Effectiveness of UK Legislation and Management in Producing Nature Conservation Outcomes: a Case Study of the Purbeck Heaths

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September 2022

Abstract

National Nature Reserves (NNRs) are a form of nature conservation management using protected areas to improve specific site features or wider biodiversity. This study focuses on the UK case study of the Purbeck Heath NNR. Formed through the partnership of seven stakeholders, the management aim of this reserve is to restore the Purbeck Heath to its natural habitat and increase overall biodiversity through landscape-scale management. The Purbeck Heath covers designated protected areas such as Sites of Special Scientific Interest (SSSI), Special Areas of Conservation (SAC), Special Protected Areas (SPA), and Ramsar Sites. This study investigated whether the management used within the protected areas of the Purbeck Heaths will benefit overall biodiversity goals and fulfil legislation. Site observations were used to assess public compliance in accordance with the legislation and management measures of the specific site, whilst personal communications were carried out to gain representations of what key ecological management measures are currently used on site. Bayesian Belief Networks were used to evaluate how different designated features within the NNR will continue to perform under current management methods. Results showed that protected designated features within the reserve would improve under the landscape-scale management of the Purbeck Heath NNR with ecosystem services, biodiversity, protected target species, and protected target habitat likely to increase despite climate change likely to increase. Ecosystem services are likely to increase the most in SSSIs. Protected target species and protected target habitat are likely increase the most in Ramsar sites. Invasive species are expected to increase within Ramsar sites, Special Protected Areas, and Special Areas of Conservation. Spatial zoning, natural succession and fragmentation are likely to decrease the most in SSSIs and Ramsar sites. Discussions showed that the main conservation outcome for the Purbeck Heath NNR is to increase landscape connectivity, climate resilience and overall biodiversity by placing nature first. Overall, the Purbeck Heath NNR has the potential to fulfil the legislation aims set out under the various designations of SPAs, SACs, SSSIs, and Ramsar sites.

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Acknowledgements

Firstly, I would like to thank my supervisors Rick, Tilak, and Iain for all the support and help you have given me over the course of this research and during my time with Bournemouth University. I am forever grateful for your guidance and words of wisdom in navigating my early career as an academic. I would also like to thank the representatives from Natural England and the National Trust for their expert opinion and personal communications. The information gathered from them has contributed to the outcome of this work.

To my dear friend Cliff, thank you for being there when I needed someone to talk to throughout my time at Bournemouth. To my partner Fin, thank you for making me laugh when things got tough and for making me cups of coffee every morning. I could not have done this without you. To my parents, thank you for your continuous love and support throughout my time at University. Words cannot express how grateful I am to you both for the opportunities you have given me.

Chapter One – Introduction, Background, and Literature Review

1. Introduction

This chapter outlines an introductory background into the reasoning for this research. A literature review is provided outlining the threats to nature conservation management, specific conservation techniques, and supporting legislation, as well as introducing the case study of this research which focuses on the Purbeck Heath National Nature Reserve. The research aims and objectives are also discussed in this chapter. Chapter two outlines the research methods, and Chapter three presents the results of this research, whilst Chapter four provides an overall discussion and final conclusions to this work.

2. Background

2.1 Biodiversity and Habitat Loss

The variation of species within a given ecosystem and their various interactions within the different communities can be defined through biological diversity. Biodiversity is of particular importance when discussing nature conservation efforts as it supports ecosystem multifunctionality (Lohbeck et al. 2016). However, biodiversity is decreasing because of climate change, anthropogenic pressures and associated consequences (Malcolm and Markham 2000; Tilman et al. 2017). One related consequence of both climate change and anthropogenic stressors is habitat loss. Considered to be the greatest threat to biodiversity (Brooks et al. 2002; Hanski 2011), habitat loss and fragmentation are key factors to consider when attempting to conserve a specific species or overall biodiversity of a site.

Human activities such as land-use changes, agriculture, overexploitation of natural resources, and pollution are all contributing factors that increase the rate of habitat loss and result in the formation of fragmented areas of habitat (Tilman et al 2017). These anthropogenic changes place an increasing amount of pressure on wildlife to adapt or risk becoming extinct. The rate of species extinction resulting from habitat loss is already on the rise (Giam et al. 2010; Johnson 2022), with 25% of plant and animal species listed under the IUCN Red List criteria being classified with the threat of extinction, whilst 59% of megafauna are threatened with 70% in decline (Johnson 2022). Understanding the

impacts of anthropogenic stressors and habitat loss is important when managing conservation efforts with the aim of producing effective nature conservation outcomes that are sustainable (Giam et al 2010). It is common for conservation efforts aimed at improving biodiversity to be applied on a local context with irrelevance for global biodiversity goals (Keil et al. 2015). If conservation efforts are to increase biodiversity whilst reducing habitat loss and the threat of species extinction, attitudes towards adopting different management techniques need to change to allow for the application of effective management.

To maximise the success of conservation efforts offsetting the impacts of habitat loss and anthropogenic pressures, it has been proposed that management techniques should move away from local reserve application and instead apply large landscape-scale conservation efforts (Hanski 2011; Wilson et al. 2016; Donaldson et al. 2017). Not only is this change in conservation management deemed cost-effective, but it also combats habitat fragmentation by grouping areas together that would otherwise be separated due to different management techniques and zoning (Hanski 2011). Adopting large landscape-scale conservation techniques enhances habitat connectivity whilst improving habitat quality and ecosystem function. It provides a pathway for species to migrate and adapt to ecosystem change in wake of anthropogenic land-use changes and climate change (Donaldson et al. 2017). As a result, it creates a buffer for biodiversity to thrive on a regional and global scale. Yet, biodiversity is not only impacted by anthropogenic stressors but is also influenced by climate change.

2.2 Climate Change

In some habitats such as coral reefs, climate change is the biggest driver in determining the rate of biodiversity loss (Hoegh-Guldberg et al. 2017). Species response to changes in climate can be expressed across three climatic niches; phenology, range, and physiology (Bellard et al. 2012). Changes to these three niches can pose several issues for nature conservation management and the intended management outcomes.

Changes in species phenology has already been documented in different species of flora and fauna. Root et al. (2003) found that the mean number of days in spring phenological events in species shifted to 5.1 days earlier per decade over the past 50 years (Bellard et al. 2012). Such disruption in phenological cycles because of climate change can interrupt the coordinated life cycles of predator-prey interactions and pollinating systems (Parmesan 2006), contributing to species extinction. Predicting such changes to

phenological interactions between species can be a challenge when designing and implementing effective conservation management techniques. Understanding species response to climate change is important as it allows for conservation efforts to be prioritise the protection of species that are most likely to be at risk of extinction (McLean et al. 2016). It also allows conservation practitioners to assess what future levels of biodiversity might look like, how population dynamics will be affected, and what needs to be implemented to reduce the impact of climate change within an ecosystem (McLean et al. 2016).

Climate change can affect the conditions of habitats resulting in species responding by shifting their range and dispersal (Bellard et al. 2012). Species are adapted to occupy a habitat that supports their climatic equilibrium, conditions that alter this equilibrium affects the species that are not able to biologically adapt fast enough causing them to alter their spatial range. Spatial shifts can occur on a local scale but has been most noticeable on a regional scale in birds and insects (Bellard et al. 2012). Reductions in species range can increase their vulnerability to habitat loss, increasing the need for specific nature conservation outcomes that facilitate support for the species to adapt and survive (Summers et al. 2012). Habitat loss linked to climate change can also alter the physiological function of plant species resulting in the interactions between other plant species and pollinators being altered along with the ecosystem (Becklin et al. 2016). Having a broad spectrum of physiology in an ecosystem contributes to a high level of biodiversity that improves ecosystem health and function (Wikelski and Cooke 2006). Conservation physiology significantly contributes to nature conservation management efforts as it can highlight likely stressors that place species and habitats at risk of declining (Wikelski and Cooke 2006). By addressing the area most likely impacted by climate change, conservation efforts can also combat habitat and biodiversity loss.

2.3 Conservation

Conservation efforts can involve various forms of hard and soft engineering varying from the influence of manufactured processes, the use of new and existing technology, and relying on natural processes to influence management techniques. Conservation can focus on protecting specific target species or habitat currently in decline or focus on recovering ecosystem health and function. This study focuses on the use of landscape-scale habitat restoration.

Habitat restoration processes are being used to support ecosystems in becoming more resistant to disturbances from climate change and habitat loss (Török and Helm 2017; Loch et al. 2020). Through active and passive manipulation techniques, nature can be restored to a natural condition that enhances biodiversity, ecosystem services, and fights against habitat loss (Loch et al. 2020). Increases in species interactions as part of the restoration process enables ecosystem services such as natural pest control, pollination, and resistance to invasive species to be increased (Montoya et al. 2012). These services also aid the development and success of restoration projects in increasing biodiversity and ecosystem enhancement (Montoya et al. 2012). For restoration to be successful a clear rationale needs to be developed along with designated objectives to the project, as well as providing explanations on how the restoration project will complement the landscape whilst working with a stakeholder strategy (Society for Ecological Restoration International Science & Policy Working Group 2004).

Designating habitat restoration to areas of shared land, such as sites that were used for agriculture, can be beneficial as it can enhance biodiversity and ecosystem services at both a designated field site and larger landscape scale. This can be compared to restoring sites that are divided and fragmented, which would only benefit the individual site rather than in collaboration (Benayas and Bullock 2012). Conservation efforts adopting a restorative approach supports the maintenance of habitat connectivity and resilience allowing for species and ecosystems to viably function under the pressure of climate change (Poiani et al. 2011). Overall, habitat restoration efforts allow ecological enhancement of ecosystem services on both a landscape scale and field level to fight against environmental degradation. Restoration efforts are beginning to move away from the use of human interference in nature conservation techniques and move towards the advancements in natural processes through rewilding efforts.

Rewilding efforts are being installed within conservation frameworks focusing on restoring ecosystem processes and increasing biodiversity by allowing nature to recover on its own with limited human involvement (Corlett 2016; Fernández et al. 2017). Techniques include re-establishing populations of large mammals and managing areas of abandoned agricultural land (Corlett 2016). The type of rewilding practice that may be installed relates to an ecological baseline guiding the desired outcomes for this type of conservation practice. Cultural landscapes have been developed through active and passive means with varying dependences and influences from human activity (Lorimer et al. 2015). Ecological records from the Pleistocene, Holocene, and ‘Novel ecosystems’

influenced by the Anthropocene may be used as benchmarks to determine the extent an area of land may be restored through rewilding processes (Lorimer et al. 2015). Rewilding was first introduced in North America with an approach surrounding the 3Cs; core areas, corridors, and carnivores (Lorimer et al. 2015; Carver 2016). In Europe, re-introduction programmes involving European bison and grey wolves is one approach being discussed (Ceauşu et al. 2015), although it is met with concern on how these animals may conflict with human activities around the protected area (Corlett 2016).

Another approach is managing core areas of habitat; for Europe this is lowland grassland and heathland that were once cultivated for agriculture (Lorimer et al. 2015; Fernández et al. 2017). These habitats share characteristics that show early signs of succession and are commonly managed through human involvement, but to encourage biodiversity growth in Europe, it is possible to reduce human interference and allow nature to recover. The issue with adopting a bold and broad conservation technique such as rewilding, is that it may conflict with certain protected area designations and intended legislation outcomes. Possible conflicts between intended management and legislation outcomes are addressed in this research in the context of the chosen UK case study.

The National Parks and Access to the Countryside Act (1949) outlines the initiatives for the creation and management of Local and National Nature Reserves. This legislation stems from the 1947 work by the Wild Life Conservation Special Committee (1947) that first established a nature conservation framework that supported designing protected areas (Barker and Box 1998). Along with conserving nature, it was also agreed that National Nature Reserves should aim to maintain public rights of way to ensure that the public can escape to green areas and enjoy the benefits of nature (Sheail 1996). Under the Wildlife and Countryside Act (1981), National Nature Reserves (NNRs) may also be designated as Sites of Special Scientific Interest (SSSIs; Barker and Box 1998). There is considerable overlap between NNRs and SSSIs but there is no regulatory requirement for NNRs to be SSSIs as Nature Reserves can be selected through different means. SSSIs are evaluated through assessing the abundance of species in sites and whether those present are of value supported by scientific rationale (Prendergast et al. 2001; Bainbridge et al. 2013). Another way to select sites is through classifying areas based on how well they reflect different ecological, physiological, and climatic regional characteristics. This has been used in the UK to designate sites that serve as areas for rare or declining species or habitats (Prendergast et al. 2001).

Despite NNRs being used as a form of nature conservation for threatened species, a recent study shows that NNRs found in England are under high levels of climate vulnerability (Duffield et al. 2021). The levels of biodiversity that these reserves were designed to protect are now under threat from changes in temperature and rainfall (Duffield et al. 2021). With current nature conservation statutes and management focusing on using habitat restoration techniques that compliment current site characteristics as the intended outcome, there is little movement in amending statutes and management to include promoting resilience to allow nature to survive under climatic pressures (Duffield et al. 2021). The balance between legal and scientific opinion is important when implementing a conservation framework that is effective for long-term success. For Nature Reserves to succeed in supporting conservation frameworks, the effectiveness of legislation and nature management needs to be assessed when achieving intended nature conservation outcomes and biodiversity goals. The focus case study of this research, the Purbeck Heath NNR, seeks to address biodiversity goals and legislation that aid habitat restoration, but also build resistance to climate change.

3. Literature Review

3.1 Nature Conservation Policy and Law

NNRs were established as a form of Protected Areas (PAs) that aim to conserve specific habitats, species, and geology of national importance, whilst also providing opportunities for the public to engage with nature (Natural England 2021). When evaluating the effectiveness of NNRs, it is essential to examine the nature conservation legislation surrounding the management of Nature Reserve sites to determine whether the legislation is robust in supporting and enforcing the correct management practice.

Natural England is the statutory body formed under the Natural Environment and Rural Communities (NERC) Act 2006, responsible for designating and managing NNRs and SSSIs within England (Bell et al. 2017). Natural England enforces the conservation laws that influence the management of NNRs under the Wildlife and Countryside Act 1981. Part II of this Act outlines the principal domestic measures based on voluntary agreements combined with financial incentives to achieve targets rather than a regulatory approach (Last 1999; Peters 2014). Although the Wildlife and Countryside Act (1981) appears to be a promising piece of legislation outlining the priority of PAs and regulation of land use, Section 28 of the Act (1981) outlines the duty of Natural England to notify

landowners of any area of land or species on the land that is under protection or site designation. On a broader scope, the role of Natural England is to install a set of compliance and enforcement objectives by giving consent for certain actions to occur on designated sites, whilst they may issue unlimited fines to landowners who take on unconsented work on site. At first glance, the Wildlife and Countryside Act (1981) could be considered to adopt a Precautionary Approach; however, enforcement of land management is weak, and Natural England are only responsible for providing notification of site designation (voluntary approach) with the addition of consent to certain activities on sites. With weak enforcement and lack of legal obligations, the Wildlife and Countryside Act (1981) provides the opportunity for the nature conservation management techniques used to be weak in protecting target species and habitats within NNRs, allowing questioning of the effectiveness of the present legal regime in achieving nature conservation aims.

Natural England was also responsible for enforcing the management of European Union (EU) PAs under the EU Habitats and Birds Directives (Council Directive 92/43/EEC; Directive 2009/147/EC). However, with the UK's withdrawal from the EU the commitment of upholding EU agreements no longer stands. Although the PAs that were designated under the influence of EU law remain protected under UK law, their protection and management moving forward is regulated without influence and oversight from the EU commission. Data collection, reporting and collaboration of transboundary networks made the EU enforcement effective, but Brexit could jeopardise this management practice (Heyvaert and Čavoški 2017). The new government body Office for Environmental Protection (OEP) is now responsible for overseeing site monitoring and data collection on the performance of EU PAs within the UK. Without legal inputs from government bodies, both within the EU and UK, site monitoring and assessment may decline along with the effectiveness of nature conservation legislation and management techniques (Heyvaert and Čavoški 2017).

The UK government's 25 year Environment Plan (Department for Environment, Food and Rural Affairs [Defra] and Gove 2018) outlined the government's initiative of leading a green future for improving the environment outside the realms of the EU. The plan addresses the formation of a Nature Recovery Network aimed at linking existing PAs through effective management and stakeholder involvement. Though the plan appears to place nature's best interest at the forefront, these intentions have been overshadowed by the inclusion of natural capital (Dempsey 2021). This economics-based approach

highlights the need for our natural assets such as forests, waters, and soils to provide an economic gain rather than an ecological one. The Environment Act 2021 is no different, also using natural capital as a conservation approach. The Act outlines the use of a Biodiversity Net Gain alongside a Local Nature Recovery Strategy like that outlined in the 25 Year Environment Plan (Defra and Gove 2018; Dempsey 2021). The introduction of the use of the Biodiversity Metric 2.0 tool will allow the government and stakeholders to measure any biodiversity loss or gains (Defra 2020). This could be a promising use of statistics to measure and assess the effectiveness of management techniques occurring at different sites. Yet, clarity is needed over the communication between stakeholders about the decision-making process and management techniques (Dempsey 2021). If NNRs are to successfully fulfil their nature conservation aims, and for management to be effective, legislation needs to explore environmental protection for the environment, not just for the economy.

In dealing with the environment, solid enforcement that supports the intended management is needed. Manchester and Bullock (2001) stated that the effectiveness of nature conservation in dealing with the threat of non-native species impacting biodiversity within NNRs could be considered ineffective due to a lack of enforcement. One disadvantage to Manchester and Bullock's work is that it is 21 years old, and situations may have changed since then. However, Bowen (2021) highlights how enforcement is the least effective area in dealing with threats of non-native species on NNRs and recommends that existing enforcement and management structures need to be updated to resolve current threats, along with the support of continuous monitoring. Although monitoring the effectiveness of law enforcement is rarely scrutinised due to financial costs, enforcement of legal instruments needs to be improved for conservation practices to be successful (Critchlow et al. 2016; Bowen 2021).

The UK government have adopted a new initiative as part of the Conference of the Parties 15 (COP15) of the Convention on Biological Diversity (CBD) (Tonassi 2021). As part of this pledge, the UK government are responsible for protecting 30% of our land and seas by 2030 (Williams 2020). Where 26% of land in England are under some form of designated PA, a further 4% will also become protected (Defra and Johnson 2020). Yet with 2030 edging close, there is pressure for these pledges to be fulfilled. For the outcomes of the CBD to be successful, historical records of site conditions must remain updated to inform management measures on how to effectively support biodiversity. This

is to ensure that favourable conditions are maximised to benefit the biodiversity of the area and aid the UK in reaching its aim of effective protection by 2030.

3.2 The Importance of National Nature Reserves

PAs, including Nature Reserves, play a key role in conservation, covering approximately 15% of the world's land surface (Maxwell et al. 2020). Nature Reserves provide a fundamental role in protecting species and habitats as well as providing benefits for people. The expanse of PAs allows for long-term nature conservation. There has been added pressure on PAs to perform well over the past decade, with their effectiveness being questioned in relation to funding, management, and ecological damage, especially where there has been an increase in coverage (Pringle 2017). Although there have been studies exploring the performance of Nature Reserves and their effectiveness at achieving ecological, social, and economic objectives (Butchart et al. 2012; Watson et al. 2014; Pringle 2017), there is limited use of adopting a meta-analysis modelling approach to measure and predict the overall effectiveness of reserves. One study has used modelling approaches to predict species distribution within an area against climate change (Martin et al. 2012), although this study modified the network to suit the current ecological state of Australia (Martin et al. 2012). Whilst another study by Stafford et al. (2016) focused on applying a model to the management of marine reserves in Ecuador. This research differs from these studies as it focuses on a UK NNR case study.

In the UK, Nature Reserves are used to sustain and protect a valued habitat from agricultural and urban expansion. Many of UK Nature Reserves are categorised into sub sites; Special Protection Areas (SPAs), Special Areas of Conservation (SACs), Ramsar Sites, Sites of Special Scientific Interest (SSSIs), Areas of Outstanding Natural Beauty (AONBs). Yet whether site designation and current management is effective at achieving site objectives is not always clear. Concerns have been raised for Nature Reserves where a protected species has changed its distribution in response to climate change (Gillingham et al. 2015). A third of SSSIs are managed by non-governmental organisations (NGOs), with other sites being managed by statutory and non-statutory bodies (Gaston et al. 2006). The effectiveness of a protected site may come down to not only the management practice but who is enforcing such practice. If a site is not performing well, is it because of the management plan or the laws and regulations put forward by the management body? Understanding the interactions between the scientific and legal fields and highlighting where future weaknesses within nature conservation management may fall need to be addressed.

The importance of NNRs stems from the need for ecological restoration against the backdrop of anthropogenic activities (Sutherland et al. 2010). They provide a haven for ecological biodiversity to flourish and allow for a natural ecological equilibrium to be restored. Yet with the threat of climate change, fragmentation, non-native species, and ultimate decline in ecological biodiversity, it begs the question of how effective NNRs are in aiding the ecological management of nature conservation.

3.3 Threats to National Nature Reserves

The effectiveness of NNRs on the ecological management of nature conservation is not without its threats. The main threats to the success of NNRs comes from fragmentation, biodiversity loss, invasive species and climate change (Harrison and O'Donnell 2010). It is anthropogenic activities that cause many of these threats to be present. The expansion of urban areas in the UK has led to habitat loss and decline in species populations (Adams 1997). The construction of the Newbury bypass threatened the already declining Desmoulin's whorl snail, yet construction still went ahead (Adams 1997). Although this case study is dated, its impact is still relevant, showing how the damaging impact and threat humans pose to the natural environment. It should also be noted that this decision came about before the implementation of Environmental Impact Assessments in UK law; if this project was proposed today, an EIA would have to be carried out to determine the type of damage caused along with the benefits. Other UK habitats can be heavily influenced by the presence, or lack of, human involvement. The existence of heathland and wetland fens are threatened by the process of natural succession (Harrison and O'Donnell 2010). As the area slowly reaches its climax community, the specific habitats are lost and become displaced. Human involvement is needed to keep these habitats in the equilibrium in which they exist. Such management practice can only occur if the area is within protected measures. The examples given highlight the importance for NNRs and the need for conservation management techniques to be successful. It supports the rationale for this research where strengths and weaknesses within the current framework will be evaluated and solution proposed.

Whilst agricultural and industrial activities are the leading causes of habitat fragmentation (Zhang et al. 2021), anthropogenic activities encroaching on Nature Reserves can threaten the existence of natural ecosystems by affecting plant reproduction and the community presence of pollinators in that area, subsequently reducing the habitat quality (Cunningham 2001; Zeng and Wu 2005; Zhang et al. 2021). The reserves are formed to protect nature from exploitive activities, yet the legal designations do not eliminate the

threat of landscape fragmentation. This reaffirms the need for this research questioning whether nature conservation laws are substantial in enforcing the most effective management technique for protected sites. For mass reserves such as the Purbeck Heaths to be effective in nature conservation and reduce the threat of fragmentation, effective planning and management practices need to be adopted. Yang et al. (2019) proposed that the impacts of fragmentation will be lower if protection is high, and the economic growth of the surrounding area is slower. Although this is an important point to consider when addressing the effectiveness of NNRs on the ecological management of nature conservation, Yang et al. (2019) focused on China's nature reserves. Here, there is a difference of scale; the UK has a smaller land mass compared to China, and therefore has a smaller area for PA designation. The impacts of fragmentation could be felt more in the UK compared to China due to scale differences.

Human activities involving agriculture and urbanisation are the major influences for the biodiversity loss of our green spaces and PAs (Beckline and Yujun 2014). This ecological decline creates an ecosystem that is less resilient, high in vulnerability and therefore likely to fail in providing beneficial ecosystem services (Beckline and Yujun 2014). Despite international efforts to increase biodiversity, a global decline continues to persist (Stokstad 2010). Although a recent report has indicated that reversing this decline is possible post-2020, the global Living Planet Index continues to decline (WWF 2020). For this to be the case, it must mean that current management practices are acting at a slower rate and are weak in comparison to the act of depletion (Wood et al. 2000). Furthermore, the biological threat of invasive species on NNRs poses a risk to the effectiveness of PAs (Genovesi and Monaco 2013). NNRs are designed to benefit the native flora and fauna of the local area, but the presence of an invasive species can be damaging to the local ecosystem. As such, stakeholder management of PAs, including NNRs, should be assessed to examine their efficacy in reducing the threat of invasive biological invasions (Genovesi and Monaco 2013).

One of the largest threats facing the success to UK NNRs is the rate of climate change and the reserves' high levels of climate vulnerability (Duffield et al. 2021). The threat of climate change poses a risk for species distribution, especially where PAs are formed to protect a target species within a given area. There have already been studies showing a shift in species distribution during the winter season of Britain (Rehfisch et al. 2004; Gaston et al. 2006). The longevity of NNRs being a method for conserving biodiversity has long been questioned as species shift their distribution in response to an ever changing

climate (Gillingham et al. 2015). If NNRs are to be effective in conserving nature, what they are conserving needs to be closely monitored; whether the aim of the reserve is to protect a specific species population and habitat, or conserve the overall native biodiversity of that area.

3.4 Management of National Nature Reserves

Within NNRs there are different PA designations (SSSI, SPA, SAC, Ramsar) that require different forms of management and allow different forms of activities. Management should focus on land-processes and reducing the impact of disturbances as well as the species present and ecosystem function (Baker 1992). Types of management techniques that may occur on PAs within NNRs includes cattle grazing, temporal and spatial zoning, restricting public access, and management of woodland. SSSIs are a form of designation that protects rare species of flora and fauna, as well as geological and physiological structures that may interest scientific research (Cottam 2019). Natural England is responsible for the management of this type of PA where it is owned or managed by Natural England. SPAs are managed for the protection of birds. The Joint Nature Conservation Committee (JNCC) can provide advice on site designation and can advise on how to classify SPAs within the UK (JNCC 2021). SACs are PAs that protect specific habitats or habitats of species of ecological importance. A large part of the work carried out by the JNCC on both SACs and SPAs involves continuous monitoring and site assessment. This is to assess the status and trends of protected species within the PA and condition of habitats within the site (JNCC 2021).

3.5 Formation of the Purbeck Heaths

In 2020, seven stakeholders came together to form the UK's first 'super' nature reserve spanning 8,231 acres with 11 key wildlife habitats (National Trust 2021). The Purbeck Heath NNR forms a partnership between Natural England, RSPB, Forestry England, Dorset Wildlife Trust, Amphibian and Reptile Conservation Trust, the Rempstone Estate, and National Trust (National Trust 2021).

The site ranges from Studland, Arne, Norden, and Grange Heath, encompassing Hartland Moor, Stoborough Heath, and Studland and Godlingston Heath, which are already existing NNRs (Dorset Area of Outstanding Natural Beauty 2021). Within the Purbeck Heaths are areas designated as SSSIs, SACs, SPAs, and Ramsar sites. The connection of these habitats and PAs falls under the Nature Recovery Programme of the government's 25 Year Environment Plan (Defra and Gove 2018). According to Natural England, it is

hoped that this super reserve will benefit both people and the natural environment (Jones and Comfort 2021). The formation of a super reserve connecting landscapes may aid environmental resilience against climate change, biodiversity loss, and other anthropogenic stressors (Rewilding Britain 2021). Yet, with the involvement of various stakeholders with varying interests and objectives, the aim of the Purbeck Heaths may cause stakeholder conflict. The Amphibian and Reptile Conservation Trust wish to conserve sites that support all six of the UK's reptiles by protecting their habitat and food source (Amphibian and Reptile Conservation 2021), whilst the National Trust wish to provide ways that members of the public can engage with nature whilst also conserving sensitive sites. These matters of interest have the potential to spark conflict making the management of such a large site difficult. The management of the Purbeck Heaths may only be effective if the communication between all those involved is clear and open. This is especially critical if the site is to succeed in being part the governments Nature Recovery Programme.

4 Aims and Objectives

The aim of this study is to evaluate whether the management methods employed across the Purbeck Heaths will benefit biodiversity and fulfil legislation.

The objectives of this study are to (1) Explore what legal designations and protected features exist within the Purbeck Heath National NNR, (2) Identify management measures in place on the Purbeck Heath, (3) Outline how legislation and management can be improved to increase protection of designated features and wider biodiversity.

5 Chapter Summary

This chapter has outlined the rationale for this research addressing the threat to biodiversity and causes of habitat loss, as well as the impact of climate change. It has also outlined nature conservation techniques such as habitat restoration and rewilding techniques. The literature review examined the need for nature conservation management and legislation, as well as the role and importance of National Nature Reserves. The introductory section outlining the case study of the Purbeck Heath illustrates the application of this research using UK-based example. The next remaining chapters will aim to answer the research aims and objectives in a detail.

Chapter Two – Methods

1. Chapter Introduction

The previous chapter set the tone for this research, underpinning the rationale for this research along with outlining the research aims and objectives. This chapter seeks to demonstrate the methods used to collect data, and application of Bayesian Belief Networks.

2. Overview of Methods

This research evaluated whether the proposed management methods employed across the Purbeck Heath National Nature Reserve (NNR) will benefit biodiversity and fulfil legislation aims. To measure the effectiveness of likely future management plans for the Purbeck Heath NNR, a Bayesian Belief Network (BBN) is used to predict how different designated protected areas within the reserve will continue to perform under future management plans and supporting legislation.

Data from site observation and personal communications were used to form prior beliefs for the BBN and determine the probability of various outcomes for designated features within the Purbeck Heath NNR. Designated protected areas include Sites of Special Scientific Interest, Special Areas of Conservation, Special Protected Areas, and Ramsar Sites.

2.1 Site Observations

The Purbeck Heath NNR is based in the South West of the UK (Figure 1.0) and spans across 8,231 (Figure 1.1; National Trust 2021). The site combines three existing NNRs and includes habitats of lowland and wetland heath, valley mires, grassland, woodland, saltmarsh, and sand dunes (National Trust 2021). The seven stakeholders are responsible for the management of specific areas within the reserve highlighted in Figure 1.1.

Following approved risk assessments (Appendix I), in-field site observations were made to explore what protected features exist within the Purbeck Heath NNR and to identify current management measures in place. Management activities were observed to assess whether operations occurring on site were in accordance with the intended legislation and management outcomes. The sites visited within the Purbeck Heath NNR included RSPB Arne, Hartland Moore, Stoborough Heath, and Studland and Godlingston Heath. During these visits, public compliance with the intended management was observed taking

photos of examples of management used on site, along with observing public activities such as dog walking and cycling noting whether they are being carried out in the correct designated zones.

Figure 1.0: Map of the Purbeck Heath NNR in relation to the rest of the UK. The red pin highlights where the Purbeck Heath NNR is based in the UK with the Stoborough Heath NNR being part of the reserve (Google Maps 2022).

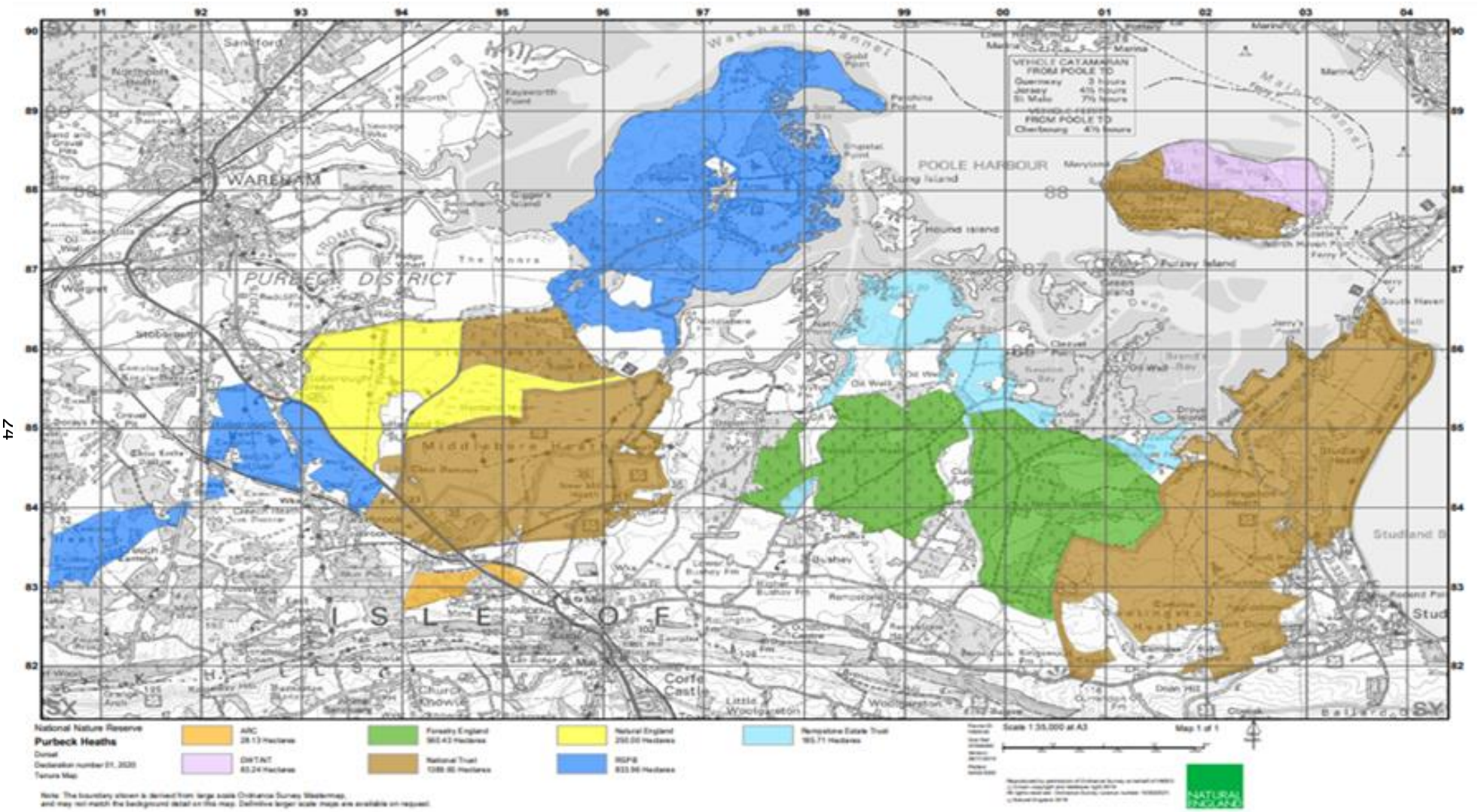

Figure 1.1: Map of the Purbeck Heath NNR. Highlighted areas demonstrate the occupancy of stakeholder management (Natural England 2020).

2.2 Personal Communications

Following an approved Ethics Checklist (Appendix II), representatives from Natural England, RSPB Arne, Dorset Wildlife Trust, National Trust, and the Amphibian and Reptile Conservation Trust were contacted for personal communications (Appendix III). Responses from Natural England and the National Trust were received agreeing to be part of a discussion to gain information for the purpose of this research (Appendix IV, V, VI).

Questions were asked surrounding the key ecological management methods currently used on selected sites, managing and monitoring activities allowed on site, and threats to the reserve (Appendix IV). Other questions were based upon current nature conservation legislation enforcing the most appropriate management technique, and what changes each representative would like to see on the reserve as well as changes to nature conservation legislation (Appendix IV). Questions were also asked based on what the aim and intended outcomes were for joining existing reserves to create the Purbeck Heath NNR (Appendix IV). The rationale for communicating with stakeholders who are involved with the direct management of the Purbeck Heath NNR was to gain an understanding of the management of the Purbeck Heath and to discuss their expert opinion on nature conservation. The rationale for communicating with a government body such as Natural England was to discuss how legislation can be involved in nature conservation management. Overall, the rationale for communicating with various stakeholders was to gather information based on expert opinion on nature conservation management and legislation involved. Answers given were used to influence the formation of the BBN models.

