PATCHY ANTHROPOCOASTS:

A transdisciplinary perspective on dunes, plants, rabbits, and humans in the United Kingdom

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ABSTRACT: In recent years, there has been increasing societal awareness of the crucial role that coastal dunes play in protecting against rising sea levels, mitigating climate change impacts, promoting biodiversity, and providing recreational opportunities. In some regions, dune management has been particularly focused on biodiversity and ecosystem restoration and the presence of alien species on dunes raises concerns about how these species become 'native,' 'invasive,' or 'hybrids' and whether they belong in their new ecosystems. These concerns illustrate how certain animals and plants assume different statuses according to normative categories associated with varying objectives. This article explores how perceptions of coastal dunes in the UK have transformed over time, from marginal resource frontiers to highly valued environments shaped by multispecies relations. In addition, this work explores how dunes around the UK emerge as 'patchy anthropocoasts,' that is, uneven landscapes designed by human purposes linked to economic activities, conservation, rabbit populations, unwanted vegetation, and the control of unpredictable sand movements. Bringing together diverse historical materials and scientific literature, this article links human and nonhuman histories with present debates on dune restoration from a transdisciplinary perspective rooted in anthropology, environmental history, and the natural sciences.

KEYWORDS: Dune management, Human-animal relations, Dune vegetation, Environmental History, United Kingdom

Introduction

Coastal dunes are relatively unstable environments – "solid fluid" spaces (Ingold & Simonetti, 2021) that perpetually shift their affordances. At times changes occur over a few hours or days, and at others, they are almost imperceptible, taking place over centuries or millennia. Despite their uncertainty, dunes have always attracted colonisation by humans and nonhumans alike. For instance, native and invasive animal and plant species have found homes amid the sands, such as the case of rabbits and marram grass. In addition, archaeological research shows the existence of prehistoric populations and temporary settlements on dunes (Steers, 1937), with local communities later exploiting their resources as grazing for cattle and sheep, collecting wood, and cutting grass for mat making and household roofing (Clarke & Rendell, 2014). Despite this, the continuously shifting sands, driven by the winds, and the hybridity of dune ecosystems – a place neither entirely belonging to the sea and nor entirely part of land – create many challenges for those living along coastal margins. Sea-level rise or strong winds can drive coastal dunes further inland, creating transgressive ecosystems that can affect human activities and infrastructures lying just beyond them (Harley & Ciavola, 2013). On occasions, dunes have redrawn the boundaries of community life, requiring abandonment or relocation when sand interrupted daily routines rendering agricultural fields unproductive and covering houses. Indeed, when the invading sands encroached onto Gullane in Scotland in 1612, people were advised to move to other locations far from dunes (Whyte, 1981). Later, in official documents, travelling accounts or newspaper articles, characterisations of dunes varied, being represented as dreary and unruly sand wastes containing nothing noteworthy in some accounts (e.g., Royal Commission Report, 1911) or as lands that could offer economic opportunity through rabbit farming and afforestation in others (e.g., Sheail, 1971b), through to appreciation of the beauty and uniqueness of sandy landscapes (e.g., Gray, 1909). The relationship between humans and dunes, like the landscape itself, has always been plural.

While the ongoing work of tides, waves, sediment travel, and aeolian processes have shaped dune ecosystems over time, the interwoven practices of humans, plants, and animals, such as rabbits, have also been a significant force molding dune landscapes in coastal United Kingdom for over 900 years (Rhind & Jones, 2009; Sheail, 1971a). In the case of the rabbit (*Oryctolagus cuniculus*),[1] which the Normans introduced in Britain in the medieval period, their populations proliferated due to the demand for their meat and fur and as hunting targets for the nobility (Sheail, 1971b). Many marginal dune areas became home to these rabbits through the creation of warrens by landowners interested in increasing their income from these barren lands (Dickson, 1823). Moreover, to guarantee the survival and high reproductive numbers of rabbits for commercial purposes, warreners and landowners devised ways to modify coastal dunes to make sandy expanses more liveable for those animals (Dickson, 1823; van Dam, 2010). Throughout time, rabbit grazing on dunes has been a controversial issue and the environmental impact of rabbit grazing on different dune habitats has also led to debates about the useful or destructive nature of their feeding habits (Pye et al., 2014). Some authors claim that coastal dune plant community structure in Europe prior to the lethal myxomatosis disease (i.e., before 1955) was the product of intensive rabbit grazing (Ranwell, 1959; Thomas, 1960), and van Dam refers to coastal dunes in the Netherlands as a "man-made rabbit garden" (van Dam, 2001, as cited in Baeyens & Martinez, 2004, p. 280).

