Pre-feasibility Study: White-Tailed Eagle (WTE) Reintroduction in Cumbria

Funded by Natural England

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Expert advice and guidance from the Roy Dennis Wildlife Foundation

University of CUMBRIA

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Executive Summary

This is a pre-feasibility report that designed to inform the next steps for a full feasibility study of white tailed eagle *Haliaeetus albicilla* (WTE) in Cumbria. This report highlights potential risks for such an introduction, to wildlife and the general public, habitat suitability (including observations form a site visit report from Roy Dennis a leading expert in WTE reintroductions), and detailed habitat suitability modelling and social and economic impacts. This report has been developed in collaboration with a broader Cumbrian WTE group (including representatives from Cumbria Wildlife Trust, RSPB, Solway AONB, Natural England, and local political representatives).

Evidence shows that there is ample suitable habitat in Cumbria, in the south of the county and around the Solway to the north as illustrated through habitat mapping [**Section 3**]. Reviews of local species records also highlight that Cumbria has a range of suitable prey species available all year round [**Section 4**].

Risks to rare species, wildlife, and the public are generally low. This report highlights that the potential benefit of such an introduction far outweighs the risk [**Section 4** / **Section 7**].

Other potential risks from the project include unsuccessful establishment of WTEs in the area and dispersal from release sites, and thus a detailed post release strategy and monitoring programme will need to be implemented as well as an exit strategy [**Section 9**]. It is hoped that this report will inform a full-scale feasibility study and license application for a WTE reintroduction.

Expert opinion: *'My overall view was positive…all the coastal areas I visited were suitable for non-breeding and juvenile white- tailed eagles. There are large areas of hunting habitat and many mature trees suitable for perching and loafing* **[however]** *I did not find immediately a suitable* [hacking] *site. Finding perfect hacking sites will take time and much exploration, as well as talking with landowners, wardens, foresters and farmers. But is essential for success'* [**Section 11**].

White Tailed Eagle, Scotland (Roy Dennis Foundation)

1. PROJECT GOALS AND JUSTIFICATION

Aims and Objectives

The aim of this pre-feasibility project is to conduct a preliminary pilot study to support, inform and provide scoping for a comprehensive feasibility study which complies with the IUCN Guidelines for reintroductions and other conservation translocations (IUCN/SSC, 2013) ("the IUCN Guidelines") and the Reintroductions and other conservation translocations: code and guidance for England (DEFRA, 2021) ("the English code and guidance") for the reintroduction of white-tailed eagles (*Haliaaetus albicilla*) (WTE) to the Cumbrian lowlands. The re- establishment of a viable breeding population in Cumbria has the potential to expand the distribution, metapopulation structure and genetic diversity of WTEs towards a national recovery for the species across their geographic range in the UK. As keystone species and apex predators, WTEs can regulate prey populations, helping to establish more resilient coastal and freshwater ecosystems. In Cumbria, WTEs could be promoted as ambassadors to raise awareness of the wider conservation needs of the region. High profile raptor reintroductions have been shown to bring far reaching economic benefits through the generation of ecotourism revenues and a reintroduced population would provide a year-round visitor attraction which would support a more equitable distribution of tourists across all Cumbrian districts.

These aims are well aligned with the goals of the Governments 25-year Environment plan to use reintroduction as a method to recover nature and to create opportunities for people to connect with their natural environment.

Project objectives

1. Set out what steps would need to be taken to determine the feasibility of a reintroduction of WTEs to the lowlands of Cumbria, in a way which complies with the IUCN and NE Guidelines.

2. Specific steps toward assessing feasibility will be taken, including:

    i. Develop ecological niche and risk models to identify suitable habitat along the north Cumbrian coast and inland adjacent to large bodies of freshwater.

    ii. Ground truth habitat maps by conducting field visits and meetings with landowners to identify priority locations for reintroduction which are low risk and meet the foraging and nesting requirements of the species.

    iii. Conduct ecological risk assessments to quantify risks to sympatric native species including wintering wildfowl and waders of national and international importance, red listed breeding birds and Cumbrian mammals at risk of extinction.

iv. Undertake a high-level cost-benefit analysis of a WTE reintroduction in Cumbria building on existing work to quantify amongst other factors, potential revenues from ecotourism and losses to the farming and field-sports sectors.

v. Develop an outline approach to local and regional community consultation and engagement including the general public and key stakeholder groups.

Overview of the ecology and biology of White-Tailed eagles

White-Tailed Eagles (WTE) are the largest native bird of prey in the United Kingdom. Adults can have a wingspan of up to 2.5 metres and are sexually dimorphic with the larger females weighing up to 25% more than the males (Love, 1983).

WTEs have a restricted range in the United Kingdom but are widely distributed across the northern palearctic from Greenland in the west to the Kamchatka peninsula in the east and south to parts of the Mediterranean basin. They are opportunistic predators, scavengers and kleptoparasites feeding predominantly on waterbirds, medium to large fish species, mammals such as lagomorphs and carrion (Ekblad et al., 2020; Sandor et al., 2015; Whitfield et al., 2013).

Adults breed from four years of age and typically build large nests out of sticks in a range of conifer and broadleaf trees. However, in the absence of suitable arboreal sites, nests can also be found on cliff ledges, artificial platforms and even on the ground (Love, 1983). Females lay 1 to 3 eggs which are incubated by both sexes for 38 days. Altricial hatchlings often start feeding themselves in the nest at 35-40 days and fledge at approximately 70 days. Adult birds are territorial and display natal philopatry but juvenile WTEs often disperse widely during the first few years before returning to breed close to their natal sites (Dennis et al., 2019).

WTEs are categorized as Least Concern with an estimated 20,000 to 60,000 mature individuals and this population increasing (Birdlife International, 2021). However, the species is amber listed in the United Kingdom with all adult birds restricted to the Scottish mainland and offshore islands (Dennis et al., 2019; Sansom et al., 2016).

History of WTEs in Great Britain, including Cumbria

In summary, the history of WTEs in Great Britain is as follows:

1. WTEs were once widespread in Great Britain.
2. WTEs declined in number in Great Britain due to anthropogenic influences since the Middle Ages, eventually becoming extinct in Great Britain in 1916.
3. WTEs were once found in Cumbria, with the last recorded breeding attempt near Haweswater in 1787.
4. Changes in the law and in public perceptions have resulted in WTEs increasing in number across their range. Successful reintroductions have taken place in Scotland and a reintroduction is currently underway on the Isle of Wight in England.

There is substantial archaeological evidence to suggest that from the end of the last ice age 15,000 years ago and throughout the Holocene until the arrival of the Anglo Saxons, WTEs were widespread in Great Britain (Evans et al., 2012; Yalden, 2007; Love, 2003; Love 1983). During that time landscapes were shaped by natural disturbance and suitable wetland and coastal habitats existed in abundance (Love, 1983).

Throughout their British range the eventual decline of the WTE was precipitated by anthropogenic influences (Love, 2003; Love, 1983). In the Middle Ages, the landscape scale felling of mature woodland and draining of wetlands reduced available foraging and nesting habitat; by the eighteenth-century indiscriminate persecution using poisoned baits and early firearms had devastating consequences for the dwindling populations in Great Britain (Love, 2003; Love, 1983).

Love (1983) describes the coastal marshes and lakes of Cumbria as the last refuge for WTEs in mainland England, but even here they were exposed to egg collectors and relentless persecution until the last pair attempted to breed near Haweswater in 1787. Although WTEs were still common in Scotland during the early eighteenth century, the rise of Victorian shooting estates in the nineteenth century brought the species into conflict with shepherds, gamekeepers and landowners and the last WTE was shot on Shetland in 1918 rendering the species extinct in Great Britain (Love, 1983).

Following legal protection, changes in perceptions towards raptors and the banning of bioaccumulating agricultural toxins, WTE populations have rebounded across their range in the northern palearctic (Love, 1983). In Scotland successful reintroduction programmes on the Isle of Rhum, in Wester Ross and in Fife between 1975 and 2012 re-established a viable breeding population of WTEs (Evans et al., 2009; Love, 2003; Love, 1983). Although the Scottish population remains precarious at just 123 pairs, gains in abundance and distribution resulted in the species being moved from red to amber in the 2021 assessment of the Birds of Conservation Concern 5. (Stanbury et al., 2021).

Currently there are no viable breeding populations of WTEs in England and Wales although a reintroduction is underway on the Isle of White led by the Roy Dennis Wildlife Foundation

(Dennis et al., 2019). This initiative has great potential to establish breeding pairs on the south coast with connectivity to small populations on the near continent (Dennis et al., 2019).

The feasibility study will expand on the drivers of WTE population decline in Cumbria and the history of WTE reintroductions across Great Britain from early efforts by the RSPB on Fair Isle in 1968 to the most recent translocation project on the Isle of White. The study will also evaluate how a range of social, cultural and economic factors have shaped historic and contemporary attitudes and behaviours towards birds of prey (e.g. persecution risks and mitigation measures).

1.1 Rationale for Reintroduction

The establishment of a viable breeding population in Cumbria would potentially support the recovery of WTEs across their former range in England, expand the national metapopulation structure and facilitate dispersal and gene flow with the nearest Scottish population in Fife and Tayside.

In Cumbria there are occasional records of WTEs using the Solway such as an immature bird that was identified in February 2009 (BBC News, 2009), but natural recolonisation of the Cumbrian lowlands would take many years given the limited dispersal potential and delayed sexual maturity of the species (Whitfield et al., 2009). Males and females recruit at a median age of 4 and 5 years respectively and mean natal dispersal distances (distance between natal (or release) and first breeding site) are only 42kms for males and 59kms for females (Whitfield et al., 2009). As a philopatric species new recruits to the population choose nest sites close to occupied breeding territories.

The reintroduction of an apex predator such as the WTE to Cumbria would re-establish top- down regulation on prey and meso-predator populations at lower trophic levels with resulting benefits to the wider ecosystem and the potential to control populations of non-native waterfowl (Kamarauskaitë et al., 2019; Lyly et al., 2015). Growing numbers of Canada geese (*Branta canadensis*) in Cumbria are causing eutrophication of the large freshwater bodies such as lake Windermere with impacts on water quality, dissolved oxygen levels and native fauna (LDNP 2019). Current practices to control Canada geese include egg oiling and are being implemented by the Windermere Geese Management Group administered by the Lake District National Park Authority (LDNP 2019). An expanding WTE population would support the control of Canada geese by preying on goslings in the breeding season.

The return of a large predator also has consequences for human populations coexisting in the landscape and it is important to collate public and stakeholder opinions and address concerns. However, studies from the islands of Mull and Skye have demonstrated the potential for a charismatic, flagship species such as the WTE to attract tourists to an area and support the hospitality sector and associated supply chains (Molloy, 2011). Cumbria has 29 communities that rank within the 10% most deprived of areas in England including coastal communities in Copeland, Allerdale and Barrow-in-Furness (Cumbria Intelligence Observatory, 2022). WTEs would provide a year-round attraction which would support these communities by diverting tourists from popular locations in the Lake District National Park.

As a signatory to the Convention on the Conservation of European Wildlife and Natural Habitats ("the Bern Convention") and the Convention on Biological Diversity, the UK government should consider the reintroduction under licence of WTEs subject to comprehensive social and ecological feasibility studies in line with the IUCN Guidelines and the English Code and Guidance.[1]

The feasibility study will further investigate the rationales for reintroducing WTEs in Cumbria, and in particular will consider the social context of a reintroduction and the viability of a reintroduced population.

1.2 Causes of Extinction

To comply with IUCN Guidelines and the English Code and Guidance and to ensure the success of a reintroduction initiative it is important to demonstrate that the causes of extinction havebeen removed.

