compared to the angle of European decline, the trajectory of the UK numbers is an almost vertical dive. The turtle dove's predicament in Britain is rooted in the almost complete transformation of our countryside – something that has come about in just fifty years. Changes in land use and, in particular, intensive farming have altered the landscape beyond anything our great-grandparents would recognize. These changes have taken place at all scales in the landscape, from the size of fields that now cover entire valleys and hills to the almost total disappearance of native flowers and grasses from farmland. Chemical fertilizers and weedkillers have eradicated common plants like fumitory and scarlet pimpernel, on whose tiny, energy-rich seeds the turtle doves feed; while the wholesale clearance of wasteland and scrub, the ploughing of wildflower meadows, and the draining and pollution of natural water courses and standing ponds has wiped out their habitat.

The same agricultural revolution has taken place on the Continent, but in Europe, it seems, there is enough wild land left – and in large enough areas – to slow the decline in turtle-dove numbers. But in lowland England what tiny fragments of nature remain, whether left by accident or by design, are like oases in a desert, disconnected from natural processes – the interactions and dynamism that drive the natural world. We lost more ancient woods – tens of thousands of them – in the forty

years after the Second World War than in the previous four hundred. Between the beginning of the war and the 1990s we lost 75,000 miles of hedgerows. Up to 90 per cent of wetland has disappeared in England alone since the Industrial Revolution. 80 per cent of Britain's lowland heathland has been lost since 1800; a quarter of the acreage in the last fifty years. 97 per cent of our wildflower meadows have been lost since the war. This is a story of unremitting unification and simplification, reducing the landscape to a large-scale patchwork of ryegrass, oilseed rape and cereals, with scattered, undermanaged woods and remnant hedgerows the only remaining refuge for many species of wildflowers, insects and songbirds.

Underfunded and unprioritized, conservation measures have failed to hold ground against agricultural intensification and development. Ironically, England, which boasts one of the greatest traditions of recording its wildlife and has the largest membership of wildlife-protection organizations in Europe, has among the smallest amount of land nationally protected as nature reserves. Compared to 2.75 million hectares in France, England has only 94,400 hectares (364 square miles, less than 1 per cent of its land area) conserved for nature. Even Estonia manages over 258,000 hectares. Our tiny SSSIs (Sites of Special Scientific Interest), SACs (Special Areas of Conservation) and SPAs (Special Protection Areas designated under European legislation) are eroded, neglected and sometimes completely forgotten about. In many cases, their role is overruled by bigger priorities such as roads and building projects. All of England's ten National Parks contain large areas intensively grazed by sheep or managed as grouse moors. Unlike the American National Park model, sacrosanct areas of wilderness where nature is primary, ours are regarded primarily as 'cultural' landscapes for human recreation.

The transformation of our countryside has impacted not just on turtle doves but on birds in general. In 1966, according to the RSPB, there were 40 million more birds in the UK than there are today. Our skies have emptied. In 1970 we had 20 mil-

lion pairs of what are known as 'farmland birds', such as quails, lapwings, grey partridges, corn buntings, linnets, yellowhammers, skylarks, tree sparrows and turtle doves – most of them songbirds that depend on insects for their chicks and copses or hedgerows for their nests. By 1990 we had lost half of them. By 2010 that number had halved again. It is hard to countenance figures of this magnitude. Reframing the statistics, putting them in another context, is helpful. Over those forty years, for example, our country has gained another 5 million people. So for every extra person living in the UK we have lost three pairs of what are now considered 'priority' farmland birds.

But what does this mean for us as a nation? Do we need to worry about the loss of these birds, lovely as they are? Certainly Charlie and I would be desperately sad if we or our children were never to hear a nightingale or a turtle dove on English soil again. But their loss represents something far more important than that. Familiar, conspicuous in our skies and in our landscape, birds are, in a very real sense, our canaries in the mine – casualties connected to far greater and less visible losses. Preceding them, and following in their wake, are all the other species – including the less glamorous forms of life like insects, plants, fungi, lichens, bacteria – that share their fate. As the American biologist E. O. Wilson explained just thirty years ago, life's diversity is dependent on a complex web of natural resources and inter-species relationships. In general, the more species living in an ecosystem, the higher its productivity and resilience. Such is the wonder of life. The greater the biodiversity, the greater the mass of living things an ecosystem can sustain. Reduce biodiversity, and biomass may decline exponentially; and the more vulnerable individual species collapse. In *The Song of the Dodo* (1996), David Quammen describes an ecosystem as being like a Persian carpet. Cut it into tiny squares, and you get not tiny carpets, but a lot of useless scraps of material fraying at the edges. Population crashes and extinctions are the signs of an ecosystem unravelling.

The ground-breaking 2013 *State of Nature* report, compiled

by scientists from twenty-five British wildlife organizations, reveals a bleak story for wildlife in the UK over the previous fifty years. The numbers of Britain's most endangered species have more than halved since the 1970s, with one in ten species overall threatened with extinction within our shores. The abundance of all wildlife has fallen dramatically. Insects and other invertebrates have been particularly badly hit, more than halving since 1970. Moths have declined 88 per cent, ground beetles 72 per cent and butterflies 76 per cent. Bees and other pollinating insects are in crisis. Our flora is also failing. Seed-bearing 'weed' species – upon which turtle doves and countless other birds depend – declined by 1 per cent every year during the twentieth century since the records began in the 1940s. According to the 2012 *Our Vanishing Flora* report, one plant species becomes extinct every other year in sixteen counties of the UK. And these are just the species that can be identified and monitored. Countless other insects, water plants, lichens, mosses and fungi are not even on the radar.

In 2016 a new *State of Nature* report, compiled by scientists from fifty conservation organizations, found some grounds for optimism. The numbers of certain species such as bats, including the greater horseshoe bat, have increased in recent years thanks to legal protection; the creation of new reed-beds has enabled the bittern to recover from just 11 booming males in 1997 to 156 in 2015. Some locally extinct species like the short-haired bumblebee and the large blue butterfly have been successfully reintroduced. Red kites have spread following successful introductions, and otters are making a comeback in many rivers. But the report offers a sober reminder of the longer historical context. 'Although these recoveries are certainly worth celebrating,' it says, 'we should remember that they have only brought species back to a fraction of their former level.'

Across the board, substantial losses continue. Between 2002 and 2013, more than half our species declined in numbers. This is not something we can assign conveniently to failures in the

1970s. In recent years, some of our best loved 'common' species like hedgehogs, water voles and dormice have become scarce. The government's own assessment, published in August 2016, found that a hundred and fifty of two hundred so-called 'priority' species are still falling in number across the country and we are in imminent danger of losing 10–15 per cent of our species overall.

It is tempting to assume that such declines are no different to the rest of the world. But they are different. Using the 'biodiversity intactness index' – a new system that measures the condition of a country's biodiversity – the updated 2016 *State of Nature* report discovered that the UK has lost significantly more biodiversity over the long term than the world average. Ranked twenty-ninth lowest out of 218 countries, we are among the most nature-depleted countries in the world.

Against this background of almost inconceivable loss the turtle doves' appearance at Knepp seems little short of a miracle. Our patch – 3,500 acres of former intensive arable and dairy farmland, just forty-four miles from central London – is bucking the trend. The turtle doves are here now because we have turned our land over to a pioneering rewilding experiment, the first of its kind in Britain. Their arrival has taken us and all those involved in the project completely by surprise.

We began to hear turtle doves, only ever recorded here in ones and twos, just a year or two after the project began – three in 2005, four in 2008, seven in 2013 and by 2014 we reckoned we had eleven singing males. In the summer of 2018 we counted twenty. Occasionally, over the last couple of years, we've chanced upon a pair out in the open, sitting on telephone wires or on a dusty track, their pink breasts touched by the glow of evening, the tiny patch of zebra stripes on their necks a hint of Africa – a reminder that, just a few weeks earlier, these birds would have been flying over elephants. Their colonization of Knepp is one of the few reversals in the otherwise inexorable trend to national extinction; possibly the only optimistic sign for turtle doves on British soil.

But it's not just turtle doves that have found us. Other endangered British birds – migrants like nightingales, cuckoos, spotted flycatchers, fieldfares and hobbies, and residents like woodlarks, skylarks, lapwings, house sparrows, lesser spotted woodpeckers, yellowhammers and woodcock – have been recorded here in good numbers since the project began or are now breeding at Knepp. So too are ravens, red kites and sparrowhawks, lording it at the top of the food chain. Every season new species arrive. In 2015 the big excitement was long-eared owls and in 2016 we had our first pair of breeding peregrine falcons. Populations of common birds are rocketing, too, and occasional visitors like osprey, green sandpipers and little egrets are also on the rise.

And it's not just birds. Other rare creatures, solemnly declared 'UK Biodiversity Action Plan species' by the civil servants, are also back – Bechstein's and barbastelle bats, dormice, slow-worms, grass snakes and butterflies: purple emperor, brown hairstreak and white-letter hairstreak. The speed at which these events have happened has astonished observers, not least ourselves, particularly given the dire condition of our land before we made our first tentative steps into what we now call 'rewilding', back in 2001.

The key to Knepp's success, conservationists are beginning to realize, is its focus on 'self-willed ecological processes'. Rewilding is restoration by letting go, allowing nature to take the driving seat. In contrast, conventional conservation in Britain tends to be about targets and control, doing everything humanly possible to preserve the status quo, sometimes to maintain the overall look of a landscape or, more often, to micro-manage a particular habitat for the perceived benefit of several chosen species, or just a single, favoured one. In our nature-depleted world this strategy has played a crucial role. Without it, rare species and habitats would have simply disappeared off the face of the earth. Such nature reserves are our Noah's Arks – our natural seed banks and repositories of species. But they are also increasingly vulnerable. Biodiversity

continues to decline in these costly and micro-managed oases, sometimes even threatening the very species these areas are designed to protect. Something drastic needs to happen, and happen soon, if we are to halt this decline, and perhaps even reverse it.

Knepp presents an alternative approach – a dynamic system that is self-sustaining and productive, as well as far cheaper to run. Such an approach can work in conjunction with conventional measures. It can be rolled out on land that on paper, at least, is of no conservation importance. It can add buffers to existing protected areas, as well as bridges and stepping stones between them, increasing the opportunities for species to migrate, adapt and survive in the face of climate change, habitat degradation and pollution.

Allowing natural processes to happen, and having no predetermined targets to meet, no species or numbers to dictate the plan, is a challenge to conventional thinking. It particularly unsettles scientists who like to test hypotheses, run computer models, tick boxes and fix goals. Rewilding – giving nature the space and opportunity to express itself – is largely a leap of faith. It involves surrendering all preconceptions, and simply sitting back and observing what happens. Rewilding Knepp is full of surprises, and the unexpected outcomes are changing what we thought we knew about some of our native species' behaviour and habitats – indeed it is changing the science of ecology. And it is also teaching us something about ourselves, and the hubris that has led us to our current predicament.

When we began rewilding the estate nineteen years ago we had no idea about the science or the controversies surrounding conservation. Charlie and I embarked on the project out of an amateurish love for wildlife and because we would have lost an impossible amount of money if we had continued to farm. We had no idea how influential and multi-faceted the project would become, attracting policy makers, farmers, landowners, conservation bodies and other land-management NGOs, both British and foreign. We had no idea Knepp would end up a focal

point for today's most pressing problems: climate change, soil restoration, food quality and security, crop pollination, carbon sequestration, water resources and purification, flood mitigation, animal welfare and human health.

But what is happening here also seems to touch a deeper chord, something more visceral. In 2013 George Monbiot published a plea for a wilder Britain in his inspirational book *Feral.* The public response was extraordinary. He seemed to have attuned to a craving that people were feeling but hadn't yet voiced: the idea that we are missing something – some more fulfilling connection with nature in all its awe-inspiring, unfettered complexity; that we are living in a desert compared to our gloriously wild past.

Inspired by this public outpouring and desire for change, the charity Rewilding Britain was launched in 2015, with my husband Charlie as one of its trustees and then its chair. Its goals are ambitious. By 2030 it aims to have returned natural ecological processes and key species to 300,000 hectares of core land (1,158 square miles, equivalent to the size of Britain's golf courses, or roughly equivalent to a large county) and three marine areas, crucial for the restoration of our fisheries and marine wildlife. Over the next hundred years it hopes this will have extended to at least 1 million hectares, or 4.5 per cent of Great Britain's land and 30 per cent of our territorial waters, with at least one large rewilded area connecting both land and sea, descending from mountaintops to coastal waters. Its overall aim is not to rewild everywhere – prime agricultural land will naturally always be needed for food production and much land will still, of course, be required for housing and industry – but to restore parts of the British Isles to wild nature and to allow lost creatures, like the lynx and beaver, the burbot, eagle owl and Dalmatian pelican, and, in our remotest places, elk and wolf, to live here once more.