[1] The only member of the Lagomorpha order (comprising hares and rabbits) native to Britain is the mountain hare (*Lepus timidus*). The rabbit (*Oryctolagus cuniculus*) is an introduced species.

This article addresses the historical transformations of dunes into a resource and conservation frontier embedded in smaller-scale "contact zones" (Haraway, 2008) partly formed by human-sand-plant-animal relations that occurred across different economic and livelihood trajectories as well as scientific ones and with regard to aesthetics related to nature and biodiversity conservation. This article is based on the analysis of multiple historical sources, newspaper articles, scientific literature, and reports of projects presently involved in dune restoration such as Dynamic Dunescapes project, a conservation initiative focused on restoring coastal dunes across England and Wales. In addition, diverse materials were read and analysed through historical, anthropological, and scientific lenses and later discussed from a transdisciplinary perspective. We have attempted to weave these into a single written fabric, presenting different views that promote sensitivity toward nonhuman agency (Tsing, 2015) while also including descriptions of the evolutionary processes of coastal dunes, accounts of human-nonhuman relations, adaptations made to sand drift and how these changed over time. The objective of this article is to link these human and nonhuman histories with present debates on dune restoration and biodiversity conservation. We do not intend to define dune management using tight parameters that revolve around what is or is not dune management or the right or wrong approach. Instead, we maintain an interest in how dune management approaches have taken hold over time and identify specific trends that drive the restoration of dune landscapes in order to promote biodiversity over other priorities and the issues this option has raised.

The preliminary formation of notions of biopolitics by Foucault in the mid-late 1970s[2] and the work of subsequent authors who have developed the concept has significantly influenced scholarship that explores human relations beyond interactions with other people and extends to nonhuman entities (Asdal et al., 2017). Specifically, concepts such as biopolitics and governmentality have increasingly been applied to analyse the management of nonhuman life in the context of nature conservation (Cavanagh, 2018). But the emphasis on power dynamics and human institutions in Foucauldian scholarship can sometimes obscure the agency and perspectives of nonhuman entities (Jørgensen, 2015). As a result, the authors of this article advance a provocation inspired by Nustad and Swanson (2022), which is rooted in political ecology debates regarding how to understand the emergence of landscapes from practices of governance and politics, as well as nonhuman agency and the materiality of the environment. Following the authors, who argue that rivers and trout introductions in South Africa can be understood as more-than-human institutions in the Foucauldian sense (Nustad & Swanson, 2022, p. 939), we ask if it is too far-fetched to conceive of dunes and rabbits in similar ways. The human-rabbit stories woven on dune landscapes revolve around themes such as power, control, authority, experimentation and surveillance. Likewise, dune commodification and management can be understood as a form of disciplinary power, which in the context of more-than-human institutions, can be defined as the subtle, pervasive control exerted by institutions over landscapes and nonhuman life (Biermann and Mansfield, 2014; Braverman, 2015).

However, in more-than-human institutions, we must also consider the forms of subtle and overt power manifested by nonhumans and the materiality of the landscape, which in turn reshape those same institutional objectives (Nustad & Swanson, 2022). Unlike the Foucauldian penitentiary walls that contain and limit, sand is fluid and permeable. Its uneven and unstable ground produces patchy socio-ecological assemblages tied to the

[2] This concept was advanced in a series of lectures at delivered at the Collège de France, see particularly Foucault (2008).

historically contingent politics of land tenure, nature conservation and ethical dilemmas that revolve around managing a landscape of unruly wind, waves, sand, animals and plants. In this vein, we borrow Tsing's succinct definition of landscape as "the configuration of humans and nonhumans across a terrain" (2005, p. 173) to consider the materiality of dune landscapes in ways that can further contribute to human and more-than-human approaches to coastal environments in the Anthropocene.