The extinction of WTEs in the British Isles towards the end of the 18th and start of the 19th century resulted from the indiscriminate shooting, poisoning and egg collecting activities of gamekeepers and landowners who were incentivised by bounty payments and perceived raptor as a threat to gamebird and livestock interests (Love, 2003; Love, 1983).

By the mid-20th century public perceptions were improving towards birds of prey following legal protection, the rise of conservation NGOs and the migration of rural communities to urban areas (Love, 1983). Recent questionnaire-based surveys in Cumbria revealed a high level of public support for the reintroduction of WTEs as a species which would enrich people's experience of nature (Mayhew et al., 2015).

The WTE is protected under Schedule 1 of the Wildlife and Countryside Act 1981, but incidents of raptor persecution persist. Of the 300 respondents to a questionnaire administered face to face to communities along the west Cumbrian coast in 2012, one participant admitted laying poison baits to kill raptors (Mayhew et al., 2015). Furthermore between 2016 and 2020, the RSPB investigations team confirmed 6 cases of raptor persecution in Cumbria although 4 of the 6 incidents occurred in the Pennine uplands which would not constitute priority breeding habitat for WTEs (RSPB, 2022a). Recent successful WTE reintroductions in Ireland and Scotland have demonstrated the importance of public and stakeholder engagement to

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[1] Bern Convention Article 11(2)(a); Convention on Biological Diversity

address concerns relating to perceived threats to livestock from WTEs and similar social feasibility studies would be conducted in Cumbria to mitigate any remaining persecution threats.

Any analysis of extinction risk also needs to consider novel threats to reintroduced species and along the coast of Cumbria and inland the installation of wind farms poses a risk of fatal collisions to WTEs of all ages (Nygard et al., 2010). However, it is noteworthy that across some parts of the Scottish range of WTEs such as the Isle of Skye and the Outer Hebrides, viable breeding populations are maintained despite substantial onshore wind development. Currently Robin Rigg, with 58 turbines, is the only fully commissioned wind farm in the Solway (RWE, 2022) and whilst there is potential for the expansion of offshore wind projects in the estuary, this seems unlikely given the extent of land-based and marine designated areas. These include the Upper Solway Flats and Marshes Ramsar site and the Solway Special Protection Area (SPA) which are designated for a range of waders and waterfowl of national and international importance (Solway Firth Partnership, 2016).

The feasibility report will update (where required) the level of risk associated with current threats such as wind farms, overhead power lines and lead poisoning from the ingestion of game bird carcasses. Conclusions will be drawn with due consideration for mitigation measures which have been used with success to protect reintroduced WTE populations at other sites across Great Britain.

2. Habitat preferences

2.1 Foraging/nesting habitat

As a lowland species, WTEs show a strong preference for certain foraging and nesting habitats (Treinys et al., 2015; Sanson et al., 2016). Most foraging is carried out within a territory of 5-10km radius from the nest site although territory size varies widely with habitat quality and population density (Treinys et al., 2015; Sansom et al., 2016). European studies from Finland, Romania, Poland and Scotland demonstrate a preference for wetlands, peatlands, large bodies of freshwater and shallow coastlines which provide a seasonal abundance of food (Balotari-Chiebao et al., 2021; Zawadzki et al., 2020; Ekblad et al., 2020 Evans et al., 2010). By contrast WTEs tend to avoid human-modified landscapes dominated by agriculture, industry and urban areas (Tikaanen et al., 2018). Although WTEs show a preference for areas of low human population density, there is some evidence that they can adapt to low levels of disturbance (Santangeli et al., 2012). On the island of Mull WTEs have nested successfully adjacent to busy foot paths (David Morris pers. comm.) and in Finland nest occupancy and breeding success were not impacted by the presence of roads and buildings (Santangeli et al., 2013)

Nest site selection also varies across their geographic range and WTEs will nest on the ground, on cliff ledges or on artificial platforms if suitable woodland sites are unavailable (Nygård et al., 2010). However, in Scotland and across most of mainland Europe WTEs prefer to nest in trees adjacent to large water bodies (Fig. 1) (Sansom et al., 2016; Evans et al., 2010). Nests are located in a range of conifer and broadleaf tree species but are often built at a considerable height and WTEs show a preference for older trees with above average measurements of diameter at beast height (DBH) (Zawadzki et al., 2020; Sandor et al., 2015).

Comparisons between nest site locations of golden eagles (*Aquila chrysaetos*; GE) and WTEs in Scotland have demonstrated only low levels of competitive exclusion between these species based on strong altitudinal niche partitioning of nesting and foraging habitat (Evans et al., 2010). All Scottish WTE nests up to 2005 were located below 150 metres and the mean altitude of WTE and GE nest sites was 67 and 231 metres respectively (Evans et al., 2010).

In Cumbria, many of the landscape features which contribute to designated sites along the coastal lowlands, constitute highly suitable foraging habitats for WTEs. Habitats listed in Annex 1 of the Habitats Directive (Council Directive 92/43/EEC) in the Solway Firth Special Area of Conservation (SAC) include mud flats, salt marsh, estuaries and lagoons whilst priority features of the South Solway Mosses SAC include large areas of lowland raised bogs (JNCC, 2022).

Figure 1 Adult white tailed eagle nesting in larch (*Larix decidua*), Wester Ross (photo credit: M Mayhew).

2.2 Summary

Data and methods for modelling nest site suitability, habitat suitability/foraging potential and risks to reintroduced birds are presented and described here. The outputs from these models are a map assessing the spatial variations in each of these three aspects of the reintroduction project for the Cumbria project area. These can be interrogated individually or combined to produce a map showing the overall suitability for WTE reintroduction taking nesting, foraging and risk into account. These mapped outputs can be used to support field-based assessments and stakeholder inputs, and ultimately be used to help inform decisions regarding optimal/near-optimal locations for reintroductions.

3. Assessment of need

Spatial analyses of breeding and habitat suitability together with any associated risk elements should be a key component of any reintroduction project (IUCN, 2013; Seddon et al., 2007). All species have specific requirements for their respective ecological habitats as regards breeding, foraging and movement/migration and thus occupy particular habitats and niches. Many of the factors determining suitability for breeding, foraging and movement are inherently spatial in nature and so can be mapped and modelled using GIS and other spatially explicit approaches. Mapping and analyses carried out in support of species reintroduction can be highly valuable tools to assess the feasibility of a successful reintroduction in many cases.

As regards testing the feasibility of WTE reintroduction into Cumbria, a spatial assessment of nest site suitability, habitat suitability/foraging potential and likely risks to the reintroduced birds is a valuable aid to assessing the feasibility of reintroduction. Decisions made as to reintroductions based on potential nest site location(s), available food and habitat, and any potential risk are best made with full information on spatial variation in these factors to maximise chances of a successful outcome. The models used here are a key contribution towards assessing the potential for WTE reintroduction in Cumbria based on a spatial assessment of (1) nesting potential, (2) habitat suitability and foraging potential, and (3) risks from land use, infrastructure and possible human-wildlife conflicts. Each assessment required specific spatial data inputs and models. All three assessments can be combined into a single map showing overall suitability for WTE reintroduction with relevant stakeholder input.

Nest site suitability requires two sub-models; the first assessing the availability of suitable nest sites on cliffs and in trees with enough suitable habitat for foraging within 6-10km of the nest site, and the second assessing the potential location of artificial nest site platforms based on optimising suitable habitat for foraging. A MaxEnt model is used to assess the combined suitability of cliff/tree nest sites and habitat/foraging potential, while MCE (multi-criteria evaluation) models are used to assess platform location based on available habitat and foraging potential. These models are provided as initial indicative outputs. Further work may be required to refine and test these in the full feasibility study.

Habitat suitability and foraging potential can be assessed using empirical knowledge of WTE habitat requirements based on land cover/habitat type and proximity to open water (either coastal marine or inland freshwater) for foraging. A preliminary MCE model is developed to assess habitat suitability and foraging potential.

Risk assessments can be made using land cover/land use data combined with information on the location of dangerous infrastructure (principally wind turbines) and potential for human- wildlife conflicts. An MCE model is proposed to assess the spatial pattern in risk factors.

3.1 Previous work

Previous work on WTE reintroductions has been carried out in Ireland and Scotland (see for example O'Rourke, 2014; Whitfield et al., 2009; Whitfield et al., 2013). Some of this work has used spatial analysis to help understand nest site selection and habitat suitability/foraging potential (as well as dispersal patterns) among WTEs (e.g. Evans et al., 2010) while Mayhew et al (2016) assesses the public response to reintroduction. Recent work by Williams et al (2020) has focused on WTE reintroductions in Wales and use of historical records to evaluate their likely past distribution along with Golden Eagle.

The work of Williams in her PhD thesis has included the use of GIS and MaxEnt models to assess the location of potential nest sites for WTE based on data from existing known WTE nest sites and their surrounding habitat across Scotland. The MaxEnt model uses the location of these known sites together with a suite of spatial datasets relating to nest site and habitat suitability to predict the potential distribution of a species based on the theory of maximum entropy. This estimates a probability distribution of species occurrence that is closest to uniform while accounting for variations in environmental variables influencing nest site location and habitat suitability (Philips et al., 2006).

A range of nest site and habitat variables are used by Williams in the MaxEnt model. These are: altitude, slope, aspect, distance from coast, distance from inland water bodies (lakes), distance from woodland and habitat type. The work reported here builds on this work.

3.2 Nest site suitability assessment

Nesting sites of WTEs are generally found on cliffs or in mature trees. There are around 150 breeding pairs located mainly in the northwest Highlands and Islands. Data has been made available at a 1 km resolution showing the grid squares in which breeding WTEs have been observed. The exact coordinates of nest sites are known but not made available for this project due to concerns over data sensitivity and risk of persecution. However, dasymetric mapping techniques can be used with the data provided to identify probable nest sites based on the 1 km grid squares plus a 500m buffer (to allow for possible rounding of 1 km resolution coordinates) and the location of suitable nesting cliffs and/or woodland. A 50m point mesh is overlaid on these data to identify all locations meeting the above criteria and used as input to the MaxEnt model to represent known nest site locations (see Figure 2 showing Canna asan example). All other locations are ignored. This approach enables higher precision data to be derived than that provided by a simple 1 km grid cell centroid that may not accurately represent the nest sites of breeding WTEs observed in the cell.