2.3 Bayesian Belief Network

Bayesian Belief Networks (BBN) are a form of meta-analysis that places a quantitative or semi-quantitative value on varying *nodes*. Nodes can represent varied factors such as biodiversity, conservation practices, or recreational activities. The quantitative value of each node can be in two fixed states: increasing or decreasing. The probability ranges between 0 and 1 where 1 represents the probability being ‘high’ or ‘increasing’. Edges connect the nodes to show interactions between different nodes reflecting the degrees of certainty of the interaction occurring, again between 0 and 1. Secondary data in the form of quantitative and qualitative data such as expert opinion and peer reviewed literature is used to determine the value of each edge. In the case of this research, site observations, stakeholder interviews, and existing conservation legislation were used to determine the value of each node and the degrees of certainty of each edge. This research was conducted

using modified versions of BBNs detailed in Stafford et al. (2015), which allow for reciprocal interactions between nodes and simplify the combined probability of multiple node interactions, allowing for more complex models of the interactions on nature reserves to be produced.

Four BBNs were constructed to reflect the different activities, management and ecology that are present on the Special Protected Areas, Special Areas of Conservation, Sites of Special Scientific Interest, and Ramsar sites within the Purbeck reserve. Each BBN model was altered specifically to each protected area designation within the reserve. Interaction probabilities between nodes were altered specifically to each protected area designation along with the addition of nodes specific to the individual designations. Information collected from stakeholder interviews, site observations, and existing legislation informed the probability of each node increasing or decreasing based on changes in management due to the formation of the NNR, node interactions, and prior beliefs. Interactive diagrams were created to reflect the numerous factors (nodes) that are present within each protected area designation. Connecting edges within each diagram demonstrates the direct interactions between nodes. Site observations, personal communications, and legislation determined the weight and probability of these interaction. Figure 2.0 provides a simplified diagram to illustrate the operations of the BBN networks used in this study.

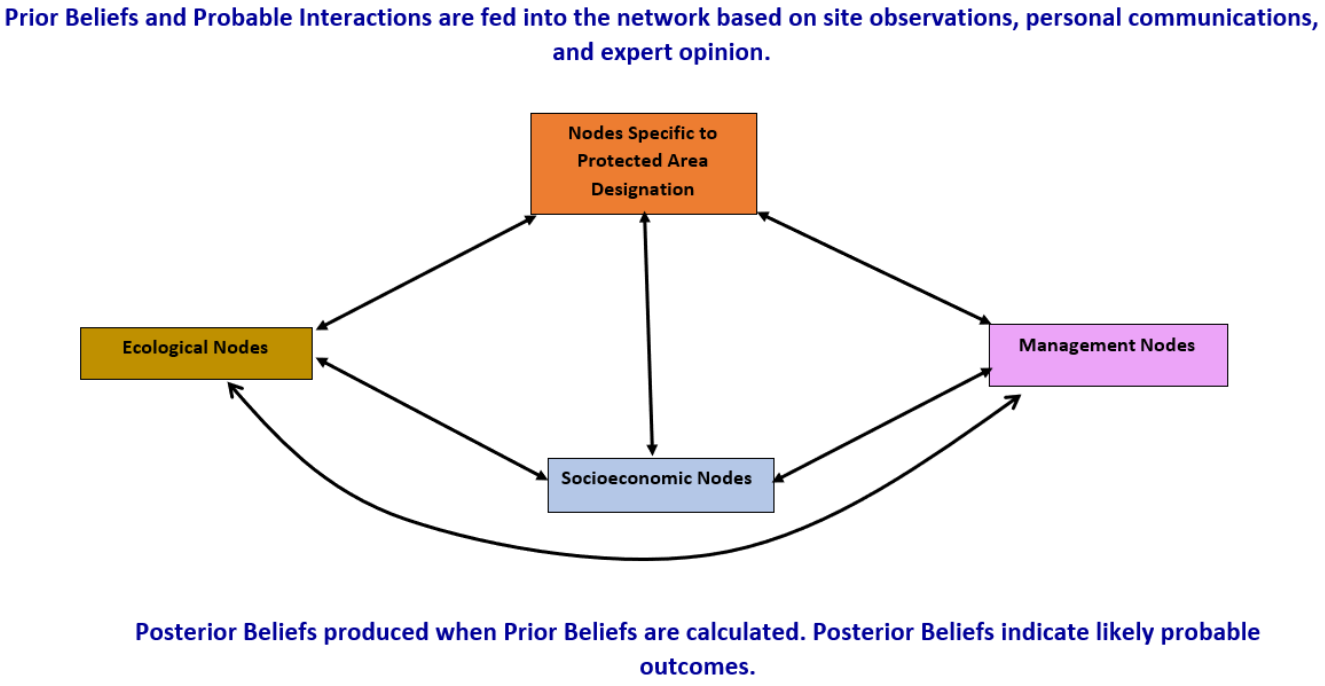

Figure 2.0: Simplified BBN network to demonstrate how the networks used in this study operate. Boxes show the different factors known as nodes. Arrows illustrate the different interactions within the networks.

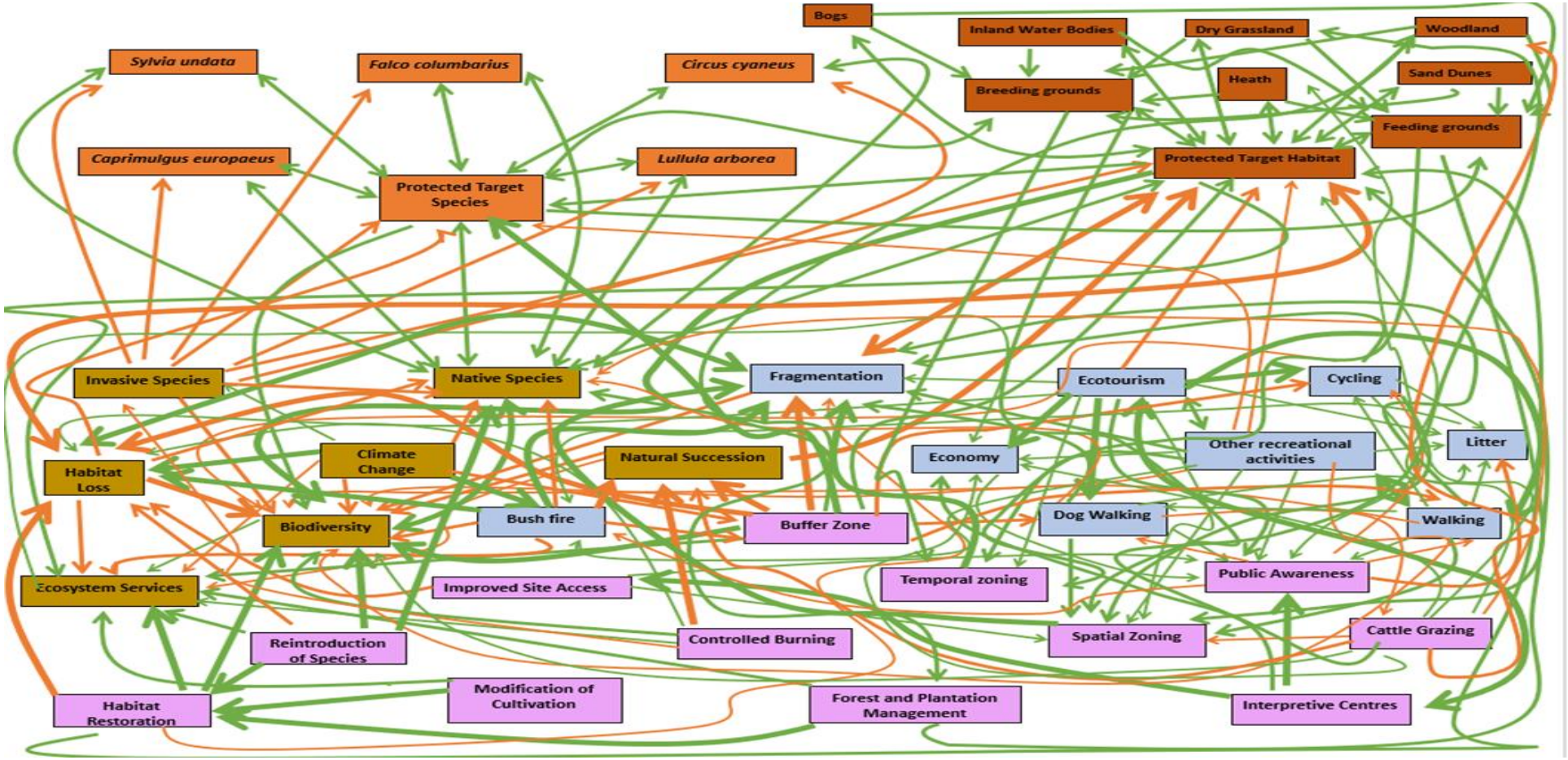

Figure 2.1: Interaction Diagram demonstrating the interactions that occur on SPAs within the Purbeck Heath NNR. Green arrows represent positive interactions (increasing node to increasing node), red arrows represent negative interactions (increasing node to decreasing node). Line thickness indicates the strength and therefore probability of an interaction, the thicker the line, the stronger the probability of an interaction. Light blue nodes indicate socioeconomic activities. Pink nodes indicate management factors. Yellow nodes indicate ecological factors. Light orange nodes indicate protected target species. Dark orange nodes indicate protected target habitats.

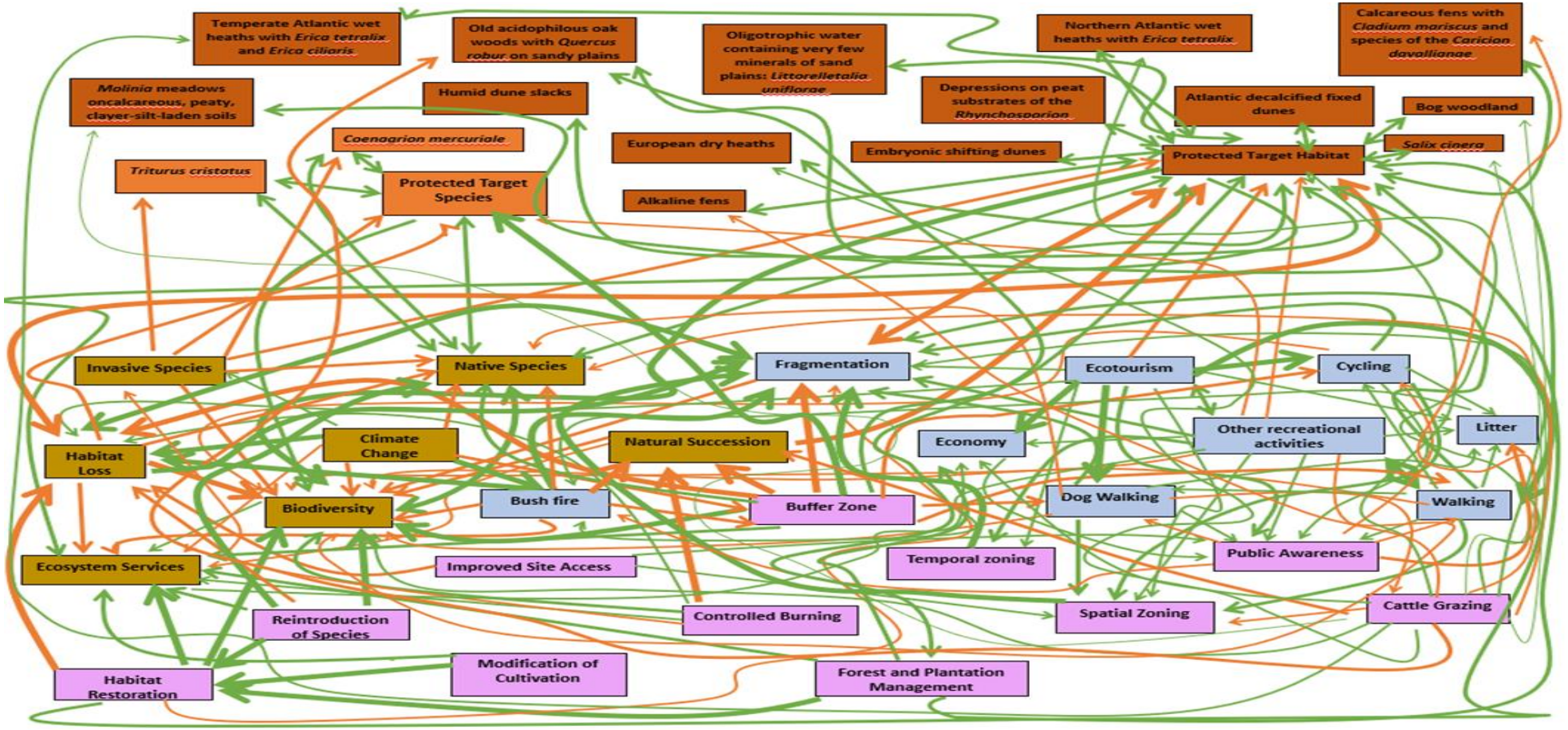

Figure 2.2: Interaction Diagram demonstrating the interactions that occur on SACs within the Purbeck Heath NNR. Green arrows represent positive interactions (increasing node to increasing node), red arrows represent negative interactions (increasing node to decreasing node). Line thickness indicates the strength and therefore probability of an interaction, the thicker the line, the stronger the probability of an interaction. Light blue nodes indicate socioeconomic activities. Pink nodes indicate management factors. Yellow nodes indicate ecological factors. Light orange nodes indicate protected target species. Dark orange nodes indicate protected target habitats.

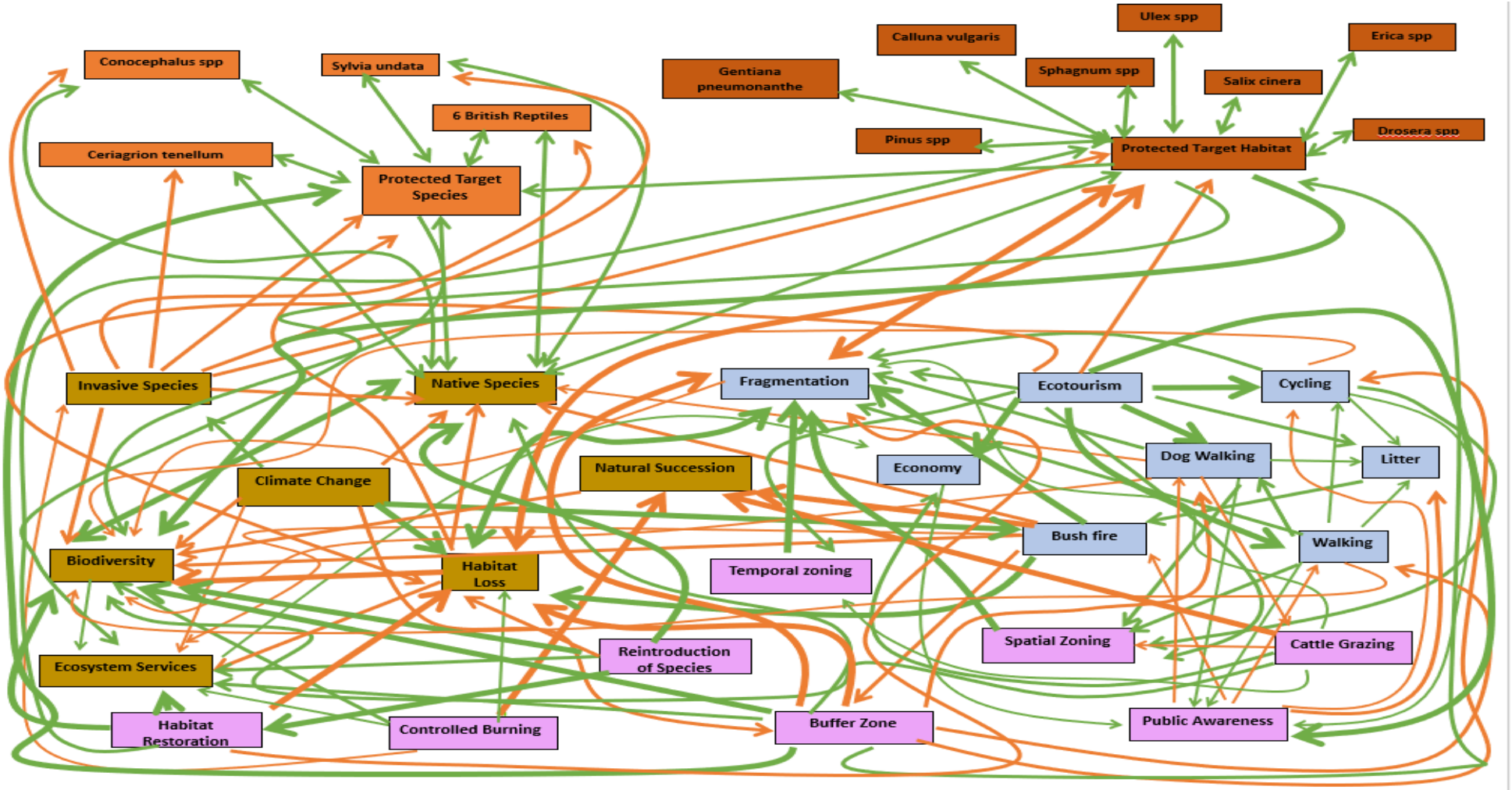

Figure 2.3: Interaction Diagram demonstrating the interactions that occur on SSSIs within the Purbeck Heath NNR. Green arrows represent positive interactions (increasing node to increasing node), red arrows represent negative interactions (increasing node to decreasing node). Line thickness indicates the strength and therefore probability of an interaction, the thicker the line, the stronger the probability of an interaction. Light blue nodes indicate socioeconomic activities. Pink nodes indicate management factors. Yellow nodes indicate ecological factors. Light orange nodes indicate protected target species. Dark orange nodes indicate protected target habitats.

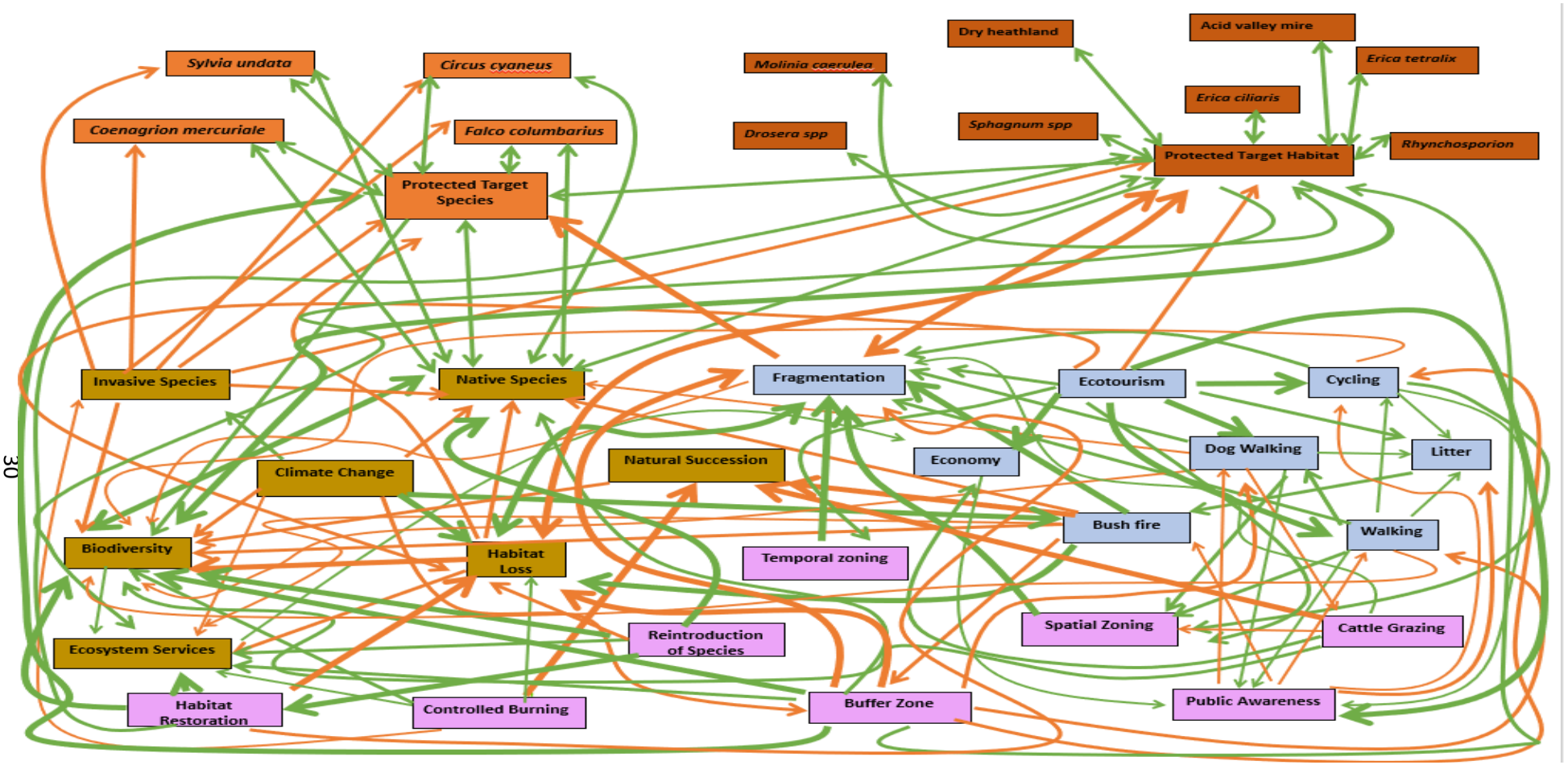

Figure 2.4: Interactive Diagram demonstrating the interactions that occur on Ramsar sites within the Purbeck Heath NNR. Green arrows represent positive interactions (increasing node to increasing node), red arrows represent negative interactions (increasing node to decreasing node). Line thickness indicates the strength and therefore probability of an interaction, the thicker the line, the stronger the probability of an interaction. Light blue nodes indicate socioeconomic activities. Pink nodes indicate management factors. Yellow nodes indicate ecological factors. Light orange nodes indicate protected target species. Dark orange nodes indicate protected target habitats.

2.3.1 Application of BBN on Protected Areas

The Birds Directive outlines how Special Protected Areas (SPAs) are threatened by natural succession, recreational activities, grazing, and invasive species. The directive also highlights how SPAs are benefitted by controlled grazing, improved access to sites, modification of cultivation, forest and plantation management, and interpretative centres. For this reason, improved site access, modification of cultivation, forest and plantation management, and interpretative centres were added as nodes specifically to the SPA BBN model. Certain protected target species and protected target habitats that are found on SPAs within the Purbeck Heath NNR reserve were also added as specific nodes. The protected areas within the Purbeck Heath listed under SPAs include Arne, Hartland Moor, Rempstone Heath Stoborough Heath, Studland and Godlingston Heath.

The Habitats Directive outlines how Special Areas of Conservation (SACs) are threatened by natural succession, recreational activities, grazing, and invasive species. The Habitats Directive also highlights how SACs are benefited by controlled grazing, improved access to sites, modification of cultivation, and forest and plantation management. For this reason, improved site access, modification of cultivation, forest and plantation management were added as nodes specific to the SAC BBN. Certain protected target species and protected target habitats that are found on SACs within the Purbeck Heath NNR reserve were also added as specific nodes. The protected areas with the Purbeck Heath NNR listed under SACs include Arne, Hartland Moor, Rempstone Heath, Stoborough Heath, Studland and Godlingston Heath.

The Wildlife and Countryside Act (1981) outlines the use of Sites of Special Scientific Interest (SSSI) to conserve and restore flora and fauna. Certain protected target species and protected target habitats that are found on SSSIs within the Purbeck Heath NNR reserve were added as specific nodes. The protected areas within the Purbeck Heath NNR listed as SSSIs include Arne, Hartland Moor, Rempstone Heath, Stoborough Heath, Studland and Godlingston Heath. Ramsar sites are listed under the Joint Nature Conservation Committee. Certain protected target species and protected target habitats that are found on Ramsar sites within the Purbeck Heath NNR reserve were also added as specific nodes. The protected areas with the Purbeck Heath NNR listed as Ramsar sites include Arne, Hartland Moor, Rempstone Heath, Stoborough Heath, Studland and Godlingston Heath.

3. Chapter Summary

This chapter has addressed the specific methods used in this research along with outlining the rationale for using site observations and personal communications to aid the formation of the BBN models. It has provided visual representations of the Purbeck Heath NNR in Figures 1.0 and 1.1. It also provides detailed descriptions into the interactions used in the BBN models (Figures 2.0, 2.1, 2.2, 2.3, and 2.4). The next chapter will detail the results produced in this research following the methods outlined in this chapter.

Chapter Three – Results

1. Chapter Introduction

This chapter will evaluate the application of the intended management of the Purbeck Heath National Nature Reserve. It will analyse and describe the results produced by the four Bayesian Belief Networks and help contribute to answering the aims and objectives of this research outlined in Chapter one. The chapter will conclude by providing an overall summary of the results produced by the Bayesian Belief Networks.

2. Overview of Results

To differentiate between the different protected areas within the Purbeck Heath reserve, interaction probabilities between nodes were altered specifically to each protected area designation. Discussions with stakeholder representatives from Natural England and National Trust revealed that the Purbeck Heath National Nature Reserve is to be managed on a landscape-scale focusing on habitat restoration and increasing biodiversity across the whole reserve. The agreed upon management plan involves increasing habitat restoration efforts through the re-introduction of species and wild cattle grazing, along with managed controlled burning of some areas of the reserve as part of fire management and increasing buffer zones. Stakeholders also seek to increase ecotourism activities to engage the public with nature. The management of the Purbeck Heath reserve seeks to decrease fragmentation and increase the reserve resistance to climate change.

To differentiate between the different protected areas within the Purbeck Heath reserve, each BBN model was altered specifically to each protected area designation within the reserve. Interaction probabilities between nodes were altered specifically to each protected area designation along with the addition of nodes specific to the individual designations. Information collected from stakeholder interviews, site observations, and existing legislation informed the probability of each node increasing or decreasing, node interactions, and prior beliefs.

2.1 Site Observations

Observed management techniques included spatial and temporal zoning. Figure 3.0 demonstrates how wide public footpaths are used to keep visitors off the heathland and protect it from damage. Wide paths are also used as a buffer between areas of heath to prevent fires from burning through the whole area. Clear sign posting on gates is used to inform visitors about specific management techniques. Figure 3.1 shows an example of a

sign that was attached to a gate to inform visitors about the type of grazing that was occurring on site. It asked that visitors close the gate when passing through to ensure that the cattle remained in that specific area. For specific species of flora and fauna, spatial zoning using fences is practiced. Figure 3.2 demonstrates how sand dunes are zoned off from the public to protect sand lizards that inhabit there. Designated areas for recreational activity included public footpaths for hiking, dog walking, horse riding, and cycling (Figure 3.3). In some areas of the reserve there was clear signposting explaining high fire risk advising against public BBQs and bonfires.

Figure 3.0: Photo taken during site visits showing a designated footpath for visitors to keep to whilst visiting the Purbeck Heath NNR.

Figure 3.1: Photos taken during site visits showing evidence of grazing. Photo on the left shows a sign about the grazing occurring on areas within the Purbeck Heath NNR that are managed by RPSB Arne. The sign asks for visitor to close the gate when passing to ensure that grazing is occurring in the specific area. Photo on the right shows cattle grazing on site.

Figure 3.2: Photo showing an example of spatial zoning as fences protect sand dunes from visitors. The sign warns of not climbing the sand dunes and cliffs as they are the habitat for sand lizards.

Figure 3.3: Map of the area of the Purbeck Heath managed by RSPB Arne.

2.2 Personal Communications

Personal communications with stakeholder representatives from Natural England and National Trust discussed the future intended management of the Purbeck Heath NNR. These discussions were paired with the outcomes to the site observations to allow for the prior beliefs of the BBN models to be determined.

Through these discussions, it was found that the aim of the Purbeck reserve is to promote landscape-scale biodiversity and promoting climate change resilience. The management plan that the stakeholders have agreed upon include techniques that aid habitat restoration such as controlled burning, increases in buffer zones, reintroduction of species, temporal and spatial zoning for recreational activities, wild cattle grazing, public access, ecotourism, and decreasing fragmentation. Management scenarios used in the BBNs below have used information from these discussions to inform the prior beliefs (or inputs) of the model. Where specific concepts have arisen from discussions, they have been cited as personal communications.

2.3 Special Protected Areas

Considering the threats and benefits to SPAs outlined in the Birds Directive, along with the information gathered form site observations and stakeholder interviews the prior belief were input (Table 1.0). These prior beliefs created posterior increases shown in Table 1.1 and Figure 4.0. Prior beliefs created a posterior decrease in habitat loss, natural succession, temporal zoning, spatial zoning, fragmentation, and woodland to 0.59, 0.64, 0.61, 0.67, 0.8, and 0.53, respectively. These were decreases as the probability of these nodes increasing was <0.5 (Figure 4.0).

Table 1.0: Prior beliefs of nodes for SPAs within the Purbeck Heath NNR along with the justification for the assigned weight of belief. .

Node Name	Prior Belief	Justification
Habitat Restoration	0.80	Personal Communications. Aim of Purbeck Heath NNR to increase habitat restoration. Part of intended future management plan.
Controlled Burning	0.60	Existing management method used on heathland. Likely to remain and be used across the NNR but not significantly increase.
Buffer Zone	0.70	Existing management method used on heathland. Personal Communications. Likely to remain and be used across the NNR to allow a connection between different habitats.
Reintroduction of Species	0.80	Personal Communications. Part of intended future management plan.
Temporal Zoning	0.35	Personal Communications. Aim of Purbeck Heath NNR to increase habitat connectivity and manage site on a landscape-scale. May still be present in some areas in specific seasons to allow for breeding and feeding grounds.
Spatial Zoning	0.30	Personal Communications. Aim of Purbeck Heath NNR to increase habitat connectivity and manage site on a landscape-scale.
Cattle Grazing	0.80	Personal Communications. Part of intended future management plan and conservation outcomes. Part of the rewilding process.
Walking	0.65	Already present on site. Not the main intended conservation outcome of the Purbeck Heath NNR management plan. Tourism and visitors will still be present on existing sites.
Cycling	0.65	Already present on site. Not the main intended conservation outcome of the Purbeck Heath NNR management plan. Tourism and visitors will still be present on existing sites.
Dog Walking	0.65	Already present on site. Not the main intended conservation outcome of the Purbeck Heath NNR management plan. Tourism and visitors will still be present on existing sites.
Ecotourism	0.70	Not the main intended conservation outcome of the Purbeck Heath NNR management plan. Tourism and visitors will still be present on existing sites as some stakeholders rely on visitor interaction to help maintain management practices. Personal Communications.
Fragmentation	0.20	Personal Communications. Part of intended management plan to increase habitat connectivity and therefore significantly reduce fragmentation.
Other Recreational Activities	0.65	Already present on site. Not the main intended conservation outcome of the Purbeck Heath NNR management plan. Tourism and visitors will still be present on existing sites.
Improved Site Access	0.65	Not the main intended conservation outcome or management plan. Some sites owned and managed by specific stakeholders rely on public engagement and therefore require public access.
Modification of Cultivation	0.60	Already present on site. Not the main intended conservation outcome of the Purbeck Heath NNR management plan.
Forest and Plantation Management	0.65	Already present on site. Not the main intended conservation outcome of the Purbeck Heath NNR management plan.
Interpretive Centres	0.65	Already present on site. Not the main intended conservation outcome of the Purbeck Heath NNR management plan. Tourism and visitors will still be present on existing sites.
Climate Change	0.65	Ongoing natural process that is occurring at an increasing rate. Natural phenomenon.

Table 1.1: Posterior increases of nodes on SPAs with the application of the Purbeck Heath Management Plan.

Node Name	Posterior Increase
Ecosystem Services	0.58
Biodiversity	0.57
Climate Change	0.65
Native Species	0.52
Invasive Species	0.52
Habitat Restoration	0.84
Controlled Burning	0.60
Buffer Zones	0.67
Reintroduction of Species	0.80
Public Awareness	0.57
Cattle Grazing	0.78
Walking	0.68
Cycling	0.67
Dog Walking	0.67
Ecotourism	0.75
Economy	0.60
Litter	0.55
Bush Fire	0.59
Improved Site Access	0.71
Modification of Cultivation	0.60
Forest and Plantation Management	0.64
Interpretative Centres	0.74
Other Recreational Activities	0.70
Protected Target Species	0.55
Sylvia undata	0.51
Circus cyaneus	0.51
Falco columbarius	0.51
Caprimulgus europaus	0.51
Lullula arborea	0.51
Protected Target Habitat	0.58
Breeding Grounds	0.53
Feeding Grounds	0.53
Sand Dunes	0.53
Inland Water Bodies	0.53
Bogs	0.53
Heath	0.58
Dry Grassland	0.65

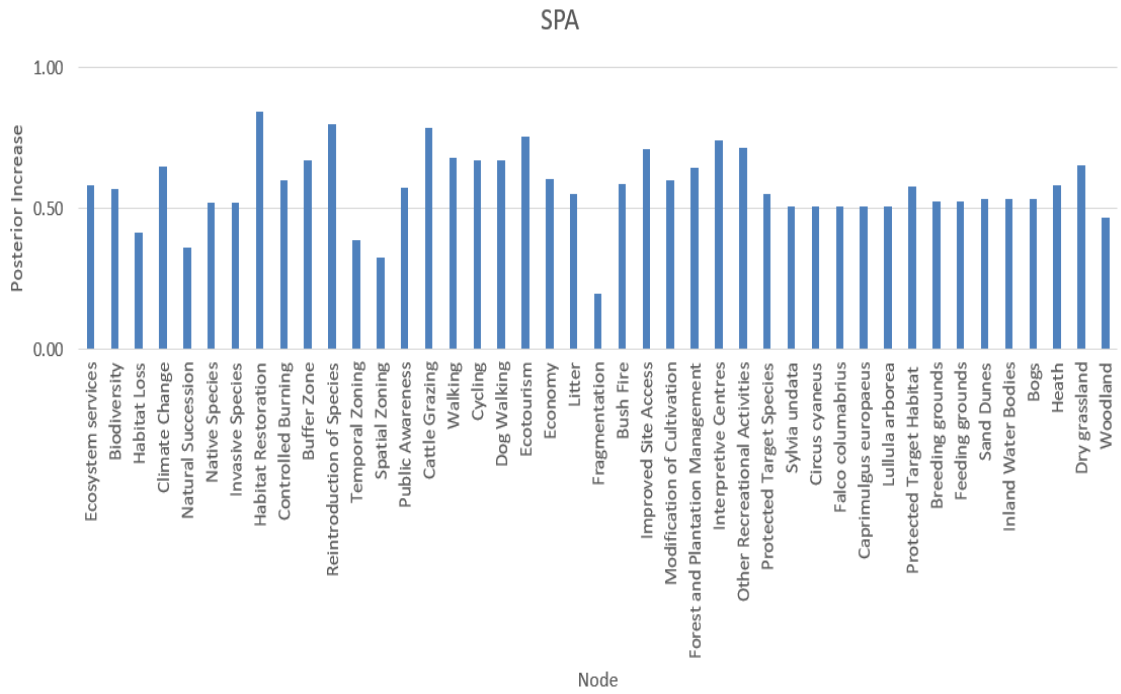

Figure 4.0: The calculated probability of increase in nodes on SPAs with the application of the Purbeck Heath NNR Conservation Management Plan

2.4 Special Areas of Conservation

With the information gathered from the Habitats Directive, site observations, and stakeholder interviews, prior beliefs were input (Table 1.2). These prior beliefs created posterior increases shown in Table 1.3 and Figure 4.1. Prior beliefs created a posterior decrease in habitat loss, natural succession, temporal zoning, spatial zoning, fragmentation, Old acidophilous oak woods, Calcareous fens, and Alkaline fens to 0.58, 0.64, 0.60, 0.67, 0.80, 0.64, 0.53, and 0.53, respectively. These were decreases as the probability of these nodes increasing was <0.5 (Figure 4.1).

Table 1.2: Prior beliefs of nodes for SACs within the Purbeck Heath NNR along with the justification for the assigned weight or belief.