Key Sites: Characterisation

Different sites were referred to in this study as examples, including the Culbin Sands in Scotland, Newborough Warren in Wales, Holkham Estate in eastern England, and Ingoldmells, in the English East Midlands. However, the bulk of information collected and analysed here concerns Kenfig, in southern Wales, and the Sefton coast, in Northwest England (Figure 1). In the present, the dune system in Kenfig consists of a series of dune ridges dissected in places by blowouts[3] and incipient parabolic dunes[4] slacks[5] and hummock dunes[6] further inland (Saye et al., 2005). These are formed by the prevailing southwesterly winds that sweep sand inland and are aligned approximately west to east (Jones et al., 2017). Kenfig Burrows represents one of Wales's most extensive intact coastal dune systems and forms a key constituent of the Kenfig Site of Special Scientific Interest, the Kenfig National Nature Reserve, and the Kenfig Special Area of Conservation, which integrates a large area of tidal rivers, estuaries, lagoons, salt marshes, sand beaches and woodlands (Zhang & Baas, 2012). The Sefton coast is located between the Mersey and the Ribble estuaries and consists of a complex network of tidal flats, dunes, salt marshes, and beaches (Esteves et al., 2012, p. 53). The dunes stretch for around 20 km and present several dune forms, including foredune ridges, blowouts, parabolics, and sand sheets[7]; embryo dunes are also present seaward of the foredune where accretion occurs to the north and south of Formby Point (Saye et al., 2005). This area is considered one of the most critical dune habitats in Northwest Europe and has been designated as a Site of Special Scientific Interest.

The highly dynamic and unpredictable sandy environment is an agent in the life and history of coastal settlements in these areas. Kenfig, an old town with Norman roots, was attacked many times by the Welsh while also being subjected to the "siege of the sands" (Gray, 1909). Writing in 1849, Lewis portrayed Kenfig as an old decaying town that suffered "an overwhelming inundation of the sea, which took place about the middle of the 16th century, and covered with sand an extensive tract in the neighbourhood of the coast." (1849, pp. 445-456). At the beginning of the 20th century, Gray described the sands at Kenfig as "cruel" (1909, p.16) and sand dunes as a place teeming with loneliness, where "the hillocks seem endless… brightened… here and there by patches of bloom, and with life in the scuttling rabbit and whir of pheasant" (Gray, 1909, p. 230). Similar words and expressions were used to illustrate the barrenness of the Culbin Sands, where legend has it that on a stormy night in the 17th century, the fertile land was covered by sand as a punishment for the impishness of its lord (Bain, 1900). Formby on the Sefton coast was also an old place, dating back to the

[3] Depressions in dunes scooped out by wind.
[4] Elongated blown scoops tapering to the windward side.
[5] Depressions resulting from wind scooping that reaches down to the water table that are often water-filled.
[6] Small dunes that often appear in rows.
[7] Flat, gently undulating areas of sand.

12th century, bounded to the west by the sea and protected by extensive sandhills, that represented a danger to the town. In the 18th century the sand gradually inundated the lands by the shore and affected some infrastructure. The old chapel, being almost overwhelmed by the sand, was replaced by the church of St. Peter, erected in 1736 in a more central position (Farrer & Brownbill, 1907). Kenfig, Culbin, and other locations along the UK coast share stories of ruination, of lost estates that once prospered, before being claimed by the sand, leaving ruins behind where once life thrived and flourished.

Figure 1 – Chief locations discussed in article.

Rabbits and Sand Drift

Historical records from Kenfig Burrows (Figure 2) reveal the existence of rabbits and extensive rabbit warrens as far back as 1314 (Gray, 1909, pp. 23-24). The introduction of rabbits by the Normans in the 13th century spurred novel ecologies and unforeseen multispecies relations in the pre-existing circumstances between humans and dunes. Since rabbits thrived in the sandy soils and environmental conditions found in dune habitats, landowners who controlled large expanses of land in coastal areas, including dunes, began investing in rabbit farming for commercial purposes (Sumption & Flowerdew, 1985; Veale, 1957). While warrens existed inland throughout the UK, landowners often noticed that the most profitable warrens thrived on coastal dunes (Matheson, 1941, p. 374). These also tended to outlive warrens established inland due to their poor soils, which did not allow for prosperous agriculture, making rabbit breeding a lucrative alternative (Dickson 1823).

Figure 2 – Kenfig Burrows (photo by Nigel Homer, Wikimedia Commons, n.d.)

