Restoring our lost wildlife: a review of the ecological, social and economic factors in the potential reintroduction of six mammal species to Cornwall

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RESTORING OUR LOST WILDLIFE

A REVIEW OF THE ECOLOGICAL, SOCIAL AND ECONOMIC FACTORS IN THE POTENTIAL REINTRODUCTION OF SIX MAMMAL SPECIES TO CORNWALL

A Report for Cornwall Council by the Derek Gow Consultancy Ltd

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EXECUTIVE SUMMARY

Background

In 2016, the Cornwall and Isles of Scilly Local Nature Partnership (CIoS LNP) and Cornwall Council launched the 'Environmental Growth Strategy'. To support this, Cornwall Council created a draft 'Local Nature Recovery Strategy'. Part of this strategy explores reintroducing lost species. Cornwall Council commissioned the Derek Gow Consultancy to undertake a feasibility study into the reintroduction of six mammal species: beaver, pine marten, red squirrel, water vole, wild boar and wildcat.

The report explores whether mammal reintroductions can help meet environmental and social goals, including habitat recovery, flood management, carbon capture and social well-being. It also aligns with one of Cornwall Council's key principles of "the right habitat in the right place".

Scope

This report is the outcome of the feasibility study and provides a strong evidence base. This can support decision-makers considering reintroducing any of the six mammals. It is not an intention by Cornwall Council to reintroduce any of the species either wholly or as a contributing party. Nor is it a statement of intent on behalf of any other party.

Methods

The study used a variety of methods to assess the reintroduction process for each species. **Species profiles** used desk-based reviews of existing literature. They contain information about the mammal, their historical presence in Britain and Cornwall and the benefits they provide. They also give examples of previous reintroduction experience from Britain and Europe.

Risk tables assess the level of risk posed to the species, the release environment and human interests. Scores are for the likelihood of the risk occurring and the consequence if they did occur. Each risk has suggested mitigation strategies.

Experts advised on **health screening requirements and disease risk mitigation** for each species. This is a guide and not a replacement for a full Disease Risk Analysis (DRA). The **legislation and licensing considerations** for a reintroduction are presented for each species. Desk-based assessments and expert knowledge and experience provides **cost estimates** for each phase of a reintroduction.

Online surveys captured the **public and stakeholder's views** and opinions regarding reintroductions. Stakeholders attended an in-person workshop to give views on management requirements of reintroductions, as well as to discuss principles of engagement for consultations. These views give context of the current level of support for each species. The findings are not a replacement for local engagement during reintroduction projects.

Expert modelling techniques created **habitat availability maps** for each species. For beavers and water voles the map shows the highest number of dams a waterbody

could support. For the four other species maps show the woodland blocks available across Cornwall.

Species overviews

It is likely that all six species were historically present in Cornwall. **Red squirrels** and **water voles** went locally extinct within peoples living memory. **Beavers** and **wild boar** went extinct at some point in medieval times, and **pine marten** and **wildcats** went extinct in the 18th and 19th Century.

Beavers provide a huge array of ecological and economic benefits. These include habitat creation, flood management and capture of pollution run-off. They provide climate benefits through increased drought resilience and acting as breaks for wildfires. Beavers are already reintroduced to enclosed areas in Cornwall.

Pine martens may provide indirect beneficial effects on ecosystem functioning and forestry. They predate grey squirrels, which benefits woodland planted for carbon capture. **Red squirrels** help with seed and fungi dispersal. Grey squirrel management is needed for successful reintroductions. This also benefits forestry. Red squirrels are already reintroduced to Tresco on the Isles of Scilly.

Water voles shape riparian vegetation communities and provide a prey base for predators. **Wild boar** create small ponds. Their rooting behaviour helps seed and fungi dispersal, improves soil nutrient cycling and increases plant species diversity and richness. These benefits are likely to be ineffective without effective population management.

Wildcats may provide benefits to ecosystem functioning through predation of small mammals and rabbits. They can also act as a conservation ambassador species.