Node Name	Prior Belief	Justification
Habitat Restoration	0.80	Personal Communications. Aim of Purbeck Heath NNR to increase habitat restoration. Part of intended future management plan.
Controlled Burning	0.60	Existing management method used on heathland. Likely to remain and be used across the NNR but not significantly increase.
Buffer Zone	0.70	Existing management method used on heathland. Personal Communications. Likely to remain and be used across the NNR to allow a connection between different habitats.
Reintroduction of Species	0.80	Personal Communications. Part of intended future management plan.
Temporal Zoning	0.35	Personal Communications. Aim of Purbeck Heath NNR to increase habitat connectivity and manage site on a landscape-scale. May still be present in some areas in specific seasons to allow for breeding and feeding grounds.
Spatial Zoning	0.30	Personal Communications. Aim of Purbeck Heath NNR to increase habitat connectivity and manage site on a landscape-scale.
Cattle Grazing	0.80	Personal Communications. Part of intended future management plan and conservation outcomes. Part of the rewilding process.
Walking	0.65	Already present on site. Not the main intended conservation outcome of the Purbeck Heath NNR management plan. Tourism and visitors will still be present on existing sites.
Cycling	0.65	Already present on site. Not the main intended conservation outcome of the Purbeck Heath NNR management plan. Tourism and visitors will still be present on existing sites.
Dog Walking	0.65	Already present on site. Not the main intended conservation outcome of the Purbeck Heath NNR management plan. Tourism and visitors will still be present on existing sites.
Ecotourism	0.70	Not the main intended conservation outcome of the Purbeck Heath NNR management plan. Tourism and visitors will still be present on existing sites as some stakeholders rely on visitor interaction to help maintain management practices. Personal Communications.
Fragmentation	0.20	Personal Communications. Part of intended management plan to increase habitat connectivity and therefore significantly reduce fragmentation.
Other Recreational Activities	0.65	Already present on site. Not the main intended conservation outcome of the Purbeck Heath NNR management plan. Tourism and visitors will still be present on existing sites.
Improved Site Access	0.65	Not the main intended conservation outcome or management plan. Some sites owned and managed by specific stakeholders rely on public engagement and therefore require public access.
Modification of Cultivation	0.60	Already present on site. Not the main intended conservation outcome of the Purbeck Heath NNR management plan.
Forest and Plantation Management	0.65	Already present on site. Not the main intended conservation outcome of the Purbeck Heath NNR management plan.
Climate Change	0.65	Ongoing natural process that is occurring at an increasing rate. Natural phenomenon.

Table 1.3: Posterior increases of nodes on SACs with the application of the Purbeck Heath Management Plan.

Node Name	**Posterior Increase**
Ecosystem Services	0.58
Biodiversity	0.57
Climate Change	0.65
Native Species	0.52
Invasive Species	0.52
Habitat Restoration	0.84
Controlled Burning	0.60
Buffer Zones	0.67
Reintroduction of Species	0.80
Public Awareness	0.56
Cattle Grazing	0.78
Walking	0.68
Cycling	0.67
Dog Walking	0.67
Ecotourism	0.75
Economy	0.60
Litter	0.55
Bush Fire	0.59
Improved Site Access	0.65
Modification of Cultivation	0.60
Forest and Plantation Management	0.65
Other Recreational Activities	0.71
Protected Target Species	0.55
Triturus cristatus	0.51
Coenagrion mercurial	0.51
Protected Target Habitat	0.56
Temperate Atlantic Wet Heaths	0.58
Oligotrophic Water	0.53
Rhynchosporion	0.53
Northern Atlantic Wet Heaths	0.58
Atlantic Decalcified Fixed Dunes	0.53
Bog Woodland	0.54
Salix cinera	0.54
Molinia Meadows	0.54
Humid Dune Slacks	0.53
European Dry Heaths	0.58
Embryonic Shifting Dunes	0.53

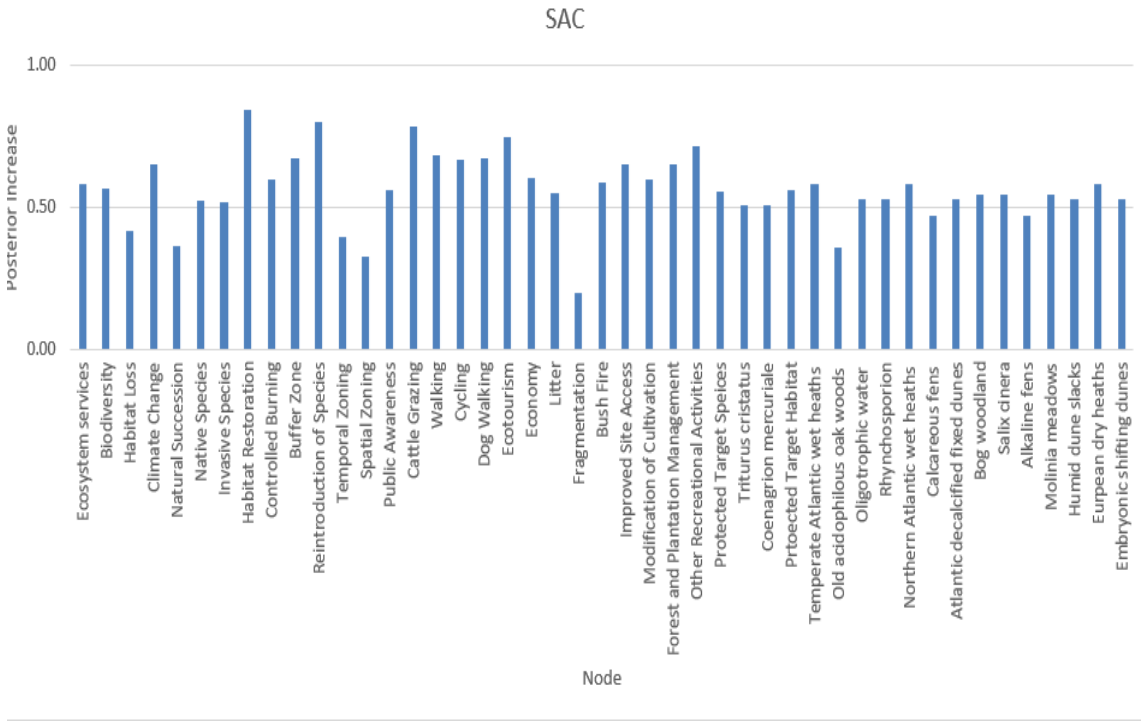

Figure 4.1: The calculated probability of increase in nodes on SACs with the application of Purbeck Heath NNR Conservation Management Plan.

2.5 Sites of Special Scientific Interest

With the information gathered from the Wildlife and Countryside Act (1981), site observations, and stakeholder interviews prior beliefs were input (Table 1.4). These prior beliefs created posterior increases shown in Table 1.5 and Figure 4.2. Posterior decreases in habitat loss, natural succession, temporal zoning, spatial zoning, and fragmentation were to 0.58, 0.67, 0.60, 0.68, and 0.81, respectively. These were decreases as the probability of these nodes increasing was <0.5 (Figure 4.2). The posterior output of invasive species remained the same as its prior belief at 0.50 (Figure 4.2).

Table 1.4: Prior beliefs of nodes for SSSIs within the Purbeck Heath NNR along with the justification for the assigned belief..

Node Name	Prior Belief	Justification
Habitat Restoration	0.80	Personal Communications. Aim of Purbeck Heath NNR to increase habitat restoration. Part of intended future management plan.
Controlled Burning	0.60	Existing management method used on heathland. Likely to remain and be used across the NNR but not significantly increase.
Buffer Zone	0.70	Existing management method used on heathland. Personal Communications. Likely to remain and be used across the NNR to allow a connection between different habitats.
Reintroduction of Species	0.80	Personal Communications. Part of intended future management plan.
Temporal Zoning	0.35	Personal Communications. Aim of Purbeck Heath NNR to increase habitat connectivity and manage site on a landscape-scale. May still be present in some areas in specific seasons to allow for breeding and feeding grounds.
Spatial Zoning	0.30	Personal Communications. Aim of Purbeck Heath NNR to increase habitat connectivity and manage site on a landscape-scale.
Cattle Grazing	0.80	Personal Communications. Part of intended future management plan and conservation outcomes. Part of the rewilding process.
Walking	0.65	Already present on site. Not the main intended conservation outcome of the Purbeck Heath NNR management plan. Tourism and visitors will still be present on existing sites.
Cycling	0.65	Already present on site. Not the main intended conservation outcome of the Purbeck Heath NNR management plan. Tourism and visitors will still be present on existing sites.
Dog Walking	0.65	Already present on site. Not the main intended conservation outcome of the Purbeck Heath NNR management plan. Tourism and visitors will still be present on existing sites.
Ecotourism	0.70	Not the main intended conservation outcome of the Purbeck Heath NNR management plan. Tourism and visitors will still be present on existing sites as some stakeholders rely on visitor interaction to help maintain management practices. Personal Communications.
Fragmentation	0.20	Personal Communications. Part of intended management plan to increase habitat connectivity and therefore significantly reduce fragmentation.
Climate Change	0.65	Ongoing natural process that is occurring at an increasing rate. Natural phenomenon.

Table 1.5: Posterior increases of nodes on SSSIs with the application of the Purbeck Heath Management Plan.

Node Name	**Posterior Increase**
Ecosystem Services	0.60
Biodiversity	0.59
Climate Change	0.65
Native Species	0.56
Habitat Restoration	0.87
Controlled Burning	0.60
Buffer Zones	0.67
Reintroduction of Species	0.80
Public Awareness	0.57
Cattle Grazing	0.78
Walking	0.67
Cycling	0.67
Dog Walking	0.67
Ecotourism	0.70
Economy	0.65
Litter	0.55
Bush Fire	0.61
Protected Target Species	0.63
Sylvia undata	0.53
6 British Reptiles	0.53
Ceriagrion tenellum	0.53
Conocephalus spp.	0.53
Protected Target Habitat	0.58
Pinus spp.	0.54
Gentiana pneumonanthe	0.54
Calluna vulgaris	0.54
Sphagnum spp	0.54
Ulex spp	0.54
Salix cinera	0.54
Erica spp	0.54
Drosera spp	0.54

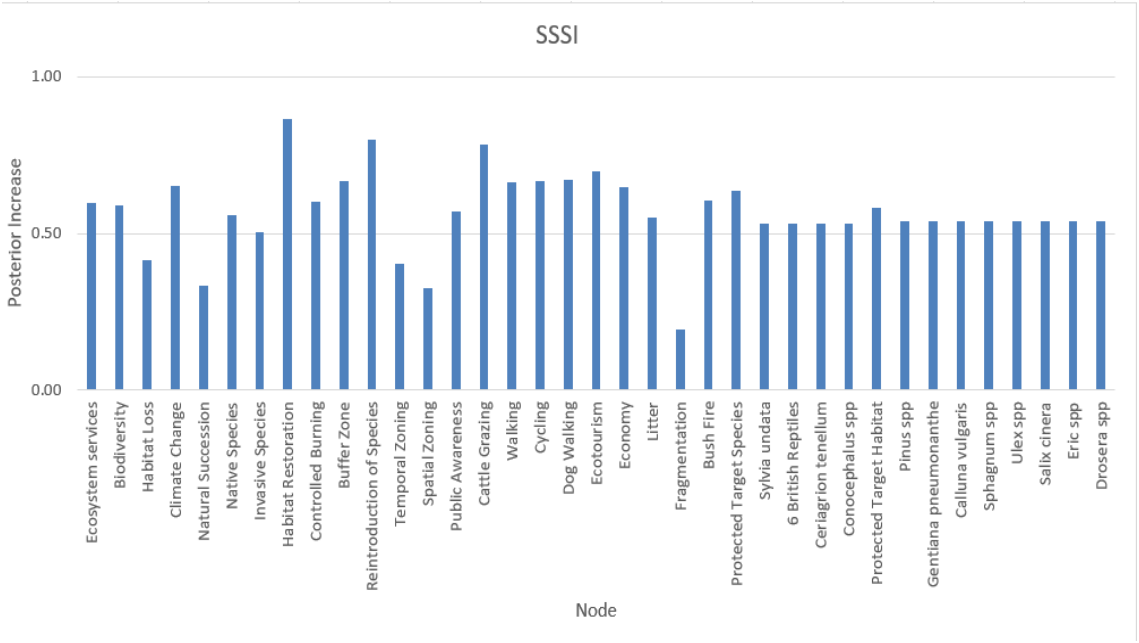

Figure 4.2: The calculated probability of increase in nodes on SSSIs with the application of Purbeck Heath NNR Conservation Management Plan.

2.6 Ramsar

With the information gathered from the JNCC, site observations, and stakeholder interviews prior beliefs were set (Table 1.6). These prior beliefs created posterior increases shown in Table 1.7 and Figure 4.3. Posterior decreases in habitat loss, natural succession, temporal zoning, spatial zoning, and fragmentation were to 0.59, 0.67, 0.61, 0.68, and 0.81, respectively. These were decreases as the probability of these nodes increasing was <0.5 (Figure 4.3).

Table 1.6: Prior beliefs of nodes for Ramsar sites within the Purbeck Heath NNR along with the justification of the assigned belief.

Node Name	Prior Belief	Justification
Habitat Restoration	0.80	Personal Communications. Aim of Purbeck Heath NNR to increase habitat restoration. Part of intended future management plan.
Controlled Burning	0.60	Existing management method used on heathland. Likely to remain and be used across the NNR but not significantly increase.
Buffer Zone	0.70	Existing management method used on heathland. Personal Communications. Likely to remain and be used across the NNR to allow a connection between different habitats.
Reintroduction of Species	0.80	Personal Communications. Part of intended future management plan.
Temporal Zoning	0.35	Personal Communications. Aim of Purbeck Heath NNR to increase habitat connectivity and manage site on a landscape-scale. May still be present in some areas in specific seasons to allow for breeding and feeding grounds.
Spatial Zoning	0.30	Personal Communications. Aim of Purbeck Heath NNR to increase habitat connectivity and manage site on a landscape-scale.
Cattle Grazing	0.80	Personal Communications. Part of intended future management plan and conservation outcomes. Part of the rewilding process.
Walking	0.65	Already present on site. Not the main intended conservation outcome of the Purbeck Heath NNR management plan. Tourism and visitors will still be present on existing sites.
Cycling	0.65	Already present on site. Not the main intended conservation outcome of the Purbeck Heath NNR management plan. Tourism and visitors will still be present on existing sites.
Dog Walking	0.65	Already present on site. Not the main intended conservation outcome of the Purbeck Heath NNR management plan. Tourism and visitors will still be present on existing sites.
Ecotourism	0.70	Not the main intended conservation outcome of the Purbeck Heath NNR management plan. Tourism and visitors will still be present on existing sites as some stakeholders rely on visitor interaction to help maintain management practices. Personal Communications.
Fragmentation	0.20	Personal Communications. Part of intended management plan to increase habitat connectivity and therefore significantly reduce fragmentation.
Climate Change	0.65	Ongoing natural process that is occurring at an increasing rate. Natural phenomenon.

Table 1.7: Posterior increases of nodes on Ramsar sites with the application of the Purbeck Heath Management Plan.

Node Name	**Posterior Increase**
Ecosystem Services	0.59
Biodiversity	0.59
Climate Change	0.65
Native Species	0.56
Invasive Species	0.52
Habitat Restoration	0.87
Controlled Burning	0.60
Buffer Zones	0.67
Reintroduction of Species	0.80
Public Awareness	0.57
Cattle Grazing	0.78
Walking	0.67
Cycling	0.67
Dog Walking	0.67
Ecotourism	0.70
Economy	0.65
Litter	0.55
Bush Fire	0.60
Protected Target Species	0.67
Sylvia undata	0.53
Circus cyaneus	0.53
Falco columbarius	0.53
Coenagrion mercurial	0.53
Protected Target Habitat	0.60
Drosera spp	0.55
Sphagnum spp	0.55
Rhynchosporion	0.55
Erica cillaris	0.55
Erica tetralix	0.55
Acid Valley mire	0.55
Dry Heath	0.55
Molinia coerulea	0.55
Wet Heath	0.55

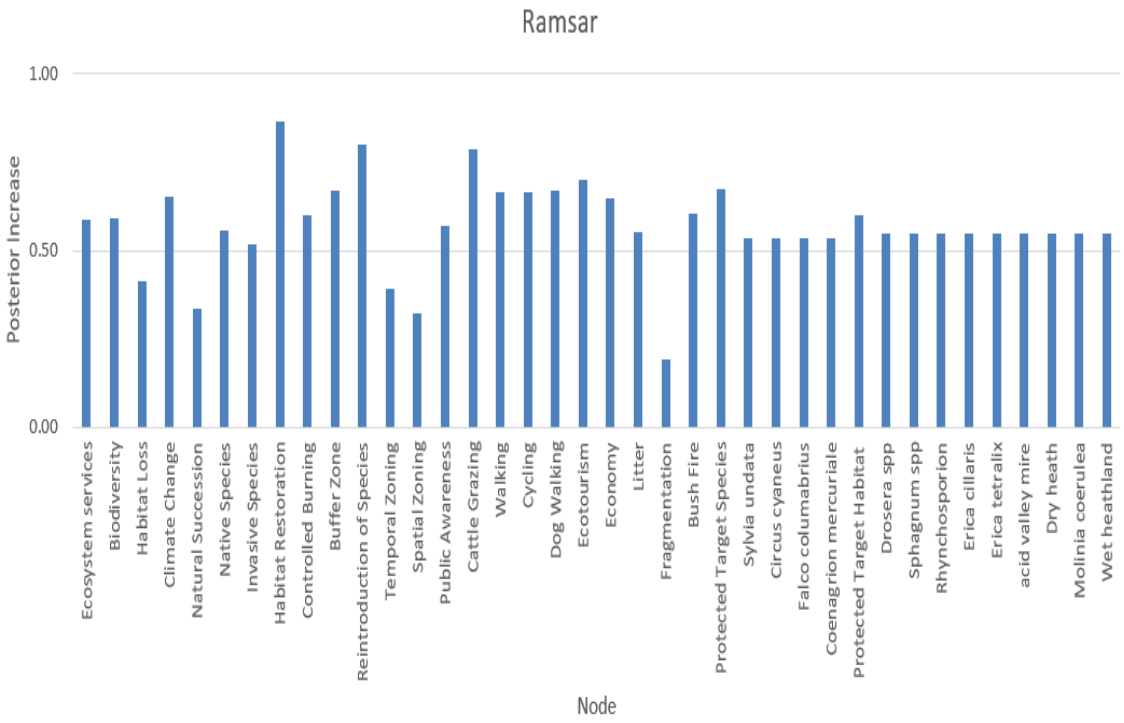

Figure 4.3: The calculated probability of increase in nodes on Ramsar sites with the application of Purbeck Heath NNR Conservation Management Plan.

2.7 Combined Results

To evaluate whether the Purbeck Heath NNR management plan will benefit biodiversity and fulfil legislation aims a combined comparison across all four protected areas was produced (Figure 4.4). Key findings show that overall, across all four designated Protected Areas (PAs) within the Purbeck Heath NNR, there is an increase in ecosystem services, biodiversity, native species, habitat restoration, population of protected target species, and protected target habitat. This is promising as climate change and bush fires are also likely to increase across all four PAs.

SSSIs and Ramsar sites are likely to perform the best under the management of the Purbeck Heath NNR. Ecosystem services are likely to increase the most in SSSIs with a posterior increase of 0.60 (Figure 4.4). Whilst protected target species and protected target habitat are likely to increase the most in Ramsar sites with a posterior increase of 0.67 and 0.60, respectively (Figure 4.4). Biodiversity, native species, habitat restoration, and economy are all likely to increase under SSSIs and Ramsar sites with a posterior increase of 0.59, 0.56, 0.87, and 0.65, respectively (Figure 4.4). Invasive species are likely not to increase or decrease in SSSIs, whilst they are expected to increase within Ramsar sites, SPAs, SACs under the Purbeck Heath NNR to 0.52 across all three PAs (Figure 4.4).

Spatial zoning, natural succession and fragmentation are likely to decrease the most in SSSIs and Ramsar sites within the Purbeck Heath NNR with posterior decreases of 0.68, 0.67 and 0.81, respectively. These are considered decreases as the probability of these nodes increasing is <0.5 (Figure 3.4). Walking is likely to increase the most in SPAs and SACs within the Purbeck Heath NNR to 0.68.

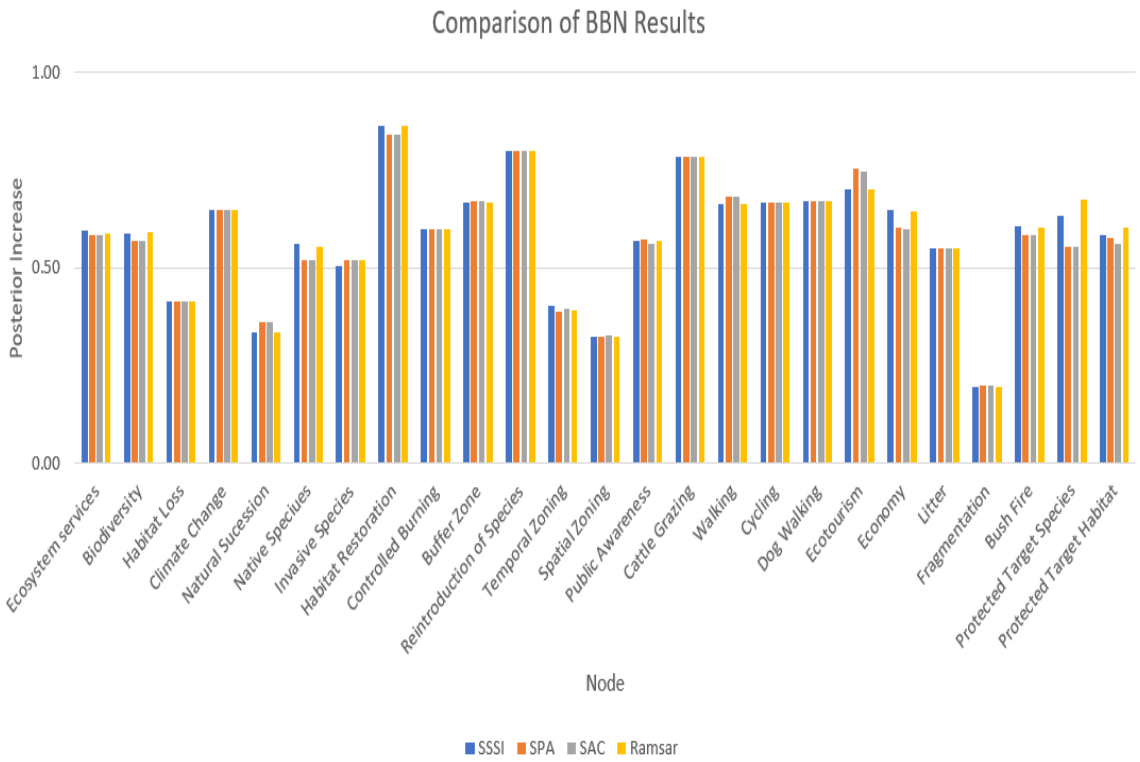

Figure 4.4: The calculated probability of increase in nodes across all protected area designations within the Purbeck Heath NNR with the application of Purbeck Heath NNR Conservation Management Plan.

3. Chapter Summary

Results show both similarities and differences between different levels of PAs. Ecosystem services, biodiversity, climate change, public awareness, recreational activities, ecotourism, litter, economy, protected target species, and protected target habitat are expected to increase across all PAs within the reserve under the adoption of the Purbeck Heath NNR management plan (Figure 4.4). Although there are minor differences in the level of increases of these nodes across the different PAs. Ecosystem services are likely to increase the most in SSSIs, whilst biodiversity is likely to increase the most in SSSI and Ramsar sites within the reserve (Figure 4.4). Both native and invasive species are likely to increase in all PAs within the reserve except from in SSSIs where invasive species is likely to remain at the current level (Figure 4.2; Figure 4.4). Habitat loss, natural succession, temporal and spatial zoning, and fragmentation are likely to decrease in all

PAs within the reserve. Any differences between the decreases of these nodes within the PAs is minor.

It is important to note that ecosystem services, biodiversity, native species, protected target habitat, and protected target species are all likely to increase in all PAs across the Purbeck Heath against the backdrop that climate change is also likely to increase. This suggests that the management of the Purbeck Heath NNR is effective in producing the intended nature conservation outcomes of increasing resilience to climate change, habitat connectivity, and overall biodiversity across the reserve.

The next chapter will continue to answer the research aims and objective in more detail providing an in-depth discussion and overall conclusion.

Chapter Four – Overall Discussion and Conclusion

1. Chapter Introduction

This concluding chapter will provide an overall comment on the results of this study and allow for a discussion into the current management of the Purbeck Heath National Nature Reserve and supporting legislation. This chapter will also outline how legislation and management can be improved to increase protection of designated features and wider biodiversity, whilst also providing comments on the future of nature conservation outcomes. The aim of this chapter is to draw conclusions from the results produced in the previous chapter and answer any research aims and objectives that have not yet been addressed.

2. Overview of Results

Adopting a landscape-scale management approach to the Purbeck Heath National Nature Reserve (NNR) benefits the biodiversity and ecosystem health of the reserve whilst reducing fragmentation of the site. Adjusting the prior beliefs in the Bayesian Belief Network (BBN) in relation to future management scenarios predicted increases in ecosystem services, biodiversity, climate change, native species, invasive species, habitat restoration, controlled burning, buffer zones, reintroduction of species, public awareness, cattle grazing, walking, cycling, dog walking, ecotourism, economy, litter, bush fire, improved site access, modification of cultivation, forest and plantation management, interpretative centres, other recreational activities, specific protected target species, and specific protected target habitat. There was a predicted decrease in habitat loss, natural succession, temporal zoning, spatial zoning, fragmentation, woodland, and fens. In the case of applying a landscape-scale management approach to Sites of Special Scientific Interest (SSSI), there was no change in the level of invasive species despite management efforts trying to restrict their presence and impact within the reserve. Any changes to predicted outputs were of moderate impact. Overall results show that by adopting a landscape-scale management approach that involves moderate grazing and recreational activities, biodiversity, native species, and protected target species and protected target habitat are still able to flourish and increase in an environment where climate change is also set to increase.

3. Discussion

3.1 Effectiveness of Management in Producing Nature Conservation Outcomes

For the overarching aim of this thesis to be addressed, it needs to be decided as to what are the intended outcomes of creating the NNR; is it to support nature in building climate resilience and increase biodiversity, or is it to increase public engagement with nature and boost attraction to the reserve through ecotourism and recreational activities? If the main purpose is for nature, then is management in favour of overall biodiversity of the reserve, or is it focused on the protection of specific species and habitats protected under current Protected Area (PA) designation? In the case of the Purbeck Heath NNR, the main objective agreed upon between stakeholders is to put nature first by increasing landscape connectivity, climate resilience and increase overall reserve biodiversity.

The Purbeck Heath NNR consists of various habitats including heathland (covering much of the area), woodland, grassland, saltmarsh, reedbeds, and wetland fens. With the formation of the super reserve combining individual PAs to create a larger landscape of PA, the collaboration and expansion of this NNR allows for stakeholders to move away from tightly prescribed micromanagement and move towards restoring natural processes so that the whole landscape functions ecologically (D. Brown, pers. comm.). The effectiveness of landscape-scale management does have its benefits. The formation of large reserves can benefit species suffering from range dispersal resulting from climate change (Donaldson et al. 2017). For species with high dispersal rates, it has been suggested that the quantity of habitat patches available should be focused on before increasing the quality of the area, whilst the phenology of species can also benefit from smaller reserves that correspond to the desired conditions for that stage within the species life cycle (Donaldson et al. 2017). However, large reserves such as the Purbeck NNR have heterogeneous environments that can mirror the habitats for edge species (Donaldson et al. 2017). Specialist species that tend to be more threatened and benefit from homogeneous environments can also benefit from NNRs like the Purbeck Heath as they have the potential to be supported by the buffer zone provided by landscape-scale management (Donaldson et al 2017). The development of landscape-scale management on the Purbeck Heath NNR has the potential to succeed in achieving the desired conservation outcomes of climate change resilience and connectivity, although it is important to consider the quantity and quality of sites for management efforts to succeed in achieving optimum outcomes, there needs to be the inclusion of both the current suitable habitats (for target species) and surrounding landscapes (Donaldson et al. 2017; Guttery et al. 2017).

Whilst the adoption of large landscape-scale management may be beneficial for species dispersal and specialist species by increasing habitat connectivity and buffer zones, it could be less effective in conserving other specific protected target species. Sites of Special Scientific Interest (SSSI) were created to protect the six species of British reptiles that are found within the Purbeck Heath. Sand lizards reside in the heathland burrowing and laying their eggs in the sand banks of the bare ground found within the heathland (D. Brown, pers. comm.). In the past, management of this species' habitat has been intense, using diggers or bringing in volunteers to clear patches of heath to create bare ground (D. Brown, pers. comm.). Whilst this is a resource heavy method for conserving a single species, it is not effective when attempting to scale up the Purbeck reserve to a 'super' reserve. To keep in line with new conservation outcomes, management has swapped to natural processes across the landscape and intense human involvement will be reduced. What stakeholders of the Purbeck NNR are pushing for instead is the reintroduction of herbivores. Although there are currently some domestic cattle on the reserve, they are constricted to spatial and temporal zoning (Figure 3.1). Instead, reserve managers are attempting to introduce wild cattle and pigs that roam across the whole reserve in the hope that they provide naturalistic grazing to mirror the human management of woodland clearance for agricultural practices that subsequently contributed to the widespread formation of heathland (D. Brown, pers. comm.; Hodder et al. 2014).

Heathland requires podzolic soils which are commonly formed when trees are removed (Nolan 1999). There is evidence to suggest that heathland within the Purbeck Heath NNR was formed during the bronze age where intense human management and agricultural practices removed woodland, supporting the process for podzolic soils and heathland to form (Haskins 1978). The idea of recreating a pre-neolithic ecosystem using wild herbivores whilst still maintaining a high quality heathland may be challenging as heathland requires intense human management which grazing may not be able to suffice. The introduction of free range pigs is to replicate the presence of wild boar, in addition to the presence of wild cattle, the presence of which could result in elevated levels of ground disturbance as part of the restoration process, creating bare ground that would benefit the existence of sand lizards (Bullock and Pakeman 1996; Mitchell et al. 2008; Grudzinski et al. 2015; Read and Bealey 2021). The level of ground disturbance is of concern for the existence of the Mason Wasp in which there are believed to be two to three colonies within the reserve. The disturbance caused by the ploughing of pigs and cattle could cause these colonies to disappear from their protected area or disappear from

the reserve altogether. Yet if heathland is to remain within the Purbeck Heath NNR, intense grazing would be needed to match the existing level of intense human management to maintain heathland health. The management of grazing on the heathland may conflict with the protection of the Mason Wasp. For this not to be the case, effective management measures need to include the continuous use of effective site monitoring to ensure that threatened species that are protected under legal designations are not lost. The predictions shown in Figure 4.4 of Chapter Three indicate that under the landscape-scale management of the Purbeck Heath NNR biodiversity, protected target species and habitat are set to increase. For these results to be observed within the Purbeck Heath NNR in the future, long term monitoring is needed to ensure that there are minimal conflicts when managing specific habitats and species. Losing a species because of landscape-scale management would not aid the outcome of increasing biodiversity, therefore it is important that even if a particular species is lost in designated sites within the NNR, a viable population appears elsewhere within the NNR.

As previously discussed in Chapter One, biodiversity conservation aims are commonly adopted on a local scale without considering wider biodiversity goals. To ensure that landscape-scale management is effective in producing positive outcomes for biodiversity, grazing on the Purbeck Heath NNR will need to be closely monitored. The impacts of grazing can vary depending on the type of herbivore grazing, the number of herbivores within a given site and the type of fauna they are grazing on (García et al. 2013). High stocking density leading to overgrazing can reduce biodiversity (Broom 2018), whilst increasing sheep and deer grazing can also contribute to the loss of biodiversity (García et al. 2013). Overgrazing can result in the decline of *Calluna vulgaris* (Bullock and Pakeman 1996; Mitchell et al. 2008), an important species of fauna commonly found in heathland which contributes to biodiversity. The presence of woodland on the Purbeck Heath NNR contributes to increasing levels of biodiversity and species richness across the reserve (Neilly et al. 2017). Yet there is conflict between grazing and allowing woodlands to form. Grazing has the potential to lead to major tree declines if too much land is covered by bare ground not allowing for natural succession to occur and woodland to form (Fischer et al. 2009; Neilly et al. 2017). Whilst the process of natural succession resulting in woodland formation threatens the existence of heathland and their supporting soils (Mitchell et al. 1997). Both Special Areas of Conservation (SACs) and Special Protection Areas (SPAs) are threatened by grazing. For the outcome of increasing biodiversity to be achieved, management of grazing needs to be closely monitored. The

presence of grazing can prove beneficial; as the herbivores graze on combustible material, the risk of bush fires decreases (García et al. 2013), whilst low intensity grazing can be beneficial for reptiles relying on bare ground (Denton 2014). For the implementation of wild, naturalistic grazing to be effective in producing outcomes that benefit the biodiversity goals of the Purbeck Heath NNR, a baseline survey assessing the presence of flora and fauna on the reserve needs to be conducted to ensure that further decline does not occur. Some zoning should be used to conserve key features that are negatively impacted by grazing and within PAs that state grazing to be a threat (Denton 2014). By providing this buffer zone stakeholders can increase connectivity and reduce fragmentation of biodiversity across the reserve. For management to succeed in achieving a NNR that aids climate change resilience, habitat connectivity, and increase in biodiversity, stakeholders will have to use methods other than reintroduction of species and naturalistic, wild grazing.

The landscape-scale management techniques employed across the Purbeck Heath NNR focus on habitat restoration techniques. Agreements between stakeholders have settled on using reintroduction of species, wild cattle grazing, controlled burning, and increasing buffer zones across the reserve. Involvement from the National Trust, RSPB, and Rempstone Estate also seek to promote positive public interactions by promoting ecotourism, using interactive centres, and improved site access. It is hoped that by raising public awareness about what threatens NNR sites such as the Purbeck Heaths, the public will be more likely to aid in reducing activities that threaten biodiversity and connectivity of the site. By involving the public, stakeholders will be able to build on achieving the intended nature conservation outcomes of climate change resilience, habitat connectivity, and biodiversity goals. For Non-governmental Organisations such as the National Trust and RSPB, they rely on public memberships to keep the site functioning through job security and maintenance of landscapes (David Brown, pers. comm.). To maintain the continuity of people visiting the sites managed by the National Trust and RSPB, it is important that these PAs do not become degraded under the pressures of climate change. Instead, climate resilience needs to be upheld to ensure that landscapes maintain a high-quality matrix that generates income that can be fed back into the management of the reserve (Jopp et al. 2010). In Highly Industrialised Countries such as the UK, there is an increasing demand for nature-based holidays that result in NNRs being an attractive destination (Gössling 1999). This places an economic need for the intended nature

conservation outcomes of the Purbeck Heaths to be effective in protecting and conserving the heath on a landscape-scale.

The role of ecosystem services in the Purbeck Heath NNR can contribute to the effectiveness of management in producing nature conservation outcomes. Several types of ecosystem services can provide a different value in supporting the need for landscape-scale management using restorative and rewilding processes. Regulating services such as climate regulation, carbon storage, and flood risk management, Cultural services such as recreational activities, and supporting services such as biological diversity are all types of ecosystem services that habitats found within the Purbeck Heath NNR provide (Adams 2014). By incorporating the conservation of ecosystem services into the landscape-scale management of the Purbeck Heath NNR, stakeholders will be able to effectively increase reserve resilience to climate change and improve climate regulation. When carrying out habitat restoration across areas of the NNR that contain areas of peat and wetlands, the level of carbon storage will increase which in turn will help to build local climate regulation and reserve resilience (Ockendon et al. 2018).