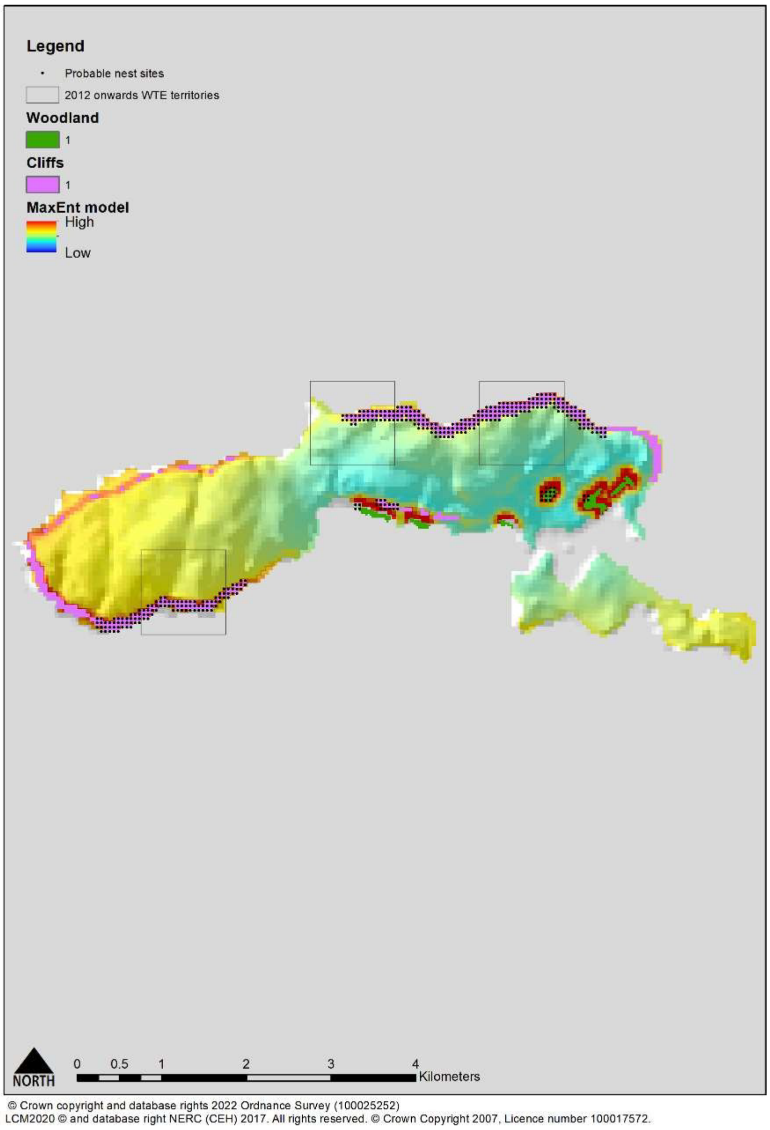

Figure 2 WTE territories on Canna showing possible cliff and tree nest sites together with MaxEnt model results

Having identified probable nest site locations these data can be combined with the habitat and nest site requirements of WTEs in a MaxEnt model. These data are altitude, slope, aspect (measured as cosine of aspect), distance from coast, distance from inland water bodies, distance from woodland and habitat type. The results from the initial MaxEnt model run using these input layers are shown in Figure 3 for NW Scotland and Cumbria.

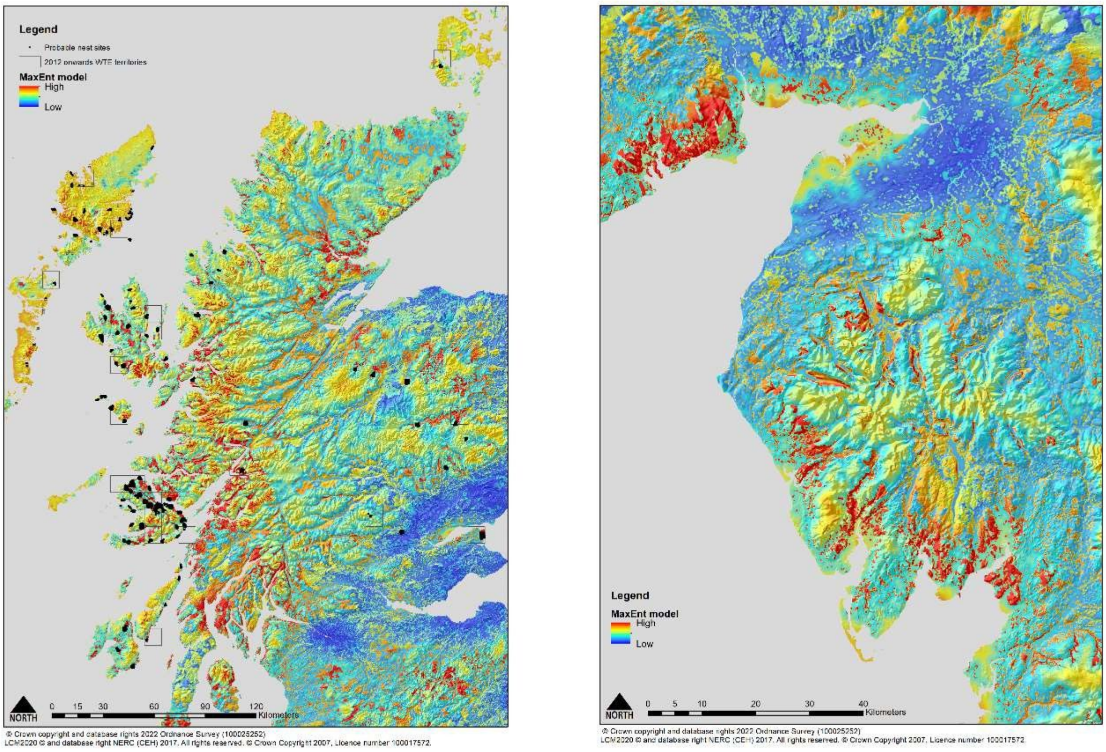

Figure 3 MaxEnt model results for a. NW Scotland (with existing nest sites shown) and b. Cumbria

GIS is used to model each of these factors from existing spatial datasets derived from Ordnance Survey digital terrain data (OS Terrain50) and CEH Land Cover Map 2020. The CEH land cover data is reclassified into 3 classes (1= low, 2 = medium and 3 = high) describing both nest site suitability and habitat/foraging potential based on known nesting and habitat requirements of WTE from the literature (Figure 4).

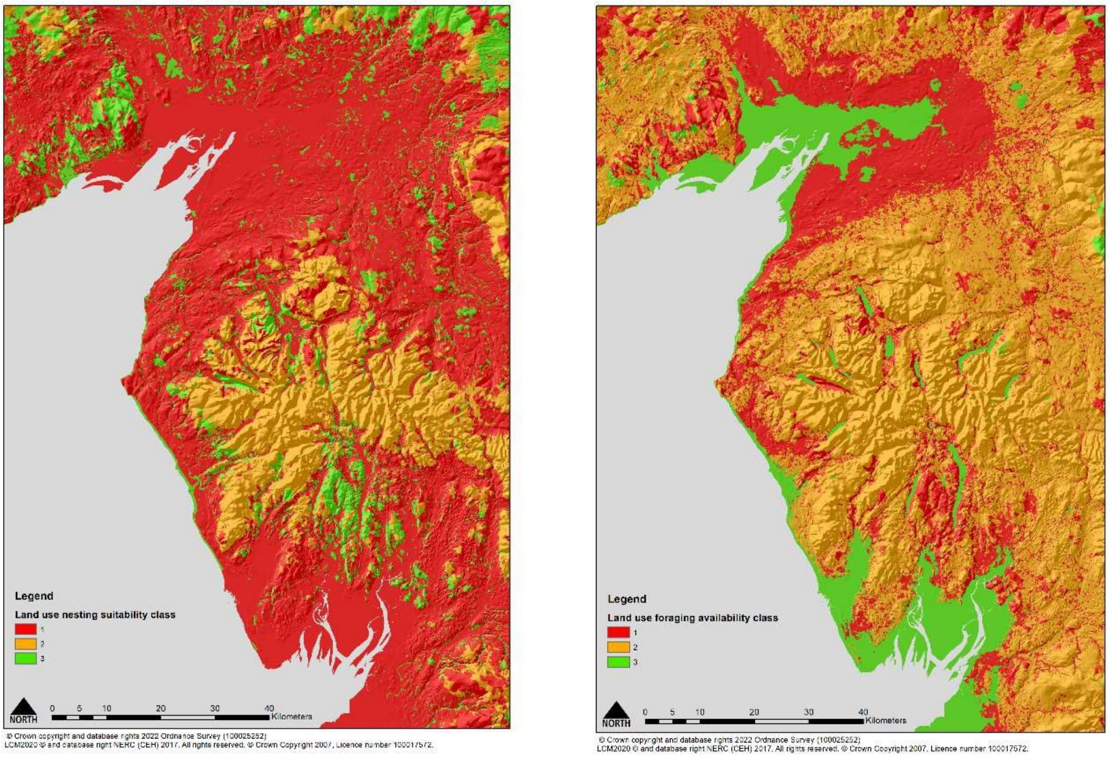

Figure 4 .Land use nesting suitability (left) and foraging availability class (right), where 1= low, 2 = medium and 3 = high

This site suitability model assumes that WTEs will be nesting on natural features of either cliffs or mature trees. It is also possible that WTEs can nest on artificial platforms erected for the purpose. In this instance, an MCE model can be used to assess the habitat and foraging requirements of WTE across the proposed reintroduction project area to identify suitable sites for erection of a platform. As with the MaxEnt model, these data inputs will include altitude, distance from coast, distance from inland water bodies, distance from woodland and habitat type. Data on slope and aspect are left out in this instance as these are variables that relate specifically to cliff nest sites. Results from the preliminary MCE models are shown in Figure 5.

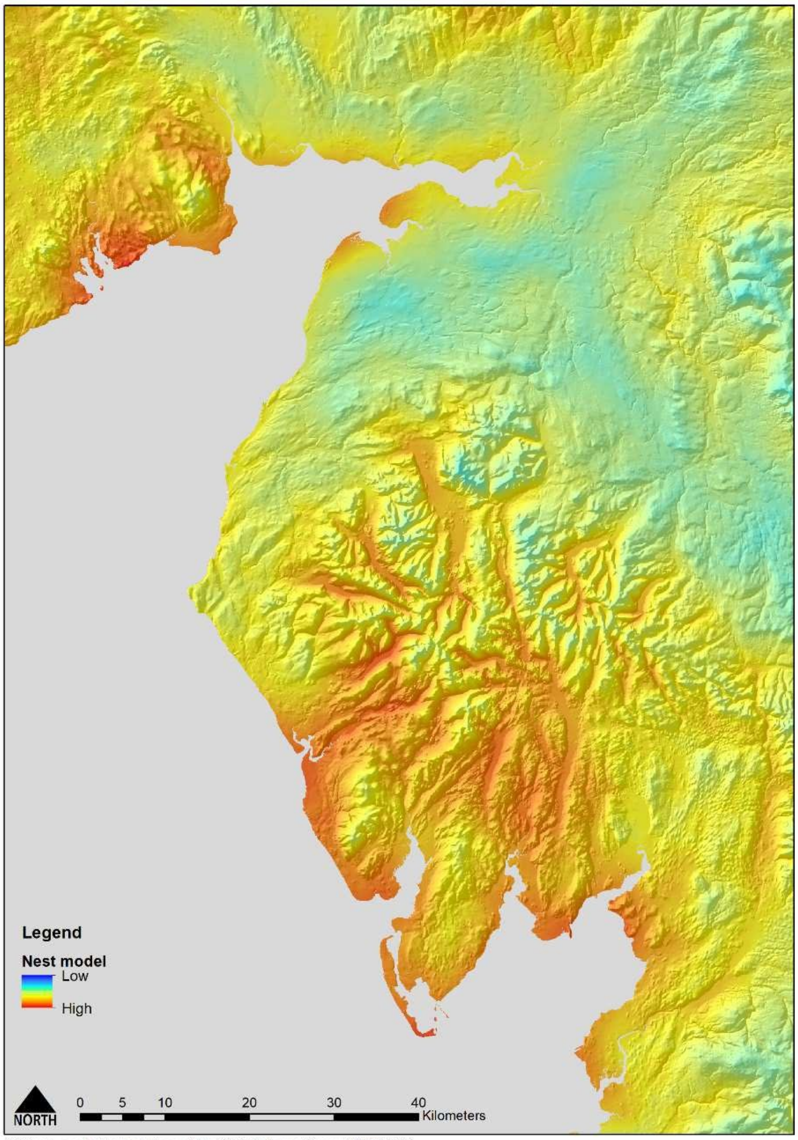

Figure 5 MCE model results for nest site suitability (platform) in Cumbria

3.3 Foraging suitability assessment

A sub-model to the nest site suitability assessment is foraging potential. In this instance, empirical observations of WTE nest site selection and foraging behaviour suggest that breeding pairs will select nest sites with suitable habitat types and foraging potential within a maximum 6-10km radius. Suitable habitats and foraging areas are therefore modelled with both 6 and 10 km search radii based on spatial patterns in land cover reclassified into three classes describing habitat/foraging potential and distance from coast and inland water bodies.