Knepp is but a small step on that road to a wilder, richer country. But it shows that rewilding can work, that it has multiple benefits for the land; that it can generate economic

activity and employment; and that it can benefit both nature and us – and that all of this can happen astonishingly quickly. Perhaps most exciting of all, if it can happen here, on our depleted patch of land in the over-developed, densely populated south-east of England, it can happen anywhere – if only we have the will to give it a try.

1. Meeting a Remarkable Man under a Remarkable Tree

A single 400-year-old-oak . . . [is] a whole ecosystem of such creatures for which ten thousand 200-year-old oaks are no use at all.

Oliver Rackham, *Woodlands*, 2006

Ted Green came to a standstill under the canopy of the old oak. He caressed the rippled bark with a weather-worn hand. 'You're a sight for sore eyes,' he said. As if in response a stirring shuffled through the foliage above our heads and a smattering of acorns thudded to the ground. Handing Charlie one end of a 'Diameter at Breast Height' measure, Ted extended the tape around the trunk and with a cry of delight read off 7m. Its girth made it about 550 years old. Most likely, it had started life during the Wars of the Roses, nearly three centuries before my husband's family, the Burrells, had arrived at Knepp. It would have germinated when 'Knap' was a thousand-acre deer park owned by the Dukes of Norfolk, its acorns fodder – or 'pannage' – for wild boar and fallow deer. As a fine young tree only a hundred years old, it would have welcomed the arrival of the Carylls, Catholic ironmasters, owners of Knepp for over a hundred and seventy years. In the mid-seventeenth century it would have witnessed the Civil War, the assault on Knepp by Parliamentary troops and counter-assaults by Royalists. It

had lived and breathed what we can only absorb from history books.

Looming over the approach to the nineteenth-century castle it has been known for as long as anyone can remember as the Knepp Oak. It would have been 350 years old when Charlie's ancestor Sir Charles Merrik Burrell, the 3rd baronet, commissioned the up-and-coming architect John Nash to build him a mansion house right next to it.

The Burrells have been associated with Sussex since the fifteenth century, first as farmers and vicars of Cuckfield, then as ironmasters in the seventeenth century. Knepp came into the Burrell family when William Burrell, a lawyer and Sussex historian, married an heiress, his second cousin, Sophia Raymond. Her father, Sir Charles Raymond, had bought Knepp in 1787, shortly after the Caryll dynasty had dissolved. Sir Charles gave the estate, then 1,600 acres, to his daughter, and the Raymond baronetcy to his son-in-law.

It was their son, Sir Charles Merrik Burrell (3rd Bt), who put down roots at Knepp. The new castle, designed by Nash in his new 'picturesque' Gothic style, would have crenellations and turrets and studded oak doors and stand on an 'elevated and beautiful' spot only 100 yards or so away from the great oak, overlooking the old 80 acre mill pond – then the largest body of water south of the River Thames.

Like all the Burrells who have lived here since, our fortunes have seemed somehow wedded to the fate of this tree. Horses and carriages, ponies and traps, steam ploughs, men heading off to two world wars, the first Bentley, Charlie's grandfather's Series One Land Rover, the first combine harvester would all have passed beneath its branches. It had witnessed marriage processions, funeral cortèges, bizarre twists of family fate. When our son was born in the autumn of 1996 – a prolific year for oak mast – we grew one of its acorns on in a jar and planted the sapling out for the future, a stone's throw from the original. We wondered how much longer the old tree could survive. Sometime in the early twentieth century it had begun to split

down the middle and during the Second World War the Canadian army stationed at the castle had strapped it together with tank chains. By the late 1990s it seemed that its gigantic outstretched limbs were once again threatening to tear it apart. We were told of a man who would know what to do.

Ted stood back, assessing the bifurcating structure above us. His brow furrowed as he studied the chainsawed amputation of a lower limb. As it grows old a tree sometimes lowers its branches towards the ground, for stability, Ted explained, like an old man using a walking stick. To the modern eye this self-buttressing tendency is considered a weakness and the walking stick – the lowering branch – is generally removed. 'We have a fixed image of how a tree should look,' Ted said, 'like a child's drawing with a straight trunk and a pom-pom on top. We don't want to see anything else. We deny the tree its ability to grow old, to gain character, to be itself. It's like taking away my bus pass and giving me a facelift so I always look fifty.'

One of our longest-lived trees, the oak – so the saying goes – grows for 300 years, rests for another 300 years and spends the last 300 gracefully declining. But that mid-life period of 'standing still' is deceptive, Ted said. The tree may have reached its optimum mass but it is always shifting, balancing its weight, responding to its environment and the growth of vegetation around it – only at a pace that humans can barely register. Top-heavy and unable to find equilibrium, the Knepp Oak was struggling to hold itself together – an allegory, perhaps, of Knepp in the twentieth century.

Ted, at least, was optimistic about the tree. 'A bit of a haircut should do it – a little at a time over the next few years. If we can reduce the crown by 10 per cent – just a metre or two – that'll be enough to reduce the wind effect by around 70 per cent and prevent it wrenching itself down the middle. See, it's already beginning to drop this branch over here. In time, if you let that reach the ground, it'll have a lot more support.'

He looked thoughtfully up into the crown. 'This old soul could see another four centuries.'

For the past decade Ted Green, then in his sixties, had been custodian of the royal oaks in Windsor Great Park. One of the most distinguished tree experts in the country, and recently awarded the Royal Forestry Society's prestigious gold medal, he had, like the tree he was currently admiring, started out life on the other side of the fence. His father, captured in the war, had been killed when a US submarine torpedoed an unmarked Japanese ship carrying prisoners of war. The loss had devastated Ted, an only child, living with his mother on the borders of Silwood, Sunninghill and Windsor Great Parks in Berkshire. He turned feral, running wild in the woods and meadows. When Ted and his mother were evicted from their home they took over a hut from an abandoned military camp at Silwood. Ivy and honeysuckle wound around the inside walls and his mother slept in bed under an oilskin when it rained. A dab hand with a slingshot, Ted took to poaching rabbits and pheasants off the Crown Estates.

'I was a problem kid,' he said in his soft Berkshire burr. 'Running about on my own – that's how I made sense of the world. Nature taught me things: observation and patience. That's what saved me.'

Ted had arrived in academia sideways, thanks to a scientist he had met bird-watching. Posted as technician in plant pathology at Imperial College's new field station in Silwood Park, he was eventually given an honorary lectureship – only the second ever in the history of the college. His students, invariably, adored him. In the 1980s, after thirty-four years supporting research and teaching botany and biology, he left to become conservation consultant to the Crown Estates at Windsor. His life, it seemed, had come full circle.

As we wandered back along the drive towards the house Ted paused. 'Now those old trees,' he said, 'they're the ones we should be worrying about.' He was gazing out at the scattered oaks, once features of the nineteenth-century deer park, now stranded like lighthouses in a choppy sea of agriculture and currently presiding over a ley of shiny Italian ryegrass. It wasn't an

exact science, identifying sickness in a tree, Ted said, more a matter of intuition, like sensing when a close friend is unwell. A healthy oak has the bloom of giant broccoli, with a dense, rounded crown, bursting with life. These trees, planted two centuries ago or more, sentinels of Humphry Repton's park setting for Nash's castellated mansion, were growing thin and stag-headed, losing their leafy abundance. Half the age of the Knepp Oak, they looked crumpled by comparison, like war-weary veterans. 'It's ploughing that's doing them in,' said Ted, 'and everything that comes with it.'

Like most of their landowning neighbours, the Burrells had responded with patriotic ardour to the government's cry to 'Dig for Victory' in the Second World War. Isolated, and with German U-boats torpedoing supply lines across the Atlantic, Britain's 50 million inhabitants faced starvation. As chairman of the West Sussex 'War Ag' (War Agricultural Executive Committee), Charlie's great-grandfather Sir Merrik Burrell, then sixty-two, had been charged with impelling the county, most of which was under permanent pasture and made up of subsistence farms with small fields, horse-drawn machinery and little electricity between them, into intensive dairy and arable production. Sometimes, Sir Merrik admitted to the Royal Agricultural Society (of which he had recently been President), he had to 'lean quite hard' on farmers who were reluctant to put their pastures to the plough.

He had led by example, ploughing up those parts of his estate that for decades had been considered either sacrosanct or too costly and problematic to farm. Two huge tractors yoked with chains were sent into hundreds of hectares of scrub, ripping up gorse, hawthorn, sallow and dog rose, and levelling anthills. Easier to plough were the old water meadows, known locally as 'laggs', and the 350-acre Repton park around the house.

Timber was required for the war effort too, with carrot-and-stick incentives from the government – £60 for felling and grubbing out a mature oak, and a quota that every landowner

was required to fulfil. Sir Merrik felled the old trees along the ancient droving road of Greenstreet and the great oaks of Big Cockshalls, and clear-felled Jockey Copse. He spared – at least – the oaks in the park around the castle, though to his dismay he was forced to surrender the elm boards he was carefully seasoning for the family's coffins.

The war utterly transformed West Sussex, like everywhere in Britain. On Knepp's horizon, tides of wheat rolled over the chalk grasslands of the South Downs – traditional grazing lands since the Bronze Age, meadows of cowslips and orchids considered out of bounds even during the First World War, when they supplied hay for military transport. Around the nearby villages of Dial Post, Shipley and West Grinstead, woods were felled and thousands of acres ditched and drained. At Knepp and on neighbouring farms, farmers too old to go to war were supported by an army of Land Girls, a national task force of 80,000 female volunteers and conscripts under the command of Charlie's great-grandmother Trudie Denman, a pioneering feminist. The Land Girls laboured up to a hundred hours a week, mounting headlights onto tractors so they could plough day and night. During the war they more than doubled the acreage producing fodder for livestock and more than tripled the acreage of fields under cereal.

'Dig for Victory' achieved what many had considered impossible. In the years just before the war, Britain imported nearly three-quarters of its food. Increased grain production abroad – particularly in Russia and America – and cheap transport by steamship had pushed food prices to rock bottom. Naturally enough, the acreage of arable land in Britain had fallen to an all-time low – an effect of what we would today refer to as 'globalization'. By the end of the war, arable land in Britain, now subsidized by the government, had doubled to 20 million acres – from the smallest to the largest area ever in just five years. An extra 10,000 square miles had been 'brought under the plough', doubling Britain's output of wheat.

Whether or not Sir Merrik ever dreamed the park would

one day be restored to its original state, he must have given up hope by the time he died in 1957. After the war, Britain verged on bankruptcy. With little to export and little foreign currency to pay for imports, with much of Continental Europe starving, with dependants in her protectorates to feed, and her allies no longer coming to her aid, there was less food in Britain than during the war itself. Food rationing continued until 1954, a full nine years after VE-Day. And the result was a sea change in the nation's mentality. That memory of privation, stretching well into the 1950s, etched itself into the country's subconscious. Feeding ourselves became as much a matter of honour as it was of security. Never again, the government declared, would Britain allow herself to be threatened with starvation. Supported by subsidies, the country would remain in peak production. Fallow land came to be considered wasted land. As Charlie's aunt Penelope Greenwood, now in her eighties, describes it, 'We were all brought up to believe we would go to heaven if we made two blades of grass grow where one had grown before.' Knepp's park – indeed every conceivable inch of the estate – would remain dedicated to intensive agriculture.

Ted marched off across the ryegrass, clods of clay sticking to his walking boots, making a beeline for one of the old park oaks. We joined him on the tiny coracle of turf left unploughed directly around its trunk. 'This is the problem,' he said, leaning against the tree and staring at the tussocky ground beneath our feet. 'We never think of what's going on below ground. The tree we see is just the tip of the iceberg.'

An oak's roots spread way beyond the drip-line of the leaves, he told us, to a distance of up to two and a half times the radius of the crown. At Windsor recently, he had found roots from one of the veteran oaks extending a full fifty yards from the trunk. With oxygen available in soil only relatively close to the surface, the majority of a tree's roots are found in the top twelve inches and are therefore vulnerable to ploughing and compaction. Our dairy cows, weighing half a ton each, congregating en masse in the shade on a summer's day – a pastoral

idyll, so we had thought – were doing the roots no favours, and the repeated ploughing and the traffic of heavy combines, power harrows and seed drills directly under the oaks and further into the field were constantly assailing their roots.

And the roots are just the beginning. A tree's life-support system extends further still, into a dark and invisible universe that microbiologists and mycologists are only just beginning to fathom: that of the mycorrhizae – fine, hair-like filaments of fungus that attach themselves to the roots and create a deep, intricate and vast underground network.