Risks associated with reintroductions

The potential risks, both ecological and social, are highest for **wild boar**. This is due to the likely impact of rooting on agriculture and other land uses, negative effects on rare native species, the potential spread of livestock diseases and the infrequent but real chance of them chasing both dogs and people. **Beavers** can create significant issues with other land uses close to watercourses. Their dams cause local flooding, burrowing compromises ground stability and valued trees could be felled without mitigation. The geography of Cornwall may make such cases less frequent than in other parts of the country. Localised issues of poultry and game predation from **pine martens** and wildcats may occur. **Red squirrel** and **water vole** reintroductions without adequate associated invasive species control are likely to fail.

Diseases

All species bring potential disease risks which can be mitigated by appropriate health screening and sourcing of animals from captive populations for most species and where available. The exception to captive animals being preferred is for wild caught **beavers** from Scotland which are regularly trapped, quarantined and tested as part of their population mitigation strategy. The species which poses the biggest disease risk is **wild boar**, which can carry zoonotic diseases significant to human health as well as

livestock diseases. The species most at risk from disease post-release is the **red squirrel**, with many reintroductions failing due to population losses from contracting squirrelpox from grey squirrels. Therefore, grey squirrel control is key to the success of **red squirrel** reintroductions.

Licensing and legislation

There are a number of licenses and pieces of legislation to comply with during a reintroduction of any of the species considered in this report. Where licensing may not be required, other regulatory measures such as Environmental Impact Assessments may be needed prior to reintroduction. The key pieces of legislation relevant to reintroductions are there to protect the species both before reintroduction, for example whilst in captivity or under human control (e.g., when in transit to the release site) and post-release by prohibiting disturbance, injury, capture and killing. It is crucial for projects to comply with the relevant licences and legislation.

Reintroduction costs

Reintroduction costs can be high but may reduce as reintroductions become more commonplace, and vary depending on the species home range size and level of public engagement required. The cost for the feasibility phase is estimated between £58,000-£480,000 per year. The delivery phase is estimated at costing between £83,000-£285,000 per year and the monitoring phase as between £70,000-£195,000.

Public and stakeholder views

943 members of the public responded to the survey to give their views on reintroducing the six species. Over half of respondents support reintroducing all species. There was variation in levels of support and opposition between each species, particularly from those working in farming and agriculture.

Those in support are interested in bringing back native species, both to increase biodiversity and to provide ecosystem services. The **water vole** and **red squirrel** received the highest level of support from both the general public (over 90%) and the agriculture and farming community (80% and 60% respectively). Over 80% of people support the reintroduction of **beavers** and **pine martens**, with lower levels of support from the agriculture and farming community (50% and 40% respectively). Support for **wildcat** and **wild boar** reintroduction was still relatively high from the public (70% and 60% respectively) but was very low in the agriculture and farming community at 20%.

Stakeholders have similar views to the public. They felt positively about restoring lost species, particularly when other species benefit and where invasive species control may follow as a result of a reintroduction. They had concerns about the impact of species like **beaver** on land use and of predation on game, livestock and wildlife by **wildcat** and **pine martens**. Similar to the public, stakeholders showed the most concern towards **wild boar**, suggesting this species would require significant effort in social engagement should a reintroduction project be proposed.

Habitat availability mapping

The **Beaver** Dam Capacity model shows that many of Cornwall's rivers are able to support a maximum of 15-30 dams per kilometre stretch. In turn dams create suitable

habitats for **water voles**, through encouraging complex vegetation structures and reduced flow speeds. Food availability maps for **beavers** show that there are large areas with low forage suitability, particularly in northeast Cornwall. Areas around the River Fal and Helford show suitable areas of forage.

There are relatively few blocks of woodland which can support **pine martens**, **wild boar** and **wildcats**. **Pine martens** are more reliant on woodland cover compared to other species, and so we see notable gaps around Bodmin Moor and West Penwith where woodland cover is low. **Wild boars** have large foraging ranges, and so are likely to move between blocks. This will bring them into contact with agricultural and other land uses, and lead to potential stakeholder conflict. **Wildcats** can persist in smaller woodland areas, with a large woodland block available in northeast Cornwall. **Red squirrels** are capable of occupying very small blocks of woodland, and so can inhabit most of Cornwall's woodland.