An MCE model then used to combine these three inputs into a single habitat suitability/foraging potential layer (Figure 6).

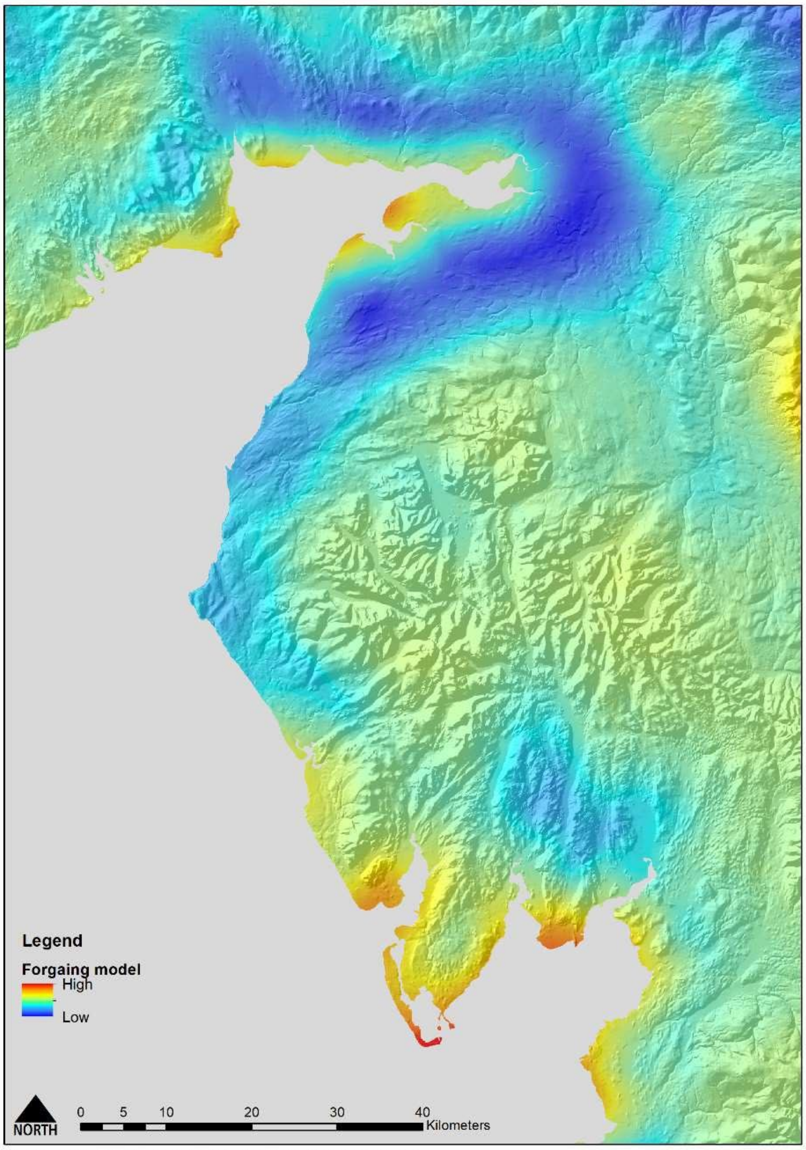

Figure 6 MCE model results for WTE foraging in Cumbria

3.4 RISK ASSESSMENT

A third assessment is based around modelling the potential risk to WTEs from land use, collision with large scale infrastructure and potential for human-wildlife conflict. As with both nest site and habitat/foraging suitability, land cover data is reclassified into three classes describing likely risk to WTE associated with different land uses. Collision with wind turbines is also a concern. The location of all industrial wind turbines in the UK (both onshore and offshore) and these are used to define a wind turbines density surface. WTE are known to occasionally feed on carrion (including dead sheep/lambs) and may predate on live lambs. This has given rise to concerns among sheep farmers that WTE pose a risk to their livestock, particularly around lambing time. Data from the Agricultural Census on numbers of lambs and sheep are used to create a sheep density surface. All three layers (general land use, wind turbines and sheep density) are combined using an MCE model to create a risk assessment for WTE (Figure 7).

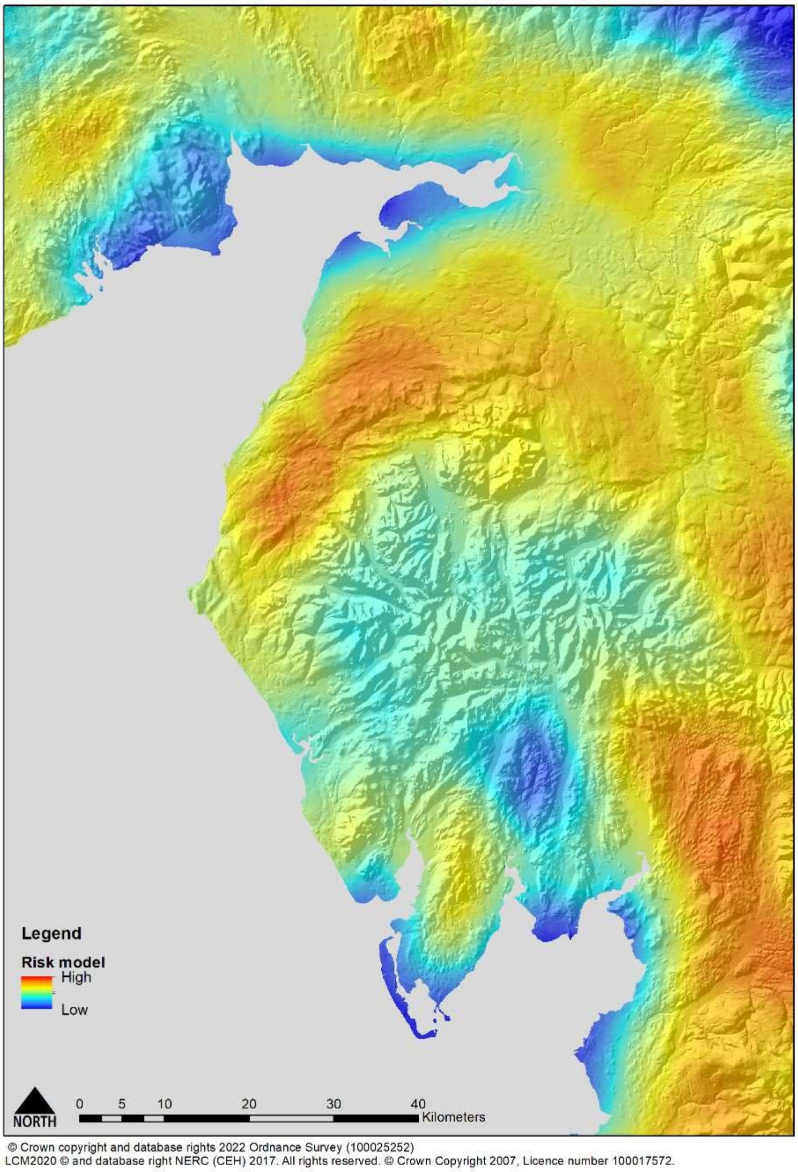

Figure 7 Mortality isk factors for WTE in Cumbria (MCE model results), low risk indicated in blue to high risk indicated in red.

3.5 Further work

The spatial modelling presented here as part of this pre-feasibility study is exploratory in its nature and serves to demonstrate the feasibility and value of spatial modelling of WTE habitat requirements and potential risk factors. Further work is required to refine and improve these models. This will include sensitivity analysis for data inputs in both the MaxEnt and MCE models, development of input factor weighting schemes based on expert and stakeholder input, and comparison with existing models. This work will form part of the full feasibility study.

Sensitivity analysis is an essential part of most modelling. Here, our knowledge of WTE habitat and nesting choices are limited by observation of the small existing population in NW Scotland. This might prove to be sub-optimal habitat and therefore further analysis of the inputs and assumptions made in the models used is required to better asses nest site selection and foraging suitability in the Cumbria region. Further work will employ Monte Carlo Simulation ("Bootstrapping") techniques and Leave-one-out analyses ("Jack-knifing") to determine the sensitivity of the models to input data uncertainty and assumptions. Monte Carlo methods work by adding random noise to the input data and repeating the analysis n times (where n ~100) to assess the impact on model results. Leave-on-out analysis do repeat re-runs of the models leaving one of the input layers out each time. Variations in the model outputs show the sensitivity of the models to each of the input layers. MCE models are also sensitive to input layer weights. The models preliminary models reported here all assume equal weights for all input layers. Further work with WTE experts and relevant stakeholders will be used to refine and adjust these weights to provide more realistic model outputs. Again, a Monte Carlo Simulation will be used to determine the effects of input weight uncertainty on the model results.

3.6 Priority Sites

We have carried out preliminary research into potential suitable release sites as part of this project, using a combination of the habitat suitability modelling described above and ground truthing. A report prepared by Roy Dennis from the Roy Dennis Wildlife Foundation on the potential release sites investigated can be found in Annex I to this report.

The feasibility study will investigate release sites further and select the most appropriate according to the following criteria:

1. Results of habitat surveys to identify suitable foraging and nesting habitat
2. Protected area status and security from land-use change
3. Levels of disturbance
4. Access agreements with landowners

4. Diet

Range wide dietary studies based on the analysis of pellets and nest site remains have revealed that WTEs are opportunistic hunters and scavengers that take advantage of a wide range of seasonally abundant food resources. Waterbirds and fish are the most important constituents in the diet with small to medium sized mammals and carrion also consumed when available (Ekblad et al., 2020; Sandor et al., 2015; Whitfield et al., 2013).

Evidence from the Isle of Wight reintroduction suggests that WTE populations in shallow estuarine areas are heavily dependent upon seasonally abundant grey mullet, shifting to waterbirds in the winter months.

Many European WTE populations are heavily dependent on wildfowl and seabirds. In the Danube Delta Sandor et al., (2015) revealed that 55% of the dietary biomass of WTEs was avian prey with Eurasian coot (*Fulica atra*) and greylag goose (*Anser anser*) as the two dominant species. On the Inner and Outer Hebrides, Whitfield et al., (2013) observed that 49.6% of the diet in predominantly coastal WTE populations was colonial nesting seabird species, with fulmar (*Fulmarus glacialis*) constituting the most important prey resource.

Some WTE populations have adapted to exploit abundant freshwater and marine fish species. Ekblad et al., (2020) analysed prey remains from WTE populations foraging near large freshwater lakes in northern Finland and observed that fish made up 64% of all identified prey items with pike (*Esox Lucius*) representing the most common species. Dietary studies in north- eastern Germany also revealed a high dependence on fish (77%) and a correlation between the size of the fish and species selected. In line with optimal foraging theory, WTEs were targeting medium to large bream (*Abramis brama*), carp (*Cyprinus carpio*) and pike between 30-50cms in length (Nadjafzadeh et al., 2015).