Farmers and foresters, however, considered rabbits an invasive species, not so much for their alien origins but for their tendency to invade nearby farmland and destroy crops and affect afforestation initiatives by nibbling on young trees (Royal Commission Report, 1909; Sheail, 1991). The rabbits' insatiable appetite not only affected agriculture but also degraded the quantity and quality of important vegetation for cattle and sheep inside common lands (Veale 1957). However, despite being loathed, their value for commercial rabbit farm owners "far outweighed its destructive capacity" (Bailey, 1988, p. 20). This allowed rabbits to coexist amid fuzzy boundaries, generating zones of opportunity in the marginal economies of coastal areas, while feeding ongoing tensions on adjacent lands. Laying the blame on rabbits and rabbit warrens for sand drifts is also linked to these disputes (Veale, 1957).

Warrens that could sustain large populations of rabbits were seen to play a major role in destabilising sands that troubled nearby communities (Brown, 2015). For instance, the vegetation cover of dunes was negatively affected by the feeding and burrowing of rabbits and by humans, who constructed large-scale artificial warrens, digging pits, and tunnels to suit rabbits' reproductive and daily needs (Gould, 2017). Nevertheless, the belief that rabbits were harmful was based on a misunderstanding of the relationship between sand, climate, rabbits, and vegetation. The English historical geographer John Sheail urges caution in ascribing a direct relationship between overgrazing by rabbits and sand drift in coastal areas (1971a, p. 55). Rabbits can contribute to sand drifting but there are several other natural and human causes. Indeed, the period between the 16th and the 19th centuries is known for the occurrence of large-scale transgressive coastal dune behaviour in Europe due to a confluence of climatic factors (such as the cold storminess of the Little Ice Age [LIA]) –and the intensification of human activities, such as agricultural expansion and deforestation, that contributed to the loss of the vegetation on the foredunes, the exposure of bare sand to wind erosion and the remobilisation of dune systems (Jackson et al., 2019).

Sand drifting and dune stabilisation

From early times, populations living near the coast tried to prevent and control sand drifting by protecting the dunes' vegetation cover, which was vulnerable to over-exploitation (cutting, rabbit farming, and cattle grazing) and natural phenomena (wind, waves, rain, and fire) (Clarke & Rendell, 2014). This concern is present in the Kenfig Charter of 1330 that stated, in articles 50 and 51, that no person or persons could reap any sedges, neither draw nor pull any roots, not cut any furzes or any other thing that could lead to the ruin, destruction, and overthrow of the borough (Evans, 1791). Dunes were not referred to but knowing that in the 1500s sand covered most of the borough and its church and that this was a slow disaster, it could be hypothesised that earlier local authorities were aware of the problem and took steps to prevent it from happening. Such measures were not unique at the time. In the 14th century, the Manor of Ingoldmells, in Lincolnshire, also had laws to protect the vegetation of the dunes that safeguarded the lands from sea flooding (Massingberd, 1902). Later, in 1561, an injunction was issued by Elizabeth I for the "mayor and bailiffs of Newborough to punish whoever was found cutting, uprooting, or carrying away marram grass" (Ranwell, 1959, p. 573). While it is difficult to set a specific date, historical records indicate that in the 18th century (and most probably earlier), coastal communities in several places in Great Britain actively planted marram grass (*Ammophila arenaria*), a well-known sand-biding plant, to stabilise the dunes (Clarke & Rendell, 2014). This was the case in Kenfig and Formby where tenants gave some days of labour annually to such activity (Lewis, 1849).

It was later, in the 19th century, that afforestation became considered the most suitable solution to halt the drifting sands and make them more profitable. The Sefton coast was partially planted with trees in 1790 and 1887, the Culbin Sands in 1839 and the Holkham Estate in the 1850s (Clarke & Rendell, 2014; Steers, 1937). However, forestry planners needed to contain rabbits before planting trees, as they considered that "rabbits and forestry will not go together" (Royal Commission Report, 1909, p. 233). Rabbits showed a penchant for certain types of conifers that foresters used to affix dunes and, on occasions when rabbits swarmed the dunes in large numbers, landowners needed to devise an eradication plan before any planting could occur (Royal Commission Report, 1909). The English novelist Sir Rider Haggard, who also advised the state in matters of agriculture, considered that "if you were to put out tin plants painted green rabbits would gnaw them" (Royal Commission Report 1909 p. 281). The Royal Commission Report's minutes of evidence contain numerous examples of rabbit entanglements in human projects designed to control sand and reclaim coastal areas. For example, measures such as placing wire fences around recently afforested areas were deemed costly and would not prevent rabbits from entering (Royal Commission Report, 1909). Thus, afforestation practices and rabbit population control enacted a double policy of containment, to halt the movements of rabbits toward budding trees and sand toward community infrastructure and agricultural plots inland.