For biodiversity to increase, habitat connectivity throughout the landscape also needs to increase. Support from a functioning ecosystem will aid in this endeavour and contribute to habitat heterogeneity (Hughes et al. 2016). By reducing fragmentation and increasing connectivity, the trade-off between biodiversity and ecosystem services decreases, allowing for the provision of both biodiversity and ecosystem services at landscape-scale (Cordingely et al. 2015). The inclusion of ecosystem services within the management of the Purbeck Heath NNR has the potential to increase biodiversity and ecotourism, although the concept of ecosystem services remains anthropocentric as the ‘value’ given to the service provided is determined by the benefit supplied to human demand (Morán-Ordóñez et al. 2013). If the management of the reserve is to be true in achieving its intended nature conservation outcomes, then the economy will need to align with the landscape in a way that the landscape provides a high-quality environment that generates income rather than trade-offs. There needs to be a shift in the anthropogenic use for nature moving away from an economic value to a landscape focus. In the past, the focus has been about production (mainly agriculture), but this has been proven to be nature poor and lacking in diversity. If the landscape-scale management of the Purbeck reserve is to be for nature using rewilding techniques and natural restoration methods, then nature’s needs must come first.

The effectiveness of management on producing nature conservation outcomes within the Purbeck Heath NNR could prove to be successful if natural restorative techniques such as reintroduction of species and naturalist grazing are continuously monitored against a base line survey. Increases in biodiversity can be achieved through low level grazing across the whole of the reserve with buffer zones for sensitive areas threatened by grazing. These buffer zones aid habitat connectivity against habitat fragmentation by helping to sustain a heterogeneous environment that can support a diverse ecosystem under increasing climate pressure. The provision of ecosystem services within landscape-scale management can aid the outcome of climate change resilience by conserving habitats that contribute to regulating services. Overall, expanding and collaborating existing PAs to form the Purbeck Heath NNR allows for a balance between all three nature conservation outcomes to be achieved with limited trade-offs. By focusing on increasing biodiversity, habitat connectivity, and climate resilience, all three outcomes interact with each other on an intrinsic level complimenting different restorative method that benefit each intended outcome as well as providing cultural services. When evaluating whether the management methods employed across the Purbeck Heath will benefit biodiversity, it is easy to focus on the perspective of intended nature conservation outcomes. However, it is also important to consider the intended nature conservation outcomes of legislation and how the proposed management (and intended outcomes) may differ from legislation in producing effective nature conservation outcomes.

3.2 Effectiveness of Management in Fulfilling Legislative Outcomes

As previously discussed, the intended nature conservation outcomes put forward by the management of the Purbeck Heath NNR is to increase biodiversity, habitat connectivity, and climate resilience across the reserve. Although the results of this study suggest that adopting new landscape-scale management approaches may be effective in achieving these nature conservation outcomes, management practices carried out by the stakeholders of the NNR will still need to be in line with nature conservation legislation.

Both SACs and SPAs are supported by the Joint Nature Conservation Committee (JNCC) that can provide advice on designation and to a lesser degree on management. These designations came about from the Habitat and Birds Directive. These Directives were established under Natura 2000, a conservation framework set up by the European Union (EU) to mark the nature conservation areas within the EU. Natura 2000 sites often favour site conditions that share characteristics of an area that has been managed under extensive farmland practices (Ceasuşu et al 2015). To ensure that these habitats sustain elements

noticeable to an area showing early signs of succession (heathland for example), it is important that management plans have human involvement. This involvement in managing European sites ensures that PAs are compliant in the agreed upon Natura 2000 legislation outcomes that maintain the landscapes favourable condition (Lorimer et al. 2015). Natura 2000 and supporting Directives are focused on protecting areas that are deemed as Favourable Conservation Status and uses management techniques that keep them in this equilibrium. This differs to the intended nature conservation outcomes of the Purbeck Heath rewilding plan which focuses on restoring ecological control to nature and enhance biodiversity. This could mean that where a habitat is considered favourable under Natura 2000, removing human involvement and allowing natural successional processes to occur would remove this favourable status (Carver 2016). Although the new habitat would fit the intended outcomes of rewilding conservation, it would fail at fulfilling the legislation outcomes assigned under Natura 2000. For both intended outcomes to be fulfilled, it is proposed that the Natura 2000 framework be revised and amended to include rewilding initiatives that benefit biodiversity on a landscape-scale, but also ensure the protection of threatened species (Ceasuşu et al 2015).

As noted above, both SACs and SPAs are threatened by grazing and the Habitats and Birds Directive outline measures to ensure that these impacts are minimised. If the managing stakeholders of the Purbeck Heath is set on including naturalistic wild grazing, buffer zones will need to be established to protect threatened species and habitat. Grazing practices have already been used in Europe to encourage biodiversity growth and reduce human interference. Re-introduction programmes involving European bison and grey wolves is one approach that has been discussed (Ceasuşu et al 2015), although it has been met with concern on how these animals may conflict with human activities around the PA (Corlett 2016). What does need to be considered when designing and implementing new conservation techniques is how these methods will interact with existing nature conservation outcomes and legislation.

Referring to Chapter Three of this research, results for the application of the Purbeck Heath NNR restoration management plan on SACs and SPAs showed that ecosystem services, biodiversity, buffer zones, public awareness, recreational activities, ecotourism, and improved site access are all likely to increase along with native species, protected target species, and protected target habitat. The latter three factors are evidence to suggest that under the new landscape-scale management plan, SAC and SPA designated areas will continue to fulfil the intended nature conservation outcomes of the supporting

legislation. It shows that the development of landscape-scale management can be effective in fulfilling the intended nature conservation outcomes for restoration and rewilding, along with keeping in line with legislation. This effect is promising especially given that climate change and invasive species are also set to increase. The fact that models show that grazing and recreational activities are also set to increase but SACs and SPAs within the Purbeck Heath will be able to function and support their intended specific target species and habitat outlined in the Habitats and Birds Directives is of importance, as it reaffirms the idea that the proposed management plan put forward by the Purbeck Heath NNR stakeholders will be effective in delivering beneficial nature conservation outcomes and support legislation.

Unlike SACs and SPAs, management and activities that occur on SSSIs within the Purbeck Heath NNR need to be approved by Natural England. Currently, of the five SSSIs found within the Purbeck Heath only two have approximately 99% of PA assessed as meeting the condition of favourable or unfavourable recovering (Natural England 2022a; Natural England 2022b). The other three sites have between 84% and 96% (Natural England 2022c; Natural England 2022d; Natural England 2022e). Designed to support species of national importance, SSSI designation and legislation outcomes have the potential to partner with the intended nature conservation outcomes of the landscape-scale management of the NNR. As with SACs and SPAs within the reserve, Chapter Three found that landscape-scale management can be effective in producing nature conservation outcomes as well as supporting the favourable characteristics of a SSSI with ecosystem services, biodiversity, native species, habitat restoration, specific protected target species, and specific protected target habitat all likely to increase. Not all NNRs are SSSIs, yet there is considerable overlap. Where overlap occurs, any intended conservation outcomes for the NNR must also benefit the target species and the intentions of the legislation supporting the SSSI designation (Oldfield et al. 2004). NNRs and SSSIs are typically selected for having a diverse range of supportive habitat (Cunningham et al. 2021), by implementing management that aids the enhancement of biodiversity, the management is effective in fulfilling nature conservation outcomes and legislation.

Ramsar sites are designated under the Ramsar Convention that protects Wetlands of International Importance (Starnes et al. 2021). The broad aim of the convention is to reduce the rate of habitat loss from Wetlands (Koester 1989). The UK is partied to this convention and its key objectives of reducing wetland habitat loss and conserving and protecting target flora and fauna (Koester 1989). The management plan proposed for the

Purbeck Heath NNR does aid the reduction of habitat loss although it does not focus on protecting target flora and fauna but rather overall biodiversity across the reserve. The involvement of wild naturalistic grazing within the management plan of the Purbeck Heath NNR is likely to impact wetlands. Cattle disturbances on wetlands may allow for invasive flora to occur and according to the results presented in Table 1.7, and Figures 3.3 and 3.4, invasive species are likely to increase on Ramsar sites (Middleton 2004), whilst stock trampling can result in increases in turbidity and nitrogen levels (Hughes et al. 2013). However, the practice of landscape-scale management approach of using wild cattle grazing may be minor on wetland areas as cattle are not always inclined to wanting to graze on wetlands. This is presumably due to fear of entrapment and preference of grazing material (Hughes et al. 2013).

The government's 25-Year Environment Plan outlines the ways to develop a Nature Recovery Network (NRN) that provides 500,000 hectares of additional habitat to increase landscape connectivity (Defra and Gove 2018). The NRN focuses on producing nature conservation outcomes that focus on habitat connectivity and restoration on a landscape scale (Defra and Gove 2018). The landscape-scale management and restoration of the Purbeck Heath NNR compliments the intended outcomes of the government's 25-Year Environment Plan (Defra and Gove 2018). The effectiveness of the management of the reserve can aid the government in their ability to enforce the NRN that could prove to be effective. The Purbeck Heath NNR serves as a clear example of how government plans can be executed and implemented effectively. This policy change presents an important opportunity for conservation methods to be evaluated and assessed on their effectiveness on implementing a NRN (Cunningham et al. 2021).

3.3 How Legislation and Management Can Be Improved to Increase Protection of Designated Features and Wider Biodiversity

The Convention on Biological Diversity (CBD) determines restoration efforts as a key tool in obtaining ecosystem services along with reducing the rate of biodiversity loss (Rands et al. 2010; Ockendon et al. 2018). As a party to this agreement, the UK have installed biodiversity action plans into their legislation framework to work towards reducing biodiversity loss (Rands et al. 2010). The fact that the Purbeck Heath aims to produce effective conservation outcomes that benefit overall biodiversity highlights how management can be used in partnership with legislation to inform management decisions that have the potential to have positive outcomes. The UK is contracted to this conference for the long-term development of conservation strategies. Reaching targets back in 2010,

and furthering action plans for the target of 2050 is a promising factor (Rands et al. 2010). With post-2020 targets reaching for 30% of the planet being protected through increased landscape connectivity by 2030 (Pettorelli et al. 2021), there is a global pressure on the UK government to support the continuous improvement in protecting designated features and conservation of wider biodiversity goals. Landscape-scale management projects such as the Purbeck Heath NNR have a heightened pressure to perform well in achieving the intended nature conservation outcomes as they fall in line with the CBDs post-2020 targets. Conventions such as the CBD and Ramsar can be considered ambitious in their attempt to tackle biodiversity and climate change where they are already under-resourced and therefore their execution in achieving such targets may be lacking (Pettorelli et al. 2021). To ensure the long-term sustainability of management outcomes that protect designated features and succeed in achieving nature conservation outcomes, adequate funding needs to be supplied. By placing tools such as ecosystem services in biodiversity frameworks, policymakers and stakeholders can use environmental economic values as a strategic goal in improving nature conservation.

To ensure that the UK remains on track for contributing to the achievement of the CBDs post-2020 targets, the UK government have committed to protect 30% of the UK's land and sea by 2030. The focus of this framework is to assess how existing designated features can be improved to support intended outcomes and wider biodiversity rather than creating new PAs against failing ones (Bailey et al. 2022). For a designated feature such as the Purbeck Heath NNR to be successful in the long-term, there are four points that legislation and management need to consider; (1) the area delivers for nature in the long term, (2) the area builds ecological resilience and improve biodiversity, (3) conservation outcomes are achieved through effective management and monitoring, and (4) that legislation and management are developed and delivered inclusively (Bailey et al. 2022). The Purbeck Heath NNR is effective in securing the achievement of point two by implementing these targets through the intended nature conservation outcomes, but if this is to be a successful long-term project (1), then funds need to be set aside to assist in the continuous and in-depth monitoring of the site (3), along with allowing management and legislation to be updated alongside each other to allow for continuous future improvements (4).

Non-governmental organisations involved in the Purbeck Heath NNR such as the National Trust, and RSPB Arne rely on membership admissions to help fund the management and monitoring of their sites, for stakeholders such as the Rempstone Estate, they rely on private and public funding and tourism to aid the management of their sites.

With the UK having left the EU and agri-environmental schemes, funding that was once paid to sites within the Purbeck Heath has been stopped or reduced (Brown, pers. comm.). With the lack of funding, the long-term success of the NNR is threatened. Moving forward, to ensure that the management and supporting legislation is effective in producing nature conservation outcomes, financial schemes need to adopt a different approach that puts nature first. To replace EU agri-environmental schemes, innovation funds, nature recovery area funds, and Countryside Stewardship Facilitation funds have been set aside as part of the government's 25-Year Environment Plan (Sandom et al. 2019). Securing this financial support is vital to ensure that the Purbeck Heath NNR management is effective in producing the intended nature conservation outcome within the next decade to ensure that the UK achieves its target of 30 x 30.

The 25-Year Environment Plan and Environment Act 2021 work together to achieve a Nature Recovery Network. The Environment Act 2021 defines environmental protection as the maintenance, restoration, or enhancement of the natural environment. This definition alone acts as a prompt for the continuous improvements for nature conservation management to be successful. The Act also illustrates biodiversity metrics that measures the value of a habitat or habitat enhancement. Using this metric allows for an ecosystem service value to be placed on management tools that contribute to the biodiversity metric. Altering the economy to align with nature and the natural landscapes will improve the protection of designated features and wider biodiversity as it places an economic importance on conserving habitats such as the Purbeck Heath, making their role relevant for the foreseeable future, achieving both legislation and management outcomes. Although this a positive prospect of the Environment Act 2021, there is hesitation as to how the legislation may restrict or impact the desired management of the Purbeck Heath NNR. The management plan and intended outcomes for the reserve relies heavily on wild cattle grazing. Cattle are seen as domestic animals and therefore require registration under law. When a calf is born, they need to have been clipped with an ear tag within 48 hours of birth. For wild grazing to occur across the whole reserve, locating the herd may be difficult to track, yet legislation is lacking in supporting the development and management of wild herds, something which the management of the Purbeck Heath is keen on. If the UK is aiming towards 30 x 30 and building a Nature Recovery Network, then supporting legislation will need to improve to aid the use of landscape-scale restoration techniques.

4. Limitations and Recommendations

The use and development of Bayesian Belief Networks (BBN) are not without their limitations. BBNs are not typical predictive quantitative models but provide an indication of the direction and magnitude of changes which occur, with suits of predictions providing 'ordinal' or ranked outcomes on variables of interest. While the ease of parametrisation is considered an advantage, converting data to meet the requirements of the parameters in a transparent and replicable manner can be difficult. For example, some of the parameters used to determine the values of nodes are quantitative, with nodes such as climate change being quantified as a predicted mean temperature rise in degrees Celsius. This limitation can be minimised through discretisation of quantitative and qualitative data used as part of justifying prior beliefs (for example, providing high prior beliefs, closer to 1, as climate scenarios intensify). However, this can result in the loss of detailed information.

The collection and structuring of expert knowledge can also present itself as a limitation. The fact that personal communications present as qualitative data can create uncertainties in translating this information into parametrisation data. This limitation can be reduced by obtaining multiple opinions which can help determine the strength and certainty of the parameters (Stafford et al. 2015). For this study, gathering expert knowledge and personal communications was limited due to the impact of the Coronavirus pandemic. When attempting to contact various stakeholders involved in the management of the reserve, many were not able to response to contacts due to staffing issues and demands on the reserve.

Another limitation to this study is that BBNs do not show spatial or temporal scales creating uncertainty as to when the posterior outputs are likely to occur. The intended landscape-scale management of the Purbeck Heath NNR is likely to be in place for the next ten years, allowing any changes to be measured and patterns to arise. Parametrisation therefore needs to be conducted over appropriate timescales for the predictions (an extreme example would be while increased grazing may reduce plant cover, this would be negligible over a period of minutes). Spatial limitations are minimised to each protected area designation within the reserve.

Future recommendations are that there is continuous, regular monitoring across the site to assess the intended management to ensure that the intended outcomes are achieved as well as to ensure that wild grazing is not degrading areas threatened by intense over grazing. This is important as cattle may selectively graze on the reserve. It is also recommended that legislation supports the intended management outcomes by providing

funding that supports regular site assessments. It is hoped that the results of this study will assist those involved in the management of the Purbeck Heath Reserve to implement the best possible measures that support the biodiversity and conservation aims of the reserve as well as outline how legislation and management can be improved to increase site features and biodiversity of future reserves.

5. Conclusion

The management plan of the Purbeck Heath NNR is predicted to be successful in achieving the intended nature conservation outcomes of increasing landscape connectivity, climate resilience and overall biodiversity of the reserve by placing nature first. In doing this, the Purbeck Heath NNR can fulfil the legislation aims set out under the various PA designation of SPAs, SACs, SSSIs, and Ramsar sites. The Purbeck Heath NNR also contributes to the UK succeeding in achieving the target of 30x30.

Landscape-scale management has the potential to have a positive impact on overall biodiversity as well as designated features. Across all four protected area designated features assessed in Chapter three, biodiversity is set to increase despite climate change also increasing across the Purbeck Heath NNR. According to results produced in Chapter Three, SSSIs and Ramsar sites are predicted to benefit the most under the landscape-scale management plan proposed by the stakeholders of the Purbeck Heath NNR.

To reduce conflicts over whether to protect overall biodiversity or specific protected target species and habitat where the proposed management may threaten one of these features, substantial monitoring is needed to ensure that species that are protected under legal designations are not lost to compromise for biodiversity growth. For effective monitoring to occur, it needs to be continuous and therefore suitable funding is needed to maintain the high quality ecosystem health found within the Purbeck Heath NNR.

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Directive

Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora [1992] OJ L206/7.

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Legislation

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Appendix I – Risk Assessment Approval

Risk Assessment Form

About You & Your Assessment

Name	Molly Bridger
Email	s5103466@bournemouth.ac.uk
Your Faculty/Professional Service	Faculty of Science and Technology
Is Your Risk Assessment in relation to Travel or Fieldwork?	Yes
Status	Approved
Date of Assessment	13/10/2021
Date of the Activity/Event/Travel that you are Assessing	01/11/2021

What, Who & Where

Describe the activity/area/process to be assessed	Site visits to nature reserves to observe management techniques being used to conserve nature, protected species, and their habitats.
Locations for which the assessment is applicable	Purbeck Heath National Nature Reserve
Persons who may be harmed	Student

Hazard & Risk

Hazard	Covid-19 Coronavirus
Severity of the hazard	High
How Likely the hazard could cause harm	Medium
Risk Rating	High
Control Measure(s) for Covid-19 Coronavirus: Student will observe social distancing and wear a face covering where appropriate such as in public spaces e.g., cafe, v centres. Student will observe the regular cleansing and washing of hands to reduce transmission of the virus. Student wi covid before and after site visits.	

With your control measure(s) in place - if the hazard were to cause harm, how severe would it be? Medium	
With your control measure(s) in place - how likely is it that the hazard could cause harm? Low	
The residual risk rating is calculated as: Low	
Hazard	High/Low temps & weather factors
Severity of the hazard	Medium
How Likely the hazard could cause harm	Medium
Risk Rating	Medium
Control Measure(s) for High/Low temps & weather factors: Student will look at the weather forecast for the area visiting and dress accordingly. They will bring spear waterproof and clothing or sunscreen when necessary. They will seek shelter when necessary.	
With your control measure(s) in place - if the hazard were to cause harm, how severe would it be? Low	
With your control measure(s) in place - how likely is it that the hazard could cause harm? Low	
The residual risk rating is calculated as: Low	
Hazard	Car accident
Severity of the hazard	High
How Likely the hazard could cause harm	Medium
Risk Rating	High
Control Measure(s) for Car accident: The driver will be well rested before the journey and take regular breaks when necessary. The car will be checked to ma that it is road safety for travel.	
With your control measure(s) in place - if the hazard were to cause harm, how severe would it be? Low	

With your control measure(s) in place - how likely is it that the hazard could cause harm? Low	
The residual risk rating is calculated as: Low	
Hazard	Injury when walking
Severity of the hazard	Low
How Likely the hazard could cause harm	Low
Risk Rating	Low
Control Measure(s) for Injury when walking: Student will be careful when walking around the reserve and where suitable footwear to reduce injury when walking	
With your control measure(s) in place - if the hazard were to cause harm, how severe would it be? Low	
With your control measure(s) in place - how likely is it that the hazard could cause harm? Low	
The residual risk rating is calculated as: Low	

Review & Approval

Any notes or further information you wish to add about the assessment	
Names of persons who have contributed	
Approver Name	Rick Stafford
Approver Job Title	Research Supervisor
Approver Email	rstafford@bournemouth.ac.uk
Review Date	

Uploaded documents

No document uploaded

Appendix II– Ethics Approval

Research Ethics Checklist

About Your Checklist	
Ethics ID	39711
Date Created	06/10/2021 15:33:44
Status	Approved
Date Approved	10/01/2022 09:08:34
Date Submitted	13/10/2021 12:38:31
Risk	Low

Researcher Details	
Name	Molly Bridger
Faculty	Faculty of Science & Technology
Status	Postgraduate Research (MRes, MPhil, PhD, DProf, EngD, EdD)
Course	Postgraduate Research - FST
Have you received funding to support this research project?	No

Project Details	
Title	A Critical Evaluation into the Effectiveness of UK National Nature Rese Ecological Management of Nature Conservation.
Start Date of Project	20/09/2021
End Date of Project	20/07/2022
Proposed Start Date of Data Collection	18/10/2021
Original Supervisor	Rick Stafford
Approver	Robert Britton
Summary - no more than 600 words (including detail on background methodology, sample, outcom	

My research is based on the newly formed Nature Reserves of the Purbeck Heaths and the current manag
in place to conserve nature. Using a Bayesian Belief Network model, I wish to evaluate whether current m
practices are effective in ecological conservation or whether the laws or management need to be changed

Filter Question: Does your study involve Human Participants?

Participants

Describe the number of participants and specify any inclusion/exclusion criteria to be used

Participants must work for the Stakeholders involved in managing the Purbeck Heaths. For example, head site rangers of the nature reserves who enforce management techniques. If all participants wish to partake then the total number of participants would be ten.

Do your participants include minors (under 16)?	No
Are your participants considered adults who are competent to give consent but considered vulnerable?	No
Is a Disclosure and Barring Service (DBS) check required for the research activity?	No

Recruitment

Please provide details on intended recruitment methods, include copies of any advertisements.

I intend to email stakeholders and site rangers of the nature reserves. The Participation Information Sheet will be attache
inform participants. Email is drafted below:

To whom it may concern,

I am a postgraduate research student at Bournemouth University. My current field of research is based on the Purbeck H
Reserve and the management techniques being used at the various sub sites within this new nature reserve.

It is my understanding that you are part of the stakeholders involved in the management of the reserve. I would greatly a
could schedule a time with you to discuss the work you do on the reserve and ask some questions relating to the manag
reserve.

I have attached a participation sheet with more information on for you to read. If you have any questions or concerns the
hesitate to let me know.

Many thanks,

Molly Bridger

Do you need a Gatekeeper to access your participants?

Data Collection Activity

Will the research involve questionnaire/online survey? If yes, don't forget to attach a copy of the questionnaire/survey or sample of questions.

Will the research involve interviews? If Yes, don't forget to attach a copy of the interview questions or sample o questions

Please provide details e.g., where will the interviews take place. Will you be conducting the interviews or someo

Interviews will be scheduled over zoom or Microsoft teams. I will be conducting the interviews myself.

Will the research involve a focus group? If yes, don't forget to attach a copy of the focus group questions or sample of questions.

Will the research involve the collection of audio materials?

Will your research involve the collection of photographic materials?

Will your research involve the collection of video materials/film?

Will any photographs, video recordings or film identify an individual?

Please provide details

I intend to record the virtual interviews. However, once the interviews have taken place and the information used. I will di recordings in accordance with Bournemouth University's data handling and protection.

Will any audio recordings (or non-anonymised transcript), photographs, video recordings or film be used in any outputs or otherwise made publicly available?

Will the study involve discussions of sensitive topics (e.g., sexual activity, drug use, criminal activity)?

Will any drugs, placebos or other substances (e.g., food substances, vitamins) be administered to the participants?

Will the study involve invasive, intrusive or potential harmful procedures of any kind?

Could your research induce psychological stress or anxiety, cause harm or have negative consequences for the participants or researchers (beyond the risks encountered in normal life)?

Will your research involve prolonged or repetitive testing?

Consent

Describe the process that you will be using to obtain valid consent for participation in the research activities. If to be obtained explain why.

I will ask participants for consent of partaking in the interview and recording of interview via written consent and again be the interview. They will be able to stop the interview at any point.

Do your participants include adults who lack/may lack capacity to give consent (at any point in the study)?

Will it be necessary for participants to take part in your study without their knowledge and consent?

Participant Withdrawal

At what point and how will it be possible for participants to exercise their rights to withdraw from the study?

Participants can withdraw at any point. They can exercise their right by informing me either via email or verbally (if it is d interview itself).

If a participant withdraws from the study, what will be done with their data?

Their data will be removed and disposed of in accordance with Bournemouth University's code of practice and data hand

Participant Compensation

Will participants receive financial compensation (or course credits) for their participation?

Will financial or other inducements (other than reasonable expenses) be offered to participants?

Research Data

Will identifiable personal information be collected, i.e., at an individualised level in a form that identifies or coul enable identification of the participant?

Please give details of the types of information to be collected, e.g., personal characteristics, education, work ro experiences

Video recordings will be taken involving the participants voice and video image.

Will the personal data collected include any special category data, or any information about actual or alleged criminal activity or criminal convictions which are not already in the public domain?

Will the information be anonymised/de-identified at any stage during the study?
Will research outputs include any identifiable personal information i.e., data at an individualised level in a form which identifies or could enable identification of the individual?

Storage, Access and Disposal of Research Data	
During the study, what data relating to the participants will be stored and where?	Video recordings of the interviews will be stored on the BU system.
How long will the data relating to participants be stored?	It will be stored for the duration of the study.
During the study, who will have access to the data relating to participants?	Only I will have access to the interviews.
After the study has finished, what data relating to participants will be stored and where? Please indicate whether data will be retained in identifiable form.	No data will be stored after the study has been completed.
After the study has finished, how long will data relating to participants be stored?	No data will be stored after the study has been completed.
After the study has finished, who will have access to the data relating to participants?	No one will have access to the data as it will be destroyed after the stu completed.
Will any identifiable participant data be transferred outside of the European Economic Area (EEA)?	No
How and when will the data relating to participants be deleted/destroyed?	The data will be deleted after finishing the study. Any information store will be deleted under the advice of the IT services.
Once your project completes, will any anonymised research data be stored on BU's Online Research Data Repository "BORDaR"?	No
Please explain why you do not intend to deposit your research data on BORDaR? E.g., do you intend to deposit data in another data repository (discipline or funder specific)? If so, please provide details.	
Not applicable	

Dissemination Plans

How do you intend to report and disseminate the results of the study?
Peer reviewed journals, Conference presentation, Other
If Other, please provide details.
Intend to report the results in my MRes thesis
Will you inform participants of the results?
If Yes or No, please give details of how you will inform participants or justify if not doing so
I will email them a copy of my results if they wish to receive the results.

Final Review

Are there any other ethical considerations relating to your project which have not been covered above?

Risk Assessment

Have you undertaken an appropriate Risk Assessment?

Attached documents

Participant Agreement Form.docx - attached on 13/10/2021 12:30:16

Participant Information Sheet.docx - attached on 13/10/2021 12:30:21

Interview Script Questions.docx - attached on 13/10/2021 12:38:16

Appendix III – Participant Information Sheet

Participant Information Sheet

The title of the research project

A Critical Evaluation into the Effectiveness of UK National Nature Reserves in the Ecological Management of Nature Conservation.

Invitation to take part.

You are being invited to take part in a research project. Before you decide it is important for you to understand why the research is being done and what it will involve. Please take time to read the following information carefully and discuss it with others if you wish. Ask us if there is anything that is not clear or if you would like more information. Take time to decide whether you wish to take part.

What is the purpose of the project?

The Purbeck Heath National Nature Reserve was formed in 2020 providing an ecological haven for endangered and protected species to flourish. However, with the threat of climate change, fragmentation, non-native species and ultimate decline in biodiversity , it begs the question of how effective National Nature Reserves are in aiding the ecological management of nature conservation.

The purpose of this project is to evaluate the effectiveness of current nature conservation legislation and management practices to (1) explore what legal designations, protected features and management measures exist within the Purbeck Heath Reserve, (2) evaluate whether the management effectively protects legally designated features and wider site biodiversity, and (3) to outline how legislation and management can be improved to increase protection of designated features and wider biodiversity.

Why have I been chosen?

You have been chosen to take part in this study as you work within an area of the Purbeck Heath National Nature Reserve. You have a detailed understanding of what management occurs within the protected sites and could provide expert opinion on what is lacking/what could be done.

Do I have to take part?

It is up to you to decide whether to take part. If you do decide to take part, you will be given this information sheet to keep and be asked to sign a participant agreement form. We want you to understand what participation involves before you make a decision on whether to participate.

If you or any family member have an on-going relationship with BU or the research team, e.g., as a member of staff, as student or other service user, your decision on whether to take part (or continue to take part) will not affect this relationship in any way.

Can I change my mind about taking part?

Yes, you can stop participating in study activities at any time and without giving a reason.

If I change my mind, what happens to my information?

After you decide to withdraw from the study, we will not collect any further information from or about you.

As regards information we have already collected before this point, your rights to access, change or move that information are limited. This is because we need to manage your information in specific ways in order for the research to be reliable and accurate. Further explanation about this is in the Personal Information section below.

What would taking part involve?

You would be asked to have a recorded interview held on a virtual platform with the researcher of this study. The interview would involve answering questions regarding stakeholder management of the Purbeck Heath National Nature Reserve and protected area features within the reserve.

Will I be reimbursed for taking part?

You will not be reimbursed for your time in taking part of this study.

What are the advantages and possible disadvantages or risks of taking part?

Whilst there are no immediate benefits to you participating in the project, it is hoped that this work will explore the effectiveness of current conservation management practices and whether the management practices and/or nature conservation legislation need to be improved to benefit nature conservation sites and wider biodiversity.

Whilst we do not anticipate any risks to you in taking part in this study, you may wish to take brakes during the interview process to reduce screen time on the eyes.

What type of information will be sought from me and why is the collection of this information relevant for achieving the research project's objectives?

Information regarding your role on the reserve and the management practises used and opinion on nature conservation laws will be collected. This is relevant to the project as it will help form prior beliefs for formulating quantitative data that can be used to evaluate the effectiveness of nature conservation management techniques.

Will I be recorded, and how will the recorded media be used?

The interview will be recorded. The audio and/or video recordings of your activities made during this research will be used only for analysis and the transcription of the recording(s) for illustration in conference presentations and lectures. No other use will be made of them without your written permission, and no one outside the project will be allowed access to the original recordings.

How will my information be managed?

Bournemouth University (BU) is the organisation with overall responsibility for this study and the Data Controller of your personal information, which means that we are responsible for looking after your information and using it appropriately. Research is a task that we perform in the public interest, as part of our core function as a university.

Undertaking this research study involves collecting and/or generating information about you. We manage research data strictly in accordance with:

- Ethical requirements; and
- Current data protection laws. These control use of information about identifiable individuals, but do not apply to anonymous research data: "anonymous" means that we have either removed or not collected any pieces of data or links to other data which identify a specific person as the subject or source of a research result.

BU's Research Participant Privacy Notice sets out more information about how we fulfil our responsibilities as a data controller and about your rights as an individual under the data protection legislation. We ask you to read this Notice so that you can fully understand the basis on which we will process your personal information.

Research data will be used only for the purposes of the study or related uses identified in the Privacy Notice or this Information Sheet. To safeguard your rights in relation to your personal information, we will use the minimum personally identifiable information possible and control access to that data as described below.

Publication

You will not be able to be identified in any external reports or publications about the research without your specific consent. Otherwise, your information will only be included in these materials in an anonymous form, i.e., you will not be identifiable.

Security and access controls

BU will hold the information we collect about you in hard copy in a secure location and on a BU password protected secure network where held electronically.

Personal information which has not been anonymised will be accessed and used only by appropriate, authorised individuals and when this is necessary for the purposes of the research, or another purpose identified in the Privacy Notice. This may include giving access to BU staff or others responsible for monitoring and/or audit of the study, who need to ensure that the research is complying with applicable regulations.

Data collected from the interview will only be identifiable form for a small part of the study to allow for prior beliefs to be created. After which, data will be anonymised.

Sharing your personal information with third parties

As well as the BU student working on the research project, we may also need to share personal information in non-anonymised for with BU staffed involved with this project.

Further use of your information

The information collected about you may be used in an anonymous form to support other research projects in the future and access to it in this form will not be restricted. It will not be possible for you to be identified from this data.

Keeping your information if you withdraw from the study

If you withdraw from active participation in the study we will keep information which we have already collected from or about you if this has on-going relevance or value to the study. This may include your personal identifiable information. As explained above, your legal rights to access, change, delete or move this information are limited as we need to manage your information in specific ways in order for the research to be reliable and accurate. However, if you have concerns about how this will affect you personally, you can raise these with the research team when you withdraw from the study.

You can find out more about your rights in relation to your data and how to raise queries or complaints in our Privacy Notice.

Retention of research data

Project governance documentation, including copies of signed **participant agreements**: we keep this documentation for a long period after completion of the research, so that we have records of how we conducted the research and who took part. The only personal information in this documentation will be your name and signature, and we will not be able to link this to any anonymised research results.

Research results:

As described above, during the course of the study we will anonymise the information we have collected about you as an individual. This means that we will not hold your personal information in identifiable form after we have completed the research activities.

You can find more specific information about retention periods for personal information in our Privacy Notice.

We keep anonymised research data indefinitely, so that it can be used for other research as described above.

Contact for further information

If you have any questions or would like further information, please contact:

Molly Bridger Postgraduate Researcher mbridger@bournemouth.ac.uk

Rick Stafford Supervisor rstafford@bournemouth.ac.uk

Iain Green Supervisor igreen@bouremouth.ac.uk

Tilak Ginige tginige@bournemouth.ac.uk

In case of complaints

Any concerns about the study should be directed to Bournemouth University by email to researchgovernance@bournemouth.ac.uk.

Finally

If you decide to take part, you will be given a copy of the information sheet and a signed participant agreement form to keep.

Thank you for considering taking part in this research project.

Appendix IV – Questions asked to Stakeholder Representatives

For the purpose of this interview, please could you state your job title and what this means for your role on the reserve.

What is your interaction with designating and regulating site management?

What key ecological management methods do you use on your site?

How does the site interact with the wider public? Is there any conflict of interest between socioeconomic needs and ecological needs?

Does the site experience any stakeholder conflict? If so, how is this dealt with?

How do you control site activities and monitor what occurs on site?

What are the biggest threats to your nature reserve?

Do you believe that current nature conservation legislation is effective in enforcing the most appropriate management technique?

Moving forward, what change would you like to see on your reserve?

Moving forward, what change would you like to see within nature conservation legislation?

Appendix V – Personal Communications with the National Trust

Date: 28/01/2022

Present: Molly Bridger (student)

David Brown (National Trust)

Molly Bridger

Just for the purpose of this interview, and would you mind stating what is your job title and what this means for your role on the reserve.

David Brown

David Brown, I'm the landscape partnerships manager for the National Trust and I'm also senior ecologist for the Trust and Purbeck though my role has been assessed for National Trust point of view. I'm our technical lead in terms of how our sites within the National Nature Reserve get managed. I don't do the management, but I kind of inform the management plans identifying the kind of interest, features and threats and so on. So kind of you know what we should be managing our land for, but in terms of the land of the whole NNR as a partnership, I was been sort of bring the very early days. I guess one of the core team of people that started to work with Natural England to create a single National nature reserve over a bigger landscape. Prior to this there was we had Studland and Godlings Heath and then we switched for National Nature reserve and there was Heartland Moore which is National Nature Reserve and then there is Stoborough Heath which is Natural England another Nature Reserve and so the idea of kind of you knows, expanding them and merging them. I've been on the part of that kind of thinking group, working group and I'm on the steering group for the NNR as a whole now and within that I lead for the partnership I chair the lead for the sites monitoring groups so the sort of where we're trying to move towards, which has to partly manage it as one landscape, but to in my mind particularly understand it as one landscape and gauge success around rather than moving away from evaluating success based on a very small unit of a SSSI and whether it's got it in the right condition, it's got the right numbers of whatever species should be there. Trying to understand that a

landscape scale up, and that's it. Hence the importance of sort of monitoring at landscape scale. And that's why I'm leading on.