Medium and large sized mammals are more commonly exploited as carrion than hunted as live prey (Dementavicus et al., 2020; Ekblad et al., 2020; Whitfield et al., 2013). WTEs will scavenge from the carcasses of red fox (*Vulpes vulpes*), roe (*Capreolus capreolus*) and red deer (*Cervus elaphus*), but smaller species such as rabbits (*Oryctolagus cuniculus*) and hares (*Lepus europaeus*) are often hunted as live prey (Ekblad et al., 2020; Sandor et al., 2015). Several immature birds from the ongoing Isle of Wight WTE reintroduction project have settled in inland areas to take advantage of abundant hare and rabbit populations and Rijn et al., (2010) observed rabbit and brown rat (*Rattus norvegicus*) in the prey remains of WTE foraging at Oostvaardersplassen in the Netherlands.

Various authors have documented a perception amongst sheep farmers in Scotland that declines in lambing percentages were attributed to WTE predation of live lambs (Simms et al., 2010; Marquiss et al., 2004; Marquiss et al., 2003). However, studies in Gairloch in Wester Ross (2009) using radio tags on lambs and direct observation of WTE foraging behaviour, did not confirm any incidents of live lamb predation (Simms et al., 2010). Furthermore, the analysis of lamb remains from WTE nest sites on the Isle of Mull has revealed that the majority were scavenged, small for their age and non-viable (Marquiss et al., 2004).

4.1 BIRDS

The south side of the Solway Firth estuary from Rockcliffe Marsh to St Bees Head supports internationally important populations of waterbirds on a range of intertidal habitats, peatlands, marshlands, and areas of wet grassland (Solway Firth Partnership, 2016). A large proportion of the landscape is designated to protect a species and habitats of conservation concern. Designated sites include the Solway Firth Special Area of Conservation (SAC), Upper Solway Flats and Marshes Ramsar Site, the South Solway Mosses National Nature Reserve (NNR), The Solway Coast Area of Outstanding Natural Beauty (AONB) and several Sites of Special Scientific Interest (SSSIs) (MAGIC, 2022). Additional protection for wintering and breeding ducks, geese, wading birds and seabirds is provided by two RSPB reserves at Campfield Marsh and St Bees Head (MAGIC, 2022).

The Solway coast, which straddles the border between England and Scotland, is one of the most extensive intertidal habitats in the UK and supports 145,000 overwintering and breeding wildfowl, waders and seabirds (Solway Firth Partnership, 2016). The Solway Firth Special Protection Area (SPA) was designated to protect a range of avian species including Svalbard barnacle geese (*Branta leucopsis*), pink- footed geese (*Anser brachyrhynchus*), pintail (*Anas acuta*) as well as waders such as bar- tailed godwit (*Limosa lapponica*), golden plover (*Pluvialis apricaria*), oystercatcher (*Haematopus ostralegus*), dunlin (*Calidris alpina*), knot (*Calidris canutus*), curlew (*Numenius arquata*) and lapwing (*Vanellus vanellus*) (JNCC, 2022) (Table 1.).

Many waterbird populations are sustained by the abundant intertidal invertebrates such ragworm (*Hediste diversicolor*), lungworm (*Arenicola marina*), mudsnail (*Hydrobia ulva*e) common blue mussels (*Mytilus edulis*) and common cockles (*Cerastoderma edule*) (Solway Firth Partnership, 2016).

During the late autumn and winter, it is likely that WTEs would feed opportunistically on abundant adult barnacle and pink-footed geese, ducks such as wigeon (*Mareca penelope*) and teal (*Anas crecca*) and small to medium sized gulls such as black-headed gull (*Chroicocephalus ridibundus*). In the breeding season WTEs would hunt goslings from growing populations of non-native Canada (*Branta canadensis*) and feral greylag geese (*Anser anser*), resident duck species such as shelduck (*Tadorna tadorna*) and young corvids.

Table 1 5-year average population size for avian species listed in the Solway Firth SPA (https://app.bto.org/webs-reporting/principal.jsp). (A wetland is of international importance if it regularly supports 1% of individuals in a population of one species or a or a minimum of 20,000 birds. A wetland of national importance holds a minimum of 1% of the British population of one species).

Common name	Scientific name	5 year average (15/16-19/20)	Threshold Exceeded	Red List Status
barnacle goose	*Branta leucopsis*	40958	International	
bar-tailed godwit	*Limosa lapponica*	552	National	
black-headed gull	*Larus ridibundus*	3436		
common goldeneye	*Bucephala clangula*	54		
common gull	*Larus canus*	2158		
common scoter	*Melanitta nigra*	271		
common shelduck	*Tadorna tadorna*	2772	International	
cormorant	*Phalacrocorax carbo*	821		
dunlin	*Calidris alpina alpina*	17418	International	
eurasian curlew	*Numenius arquata*	2183	National	
eurasian oystercatcher	*Haematopus ostralegus*	26672	International	
eurasian teal	*Anas crecca*	3357		
golden plover	*Pluvialis apricaria*	5395	National	
greater scaup	*Aythya marila*	596	National	
grey plover	*Pluvialis squatarola*	349		
herring gull	*Larus argentatus*	1898		
knot	*Calidris canutus*	8227	International	
red breasted merganser	*Mergus merganser*	53		
northern lapwing	*Vanellus vanellus*	4723		
northern pintail	*Anas acuta*	3042	International	
northern shoveler	*Anas clypeata*	197	National	
pink footed goose	*Anser brachyrhynchus*	11346	International	
red throated diver	*Gavia stellata*	5		
redshank	*Tringa totanus*	2836	International	
ringed plover	*Charadrius hiaticula*	964	International	
ruddy turnstone	*Arenaria interpres*	485		
sanderling	*Calidris alba*	455	National	
whooper swan	*Cygnus cygnus*	303	National	

4.2 FISH

The shallow waters of the Solway Firth estuary provide nursery and spawning grounds as well as migratory passage for up to 130 species of fish (Potts and Swaby, 1993). As sight feeders WTEs will catch fish on the wing in the top of the water column or in the shallows and will feed on dead fish washed up in the intertidal zone. Seasonally abundant species likely to beeaten are shown in table 2.

Table 2 Seasonally abundant fish species likely to be eaten by WTEs in the Solway Firth (Solway Firth Partnership, 2022; Philip Ramsden, Environment Agency, pers. comm.)

Grey mullet (*Chelon labrosus*)	Very abundant surface feeders in the inner reaches of the Solway Firth during the summer months of the year extending into brackish areas of river inlets with the rising tide. Rarely targeted by recreational anglers but fished commercially due to a rising market value.
Bass (*Dicentrarchus labrax*)	Young bass will also feed in the top of the water column and like grey mullet are plentiful in the upper reaches of the Solway Firth during the summer months.
Flounder (*Platichthys flesus*)	A range of flatfish including dab and plaice occur as adults in the outer reaches of the Solway. However as bottom feeders they occupy the demersal zone and would not be accessible to WTEs. By contrast flounder are abundant in the shallow waters of the inner estuary and migrate into the brackish waters of river inlets. They constitute an important component of the diet for nesting ospreys on the north side of the Solway and would also be hunted by WTEs.
Mackerel (*Scomber scombrus*)	Large shoals of surface feeding mackerel can be found along the coastline in the outer reaches of the Solway Firth although smaller numbers do move up the estuary into shallow waters.
Atlantic salmon (*Salmo salar*) Sea trout (*Salmo trutta*)	These two anadromous species spawn in the rivers which drain into the Solway Firth including the Border Esk, Eden and Annan and would provide a prey resource for WTEs during their summer and autumn migration. Sea trout and salmon would be particularly vulnerable to predation as

	they shoal in shallow water at the river mouths waiting for rising water levels to enable them move into freshwater.

4.3 MAMMALS

Dietary studies of WTEs across their geographic range have revealed that a restricted number of medium sized mammal species are hunted as live prey by WTEs (Ekblad et al., 2020; Sandor et al., 2015). Foxes, larger mustelids such as badgers and deer species are too large and high risk to target as live prey and small mammals such as mice and voles are also rarely hunted (Ekblad et al., 2020; Sandor et al., 2015). By contrast lagomorphs such as rabbits and hares and brown rats are seasonally abundant along the Cumbrian coast and lowlands and would be accessible to WTEs as they forage across open grassland habitats.

4.4 CARRION

WTEs will feed on carrion at all times of year but the proportion in the diet is likely to increase through the winter months due to the greater abundance of wintering wildfowl and increase in mammalian mortality rates. Along the Solway coast and lowland areas further inland, WTEs would scavenge medium to large mammal carcasses such as deer species and fallen livestock and would also have access to carcasses of wildfowl, waders and seabirds and pheasants. Additional food resources would be provided intermittently by carcasses from the grey seal (*Halichoerus grypus*) colony managed by the Cumbria Wildlife Trust (CWT) at their South Walney Nature Reserve and spawned Atlantic salmon (*Salmo salar*) in the lower reaches of the rivers Eden and Esk (Toby Mounsey-Heysham pers. comm.). Drone surveys conducted in spring 2021 counted 518 individuals at the reserve and the colony has grown five-fold in the last decade (Cumbria Wildlife Trust, 2021).

The full feasibility will update the likely diet range of WTEs in Cumbria with reference to recent data obtained from biological record centres such as the Cumbria Biodiversity Data Centre and local organisations such as the Cumbria Bird Club, the Solway Firth Partnership and the North West Inshore Fisheries and Conservation Authority. Given the diversity and seasonal abundance of prey species in the coastal lowlands of Cumbria it is unlikely that prey availability will constrain population establishment and growth following a WTE translocation.

5. RISK ASSESSMENT

5.1 IMPACTS ON AVIAN SPECIES

Reintroduced WTEs could impact on avian species of conservation concern through direct predation events and disturbance at roost sites in the winter and nest sites during the breeding season (Collop et al., 2016). Repeated disturbance by an apex predator could reduce available foraging time, increase energy use and impact on prey survival (Collop et al., 2016). These direct and indirect effects are density dependent and are likely to increase as the WTE population grows towards carrying capacity.

However, many important prey species such as geese and ducks are migratory and already encounter WTEs on their arctic breeding grounds or on passage to their wintering grounds. Seasonally abundant prey is therefore likely to have evolved behavioural adaptations to mitigate disturbance impacts and enable them to coexist as sympatric species (Clausen et al., 2018). The presence of WTEs could also reduce disturbance to waders and waterfowl by displacing avian meso-predators at lower trophic levels such as peregrine falcons (*Falco peregrinus*) which are abundant along the Cumbrian coast.

WTEs frequently target sick and injured birds in preference to healthy adults. Therefore, although direct predation of avian prey is inevitable, population level impacts are often reduced or negligeable as those individuals hunted by WTEs were likely to die of other causes and therefore mortality is compensatory rather than additive.

Method

Data from the Wetland Bird Survey (WeBS) **(https://app.bto.org/webs-reporting/principal.jsp)** and Cumbria Bird Atlas (2007-2011) (Cumbria Biodiversity Data Centre, 2015) were used to select a short list of native breeding and overwintering species in the following categories:

1. The species is of national or international importance in the Solway SPA; or
2. The species is red listed with a Cumbrian distribution that overlaps with areas of suitable WTE habitat.

A literature-based risk assessment was then conducted on the short-listed species by identifying and quantifying range wide evidence of predation by WTEs.

Geese and ducks

The Solway Firth holds the entire population of overwintering Svalbard barnacle geese and internationally important populations of pink-footed geese which would constitute an important resource for WTEs during the winter months **(https://app.bto.org/webs-reporting/principal.jsp)**. Populations of pink-footed geese can fluctuate widely from year to year but the five-year average for barnacle geese has increased 20-fold over the last 50 years from approximately 2,000 to 40,000 birds despite a moderate population decline over the last three years (**https://app.bto.org/webs-reporting/numbers.jsp**). With a combined 5-year average of 52,000 birds, it is unlikely that WTEs would impact at a population level on these two species (**https://app.bto.org/webs-reporting/numbers.jsp**).