Mycorrhizae, from the Greek *mikas-riza* (literally 'fungus-root'), relate symbiotically to plants. The fine fungal filaments extend from the roots of plants to supply their hosts with water and essential nutrients. The plants, in return, provide the mycorrhizal fungi with carbohydrates they need for growth. At a hundredth of a millimetre in diameter – ten times finer than the finest root – these filaments, or 'hyphae', are invisible to the naked eye. A single filament may extend hundreds or thousands of times the length of one tree root. Mycorrhizal partnerships can be highly specific, Ted told us, associating only with an individual plant or species. They can also be generalist and promiscuous, creating vast community structures, known as common mycelial networks. These networks can be indefinitely huge, spanning – some believe – entire continents.

One of the most crucial processes of life on earth, mycorrhizae arose 500 million years ago, when primitive plants emerged from the oceans to experiment with terrestrial life. To colonize land, plants had to find a way of acquiring mineral nutrients, in particular scarce minerals like phosphate – an essential nutrient readily available in water but occurring in extremely low concentrations in soil. On its own, a plant's ability to extend its roots to explore for nutrients is limited. Partnerships with mycorrhizae expand that capability exponentially. 90–95 per cent of terrestrial plants in all ecosystems on every continent have mycorrhizal relationships. A single bluebell, for example, may be colonized by eleven or more species

of mycorrhizal fungi, most of which have not yet been scientifically described. Without them, a bluebell, with its short, thick roots, growing in soils where phosphate is typically available at less than 1 part per 10 million, would die. The same is true for trees. One study in North America discovered over a hundred species of mycorrhizal fungi associated with a single tree. Using an arsenal of biochemicals unique to fungi, mycorrhizae can even mine rock, extracting minerals and bringing them into the plant food cycle.

Another key function of mycorrhizae is to act as an early warning system. Chemical signals transmitted by mycorrhizae from a plant under attack stimulate a defensive response in other plants in the vicinity, prompting them to raise levels of protective enzymes. By acting as a communications network – even between plants of different species – mycorrhizae alert plants and trees to the threat of pathogens, and to predation by insects and herbivores. They can even stimulate the release of chemicals from the tissues of a tree to attract predators for the particular pest assailing it. And they can alert trees to provide intensive care for ailing individuals or vulnerable offspring, supplying them with a boost of nutrients as though plugging them into an intravenous drip. As Canadian forest ecologist Suzanne Simard discovered in the late 1990s, and Peter Wohlleben describes in his remarkable book *The Hidden Life of Trees – what they feel, how they communicate* (2015), this underworld system of molecular signalling reveals a world where trees are responsive and sociable creatures, much more like us than we ever imagined.

The delicate mycorrhizae are, inevitably, destroyed by the churning blades of ploughs. They are also highly susceptible to agricultural chemicals, whether in fertilizers or pesticides. At low concentrations, phosphate is a nutrient that mycorrhizae convey to support life. When added to the land in large quantities as artificial fertilizer it becomes a pollutant, overwhelming natural biological systems and depressing the mycorrhizae's spore germination and viability. Nitrates, insecticides,

herbicides and, of course, fungicides reduce mycorrhizal colonization of roots and inhibit the elongation of the hyphae, the fungal filaments. Even livestock dung, which is routinely loaded with anti-worming agents (avermectins) and, often, antibiotics, can leach into the soil and destroy mycorrhizae.

'So what we're seeing with these trees,' Ted explained, 'is most likely an effect of what's been happening to the soil. These trees have been cut off from their allies. They're stranded out there on their own.'

In the early twentieth century, a Prussian chemist, Fritz Haber, pioneered modern chemical fertilizers, by inventing a technique to draw nitrogen from the air and transform it into the plant-available nitrates that stimulate plant growth. A process that can take place only under intense heat and pressure, the manufacture of artificial nitrates requires huge inputs of fuel – generally, in today's world, gas. It can also generate the raw materials for explosives and before Haber's process became widely used in agriculture, it revolutionized the development of munitions in the Second World War.

After the war, switching manufacture from munitions to agricultural fertilizers was obvious and easy for industrialists. Tanks converted to tractors; poison gas to pesticides and herbicides. In the United States, where, far from the action in Europe, ten large-scale bomb-making factories remained unscathed after the war, nitrate production sky-rocketed, making the States the undisputed champion of artificial fertilizer, with a vested interest in driving up arable production in Britain and Europe.

Not everyone in Britain was sure that arable was the best way to continue after the war. A group of influential scientists led by Professor Sir George Stapledon, director of the grassland research station at Drayton, Stratford-upon-Avon, had recommended a return to food production based on grass – the country's richest and most reliable resource. The dash for arable crops in the early years of the war had been severely damaging to soil fertility and, in the closing years, the War Agricultural

Executive Committee had urged farmers to rotate their arable crops with leguminous nitrogen-fixating crops, such as clover, sainfoin and lucerne, and short-term pastures for livestock to allow the soil to recover. In Stapledon's view, this rotational system not only maintained soil fertility, it kept farmers self-sufficient by avoiding the need for chemical fertilizers and imported animal feeds. With low overheads farmers had no need to borrow money and build up debt. In periods of agricultural recession, mixed farming gave farmers greater resilience and stability. It was, he advised, the ultimate tool of food security.

Other celebrated farmers, like George Henderson, author of the bestselling *The Farming Ladder* (1944), also campaigned for a return to the traditional mixed-farming system. His farm in the Cotswolds had successfully weathered the agricultural depression of the 1930s and at the outset of the war had the highest outputs per acre in Britain. The Ministry of Agriculture had used it as a showcase farm, bussing people to the Cotswolds to learn from it. Maintaining the natural fertility of the soil, Henderson was convinced, was the key. 'If all of Britain was farmed this way,' he wrote, 'our country could easily feed a population of a hundred million people.'

Henderson was adamantly against continuing farm subsidies after the war. They would be disastrous for the country in the long run, he warned, removing all incentive, instinct and self-reliance for farmers, creating a culture of dependency and giving bureaucrats control over what farmers did with their land. However the National Farmers' Union disagreed and lobbied hard to retain subsidies. In 1947 Clement Atlee's government passed the Agriculture Act – drawn up by Professor John Raeburn, the agricultural economist behind the Dig for Victory campaign – guaranteeing fixed market prices for farm produce in perpetuity.

By the time Charlie's grandparents were running the Knepp estate, subsidies were already beginning to affect the choices farmers made. By the late 1960s the rising trend was for large,

specialized farms, the majority of which focused solely on arable, with grass eliminated from the rotation altogether. Without the fertility-building benefits of grass, clover and livestock, chemical fertilizers and sprays were needed to grow decent crops, and it was the generous subsidies provided by the government that made these additional costs affordable for farmers. The idea of being able to fertilize the soil artificially seemed nothing short of a miracle and, together with improvements in technical efficiency, bigger and better machinery and the development of new varieties of crops, the era of industrialized agriculture – misleadingly named the 'Green Revolution' – was firing on all cylinders.

Trees had no place in this new scheme of things. Free-standing trees in the middle of fields were now an aggravation, disrupting the trajectory of farm machinery and taking up precious yards of viable land. Many farmers, if they did not remove them altogether lopped off the lower branches so they could plough right up to the trunk, as we did. Trees, particularly old trees, began to be seen as a potential source of disease and pests – a threat to crops. In an effort to maximize efficiencies and to accommodate bigger machines with broader turning requirements, fields were enlarged. Between 1946 and 1963, hedgerows were ripped out at the rate of 3,000 miles a year. By 1972, according to a report by the Countryside Commission, the rate of destruction had increased to 10,000 miles a year. Included in these hedgerows were thousands upon thousands of trees that, down the centuries, had been allowed to grow out and above the hedgerow for fodder, fuelwood, timber and shelter, the vast majority of them oaks.

To Ted, the loss of ancient open-grown oaks from Britain is an unacknowledged catastrophe. Britain's ancient Druids worshipped in groves of oaks, and our first kings adorned themselves with coronets of oak leaves. No tree, to his mind, is more closely entwined with our culture. A symbol of strength and survival, couples would marry under its branches, carry acorns in their pockets for good luck, decorate Yule logs of oak

with mistletoe and holly at Christmas. Conspicuous in the landscape, oaks magnetized key moments in history. King John held political 'parleys' under landmark trees such as the King John Oak at Woodend Park in Devon and the Parliament Oak in Nottinghamshire's Sherwood Forest, both still surviving after nearly a thousand years. In 1558 Queen Elizabeth I learnt of her succession to the throne as she sat under a great oak in the park at Hatfield House. 'Her' tree became a place of pilgrimage; its hollow bole, propped and fenced, was celebrated in Edwardian postcards. When, eventually, the old tree died, the present Queen Elizabeth planted a young oak to replace it. In 1651, after losing the Battle of Worcester, King Charles II hid from his Roundhead pursuers in an oak at Boscobel House before escaping into exile – a feat immortalized in pubs up and down the country. There can be few Britons who have not downed a pint in a Royal Oak. The day of the king's entry into London after his exile – 29 May 1660 – became a national holiday, still celebrated in some parts of the country as Oak Apple Day.

To the commoner the oak was both sustenance and livelihood: providing acorns for feeding pigs and making bread; bark for tanning leather; pollarded branches as tree fodder for livestock in winter and fuel for domestic fires; sawdust for smoking meat and fish; oak galls for making ink; and wood for charcoal and hence for smelting iron – especially here in the Weald where iron foundries abounded until the end of the sixteenth century. But the English oak, one of the hardest and most durable woods in the world, was most prized for its timber – as boards for flooring, support beams for houses and barns and most important of all, for an island nation, for ship-building.

'See that limb there,' said Ted, extending his arm to mirror an upwardly arching branch, 'split in two that makes a matching pair of timbers for the hull of a ship. And the genius of it was, you didn't have to kill the tree to do it. You could just take the limbs that suited what you needed them for.' The oak's very name in Latin, *Quercus robur*, resonates strength and until the

middle of the nineteenth century shipbuilders relied almost entirely on oak, 'the wooden walls of Old England' carrying sailors around the globe, fuelling the expansion of the British Empire. The tree is saluted in the naming of eight HMS *Royal Oak* warships down the centuries, in the 'Hearts of Oak' march of the Royal Navy and even in a verse of 'Rule, Britannia'.

But beyond its historic associations, it is for biodiversity in the present day that Ted most bemoans its loss. 'You never see crowns like these in woods,' he said looking across at five or six trees, spaced generously apart, standing between us and the lake. 'Oaks need light and space.' Spreading horizontal limbs in all directions to make the most of the sun, an open-grown English oak has six times the leaf cover of woodland trees. 'That's 360 degrees of niches and cover for wildlife,' he said. It supports more life forms than any other native tree, including over 300 species and subspecies of lichens and a staggering number of invertebrate species, providing food for birds including treecreepers, nuthatches, pied flycatchers, great and lesser spotted woodpeckers and several species of tits which nest in the tree's holes and crevices, or in the spreading branches. Bats roost in old woodpecker holes, under loose bark and in the tiniest of cracks. Its acorns – millions over a lifetime – feed badgers and deer in the run-up to winter, as well as jays, rooks, wood pigeons, pheasants, ducks, squirrels and mice, which, in turn, attract birds of prey such as owls, kestrels, buzzards and sparrowhawks, which may also nest in oaks. The soft leaves – 700,000 produced by a mature oak every year – break down easily in autumn, forming a rich leaf mould on the ground – habitat for scores of fungi including many colourful milkcaps, boletes, brittlegills and truffles.

But it is when it begins to retract and hollow with age that the oak really comes into its own as an ecosystem. As the heartwood rots down, the slow release of nutrients gives the trunk a new lease of life. The droppings of bats and birds roosting inside the hollow tree provide additional fertilizer. Bat guano, indeed, contains levels of phosphate and nitrogen as high as the

guano of seabirds. Fallen branches supply yet more nutrients to the roots.

Key to this recycling process are yet more fungi, this time visible and above ground – such as the edible and appropriately named chicken-of-the-woods and beefsteak fungus. Fungi, often maligned as the harbingers of death for trees, are more often decomposers of deadwood than they are parasites, explained Ted. Rather than causing a tree to die, they rid it of the useless burden of dead tissues, breaking them down and creating another reservoir of plant nutrients accessible to the roots. In the process they convert the tree into a hollow cylinder, creating a stronger, lighter structure that can withstand hurricane-force winds – as testified by the ancient hollow oaks in Windsor Great Park that survived the storm of 1987, while younger, solid trees blew down. It was the strength and resilience of the hollow oak that inspired the eighteenth-century civil engineer John Smeaton to revolutionize the design of the lighthouse.

