A new world

Some years ago, while hiking in a relatively remote area of Alaska, I was struck by the feeling of being, if not the first person, then one among very few people who had ever been there before. I didn't end up running into one, but my senses were on high alert for bears. Bears may still be reasonably plentiful, but most of the large animals that once roamed Alaska are long extinct, done in soon after the first people spread from Siberia into the Americas. The plants of the forests and glades have likely changed from the absence of these large animals in ways unknown to me. Although imperceptible to any of my senses, there was the ubiquitous, ongoing increase in atmospheric CO_2, and visible high overhead were white contrails tracking the daily criss-crossing of planes. The length of winter ice and snow cover has also likely diminished from what it was just a century before. Despite being aware of these human impacts, the place still felt like true wilderness, or at least as close to a world before people that I had ever experienced. I have travelled to some remote areas since, including parts of the West Coast but – with the exception of the Namib Desert – have never again had that sense of being immersed in true wilderness. In most places, if you look closely enough, the direct and indirect traces of human activity can be found. Slow at first, the changes instigated long ago by our hunter-gatherer ancestors have accelerated exponentially along with the number of people in pursuit of water, food, energy, mobility, comfort and pleasure. Our activities have transformed the West Coast, like so many other places, into a new world, a world that many consider to be so impacted by us as to constitute a new human ecology.[75]

The new human ecology reflects the sum of our many impacts on the natural world – the alteration of habitats, hunting and fishing, the global mixing of species, and the proliferation of people and of those species selected by us for our benefit. Our footprint has impacted an incredible three-quarters of Earth's surface and most of its fresh water.[76] In the process most original habitats have been destroyed, with only compromised bits and fragments remaining. Most large animals have been wiped out, if not to extinction then to limited numbers within game parks, reserves and zoos. The large wild animals have been displaced by farm animals, with the total mass of animals living today – 22 billion chickens, 1.5 billion cattle and a billion sheep among them – being seven times greater than before farming. And people, numbering more than 7 billion, make up on the order of 30% of the total mass of animals on the planet today. Similar to the fate of animals, plants have been displaced, largely by a handful of species selected by humans: maize, wheat, rice, pine plantations, fruit groves and vineyards. As in other parts of the world, it is the low-lying arable lands that have been most impacted on the West Coast,

the dry and mountainous regions far less so. The Cederberg Mountains, Namaqualand and Namibia still retain many of the plants that grew there prior to human arrival. And yet much of the coastal plain, even in remote areas, has been altered by overgrazing, and mountain areas have burnt more frequently while alien plants persistently spread out from their initial points of infiltration along gravel roads and river courses.

The current changes are in some respects without precedent. We have not only brought about the extinction of many other species, but we have also managed to alter the composition of the atmosphere significantly, as well as warm and acidify the ocean. These are not trivial outcomes considering the vastness of the ocean and atmosphere. However, we are not the first species whose evolution precipitated major changes on Earth. Early on, the evolution of photosynthesis markedly transformed the composition of the atmosphere from one that was free of oxygen to one that is rich in oxygen. Today oxygen makes up 21% by volume of the air we breathe, and without so much oxygen, the evolution of large, complex animals such as ourselves wouldn't have been possible. For many other organisms oxygen gas is toxic and as it rose they were forced to retreat to oxygen-free places, such as mucky sediment and our intestines. Similarly, when algae first ventured onto land and evolved into woody (vascular) plants, dry land was transformed, becoming home to a rich diversity of plants, myriad insects and larger animals. The rise of photosynthesis early on by simple bacteria, which gave rise to our planet's oxygen-rich atmosphere, together with the rise of land plants, certainly had far greater impacts than anything we have done so far. If the evolution of photosynthesis and woody plants could so transform the world, why not us?

Many would consider the global changes in oxygen brought about by bacteria and the proliferation of plants as natural outcomes of evolution, whereas human impacts are considered 'unnatural' and our selection of traits in plants and animals beneficial to us 'artificial'. But is there anything unnatural about us? As much as we may like to imagine ourselves as somehow exceptional, as other than, superior to or above Nature, we are not. Our species is a natural outcome of millions of years of evolution. In fact, like all life on Earth, we owe our existence to a long line of descent from the first life forms. Hence, we are related and linked to all life on Earth. However, there is no doubt that we have had, particularly in the last several centuries, an outsize impact, and one that can largely be attributed to our rapid cultural evolution. Many animals alter habitats by their activities – elephants impact the abundance of trees, beaver-built dams alter river habitats – but our activities have so pervasively altered the existing natural world that some consider the effect to be the end of Nature.

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We know from the fossil record that this is not the first time life has been threatened by rapid change. The history of Earth reveals that life was established early on and that conditions have, ever since, remained conducive to life. However, there were times in the past when surface conditions were altered so radically that over half the living world vanished in a short period of time – the so-called Big 5 mass-dying or mass-extinction events. Exactly what caused them is debated, but collisions with large asteroids and major volcanic eruptions are likely culprits. In the most devastating, the End Permian mass-extinction event 252 million years ago, 90% of life in the sea and 70% on land was wiped out. Fortunately, in the aftermath of the devastation, conditions conducive to life gradually returned and life rebounded. Life is vulnerable but also highly resilient, and can recover quickly. The survivors spread into the newly vacated habitats and diversified over time, giving rise to a new living landscape, one filled with a cast of new species.