The Solway SPA also holds internationally important populations of overwintering and breeding shelduck and overwintering northern pintail both of which are amber listed as a result of moderate breeding population declines in the UK (Stanbury et al., 2021). Smaller numbers of nationally important scaup and northern shoveler are also present mainly as winter visitors to the Solway (**https://app.bto.org/webs-reporting/principal.jsp**). WTEs are likely to opportunistically hunt the most abundant species and could take adult pintail and shelduck in the winter and shelduck chicks during the breeding season. Prey remains and direct observations of hunting WTEs at Oostvaarderplassen in the Netherlands and from Lithuania have revealed that pintail, shelduck and northern shoveler constitute a small part of the diet (Dementavicus, 2020; Rijn et al., 2010). Red-listed goldeneye and common scoter are recorded in the Solway SPA but at such low numbers that exploitation by WTEs would be very rare (**https://app.bto.org/webs-reporting/principal.jsp**).Waders

Large populations of wading birds feed in the rich intertidal habitats along the Solway Firth and breed in the saltmarsh and wet grassland habitats adjacent to the coast (Solway Firth Partnership, 2016). In the winter the most abundant species include internationally important populations of dunlin, knot and oystercatcher and nationally important populations of golden plover (**https://app.bto.org/webs-reporting/principal.jsp**). Protected sites along the Solway such as RSPB Campfield Marsh and Drumburgh Moss NNR are managed as breeding habitat for red-listed ground nesting waders such as curlew and lapwing. The species of wading birds listed in the Solway SPA coexist with WTEs across large parts of their geographic range but do not constitute a large proportion of the seasonal diet of WTEs (Dementavicus et al., 2020; Ekblad et al., 2020; Whitfield et al., 2013). Studies in Scotland, Lithuania and Finland established that waders only constituted 2.7%, 0.7% and 1.2% of the diet respectively (Dementavicus et al., 2020; Ekblad et al., 2020; Whitfield et al., 2013). Peregrine falcons and common buzzards are likely to pose a greater threat to adult wading birds in the winter and chicks in late spring and early summer and the risk of population level impacts to waders as a result of WTE predation is very low.

Gulls

The only gull species cited in the Solway SPA is the red-listed herring gull (JNCC, 2022). Small to medium sized gulls are hunted by WTEs but the evidence suggests that herring gulls are not a prominent part of the diet (Dementavicus et al., 2020; Koryakin and Boyko, 2005). As colonial breeders, gulls display defensive behaviour around the nest and it is likely that they would mob hunting WTEs to protect adults and chicks in the colony. Herring gulls nest along the Cumbrian coastline from Whitehaven to St Bees Head (Cumbria Biodiversity Data Centre, 2015) but many colonies are situated in urban areas with substantial anthropogenic disturbance such as the rooves of industrial units and warehouses which would not be accessible to WTEs. Whilst the predation of chicks by WTEs at individual breeding colonies could reduce productivity, population level impacts on herring gulls are unlikely.

4.2 Impacts on mammalian species

Method

Data from the IUCN – compliant Red List for Britain's Terrestrial Mammals (Mathews and Harrower, 2020) and Cumbria Mammal Atlas (2017) (Cumbria Biodiversity Data Centre, 2017) were used to select native species for risk assessment if they met the following criteria:

1. The species is categorised in England as near threatened, vulnerable, endangered or critically endangered and therefore at risk of extinction.
2. The species is distributed in Cumbria in areas of suitability for WTEs.

A literature-based risk assessment was then conducted on the short-listed species by identifying and quantifying range wide evidence of predation by WTEs.

Results

WTEs would exploit more abundant populations of terrestrial mammals but most studies have shown that mammalian prey is a small proportion of the overall diet, and a restricted number of medium sized species such as rabbits and hares are targeted (Ekblad et al., 2020; Sandor et al., 2015).

An analysis of the 34 extant, native terrestrial mammal species in Cumbria identified 8 at risk of extinction; hedgehog (*Erinaceus europaeus*), red squirrel (*Sciurus vulgaris*), water vole (*Arvicola amphibius*), hazel dormouse (*Muscardinus avellanarius*), pine marten (*Martes martes*) barbastelle bat (*Barbastella barbastellus*), Leisler's bat (*Nyctalus leisleri*), Nathusias' pipistrelle bat (*Pipistrellus nathusii*) (Mathews and Harrower, 2020; Cumbria Biodiversity Data

Centre, 2017). None of these 8 taxa require comprehensive risk assessment because there is no evidence of predation events relating to these species in the literature of WTE dietary studies.

Along the Solway there may be concern from the public about WTE impacts on red squirrels and brown hares. Hares are abundant in some low-lying areas along the Cumbrian coast and are hunted as live prey in other parts of the WTEs range (Ekblad et al., 2020; Cumbria Biodiversity Data Centre, 2017). However, as a non-native, naturalised species the population is stable, and it is unlikely that predation would result in population level declines (Mathews and Harrower, 2020). Along the Cumbrian side of the Solway the highest density of red squirrel sightings has been recorded around the towns of Workington and Whitehaven in coastal areas which would also constitute suitable WTE habitat (Cumbria Biodiversity Data Centre, 2017). However, WTEs have adapted to passive soaring with long broad wings and deeply slotted primary feathers. As such they lack manoeuvrability in forest environments and are unable to hunt healthy red squirrels as live prey.

6. Social feasibility

We propose to build on and adapt the successful WTE consultation approach used by the Roy Dennis Wildlife Foundation for the Isle of Wight and Wild Ken Hill feasibility studies, reflecting recognised good practice alongside a focus on local needs and priorities. During the feasibility stage we will:

1. Hold a **social feasibility expert workshop** to identify best practice from UK/European raptor species translocation projects
2. Conduct a **stakeholder mapping exercise.** Whilst this will be location dependant, it is likely to include representatives from a range of sectors including (but not limited to) farming, tourism/local business leaders, game estates, conservation and protected area management, utilities, forestry, education and local government
3. Develop a **communications plan** (e.g., project newsletter, social media, links to project partner coms, etc.)
4. Develop and implement an adaptive **social feasibility plan**. Whilst this will be based on outcomes from the above activities, and will reflect local needs and priorities, it is likely to include: an **online questionnaire** (we envisage around 2000 respondents reflecting national, regional and local perspectives); **open community meetings** and **drop-in sessions** (around 4-5 events with questionnaires); 2-3 **sector-specific meetings** (e.g. farming representatives to discuss project management and compensation approaches, tourism/local business leaders, conservation agencies), 2- 3 **open webinars**; around 10 **individual meetings** with key stakeholders (leading to the establishment of a stakeholder forum, which we envisage functioning as a communication and conflict management resolution group), and an **education outreach strategy** (we see the development of a schools programme as essential for project sustainability and 'next generation' support).
5. Conduct a **social feasibility evaluation exercise** to review efficacy of activities and data quality

We will also develop an outline plan for longer-term community engagement (should WTE translocation be found to be socially and ecologically feasible). This is likely to take the form of the stakeholder forum mentioned above – the composition and terms of reference for this group will be developed during feasibility. We suggest a two-tier consultation approach; **Tier 1** within 50 km of reintroduction sites to accommodate immediate habitat use. **Tier 2** consultation at regional/national level (given that WTEs are likely to disperse more widely).

Tier 1 'core communities' are more likely to be affected by the reintroduction and we will prioritise consultation activities in these areas (following IUCN Translocation Guidelines). Alongside activities outlined above, we will also work with relevant stakeholders to (where possible) co-develop other areas of project activity, including (but not limited to) predation mitigation/compensation protocols, success indicators and exit strategies.

Tier 2 consultation will focus on the regional/national level, and this is likely to be mostly online survey work, video-call meetings and webinars.

The communications plan for feasibility consultation activities will also scope potential implementation communications should this stage be reached. Again, this will be developed to reflect local needs and priorities, but is likely to include a project website, regular newsletter, attendance at local/regional events (e.g. agricultural shows) and a WTE local champion/ambassador programme.

Social feasibility activities are likely to take between 6-9 months[2]. We will, however, take an adaptive approach in order to respond to any significant issues that arise during the initial phases of consultation activity, and it may be prudent to expand and/or intensify specific areas of the consultation plan. This might include targeted community plans, education plans, and the use of conflict management techniques such as Q Methods.

As background for the above, there is already evidence that a WTE reintroduction would be accepted in Cumbria, albeit from a small (n=300) conservation-minded sample group. A 2020 survey of Cumbria Wildlife Trust members based on the Lifescape Project missing species report[3] identified that 96% of respondents had heard of WTEs, 77.5% agreed that they should be reintroduced to northern England, 77.5% felt that WTEs have a positive economic impact on the reintroduction area, and 89.3% either agreed or strongly agreed with the statement *'If I was to go for a walk in the countryside and there were white-tailed eagle in the area, it would make the experience more enjoyable'*. Whilst we recognise the limitations of these data, it nevertheless encouraging that there is support in the conservation sector, and there are likely to be community members willing to act ambassadors for the project. Similarly, an earlier study by Mayhew *et al.* (2016) identified broad public support for this reintroduction (in Cumbria), which transcended differences in the demographic, geographic, and employment profiles of the study cohort. There was also public recognition that white-tailed sea eagles could deliver a broad range of socioeconomic and environmental benefits with few detrimental impacts

[2] A detailed timeline setting out timeframes for each element of the consultation will be developed as part of the full social consultation plan.

[3] https://lifescapeproject.org/wp-content/uploads/2020/04/Lifescape-Species-Reintroductions-report-2019-Final-226322-4-359-v0.5.pdf

7. Cost-benefit analysis

7.1 Overview

The aim of this assessment is to provide an initial, high level overview of the costs and benefits of a proposed white-tailed eagle (WTE) reintroduction in Cumbria. Further, more detailed assessments could be undertaken in future stages of any reintroduction project.

7.2 Scoping

In order to determine the impacts and dependencies to be included within the assessment, a qualitative materiality assessment was undertaken based on the findings of a literature review. A longlist of environmental, economic, and social impacts was drawn up based on a multi capitals framework, and the impacts of the proposed reintroduction was assessed against each metric as follows:

- áá significant positive impact
- á minor positive impact
- à no or overall neutral impact
- â minor negative impact
- ââ significant negative impact
- á/â both negative and positive impacts

Based on this assessment, the materiality of the potential impacts was then categorised as:

- **High** = high impact and likely to be of importance
- **Medium** = medium impact and potential to be of some importance
- **Low** = low impact and unlikely to be of importance

Impacts that were assessed as having high materiality were considered above the threshold and a priority for inclusion in the assessment. Impacts scored as medium materiality couldbe explored in more detail in future studies. Following this assessment process, a shortlist of material impacts was identified as follows:

- Livestock
- Recreation
- Whole life costs (WLC)

Beyond these impacts, several further areas were identified as having potential impacts that could be explored in more detail in future assessments:

1. Biodiversity	2. Public trust / institutional support	3. Employment and skills
4. Wild foods (including game birds)	5. Community cohesion	6. Data assets
7. Fisheries (commercial and recreational)	8. Volunteering, donation, and charity	9. Knowledge and learning
• Disease and pest control (possible control of invasive Canada geese populations)	10. Culture, identity, and heritage	

The full results are set out in Table 3.