'I don't believe it!' Ted said, barely able to contain his excitement. He had led us to an oak on the edge of the lake and was pointing at a woody excrescence like a camel's foot protruding from the trunk. Black on top, dark ginger underneath, *Phellinus robustus* is one of the rarest of the bracket fungi in the whole of Europe, a species dependent on veteran oaks. 'As far as we know, there are fewer than twenty trees in the UK with this fungus. The reason it's so rare is the lack of host trees left for it to colonize.'

Ted was now like a terrier onto a scent, peering around the base of the old trees and up into their branches, searching for biological treasure. *Phellinus robustus* was soon joined by *Podoscypha multizonata*, a fungus that looks like a brain, growing in the grass at the foot of a tree, a species associated with the roots of old oaks; *Ganoderma resinaceum*, a bracket fungus that looks like American pancakes high up on a branch; and *Buglossoporus quercinus*, another bracket like a fungal tiramisu – all of them rare not just in Britain but in the whole of Europe.

'Because these fungi are associated only with veteran trees they are important indicators of biological continuity,' said Ted. 'They tell us that old oaks have been in this landscape for hundreds, if not thousands, of years. The spores will have passed down generations of ancient oaks. Once an ancient oak dies, if there are no other veteran oaks nearby, the fungus dies too.'

Ted's discoveries gave our trees a perspective extending way beyond their years. We were looking at descendants of fungi that would have fruited on oaks in the thousand-acre Norman deer park, the setting for the original Knepp castle – the twelfth-century hunting lodge, now little more than a single ruined tower. Standing on its grassy mound above the River Adur, old Knepp Castle stares across the lake at its Nash successor down a vista of a thousand yards and nigh on nine hundred years. The fortified hunting lodge of 'Cnappe' had once belonged to King John, who stayed here a number of times, hunting deer and wild boar in a park distinguished by great acorn-bearing oaks. During the first War of the Barons, King John used 'heart of oak from Cnapp' to build engine towers to protect Dover Castle from Prince Louis of France. His son Henry III visited Knepp after it was restored to its original owners, the de Braose family, and sent fifteen does from the park as a gift to the Archbishop of Canterbury. Edward II stayed here in the early fourteenth century and King Richard II sixty years later. Sometime in the late sixteenth century the thousand-acre deer park fell into disrepair and the castle was eventually destroyed by Parliamentary troops to prevent its use as a military asset by the Royalist Cavaliers during the English Civil War. In 1729 the site was robbed for hardcore to build the Horsham–Steyning road, now the A24 dual carriageway that roars alongside it. But the tower, standing sentinel on its knoll in the heart of the estate, touched by sunlight, as it seems to be on even the dullest of days, is a reminder of the royal hunting forest – a near-mythical landscape that breathed life into generations of oaks at Knepp and provided the nursery for Repton's nineteenth-century park is revival.

'So here we are, with these extraordinary trees in our landscape, beacons of continuity, surviving against all the odds, and we barely give them a nod. Every one of these oaks would have a plaque on it if it was standing in Germany or Holland,' Ted said.

That might be because Britain, impoverished of ancient oaks as it is, still has many more than most countries in Europe. Over the centuries, as wars ebbed and flowed across the Continent, invading armies and displaced peasants plundered trees for shelter and firewood. Old, hollow oaks were the easiest to axe and easiest to burn. The nobility, champions of blood sports and hunting, had afforded some protection for oaks as source of the acorns that would see their deer and wild boar through the winter. But the Napoleonic code of inheritance rang the death knell for aristocratic estates in France and many other European countries. By the turn of the nineteenth century most traditional deer parks on the Continent had been broken up, depriving old oaks of their last redoubts.

In England, centuries of peace, primogeniture and the continuation of medieval deer parks as a source of pleasure for the nobility – the context for their stately homes – underpinned our ancient oaks' survival. A study recently conducted by the Woodland Trust identified 118 oaks in England with girths greater than 9m, making them around nine hundred years old or more – the majority of them in parkland on aristocratic estates – compared to only 97 oaks of the same age recorded in the whole of the rest of Western Europe. There are oaks at Windsor, Ted said, that quite possibly pre-date the tenth century, when the kingdom of England came into being.

That day in 1999, when Ted visited, Charlie and I began to look at the oaks we woke up to every morning with creeping unease. They were no longer stalwart companions, trees that would last out our lifetime and those of our great-grandchildren but beleaguered refugees, their skeletal limbs semaphoring distress. The implications of what Ted was saying were both profound and shocking. These oaks, which should be in their

prime, were ailing, possibly fatally, and their condition was down to us. Intensive farming had been taking its toll, and not simply on the trees themselves but the very earth in which they stood. The soil of the park that, under permanent pasture five decades ago, would have been full of vegetal chatter as mycorrhizae fired off messages between trees like a chemical circuit board, was now, in all probability, as silent as the grave.

2. At Odds with Everything

Until we understand what the land is, we are at odds with everything we touch.

Wendell Berry,
The Art of the Commonplace: Agrarian Essays, 2002

I am at two with nature

Woody Allen, *Clown Prince of American Humor*, 1976

Ted's visit to Knepp in 1999 was, in hindsight, an epiphany. It was the beginning for us of a new way of thinking; a spark that, ultimately, triggered a sweeping chain reaction that continues to this day. Our decision to protect the park oaks would, within a matter of years, begin to change everything. And as with all such pivotal moments the timing was key. Had Ted come a decade earlier his warnings might well have fallen on deaf ears. We would have listened to the impassioned tree man, an expert in his field, with interest, perhaps even regret, and unswervingly continued as we were. We would have been too engrossed in the unrelenting challenges of improving the farm and making a success of the business – not least, of clearing our overdraft – to give nature a second thought. In 1999, however, all that was about to change. By the end of the century, we were close to hitting the buffers; our arable and dairy business was in crisis. Faced with the uncomfortable truth that all our efforts over the

past fifteen years had come to nothing, we were desperately searching for alternatives to the current regime of intensive farming.

For over half a century Knepp had, like farms up and down the country, been speeding along a trajectory of intensification. Charlie had taken over the estate from his grandmother in 1987, her death attributed – by those who knew her well – to the twin blows of the hurricane that levelled acres of Knepp forestry and the Black Monday stock-market crash that had, for her, levelled everything else. In his early twenties, fresh out of Cirencester Agricultural College and a child of the so-called Green Revolution, Charlie was convinced he could make a go of a business that, even with heavy subsidies, had been haemorrhaging money. He had attributed the failing enterprise to his grandparents' failing energy and their reluctance to modernize. For a young man, working in partnership with them for two years had been fraught with frustration. In their weekly meetings in the Estate Office questions about efficiency and profit margins had been habitually brushed aside as bad form. The farm accounts were a gentlemanly pretence, with income presented every month excluding any of the associated costs, such as the wages of the farm manager and employees, the costs of farm machinery, tied cottages, the maintenance of farm buildings, veterinary bills and the rest. Talk had dwelled, instead, on country shows and livestock bloodlines and accessibility for the Hunt.

As soon as Charlie took over, shortly after he and I got together, he began doing what every modern farmer is supposed to do: rationalize, intensify, diversify and, if possible, spread fixed costs over a larger area. Britain, having joined the Common Market in 1974, was now wedded to European subsidies, which had neatly dovetailed with Britain's own post-war policy. After the war, France, desperate to protect her 'green gold', as de Gaulle referred to the country's farms, had persuaded the other Western European countries to subscribe to a similar system of government intervention based on industrial-scale production, guaranteed prices and protectionism.

Improvements in technical efficiency increased outputs further still – beyond what anyone had imagined – and by the 1970s Europe's agricultural supply so outstripped demand that grain and butter mountains, and milk and wine lakes accumulated in colossal grain bins and refrigerated warehouses across the Continent. By the early 1980s the Common Market butter mountain alone had reached 1 million tonnes. With a superabundance of grain the principal problem for the new wave of European cereal growers was how to prevent prices falling through the floor. Fattening beef animals on grain had been common practice for decades. Now, there was added incentive to feed animals on grain all year round. And not just beef animals. Sheep and dairy cows, too, would now be drawn into the compulsion for factory farming. The term 'zero grazing' became part of the vernacular.

Small farmers, especially those on marginal land like ours, were increasingly finding it impossible to compete with the new, big industrialized farms. By 1989 there were only 392 farms in Sussex maintaining a dairy herd – down from 1,900 in the mid-1960s – and the number of dairy cattle had halved. Only smallholders canny enough to improve their bloodlines, modernize their milking parlours and eradicate their inefficiencies could hope to survive. From just over 7,250 farms in Sussex in 1965 there were, by the late 1980s, fewer than 4,500 and these were mostly much larger and focused on arable.

By the time we took over, the five farm tenants at Knepp were ready to throw in the towel. Taking the tenant farms back in hand, amalgamating the dairies and investing in bigger and better machinery and farm buildings would, we hoped, bring us the efficiencies we needed to make the home farm profitable. Selling his grandmother's old-breed Red Poll cattle – the epitome, so it seemed to him at the time, of his grandparents' hobby-farming approach – had been a defining moment for Charlie. Following the national trend he had bought Holsteins and Friesians – modern cows bred specifically for dairy that could produce 8,500 litres of milk a year compared to a Red

regardless of the length of their legs, look to the loamy Grade 1 plains of Chichester with undisguised envy.

Sussex's clay hampered our machinery and our ability to compete with farms on better soils. Though, astonishingly, hedgerows could be removed on British farms without permission until 1997, enlarging the fields was not an option for us. The Victorian grid of ditches and underground drains that made farming Knepp possible at all was aligned to our small fields. The cost of installing entirely new, industrial-style drainage was beyond the realms of possibility. But the existing system was still costly to maintain. Clearing all the drains and ditches – just keeping them functioning – was three months' work for one man every year.

Small fields, inevitably, restricted the size of our farm machinery. Combines, rotavators, harrows and sprayers had to be able to turn nimbly in field corners and fit through our gateways: the efficiencies of the massive prairie-style machines of East Anglia were beyond us. In wet weather the clay hampered our ability to do anything. The weeks following harvest in September were a headlong rush to get the winter crops sown, all the ditches cleared and hedges cut before the rains set in and turned the land into a no-go zone. Spring crops were rarely an option. Nine times out of ten, tractors could not get onto the land by then.

Nonetheless, we had seemed to have been making headway. From 2.5 tonnes of wheat per acre in 1987 our yields had increased to an average of 2.75 in 1990. We had come a long way from the 1940s when Sir Merrik considered it a good crop if you could throw your hat and it didn't land on the ground. Occasionally, when the sun and the wind and the rain had all done the right thing, when we had sown and sprayed and harvested at the right time, when all the components of the algorithm miraculously coalesced, a field or two would even hit the 3-tonne mark, the yield routinely achieved on the loamy soils of Chichester. In 1996, when several fields produced 3.5 tonnes, and one a stunning 4 tonnes, we thought we might have

cracked it. I took photos of Charlie with our one-and-a-half-year-old daughter, jubilant in mountains of wheat safely stashed in our grain silos, hands plunged to the armpits in the fat, dusty grains. Our dairy herds were performing like a dream, consistently rated in the top 25 per cent of the British Oil & Cake Mills (BOCM) dairy herd costings, with one of our herds, run by a remarkable dairyman from Cornwall, rated top in the country. It was difficult to conceive of any dairy performing better on our type of soil.

We had diversified, too. Charlie Burrell's Castle Dairy Luxury Ice-Cream, produced in a state-of-the-art factory we installed in one of our old Sussex barns, was, by 1990, flying out of freezers throughout the south-east and in pride of place in Fortnum & Mason's, Harrods Food Halls and West End theatres, and we were poised to go national. Skimmed milk left over from the ice-cream was made into Castle Dairy low-fat yoghurt in a range of exotic flavours. We had even tried our hand at milking sheep and producing sheep's cheese and old-fashioned junket.

Quite when we realized the farm was doomed to fail is hard to pinpoint now, almost two decades on. Most years our sights were fixed so hard on improvements, always hoping the next year would bring greater returns, that failure seemed unimaginable. Increases in yields invariably instilled optimism as long as one looked at them head on without a sideways glance at the costs or the competition. Determination deceived us. The complexity of the mixed-farming business – dairy, sheep-dairy, beef and a rotation of nine different arable crops – made it difficult to identify the profitability of each enterprise month-to-month and year-to-year, throwing a smokescreen over a yawning chasm of costs – unrelenting capital investments in farm machinery and infrastructure: a new combine needed, further improvements to buildings, and compliance with endless new regulations from the Ministry of Agriculture, Fisheries and Food and from the EU, plus the rising costs of farm labour. And then there was the wildly fluctuating rate of the green

pound (until 1999 the exchange rate used to calculate the value of financial support within the EU's Common Agricultural Policy), which periodically screwed up everyone's calculations.