Conclusion

Reintroductions can be challenging and costly, but can also provide wider benefits for ecosystems and climate beyond the simple reinstatement of a species. The overall positive responses from the public demonstrates that support for these projects and the capacity to raise awareness of conservation in the local area is large. **Water voles** are likely to be the easiest species to reintroduce due to their popularity with the public and very few associated risks or land use conflicts. **Wild boar** received the most controversial responses. **Beavers**, which have already been reintroduced to some areas in Cornwall, provide a number of ecosystem and climate benefits and are generally well-received by the public and stakeholders. Engagement and management plans would be needed to reduce land use conflict.

Subsequently, mammal reintroductions have the capacity not only to reach nature recovery targets, but to increase the connection of local communities to wildlife. It is hoped the findings in this report can be used to guide decision making for local practitioners and communities who may wish to investigate the feasibility of restoring any of these species.

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1. INTRODUCTION

Among the methods used to conserve and restore nature, reintroductions of species into their former range is becoming an increasingly common practice to improve the status of species at a local and/or global scale. Reintroductions can be costly, are generally complex at both ecological and often social levels and historically have been regarded as having a high precedent of failure (Armstrong & Seddon 2008; Macdonald 2009). However, both the number of reintroductions and successful outcomes continue to increase as demand grows and practice improves, so that many species have had fortunes reversed as a result of well-implemented reintroductions (Price & Soorae 2003; Ren et al. 2014). In Britain, a growing number of species have also seen their status improved or local extinction reversed through reintroductions, including the Large Blue butterfly (Phengaris arion) (Andersen et al. 2014), Pool Frog (Pelophylax lessonae) (Sainsbury et al. 2017) and White-tailed Eagle (Haliaeetus albicilla) (Carter et al.2008).

In 2016, The Cornwall and Isles of Scilly Local Nature Partnership (CIoS LNP) and Cornwall Council officially launched Cornwall's 'Environmental Growth Strategy' which works towards a vision of Cornwall's environment being "*naturally diverse, beautiful and healthy, supporting a thriving society, prosperous economy and abundance of wildlife*" by 2065. The creation of this strategy has enabled Cornwall and the Isles of Scilly to develop strategic priorities including the 'Carbon Neutral Action Plan' and the draft 'Local Nature Recovery Strategy'. In response to these new priorities, Cornwall Council commissioned the Derek Gow Consultancy (DGC) to provide a scoping report outlining the feasibility for the reintroduction of an assemblage of key lost mammal species from the county. DGC invited several independent experienced individuals to provide specialist advice and/or contributions to the work.

This project sought to consider how mammal reintroductions could help meet delivery on carbon neutral and environmental growth goals, particularly carbon sequestration, habitat recovery and flood prevention. Additionally, it aimed to see how such projects could have wider socio-economic benefits including eco-tourism and individual well-being. In order to provide this an evidence-based assessment was conducted over the course of 18 months, supported by the practical experience of the authors and open consultation with the public and key stakeholders of Cornwall.

1.1. Statement of intent

The subsequent report has been produced to provide an overall assessment of how each of the key species could help Cornwall meet its nature recovery targets if reintroduced, while also giving expectation to the degree of risk, costs, legislation and social response if reintroductions were implemented. It is neither a plan by Cornwall Council to reintroduce any of the candidate species either wholly or as a contributing party, nor a statement of intention on the behalf of any other party. Its intended use is as a resource in guiding planning and decision making rather than a commitment to reintroduce any of the species considered in the report.

1.2. Selection of candidate species

At the project's inception, DGC were required to consider eight mammal species for the project, namely bison; beaver; lynx; pine marten; red squirrel; wild boar; wildcat; and wolf. While other taxa were open to consideration in the study, including birds, to best suit the abilities and time of the authors and create a more concise study, mammals were to remain the focus of this particular report. The option for future reports considering other taxonomic groups remains open.