Table 3 Capitals materiality assessment for WTE reintroduction in Cumbria

Ecosystem services	Impact	Explanation	Materiality
Natural capital			
Crops	à	No significant impact identified.	Low
Livestock	ââ	WTEs may occasionally predate live lambs. However this is rare and there is evidence to suggest that when WTEs do predate live lambs the lambs taken are often not viable. This has	High

Ecosystem services	Impact	Explanation	Materiality
		given rise to concerns among sheep farmers that WTE pose a risk to their livestock, particularly around lambing time. In other WTE reintroduction projects (such as in Scotland) there have been conflicts with farmers and, as such, the possible risk needs to be considered. Poultry and pigs could also be affected although the risks are negligible.	
Fisheries	â	A key source of food for WTE is fish species. However, their preference for seasonally abundant prey and varied diet amongst other factors means negative impacts on fishing are very unlikely. There has been no conflict with fishing interests in Germany, Netherlands, Denmark, or Scotland.	Medium
Aquaculture	à	No significant impact identified.	Low
Wild foods	â	There are possible impacts of predation upon game species such as grouse and pheasant although these are not the main target species of prey for WTE due to WTEs' low agility. Studies suggest that gamebirds do form a very small proportion of WTE diet (although at least some of these are scavenged). There is no conflict with shooting interests in Germany, Netherlands, or Denmark.	Medium
Timber	à	No significant impact identified.	Low
Energy (renewables)	à	No significant impact identified.	Low
Biochemicals and medicines	à	No significant impact identified.	Low
Water supply	à	No significant impact identified.	Low
Fibres and ornamental resources	à	No significant impact identified.	Low
Genetic resources	à	No significant impact identified.	Low

Ecosystem services	Impact	Explanation	Materiality
Local climate regulation	à	No significant impact identified.	Low
Global climate regulation	à	No significant impact identified.	Low
Air quality regulation	à	No significant impact identified.	Low
Flood regulation	à	No significant impact identified.	Low
Water quality	à	No significant impact identified.	Low
Pollination	à	No significant impact identified.	Low
Disease and pest control	á	Reintroduction of an apex predator such as the WTE to Cumbria would re-establish top-down regulation on prey and meso-predator populations at lower trophic levels with resulting benefits to the wider ecosystem and the potential to have an impact on populations of non-native waterfowl. Growing numbers of Canada geese in Cumbria are causing eutrophication of the large freshwater bodies such as Lake Windermere, with impacts on water quality, dissolved oxygen levels, and native fauna. Current practices to control Canada geese include egg oiling and are being implemented by the Windermere Geese Management Group administered by the Lake District National Park Authority. An expanding WTE population could potentially support the control of Canada geese by preying ongoslings in the breeding season.	Medium
Noise regulation	à	No significant impact identified.	Low
Soil quality regulation	à	No significant impact identified.	Low
Recreation	áá	Studies from the islands of Mull and Skye have demonstrated the potential for a charismatic, flagship species such as the WTE to attract tourists to an area and support the hospitality sector and associated supply chains. Cumbria has 29 communities that rank within the 10%	High

Ecosystem services	Impact	Explanation	Materiality
		most deprived of areas in England including coastal communities in Copeland, Allerdale, and Barrow-in-Furness. WTEs would provide a year-round attraction which would support these communities by diverting tourists from popular locations in the Lake District National Park.	
Education	à	*Captured within Intellectual Capital.*	Low
Heritage	à	No significant impact identified.	Low
Visual and amenity	à	No significant impact identified.	Low
Biodiversity	á/â	A WTE reintroduction could lead to a complex set of interactions at a species level, but on the whole the reintroduction of a native species would be expected to have a positive impact on biodiversity. The introduction of a charismatic species could also have value in and of its own right through the existence value of the species, although this is likely to be challenging to value within the scope of this assessment so has been scoped out at this stage.	Medium
Social capital			
Public trust / institutional support	á/â	A reintroduction project has the potential to have positive or negative impacts on levels of trust amongst communities, depending on whether it is handled well or poorly. At this stage this has been scoped out of the assessment but could be included at a later stage.	Medium
Physical and mental health	à	No significant impact identified.	Low
Crime	à	No significant impact identified.	Low
Wellbeing	à	No significant impact identified.	Low
Quality of service	à	No significant impact identified.	Low
Community cohesion	â	An increase in the number of tourists couldlead to an increase in disruption to local communities with a knock on impact on their wellbeing. At this stage this has been scoped out of the	Medium

Ecosystem services	Impact	Explanation	Materiality
		assessment but could be included at a later stage.	
Community safety	à	No significant impact identified.	Low
Economic and social inclusion	à	No significant impact identified.	Low
Accessibility	à	No significant impact identified.	Low
Gender equity	à	No significant impact identified.	Low
Racial equity /impacts on BAME	à	No significant impact identified.	Low
Volunteering, donation, and charity	á	A reintroduction project provides an opportunity for volunteers to participate in practical conservation activities providing training, skills, and opportunities for personal growth and development. There are no specific volunteering plans at this stage of the scheme, but this could be explored at a later stage.	Medium
Education	à	*Captured within Intellectual Capital.*	Low
Engagement and networks	à	No significant impact identified.	Low
Creativity	à	No significant impact identified.	Low
COVID-19 recovery	à	No significant impact identified.	Low
Culture, identity, and heritage	á/â	The reintroduction of a predator lost from the landscape could provide positive benefits in terms of connecting people to the landscape and species around them, however, it could lead to challenges to the cultural identity of farming communities who see their role as managing the populations of predators. This issue could be explored in more detail at a later stage.	Medium
Human capital			
Employment and skills	á	A reintroduction project could have the potential to generate jobs as part of the project. This could be explored in more details in future	Medium

Ecosystem services	Impact	Explanation	Materiality
		stages.	
Health and safety	à	No significant impact identified.	Low
Equality, diversity and inclusion	à	No significant impact identified.	Low
Local procurement /supply chain	à	No significant impact identified.	Low
Intellectual capital			
Data assets	á	The reintroduction process could generate data that could be used to inform the science and understanding of conservation practices within the UK. This is an area which could be explored more in future stages.	Medium
Research and development	à	No significant impact identified.	Low
Knowledge and learning	á	A reintroduction project provides an opportunity for schools and universities to undertake research and education projects. There are no specific plans at this stage of the scheme, but this could be explored at a later stage.	Medium
Processes and efficiency	à	No significant impact identified.	Low
Manufactured capital			
Asset value	à	No significant impact identified.	Low
Waste use and reuse	à	No significant impact identified.	Low
Energy production	à	No significant impact identified.	Low
Decommissioning	à	No significant impact identified.	Low
Resilience	à	No significant impact identified.	Low
Financial capital			
CAPEX	à	Captured within WLC.	Low

Ecosystem services	Impact	Explanation	Materiality
OPEX	à	Captured within WLC.	Low
TOTEX	à	Captured within WLC.	Low
WLC	ââ	The reintroduction project is likely to require financial investment to cover the set-up and operational costs of the scheme.	High

7.3 Cost-benefit analysis

This section presents the results of the initial high-level cost-benefit analysis for the three metrics scoped into the assessment: livestock, recreation, and whole life costs. All results are discounted over a five year period (2022 to 2026) and presented in 2020 prices. It is important to note that this is a high level assessment and further work would be needed to verify and expand upon these initial calculations in future assessments.

7.4 Livestock

In order to estimate the potential impacts on livestock the 'White-tailed Eagle Action Plan' in Scotland was reviewed (NatureScot, 2020)During a five-year monitoring project of the impact of WTEs on livestock, this study reported that between 2015 and 2019, 12 lamb carcasses were sent for post-mortem analysis to identify a cause of death, of which 6 were found likely to have been predated upon by WTE or golden eagle. Assuming that all 6 lambs were predated upon by WTE suggests an average predation rate of 1.2 lambs per year.

Alternatively, the same study looked at the expected and actual number of lambs weaned on three farms over a period from 2008 to 2019 in order to assess whether there was a change in lamb loss after WTE were reintroduced in 2015. An analysis of these figures suggests that there were around 38.2 more lambs lost per year after the WTE reintroduction, although it is caveated that there are likely to be a number of causes for this (including the 'Beast from the East' storm in 2018). If this situation occurred in the Cumbria reintroduction, then the number of lambs lost could reach 38.2 per year.

Assuming an average weight per lamb of 20 kg (Statistica, 2022) and a price of £4.79 per kg (DEFRA, 2022), the total annual cost of predation could be between £115 and £3,663 per year.

The total discounted value over the five-year period is therefore estimated to be -£0.001m to -£0.02m.

7.5 Recreation

In order to estimate the potential impacts on recreation 'The economic impact of white-tailed eagles on the Isle of Mull' study was reviewed (Molloy, 2011). Assuming that Cumbria could see a similar increase in visitors and expenditure as the Isle of Mull following a WTE reintroduction, and using the studies central scenario, the total number of visitors to Cumbria interested in seeing WTE could reach 78,085 per year, generating up to £4.5m. Alternatively, assuming the potential number of additional visitors to Cumbria could be better proxied by only those visitors to Mull who listed WTE as the primary reason for their visit, then the total number of visitors could be 4,305 generating around £0.6m per year.

The total discounted value over the five-year period is therefore estimated to be £2.7m to £20.9m.

7.6 Whole life costs

In order to estimate the potential costs of a WTE reintroduction scheme in Cumbria, the 'White- tailed Eagle Action Plan' in Scotland was reviewed (NatureScot, 2020), together with discussions with the RDF re earlier UK WTE translocations (RDF, 2022, pers comm., March 2022). The feasibility report will provide a full implementation budget, but based on theabove we estimate an annual cost of around £200,000 per year.

The total discounted value over the five-year period is therefore estimated to be around -£0.8m.

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7.7 Summary

This high level estimate suggests that **the net present value of a potential WTE reintroduction in Cumbria could be in the region of £1.9m to £20.1m**, although further work would be needed to build on this initial analysis, collect primary data, and undertake a more detailed model (table 4).

Table 4 Summary of CBA results for a WTE reintroduction in Cumbria (2020 prices, millions, net present values, discounted over a five-year period)

Impact	Worst	Central	Best
Livestock	-£0.02m	-£0.01m	-£0.001m
Recreation	£2.7m	£11.8m	£20.9m
Whole life costs	-£0.8m	-£0.8m	-£0.8m
Total	**£1.9m**	**£11.0m**	**£20.1m**

As a postscript to this section, in the same week as this report was being finalised the RSPB published a report indicating "The Economic Impact of White-Tailed Eagles on the Isle of Mull". WTE tourism accounts for between £4.9 million and £8 million of spend annually, supporting between 98 and 160 full time jobs on the island, and providing between £2.1 million and £3.5 million of local income annually (RSPB, 2022b).

8. Governance and team structure for feasibility study The project

team will consist of:

1. A project officer primarily responsible for managing the delivery of the feasibility study and any post-release activities.
2. Team members responsible for producing feasibility study outputs (social consultation, ecological feasibility, release and other practicalities, disease risk assessment, legal and regulatory compliance, detailed cost-benefit analysis, post-release monitoring and evaluation).

The membership of the project team will be determined in advance of the launch of the feasibility study.

A steering group (the Cumbria White-Tailed Eagle Group) has been set up consisting of a number of conservation organisations with a shared interest in the potential for WTEs to be reintroduced in Cumbria. This Group will oversee on the development of the feasibility study and post-release activities (should reintroduction go ahead). The purpose, aims and functions of the Cumbria White-tailed Eagle Group are further set out in the Group's Terms of Reference (see Annex II). The current members of the Cumbria White-tailed Eagle Group are set out in Appendix I to the Terms of Reference. It is expected that new members will be invited to join as the project progresses.

A further working group will be set up to assist with monitoring and evaluation of the post- release phase of the project (assuming that reintroduction is found to be feasible) as part of the work product for the full feasibility study.