With the ice-cream business the prognosis was more clear-cut. In 1991 the surprise invasion of the UK by Häagen-Dazs, a brand invented by the $15 billion US company Grand Met (the Darth Vader of food conglomerates), had us laying down our light sabres in surrender. With a sexy $35 million advertising campaign and an aggressive strategy of installing free Häagen-Dazs-only display freezers in thousands of outlets (a practice since made illegal), we were blown out of the galaxy along with most of the UK's ice-cream makers.

But it wasn't just Häagen-Dazs. Even if Darth Vader hadn't blasted into our orbit, ice-cream was probably never going to save us. The margins were much smaller than our advisers had predicted. Häagen-Dazs itself took over a decade to see itself out of the red.

Ultimately it was farming itself that undermined us. After fifteen years we had made a cash surplus in only two. As the global market expanded, farmers across Europe were competing with cheap cereals from Asia, Russia, Australia and the Americas. We were worried, too, about huge fluctuations in the value of milk quota, in which we were now invested to the tune of 3.2 million litres. Every time the price per litre dropped by a penny we lost a fortune, and when the price dropped, so did the value of our cows. Yet there was no let-up in the cost of maintaining the dairies and farm buildings. We were worried, too, for the long-term future of arable. The days of huge, illogical European farm subsidies – comprising a staggering 57 per cent of the total EU budget – were surely numbered. Sooner or later, one had to imagine, subsidies would be phased out and without them we, like virtually all farmers on marginal land in the UK, would be making unsustainable losses and heading towards the oblivion of bankruptcy.

In long, weary meetings with our land agents Charlie had begun considering our long-term strategy. We had become

increasingly aware that we were tiptoeing around a time bomb. The fateful detonation was triggered in 1999, a few months before Ted's visit, when our farm manager suggested amalgamating two of the dairies. His plan made logical sense – it was another way of rationalizing the farm and ironing out inefficiencies – but it would cost us a cool £1 million. Our overdraft was already £1.5 million. The proposal threw our position into stark relief: we couldn't afford any more 'improvements'. And without improvements our productivity would stagnate. We were caught in a trap. The farm was unsustainable and the figures were now shouting it out.

This was the prospect we were facing when Ted came to advise us on the Knepp Oak. We were, for the first time since we had taken over the estate, open to other options. Looking at the park trees with fresh eyes suggested a solution for 350 acres around the house, at least. In 1991 the European Community, increasingly concerned about the environmental impact of agriculture across Europe, had set up an agri-environment programme. It was a somewhat perverse strategy that, for the first time, created two opposing forces of European funding administered under one roof: incentives for all-out intensive agriculture on the one hand and incentives for reversing the effects of intensive agriculture on the other. Under the European agri-environment umbrella the UK government had established the Countryside Stewardship Scheme administered by the Ministry of Agriculture, Fisheries and Food with aims 'to improve the environmental values of farmland throughout England'. They were currently appealing for park-restoration projects. The timing was spot on and our submission to restore the Repton park received funding, to commence the following spring.

The only alternative for the rest of the land – as far as we could see – was to cut our overheads, give up dairying, sell all our farm equipment and put everything to arable under contract. The only problem was that neither of the two big farming contractors in the country would take us on. In the end,

Charlie's uncle Mark Burrell, already contract farming on our northern border, came to our rescue. In much the same position as us, he could still see advantages in spreading his overheads over a larger area and agreed to take on all our arable land.

The decision to give up in-hand farming, though, was a sombre moment. On 1 February 2000 Charlie called our farm manager, John Maidment, into the office where, beneath the black and white photos of prize cows and sixty years of Royal Show certificates, he broke the news. Acutely conscious of the farm's predicament, John was, nevertheless, devastated. After all the hard work, with respectable arable yields and outstanding milk production, he found it impossible not to believe that another solution was waiting out there somewhere. The farm workers were stunned. With those patient enough to listen, or blankly disbelieving, Charlie went through the figures. They left the office grimly shaking their heads, trying to take it in. It was a black day. Eleven men lost their jobs.

Over the next six months Charlie and John tried to sustain morale long enough for the farm to be dismantled. Our three dairy herds were dispersed – forty or so cows at a time, loaded up directly after the early milking so they could make it to their destinations at other ends of the country in time to be milked that evening. For the first time in its history Knepp was without livestock.

The wet and windy weather that set in on Sussex in mid-September, causing the first of the big floods along the south coast, did not let up on Thursday 28th, the day we sold our farm machinery. It was the beginning of the bleakest autumn in the UK since records began in 1766 and the clay underfoot felt as though it was pulling the world down with it. The local farming community turned out in force – some to take advantage of knockdown prices, others, tight-lipped, wondering, perhaps, what lessons our demise might hold for them. Along the length of West Drive, the sale paraded Knepp Estate's failed investments and evaporated energies and aspirations for all to see. In place of honour stood our state-of-the-art John Deere

3. The Serengeti Effect

One touch of nature makes the whole world kin

William Shakespeare, *Troilus & Cressida*, c. 1603

The summer of 2002 was a revelation. Every morning we woke up cradled in undulating prairie. From our windows industrial farming had vanished. No excavated soil, no machinery, no serried ranks of arable, no fences. Returning the park to permanent pasture was more than a lifeline for the oak trees: it was proving a tonic for us. The land, released from its cycle of drudgery, seemed to be breathing a sigh of relief. And as the land relaxed, so did we. This was a different feeling from the relief of giving up in-hand farming on the rest of the estate. Handing over the farm to a contractor had lifted much of the angst and responsibility from our shoulders but apart from removing our dairy cows from the fields it hadn't changed the landscape or the way we thought about Knepp. With contract farming we were still asking the same of our land – only at a further remove. We were silent witnesses to the same Sisyphean struggles, locked in the same gritted-teeth compact with the clay. With those labours gone within the sightline of the house, there was a deeper sense of release. Something gentler, more harmonious, seemed to be stirring into life. For the first time, the park restoration showed us, we were doing something *with* the land, rather than battling against it.

Most conspicuous of all was the ambient noise: the low-level surround-sound thrumming of insects – something we hadn't even known we'd been missing. We walked knee-deep through ox-eye daisies, bird's-foot trefoil, ragged robin, knapweed, red clover, lady's bedstraw, crested dog's tail and sweet vernal grass, kicking up clouds of butterflies – common blues, meadow browns, ringlets, marbled whites, small and Essex skippers – and grasshoppers, hoverflies and all sorts of bumblebees.

To us, unattuned, as yet, to the explosive reactions of nature, it seemed this fluttering, flopping, hopping, buzzing phenomenon was coming from nowhere – like Virgil's bees from the belly of a rotting ox. But the truth was perhaps even more miraculous. Somehow, nature had found us, homing in on our tiny patch of land from unseen distances, the moment these few acres had become hospitable again.

Most insects travel with ease, often aided by the wind or passive dispersal by other birds and animals; many are opportunists, compelled by an urge to go forth and multiply even when the odds are mightily stacked against them. A marbled white or dark green fritillary butterfly, for example, can flutter determinedly over considerable distances in search of new territory. The adventure, for most, will end in starvation, predation or accidental death. But, in the remote event she does find the habitat with the particular plant she is seeking, a female can lay hundreds of eggs which will hatch into caterpillars – if the weather is favourable – in a matter of days. Others will have colonized Knepp's rejuvenated park from patches of margins closer by – from the old sward around the castle ruin or the untouched bases of hedgerows, or from the verges of the A24. The generation of invertebrates that found us that summer would have been doubly blessed by the fact that, as brand-new habitat, habitual predators in the form of bats, birds and reptiles were uncommonly scarce. The result was an insect paradise.

It had been an unsettling process, preparing the park for its new lease of life. Finding a source of grass and wildflower seeds native to our soil had proved shockingly difficult. In the whole

of Sussex there are, as I write in 2016, fewer than 870 acres of wildflower meadows left. Since the 1930s, 97 per cent of the UK's wildflower meadows – 7.5 million acres – have been lost, mostly ploughed up for arable, fast-growing agricultural grass and forestry. In the lowlands the total remaining is 26,000 acres; in all of the British uplands, it's a pitiable 2,223 acres. The Weald Meadows Initiative had discovered a tiny one-acre remnant of unploughed pasture sixteen miles to the north-east of us from which it had collected seeds. This handkerchief of native flora on land belonging to Charlie's cousin had most likely survived, a clearing amongst acres of plantation, as a stand for a pheasant shoot. Like most meadows in the UK it owed its existence not to targeted conservation or enlightened altruism but to accidents of fortune. At Knepp, we had two or three tiny scraps of wildflower meadow left, including an apron of sward that had never been ploughed because it was tucked inside the early nineteenth-century arboretum known as the Pleasure Grounds, a short walk from the house. In September devil's bit scabious turns it a sea of smoky blue. But none of these remnants were diverse enough to provide us with the full spectrum of native seeds.

To give the botanical gold dust we bought from the Weald Meadow Initiative a chance to establish we had first to sterilize the soil of undesirable competition. Most of the soil in the UK, on which our native flora has evolved, is naturally poor so our land had to be returned to its original 'unimproved' state. This meant reducing the levels of nitrates and phosphates that, for decades, had been added to the soil to drive the growth of our arable crops. It felt counterintuitive, somehow, like intensifying a sickness to achieve a cure. We were aware of shifting between opposing systems of value. We went about the task like farmers but, for the first time, we were thinking like conservationists.

So, in spring 2001, having received our funding for the park, we ploughed and rotavated the soil to a fine tilth. Three weeks later, we sprayed off the resulting growth with the herbicide glyphosate; then surface-harrowed and sprayed again in

mid-August. That September we sprinkled on our precious Weald Meadow seed mix. The following summer, we cut the new growth for haylage – a sort of semi-dry silage, giving the seeds a chance to fall from their stalks onto the earth again to germinate; and then second-cut the areas that grew back well, topping the rest. In the third year we repeated the cuttings again.

Nitrogen disappears rapidly from the soil, either used up by the plants themselves or through evaporation and run-off – which is why arable land growing non-nitrogen-fixating crops is always so hungry for it. Phosphates, on the other hand, can stay in the soil for twenty to thirty years. Cropping aggressively, repeatedly carting the vegetation growth off the land, is the most effective way of reducing artificial phosphates in the soil. By the third year we reckoned we had tipped the balance of the soil back in favour of our native broadleaf flowering plants and grasses. They could now compete with the residual seedbank of commercial grasses.

The drop in levels of chemical fertilizers, alone, was beneficial for the park oaks and over the next few years we would see a gradual rejuvenation of their crowns. But we were too late to save one grand old oak by the edge of the lake. Standing at the base of a slope where it was particularly susceptible to chemical run-off, it gave up the ghost even as the wildflower meadow erupted around it. Under the old regime we would have taken the chainsaw to it without a thought. Directly in the sightline of the house, it was a blot on the landscape; to a farmer's eye, a beacon of uselessness and neglect. Ted, by now a regular visitor, adviser and friend, cast it in a different light. He pointed us to eighteenth-century paintings with dead trees in the landscape. In the early Romantic period, Queen Charlotte, wife of George III, he said, had imported dead standing trees into the park at Kew to give a sense of age and continuity. Even Humphry Repton appreciated declining trees in his landscapes: 'The man of science and of taste,' he wrote, 'will . . . discover the beauties in a tree which others would condemn for its decay.'

The Victorians, Ted said, had a lot to answer for. It's from

them we get our corseted obsession with tidying up. That's when the rot set in – or, rather, was never allowed to set in. Dead and dying trees are part of nature's recycling process, stimulating biodiversity, but they are now conspicuously missing from our landscapes. We have become as intolerant of natural processes of decline and decay, Ted said, as we are of our own ageing and dying.

We made a vow to leave the dying tree to its own devices. It was our first lesson in sitting on our hands and leaving Nature in the driving seat. We watched as the oak began to die, first with discomfort, then fascination, and, ultimately, something close to affection. A different aesthetic was beginning to dawn. The oak took on a beauty all its own; a kind of sculptural, metaphysical grandeur. Death became a different kind of living. As beetles and other saproxylic (dead wood eating) invertebrates began to colonize the tree, another universe sprang to life. Greater spotted woodpeckers engaged in an orgy of chipping, hacking and drilling, seeking out juicy insect larvae. For interminable intervals in summer a heron would position itself on a lower limb, stock-still, angled at the water. Shortly after a colony of short-tailed voles took up residence amongst the rabbit warrens in the roots, we spotted a big red dog fox circling the trunk, trying his luck. In winter his tracks trailed back and forth to the tree from undergrowth on the other side of the lake, leaving a single tramline through the dusting of snow on the ice. The barn owl box nailed to the tree years ago had never been used, but now it attracted a pair of sparrowhawks. In the summer, a glide-past by a sparrowhawk over the castle would set the house martins chattering and wheeling around the turrets in panic. For a while sparrowhawks zeroed in on the bird table by the kitchen. We'd be startled from our lunch by the sparrowhawks in search of theirs: a thudding of blue tits against the windowpanes as the hawk swooped in and snatched her stunned quarry from the paving stones.