Upon accepting the feasibility study, DGC reviewed the species required for consideration as well as any other mammal species which were not included in the original candidate list but would be potentially well suited for reintroduction in Cornwall. Ultimately, it was decided to eliminate the following species from consideration for the report;

- **Bison.** This species would entail a conservation introduction as opposed to a reintroduction due to a current lack of evidence to suggest this species had native status in Britain. Additionally, habitat limitation is a severe issue in Cornwall for a species that requires large tracts of natural habitat free of livestock. Projects in the Netherlands and (as of 2022) in Kent demonstrate that allowing bison to roam inside large enclosures of natural habitat is viable and may have potential in Cornwall, but as the focus was intended to be on freely-roaming wild animals in this report it was ultimately eliminated from the candidate list.

- **Lynx.** For similar reasons to bison, the significant lack of extensive woodland cover in Cornwall, one of Britain's least wooded counties, was decided to be too significant a detriment to consider the reintroduction of lynx in Cornwall given the species need for complex cover at huge extents of up to 100-1500 km^2 (Herfindal et al. 2005). As a species which would be very sensitive to approach from a socio-economic perspective, it is best placed in areas with suitable extents of optimal habitat.

- **Wolf.** This species is capable of phenomenally large dispersal distances, covering hundreds of kilometres in their European range where they are rapidly recovering (Ciucci et al. 2009; Kojola et al. 2009; Andersen et al. 2015). Even though ecologically it is likely wolves would fare well in Cornwall as a habitat generalist (Fechter & Storch 2014), they would be an extremely socially sensitive species to reintroduce. The high dispersal rate makes the reintroduction almost impossible to consider at a local level and this coupled with the high degree of due diligence from the socio-political engagement also required at a national level, it was considered beyond the scope of this report.

- The **wild boar** was considered for exclusion but given the fact that many populations of this species have successfully established in British landscapes, such as in the Sussex Weald and Forest of Dean through unofficial means, it was decided to include the species on the basis it would likely be able to adapt to human landscapes, but further persistence would be determined on social support, a factor that could be assessed as part of this study.

When considering other mammal candidates for reintroduction, one species was added to the remaining five candidates:

- **Water vole.** Extinct in Cornwall since the 1990s, although at least one population has been reintroduced into the Bude Marshes at the time of the inception of the report. Given the success of many nationwide water vole reintroduction projects led by the report authors and the potential for further restoration across Cornwall, the species was considered a very suitable additional candidate.

2. SPECIES PROFILES

Within this chapter, each candidate species was reviewed under the following criteria:

- General biology and ecology of the species, including habitat use and home ranges, feeding ecology and behavioural traits;
- Historical presence as a wild species in Britain with specific focus on Cornwall;
- Ecological benefits that may be provided by the species, (e.g., habitat creation, prey regulation, nutrient cycling);
- Socio-economic benefits that may be provided by the species (e.g., pest control, flood mitigation, eco-tourism);
- Examples of previous reintroduction projects with the species, with priority focus on British schemes.

Using an evidence-based approach, a literature review was conducted to affirm each of these aspects. The authors practical experience with these species was a key element in creating these profiles, although this too was backed up with published evidence wherever possible.

2.1. Eurasian Beaver (*Castor fiber*)

2.1.1. General Biology

Eurasian beavers are large mammals, the second largest rodent in the world with morphology that reflects their adaptations to a semi-aquatic lifestyle. The beaver's body is recognisably rodent but stout, horizontally compressed, heavily muscled, and with small extremities and their fore legs being much shorter than their hind; they are described as 'drop-shaped' (Baker and Hill, 2003). Beaver fur is incredibly thick, consisting of two different hair types: long, coarse guard hairs and shorter dense soft underfur. Unfortunately, this has been heavily exploited as a luxurious item for humans. Beavers are renowned for their unique tails, which are multifunctional on both land and in water, capable of an impressive range of movement (Mahoney and Rosenberg, 1981). The tail has several uses: for signalling a warning sign to other family members to alert them to danger; as a balancing aid when the beaver is raised on its back legs while gnawing trees or carrying mud; as a swimming tool and in assisting kits; in thermoregulation; and as a fat storage unit.