Molly Bridger

Thank you. Building on from that, what would you say are the key management methods that you use on the site in terms of the landscape scale?

David Brown

So yeah, so Overall there's seven different land owners and in a way we still all do our own management. So, there's different ways of doing it. It's mostly obvious heathlands predominantly, but there's a bit of woodland, grass, then there's bits of saltmarsh, reedbeds, all sorts of habitats. We've come to the point where they get all sorts of Arctic conservation management tools for those different habitats. I think what the national nature reserve is doing is because it's a bigger scale, it's allowing us to move away from very sort of tightly prescribed micromanagement to move towards the focus is more on restoration of natural processes, so that the whole landscape functions ecologically. I can give you one example on heathland, they are designated in part for their reptile interest, to manage our heathland for sand lizards is bare ground. If you haven't got bare ground, we kind of bring in the diggers or we by hand get our volunteers that we dig so that families who got somewhere to Burrow and lay their eggs. Now that works on the one hand that's kind of we know we do that because we know it works, that's one of the reasons why we kept families in this landscape. But we also know that that are ridiculously gardening really. It's a very resource heavy way of managing for single species, and you can't do that for all species. And you can't do that if we want to scale up nature conservations so that it's everywhere and it's bigger landscapes. Yeah, we've got to think differently. So now we have a bigger landscape, it's the opportunity for us to not stop doing that straight away, but reduce some of the processes that will naturally create those habitats for families. And so, one of the big one and the key for that really is restoring the role of large herbivores. If you think about it in a natural situation you know pre human what would have created the bare ground habitat for sand lizards and all the other bare ground species to inhabit. It would have been big animals. Most of the regional ones are extinct now, but the things like you know, mammoth Mastodon, Oric and stuff like that, and they

the way they behave. You know, concentrating their grazing somewhere that would have created those habitat nations. Now we can't reinstall, we can't rewild it to that extent. We can't restore species that are either extinct or just not appropriate in today's landscape. We can't restore wolves, for example, because it's just we're not at that place but what we can do is restore proxies for those things, and that's where our management is going now, so it's particularly focused on restoring. Rewilding grazing, so bringing on cows, but not just out of a domestic cattle system, but trying to get the cows to behave more like wild herds though bigger ranges so they can be. So, I just examples of that, over the last year or year and a half we've been able to link our land together at Heartland Moore with Natural England and Stoborough Heath with RSPB Arne we are already managing our cattle differently on that bigger landscape. We have several bulls out together in the landscape and bulls when they're together when they're kind of, you know, when they're getting ready for mating and they're kind of marking their territories and they're showing from aggressive behaviour to each other, they would mark their territory by scraping the ground by pushing against each other, they create these sandpits. But essentially bare areas of bare ground which is perfect habitat for sand lizard and all the other bare ground stuff that we do, and the idea of we can introduce cattle behaving in a wilder way. They will do that management for us. Similarly, another thing we do is classic heath management we do little bits of ploughed strips or on the heathland grass it’s the early succession, the pioneer species that need bare ground to germinate in, and there's a whole list of rare plants that need those conditions. Traditionally we get in a tractor and a plough and mimic the role that wild boar would have in a natural environment. So, we're thinking well, now we've got the scale of landscape, why not reintroduce wild boar? But we can't really because, well, we maybe we could do, but they are quite controversial, or people have their concerns. So, we're introducing domestic pigs, but free ranging domestic pigs across the whole landscape. They'll be coming in April, hopefully so very soon. So the idea is restoring, kind of natural processes because they do it better than we can because it's naturally part of the ecology, and because economically it's turning something that's a cost into something that actually if we're working with a local grazier and he's running his business, albeit in a very extensive way, and it's a more sustainable economically, and so we're, yeah, so that this is very long answer to a very quick question, but

basically what we're doing or what this national nature reserve is doing is because we've got a bigger scale, we're allowing us to restore the natural processes from our landscape, and that is going to be at the heart of nature recovery.

Molly Bridger

OK, thank you. I touched on it in terms of the aim or trying to restore natural processes, I was wondering how then would you deal with trying to protect, say the target species that is designated for protections versus the biodiversity goals?

David Brown

You've really important point, and you've gone straight to the kind of one of the key challenges with this. So, there's lots of examples of rewilding around the country and it's fantastic because there's this dire parable landscape and putting in these natural processes creates variety. It's nature rich landscapes in the country and highly designated with loads of species which we've got sort of legal responsibility and more responsibility to keep here. You know things like Purbeck Mason Wasp for example with only two or three colonies on the Purbeck heath and that's it. There's nowhere else. Although the thinking behind restoring these natural processes they're exactly the processes that these rare species need, the reason why they're rare and threatened and in decline is because the landscape doesn't have those processes. Again, the Purbeck Mason Wasp it needs areas of sort of exposed clay near water and it needs to have one near Heather, young Heather. There's nothing creating those conditions. So, by bringing back wild animals we will create this. There's a risk that if we keep our eye off the ball, they may not or they don't create that habitat, or they do but the existing Purbeck Mason Wasp aren't able to thrive there for whatever reason because creating the wrong place or even worth maybe a pig comes and digs over the existing colony, and it's disappeared before it's a chance to spread. So, for me that means we've got to monitor it really carefully. We think the process we're bringing back will benefit all our target species. They're native species that have evolved with these processes in the landscape. But the risk is we don't quite know what the landscape will look like if it goes more of a natural, you know allowing grazing animals to behave in the way they want to behave. They'll probably graze very heavily in

some areas and not at all in other areas. And long term over the whole landscape that will be beneficial, but it might mean that area that you know have species that need short vegetation becomes very big and scrubby and it will disappear. So, we've got to monitor. We've got a long list of species that are of significant and within that a shorter list of bases that we think are potentially at risk or potentially things that will either benefit or might potentially be at risk from the changes and we've got for each of those we've got monitoring strategy. Now some of them, there is a few we know exactly where they are so every year we go out and survey the same colony and see how it's doing. Other a bit more complicated if we got like a sampling based approach to how we monitor them, but the idea being that you keep a close eye on them. Hopefully we'll track that they're becoming more resilient, it be expanding, but if they're not then we can go back and we can always intervene. We can either artificially go in and manage the scrub or we can get the cattle out, we can do whatever it might be. So, for Hartland Moore, you've got a particular wetland system that's the strongholds for the damselfly, which is one of our most threatened species. It's doing quite well in the New Forest, but outside the forest is only places here, and it's just on that one. There's one section of wetland, and if it gets out of good condition that species will disappear from the landscape within a few years. And that's an area where it wasn't getting grazed enough. There was very little access to open water, the flow was slowing down, and this species was going to decline. We've just intervened by putting in, making sure our cattle graze, that we put temporary fence around it and put them in there several years running and it's great again now, so it's that kind of trade off. It's not stopping that micromanagement, literally, from one day to the next. It's kind of moving towards that keeping a very close eye on it and intervening where we still need to. The conservation used to be about OK we've got this site with these important species, and we've got to make sure these species stay here. They have quite defined targets for SSSIs. Now we're saying the landscape of the future maybe some species will decline from a particular bit of land, maybe the Purbeck Mason Wasp will disappear from their particular site but that doesn't matter, so long as that Purbeck Mason Wasp is still present within the landscape. If we've lost it from 1 site, but it's reappeared in the three others, that's good. You know we talked about resilience more than target populations that are up for all these bases, but they need to be resilient in this landscape.

Doesn't matter where they are in the landscape doesn't really matter how many there on the landscape if that viable population will cope with any future threat.

Molly Bridger

So you said that you're working with the various stakeholders involved on the Purbeck Heath, so I'm just wondering if there's ever been any conflict of interest within these stakeholders. Because obviously, you know, speaking about colonies of wasps, how do you designate which areas can be managed for what and how it's dealt with.

David Brown

Yeah, there's different opinions. We got 7 land owners here of which you've got a four conservation NGOs, your National Trust Wildlife Trust, RSPB and amphibian Reptile Conservation Trust and you got two public bodies, Forestry England and Natural England. So even within the NGOs we're not all necessarily prioritizing the same things. Amphibian reptile Conservation Trust, as the name indicates, are very focused on amphibians and reptiles, and that's not their only remit. They are probably slightly wary about how this gets portrayed, but they're more wary than we are about just letting lots of grazing happen because obviously from a reptile point of view, grazing animals are actually essential for creating the habitats that reptiles will need. They do provide a direct threat; you know cows can trample. There are different parts of the partnership. You've got people like the forestry England, whose primary role as an organization isn't nature conservation, so it's about finding common. We're not trying to say every bit must be managed in the same way. What we've started with is a common vision, a common understanding. Firstly, it's all that nature conservation. Secondly, we recognize that we need scale and connectivity, and then thirdly the flow shift towards natural process is now some bit of this landscape. We're further ahead than others. What I think of as a core area, really, between Heartland Moore, Stoborough Heath, The National Trust, RSPB Natural England. We're kind of all wanting to go at the same pace there, so we're doing more things. There are some bolder things we're doing elsewhere like Brownsea Island. The island is much more traditional management really, but that doesn't feel like it must be all one or the other. We're exploring as we go. So how we dealt with it, we, I think as a partnership,

you have to recognize that each organization is slightly different and we've got different motivations and different ways we measure success rather than trying to force through a model that fits everybody, we agree what we do have in common and then within that partnership find opportunities to explore new ways of doing things in a way that we can all cope with. So, there's a different pace going on at different times.

Molly Bridger

I think it's nice to sort of hear the good collaboration between the sites and partners. So, I thought I'd bring in the public now and sort of how the Heath interacts with the public, but also the smaller sites because I know that when I visited Arne, there was a great visitor centre there, they're encouraging people to go and there is a nice walk or cycle path. So, I was wondering how the different sites interact with the public and if any conflict of interest between what the public wants versus what the site management ends up doing.

David Brown

Yeah, so I think the first thing, although it's all about nature, it is also all about people. It’s not than meant to keep people out. In fact, in different ways all of the partners depend on people, so from the point of view of all those big membership organizations like the RSPB or National Trust, we need people with members, but we don't get those if we don’t give them access to this landscape. For someone like the Rempstone estate they invite people to the campsite. If it's a landscape you can't go to, people won't camp there. We've got holiday cottages. We've got carparks, we've got all these things and so we all recognize and then you have local businesses that use this landscape to operate within so activity providers people like. I know companies that are outdoor adventure places, and we give them license to operate off our land, but it's part of the organizations directly and the local economy needs visitors. And so, I think that we're all clear in you need to get it right, but it's not a question of we don't want visitors. We've got to put up with them. This is part of the economic ability of it. And I think that's looking long term at the sustainability of nature conservation. Here we are talking about a shift in the economy, the landscape. So, it used to be about production, and that's what made it not very nature rich. People, through their short growth timber through conifer

plantations or where they ploughed up the heath to try and turn it into dairy farms for kind of more intensive cattle rearing. And we're saying, OK, now what we're trying to do really is align the economy with the landscape in a way that the economy needs it to be a high quality landscape and it's the very fact that it's a high quality matrix landscape that generates income rather than that kind of conflict. There is stopping doing the things that damage their landscape like forestry and intensive farming are doing economic activities that provide jobs but maintain a good landscape and that sort of farming still, but very extensive farming. Yeah, it's not intensive, it's very extended where we're working with local graziers local, you know the pigs that will be on the heath. They're going to end up being sold in the salt pig and where I'm at the point, the local business to do that, but the other big one is tourism. Tourism will thrive if the landscape is beautiful and wild and you like you know, a Beaver or White tailed eagle or whatever it might be, if we can make the kind of visitor economy about the stainable ecotourism, then you've got something that kind of self-perpetuates. Then the better the landscape is there more people come and do it, and that's something that I think everybody all the partners that can recognize as a Good thing doesn't mean we will do it the same way I think one of the nice things about a big landscape. Different organizations are you don't have to try and offer. You don't have to create it for everybody at everything. Though what we've been doing is we're in the middle of work now, they sort of, I guess, zoning across the landscape thing. OK where you know, high cliffs that form where you can enjoy the open landscape but doesn't mean everything. I have a cycle path on it and it and for various reason just because it's what they're interested in, or their landscape seems better. The Forestry Commission and Rempstone estate is in a great place to develop the cycling offer because they've got the sort of forest track there already because it's you know it's easy to get them. They've got cycle place nearby providing that we kind of don't have to feel under the same pressure to put it on some of our sites or similarly they've got a brilliant visitor centre at Arne. If you want to learn about the heaths you know, learn about the birds whatever. We don't have to do something like that at Heartland Moore as well. We don't need to put a campsite in the middle of studland, we can send people to the other campsite, the Rempstone estate and that way you end up kind of as a whole you can provide. You can still accommodate all the different interests, but you can do them better by not doing

them all everywhere, and I think what we're doing, we're working through that process collectively now trying to work out how best to manage the whole landscape from the point of view of visited so that we all get what we need out of it in terms of income and members and stuff. We're all engaging with people, but people can do that in a better way. It's going in really the right direction. It's exactly what we should be doing, but it's not perfect, you know there's bits of conflict and you will get conflict over dog walkers. None of the land owners really want dogs because dogs are a nightmare so how are we going to manage dogs in this landscape? There are lots of areas we don't want the dogs, or don't want them off leads, but we need to provide some areas where you can take dogs off leads and so we're kind of trying to look at that together as well. We haven't got all the solutions. But having conversations together, as land owners is useful. I'm working on a sustainable tourism plan or strategy and that's involved all the land owners and it's involved a lot of the local businesses, so that's everybody from people who run campsites to being outdoor adventure people, cycle hire people, all coming together. That's in a draft form now that'll be finished within a couple of months, and you know, that's that feels really exciting doing that.

Molly Bridger

Thank you, I like the idea of the long term shift to line the economy with the environment.

David Brown

Yeah, I think that it's also necessary in as far as conservation will always be propped up by grants and subsidies and stuff and that's never feels very sustainable. When conservation worked, when nature rich landscapes work long term, it's because they're self-sustaining the way people live is how you know these are very humanized landscape. It has been for set for millennia, so it'll only really be up sustainable if the way we live is what sustains it rather than our activity pushing it in the wrong direction. Then we find little bits of grants here and there to sort of stick plasters on that and mitigate that. That's not sustainable. And I mean a lot of it goes beyond that. And I like that a lot of what I am talking about isn't necessarily specific to an NNR, this all about nature recovery in general. The challenge for us as a nation, you can look at that on

any scale. This goes back to the Norton report and the state of Nature Report in 2010. The idea that you need our lines going to be bigger, better, more joined up for nature. And this is that playing out now we've used here the National nature reserve status as our vehicle to do that and it's been a catalyst doing there and we've had there's lots of context. There's no reason why we couldn't be doing all of this without the national nature reserve as a designation, but it does help. It's really helped give it an identity and give it some lines around a map. If forces us to have meetings and talk about this stuff and make it happen.

Molly Bridger

Thank you, and So what would you say are the biggest threats to the reserve? They can be ecological, economic, social.

David Brown

So economic, I think we asked, although I've talked about trying to move towards more, economically self-reliant, and it's not just tourism. I said tourism and extensive grazing, but also there's all sorts of other things we haven't you know, looked on which we could explore in the future. But it still depends very heavily on the subsidies and Agri environment schemes to operate now coming out of Europe coming out, leaving common cultural policy, is, a fantastic opportunity for nature conservation in this country because it's going to hopefully push a lot of inappropriately managed farmland into a different way of thinking. But here it's a risk to us. I think for Studland and Godlingston Heath alone we get like £200,000 a year through a high level stewardship and basic payment scheme. Now that's going to go its entirety or will be replaced with something else, but we don't yet know. We don’t yet know under the new land management scheme. So, the economic risk of how it's all going to be funded in 10 years’ time. That's not all doom and gloom, because by shifting the economy round and thinking OK, rather than calling it an agricultural system and subsidizing it to be a bit more nature friendly, which is what Agri environment schemes do, we're hopefully moving to a financial system where we actually value what landscapes do give us so its monetising the fact that not just the direct business interests of tourism but actually the kind of service that provides through biodiversity through clean water through carbon sequestration in soils and all these things which have a, you know, a better benefit to society will hopefully be that will play out in terms of how we get funded through public

funding for managing the landscapers condition. The carbon markets are all very in their early days of development at that moment. But what we're doing with this landscape part for the biodiversity benefits, apart from all the benefits for visitors, if you're restoring our wetlands, we get Beavers in there and we've got the right grazing and we're restoring all our wetlands back into what they once were, which is Pete forming habitats. We're creating a, you know, significant impact on carbon storage that will, we think, play out in terms of, you know how it gets funded, but it's a lot of uncertainty around that. I think there's cause for hope, but there's a risk around that. The change in funding models meaning that suddenly, you know we are will probably be alright because we're the National Trust we've got all sorts of income streams and we've got a Clear Channel objective to do this. It will find a way of financing it, but you can see someone like the Rempstone estate, a private estate, who are much more vulnerable if they're finances dropped out because they could lose all their subsidies. You know where they will go, and they want to go in the right direction and I'm sure they probably will. But it is a risk. I think another risk is, people are still as asset, it's an opportunity, but it's also a risk. We get increasingly numbers of people come here, and that's great. Holiday in the UK or whether it's just people in you know 500,000 people, Bournemouth, Poole and Christchurch. This is their breathing space that's you know it's fundamental to peoples wellbeing and all the rest of it, numbers are growing every year we get more and more people coming. Although we were going about managing that in the right way, there's always a risk there. It can get out of control; we could lose that sensitive wildness. We could lose some of those sensitive habitats we don't manage it well, but also people bring other risks like fire risks. Increasingly numbers, year before last Wareham Forest lost 200 hectares through fire caused by instant BBQs. Who's to say the things not going to happen with us could easily happen with us, and so there's you know, people come with certain amount of risk but all increased dog ownership among the public. It wouldn't stop the whole of the reserve, but for some for a lot of our species, that's a big risk. Whether it's the wetland birds and the harbour shoreline, or whether it's the ground. I think birds on the heath. There's kind of risk there today with increased visitors and disturbance from dogs, so that's another thing. Climate change is obviously a big risk for this reserve. Others are very direct risk in terms of increasing risk of fire wildfire without doubt, but

there's also a risk for a lot of our species. Having said that, changing again we're doing the right thing. The only the only way you can mitigate that is to give space to species, more variety space to move around, the space to move, and a more heterogeneous habitat so that it can find its niche to somewhere else. So, we're doing the right things, but that doesn't mean it's not a risk.

Molly Bridger

Thank you, it has been interesting to sort of see that's the difference levels of risks that could potentially, you know, pose a threat to the site. I do want to touch back on the nature conservation, legislation and policy. Do you believe that current UK conservation legislations are effective in enforcing most appropriate management technique?

David Brown

If the designations are so things like SSSIs, it’s easy to see what they're not and to criticise our designations because we're still losing nature you know left, right and centre but I think they've been incredibly important to keep our options open for the future. And the reason we're able to be in the Purbeck Heath now talking about recovering nature, managing better, and bring in wild processes and all that stuff is because back in the 50s these were some of the first designated sites. The first SSSIs, the first national agency where if they hadn't been, we have nothing left to recover from without really any doubt. I deal with maps of the sort of decline and fall of the heathlands and then actually where they're being built up again, and when most outside those designated areas things disappear. There's nothing left really or nothing functionally useful left, so our SSSIs and our national nature reserves have been. And then since the European designations came in the, the SPA and the SAC have been fundamentally important, not necessarily making things perfect, but stopping that complete loss of everything. So, they are in most of our landscapes. In the UK, that's still the need. If there's very few landscapes like Purbeck, where we're talking about properly recovering nature and the idea that these designations might now be a constraint that most places you know you, we're still losing habitats. The NNN size essential, I think where we are here though because we've now reproposed landscape because we've re-joined it together. SSSIs can be a bit of a constraint to us, because what they essentially do is

they kind of describe a very specific condition that area of land needs to be maintained in. And if you're trying to create a more sort of dynamic landscape where things move around and things change, through that prism of how SSSIs are assessed can make the land look as though it's an unfavourable condition. And again, that's something which I think certainly here, not just a sense of land owners, but the legislative. Yeah, the regulatory bodies Natural England are very aware of. One of the projects that they were doing here is trialling a new way of assessing Nature which is not through SSSI assessment, but through what's called favourable conservation status for the season for habitats which is that update will be able to kind of assess their resilience, overall landscape scale so that's Natural England behind that process, so they're recognizing that OK, those old, very tight designations have an important function. But, once you once you start recovering nature, you need to sort of move towards something a little bit more dynamic and fluid in terms of how we assess it. How you do that? Is it still very much a work in progress? I think yeah. Does the designation do enough to help protect? I think they are here because we've built that solid partnership. Are they enough across the landscape as a whole? Probably not really. I mean I think SSSIs when they are in the right hands of conservation organisations they are manged right. There are lots of SSSIs though that are in private ownership that have limited restrictions in terms of what you can and can't do but also limited in terms of resources to incentivise the correct management in the right way, and lots of our SSSIs are still very nature poor because most of our landscapes require active management that is very hard to enforce. I don't know if it's the fact that the designations are wrong. I think it's more that if they don't come with any resources, you can't oblige a private landowner to actively manage for nature, really.

Molly Bridger

Yeah, I agree. I think if we want to have these landscapes you need the resources and support them just to get the most out of them. Moving forward and thinking about short term and long term and future support, what change would you like to see it on the reserve?

David Brown

I think short term, physically on the reserve I want to see Beavers there and the

next year I want to see the pigs properly integrated, I want to see more of these bigger grazing units that we're doing more of the kind of more Wilding edge of it. I mean, for example, we're in very early days of talking with the Rempstone estate, can we create a similar common grazing unit that links Godlingston Heath with the Rempstone Estate so that what we've started on one area will carry on doing more of that stuff and more species. So yeah, Beavers kind of more, you know Wilder grazing herds. Maybe another reintroductions going to happen like a pine Martin red squirrel introduction you could bring in both those together, possibly up or the Eagles that were introduced to the Isle of Wight, we see they've started visiting here now. Occasionally they start spending more time here, but you know just we want more wildlife. Really, I suppose that's it. Other than that, more kind of, I suppose, organizationally. A lot of this is still vision rather than happening. Some of the stuff around working together, it's a journey and will probably take a long time to happen. Actually, one of the things we try to do is in order to build to monitor wildlife across the whole landscape and understand it is one landscape we need to have at the moment. Most of the monitoring get happened happens through volunteers. We've got our group team of specialist ecology volunteers and natural trust. The RSPB have got their volunteers. There's a load of other local naturalists who work independently. We're trying to bring all that together into one body and we're calling that the Purbeck Heath History Forum, which is one umbrella for the land owners and the naturalist community and all our volunteers to properly, you know, think of this as one landscape and we had an online meeting, an award cross referenced and we had about 65 people at that. And then the idea is that will get properly established as a group this spring and then that becomes then an independent group, sort of like a community group crossed with specialists that sort of champions are the NNR and double the science does all the monitoring you could have possibly getting a physical hub so there's a sort of you know natural Centre and they could have you know everything from organized events, the public through to research partnerships or all that stuff. There's lots of things we think this landscape could create that we're trying to get into motion now. I think another area I'd like to see develop more is a really exciting story that if you're in the conservation world, so I mean, I live in Swanage, people you know, we just on the doorstep. But a lot of people here don't really know what's going on. And we, yeah, we've done some. We've

made some good progress over the last year to do with that through various activities and events and engaging programs, but we could go a lot further with that. You know, we want everybody who lives around here to know how fantastic it is and also take a bit of responsibility for it and the way people interact with people uses it and that local community engagement and relevant and so on is the other big area I think we need to grow.

Molly Bridger

Thank you for that. So just last question and it's like the previous ones, but what change would you like to see within legislation?

David Brown

OK, there's probably a few. There are some very practical ones around all of our legislation assumes that all of our countryside is farmland and that's why all of our subsidising for nature conservation comes through farming subsidy. All our rules around livestock are based on farming system, so one of the reasons why it's really hard to get cattle grazing across the whole landscape is because of legislative constraints around cattle moving from one landholding to another land holding. And that's through the risk of TB, and it's to do with all sorts of stuff, some of which don't make sense here now. So, we have to jump through 101 hopes to just a link our land with Arne and Stoborough Heath. And there's a real need for agricultural legislation around grazing animals to enable landscape scale conservation to work. So, deer for example, because they're not registered, they're not native, they're not registered as a domestic herd, they are treated as a wild herd. They have no rules so that can roam from one side of the landscape to another. And although we probably have got too many deer, they can cause a problem, but in the right numbers that's fantastic ecological part of the landscape. Cattle even though you might want to manage them exactly in the same way as deer, but because they're technically domestic you can't do anything like that. When a cow is in labour they will do also sorts with the habitat in terms of the vegetation it eats and the way it creates sort of hollows in the ground when resting. All of that is brilliant habitat that doesn't exist yet now. But we can't allow our cattle to calf on the heath because by law a new calf must have an ear tag and be registered within 48 hours of being born and if there is a big landscape you'd lose track of these things. And so, the legislation constraints us now. There is one example in Northumberland where

they are treating the herd as a wild herd and so there are some things we need to get to up our game. We need to be part of where conservations going if we want to be serious about this. I've done bits of work with rewilding Europe looking at this about how you herd wild grazing herds and managed across Europe. You have different sort categories of herds whereas we don't in this country. So, there's some legislation around animal movements and you know the whole thing called cross compliance, which is to do with not contributing any agricultural laws which ties us up in knots. The other thing is around funding, I suppose. So, we've come out of the agricultural policy, come out of the basic payment schemes and countryside stewardship scheme and moving into something called environmental and management scheme. And there's only three tiers, a couple of the lower ones are like what we currently have so if offers individual farms get subsidies from managing their land in a certain way, but there's a third tier of this called the Landscape Recovery Fund. The idea is that they will fund the whole landscape. What they won't do is say we'll pay you if you manage this field in this way will give you that money. It's essentially as a landscape partnership you say this is what we want, this is how we manage the landscape, and this is what it's going to cost us to do that, and Defra will fund that landscape. And that is where we need to get to, because we can then have a big twenty year vision for a whole landscape like this, and we will say yeah, by managing the land this way we will contribute X amount of carbon X amount of biodiversity X amount local employment, our soils will be in this condition, our water like this, and this is how much it's going to cost and that freedom to build to kind of come up with sustainable local economic for this is what will unlock this sort partnership. I know we're trying to fit a kind of square peg in a round hole with the way we want to manage the land with a funding system that's based on a completely different model from post war agriculture. If we confirm that funding model so you have this more flexible top tear, and that's what is happening here. They are piloting, this year they just announced they're going to be looking at several pilot landscapes around the country to sort of try and develop how this funding might work, but that's where we need to get to. So, I'm hoping that within sort of five years, that's how we fund this landscape. So yeah, those two things. One is around funding and one around the constraints of agricultural legislation to do with animals.

Molly Bridger

No, thank you. It's interesting.

Appendix VI – Personal Communications with Natural England

Date: 28/01/2022

Present: Molly Bridger (student)

Dagmar Junghanns (Natural England)

Dagmar Junghanns
You must excuse me if I cough slightly because I had COVID a couple of weeks ago and I still got a little bit of catchy throat and so I mean it's [the Purbeck Heath NNR] massively designated, you know, it's got layers and layers and layers of designation, but basically in terms of the conservation legislation you've got many. Most of the area across Purbeck is a site of Special Scientific Interest. Most, and that's the British. That's the underpinning British legislation. So that's in our statute and it started in 1949 and it's being modified several times. But site of Special Scientific Interest these our legislation for nationally important. Nature features. Overlaying that is the European legislation and the international legislation which is SAC and that's about habitats and species that aren't birds. And then SPA special Protection area is birds. And then there's also Ramsar. And I think part of the site is Ramsar and that's a global convention for wetlands. So those are sites that those are designations that bring with them, certainly, UM, SSSI and then SAC and SPA bring with them is very specific protection and risk constraints on activities that could damage the interests are not. So that's one bunch of legislation now the status of national nature reserve. It's a slightly different status. It dates to 1949 and it's where Natural England and our predecessor bodies we declare land as National Nature reserve, where that land is naturally important for its features. And it serves the purposes of national nature reserves, which are. You know conservation.
Uhm, scientific work and connecting people and nature. So, there were three core purposes in the legislation. What NNR Declaration does is it commits that land to being a nature reserve. With the primary purpose, the primary land use being nature conservation .And that's a bit different too. And SSI. Or even an SAC or SPA because they could be the primary purpose, could be for farming for example. So, although they are protected against damage, the actual purpose of the land could be farming. Or forestry or whatever, whereas for a national nature reserve, the purpose, the primary land use is nature conservation. And it's a subtle difference, but it's that commitment to it being land managed for conservation is the sort of step change. So that's what NNR National Nature Reserve declaration achieves. What it doesn't achieve is any additional protection now, so there's no additional legal protection. And. In the case of Purbeck and in the case of most other NRS now. That protection comes from the other designations like SSSI or SPA or whatever. But one of the things that we're starting to do now with national nature reserves is to look at bringing landing for nature recovery. Which might not be high quality now. And therefore,

it might not have any underpinning protection. And so one of the things we're looking at is this is a bit of an aside and I hopefully I won't confuse you, but one of the things we're starting to look at in Natural England is how we can bring a bit more additional protection in with the NNR status to protect against protect land that doesn't have other designations because at the moment, it has that commitment to managing it for nature conservation, but it doesn't have protection against external decisions like building a road next to it or drainage or something like that. So, there's it's a bit more, you know we can do more for nature recovery, but it exposes us to other risks now. I mean, I could go. But so, what's happened with Purbeck? Is that you've got existing, UM, you've got the existing SSSIs, you've got all the international designations. You've got partners working together in that landscape, but what the NNR has done is it's sort of embraced the whole landscape, so that it's now the primary land uses nature conservation across that three and a half thousand or 3331 hectares. Uhm, so that's the difference it's made is it's really sort of consolidated that partnership across to work together across the whole landscape four conservation. Which is quite exciting.

Molly Bridger
Thank you for giving clarity to that and so touching upon the idea of nature recovery, I spoke to David Brown of the ideas of moving forward, in terms of having all these sites interconnected as one mass reserve moving forward to sort of a larger landscape scale form of management. In a way, it's a new form of management having these pockets and different activities it's all come together as one. And so, in terms of that, I wonder, does that then give rise to a potential conflict of interest if you've got one body wanting to have a grazing in one section? But then the grazing could potentially have cattle on the land that can cause a hazard risk to the native reptiles, that there sand lizards and their habitat. How do you think that could be overcome moving forward having wanted this mass nature recovery and large scale management?

Dagmar Junghanns
OK, Gee, I realized that because I gave you that explanation we we're sort of hopscotching around the question. So would it be helpful if I come back to that question, but I just cover off the sort of who I am and what my involvements being first. Otherwise, we'll forget, and I'll have to write it down.

Molly Bridger
Absolutely.

Dagmar Junghanns
What do I do now? Is a principal advisor for national nature reserves in Natural England. My specific role is, UM, the strategic development of national nature reserves across England. And what it means for the Purbeck Heath's is that I had a particular involvement in developing this. The National Nature Reserve strategy, which and the National Nature reserve strategy came out in 2017. And what we did with that was think forward about what modern national nature reserves should be. So, thinking more about nature recovery and the Lawton principles and things like that. So, moving beyond protecting single sites in isolation from each other and we chose Purbeck, we kind of invited Purbeck to

be the first of this new style .And then else because there was the previous 20 years of partnership working and ambition in the area. So, I've kind of got the role I had a few years ago was to set up the Super NNR at Purbeck. And that came out of my role with the NNR strategy. So, we were looking for the first site to do and Purbeck was ideal. The role I'm now doing, which is sort of doing the same thing across England. I still have a very light touch overview on what's happening at Purbeck because it was the first site and we tried out lots of you know, we tried out the partnership building, and we tried out the management planning. We tried out the memorandum of understanding between the partners. And so, I've been really involved in how that's happened there and now I'm translating that to other sites. But now I only have a very, very sort of general overview of what goes on there. Which I quite miss because it's such a fantastic place and such a nice group of people to be involved with. And so, the interaction with, designating and regulating site management, which is your second sort of question. Uhm, so now I oversee the designation, the Declaration of new National Nature Reserves across England and we have a pipeline of, well, it's sort of a long list of potential new major sites across England, which would take us, you know, at least 10 years' worth of new sites, I think and a lot of those are on the model with Purbeck where we've got existing Nature Reserve next to each other and you look at how you can link them. Either they don't have to be all joined up because sometimes some places you can achieve a lot without that physical join up, but some of them will be more joined up and some of them it's just about really consolidating partnerships across a big landscape to do more. So that's my main interaction now is really, sort of leading that pipeline and helping local partnerships helping develop the local partnerships and the ambitions for big sites across England. It's a very nice job.

Molly Bridger
They thank you it. It sounds positive, and I think creating a positive change, I think an idea of forming a large community I think has been truly missed these past couple of years of not being able to sort of get out and enjoy the outdoors. And so, I think you know it's grounds for remarkable change and I think something that could be solved seeing that as a UK being a leader in nature conservation through this new sort of scheme.

Dagmar Junghanns
Yeah. And the thing that we're trying to do now with national nature reserves is move beyond protecting individual nature reserves and we're looking at really recover, you know, national nature as being places for nature recovery as well as you know protection and Purbeck is a really good example of that, and the question we can come back to the question that you asked about this sort of potential conflicts of interest because Purbeck is a place where you know we are, uh, by we I mean that you know the local partnerships but also nationally we're really interested in it we're trying you know things that are quite brave, where you've got very specific rare species that need, you know, very specific rare species that we've spent, you know, collectively, we've spent lots of time and resources on protecting. Again, you know in in their sights and against all sorts of threats. And now with you know, now we're looking at more of a nature

recovery in particularly. You know what you will have picked up from David Brown and moving beyond this sort of protecting things, insight and moving more towards creating, recreating dynamic natural processes. David probably articulates it as well as anyone. And so, I'm sure you've got it all from him, but that's, you know, Purbeck is somewhere where we're trying new things in a very, very heavily protected landscape. And you know it's bold, it's trying it, you know it, it's experimental and it's what we need to do, but it carries some big risks and you identified the very obvious risk in your previous question. So, we can return to that. But is there any, is there anything that you need me to clarify from what I've just said?

Molly Bridger
Uhm, no. I mean, feel free to talk more about sort my previous question before I move on.