In this new mindset, we left fallen branches from the other trees in the park lying on the ground – another natural process

fallow were living in southern England, and quite possibly at other Roman sites around Britain, in the first century AD. Some of the bones belong to elderly fallow – evidence that the animals were not so much food or quarry but symbols of prestige, as they have remained in deer parks to the present day. They were kept with other exotics in enclosures known as 'vivaria', prototype safari parks – testimony, in a Roman's eyes, to man's civilizing control over nature. Sometimes they were even trained, to the delight of an audience, to assemble for feeding at the sounding of a horn.

Genetic analysis indicates that these Roman fallow – from the western Mediterranean – went extinct in Britain following the collapse of the Roman Empire. The fallow brought in by the Normans in the eleventh century came from the eastern Mediterranean. The Knepp deer park – a thousand acres of open wood pasture surrounding the old castle, emparked within a wooden pale (a fence made of cleft oak stakes set into the ground and nailed to a rail) – must have been one of the first, established at the very beginning of the Norman craze for hunting. Within the park, fallow were hunted on horseback with dogs – the sport of noblemen. Venison was a dish for feasts and the honouring of guests, and a gift beyond price. The castle itself, more hunting keep than fortress, was built by William de Braose, a powerful Norman supporter of William the Conqueror and Baron of the Rape of Bramber, one of the Norman subdivisions of the county, lying between the rapes of Arundel and Lewes. His base was a proper fortified castle down river near the coast, but even so, 'Cnappe' was well protected, raised on a mound of earth or 'motte' overlooking the Adur and surrounded by deep ditches most likely filled with water. It might well have been intended as a retreat from Bramber Castle in the event of invasion or rebellion.

The origins of the name are as diverse as its spellings – from the Saxon 'cneop' for the crown of a hill, perhaps; or 'knappen' meaning to hold fast; 'knappe' for a knave or knight; or the French word 'nape' for the skin of a stag. Tales and romantic

imaginings swirl around the crumbling ruin like mist from the lake. The ghost of a white hart, symbol of royalty, signaller of quests, is said to paw the ground on the motte, retrieving secrets from the past. A medieval gold ring, unearthed in the eighteenth century, engraved with a doe lying under an oak and, inside the band, the words 'Joye sans Fyn' (Joy without End), is thought to bring untold fortune to whoever possesses it.

Certainly it is for the joy of the hunt and the riches of venison that 'Knappe' gained a reputation in the thirteenth century when King John confiscated the land from one of de Braose's descendants, taking it as his own royal forest. The king would travel on horseback, covering distances difficult to achieve on Southern Rail today. Eight days in April 1206 see him at Canterbury on Monday, Dover and Romney on Tuesday and Wednesday, Battle on Thursday, Malling on Friday, Knepp on Saturday, Arundel on Sunday and Southampton on Monday. He kept 220 greyhounds at Knepp and hunted here at least four times – in 1208, 1209, 1211 and 1215. Over one Christmas his queen, Isabella, a keen huntswoman herself, stayed eleven days in the keep. In his absence, the deer at Knepp were a source of benefaction. He wrote numerous letters to his agent at 'Knappe' instructing him to send carcasses of venison to certain nobles and the royal courts, or to entertain favoured guests: 'We send you Michael de Puning, commanding you to permit him to take all the fat deer he can without the park at Cnapp [sic]; as well as by bow as by his dogs.' And not just for deer-hunting: 'We send you Wido the huntsman and his fellows to hunt in our forest at Cnappe with our boar hounds, for that they may take daily three or four boars.'

The passion for deer parks continued throughout the thirteenth century as the aristocratic culture of hunting and game-eating intensified. By the 1300s there were over three thousand fallow-stocked deer parks in England and by the fourteenth century deer parks covered roughly 2 per cent of the English landscape. It is this Norman strain of fallow that colonized our landscape as escapees when deer parks began to fall

into disrepair in the fifteenth century. Knepp itself was disemparked sometime in the sixteenth century, the deer simply released into the open countryside. 128,000 fallow deer now live wild in the UK.

But it was the emparked deer at Petworth we had in our sights. Apart from their impressive size and lineage they are accustomed to walkers and their dogs, vehicles on the drives, a park boundary and wide-open spaces with no cover. They wander the Capability Brown landscape in full view – something we hoped they would be content to do once they found themselves in the restored Repton landscape at Knepp. Getting them here, however, was not a walk in the park. Dressed in camouflage like SAS commandos one bitter February morning and marshalled by Dave Whitby, Petworth's Head Keeper, a group of twenty of us corralled two hundred panic-stricken animals down an old avenue. Too many to tranquillize, the only way was to catch them up conscious and kicking. With the deer entangled in our nets, we leapt out to immobilize them, slipping plastic cones over their faces to calm them and trussing the thrashing bodies, legs tucked carefully under, into knotted bundles. The bucks had their antlers sawn off (since the mature antler is dead bone this process is no more painful for the animals than clipping our toenails is for us) before being loaded with the others into the back of the truck.

It took the fallow the best part of spring to fully recover from the trauma of their ignominious capture but by summer they had settled down and were wandering quietly through the landscape like herds of impala in the Serengeti. Rooks and jackdaws, quick to adopt the habit of African cattle egrets, rode on their backs, pecking at parasites. During the end of June and early July our first generation of fawns were born. We would stumble across them, a day or two old, hidden in the long grass, while their mothers grazed with the herd. At this vulnerable age, until strong enough to run with the adults, they have little scent, to avoid detection by predators. Fawns are programmed to stay stock-still whenever they sense danger close by, until

their mother returns to feed them. It can be hours between visits. We began to walk carefully in fear of stepping on one. Their caramel coats are perfectly camouflaged in the summer grass. Often the first thing you see is a pair of dark, unblinking eyes.

The deer were far less timid at night and soon we were opening the front door to find a group of forty or more fallow milling around on the grass circle in front of the stone Dog of Alcibiades, the oblivious castle guardian. Twenty feet away from us, the fallow barely looked up from their grazing. Fifteen years on, it's still a wonder to stand in the dark on a still night, listening to their gentle, mewing reassurances and the soft sound of munching.

Within a year the fallow could recognize us and all the regular local walkers with trustworthy dogs, and their daytime flight distance reduced to around twenty-five yards for the bucks and seventy for the does in summer. As soon as they spotted an unfamiliar dog, however, they would bound away, bouncing on four legs – 'pronking' – in a defiant show of strength and agility.

Our powers of recognition were improving, too, as we familiarized ourselves with the four distinctive colourings: 'common' – the classic chestnut coat with white mottles pronounced in summer but darker and less spotted in winter; 'menil' – with very distinct spots continuing throughout the winter coat; 'melanistic' – very dark, almost black, with no spots; and 'leucistic', the rarest – white with no markings, leaving just the dark eyes and nose.

While the summer herds lulled us with visions of the African veldt, autumn brought drama. In October our first rut began and the mists wafting up from the lake were laced with the stench of testosterone. Deep, groaning belches – primordial and unnerving – rolled around us in the damp air, the gruff eructations pumped out day and night a surer sign to the does of a buck's physical fitness than even the size of his body or antlers.

In the Pleasure Grounds, clumps of hair and branches shredded by thrashing antlers lay scattered amongst the rotting leaves. Walking through the woods, a pheromonal whiff would suddenly kick into the nasal passages – like opening the door onto a locker room after a 1st XV rugby match, Charlie recalled. These were territorial markers where the bucks had been rubbing their facial scent glands on the trees. With seven major external scent glands – in the forehead, under the eyes, in the nose, in the feet, inside the foreskin and inside and outside the hind legs – deer are like cervine skunks, communicating with individuals from their own and other species through the raw complexities of smell. In the rut these pheromonal emissions reach peak intensity with even their salivary glands emitting a pungent stench.

As the days began to shorten, the bucks braced themselves for battle, posturing and strutting shoulder to shoulder in pairs, in a formulaic choreography known as 'parallel walking'. Sizing each other up, they walked stiffly side by side, then, in a flash, turned and clashed together, locking antlers and wrestling, muscles straining, for minutes, until one of them cantered off, tired or intimidated.

The biggest bucks staked out a lekking site on the far side of the Pleasure Grounds, a site they still use. Pawing up the earth with their hooves, drenching themselves and the ground in urine, this is their gladiatorial arena, the battleground for possession of females; a case, sometimes, of live or die. With their blackened, urine-stained bellies, they roar like primeval beasts, stinking to the heavens, crazy with aggression and lust. These are different animals to the ones we have known all summer, the old boys grazing placidly on their own, the young bloods hanging out in a gang, all lads together. There is an edge to life – the call of sex, the desperate drive to perpetuate the genes. Every buck for himself. The does milling under the oak trees focus wisely on the business of loading up calories in preparation for winter. The bucks, on the other hand, will enter winter half-starved and exhausted. The weakest will die. Nature's culling of unnecessary mouths.


image
not
available

the Dutch bay that was reclaimed over the course of the twentieth century. The scene in front of us was almost incomprehensible: the flat, grassy landscape, as tightly cropped as Kenya's Maasai Mara, was populated by meandering herds of grazing animals: stocky, primeval-looking Konik ponies the height of a zebra with black legs and faces and mouse-grey coats, foals at foot; dark-coated Heck cattle with the sharp, curving horns of oxen; great gatherings of red deer. Through the binoculars we could see, on a raised mound, a knot of furry red fox cubs scrabbling over each other in excitement as their parent, brazen as a jackal, returned to the den with a goose in its jaws. As we approached a strip of open water, greylag geese tumbled down the banks with their young like a mini-crossing of wildebeest. Thirty thousand greylags – almost half the entire population of north-west Europe – now moult here every year. For sheer biomass Charlie and I had seen nothing like it this side of Botswana's Okavango Delta.

It was hard to imagine that, a few decades ago, this animated land was all under water. In 1989, only twenty-one years after being reclaimed, it was designated a Ramsar site, a wetland of international importance for nature. The biting wind carried with it the competitive cacophony of birds. From the reeds, the virtually subsonic 'boom' of bitterns – like a child blowing into a milk bottle – played the bass refrain in a symphonic chatter of reed warblers, penduline tits, bearded tits and the familiar *brekekekex-koax-koax* of marsh frogs. Lapwings displaying over the pools furled and unfurled like black and white handkerchiefs with piercing 'pee-wits'. Spoonbills wading in the shallows, head plumes ruffled by the wind, waggled their spoons back and forth through the water. Grey herons cast a steely eye from the banks. Great white egrets and little egrets, breeding here after an absence from the Netherlands of almost a century, lumbered into the air. High above us, beyond the trilling skylarks, three white-tailed sea eagles, wings like barn doors, were being chivvied by a marsh harrier. The eagles – the fourth largest eagle in the world and, until the 1980s, all but

extinct in Western Europe – had built their nest, a gigantic shaggy thing like an African hamerkop's nest, in the branches of a dead willow. These habitués of ragged coasts and remote, secluded islands were, in effect, breeding below sea level in one of the most densely populated areas of Europe. Their arrival had been a surprise to all except, perhaps, Frans Vera.

'When I said, in 1980, that I was hoping to attract white-tailed eagles to the Oostvaardersplassen, everyone said I was mad,' Frans explained. 'For a start, I was told they would never nest so close to huge human populations, and never in anything but giant oaks, beech or pine – never in willows. But that was simply because no one had ever observed them to do this. There hadn't been that opportunity for them. So the white-tailed eagle has become tied in our minds to a remote montane habitat with oaks and pines. And if we want to conserve for white-tailed eagles, that's what we are told to provide.

'But this is a circular argument. We've become trapped by our own observations. We forget, in a world completely transformed by man, that what we're looking at is not necessarily the environment wildlife prefer, but the depleted remnant that wildlife is having to cope with: what it has is not necessarily what it wants. Species may be surviving at the very limits of their range, clinging on in conditions that don't really suit them. Open up the box, allow natural processes to develop, give species a wider scope to express themselves, and you get a very different picture. This is what the Oostvaardersplassen is about. Minimal intervention. Letting nature reveal herself. And the result is an environment we know nothing about.'

Softly spoken and meticulously reasoned, there is nonetheless an air of impassioned determination about Frans Vera. He has a message he feels people should hear. The key to the Oostvaardersplassen's extraordinary dynamism, he says, is grazing animals.