Scientists and landowners considered the possibility of managing rabbit populations using the Myxoma virus as early as the 1930s (Martin, 2010, p. 265). For instance, under the expertise of Charles Martin (physiologist and pathologist), the Cambridge University Department of Experimental Pathology successfully conducted several trials to test the lethality and transmissibility of myxomatosis, concluding that the virus was highly lethal to European rabbits (Martin 2010, p. 265). With myxomatosis wreaking havoc on the rabbit population, they gradually became a disappearing species. At the same time, open and mobile dunes became a disappearing landscape as bare areas of sand and dune grass

vegetation were steadily covered by woodland and scrub, resulting in over-stabilized dunes (Pye et al., 2014).

Until the 1940s, dunes had a certain degree of freedom in the United Kingdom. The creation of new dune slacks and blow-outs was favoured by human activities such as marram grass cutting, low intensity grazing with domestic livestock, and the existence of extensive rabbit warrens (Rhind et al., 2001). However, the Coast Protection Act of 1949 promoted further stabilisation of dunes for coastal defence purposes (Ranwell & Boar, 1986, p. 26). Coastal engineers used marram grass, fences, trees, and brushwood to ensure sand would not move further inland (Pye et al., 2014, p. 47). In addition, after WW2, as agricultural activities decreased, dune uses connected to rural ways of life progressively disappeared (Hurford & Perry, 2001). Thus, dunes started to self-stabilise, resulting in succession towards more mature vegetation due to the drastic reduction of stock grazing, increased deposition of atmospheric nitrogen,[8] the decline of the marram weaving industry (for example, in Newborough Warren) and the decline of rabbit populations (Jones et al., 2008; Rhind et al., 2001).

Natural factors also enhanced dune stabilisation. The end of the Little Ice Age (LIA) in the mid-19th century and the related reduction of storms and wind power led to less sand transport (Pye & Blott, 2017). Higher temperatures and the Current Warm Period that followed the LIA favoured the growth of vegetation that matted the dunes and prevented the wind from blowing the sand (Pye & Blott, 2017). For instance, in 1941, Kenfig Burrows had about 154 ha of bare sand and mobile dunes; moreover, a quantitative analysis of a 1946 aerial photo showed that bare sand covered 29% of the area within the Special Area of Conservation boundaries (Pye et al., 2014). However, between 1962 and 2009, as stabilisation took its course, the bare sand area was reduced to less than 4 ha or 4% (Howe et al., 2012; Pye et al. 2014). Currently, the dominant vegetation types in Wales are semi-fixed and fixed dune grasslands (grey dunes) and mature slacks (Rhind et al., 2001). Climate change projections indicate that vegetation on dunes will grow faster in the next fifty years due to wetter conditions, higher temperatures, less wind, and increased atmospheric nitrogen deposition (Pye et al., 2014).

Dune restoration

Not only did the dunes change in the 20th century, but so did perceptions about these sandy environments. With agriculture "severely depressed," a shift occurred in the relationship with nature protection that included more diverse reasons for its protection rather than solely economic purposes (Sheail, 1995, p. 79). Bird conservation, for instance, became an important objective that influenced the protection of broader nature areas that birds use for migration, nesting and reproduction, in which dunes, such as Kenfig Burrows, played an important role (Doody, 2013). As early as 1904 the Society for the Protection of Birds received a Royal Charter, and by 1910 there were already 13 sites of Special Interest acquired by the National Trust (Sheail, 1995, p. 80). In addition, State-led projects began to collect quantitative data to analyse and understand the impacts of expanding agriculture on wildlife and their habitats, eventually demonstrating that despite the widespread efforts to restore

[8] The increased emission of nitrogen into the atmosphere results from human-induced factors, primarily through agriculture, fossil fuel combustion, and industrial processes. The resulting nitrogen deposition through precipitation on coastal dunes increases vegetation growth (Doody, 2013, p.46).

wildlife, create reserves, and expand afforestation projects, these were obscured by the drastic loss of wildlife habitat (Sheail, 1995, p. 85). The rural exodus to cities during the economic boom caused by the industrial revolution eased the purchase of natural areas (Sheail, 1997). Another opportunity opened in the 1940s a part of planning for a post-War Britain with the Nature Conservancy being founded in 1949, paving the way for an increased in the establishment of National Nature Reserves (Evans, 1997, p. 86). The Sefton Coast Nature Reserve (Figure 3) was established in 1980 and the Kenfig Nature Reserve in 1989, when concerns regarding biodiversity loss on dunes shifted how rabbit grazing activities were viewed (Doody, 2013; Pye & Blott, 2017).