Dagmar Junghanns
Yeah. So, I think what you were asking was really whether there or so I'm coming at this from the point of national nature reserves, and I'll check in a bit of my own ecological stuff, but I'm not You know, I will try and steer away from saying anything wrong or right on a on the site locally because I'm not locally based and I'm not part of that. I'm not a direct player in that partnership, so I wouldn't want to be seen as the, you know, any of the sort of local decision makers on that. But the so the question you were asking really was the tension between working at a landscape scale where we surrender some control about precisely what happens on any one piece of land because we're putting in place a much broader landscape scale management and deliberately introducing management methods, that is, specifically pigs, I think is the, you know, the most controversial but producing those, introducing those into a landscape where we have some very rare species who require very specific questions, very specific. Ecological conditions and the risk are that because we're taking away the tight control of those ecological conditions, it could put those species at risk. And I think, you know, sadly is the very visible example there that you know is you know it's not it won't be the only example but it's the one that it's very easy to focus on sand lizards because they are extremely rare. There's a lot of work gone into their very specific protection and creation of the perfect conditions and protection from damage. And then if you open if you put these much more disruptive ecologically disruptive things in place that could be seen as a risk. So yes, there is a risk there. You know it's straight. Answer your question. There definitely is a risk, but what they're also the logic behind it is that to move an area into a more natural and raise more resilient, more naturally resilient ecological status. We need to be working that much larger scale. And we need to be putting ecological processes, ecological dynamics back in place to allow ecological processes to restore themselves. And those processes being a natural succession. You know and a natural dynamic where conditions will move around just you know conditions will move around the site and you get more bare ground. But that bare ground overtime will become more colonized and more succession. I knew, you know exactly what I'm talking about here, so I don't need to go bang on about it. But you know it's a way of managing that we haven't done because we've had this very site based site focused and

particularly the way that we collectively come in government in Natural England and in, you know, partners, other bodies, managing nature reserves. We've worked so hard to protect. What? Protect what we've got. That we've sort of been looking internally for 70 years and it's quite challenging to let that control go because we know what we need to do to protect site protect species on sites and inside sites. And it's quite challenging to let that go and see what happens. But and this is where the whole sort of you knows, it's a whole other conversation, but the Wilding side of conservation, you know that's bringing up that's really showing that there are other ways to do it. But you need to be careful. Well, no. You need to be brave, and you need to be monitoring what happens and that's what I was going to move on to in terms of the how to manage that risk. Uh, which is one of your one of your questions somewhere buried in your questions. But is there do you want anything else? I mean, I could ramble on for hours, but have I kind of answered the first question, your question about risks.

So, in terms of managing, it in terms of managing those risks, you know this is where the. And so sorry, I'll just come back to what I what I said at the beginning about the difference of the national nature reserve. So, what the national nature reserve has done is its consolidated the partnership of six different organisations, which might be 7 not so long since I've counted them up. But it's consolidated those different organizations. And they've got a shared management plan which they all signed up to and they've gone a memorandum of understanding which is not a legal agreement, but it's a formal agreement where they've all signed up to working with the managed working together and working with the management plan. Uhm, and that sounds like a load of process. But what it's you know, it's quite a significant change to how we've done things in the past. And it means that there is a that each organization has formally taken a step to work together across that landscape and to work to some management principles for the whole National Nature Reserve and that's quite new. We haven't done that much elsewhere, and it certainly hasn't been formalized in the same way between all the partners before. And in terms of, So what we've got now is a management plan that states about this, about the management plan. One of the objectives of the management plan is to restore ecological processes. And all the organizations are signed up to that. Alongside that is a commitment in the management plan that everyone is signed up to monitoring those changes to resourcing the monitoring and to put in monitoring in place which will record what's happening and that is how we start to bring the risk management in.

So, if you're management monitoring, you know all use the easy examples which everybody uses. But if you know you've got Purbeck Mason wasp, particularly rare species, I'm sure David will mention the Purbeck Mason wasp. And at the moment they create habitat for the Purbeck Mason Wasp by going out and digging, digging little pits for it. Now what's happening is there deliberately putting up, you know, putting a bull in putting bulls in it with this huge grazing unit, putting more bulls in the grazing unit. The Bulls start to behave more wildly. And they create pits, and the pits create the bare ground that the Purbeck Mason will succumb living. So that's, you know, and in an ideal

world that's restoring how the Purbeck Mason wasp used to live before, where people had to go round digging little scrapes for it to live in as a simple example. But so we can be monitoring or they can be monitoring you know them on the management strategy, the management plan has a monitoring strategy, the monitoring strategy says we need to money to monitor these parameters and we also need to monitor these particular species. And that's how to safeguard the perfect Mason wasp. It had safeguard sand lizards had to make sure there's enough habitat for would locks and whatever. So that monitoring strategy where the national nature reserve helps is it's brought all the partners together and committed them to not only the extensive management, but also to monitoring it and reviewing it and being able to modify it if it starts to pose a threat to, for example sand lizards. And there's another important part is the scale of or because it's 3333 hectares or whatever 3331 hectares. It means that we can have these great big grazing units, but there can also be other parts of the site that aren't included in the grazing units, which are managed more traditionally. And where you know, they're almost like a little hot spot of carefully managed habitat for some of the rare species. You know, so they which you know, hopefully over time this will all work well, and they might be overtime. It might be possible to bring those sites into a more expensive management. But in the meantime, they're like a little safety net. For the biggest site.

Molly Bridger
Yeah. Thank you. I think that helped answer some of my questions in terms of dealing with risks, threats and how a site can be managed and bringing in monitoring. It's you just said. So, the management plan it, it's not, it's not a legal agreement, so. In terms of. Moving forward into the future well the I guess is there legal consequences to a stakeholder not partaking in, like in in the involvement they should be.

Dagmar Junghanns
Yeah. So that's a good question. So, There's two elements to this. And I'll use the word statutory rather than legal. Because legal is, so it all comes under a legal framework. But so, I'll and I'll separate out the underpinning protective legislation. And the NNR Declaration. So, if we deal with the NNR first, so the national nature reserve, it is legal, it has legal status as a land use, it has legal status and each of the partners in it. So Natural England has a sort of automatic right to manage national nature reserves because they're there for the nation. Other bodies, like they, RSPB or the Rempstone estate or the UM amphibian or Reptile Conservation Trust, they must become approved bodies so Natural England approves another organization to manage national nature reserves. And so, each of the other partners has been approved as an it's called an approved body and that's approved by our National Board to do that. So, there's a statutory process by which that happens. If over let's say in 10 years' time, the RSPB wanted to withdraw from the site They wouldn't lose their approved body status because they have it on other national nature reserves. But if we had it like a real fundamental disagreement and they wanted to withdraw from the site and there was, and we did, we collectively did everything we could to keep them involved. But we, you know, eventually the decision was that they weren't going to be part of the NNR. We'd have to go through another declaration process. To

re declare the National nature reserve without that piece of land in. Uhm, so uhm, that, you know there is a legal it's a legal process to become a national nature reserve. And there's a legal process to take land out of National nature reserve. So that's one legal thing. Now I can't see that would be a case. The reason I chose RSPB is because. I think that's so impossible. But you know, I thought it was a good illustration. So that's one part of the legal thing. The other part of the legal thing is that. As I said nearly well, a lot of the NNR is already covered as SSS SPA and SAC and Ramsar and there are protective mechanisms in place relating to those. So, we would also on land that is declared has those designations any one of those designations or all those designations? There are specific legal protections in place for the water called the designated features. And that that's the nationally and internationally important components of the site and. Those all carry on whether the site is National nature reserve, so if. See UM, I'll use RSPB again. because. It's such an obvious example. If the RSPB was carrying out activities on its land that damaged Dartford warblers. Come then, and I'm using that because it won't happen. But if they did that, then that's the national nature reserve legislation, wouldn't Control that, but all the other legislation would So they were kind of two safeguards.

Molly Bridger
OK. Thank you. I think for me it's trying to picture this large land area but still having these pockets of individual dictations and so on a map you could say only made there's the boundary. But of course, nature doesn't stick to boundaries per say so it it's kind of trying to understand how management in the form of a national nature reserve and what’s going on inside.

Dagmar Junghanns
And in the case of UM, so in the case of Purbeck, most of it is that. So, the grazing unit now is what is about half the site to the big grazing unit. So, it's not across the whole site. And I'm pretty sure most of it is already SSSI you know, it's already got those multiple designations. And you need to really talk to someone else who's specific if you want to understand. Had those designations worked locally, you'll need to talk to Ian Alexander or someone like that because you know they know a lot more about it than I do, but. The new approach that we're trying to do with national nature reserves by creating these big super areas is exactly that of nature. Encouraging nature to ignore the boundaries and encouraging nature, you know the most NNR's should be existing national nature reserve certainly should be high quality wildlife habitat with high you know have high biodiversity within them. And what we're trying to do by creating the, you know the nature, the NNR strategy and the new direction for an NRS is really to go beyond those boundaries and to you know, encourage nature, encourage and encourage nature to move out of, move beyond, expand beyond, spill out of. The existing rich sites. And you know, that's where the partnership approach and that commitment to managing a large area as a national nature reserve is. You know, hopefully really secures that ambition.

Molly Bridger
Thank you. My next question really, uhm, sort of the aim of nature recovery.

And how do you think that will play out in terms of? Climate change and species migration in response to that, and obviously there's recent biomonitoring but how do you manage or supports that habitat that may not actually be there because of climate change. You know, if you have any target species you want to protect, is it worth protecting if it's not going to survive?

Dagmar Junghanns
If it's if it's not going to be there. Yeah. And so, I mean heathland, so we have different techniques and I so within Natural England, we've got one way of doing it. Other organizations and other authority, the institution, some other ways of doing it. But we have a way of measuring. Uhm, climate change, vulnerability for different habitats and UM, so the without getting into a lot of detail because I'm no expert on this, but without getting into and so without getting into a huge amount of detail, what we do is we take the different habitats and the different features in a landscape and we say here are the climate change projections, what are the anticipated changes for those features for those habitats and what adaptations and mitigations do we need to do? To really allow changes to happen, but also to prevent unnecessary loss. Uhm and? Part of the ethos of the UM Landscape Scale management and creating this more dynamic, more, more ecologically robust UM habitat pattern is to create a much finer grained mosaic of habitats because one of you know one of the biggest risks in heathland is increased risk of fire because you know drier period longer dry periods, hotter periods, maybe the heathland vegetation is more productive because it's going to get more heat. So, you might get more dead matter standing around which is then more combustible. So, fires could be more serious. One of the biggest, UM, uh. Safeguards against that is to create a more dynamic landscape so their habitats are more broken up, so you haven't got large swathes of old Heather neck. You know you haven't got large swathes of old and large swathes of knew you've got a much finer grained mosaic and it's thought that that will increase resilience to well it'll increase resilience to fire by breaking up large swathes of habitat. But it's also more there's more connectivity so. Species, you know, we'll be able to. I did. You know, the aim is that species will be more dispersed across the site and more. There's more opportunity. There's a more habitat network for them rather than it's good for nightjars in one place and it's good for would locks in another. It will be both macro and micro dynamics enabling the site to be more resilient. So, the landscape scale management by restoring ecological processes is. Intended to better allow adaptation. To climate change. The second part of your the other part of your question on that in terms of which is a very intelligent question about, is it worth managing for something that isn't going to be there in 20 years' time? Like all, I don't know enough about the micro ecology of the Purbeck Heath to know whether there are any features? They're all going to move out for climate change. What I do know is that, you know, you've got a mixed, uh, really, you've already and the extensive management will increase. This got a fine grained mosaic between wet heath, Dry heath, fan habitats. You know, there's a whole range of different habitats already and most of them are because this is southern England, most of them are habitats. You know, it's almost the hottest, driest place in England in you know Kent and Sussex are probably. Culture and dry it. But you know it's really it's one of the best, one of

the hottest places. So, what's there already is already adapted to. Hot. Dry. Conditions, so I'm not aware of, but others may well be species or habitat features which would be threatened by climate change. But it's an intelligent question and when you start talking about wetland features and things or you start talking about areas that are next to the coast and will be affected by sea level rise. You know the answers become. The answers become very different and very, very difficult. You know. So, if you're talking about Norfolk, or then happily coastal Norfolk, or the Somerset levels or somewhere like that, where there's quite a real risk of. You know. Significant movement of the coast inland as sea level rises, you know then it's a really. Well, we wouldn't be able to answer in the next 15 minutes. And I'm sure I wouldn't. I want to venture it? Because then you get into your 4th bullet point about socioeconomic and ecological. Uhm responses which is. It's a good question for the situation now, but it's an important question for climate change impacts over the next, you know, few decades.

Molly Bridger
Yeah, I'm finding that it's lots of this research talking about sort of like macro micro scale up. How would it fair then if you have UM within the reserve, you know? Let's say all you've got species of national importance there. But due to. Climate change, for example, there are no longer found in that SSSI, but there's still found within the nature reserve itself. How does that? I guess fair with the aims under nature conservation site designation.

Dagmar Junghanns
OK, so for the national nature reserve objectives, that will be fine. You know, national Nature Reserve objectives is all about making the site more, making their landscape more is more ecologically resilient, recognizing that things move around. Uhm, for the UM, for the SSSI and the SAC and SPA overall, they are, larger, so would probably cover, you know, would probably cover those. Changes for the SSSI. again, it's a question. You've got four sites in that question. We Natural England is currently. Working on how to fulfil the purposes of the SSSI legislation to safeguard species, whilst recognizing that. If you start, if you look at two smaller unit. You start to come. It's such an artificial way of looking at ecology and things do move around and there's an example that, uh, if somebody hasn't said it to you already, they almost certainly will, which is that as forestry clearance and heathland restoration and heathland development has happened on different parts of the Purbeck Keys before the NNR was the Super and then I was there and they were finding that, you know nightjars and would locks particularly were moving. You know, they would move from the RSPB lands to the National Trust land and then the other one would come in and as their habitats changed with heathland restoration, those species move around. And what we're trying to work through now in Natural England is how you continue to safeguard species within SSSIs. But recognizing that natural change will. We need to allow species to move around. So, I can't give you a specific answer other than that something it's well recognized now and we're going through a sort of updating process in how we regulate SSSIs to further nature recovery, but also to recognize that even within the current network of

sites things do move around and need to move around and climate change is accelerating that.

Molly Bridger
No, thank you. I think this draws towards of the last few of my questions. I think sort of thinking about moving forward and the changes of wanting to see or adopt within the reserve or see within nature conservation designations, regulations or legislative? And so having a super national nature reserve, do you think then that's kind of have making designations like SSSIs or EU designations that we have possibly redundant on the scale of a super national nature reserve, if you're wanting it on a larger landscape scale.

Dagmar Junghanns
And well, this comes back to the beginning where I was hopefully explained about National Nature reserve being a more flexible designation It's a voluntary designation and it does what it doesn't do is impose restrictions on how people manage land. What it does do is. Create the primary land, use being conservation. So, there's a difference between what an NNR does, what the NNR designation does versus what the SSSI and the other designations do. And you know, I'm sure you're aware there's recently been a green paper. The government has put forward, which is really looking at the future of one of the things it's looking at, is the most appropriate. Legislation to safeguard what we've got, but also to allow for nature recovery and for change. And you know, so it's a very hot question now, you know, and again, you know, that's probably, I'm sure that's something you'll pick up on. I don't know whether I'm the right person to answer that question. I can answer in a personal capacity, but kind of I'm not in my personal capacity now so I think I think there's real value in the national nature reserve. Come legislation because it's a very it's flexible, it doesn't impose constraints. So, I think it can achieve more. For it to be valuable, though, it you know, the underpinning legislation is very clear that this needs to be the national nature. Reserves are nationally important. How you define national importance? I've just spent a year rewriting the criteria for national nature reserves and how you define nationally important in a way that doesn't tie you down too much is quite a challenge. Bu you know, so there is attention about creating, about making sure that the national nature, reserve legislation and the criteria are allowed for nature recovery, allow us to bring in land of low biodiversity but still create each site. You can explain why it's nationally important and that's you know, that's a UM that's really where we need to be that we need to the framework for national nature reserves needs to be open enough to allow for change and an ambition and alive for bringing new land into conservation. But not so open that any old patch of scruffy field could become a national nature reserve because somebody might rewild it. Uhm, you know? So, there's uh, so I think I think I just summed up, you know it needs to be for national nature reserves it needs to stay at a level of national importance. But it needs to be open enough that we can bring more land into that management for conservation. However, that manifests itself. So that's one thing in terms of the SSSI and say, see, I mean we're obviously and that more protective legislation, you know that needs to develop in a way that still safeguards, important

biodiversity, and we haven't talked about geodiversity that's just as important. But it's, you know, so that's another topic, but well, it's not another topic. It's intrinsic to what we're talking about. But we haven't talked about it, but don't forget Geodiversity. But you know, we need to make sure that any changes to SSSI legislation and the recognition of the European legislation. It still safeguards UM. Important part of against damage, but also does much more for you know, facilitating and creating nature recovery and allow it. You know having mechanisms. That don't restrict it. Mechanisms that allow species to move around in response to changes. I'm going to stop there unless you. I mean, I'm happy to answer specific questions, but I don't think I'll explain that any more clearly.

Molly Bridger
Thank you. Yeah, I think that's super answers. You know and thinking about sort of future change and what I guess you hope for the public to be used and if you know it's encouraging, the formation of other super nature reserves. I think the work itself and stakeholders involved is truly ground breaking, I think. Of nature conservation perspective and the idea of not just seeing it as sort of tiny pockets here and there and then coming together, I think it. It is, I think time for positive change, especially solving. The grand scheme of things or what the environment is facing daily and stresses uhm, I think it's really sort of encouraging to hear and see, and be part of.

Dagmar Junghanns
So that they're just two other things I can think of to add, and one is a word I haven't used about national nature reserves is exemplary. And the idea? You know, we talked about it in a way with Purbeck, but the idea is that. All the new forthcoming national nature reserves are really, you know, they should be good examples of how we can push that more open, expansive nature recovery lead conservation forward. So that exemplary is an important word which I forgot. And then the other thing is which is just a wider context. So, I talked about, you know, using Purbeck as an example to inspire other sites. So, one of the things I'm working on is we've got a long list of about with about another 50 major proposals on it that could happen all around the country. And you know, I've just come off a call where we've been talking about two new national nature reserves, which are big partnership sites, and you know they're going through the approvals process now. There's another one. You know, the next one, which has already been approved and will happen be declared later in the spring, is in Somerset across the Somerset Wetlands. So, we've got kind of, you know, 10s more already in the wings and. As more get declared, I think we'll collectively across the conservation sector and beyond the conservation sector, start identifying other sites which could be national nature reserve. So hopefully you know by the end of by 2030, you know there will be a real network of Purbeck type sites around the country. So, and if you have any more questions about that in your, you know if you want to find out a bit more about that you know you do come back to me.

Molly Bridger
Well thank you for your time today. It's been interesting and very beneficial. Thank you. I think just end the recording here.

Appendix VII – Bayesian Belief Network (BBN) Spreadsheets for Special Protection Area (SPA)

Table 2.0: Levels for the SPA BBN

Node name	Ecosystem service	Biodiversity	Habitat Loss	Climate Change	Natural Succession	Native Species	Invasive Species	Habitat Resto	Controlled Burnin	Buffer Zone	Reintrodu	Temporal	Spatial Zo	Public Aw	Cattl
Prior of increasing/high	0.5	0.5	0.5	0.65	0.5	0.5	0.5	0.8	0.6	0.7	0.8	0.35	0.3	0.5	
Prior of decreasing/low	0.5	0.5	0.5	0.35	0.5	0.5	0.5	0.2	0.4	0.3	0.2	0.65	0.7	0.5	
Posterior increase	0.58	0.57	0.41	0.65	0.36	0.52	0.52	0.84	0.60	0.67	0.80	0.39	0.33	0.57	
Posterior decrease	0.42	0.43	0.59	0.35	0.64	0.48	0.48	0.16	0.40	0.33	0.20	0.61	0.67	0.43	

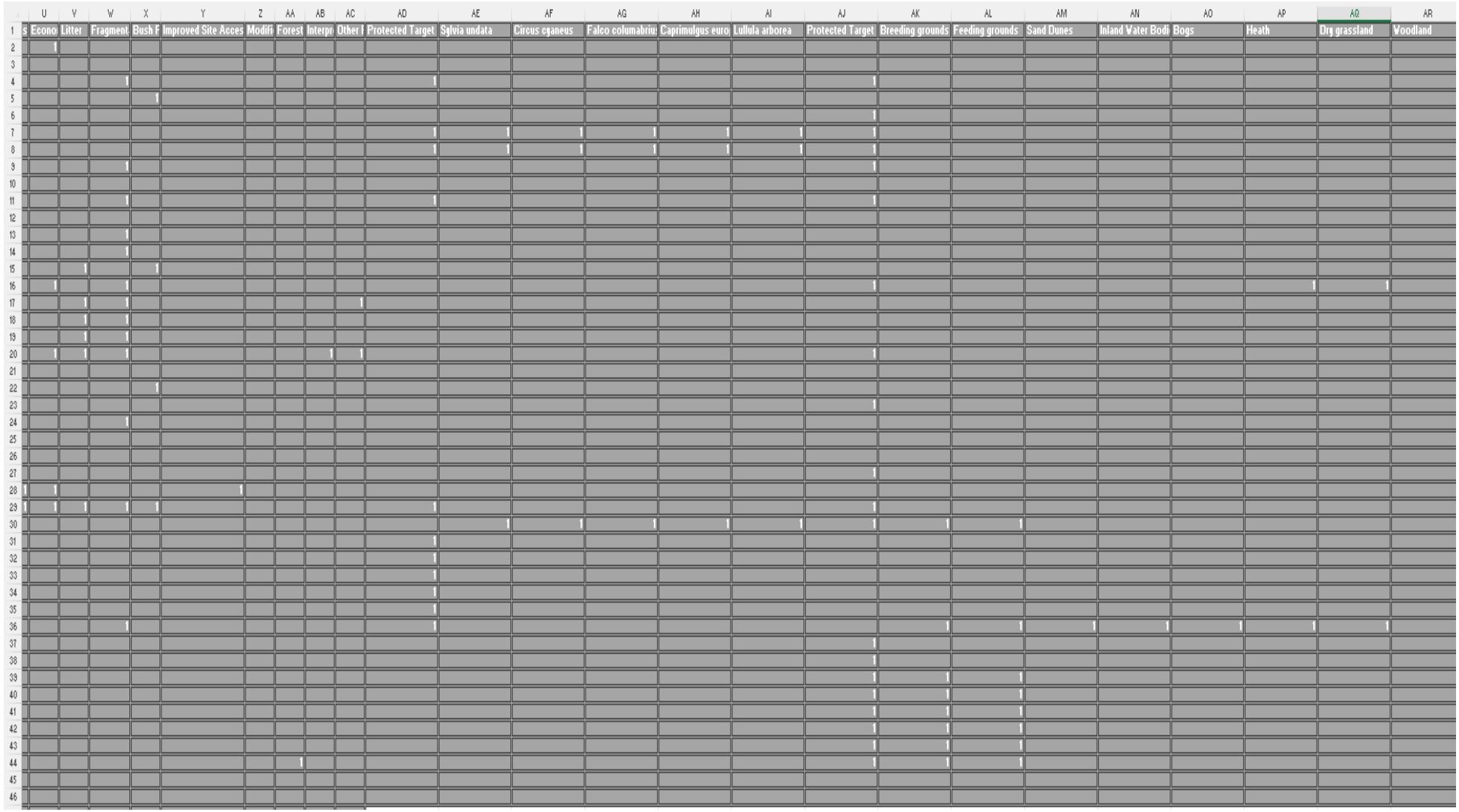
Calculate

Cattle Gra	Walking	Cycling	Dog Walki	Ecotourisı	Economy	Litter	Fragment	Bush Fire	Improved	Modificat	Forest an	Interpreti	Other Re	Protectec	*Sylvia un*	*Circus cyc*	*Falco colu*	*Caprimul*	*Lullula ar*	Protectec	Breeding	Feeding g	Sand Dun	Inland Wa	Bogs
0.8	0.65	0.65	0.65	0.7	0.5	0.5	0.2	0.5	0.65	0.6	0.65	0.65	0.65	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	
0.2	0.35	0.35	0.35	0.3	0.5	0.5	0.8	0.5	0.35	0.4	0.35	0.35	0.35	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	
0.78	0.68	0.67	0.67	0.75	0.60	0.55	0.20	0.59	0.71	0.60	0.64	0.74	0.71	0.55	0.51	0.51	0.51	0.51	0.51	0.58	0.53	0.53	0.53	0.53	
0.22	0.32	0.33	0.33	0.25	0.40	0.45	0.80	0.41	0.29	0.40	0.36	0.26	0.29	0.45	0.49	0.49	0.49	0.49	0.49	0.42	0.47	0.47	0.47	0.47	

alk	Ecotourisı	Economy	Litter	Fragment	Bush Fire	Improved	Modificat	Forest an	Interpreti	Other Re	Protectec	*Sylvia un*	*Circus cyc*	*Falco colu*	*Caprimul*	*Lullula ar*	Protectec	Breeding	Feeding g	Sand Dun	Inland Wa	Bogs	Heath	Dry grass	Woodland
65	0.7	0.5	0.5	0.2	0.5	0.65	0.6	0.65	0.65	0.65	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
35	0.3	0.5	0.5	0.8	0.5	0.35	0.4	0.35	0.35	0.35	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
67	0.75	0.60	0.55	0.20	0.59	0.71	0.60	0.64	0.74	0.71	0.55	0.51	0.51	0.51	0.51	0.51	0.58	0.53	0.53	0.53	0.53	0.53	0.58	0.65	0.47
33	0.25	0.40	0.45	0.80	0.41	0.29	0.40	0.36	0.26	0.29	0.45	0.49	0.49	0.49	0.49	0.49	0.42	0.47	0.47	0.47	0.47	0.47	0.42	0.35	0.53

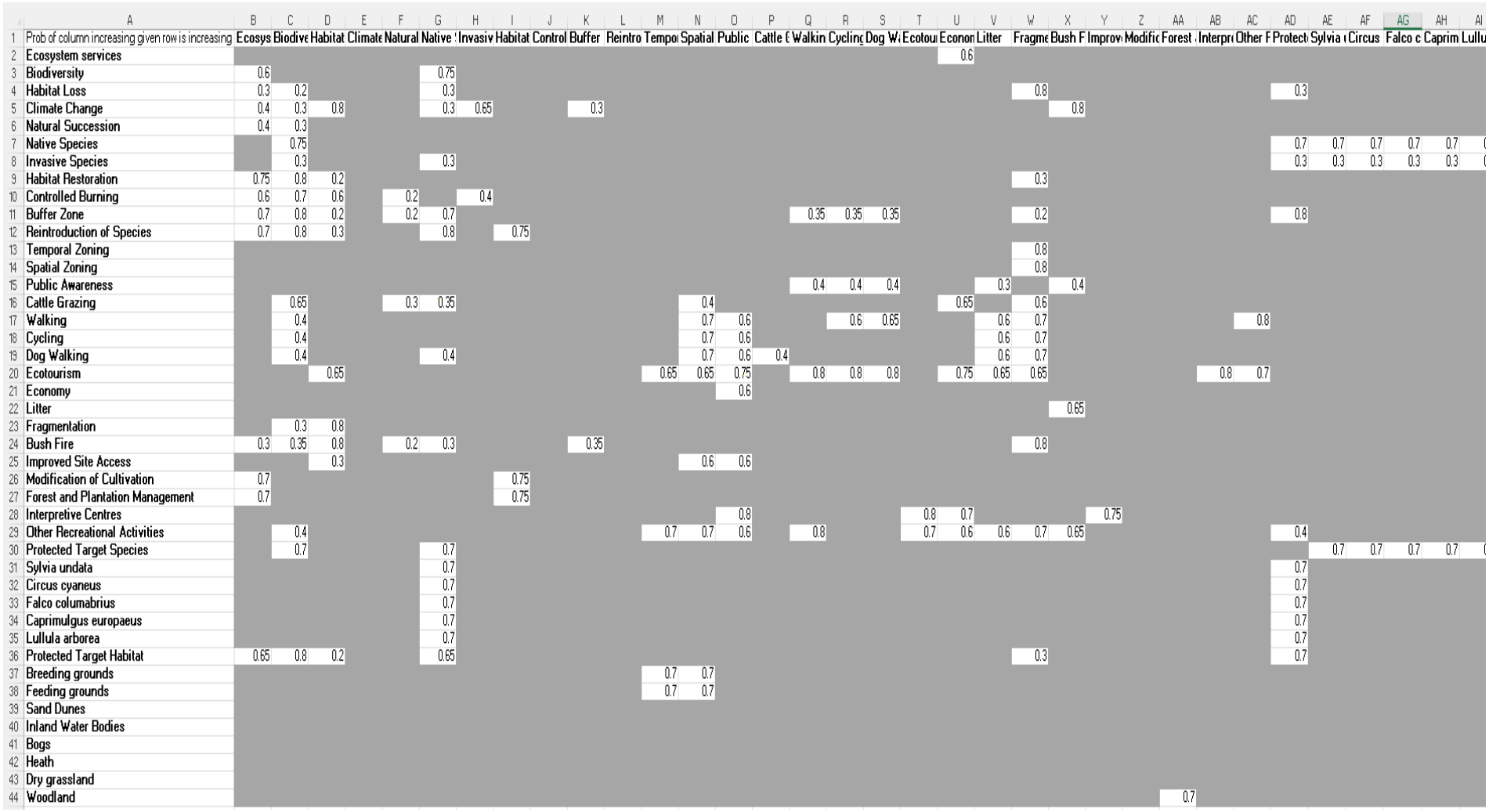
Table 2.1: Interaction grid for the SPA BBN

Row effects column	Ecosystem service	Biodiversity	Habitat Lo	Climate Chan	Natural Successi	Native Spec	Invasive Spec	Habitat Restora	Controlled Burning	Buffer Zo	Reintroduction of Spe	Temporal Zon	Spatial Zon	Public Aware	Cattle Graz	Walkin	Cyclin	Dog Walki	Ecotouris	Econo	Litter	Fragment	Bush F	Improved Site Acces	Modifi	Forest	Interpr
Ecosystem services																				1							
Biodiversity	1					1																					
Habitat Loss	1	1				1																1					
Climate Change	1	1	1			1	1			1													1				
Natural Succession	1	1																									
Native Species		1																									
Invasive Species		1				1																					
Habitat Restoration	1	1	1																			1					
Controlled Burning	1	1	1		1		1																				
Buffer Zone	1	1	1		1	1										1	1	1				1					
Reintroduction of Species	1	1	1			1		1														1					
Temporal Zoning																						1					
Spatial Zoning																						1					
Public Awareness																1	1	1			1		1				
Cattle Grazing		1			1	1							1							1		1					
Walking		1											1	1			1	1			1	1					
Cycling		1											1	1							1	1					
Dog Walking		1				1							1	1	1						1	1					
Ecotourism			1									1	1	1		1	1	1		1	1	1					1
Economy														1													
Litter																							1				
Fragmentation		1	1																			1					
Bush Fire	1	1	1		1	1				1												1					
Improved Site Access			1										1	1													
Modification of Culti	1							1																			
Forest and Plantation Ma	1							1																			
Interpretive Centres														1					1	1					1		
Other Recreational Activities		1										1	1	1		1			1	1	1	1	1				
Protected Target Species		1				1																					
Sylvia undata						1																					
Circus cyaneus						1																					
Falco columabrius						1																					
Caprimulgus europaeus						1																					
Lullula arborea						1																					
Protected Target Habitat	1	1	1			1																1					
Breeding grounds												1	1														
Feeding grounds												1	1														
Sand Dunes																											
Inland Water Bodies																											
Bogs																											
Heath																											
Dry grassland																											
Woodland																									1		

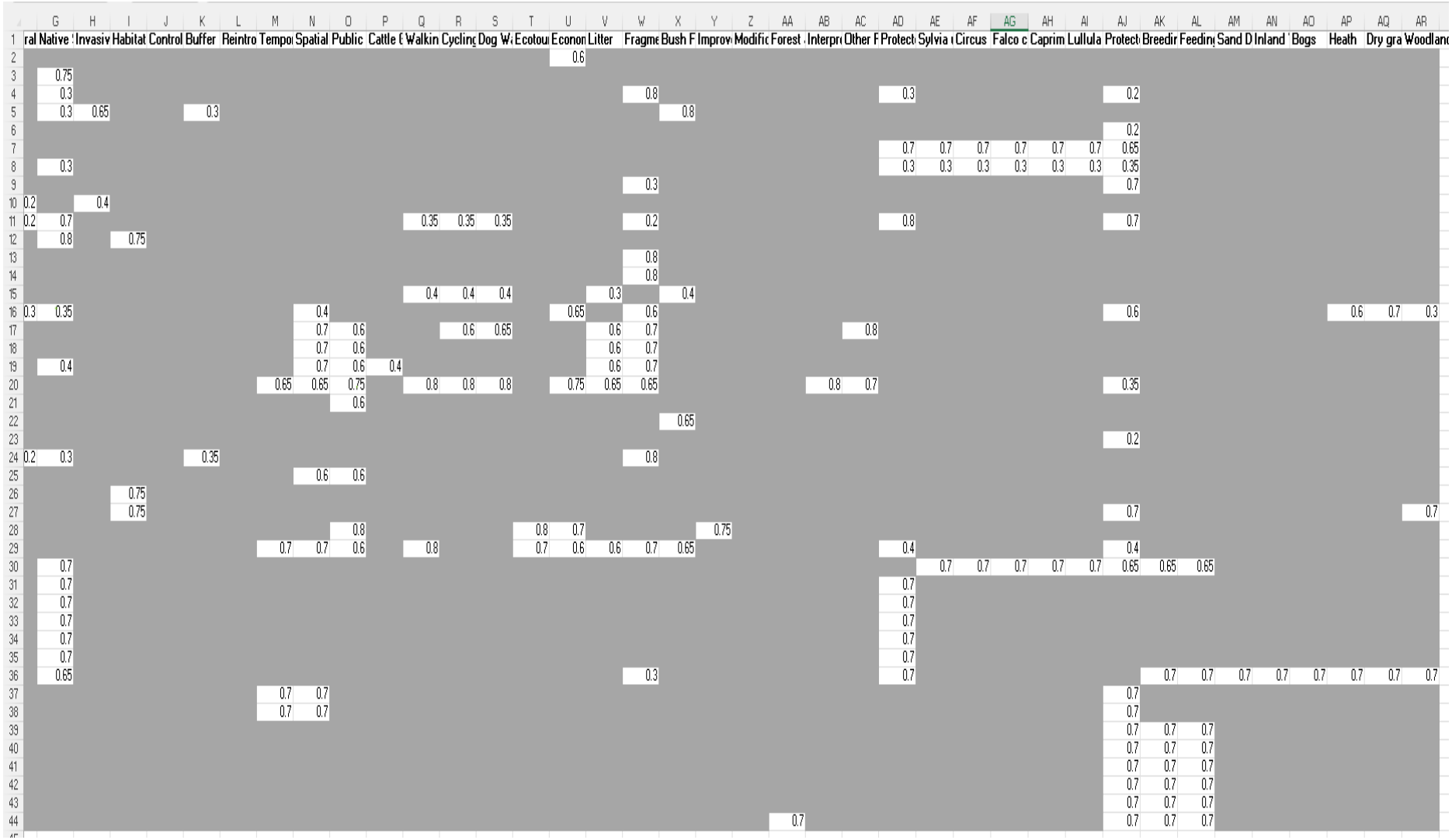


	U	V	W	X	Y	Z	AA	AB	AC	AD	AE	AF	AG	AH	AI	AJ	AK	AL	AM	AN	AO	AP	AQ	AR
1	s	Econo	Litter	Fragment	Bush F	Improved Site Acces	Modifi	Forest	Interpr	Other I	Protected Target	Sylvia undata	Circus cyaneus	Falco columbariu	Caprimulgus euro	Lullula arborea	Protected Target	Breeding grounds	Feeding grounds	Sand Dunes	Inland Water Bodi	Bogs	Heath	Drg grassland	Woodland
2		1																							
3																									
4				1							1						1								
5					1																				
6																	1								
7											1	1	1	1	1	1	1								
8											1	1	1	1	1	1	1								
9				1													1								
10																									
11				1							1						1								
12																									
13				1																					
14				1																					
15			1		1																				
16		1		1													1						1	1	
17			1	1						1															
18			1	1																					
19			1	1																					
20		1	1	1					1	1							1								
21																									
22					1																				
23																	1								
24				1																					
25																									
26																									
27																	1								
28	1	1				1																			
29	1	1	1	1	1						1						1								
30											1	1	1	1	1	1	1	1	1						
31											1														
32											1														
33											1														
34											1														
35											1														
36				1							1							1	1	1	1	1	1	1	
37																	1								
38																	1								
39																	1	1	1						
40																	1	1	1						
41																	1	1	1						
42																	1	1	1						
43																	1	1	1						
44							1										1	1	1						
45																									
46																									