'We realized something important early on in the establishment of the reserve,' said Frans. 'That there's a fundamental process we haven't accounted for in nature, something that

doesn't often get a chance to express itself when humans are in control: the influence of animals. Animals are drivers of habitat creation, the impetus behind biodiversity. Without them, you have impoverished, static, monotonous habitats with declining species. It's the reason so many of our efforts at conservation are failing.'

The harbinger of this insight was a complete surprise. 'It was the greylag goose that showed us how this worked. No one imagined this bird would turn out to be a keystone species. The geese solved what we thought was an insurmountable problem.'

The South Flevoland polder had originally been designated for agriculture, explained Frans, with the wettest, low-lying area – now the Oostvaardersplassen – earmarked for industrial development. When the oil crisis and economic recession of 1973 put industrial plans on hold, nature grabbed its chance. A large shallow lake remained in the lowest part of the polder. Very quickly, marsh vegetation developed around the shallow water and an astonishing number of wetland birds, many of them rare, began descending on the area. In 1978, a biologist, Ernst Poorter, published an article about the wildlife appearing on the polder in the *Journal of the International Council for Bird Preservation* (later 'BirdLife International'). The article was picked up by Frans Vera, Fred Baerselman and other ecologists who, excited by the arrivals, began lobbying for the area to be protected. In 1986 the Oostvaardersplassen was officially designated a nature reserve.

There were challenges in managing it for nature, however. The natural progression of such shallow ponds and marsh – as we knew from our rapidly shrinking lake at Knepp – is to close over with reeds, silting up until it is colonized by willow and eventually disappears altogether. In most wetland reserves an inordinate amount of time and effort is spent preventing this happening by mowing and cutting back the reeds. But the area of reeds in the Oostvaardersplassen was simply too large to be hand-cut the traditional way and the soil's load-bearing capacity could not sustain heavy machinery.

'Without proper management we assumed this area would simply turn very quickly into woodland,' said Frans. 'There was nothing we could do but sit back and watch it happen.'

And then something remarkable occurred. Greylag geese discovered the marsh. They came in thousands from all over Europe, attracted by the scale of the area and its inaccessibility which made it the perfect sanctuary for the four to six weeks of their summer moult as they waited – sitting ducks, you might say – for their flight feathers to grow again. For the month or so they were laid up in the Oostvaardersplassen they consumed huge quantities of marsh plants and their rhizomes and, as a result, the marsh and its interconnecting ponds did not close.

'We discovered something: the grazing of the greylags was preventing the area becoming covered with trees. This was the astonishing thing: the geese were leading vegetation succession – not the other way round. But more than that, their grazing was adding to biodiversity. They were changing extensive reed beds into a more complex habitat of reeds and shallow water, and this was attracting more species than other wetland reserves in the Netherlands that were carefully managed by humans.

'So now we had another problem. We needed to make sure the greylags would continue using the marshland. We realized we needed to create grassland – their usual habitat – adjacent to the marsh; somewhere they could congregate before and after moulting to build up their fat deposits. The question was how? Could we put grazing animals into the dry areas of the polder that were nothing but reed beds and willow saplings and see if, on their own, they could create grassland? Could grazing animals prevent the succession of trees on dry land, just as the geese had done in the marsh? And if we left the grazing animals to their own devices, as we had with the geese, might they, too, generate something even more interesting and more valuable in terms of biodiversity? In effect, could we manage this land for nature not by costly human intervention, but using natural processes, with grazing animals as the drivers?'

This idea – that grazing animals could prevent spontaneous

forest succession and generate more complex and biodiverse habitats instead – was heretical. Until this point, only one form of natural process was recognized by most ecologists as a primary driving force of nature – that of vegetation succession. As any European farmer knows, if you leave a patch of land abandoned, it soon reverts to scrub and, eventually, tall trees. It is a state known as 'climax vegetation' – the destination which nature is supposedly endlessly struggling to reach. Before human impact – the prevailing theory goes – any land with the climate, soil and hydrology for trees to grow was covered with closed-canopy forest. In temperate zone Europe only the tops of mountains, the very steepest slopes and some raised bogs would have been devoid of tree cover. This notion, known in scientific circles as 'closed-canopy theory', has permeated popular culture and become the mythological baseline for our distant past. In Britain, it is said, before men began swinging stone axes at the woods, a squirrel could have run from John O'Groats to Land's End across the tops of trees. Closed-canopy woodland has become synonymous with nature, and people are seen as its destroyer: it was man who opened up the primeval forest, and man who, maintaining the landscape for agriculture and habitation ever since, prevents the trees from taking over again.

'But this theory of closed forest overlooks another force of nature altogether,' said Frans, 'one that works in opposition to vegetation succession: animal disturbance.'

The problem, he explains, is that we have forgotten about the megafauna that would have been roaming our landscape before we arrived on the scene: large herbivorous mammals like the aurochs (the wild ox), tarpan (the original wild horse of Europe), wisent (the European bison), elk (known in North America as moose), European beaver and the omnivorous wild boar. All, according to fossil bone records, re-colonized the lowlands of Central and Western Europe along with red deer and roe deer about 2,000 years after the end of the last ice age – around 12,000 years ago. Trees, on the other hand – according to the pollen records – appear only between 9,000 and 1,500 years

today amongst both foresters and ecologists, and has Frans shaking his head in frustration. 'The problem is,' he says, 'we're always working from the wrong baseline.'

Climax vegetation theory, originally propounded by the American botanist and author of *Plant Succession*, Frederic Clements, in 1916, and subsequently further developed by the English botanist Sir Arthur Tansley, author of *The British Islands and Their Vegetation* (1939), among others, throws up a further powerful psychological barrier for conservationists devising strategies for nature management. Closed-canopy forest is demonstrably species-poor compared with managed habitats like meadows, pasture, heaths and traditional farmland.

'What it looks like, if you subscribe to the closed-canopy story,' says Frans, 'is that, in Europe – before we embarked on the destructive practices of modern industrial farming – man actually improved biodiversity because traditional farming and forestry practices like haymaking, pollarding and coppicing clearly sustain a much broader spectrum of habitats for wildlife than closed-canopy woodland.' This is the prevailing wisdom amongst ecologists like Heinz Ellenberg who, in *Vegetation Ecology of Central Europe* (1986), argues that 'Central Europe would have been a monotonous wooded landscape, if mankind had not created the colourful mosaic of fields, heaths, hay lands and pastures.'

'No self-respecting ecologist wants to see a return to dark, monotonous, species-poor forest across the whole of Europe,' Frans went on. 'This presents us with an enormous responsibility and workload. If man is the driver of biodiversity, then man has to continue to manage nature intensively and at huge expense. We simply cannot believe that nature is capable of doing this on her own. But where would biodiversity have come from in the first place, if not from nature? We forget that nature has been around a lot longer than us.'

Where, then, did all these species so happy in meadows and pastures, coppices and commons, live before we arrived with our oxen and pitchforks, our billhooks, hay carts and flails?

Ecosystems on the continent of Africa provided an answer. It is in the place of man's origin that, historically (until the colonial annihilations of the last two hundred years or so), we have had least impact on the indigenous flora and fauna. Evolving alongside man, African animals had a chance to develop defensive strategies. Elsewhere in the world, however, the arrival of humans – by then highly developed, weapon-carrying and rapidly populous – had a transformative, often catastrophic impact on wildlife, particularly on megafauna. Ecologists like Frans in the Netherlands and others in Germany were inspired by studies coming out of the African savannah including *Serengeti: Dynamics of an Ecosystem* – the work of Michael Norton-Griffiths and Anthony Sinclair, published in 1979 – which was one of the first to show how the actions of grazing herbivores encourage numerous species of plants and animals.

'Africa gives us a useful paradigm,' Frans explained. 'It shows the vital role played by large numbers of naturally occurring grazing animals in an ecosystem – how they create and sustain species-rich grasslands. So why couldn't this have happened in Europe? Why suppose that grazing animals can have a dynamic and positive impact there, but not here?'

And so began the experiment to release free-roaming grazing animals into the Oostvaardersplassen. As in Africa, the animals would be left to their own devices, living in natural herds, with no supplementary feeding or other intervention. They would need to be old breeds, sturdy, with strong survival instincts, able to fend for themselves through the winter – basically, more like their ancestors than modern, highly selected animals. They would, in effect, be acting as proxies of Europe's missing megafauna. The extinct aurochs, a beast of over ten feet from nose to tail, was represented by Heck cattle – a breed designed in the early twentieth century by the brothers Heinz and Lutz Heck, who intended to rescue the aurochs from confusion with the wisent, or bison – the other large bovine of Holocene Europe. The Hecks' attempt to recover the traits of the aurochs through selective breeding gained notoriety when it was subsequently

celebrated by the Nazis as a symbol of their racial ideology. Although the Heck brothers' methodology remains controversial, their experiment succeeded in securing recognition for the aurochs as the ancestor of modern cattle. Heck cattle carry the genes of more than eight old breeds including the Highland cattle of Scotland, Britain's White Park cattle and fighting bulls from Spain. Though still a good eight to twelve inches shorter than the massive aurochs of old, and, with a Heck bull typically weighing in at 1,300lb, at least 220lb lighter than a bull aurochs, they are, nevertheless, imposing animals. Konik ponies, a short, stocky breed with dun coats and a dorsal stripe, originally from the Biłgoraj region of Poland, were chosen for the Oostvaardersplassen experiment for their hardiness and their supposed phenotypical resemblance to the extinct tarpan. They, too, had been the subject of a 'breed-back' experiment, started by a Polish count in 1936. Roe deer were already naturally present in the Oostvaardersplassen in small numbers, and red deer were added to the mix.

'We wanted to introduce the kind of grazing variation you find in Africa and that would once have prevailed in Europe. Of course, this is an imperfect representation of all the animals that would have originally been here but there are still huge positives from bringing these species together. All these ungulates eat in different ways – they have very different mouths, different digestive systems, different behaviours and different preferences. Roe deer are browsers, for example – they feed on twigs, brambles and saplings; cattle and horses are primarily grazers, with some supplementary browsing; red deer graze in the growing season and browse and de-bark in winter when the grass gets tougher. They can even de-bark poisonous elder by neutralizing the cyanide in their stomachs – something cattle and horses cannot do.

'The ancestors of these animals would have had the same or very similar feeding strategies. They would have had the same gut flora and seed-carrying capacity – cows, for example, transport two hundred and thirty plant species in their gut, hair and

hooves. These different species would have existed together in the past and we felt their combined grazing actions in the Oostvaardersplassen would create and maintain open grassland with greater floral complexity.'

As late introductions from the Middle East, goats and sheep – descendants of the wild mouflon of Mesopotamia – do not belong to the suite of herbivores associated with the postglacial ecosystems of Western Europe so they were excluded from the mix. At first, the numbers of grazers introduced were very low – thirty-two Heck cattle in 1983; twenty Konik ponies in 1984; thirty-seven red deer, transported from Scotland and elsewhere, in 1992. The idea was to let the populations grow at will. Here, too, Africa provided inspiration.

'In Africa you have vast herds of ungulates grazing together in the landscape. There are predators, of course, but population density itself is not regulated by predation.'

The size of grazing herds is driven primarily by the amount of food available. In times of plenty, with good rains and lots of vegetation growth, populations explode. In seasons when there is less to eat – notably, for Africa, during the dry season and droughts – they fall. Under-nourished females will not ovulate. If they are in slightly better condition they may ovulate but not conceive. If they do conceive, they may abort or absorb the foetus. And if they get as far as the later stages of pregnancy, the mother will prioritize the foetus over herself, to such an extent that she may suffer toxaemia, often fatally. Older animals – males in particular – weaken and die. A decline in herbivores releases the pressure of grazing on the vegetation, allowing for a burst of growth when the conditions are right, which stimulates another population spurt.

'It's a natural cycle of fluctuations,' says Frans. 'Although the climatic conditions in temperate zone Europe are not as harsh as Africa, I see no reason why this could not have been a process that once worked here too. Our long winters have a similar impact as an African dry season; a severe winter is like

a drought. Seasonal variations and longer cycles of pressures on vegetation are, in effect, nature's way of controlling populations.'

The animals introduced into the Oostvaardersplassen did, indeed, multiply, demonstrating a far higher carrying capacity for the land than anyone thought possible. Herd numbers have now levelled out at around 800 ponies and 160 cattle grazing the 2,400 hectares of dry polder, and 2,000 red deer grazing both the dry and marshy areas, having pushed out the roe deer. Meanwhile, overall, biodiversity has risen, with the Oostvaardersplassen – grazed all year round – supporting greater species complexity than seasonally grazed farmland.