Figure 3 – Dunes at Freshfield on the Sefton Coast (photo by Sue Adair, Wikimedia Commons).

Biodiversity began to emerge as an issue in the 1990s with increased deforestation and increasing awareness of global climate change (Robin, 2011). Specifically, the 1992 Rio Summit Convention of Biological Diversity instigated an action plan for UK dunes focused on enhancing and maintaining biodiversity (Evans, 1997; Her Majesty's Stationery Office, 1994), inspiring public imagination and political projects designed to mitigate the negative effects of the Anthropocene. The rise of the biodiversity market has also popularised the concept of ecosystem services and the purpose of restoring damaged ecosystems, focusing on maintaining the goods and services that benefit humanity (Kull et al., 2015). However, there is a growing worry that prioritising ecosystem services (and some, to the detriment of others) could emphasise fulfilling human wants rather than maintaining a balanced approach that considers nonhuman autonomy (Keulartz, 2012).

Dune management includes a range of perspectives, actors and stakeholders at different scales who have overlapping and diverging objectives, making it challenging to reduce such plurality to just one or two approaches. However, the current trend that guides most dune restoration in the UK requires overt human intervention such as reseeding, mowing, reintroducing rabbits or using bulldozers to create bare sand and dune slacks to achieve idealised versions of dune landscapes – what Cooper and Jackson (2021, p. 2) refer to as "dune gardening." This intervention in dunescapes seeks to drive dunes to a point where their evolutionary processes are frozen to maintain a particular landscape aligned with

specific intentions and goals. For instance, project descriptions often illustrate past human uses of dunes and how these kept dunes open while allowing rare plants and species to flourish (Jones et al., 2021). The tendency to create areas of bare sand and short vegetation in dune management practices resists the trend toward scrub and woodland growth on dunes, driven by climatic factors. This practice raises the questions as to whether the resilience of coastal dunes in the context of coastal erosion is diminishing due to the overextension of human efforts to modify them. With overt manipulation of dune structure and rabbit reintroductions, how much freedom can be provided to rabbits and sand before their autonomy is deemed inconvenient again? Do these interventions and the uncertainty of future climatic forecasts inherently require perpetual maintenance of dune ecosystems?

To reflect on these questions requires grappling with other approaches that, to a certain degree, resemble biodiversity conservation but also offer different, less rigid angles from which to understand human control over nature. For instance, rewilding practices that seek to revitalise disrupted ecosystems by allowing natural processes such as wildfires, flooding, droughts and uncontrolled vegetation growth to shape the environment have gained traction throughout the UK (Jørgensen, 2015) (see Rewilding Britain, for example). In the context of rewilding worldviews, "nonhuman autonomy" refers to the freedom and agency given to nonhuman entities to exist, evolve, and interact without overt human interference (Ward & Prior, 2020). The geomorphic and ecological approach to dune management proposed by Cooper and Jackson (2021) is more inclined to embrace the uncertainty of future-oriented goals and nonhuman autonomy associated with some rewilding initiatives across the UK that promote "letting go in the face of unavoidable uncertainty and maintaining a lighter, more experimental framework of control" (Wynne-Jones et al., 2020, p. 74). Indeed, less intervention over dune composition results in the natural interplay between mobility and stability inherent in dune landscapes. However, in these representations, nature is sometimes associated with ideas of wilderness where there should be no human intervention, even though anthropogenic influences have shaped and maintained dunes for centuries. A form of biopower is evident in these different ways of relating to dunes. As scientists produce knowledge about coastal dunes guided by ideas of “naturalness” and the role of humans in managing (or not) the landscape, they categorise and define ecosystems and species, determining what is “normal” or “natural” and what is not according to certain aesthetic qualities or time-framed values (Gammon, 2018; Keulartz, 2012).