Table 2.2: Interaction probability grid for SPA BBN



Prob of column increasing given row is increasing	Ecosys	Biodive	Habitat	Climate	Natural	Native	Invasiv	Habitat	Control	Buffer	Reintro	Tempo	Spatial	Public	Cattle G	Walkin	Cycling	Dog W	Ecotour	Econon	Litter	Fragme	Bush F	Improv	Modific	Forest	Interpr	Other F	Protect	Sylvia	Circus	Falco c	Caprim	Lullu
Ecosystem services																				0.6														
Biodiversity	0.6					0.75																												
Habitat Loss	0.3	0.2				0.3																0.8							0.3					
Climate Change	0.4	0.3	0.8			0.3	0.65			0.3													0.8											
Natural Succession	0.4	0.3																																
Native Species		0.75																											0.7	0.7	0.7	0.7	0.7	
Invasive Species		0.3				0.3																							0.3	0.3	0.3	0.3	0.3	
Habitat Restoration	0.75	0.8	0.2																			0.3												
Controlled Burning	0.6	0.7	0.6		0.2		0.4																											
Buffer Zone	0.7	0.8	0.2		0.2	0.7										0.35	0.35	0.35				0.2							0.8					
Reintroduction of Species	0.7	0.8	0.3			0.8		0.75																										
Temporal Zoning																						0.8												
Spatial Zoning																						0.8												
Public Awareness																0.4	0.4	0.4			0.3		0.4											
Cattle Grazing		0.65			0.3	0.35							0.4							0.65		0.6												
Walking		0.4											0.7	0.6			0.6	0.65			0.6	0.7						0.8						
Cycling		0.4											0.7	0.6							0.6	0.7												
Dog Walking		0.4				0.4							0.7	0.6	0.4						0.6	0.7												
Ecotourism			0.65									0.65	0.65	0.75		0.8	0.8	0.8		0.75	0.65	0.65					0.8	0.7						
Economy														0.6																				
Litter																							0.65											
Fragmentation		0.3	0.8																															
Bush Fire	0.3	0.35	0.8		0.2	0.3				0.35												0.8												
Improved Site Access			0.3										0.6	0.6																				
Modification of Cultivation	0.7							0.75																										
Forest and Plantation Management	0.7							0.75																										
Interpretive Centres														0.8					0.8	0.7				0.75										
Other Recreational Activities		0.4										0.7	0.7	0.6		0.8			0.7	0.6	0.6	0.7	0.65						0.4					
Protected Target Species		0.7				0.7																								0.7	0.7	0.7	0.7	
Sylvia undata						0.7																							0.7					
Circus cyaneus						0.7																							0.7					
Falco columabrius						0.7																							0.7					
Caprimulgus europaeus						0.7																							0.7					
Lullula arborea						0.7																							0.7					
Protected Target Habitat	0.65	0.8	0.2			0.65																0.3							0.7					
Breeding grounds												0.7	0.7																					
Feeding grounds												0.7	0.7																					
Sand Dunes																																		
Inland Water Bodies																																		
Bogs																																		
Heath																																		
Dry grassland																																		
Woodland																										0.7								



	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA	AB	AC	AD	AE	AF	AG	AH	AI	AJ	AK	AL	AM	AN	AO	AP	AQ	AR
1	ral	Native	Invasiv	Habitat	Control	Buffer	Reintro	Tempo	Spatial	Public	Cattle	Walkin	Cycling	Dog W	Ecotou	Econon	Litter	Fragme	Bush F	Improv	Modific	Forest	Interpr	Other F	Protect	Sylvia	Circus	Falco c	Caprim	Lullula	Protect	Breedir	Feedin	Sand D	Inland	Bogs	Heath	Dry gra	Woodlan
2															0.6																							
3		0.75																																				
4		0.3															0.8							0.3						0.2								
5		0.3	0.65			0.3												0.8																				
6																														0.2								
7																								0.7	0.7	0.7	0.7	0.7	0.7	0.65								
8		0.3																						0.3	0.3	0.3	0.3	0.3	0.3	0.35								
9																	0.3													0.7								
10	0.2		0.4																																			
11	0.2	0.7									0.35	0.35	0.35				0.2							0.8						0.7								
12		0.8		0.75																																		
13																	0.8																					
14																	0.8																					
15											0.4	0.4	0.4			0.3		0.4																				
16	0.3	0.35						0.4							0.65		0.6													0.6						0.6	0.7	0.3
17								0.7	0.6			0.6	0.65			0.6	0.7						0.8															
18								0.7	0.6							0.6	0.7																					
19		0.4						0.7	0.6	0.4						0.6	0.7																					
20							0.65	0.65	0.75		0.8	0.8	0.8		0.75	0.65	0.65					0.8	0.7							0.35								
21									0.6																													
22																		0.65																				
23																														0.2								
24	0.2	0.3			0.35												0.8																				
25								0.6	0.6																													
26			0.75																																		
27			0.75																											0.7							0.7
28									0.8					0.8	0.7				0.75																		
29							0.7	0.7	0.6		0.8			0.7	0.6	0.6	0.7	0.65						0.4						0.4								
30		0.7																							0.7	0.7	0.7	0.7	0.7	0.65	0.65	0.65					
31		0.7																						0.7														
32		0.7																						0.7														
33		0.7																						0.7														
34		0.7																						0.7														
35		0.7																						0.7														
36		0.65															0.3							0.7							0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7
37							0.7	0.7																						0.7								
38							0.7	0.7																						0.7								
39																														0.7	0.7	0.7						
40																														0.7	0.7	0.7						
41																														0.7	0.7	0.7						
42																														0.7	0.7	0.7						
43																														0.7	0.7	0.7						
44																					0.7									0.7	0.7	0.7						

Appendix VIII – Bayesian Belief Network (BBN) Spreadsheets for Special Area of Conservation (SAC)

Table 3.0: Levels for the SAC BBN

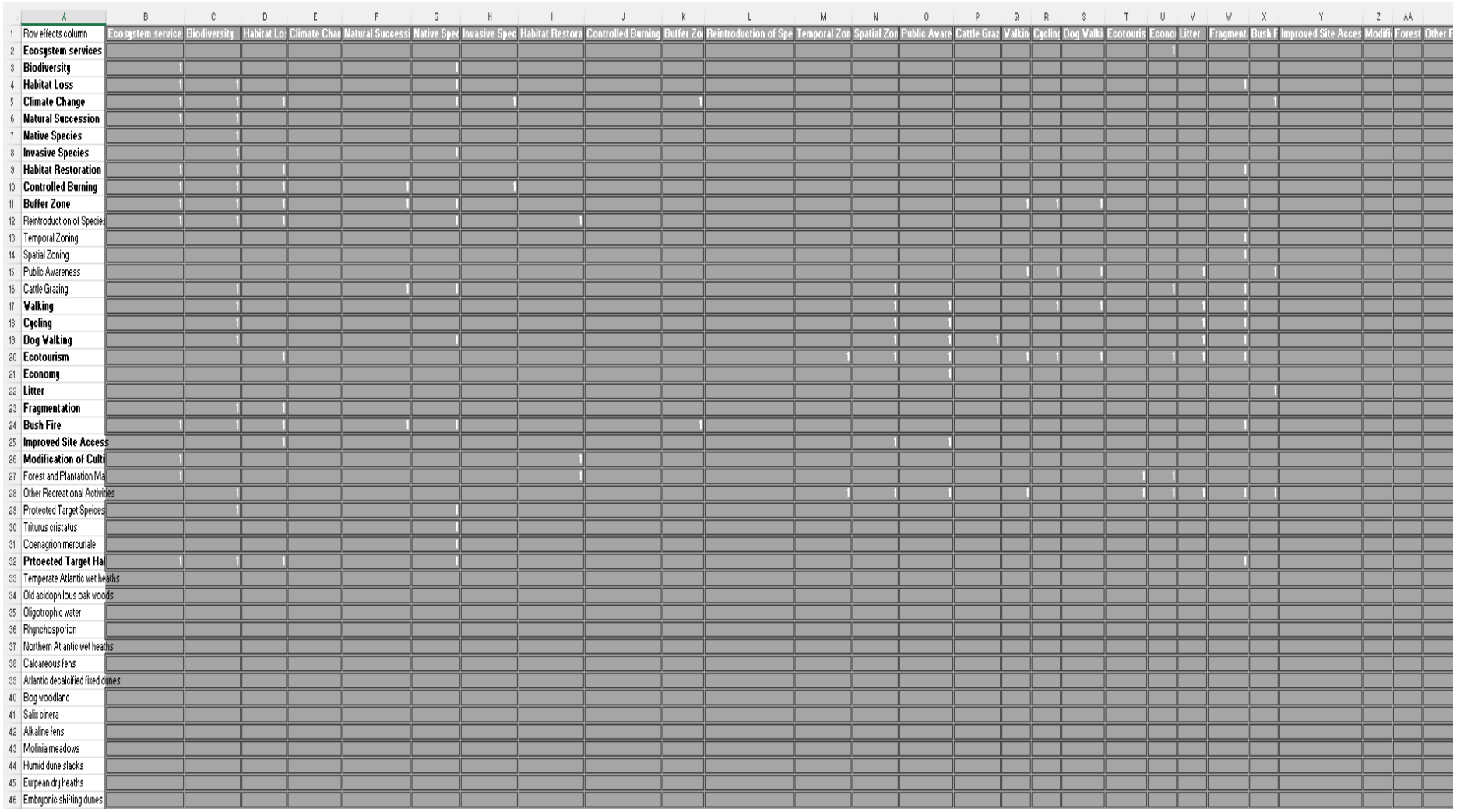
Node name	Ecosystem service	Biodiversity	Habitat Loss	Climate Change	Natural Succession	Native Species	Invasive Species	Habitat Resto	Controlled Burnin	Buffer Zone	Reintrodu	Temporal	Spatial Zo	Public Aw	Cattl
Prior of increasing/high	0.5	0.5	0.5	0.65	0.5	0.5	0.5	0.8	0.6	0.7	0.8	0.35	0.3	0.5	
Prior of decreasing/low	0.5	0.5	0.5	0.35	0.5	0.5	0.5	0.2	0.4	0.3	0.2	0.65	0.7	0.5	
Posterior increase	0.58	0.57	0.42	0.65	0.36	0.52	0.52	0.84	0.60	0.67	0.80	0.40	0.33	0.56	
Posterior decrease	0.42	0.43	0.58	0.35	0.64	0.48	0.48	0.16	0.40	0.33	0.20	0.60	0.67	0.44	

Calculate

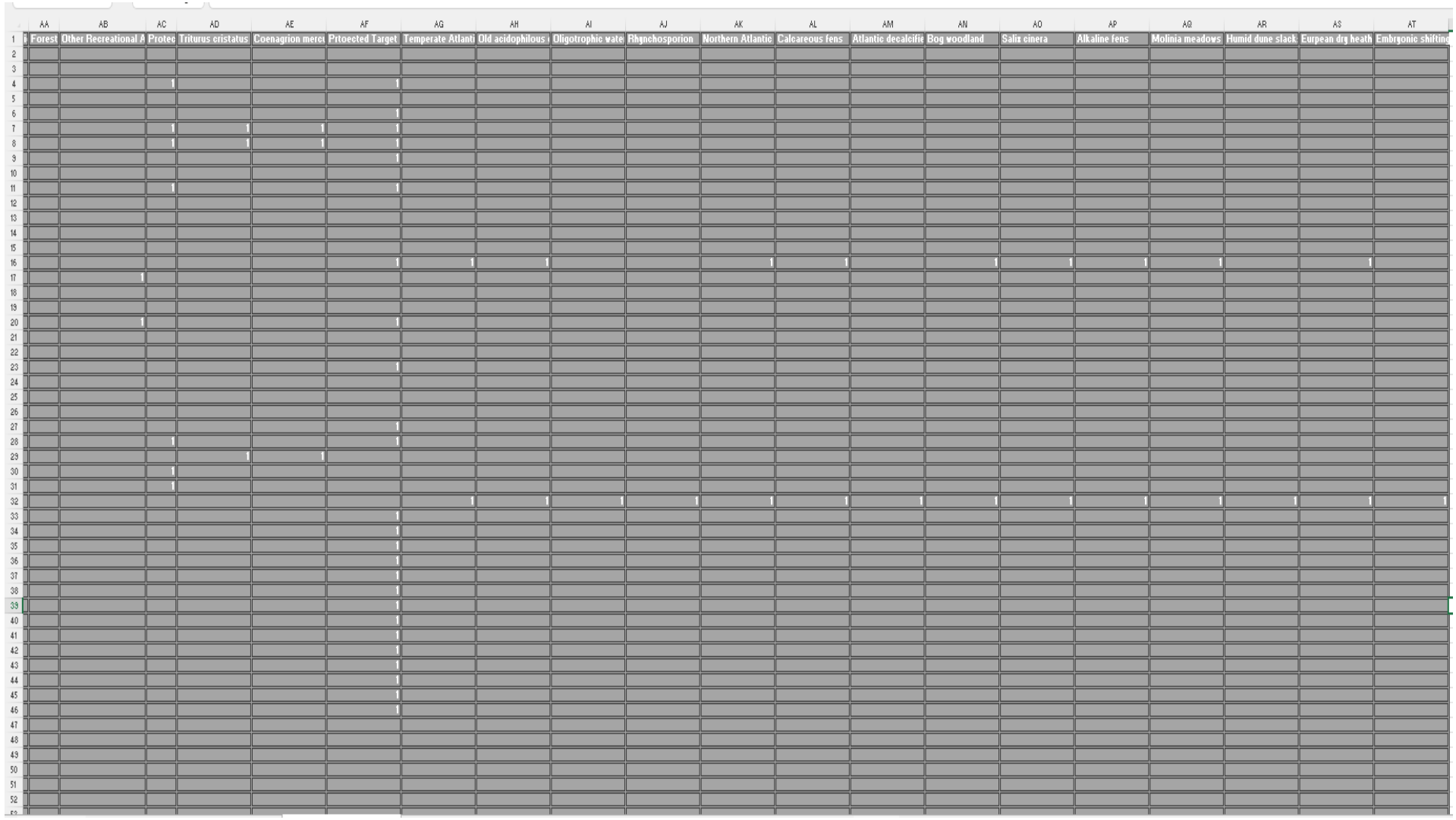
v	Cattle Gra	Walking	Cycling	Dog Walki	Ecotourisı	Economy	Litter	Fragment	Bush Fire	Improved	Modificat	Forest an	Other Re	Protected	*Triturus c*	*Coenagri*	Prtoected	Temperat	Old acido	Oligotrop	Rhynchos	Northern	Calcareou	Atlantic d	Bog wooc	Sal
5	0.8	0.65	0.65	0.65	0.7	0.5	0.5	0.2	0.5	0.65	0.6	0.65	0.65	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	
5	0.2	0.35	0.35	0.35	0.3	0.5	0.5	0.8	0.5	0.35	0.4	0.35	0.35	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	
5	0.78	0.68	0.67	0.67	0.75	0.60	0.55	0.20	0.59	0.65	0.60	0.65	0.71	0.55	0.51	0.51	0.56	0.58	0.36	0.53	0.53	0.58	0.47	0.53	0.54	
4	0.22	0.32	0.33	0.33	0.25	0.40	0.45	0.80	0.41	0.35	0.40	0.35	0.29	0.45	0.49	0.49	0.44	0.42	0.64	0.47	0.47	0.42	0.53	0.47	0.46	

	Fragment	Bush Fire	Improved	Modificat	Forest an	Other Re	Protected	*Triturus c*	*Coenagri*	Prtoected	Temperat	Old acido	Oligotrop	Rhynchos	Northern	Calcareou	Atlantic d	Bog wooc	Salix cine	Alkaline fen	*Molinia*	Humid du	Eurpean c	Embryoni
	0.5	0.2	0.5	0.65	0.6	0.65	0.65	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
	0.5	0.8	0.5	0.35	0.4	0.35	0.35	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
	0.55	0.20	0.59	0.65	0.60	0.65	0.71	0.55	0.51	0.51	0.56	0.58	0.36	0.53	0.53	0.58	0.47	0.53	0.54	0.54	0.47	0.54	0.53	0.58	0.53
	0.45	0.80	0.41	0.35	0.40	0.35	0.29	0.45	0.49	0.49	0.44	0.42	0.64	0.47	0.47	0.42	0.53	0.47	0.46	0.46	0.53	0.46	0.47	0.42	0.47

Table 3.1: Interaction grid for the SAC BBN

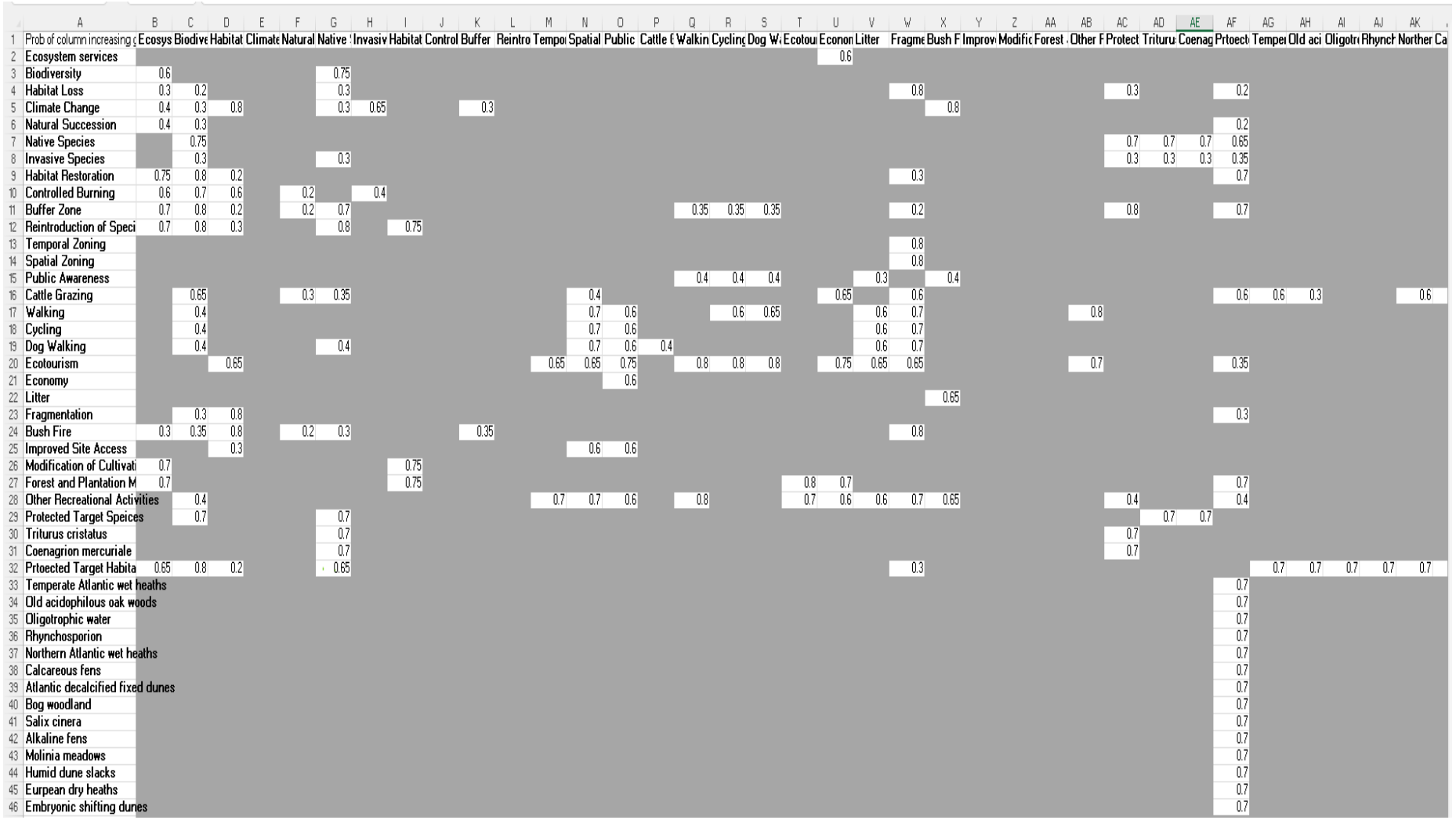


	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA
1	Row effects column	Ecosystem service	Biodiversity	Habitat Lo	Climate Char	Natural Successi	Native Spec	Invasive Spec	Habitat Restora	Controlled Burning	Buffer Zo	Reintroduction of Spe	Temporal Zon	Spatial Zon	Public Aware	Cattle Graz	Walkin	Cyclin	Dog Walki	Ecotouris	Econo	Litter	Fragment	Bush F	Improved Site Acces	Modifi	Forest	Other F
2	**Ecosystem services**																				1							
3	**Biodiversity**	1					1																					
4	**Habitat Loss**	1	1				1																1					
5	**Climate Change**	1	1	1			1	1			1													1				
6	**Natural Succession**	1	1																									
7	**Native Species**		1																									
8	**Invasive Species**		1				1																					
9	**Habitat Restoration**	1	1	1																			1					
10	**Controlled Burning**	1	1	1			1		1																			
11	**Buffer Zone**	1	1	1			1	1									1	1	1				1					
12	Reintroduction of Species	1	1	1			1		1																			
13	Temporal Zoning																						1					
14	Spatial Zoning																						1					
15	Public Awareness																1	1	1			1		1				
16	Cattle Grazing		1			1	1							1							1		1					
17	**Walking**		1											1	1			1	1			1	1					
18	**Cycling**		1											1	1							1	1					
19	**Dog Walking**		1				1							1	1	1						1	1					
20	**Ecotourism**			1									1	1	1		1	1	1		1	1	1					
21	**Economy**														1													
22	**Litter**																							1				
23	**Fragmentation**		1	1																								
24	**Bush Fire**	1	1	1			1	1			1												1					
25	**Improved Site Access**			1										1	1													
26	**Modification of Culti**	1							1																			
27	Forest and Plantation Ma	1							1												1	1						
28	Other Recreational Activities		1										1	1	1		1				1	1	1	1	1			
29	Protected Target Speices		1				1																					
30	Triturus cristatus						1																					
31	Coenagrion mercuriale						1																					
32	**Prtoected Target Ha**	1	1	1			1																1					
33	Temperate Atlantic wet heaths																											
34	Old acidophilous oak woods																											
35	Oligotrophic water																											
36	Rhynchosporion																											
37	Northern Atlantic wet heaths																											
38	Calcareous fens																											
39	Atlantic decalcified fixed dunes																											
40	Bog woodland																											
41	Salix cinera																											
42	Alkaline fens																											
43	Molinia meadows																											
44	Humid dune slacks																											
45	Eurpean dry heaths																											
46	Embryonic shifting dunes																											

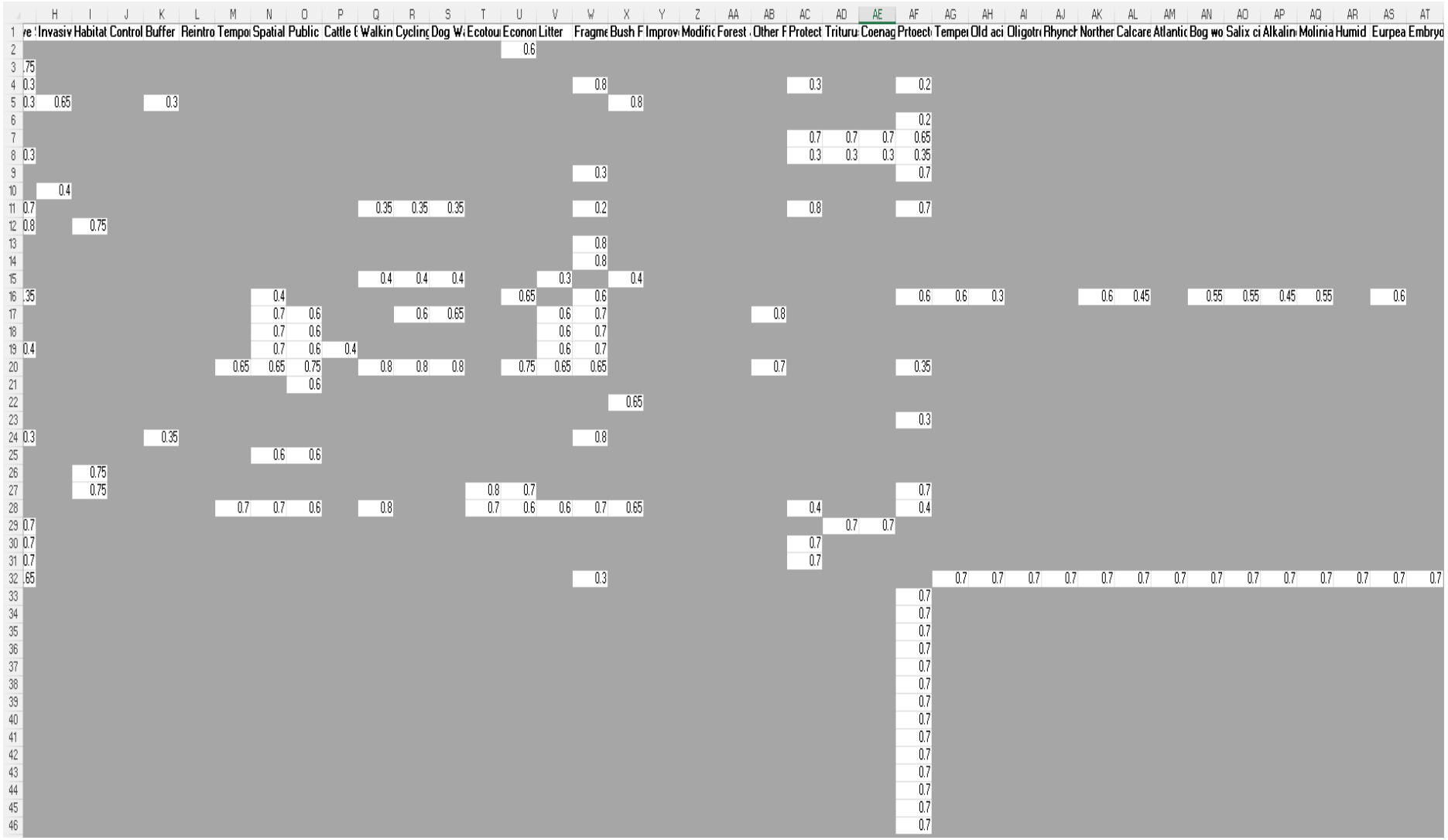


	AA	AB	AC	AD	AE	AF	AG	AH	AI	AJ	AK	AL	AM	AN	AO	AP	AQ	AR	AS	AT
1	Forest	Other Recreational A	Protec	Triturus cristatus	Coenagrion merci	Prtoected Target	Temperate Atlanti	Old acidophilous	Oligotrophic wate	Rhynchosporion	Northern Atlantic	Calcareous fens	Atlantic decalcifie	Bog woodland	Saliz cinera	Alkaline fens	Molinia meadows	Humid dune slack	Eurpean dry heath	Embryonic shiftin
2																				
3																				
4			1			1														
5																				
6						1														
7			1	1	1	1														
8			1	1	1	1														
9						1														
10																				
11			1			1														
12																				
13																				
14																				
15																				
16						1	1	1			1	1		1	1	1	1		1	
17		1																		
18																				
19																				
20		1				1														
21																				
22																				
23						1														
24																				
25																				
26																				
27						1														
28			1			1														
29				1	1															
30			1																	
31			1																	
32							1	1	1	1	1	1	1	1	1	1	1	1	1	1
33						1														
34						1														
35						1														
36						1														
37						1														
38						1														
39						1														
40						1														
41						1														
42						1														
43						1														
44						1														
45						1														
46						1														
47																				
48																				
49																				
50																				
51																				
52																				

Table 3.2: Interaction probability grid for SAC BBN



	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA	AB	AC	AD	AE	AF	AG	AH	AI	AJ	AK
1	Prob of column increasing c	Ecosys	Biodive	Habitat	Climate	Natural	Native	Invasiv	Habitat	Control	Buffer	Reintro	Tempo	Spatial	Public	Cattle (	Walkin	Cycling	Dog W	Ecotou	Econon	Litter	Fragme	Bush F	Improv	Modific	Forest	Other F	Protect	Triturus	Coenag	Prtoecti	Tempe	Old aci	Oligotr	Rhynch	Norther	Ca
2	Ecosystem services																				0.6																
3	Biodiversity	0.6					0.75																														
4	Habitat Loss	0.3	0.2				0.3																0.8						0.3			0.2					
5	Climate Change	0.4	0.3	0.8			0.3	0.65			0.3													0.8														
6	Natural Succession	0.4	0.3																													0.2					
7	Native Species		0.75																										0.7	0.7	0.7	0.65					
8	Invasive Species		0.3				0.3																						0.3	0.3	0.3	0.35					
9	Habitat Restoration	0.75	0.8	0.2																			0.3									0.7					
10	Controlled Burning	0.6	0.7	0.6		0.2		0.4																													
11	Buffer Zone	0.7	0.8	0.2		0.2	0.7										0.35	0.35	0.35				0.2						0.8			0.7					
12	Reintroduction of Speci	0.7	0.8	0.3			0.8		0.75																												
13	Temporal Zoning																						0.8														
14	Spatial Zoning																						0.8														
15	Public Awareness																0.4	0.4	0.4			0.3		0.4													
16	Cattle Grazing		0.65			0.3	0.35							0.4							0.65		0.6									0.6	0.6	0.3			0.6
17	Walking		0.4											0.7	0.6			0.6	0.65			0.6	0.7				0.8										
18	Cycling		0.4											0.7	0.6							0.6	0.7														
19	Dog Walking		0.4				0.4							0.7	0.6	0.4						0.6	0.7														
20	Ecotourism			0.65								0.65	0.65	0.75			0.8	0.8	0.8		0.75	0.65	0.65				0.7				0.35					
21	Economy														0.6																						
22	Litter																							0.65													
23	Fragmentation		0.3	0.8																												0.3					
24	Bush Fire	0.3	0.35	0.8		0.2	0.3				0.35												0.8														
25	Improved Site Access			0.3										0.6	0.6																						
26	Modification of Cultivati	0.7							0.75																												
27	Forest and Plantation M	0.7							0.75											0.8	0.7											0.7					
28	Other Recreational Activities		0.4										0.7	0.7	0.6		0.8			0.7	0.6	0.6	0.7	0.65					0.4			0.4					
29	Protected Target Speices		0.7				0.7																							0.7	0.7						
30	Triturus cristatus						0.7																						0.7								
31	Coenagrion mercuriale						0.7																						0.7								
32	Prtoected Target Habita	0.65	0.8	0.2			0.65																0.3										0.7	0.7	0.7	0.7	0.7
33	Temperate Atlantic wet heaths																															0.7					
34	Old acidophilous oak woods																															0.7					
35	Oligotrophic water																															0.7					
36	Rhynchosporion																															0.7					
37	Northern Atlantic wet heaths																															0.7					
38	Calcareous fens																															0.7					
39	Atlantic decalcified fixed dunes																															0.7					
40	Bog woodland																															0.7					
41	Salix cinera																															0.7					
42	Alkaline fens																															0.7					
43	Molinia meadows																															0.7					
44	Humid dune slacks																															0.7					
45	Eurpean dry heaths																															0.7					
46	Embryonic shifting dunes																															0.7					



Appendix IX– Bayesian Belief Network (BBN) Spreadsheets for Site of Special Scientific Interest (SSSI)

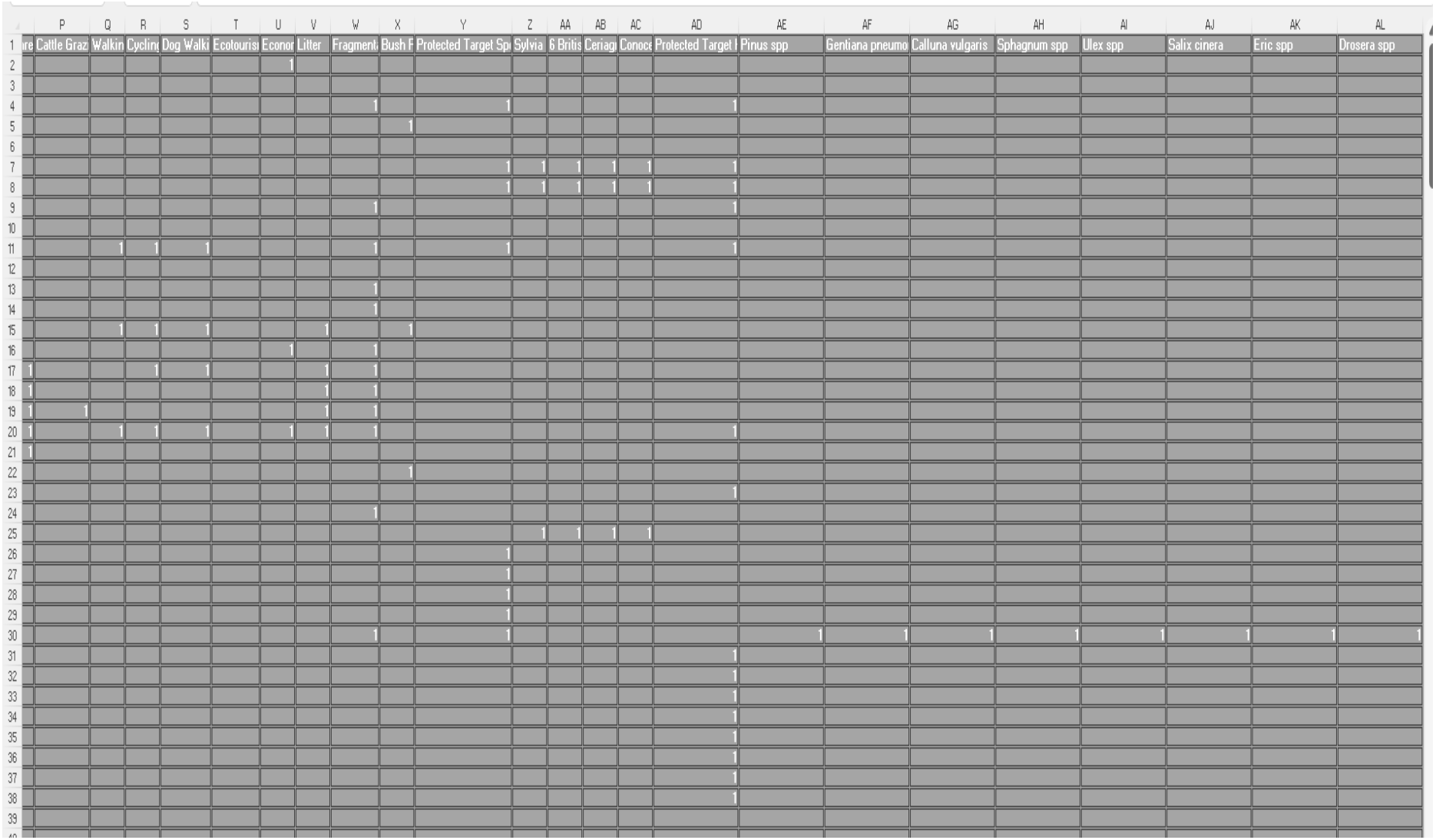
Table 4.0: Levels for the SSSI BBN

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
1	Node name	Ecosystem service	Biodiversity	Habitat Loss	Climate Change	Natural Succession	Native Species	Invasive Species	Habitat Resto	Controlled Burnin	Buffer Zone	Reintrodu	Temporal	Spatial Zo	Public Aw
2															
3	Prior of increasing/high	0.5	0.5	0.5	0.65	0.5	0.5	0.5	0.8	0.6	0.7	0.8	0.35	0.3	0.5
4	Prior of decreasing/low	0.5	0.5	0.5	0.35	0.5	0.5	0.5	0.2	0.4	0.3	0.2	0.65	0.7	0.5
5															
6															
7															
8	Posterior increase	0.60	0.59	0.42	0.65	0.33	0.56	0.50	0.87	0.60	0.67	0.80	0.40	0.32	0.57
9	Posterior decrease	0.40	0.41	0.58	0.35	0.67	0.44	0.50	0.13	0.40	0.33	0.20	0.60	0.68	0.43
10															
11															
12															
13															
14			Calculate												