The animals do not graze every part of the reserve with equal intensity, explained Frans. The areas that are under-grazed or not grazed at all during the growing seasons of spring and summer produce grass and flowering plants, which benefits mice and mouse-hunting birds like marsh harriers and buzzards. The grazed areas become a temporary home to the geese. Over the winter, areas that have been under-grazed during the growing season are eaten off and trampled, giving many plant species the opportunity to germinate here as well, resulting in a profusion of grasses and forbs in the spring. Over all, the winter die-off of animals removes pressure from the grazing for the coming spring. The fluctuation in animal numbers allows for spontaneous bursts of thorny vegetation, and occasional outbursts of willow – which adds another habitat for small mammals and songbirds, which in turn are prey for owls, goshawks and sparrowhawks living in willows in the marshy areas.

'So what we've shown in the Oostvaardersplassen is that a mix of herbivores, allowed to express themselves freely, without human control, stimulates a much greater variety of animal and plant species than can be found on the short grassland characteristic of seasonal farmland grazing.'

Water voles, rabbits, hares, stoats, weasels, polecats, foxes, grass snakes, toads, ground beetles, dung beetles, carrion beetles

of the Repton park restoration into the surrounding farmland, but do something much wilder, and self-sustaining? Could we use grazing animals to create habitats and restore wildlife across the whole estate? Could a free-willed conservation project be the answer we'd been waiting for?

5. A World of Wood Pasture

> Conservation should be based on practical observation rather than unstable theory.
>
> Oliver Rackham, *Woodlands*, 2006

Charlie's 2002 'letter of intent' addressed to English Nature, the government's advisory body for nature, funded by the Department for the Environment, Food and Rural Affairs, was forthright and full of optimism. It declared our intention to establish 'a biodiverse wilderness area in the Low Weald of Sussex'. What we envisaged, the letter explained, was a 'land management experiment' using a mix of free-roaming grazing animals to create opportunities for wildlife similar to those we had witnessed in the Oostvaardersplassen. We were seeking funding to ring-fence the entire 3,500 acres of the estate, take up all 200 miles of internal fencing, leaving only fences around houses and buildings, cattle-grid the public B roads that run through it and build a land bridge over the A272 so the animals could traverse the whole area. There might be minor problems, the letter admitted, with ear-tagging wild cattle, possible conflicts between dog-walkers and free-roaming animals, a proliferation of weeds and the public distaste for rotting carcasses, but it was hoped these would not be insurmountable.

The choice of animals, alone, may have given English Nature cause to swallow hard: red deer, fallow deer, Heck cattle and Exmoor ponies were perhaps challenging enough, but the

three 'Bs' – wild boar, European beaver and European bison – were almost unmentionable. We were aiming high.

We were particularly hopeful about wild boar. One aspect of animal processes conspicuously lacking from the Oostvaardersplassen is that of the large scavenger. Foxes and birds rip away at carcasses on the Flevoland plains but even there, there are no wild boar – Europe's equivalent of Africa's bone-crunching hyena. The other vital ecological function of wild boar is to act like a plough, their rootling exposing bare soil for colonization by invertebrates and the germination of flowering plants and shrubs. The Dutch government would not countenance an introduction into the Oostvaardersplassen on the grounds that wild boar could break out of the project and spread disease amongst the country's intensive pig farms. Ironically, many conservationists believe the threat is the other way round – that intensive pig farms, hotbeds of virus cultivation, spread disease to wild populations. Frans was holding out hope that wild boar might find their own way to the Oostvaardersplassen as they were known to be only twenty-five kilometres away. But with no pig farmers in our area, we hoped that introducing wild boar at Knepp would be less contentious than in Holland. Wild boar became extinct in England at least three hundred years ago but in recent years escapees and releases from wild-boar farms have re-established wild populations. A large population near the coast in East Sussex provides Rye's annual Wild Boar Festival in October with 'wild boargers', 'boargignon' and other delicacies from the 'last of the summer swine'. There have been sightings of wild boar only a mile or so away from us, on the other side of the busy A24 – a barrier which so far seems to have limited their westward expansion.

We were particularly keen to leave carcasses on the land rather than carting them off to be incinerated – though this, owing to UK health and safety legislation similar to that in the rest of Europe, would require a special dispensation. The absence of carcasses in the landscape is another lost aspect of natural processes. As a consequence, populations of an entire

community of necrophagous insect species such as clown beetles and blowfly maggots, as well as fungi and bacteria, have collapsed. The dead donkey fly, which gets its name from the site of its last British sighting, used to lay its eggs on decaying carcasses at the advanced skin-and-bone stage. It died out completely in Britain once carcasses were no longer left lying around. While, admittedly, few people other than entomologists may mourn the loss of these creatures, allowing carcasses to rot down on the land keeps nutrients in the food cycle including phosphorus and calcium, both of which are vital, for example, for the production of birds' eggs.

Beavers, in 2002, were still a long way off being accepted in Britain. Well on the way to recovery in Europe, they have already been spotted in the Oostvaardersplassen and are likely soon to be breeding in the reserve. With mounting evidence in Europe of their beneficial impacts on the environment, we were hopeful that the British government would see the advantages of returning this keystone species to England. Knepp, with its lakes, ponds, ditches and a considerable amount of boggy land, could, we felt, be just the place to start.

Bison are another grazer making a comeback from near extinction in Europe; Frans and other European ecologists identify it as another keystone species. There is an ongoing debate about whether bison were ever present in Britain after the last ice age. No bison bones have yet been found here. But fossil evidence is notoriously difficult to come by. No fossil bones of the wolf, for example, have ever been found in the Netherlands though it was widespread there until only a few centuries ago. The last wolf shot was killed in the southern Netherlands in 1845, and the last one seen in the country was in 1897. Indeed, fossil evidence is so rare that when it comes to light it often explodes all previous theories. A single accidental find of mammoth bones in 2009 in Condover in Shropshire moved the presence of mammoths in Britain closer to the present day by 7,000 years, to only 14,000 years ago. Uncomfortable though it may be for scientists – particularly, perhaps, for

palaeoecologists – who prefer to deal in certainties and tangible remains, absence of evidence is not evidence of absence. Moreover, bison bones have recently been discovered in Doggerland under the North Sea dating to the beginning of the Holocene (our current post-ice age epoch which began around 11,700 years ago), along with remains of other Holocene fauna such as the aurochs, wild boar, elk, beaver, roe and otter. Doggerland was the land bridge that connected Britain to Europe until rising seas separated us 8,200 years ago. It is inconceivable that, when we were still physically part of the Continent, animals tamely stopped at Calais.

In one particular respect, however, we knew our vision would have to be more constrained than that of the Oostvaardersplassen. On private land one-third the area of the Dutch reserve, and with houses and gardens and people going about their daily lives in the middle of it, we couldn't leave animals to starve. While we felt it essential for the experiment that the grazing herds interact with their environment as naturally as possible, with minimum human intervention and no supplementary feeding, the thought of watching animals dying from our windows was unconscionable, and the authorities would, in any case, never allow it. The headquarters of the Royal Society for the Prevention of Cruelty to Animals is in Southwater, a neighbouring village. Knepp's size and location – as well as our own sensitivities – would impose limitations of their own. We proposed that once the herds had grown in number we would cull the animals to a level at which they could remain healthy and well fed throughout the winter. If any animal became sick or had trouble, say, giving birth, we would intervene with veterinary attention. Selling the meat of the culled cattle, deer and boar would help, we hoped, to defray culling costs. The ponies would be rounded up annually and surplus animals sold.

Charlie's letter also explained that we intended the experiment to be for a twenty-five-year period, after which we would review the project and decide whether to continue 'rewilding' or revert to some other form of land management. We were

preserved in peat commonly known as bog oaks are a valuable complement to the pollen record. They are only a minute and unrepresentative fraction of all the trees that grew in prehistory; they lived in unusual places and died violent and unusual deaths, being killed by a sudden rise in the water table . . . Nevertheless bog trees are not to be despised. They tell us, as no evidence can, exactly what grew where, and about the structure, as opposed to the composition, of certain kinds of wildwood.' The abundant associations of fauna and flora with the oak are, in themselves, evidence of deep historical ecology. Trees that are historically rare or widely dispersed rarely have the opportunity to build up so many associations. The oak's particular association with the jay, the bird upon which it depends for the dispersal and germination of its acorns, must have evolved over millennia. So this is not a tree that has simply proliferated in modern times. And its conspicuous presence in our ancient landscape provides an obvious challenge to the closed-canopy theory.

Like hazel and birch, both oak species of lowland Europe – the sessile (*Quercus petraea*) and the pedunculate (*Quercus robur*), like the Knepp Oak – require a substantial amount of direct light, at recruitment (the early growth stage), at least. Unlike beech, hornbeam, ash, lime, sycamore, silver fir, maple, alder, wych elm, smooth-leaved elm and other tree species native to Central and Western Europe, oaks cannot regenerate in closed-canopy conditions. For foresters and tree men like Ted Green this is stating the obvious. But it is surprising how this fact has been, and continues to be, overlooked by most closed-canopy theorists.

Those that are aware of the oak's demand for light claim it can germinate and grow into a mature tree in the open glades that are created when a large tree or a clutch of trees topple in the forest due to storms or old age. Vera refutes this. He points to forest reserves across Central and Western Europe – including the so-called 'primeval' forest of Białowieża in Poland – where there is no long-term recruitment of oak, even in clearings. The

oaks are, essentially, dying out. That oaks exist in these reserves at all is either because they have been planted by foresters and deliberately protected from competition, in which case they are all of the same age and grow with long tall trunks – valuable as timber – with no large lateral branches and small crowns on top; or because they are ancient oaks with spreading lateral branches that have grown in the open and been subsequently engulfed by shade-tolerant trees. Ancient oaks with spreading limbs, Vera argues, clearly indicate that the forest was once wood pasture – a naturally occurring ecosystem driven and sustained by grazing ungulates. These open-grown oaks might originally have been solitary trees, grown from an acorn planted by a jay or wood mouse near a free-standing thorn bush, or part of a grove of oaks arising from numerous acorns planted by jays in the fringes of thorny scrub. The thorny scrub would have acted as nurseries for the oak saplings, protecting them from grazing animals without depriving them of light. When the grazing animals disappeared from this wood pasture landscape, the brakes would have been released on vegetation succession. Inevitably, shade-tolerant species would have won the day, culminating in closed-canopy forest, now 'forest reserves' – hallowed ground to conservationists and protected by law. The tallest oaks might take centuries to die, as the surrounding trees begin to overtop them and steal their light. But die they inevitably do.

We saw this ourselves, in Romania, several years into our project. We stumbled across the Breite Nature Reserve, near Sighişoara, on a trip with friends to look at wildflower meadows in the Carpathian mountains. This rare patch of ancient wood pasture, dotted with oaks – magnificent gnarled veterans, six or seven centuries old – had been abandoned when traditional shepherding went into decline fifty years ago. Without the impact of grazing animals a phalanx of hornbeam and beech was marching in. Those oaks that had already been enveloped by the shady pioneers were losing their crowns and dropping their limbs, drowning in slow motion in a vegetative sea. A few, overwhelmed, had already crashed to the forest floor.

While seedlings from old oaks like this, clinging on in their crepuscular coffin, may take root (sometimes in large numbers) in available clearings, they inevitably fail within a few years, outcompeted by shade-tolerant saplings. The same thing happens in Britain. Not far from us in Sussex, in the Mens Nature Reserve – a non-intervention zone, claimed to be one of Britain's last scraps of natural lowland closed-canopy forest – ecologists studying the site expected to see a significant recruitment of oaks after the 1987 hurricane, a one-in-300-year event that brought down numerous trees. They have been puzzled to observe no oak succession to date.

Fire, caused by lightning, is also commonly cited by closed-canopy theorists as another forest-opener that would have allowed oak saplings to regenerate in prehistoric Europe. But this argument doesn't catch light either, at least in temperate climes. It is hard to understand how fire ever gained credence as an agent of disturbance in our land of fog and rain. Anyone who has ever tried to start a fire using only the available material in a British woodland knows how reluctant it is to ignite, even in the height of summer. Bonfires on Guy Fawkes' Night would be damp squibs without litres of petrol. In contrast to the dry pine forests of the arid countries of southern Europe, Britain has no readily ignitable tree species, apart, perhaps, from Scots pine, and outbursts of lightning do not scramble the fire engines. Electric storms, when they do come, are almost always accompanied by rain. In the Second World War the renowned forester Herbert Edlin noted that even during the Battle of Britain, over a long, dry summer, not one incendiary bomb, capable of burning through concrete, started a fire in woodland. In Carpenters Wood, part of Bisham Woods in Berkshire, the crater where a plane full of explosives came down in 1944 is still visible, marked by a memorial to the airmen that died. The explosion was heard tens of miles away. But the surrounding trees, including beech, just a hundred yards from the crash site did not catch fire. Even during the great drought of 1976 – at the height of the fashion for burning stubble – no trees caught