These major shake-ups had unpredictable outcomes on the evolution of life, none of which was necessarily better or worse compared to what existed before. We have seen how life has evolved in major ways on the West Coast in just the last 5 million years. The turnover in animals on the West Coast was not anywhere near as large as in past mass-extinction events, and most appear to relate to changes in habitat brought about by changes in global climate that were far less severe than mass-extinction events. Thus, the natural world is constantly subject to change, and even the most dramatic changes that were associated with past mass-extinction events didn't spell the end of Nature. Life carries on, evolving in ways that depend on changes in habitats and on what is available genetically for evolution to work with among the survivors.

Photosynthesis allows plants to grow using energy received from the Sun. One of our major innovations was figuring out how to generate energy outside of our own bodies, initially through control of fire and later by the burning of fossil fuels. It was our tapping into the huge amount of external energy available from the burning of fossil fuels that made possible the majority of our impacts since the Industrial Revolution. The energy of fossil fuels originates from sunlight captured long ago by algae and plants whose remains were later transformed through deep burial into coal, gas and petroleum. It is through the burning of these compact forms of stored solar energy that we have managed to have such an enormous impact, including the as yet to be fully expressed consequences of the rapid increase in CO_2 on Earth's climate and ecology. To avoid the detrimental outcomes of higher CO_2 levels, we need to develop alternative energy sources to the point that they replace, rather than simply supplement, fossil fuels.

Every day the Sun shines immense amounts of energy upon us – our challenge is how

to best capture and store this bountiful influx of free energy. An even more formidable but by no means impossible challenge is the building of mini-Sun power stations on Earth, capable of doing on a small scale what the Sun does – burn hydrogen into helium. Future innovations will hopefully allow these and other alternative energy sources to replace the burning of fossil fuels. Increasing energy efficiency, promoting solar panel installations and extending the life of the Koeberg Nuclear Power Station are ways to buy time until alternative energy sources become available. What is clear is that a large source of non-fossil fuel energy will be essential if we are to address all our needs and the needs of the environment upon which we depend.

What is in store for the West Coast by the year 2100 or 2525? The physical landscape will look much the same as today, although rising sea level will increase coastal erosion and flooding depending on how quickly the ice sheets melt. The amount of rain and when it falls may change with global warming in ways that are difficult to predict. The greatest changes, however, are likely to be in the living landscape – particularly in the already heavily impacted lowland areas. There will be both losers and winners in the new human ecology – and many others who will carry on much as before. As elsewhere, the highly diverse assemblage of plants and animals on the West Coast will come under increasing pressure from our activities. The latest United Nations report estimates that one out of every eight species, known of globally, is threatened with extinction.[77] Many of these are the so-called walking dead – those that are still with us but surviving in such low numbers and within such degraded habitats that they are unlikely to last for much longer. Among the most likely to survive will be those that are not picky about what they eat (omnivores), relatively small in size and able to survive in a variety of different habitats.

There is no question that the destruction and fragmentation of natural habitats is leading to the extinction of many species, but there are both indigenous and alien species that have flourished. Winners so far include some species that previously had extremely limited natural ranges and were vulnerable to possible extinction, but have ended up at the hands of people to become incredibly successful. Examples include the widespread success of the house sparrow mentioned already, and the Monterey pine (*Pinus radiata*), whose natural distribution was restricted to small pockets on the California coast, but now grows in huge numbers in pine plantations in many areas of the world, including South Africa.

Evolution is being driven, in part, by the need of organisms to adapt to changes in the length of seasons, especially at high latitudes, the acidification of the surface ocean and

the transformation of indigenous ecosystems to human-modified environments, among many other changes. Evolution is also promoted by the spread of many species beyond their natural range, some randomly, others for a purpose. Species have always mixed in the geological past, but the rate at which people are moving species all over the globe is unprecedented. This globalisation of biology is having large impacts in each of the many regions it is unfolding. It is not a universal mixing, but a selective mixing for each locale, each of which will evolve in unique ways. As we have seen, alien species from similar climatic zones are more likely to thrive on the West Coast. Some introduced species will outcompete and drive the extinction of indigenous species, while others will provide new opportunities to those that were already living here. Because each locale varies in terms of its climate and species, introduced species will start to diverge away from the population from which they originated.

The bringing together of many species that did not live together before opens up the possibility of new interactions. If these interactions are significant, then they can drive evolution and the emergence of new species much more quickly than previously thought – taking centuries rather than thousands or millions of years. We are familiar with the rapid changes possible through artificial or human selection, from high-yielding crops of the Green Revolution, to the many different breeds of show dogs since Victorian times. More recently, studies have shown how rapidly evolution can occur in Nature. Organisms can evolve rapidly in response to new predator-prey interactions, and intermingling of closely related but long-isolated species can generate hybrids. If fertile, these hybrids can give rise to new species having novel traits. Hybridisation has been shown to be a common event in the evolution of our own species, with everyone carrying small amounts of DNA from our extinct cousins that evolved in Eurasia, the Neanderthals and Denisovans. Feral cats interbreeding with the African wild cat may produce hybrids, as might the interbreeding of introduced European pigs with African wild boar. So far, the Cape and house sparrows have yet to interbreed, but in other parts of the world the house sparrow forms a complete spectrum of hybrids – the Italian sparrow is considered a hybrid of the house and Spanish sparrow, for example.