Aesthetics or values related to biodiversity conservation do not exclusively exist “out there” but, rather, have been institutionalised and produced through practices and discourses tied to dune management and conservation and the impulse to control nature to allow a particular version of dunes to flourish. For instance, The Dynamic Dunescapes report on invasive species management describes the sea buckthorn scrub (*Hippophae rhamnoides*), Japanese rose (*Rosa rugosa*), and other similar non-native vegetation as “undesirable” (Houston, 2023). The UK Biodiversity Action Plan (1994) also considers the development of dune scrub an unwanted trend that is best countered by management practices such as grazing. These discursive evocations remake dunes into normative categories – such as unwanted or undesirable – helping shape conservation policies while simplifying a more complex reality since stable dunes are a successional stage inherent to dune ecosystems (Cooper & Jackson, 2021).

Not all alien species are alike, though. Rabbits are now included in the very same Red List as the rare dune species. Although early descriptions of rabbits stressed their negative

qualities from the perspective of farmers and foresters, they now assume a different status in biodiversity conservation as "a keystone species – ecosystem engineers – on which whole habitats and communities depend" (People's Trust for Endangered Species, n.d.). Similarly, the Bowland Ecology project on the Sefton Coast reiterates that "rabbits are a keystone species of coastal sand dunes, maintaining an open, short and diverse sward, limiting/slowing the process of succession to a more widespread species poor, rank grassland and scrub" (Bowland Ecology, n.d.).

Like warreners, dune managers seek to modify rabbit habitats to increase their populations and to promote pockets of biodiversity. For instance, the Sand Dune Managers handbook of the Dynamic Dunescapes project recommends mowing to keep dune vegetation short and to help rabbits establish colonies in strategic areas (Jones et al., 2021). According to the Kenfig SAC management plan (2008, p.41), it is necessary to monitor rabbit numbers to avoid a population explosion that could result in overgrazing. However, history reveals that rabbits rarely stay in one place, often trespassing outside the boundaries established by human control. In the Magilligan Dunes, a Special Area of Conservation in Northern Ireland, contrary to the Dynamic Dunescape project, rabbits are unwelcome as they are considered useless for dune conservation. In contrast, dune managers prefer the grazing habits of livestock, which are easier to control (*Derry Journal*, 2016). Occasionally, rabbit populations have grown to a point where overgrazing becomes a concern, requiring "humane culling by licensed and insured pest controllers" (McKinney, 2016). In the present context of dune management and its accompanying forms, rabbits mutate into "desirable life" for specific objectives, a form of caring but not caring too much as rabbits can quickly become an "undesirable species" (Wynne-Jones et al., 2020, p. 72). In this sense, rabbit grazing has transformed from an undesired practice to a highly desired one on certain over-stabilised dunes, showing how certain practices can be despised but later cherished as they gradually become embedded in shifting socioeconomic constellations.

Discussion and Conclusion

The evolution of dune areas, now of special interest, is controlled by the dynamics of natural coastal processes such as waves, tides, winds, sea-level rise, and sediment transport mechanisms. In a geological timeframe, these interlinked processes take course over centuries or millennia. On the Sefton coast, for instance, sediment analysis and radiocarbon dating suggest that the oldest dunes formed between 5700 and 5800 years ago from an emergent offshore sandbank that existed 6800 years ago (Pye & Neal, 1993). The Kenfig dune system may have evolved from a sand barrier system, which developed some distance to the west of the present shoreline during the early to mid-Holocene (Culver, 1976). The barrier system moved landwards during the late Holocene, driven by rising sea levels and periods of more frequent storms (Pye & Blott, 2017). During these different phases of coastal formation, various ecosystems thrived in these dunes only to disappear later when conditions changed. On the Sefton coast, during the earlier part of the mentioned period, oak and alder woodland covered the dunes (Pye & Neal, 1993). In Kenfig, tree roots in the peat layers indicate that a kind of forest cover would have been present over dunes at that same time (Pye & Blott, 2017). These varying dynamics illustrate that dunes have never been one environment, nor can they be reduced to historical baselines, but, rather, a succession of evolving environments, making them impossible to fully grasp according to human timeframes. Thus, choosing a particular historical point free from human influence or one in which human manipulation resulted in desirable landscapes boils down to imaginaries of

an idealised nature that are untenable today and may not promote resilience in the face of abrupt anthropogenic and climatic influences.

The concept of "novel ecosystems" has gained traction in restoration ecology, referring to ecosystems that contain new species arrangements due to the introduction of species from other areas (Keulartz, 2012; Robbins and Moore, 2013). In the realm of invasive species management, where the most popular option remains to eliminate these species in favour of native ones, the trend is shifting towards viewing invasiveness as an element that contributes to the creation of novel ecosystems that are also resilient and do not require overt human intervention (Keulartz, 2012, p. 51). Dunes are examples of these novel ecosystems that consist of biogeographically complex assemblages resulting from various animal and plant introductions as well as afforestation, rabbit breeding, vegetation removal and environmental change, what Tsing et al. (2019) refer to as the "Patchy Anthropocene," that is, the uneven and asymmetrical relations between human and nonhumans that generate heterogeneous landscapes that vary across time and space.