9. Further topics to be addressed in the feasibility study.

9.1 Assessment of disease risk

The feasibility study will include a disease risk assessment. This will include assessment of the disease risks posed to the founder population of WTEs by the reintroduction and the risks to native wildlife species, domestic livestock and humans of introducing pathogens into the release area. Actions to mitigate or avoid disease risk will be suggested.

9.2. Legal and regulatory compliance

The feasibility study will consider all relevant legal and regulatory requirements applicable to the reintroduction and set out how these will be complied with. These will include international and national obligations regarding the movement of animals, requirements such as licences relating to the capture and release of animals in relevant countries and requirements relating to animal health.

9.3. Timeline and budget

The feasibility study will set out:

1. A **timeline** (including suitable milestones) for releases and post-release activities. We expect that the time period for carrying out the feasibility study itself will be 9-12 months.
2. Details of the **budget** for implementing a reintroduction (if the feasibility study concludes that it is feasible) including a full breakdown of costs.
3. A procedure for the **reporting and dissemination of information** relating to the reintroduction
4. A **strategy for managing visitors** who wish to see white-tailed eagles, if this is found to be desirable

9.4 Practicalities relating to release

Practicalities relating to release will be thoroughly investigated as part of the feasibility study. In particular, the full feasibility study will include/address:

1. The **donor population** which would be used to provide animals for the reintroduction. The full feasibility study will set out why this donor population was chosen with reference to factors such as population characteristics and genetic considerations. The need to avoid negative impacts on wild populations will also be addressed.
2. A **release strategy**, which will be developed taking into account the biology of white- tailed eagles and will cover issues including life stage/age class and sex ratios of introduced animals, appropriate timings for release, number of individuals released, schedule/number of releases, handling, transport, post-release feeding and the management process for release.
3. Compliance with applicable **animal welfare legislation and standards** during the reintroduction process.
4. An **exit strategy**, to be implemented in the event that reintroduction has detrimental impacts which make it inappropriate for the project to continue or if monitoring efforts indicate that the project’s chances of success/progress towards meeting objectives do not justify continued resourcing.

9.5 Post-release management, monitoring and evaluation

Issues relating to post-release management, monitoring and evaluation release will be thoroughly investigated as part of the feasibility study. In particular, the full feasibility study will include/address:

1. A **monitoring programme** to measure progress post-release against objectives. This programme will cover what data needs to be collected along with timings and places for data collection. It will also specify who will be responsible for the collection, analysis, storage and dissemination of data and how monitoring will contribute to ongoing management. Monitoring will cover areas such as demographics, behaviour, ecological impacts, health and mortality, breeding activity and locations/movements of reintroduced individuals [genetic monitoring?], as well as changes in social attitudes post-release and the socio-economic benefits and costs arising from the reintroduction.
2. A plan and procedures for **project evaluation** to assess project progress and effectiveness. This will be based for example on data collected through the monitoring programme and project team feedback.
3. A plan for **ongoing management** following release, drawing on results from the monitoring programme.

9.6 Transboundary considerations

The feasibility study will address potential transboundary considerations which would arise in relation to a reintroduction of WTEs in Cumbria, in particular the likelihood that some released WTEs will disperse to the coast of Dumfries and Galloway and potentially nest there. These considerations will be taken into account for all components of the feasibility study and in particular in relation to further habitat and risk modelling work, social and community engagement and project governance.

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11. APPENDIX I: ROY DENNIS FIELD REPORT

Report on the visit to Cumbria regarding suitability for white-tailed eagle reintroduction March 2022

Hosted by University of Cumbria

Itinerary:

Wednesday, 16 March

Drove from home to Carlisle; stayed in Premier Inn; evening meal and discussions with Ian Convery and team.

Thursday 17 March

Fieldwork in southern coast of Cumbria from Muncaster to Foxfield to Foulshaw Moss and so to M6 for return to Carlisle.

Gave evening lecture on white-tailed eagle reintroductions at Carlisle museum

Joined a workshop about white-tailed eagles, hosted by Mark Jenkinson local MP, over dinner in Carlisle

Friday 18 March

Fieldwork north of Carlisle, and then west along the south coast of the Solway Firth to the RSPB Campfield Marsh reserve and then round to Moricambe Bay and so to Carlisle. Late noon drove home to Moray.

Field survey

The most important reason for of my visit was to view the potential areas where white-tailed eagles could live and breed - in the future, and to suggest locations suitable for releasing young eagles from hacking cages. It was also to get an initial impression of prey availability, especially rabbit, brown hare, fish and water birds. Importantly it was to discuss ideas with the project team and to give them in the -field advice and training. Mic Mayhew and Deborah Brady, from the team, were my local guides, and we met others on our tour.

The first place of interest, after leaving Carlisle on the A595, was south of Gosforth when we stopped to overlook the estuary of the River Irt. There was a very good area of estuary and rough grassland, with small farms and woods. Soon we were looking over the River Mite estuary near Ravenglass and then called at Muncaster Castle. We met the owners, Iona Pennington and husband, who were interested in the idea. We had a short walk round the grounds and from the elevated land beside the Castle could see much suitable eagle habitat out across the River Esk to the sand tunes as well as south over the military ranges. Looking up river, there are small farms with woods and hedges, just like around Muncaster. I considered that a search might locate a suitable hacking site with no human disturbance.

After a snack, at the Castle, when we had discussion about white-tailed eagles, we drove over a high road across moorland past Thwaites Fell which gave us outstanding views to the south over the estuaries and also in the wooded valleys to the east. We dropped down into Darden Bridge and then to Foxfield. Here we crossed the railway line to view big areas of salt marsh and exposed tidal flats at low tide. It was all excellent habitat for white-tailed eagles but I did not have data on food availability. We examined various mosses and woods before arriving at the Cumbria Wildlife Trust reserve of Foulshaw Moss. There we walked to the viewpoints on the north end of the moss and talked with the warden. This led to us following his vehicle by road to the south-west of the reserve at a farm called Ulpha. From here we had good view up over Foulshaw Moss, and also to the riverbank of the River Kent. We then drove to the M6 and up to Carlisle.

Next morning we visited an estate, known to Mic Mayhew, near Rockcliffe, which had been suggested as a potential release site. The owner is very keen on rewilding and he took us round various parts of the estate. The views north over Rockcliffe Marsh, and the barnacle geese, being particularly impressive. Unfortunately the estate was unsuitable for releasing young white-tailed eagles for several reasons including two high voltage electricity transmission lines on towers crossing the land north to south plus a high-speed electrified railway mainline London to Glasgow dissecting a wood, and also the M6 motorway just a bit further to the east. All of these would be potential collision or electrocution risk for newly flying eagles and meant that this was not a suitable site. Nevertheless it does hold some beautiful old trees, especially oaks, in woods and isolated places and an overview of the River Eden – all excellent for full-grown eagles.

Next we headed along the south shore of the Solway Firth looking at the saltmarshes at Burgh Marsh and across the marshes, islands and tidal estuary, which held large numbers of wintering barnacle geese, to the Scottish side of the firth. We continued on round the coastal road, calling at a small inland moss reserve, until we reached the RSPB Campfield Marsh reserve. The wardens took us out around the three big wetlands that have been electric fenced against ground predators, which was impressive. We looked out over the Bowness Common. I could see that many of these areas will be suitable for hunting and loafing but I did not see a suitable place for a potential hacking site.

After a snack in Bowness we continued around the shore so that we could look into Moricambe Bay. On the map I had hopes for this area but this was dispelled by a large array of very tall radio masts, with wire stays and antenna. This would be a dangerous location for newly fledged eagles. We continued and over viewed Moricambe Bay that would be good for hunting and loafing eagles. I found no potential release sites. On the way back to Carlisle we passed through an area called Finglandrig Wood, a National Nature Reserve. We did not have time to explore but the outline of the woodland on the map suggested that there might be a potential site within this area.

Expert opinion

My overall view was positive especially as previously I had only visited the main Lake District areas that I know as biologically degraded. This was a very short visit but allowed me to give some expert assessment.

A. Habitat assessment

1. Non-breeding and juvenile white-tailed eagles

All the coastal areas I visited were suitable for non-breeding and juvenile white- tailed eagles. There are large areas of hunting habitat and many mature trees suitable for perching and loafing. This species of eagle spends over 90% of its time perched and watching its surroundings. In this way the species quickly identifies animals that are injured and sick, even in large flocks of birds, while, at the same time, recognizing when scavengers such as crows and gulls have found carrion. They are an opportunistic and generalist species. Juveniles tend to feed on carrion in the first year but older birds prefer to catch live prey.

2. Habitats for future breeding white-tailed eagles

White-tailed eagles nest on sea cliffs, but many favour building a large stick nest in the fork of a big old tree, deciduous or conifer. Sometimes situated in a wood and at other times in a clump of mature trees or even a single tree in open landscape. Eyries are used for decades. They may nest anywhere in their home range, and may travel 10 to 15 kms to favoured feeding sites. Initially they prefer to build in quiet areas, away from humans, but later they become more tolerant. During my short visit I saw no shortage of potential nesting sites. This is not a limiting factor.

3. Hacking sites for rearing and releasing young

This proved to be the most difficult aspect of my visit. I did not find immediately a suitable site. The ideal site is a grazed field, of up to three hectares, surrounded by mature woodland in a quiet locality. Ideally close to an old farm with private access and an easy supply to provide electricity to run the CCTVs in the hacking cages and power for a project caravan hidden in the wood. The cages should look out on an open vista, such as an estuary or river, to allow the birds in the cages to become hefted the area. It is essential that cages can be visited easily so that fresh food can be given to the birds twice daily and because of the amount of food required van access to the caravan is necessary. I attach a copy of our expert advice guide to hacking white-tailed eagles, which covers the management techniques.

If you are receiving birds from Norway you should create two hacking sites one in the north and the other in the south, with ten birds at each site. Our advice is to release no more than ten birds at a hacking site because of dominance issues. The hacking and retention of young in the hacking area for as long as possible is a most important part of the project.

I was shown various mosses, which were quiet areas with little human activity, but they are unsuitable as release sites because of difficulty of access and long vegetation, lack of electricity and infrastructure, and usually without screening by mature trees.

Finding perfect hacking sites will take time and much exploration, as well as talking with landowners, wardens, foresters and farmers. But is essential for success.

B. Food availability

1. Food availability during breeding season – March to September

I was unable to get a proper assessment of prey availability, especially during the breeding season for future breeding eagles.

Small mammals. I saw one rabbit and no hares in the short visit; the latter is probably widespread while rabbits may be localized. The project team need to do field surveys on their distribution and numbers. These are important prey for adults, especially when feeding young in the nest.

Birds. I asked about breeding feral geese, because goslings and exhausted adults are important prey for white-tailed eagles. I did not get a clear answer of numbers or distribution, and the present feasibility report is hazy on this important matter. Black-headed gulls, coots, crows are other key species. Needs more survey and seeking advice from local bird experts.

Fish. It is very likely that grey mullet is common in all the estuaries and river mouths, but distribution needs checking as well as the seasonal availability. Flounders are difficult for eagles to catch, unless they are stranded in pools at very low tide, but they will steal flounders off ospreys. Bass is an important species for eagles but salmonids are difficult to catch and not used except salmon dying on river shingles after spawning in late autumn. Needs more survey and asking local fish experts. It’s essential to know which species are abundant and most importantly do they occur where eagles cab catch them.

2. Food availability in winter and for non-breeders

There are sufficient opportunities with the winter bird numbers and other prey as well as carrion along the shores and in the estuaries for white-tailed eagles.

This report gives my initial views on restoring breeding white-tailed eagles to Cumbria, and includes necessary actions before taking the project further and applying for licenses and permissions.

Roy Dennis 30/3/22 Roy Dennis Wildlife Foundation