Considering life's resilience and ourselves as a natural outcome of evolution does not release us from responsibility. We are increasingly becoming aware of the consequences of our actions, and the need to change our behaviour and to come up with innovative solutions in order to achieve outcomes that promote our sustainable existence. It is in our best interest that we make every effort to conserve habitats, restore those habitats that are degraded, and limit the threat of global climate change. If we are successful in

generating sufficient alternative energy, then we can work toward a new world in which the human ecology benefits all life forms. Water extraction and irrigation schemes can be used to grow more food, while minimising the amount of water used, the loss of topsoil, and the application of pesticides and fertilisers. Biodiversity can be increased by controlling aggressive alien species, rewilding and by criss-crossing modified landscapes with nature-reserve corridors. Many landscapes have been left scarred and diminished from poor past practice, but we can learn from past mistakes and work to restore these degraded areas. Like all ecosystems, the new human ecology will be in a constant state of flux and we may have to adjust how we view introduced species. The perception that all alien species are bad is a form of xenophobia that extends not just to people from elsewhere but to plants and animals as well. Some aliens are harmful and their spread needs to be controlled, but many others are not harmful and can increase diversity and enhance ecosystems in terms of their resilience, productivity and aesthetics.

The Anthropocene is usually viewed in terms of how we have transformed much of the natural world, but it is also about how our transformed world, in turn, impacts upon us. Most give little thought to how fundamentally different our lives are in comparison to those of our hunter-gatherer ancestors, who, by necessity, lived lives far more closely linked to the natural world – a world that is rapidly receding away from most of us. We walk on carpets, sleep in sheets and dress in clothes largely composed of synthetic fibres spun from the petroleum-distillate products nylon and polyester; we consume foods so reconstituted that they bear scant resemblance to anything in nature; we live, work and travel in climate-controlled, confined spaces in which few of us are fooled by the thin veneers patterned after natural stone or wood. The few hunter-gatherer groups in the world today are struggling to preserve their way of life, while the number of farmers is shrinking as people gravitate to the cities. For many this is not by choice. The world has a tendency to change in ways that leave few options for holding on to the past. No matter what your beliefs, preferences or desires, life moves on.

The trend to urbanisation has accelerated, with over half of the world's people now living in cities. It is projected that most will live in high-density megacities, each in excess of 10 million inhabitants by the year 2050.[78] One advantage to congregating in cities is that our impacts are focused in a smaller area, allowing more land outside of the cities to be spared habitat destruction. Cities are also more efficient, requiring less energy and emitting fewer by-products, such as CO_2. The West Coast is no exception, with the vast majority of its people living in the greater Cape Town city area, the population of which has doubled from 2 to 4 million in the last 20 years. It can be hard to believe so many

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live nearby when encountering a total of only a half-dozen people while on a day hike on Table Mountain. Will Cape Town become a megacity, home to 10 million people in the next 20 years? This is a frightening thought for many who currently fight the traffic each day. However, concentrating people in high-density centres makes public transportation more feasible and allows more land to be conserved for a mix of agriculture and nature reserves interconnected by corridors where reintroduced animals and rehabilitated lands provide the food and habitat necessary to sustain us. Clearly we will need to grow more food, but farms can integrate conservation corridors to augment roadside verges and thereby promote the diversity of plants and insects so vital to the pollination of crops.

Much damage has already been done and the world is in a state of flux as a result. But even before humans had arrived, the West Coast was in a state of flux and change. In this sense, it seems futile to try to return to some notion of what the natural habitats of the West Coast were like in the past. And which past: before the San, the Khoekhoen, the Europeans? Even if we switch to alternative energy sources in the near future, there is already enough CO_2 in the air to impact climate in ways we cannot predict. The current sixth mass-extinction is real, with many species globally and on the West Coast extinct or on the verge of extinction. This is a major cause for concern and calls for trying to conserve as much of what still exists before it is lost. While it is not always possible nor necessarily desirable to try to return habitats to what they were prior to European arrival, there is much that can be done to conserve what remains. We can take action to lessen the destruction and degradation of habitats and the species they support. It may not be feasible to remove all alien invasive species, but we can work at limiting the spread of the most aggressive and detrimental among them. Difficult choices may need to be made over which species can be saved and those that are beyond saving. Rewilding is one approach to conserving and promoting vibrant and resilient ecosystems that has had promising results in those places where it has been tried. Meanwhile, it is important for us to acknowledge and accept that ecosystems have changed in the past and will carry on changing in ways that are unpredictable. In this new world not all change need be viewed necessarily as bad or undesirable. Whatever we end up doing, life and its evolution will carry on as always, with some life forms lost while others adapt in response to whatever changes come their way.