This unevenness becomes evident in Newborough Warren, where ontological conflicts (Blaser, 2009) emerge between community residents and conservation objectives and the meaning ascribed to afforested dune landscapes. The planting of pine forests on coastal dunes radically transformed dune structure, making them at times unrecognisable, hidden under dense canopies and scrub vegetation, and yet the woodland habitats that emerged from widespread stabilisation efforts provide homes to ravens, red squirrels, and other wildlife that forge a strong and sometimes emotional relation with residents, such as the case of the Newborough Forest Protection Group formed by concerned citizens who staunchly oppose the conservation objectives of Natural Resources Wales (Doody, 2013, p. 166; Newborough Forest Protection Group, n.d.). However, the existence of red squirrels, pine trees and ravens in woodland habitats threatens the rarer dune species preferred by conservation organisations. Hundreds of concerned citizens who signed online petitions commented on their reasons for opposing open dunes. In addition to citing their appreciation for the species mentioned above, many comments also expressed fears of accelerated coastal erosion due to large portions of trees being cut down and the disappearance of the forested landscape, which many have known since their childhood (Newborough Forest Protection Group, n.d.).

In this context, the case of Newborough Warren sheds light on both Kenfig Burrows and the Sefton Coast Management scheme, illustrating that as management plans move forward it is critical, as anthropologists and human geographers have noted extensively, to include the views, interests and well-being of local communities in the planning, management, and maintenance of coastal areas such as dunes (Robbins, 2011). Searching for adequate approaches that involve all stakeholders can be challenging as managers have to deal with conflicting multiple land uses, such as the case of the Sefton Coast, where there are over one million visitors annually, as well as hotels, golf courses, recreation areas, and nature conservation (Van der Meulen et al., 2004). Thus, through time, dunes have changed considerably. Yet, they continue, much like in the past, to be resource frontiers, now wedded to new forms of nature commodification through the allure of coastal tourism, which is causing significant changes to dunes and their human and nonhuman inhabitants, not only in the UK but worldwide (Martinez et al., 2004). These changes, interfering with natural dynamic processes, could severely impact coastal protection from storms, rising sea levels, and flooding.

In agreement with Biermann and Mansfield, we find that dune management reflects a "biopolitical logic that emphasises distinctions between biological kinds and develops interventions based on these distinctions" (2014, p. 58). Viewing dunes as more-than-human institutions draws attention to the biopower that envelops the environmental management of coastal dunes while also maintaining openness to the historical trajectories of landscape-making practices tied to biodiversity conservation, sand stabilisation efforts and rabbit commerce. This perspective has also aided in weaving transdisciplinary threads to conceive landscapes physically, anthropologically and historically. In our case, it was necessary to move beyond populations as the unit of analysis that is common in traditional Foucauldian analyses to landscapes as a "core analytical entity" (Nustand and Swanson, 2022, p. 937) to illustrate the convergent and divergent relations between humans, sand, plants, and wildlife that shape particular ontological visions of how nature should exist.

We have argued that dunes were and still are managed to what suits best human purposes and ideas. Even when the aim is to protect and restore them, this is done according to human ideals of what a dune should resemble. Perhaps, as Knight suggests for rivers in New Zealand, it is time to start thinking about the intrinsic worth of dunes, rabbits, and vegetation without human aims and instead "reflect on how we need to 'fix' ourselves" (2018, p. 1628). In agreement with Provoost, Jones, & Edmondson (2011), it is crucial to accept that despite considerable efforts to restore dunes, these landscapes rarely return to an ideal and harmonious state (again, a human notion). Thus, it is necessary to recognise that "every single dune site has a story to tell, and management policy should incorporate this specificity" (2011, p. 220). Finally, natural sciences focusing on the geological and biological processes of coastal systems show that despite human efforts and interferences, these dynamic processes continue. Even if they are interrupted or forced to move in new directions, their long-time scales (which are much more extensive than human lives) and their uncontrollable loops and feedback assure they are not passive backgrounds but active agents in conjuring patchy coastal histories.

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