Typical body dimensions vary due to a range of factors: time of year, habitat quality, and age. New-born kits tend to weigh between 380 and 620 g (mean 525 g in captive Eurasian beavers; Zurowski, 1977) and typically reach between 7 and 9 kg by the end of their first year (Ognev, 1947). Adults (≥ 2–3 years) on average weigh around 18-20 kg but can reach >26 kg (Parker et al., 2012). Rarer examples of Eurasian beavers weighing 29-35 kg have been recorded in Russia (Danilov et al., 2011).

As typical members of the Rodentia, the digestive system of beavers consists of a relatively simple stomach with an enlarged caecum. They are entirely herbivorous, classified as monogastric hind-gut (caecum) colon fermenters based on their gut

morphology (Vispo and Hume, 1995), meaning the caecum is the main site for microbial plant carbohydrate digestion. The whole digestive tract constitutes between 9 and 13% of total body mass (Vispo and Hume, 1995; Bełżecki et al., 2018).

2.1.2. General Ecology

Beavers are large, semi-aquatic rodents that live in family units within wetland and river habitats. Beavers are one of the most significant modifiers of landscapes, altering various physical and biological features of an area through their foraging, burrowing and damming activities. As recognised ecological engineers, beavers and their activities have increased the complexity and biodiversity of freshwater ecosystems for millennia (Rosell et al., 2005; Stringer and Gaywood, 2016). For example, increasing the complexity of riparian and wetland habitats, often to the benefit of multiple other species. Even in wetlands not created by beavers, their presence and herbivory alone generate positive increases in plant species richness. Although beavers will readily impact and live along rivers and the shorelines of lakes, it is really when they modify smaller watercourses that dramatic changes can occur. As keystone species - those that have a disproportionate effect on the ecosystems within which they live (McKinstry et al., 2001) - beavers are renowned for their ability to create, modify, and maintain riverine habitats and influence floodplain connection processes on a landscape scale (Westbrook et al., 2011) (see Ecological Benefits below).

Beavers can survive within a range of freshwater landscape conditions, ranging from tundra (Tape et al., 2018), boreal forest (Naiman et al., 1988), and steppe (Pietrek et al., 2017), to desert (Andersen and Shafroth, 2010, Barela and Frey, 2016). Their main habitat requirements are: water for locomotion, dispersal, protection and movement of materials; vegetation particularly woody species for forage and construction; and suitable land for feeding and shelter. This riparian zone - or water and land interface - allows them to forage in relative safety from predators and construct protective structures. Tree availability tends to limit their distribution, especially in the northern hemisphere. However, in milder climates such as Britain, beavers are capable of surviving with limited tree coverage e.g. agricultural areas and bogs (Rebertus, 1986). Generally, beavers prefer wooded stream networks, with gradients of < 6%, composed of sediment rather than stone or gravel (Gurnell, 1998).

Being generalist herbivores, beavers can feed on a long list of plant species. Over 450 plant species have been recorded in their diets to date including a range of bark, grasses, herbs, aquatic plants, mushrooms, fruit and crops (e.g., Nitsche, 2016). This can even include plants that are poisonous or generally unpalatable for humans and other animals, such as bracken (Pteridium aquilinum) and Japanese knotweed (Fallopia japonica). Common plant defence mechanisms including toxins and thorns or burning hairs, do not appear to bother beavers.