	P	Q	R	S	T	U	V	W	X	Y	Z	AA	AB	AC	AD	AE	AF	AG	AH	AI	AJ	AK	AL
1	: Aw	Cattle Gra	Walking	Cycling	Dog Walk	Ecotourisi	Economy	Litter	Fragment	Bush Fire	Protected	*Sylvia unc*	6 British F	*Ceriagrior*	*Conoceph*	Protectec	Pinus spp	Gentiana	Calluna vu	Sphagnur	Ulex spp	Salix cine	Eric spp	Drosera spp
2																								
3	0.5	0.8	0.65	0.65	0.65	0.7	0.5	0.5	0.2	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
4	0.5	0.2	0.35	0.35	0.35	0.3	0.5	0.5	0.8	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
5																								
6																								
7																								
8	0.57	0.78	0.67	0.67	0.67	0.70	0.65	0.55	0.19	0.61	0.63	0.53	0.53	0.53	0.53	0.58	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.54
9	0.43	0.22	0.33	0.33	0.33	0.30	0.35	0.45	0.81	0.39	0.37	0.47	0.47	0.47	0.47	0.42	0.46	0.46	0.46	0.46	0.46	0.46	0.46	0.46
10																								

Table 4.1: Interaction grid for the SSSI BBN

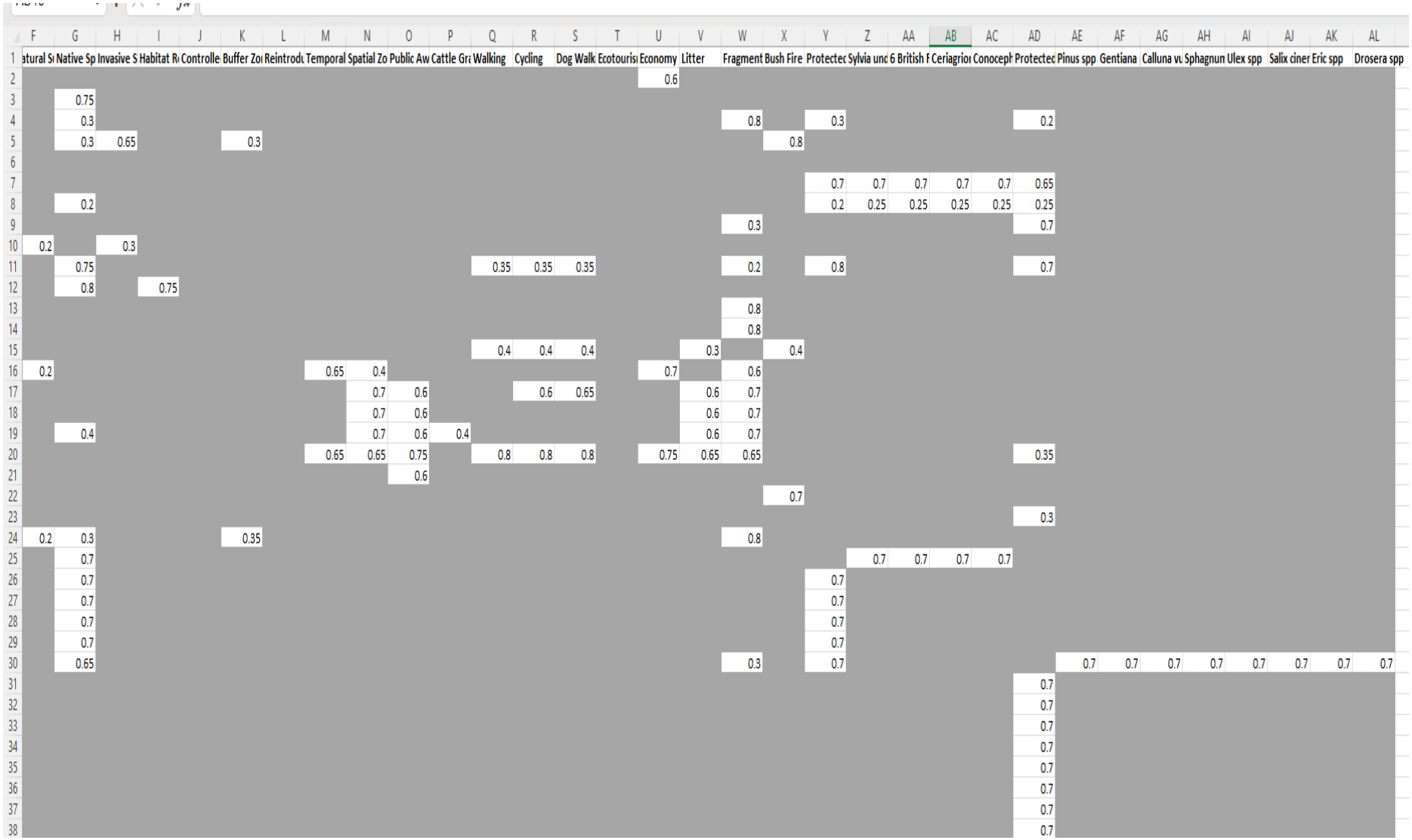
	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	
1	Row effects column	Ecosystem service	Biodiversity	Habitat Los	Climate Char	Natural Successi	Native Spec	Invasive Spec	Habitat Restorati	Controlled Burning	Buffer Zo	Reintroduction of Spe	Temporal Zon	Spatial Zon	Public Aware	Cattle Graz	Walkin	Cyclin	Dog Walki	Ecotouris	Econor	Litter	Fra
2	**Ecosystem services**																				1		
3	**Biodiversity**	1					1																
4	**Habitat Loss**	1	1				1																
5	**Climate Change**	1	1	1			1	1			1												
6	**Natural Succession**		1																				
7	**Native Species**		1																				
8	**Invasive Species**		1				1																
9	**Habitat Restoration**	1	1	1																			
10	**Controlled Burning**	1	1	1		1		1															
11	**Buffer Zone**	1	1	1			1										1	1	1				
12	Reintroduction of Specie	1	1	1			1		1														
13	Temporal Zoning																						
14	Spatial Zoning																						
15	Public Awareness																1	1	1			1	
16	Cattle Grazing		1			1							1	1							1		
17	**Walking**		1											1	1			1	1			1	
18	**Cycling**		1											1	1							1	
19	**Dog Walking**		1				1							1	1	1						1	
20	**Ecotourism**			1									1	1	1		1	1	1		1	1	
21	**Economy**														1								
22	**Litter**																						
23	**Fragmentation**		1	1																			
24	**Bush Fire**	1	1	1		1	1				1												
25	**Protected Target Species**		1				1																
26	**Sylvia undata**						1																
27	6 British Reptiles						1																
28	Ceriagrion tenellum						1																
29	Conocephalus spp						1																
30	Protected Target Habitat	1	1	1			1																
31	Pinus spp																						
32	**Gentiana pneumonanthe**																						
33	Calluna vulgaris																						
34	Sphagnum spp																						
35	Ulex spp																						
36	Salix cinera																						
37	Eric spp																						
38	Drosera spp																						



	P	Q	R	S	T	U	V	W	X	Y	Z	AA	AB	AC	AD	AE	AF	AG	AH	AI	AJ	AK	AL
1	Cattle Graz	Walkin	Cyclin	Dog Walki	Ecotourisi	Econor	Litter	Fragment	Bush F	Protected Target Sp	Sylvia	6 Britis	Ceriag	Conoce	Protected Target	Pinus spp	Gentiana pneumo	Calluna vulgaris	Sphagnum spp	Ulex spp	Salix cinera	Eric spp	Drosera spp
2						1																	
3																							
4								1		1					1								
5									1														
6																							
7										1	1	1	1	1	1								
8										1	1	1	1	1	1								
9								1							1								
10																							
11		1	1	1				1		1					1								
12																							
13								1															
14								1															
15		1	1	1			1		1														
16						1		1															
17	1		1	1			1	1															
18	1						1	1															
19	1	1					1	1															
20	1	1	1	1	1	1	1	1							1								
21	1																						
22									1														
23															1								
24								1															
25											1	1	1	1									
26										1													
27										1													
28										1													
29										1													
30								1		1						1	1	1	1	1	1	1	1
31															1								
32															1								
33															1								
34															1								
35															1								
36															1								
37															1								
38															1								
39																							

Table 4.2: Interaction probability grid for SSSI BBN

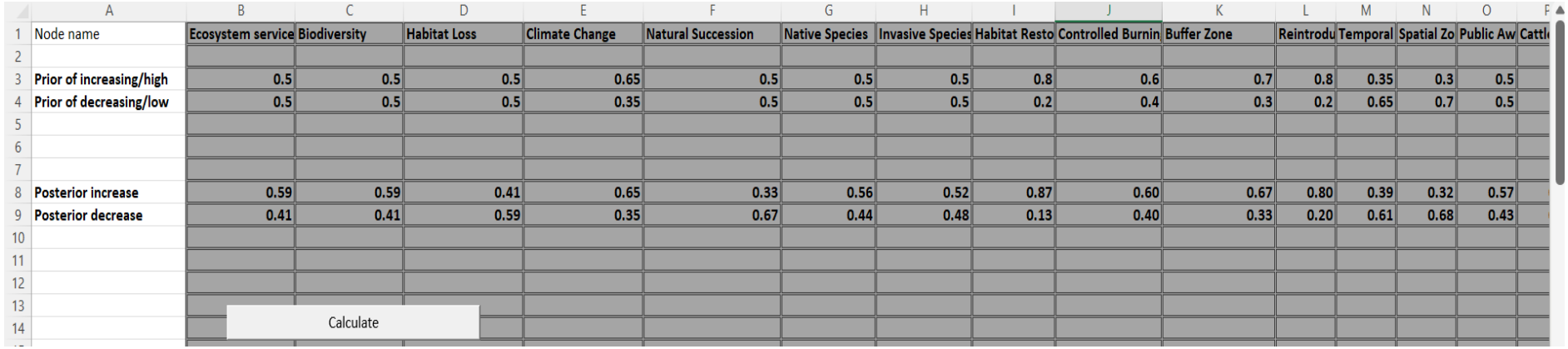
	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA	AB	AC	AD	AE	AF
1	Prob of column increasing give	Ecosysten	Biodiversi	Habitat L	Climate C	Natural Si	Native Sp	Invasive S	Habitat R	Controlle	Buffer Zo	Reintrodu	Temporal	Spatial Zo	Public Aw	Cattle Gr	Walking	Cycling	Dog Walk	Ecotouris	Economy	Litter	Fragment	Bush Fire	Protectec	Sylvia und	6 British F	Ceriagrio	Conocepl	Protectec	Pinus spp	Gentian
2	Ecosystem services																				0.6											
3	Biodiversity	0.6					0.75																									
4	Habitat Loss	0.3	0.2				0.3																0.8		0.3					0.2		
5	Climate Change	0.4	0.3	0.8			0.3	0.65			0.3													0.8								
6	Natural Succession		0.3																													
7	Native Species		0.75																						0.7	0.7	0.7	0.7	0.7	0.65		
8	Invasive Species		0.2				0.2																		0.2	0.25	0.25	0.25	0.25	0.25		
9	Habitat Restoration	0.75	0.8	0.2																			0.3							0.7		
10	Controlled Burning	0.65	0.75	0.6		0.2		0.3																								
11	Buffer Zone	0.75	0.8	0.2			0.75										0.35	0.35	0.35				0.2		0.8					0.7		
12	Reintroduction of Species	0.7	0.8	0.3			0.8		0.75																							
13	Temporal Zoning																						0.8									
14	Spatial Zoning																						0.8									
15	Public Awareness																0.4	0.4	0.4			0.3		0.4								
16	Cattle Grazing		0.75			0.2							0.65	0.4							0.7		0.6									
17	Walking		0.4											0.7	0.6			0.6	0.65			0.6	0.7									
18	Cycling		0.4											0.7	0.6							0.6	0.7									
19	Dog Walking		0.4				0.4							0.7	0.6	0.4						0.6	0.7									
20	Ecotourism			0.65									0.65	0.65	0.75		0.8	0.8	0.8		0.75	0.65	0.65							0.35		
21	Economy														0.6																	
22	Litter																							0.7								
23	Fragmentation		0.3	0.8																										0.3		
24	Bush Fire	0.3	0.3	0.8		0.2	0.3				0.35												0.8									
25	Protected Target Species		0.7				0.7																			0.7	0.7	0.7	0.7			
26	Sylvia undata						0.7																		0.7							
27	6 British Reptiles						0.7																		0.7							
28	Ceriagrion tenellum						0.7																		0.7							
29	Conocephalus spp						0.7																		0.7							
30	Protected Target Habitat	0.65	0.8	0.2			0.65																0.3		0.7						0.7	0
31	Pinus spp																													0.7		
32	Gentiana pneumonanthe																													0.7		
33	Calluna vulgaris																													0.7		
34	Sphagnum spp																													0.7		
35	Ulex spp																													0.7		
36	Salix cinera																													0.7		
37	Eric spp																													0.7		
38	Drosera spp																													0.7		



	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA	AB	AC	AD	AE	AF	AG	AH	AI	AJ	AK	AL
1	atural Si	Native Sp	Invasive S	Habitat Ri	Controlle	Buffer Zo	Reintrodu	Temporal	Spatial Zo	Public Aw	Cattle Gra	Walking	Cycling	Dog Walk	Ecotourisi	Economy	Litter	Fragment	Bush Fire	Protectec	Sylvia unc	6 British F	Ceriagrion	Conocephl	Protectec	Pinus spp	Gentiana	Calluna vu	Sphagnun	Ulex spp	Salix ciner	Eric spp	Drosera spp
2																0.6																	
3		0.75																															
4		0.3																0.8		0.3					0.2								
5		0.3	0.65			0.3													0.8														
6																																	
7																				0.7	0.7	0.7	0.7	0.7	0.65								
8		0.2																		0.2	0.25	0.25	0.25	0.25	0.25								
9																		0.3							0.7								
10	0.2		0.3																														
11		0.75										0.35	0.35	0.35				0.2		0.8					0.7								
12		0.8		0.75																													
13																		0.8															
14																		0.8															
15												0.4	0.4	0.4			0.3		0.4														
16	0.2							0.65	0.4							0.7		0.6															
17									0.7	0.6			0.6	0.65			0.6	0.7															
18									0.7	0.6							0.6	0.7															
19		0.4							0.7	0.6	0.4						0.6	0.7															
20								0.65	0.65	0.75		0.8	0.8	0.8		0.75	0.65	0.65							0.35								
21										0.6																							
22																			0.7														
23																									0.3								
24	0.2	0.3				0.35												0.8															
25		0.7																			0.7	0.7	0.7	0.7									
26		0.7																		0.7													
27		0.7																		0.7													
28		0.7																		0.7													
29		0.7																		0.7													
30		0.65																0.3		0.7						0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7
31																									0.7								
32																									0.7								
33																									0.7								
34																									0.7								
35																									0.7								
36																									0.7								
37																									0.7								
38																									0.7								

Appendix X – Bayesian Belief Network (BBN) Spreadsheets for Ramsar site.

Table 5.0: Levels for the Ramsar BBN



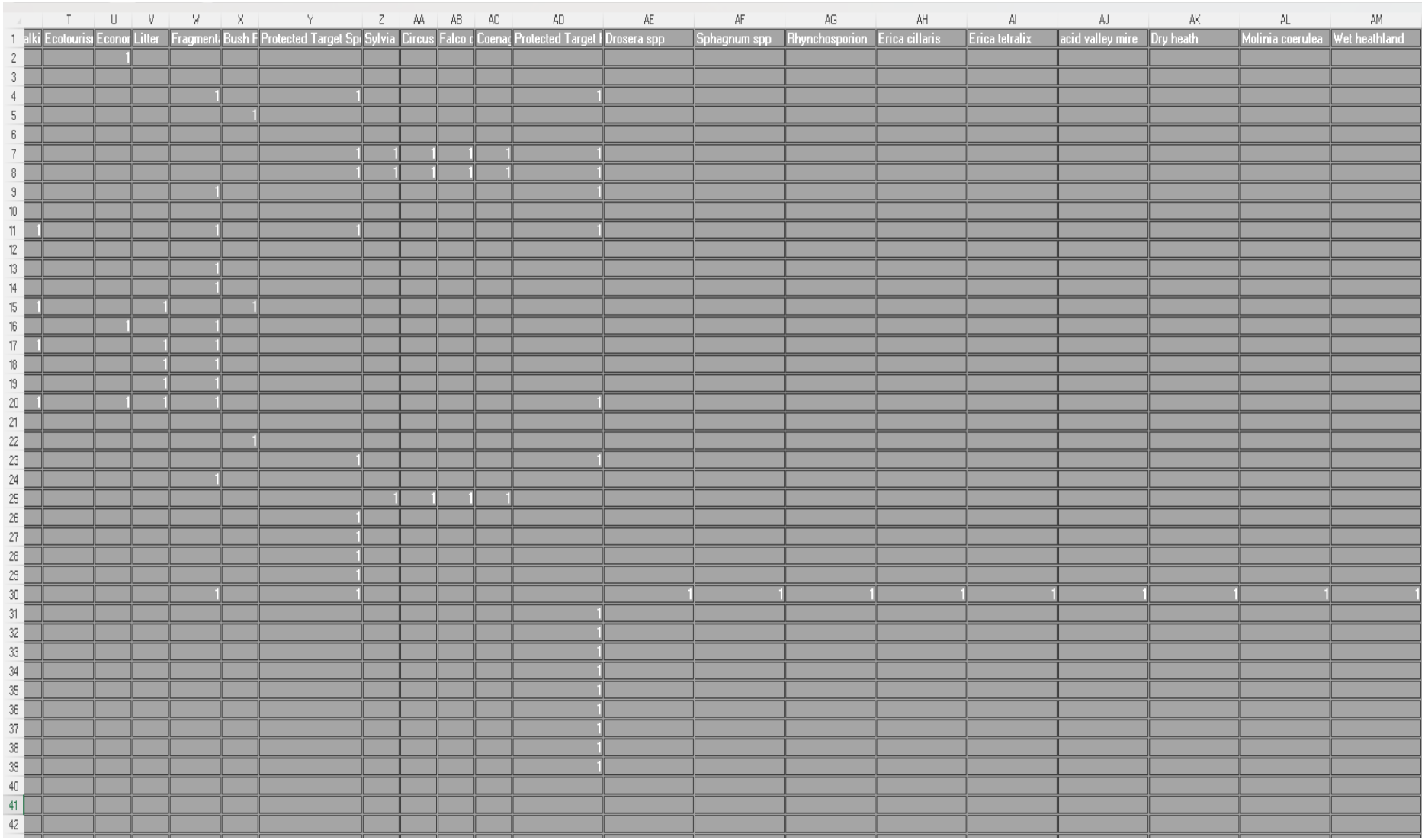
	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
1	Node name	Ecosystem service	Biodiversity	Habitat Loss	Climate Change	Natural Succession	Native Species	Invasive Species	Habitat Resto	Controlled Burnin	Buffer Zone	Reintrodu	Temporal	Spatial Zo	Public Aw	Cattl
2																
3	Prior of increasing/high	0.5	0.5	0.5	0.65	0.5	0.5	0.5	0.8	0.6	0.7	0.8	0.35	0.3	0.5	
4	Prior of decreasing/low	0.5	0.5	0.5	0.35	0.5	0.5	0.5	0.2	0.4	0.3	0.2	0.65	0.7	0.5	
5																
6																
7																
8	Posterior increase	0.59	0.59	0.41	0.65	0.33	0.56	0.52	0.87	0.60	0.67	0.80	0.39	0.32	0.57	
9	Posterior decrease	0.41	0.41	0.59	0.35	0.67	0.44	0.48	0.13	0.40	0.33	0.20	0.61	0.68	0.43	
10																
11																
12																
13																
14																

Calculate

	Q	R	S	T	U	V	W	X	Y	Z	AA	AB	AC	AD	AE	AF	AG	AH	AI	AJ	AK	AL	AM	AN
1	Walking	Cycling	Dog Walki	Ecotourisi	Economy	Litter	Fragment	Bush Fire	Protected	*Sylvia und*	*Circus cya*	*Falco colu*	*Coenagric*	Protected	Drosera s	Sphagnur	Rhynchos	Erica cilla	Erica tetr	acid valle	Dry heath	Molinia c	Wet heathland	
2																								
3	0.65	0.65	0.65	0.7	0.5	0.5	0.2	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	
4	0.35	0.35	0.35	0.3	0.5	0.5	0.8	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	
5																								
6																								
7																								
8	0.67	0.67	0.67	0.70	0.65	0.55	0.19	0.60	0.67	0.53	0.53	0.53	0.53	0.60	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	
9	0.33	0.33	0.33	0.30	0.35	0.45	0.81	0.40	0.33	0.47	0.47	0.47	0.47	0.40	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	

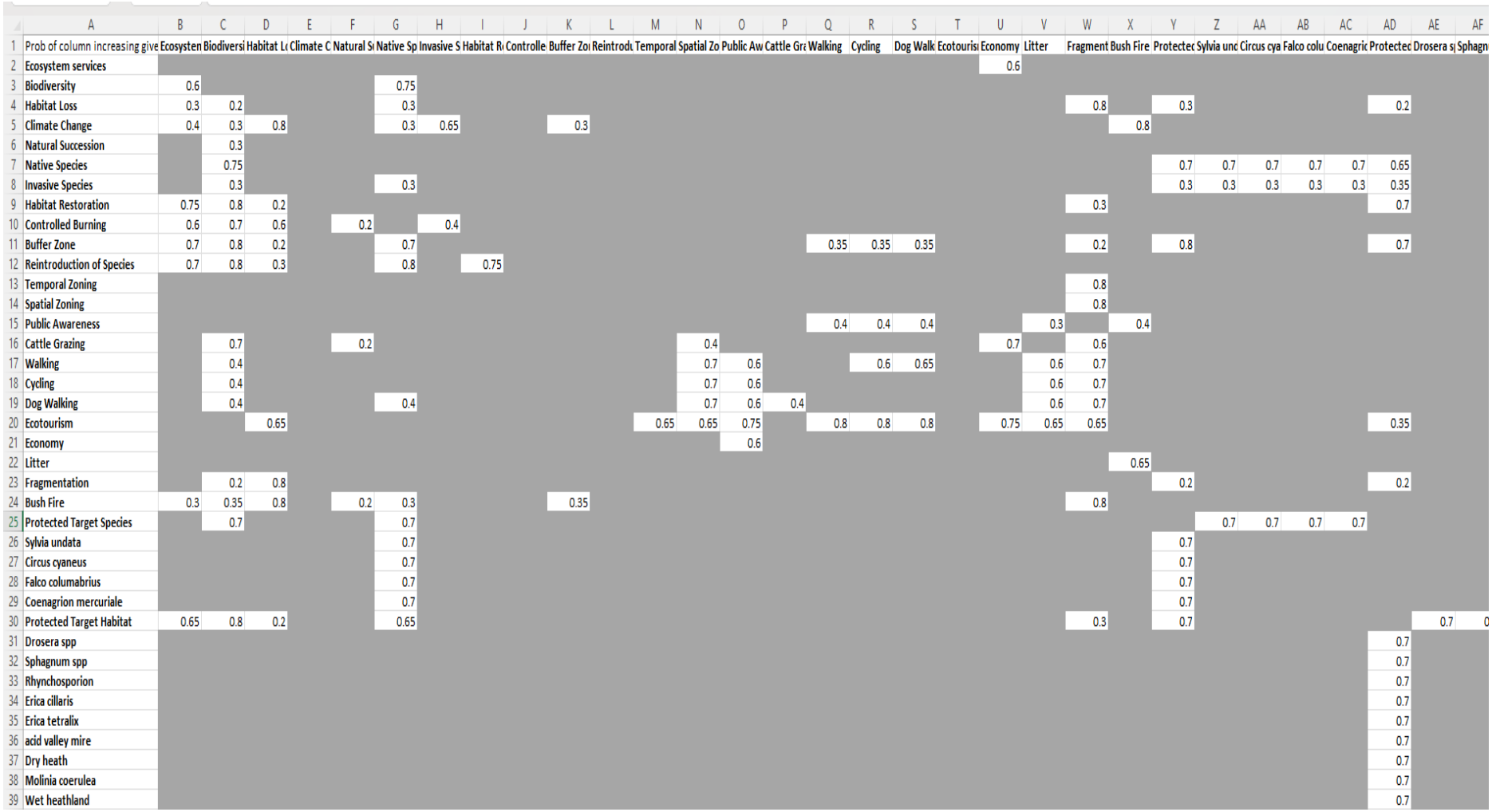
Table 5.1: Interaction grid for the Ramsar BBN

Row effects column	Ecosystem services	Biodiversity	Habitat Los	Climate Char	Natural Successi	Native Spec	Invasive Spec	Habitat Restorat	Controlled Burning	Buffer Zo	Reintroduction of Spe	Temporal Zon	Spatial Zor	Public Aware	Cattle Graz	Walkin	Cyclin	Dog Walki	Ecotouris	Econor	Litter	Fra
Ecosystem services																				1		
Biodiversity	1					1																
Habitat Loss	1	1				1																
Climate Change	1	1	1			1	1			1												
Natural Succession		1																				
Native Species		1																				
Invasive Species		1				1																
Habitat Restoration	1	1	1																			
Controlled Burning	1	1	1		1		1															
Buffer Zone	1	1	1			1										1	1	1				
Reintroduction of Specie	1	1	1			1		1														
Temporal Zoning																						
Spatial Zoning																						
Public Awareness																1	1	1			1	
Cattle Grazing		1			1								1							1		
Walking		1											1	1			1	1			1	
Cycling		1											1	1							1	
Dog Walking		1				1							1	1	1						1	
Ecotourism			1									1	1	1		1	1	1		1	1	
Economy														1								
Litter																						
Fragmentation		1	1																			
Bush Fire	1	1	1		1	1				1												
Protected Target Species		1				1																
Sylvia undata						1																
Circus cyaneus						1																
Falco columabrius						1																
Coenagrion mercuriale						1																
Protected Target Habitat	1	1	1			1																
Drosera spp																						
Sphagnum spp																						
Rhynchosporion																						
Erica cillaris																						
Erica tetralix																						
acid valley mire																						
Dry heath																						
Molinia coerulea																						
Wet heathland																						

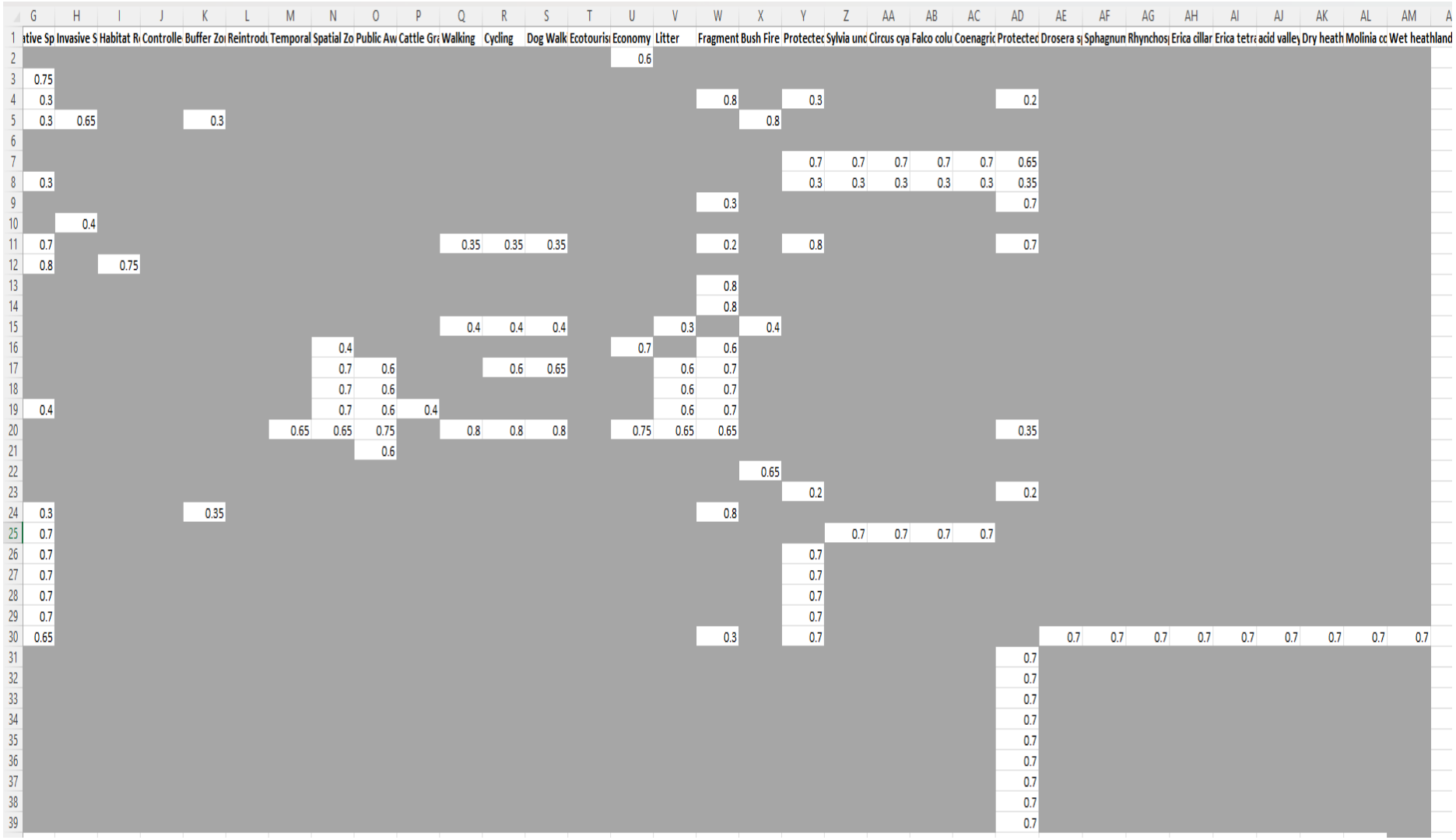


	T	U	V	W	X	Y	Z	AA	AB	AC	AD	AE	AF	AG	AH	AI	AJ	AK	AL	AM
1	alki	Ecotouris	Econor	Litter	Fragment	Bush F	Protected Target Sp	Sylvia	Circus	Falco c	Coenag	Protected Target I	Drosera spp	Sphagnum spp	Rhynchosporion	Erica cillaris	Erica tetralix	acid valley mire	Dry heath	Molinia coerulea	Wet heathland
2			1																		
3																					
4					1		1					1									
5						1															
6																					
7							1	1	1	1	1	1									
8							1	1	1	1	1	1									
9					1							1									
10																					
11	1				1		1					1									
12																					
13					1																
14					1																
15	1			1		1															
16			1		1																
17	1			1	1																
18				1	1																
19				1	1																
20	1		1	1	1							1									
21																					
22						1															
23							1					1									
24					1																
25								1	1	1	1										
26							1														
27							1														
28							1														
29							1														
30					1		1						1	1	1	1	1	1	1	1	1
31												1									
32												1									
33												1									
34												1									
35												1									
36												1									
37												1									
38												1									
39												1									
40																					
41																					
42																					

Table 5.2: Interaction probability grid for Ramsar BBN



	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA	AB	AC	AD	AE	AF
1	Prob of column increasing give	Ecosysten	Biodiversi	Habitat L	Climate C	Natural S	Native Sp	Invasive S	Habitat R	Controlle	Buffer Zo	Reintrodu	Temporal	Spatial Zo	Public Aw	Cattle Gr	Walking	Cycling	Dog Walk	Ecotouris	Economy	Litter	Fragment	Bush Fire	Protectec	Sylvia unc	Circus cya	Falco colu	Coenagric	Protectec	Drosera s	Sphagn
2	Ecosystem services																				0.6											
3	Biodiversity	0.6					0.75																									
4	Habitat Loss	0.3	0.2				0.3																0.8		0.3					0.2		
5	Climate Change	0.4	0.3	0.8			0.3	0.65			0.3													0.8								
6	Natural Succession		0.3																													
7	Native Species		0.75																						0.7	0.7	0.7	0.7	0.7	0.65		
8	Invasive Species		0.3				0.3																		0.3	0.3	0.3	0.3	0.3	0.35		
9	Habitat Restoration	0.75	0.8	0.2																			0.3							0.7		
10	Controlled Burning	0.6	0.7	0.6		0.2		0.4																								
11	Buffer Zone	0.7	0.8	0.2			0.7										0.35	0.35	0.35				0.2		0.8					0.7		
12	Reintroduction of Species	0.7	0.8	0.3			0.8		0.75																							
13	Temporal Zoning																						0.8									
14	Spatial Zoning																						0.8									
15	Public Awareness																0.4	0.4	0.4			0.3		0.4								
16	Cattle Grazing		0.7			0.2								0.4							0.7		0.6									
17	Walking		0.4											0.7	0.6			0.6	0.65			0.6	0.7									
18	Cycling		0.4											0.7	0.6							0.6	0.7									
19	Dog Walking		0.4				0.4							0.7	0.6	0.4						0.6	0.7									
20	Ecotourism			0.65									0.65	0.65	0.75		0.8	0.8	0.8		0.75	0.65	0.65							0.35		
21	Economy														0.6																	
22	Litter																							0.65								
23	Fragmentation		0.2	0.8																					0.2					0.2		
24	Bush Fire	0.3	0.35	0.8		0.2	0.3				0.35												0.8									
25	Protected Target Species		0.7				0.7																			0.7	0.7	0.7	0.7			
26	Sylvia undata						0.7																		0.7							
27	Circus cyaneus						0.7																		0.7							
28	Falco columabrius						0.7																		0.7							
29	Coenagrion mercuriale						0.7																		0.7							
30	Protected Target Habitat	0.65	0.8	0.2			0.65																0.3		0.7						0.7	0
31	Drosera spp																													0.7		
32	Sphagnum spp																													0.7		
33	Rhynchosporion																													0.7		
34	Erica cillaris																													0.7		
35	Erica tetralix																													0.7		
36	acid valley mire																													0.7		
37	Dry heath																													0.7		
38	Molinia coerulea																													0.7		
39	Wet heathland																													0.7		



	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA	AB	AC	AD	AE	AF	AG	AH	AI	AJ	AK	AL	AM	A
1	ative Sp	Invasive S	Habitat R	Controlle	Buffer Zo	Reintrodu	Temporal	Spatial Zo	Public Aw	Cattle Gr	Walking	Cycling	Dog Walk	Ecotourisi	Economy	Litter	Fragment	Bush Fire	Protectec	Sylvia unc	Circus cya	Falco colu	Coenagric	Protectec	Drosera s	Sphagnun	Rhynchos	Erica cilla	Erica tetr	acid valley	Dry heath	Molinia cc	Wet heathland	
2															0.6																			
3	0.75																																	
4	0.3																0.8		0.3					0.2										
5	0.3	0.65			0.3													0.8																
6																																		
7																			0.7	0.7	0.7	0.7	0.7	0.65										
8	0.3																		0.3	0.3	0.3	0.3	0.3	0.35										
9																	0.3							0.7										
10		0.4																																
11	0.7										0.35	0.35	0.35				0.2		0.8					0.7										
12	0.8		0.75																															
13																	0.8																	
14																	0.8																	
15											0.4	0.4	0.4			0.3		0.4																
16								0.4							0.7		0.6																	
17								0.7	0.6			0.6	0.65			0.6	0.7																	
18								0.7	0.6							0.6	0.7																	
19	0.4							0.7	0.6	0.4						0.6	0.7																	
20							0.65	0.65	0.75		0.8	0.8	0.8		0.75	0.65	0.65							0.35										
21									0.6																									
22																		0.65																
23																			0.2					0.2										
24	0.3				0.35												0.8																	
25	0.7																			0.7	0.7	0.7	0.7											
26	0.7																		0.7															
27	0.7																		0.7															
28	0.7																		0.7															
29	0.7																		0.7															
30	0.65																0.3		0.7						0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	
31																								0.7										
32																								0.7										
33																								0.7										
34																								0.7										
35																								0.7										
36																								0.7										
37																								0.7										
38																								0.7										
39																								0.7										