Beavers live in family groups which typically consists of the adult breeding pair with their offspring from the current breeding season, and the previous year's litter (Wilsson, 1971, Jenkins and Busher, 1979, Busher, 1983, McTaggart and Nelson, 2003, Busher, 2007). They are highly territorial and defend their territory and resources from other beavers. Beavers most often exhibit long-term monogamy which is rare in

mammals and especially unique among rodents. Subdominant members of the family are not normally sexually active when there is a dominant animal of the same sex present. At northern latitudes, mating peaks during mid-January and early February (Parker and Rosell, 2001) but with successful mating occurring as early as December and as late as May (Wilsson, 1971, Doboszyńska and Żurowski, 1983, Novak, 1987b). Beaver kits tend to be born from mid-April to mid-August in the northern latitudes with parturition peaking mid-May to mid-June (Semyonoff, 1951, Doboszyńska and Żurowski, 1983, Parker and Rosell, 2001). Beavers have one litter a year. Typically, 2 to 4 kits are born in a litter but this can vary from 1 to 6 (Parker and Rosell, 2001, Campbell et al., 2005, Petrosyan et al., 2019).

2.1.3. Historical Presence in Britain and Cornwall

In Europe around the twelfth century beaver numbers had been substantially reduced, and by the sixteenth century they were all but nearly completely extinct. Before this, they were widespread throughout freshwater habitats from the Arctic to the Mediterranean and from the Atlantic to the Pacific coasts, excluding areas north of the Arctic tundra, islands of Ireland, Iceland, Sicily, Corsica, Crete, the Balearics, Malta, Sardinia, and the very southern fringes of Greece and Italy, and they are not known across southern and South-East Asia (Halley and Schwab, 2020). Eurasian beavers were known in antiquity (typically 8th century BC to 6th century AD) but then disappeared early from the Mediterranean rim and southern areas of their range such as Greece, Portugal, Spain, Turkey, Azerbaijan, and Iraq (Boessneck, 1974). By the end of the 19th century an estimated 1,200 individuals were thought to remain in very small and scattered fur trade refugia populations.

By the twentieth century more countries where beavers still remained recognized their plight and began to take an interest in their restoration. Early protective decrees and charters in Europe often assigned ownership of beavers to the state or church as they became a scarce commodity; for example, some of the first national beaver protection laws had already been enacted in Norway in 1845. Although many early reintroductions were largely motivated to restore the fur trade, others that followed in more modern times did so as a realisation of the species' pivotal role in wetland ecology and began to take root in their own right. Today the Eurasian beaver is thought to number ~1.5 million individuals (Halley et al., 2020) and remains a European Protected Species throughout much of Europe, even though it is now considered to be of 'least concern' on the International Union for Conservation of Nature (IUCN)'s Red List (Batbold et al., 2008).

The Eurasian beaver is native to Britain and had a widespread distribution, but they were hunted to extinction by humans mainly for their castoreum, fur and meat (Halley et al. 2020). Despite one possible later record, the lack of archaeological remains and references to the species suggest it went extinct in southern Britain after 1300 (Raye 2015) although there is a possible record as late as the 1780s (Coles 2006). Prehistoric digs in Somerset, England, have determined that humans were attracted to beaver sites, building plank walkways in shared habitats, with beaver bone remains found in nearby caves from 12,700 to 8500 BCE (Coles, 2006). Presence in Cornwall is noted by the finding of an immature beaver's exoccipital bone from an Iron Age (800

BCE – 100 AD) settlement at the Rumps in St Minver (Brooks 1964) and the Cornish word for the species Lostledan/Lostledanes.

There have been four enclosed beaver releases in Cornwall since 2017, at enclosures sited near Ladock, Bodmin and Gweek. To date there have been no formal wild release of the species within the Duchy. However, an unlicensed wild population has been confirmed to be present and breeding within the Tamar catchment (Heydon et al. 2021).

2.1.4. Ecological Benefits

An extensive body of scientific research indicates that beaver-generated landscapes contain higher levels of biodiversity and biomass (Rosell et al., 2005; Bashinskiy, 2020). The activity of beavers creates habitats that are dynamic in nature and change over type according to activity and age, going through a series of successional stages. These can result in the formation and maintenance of wetland habitats, with a positive effect on plant and animal diversity.

Beaver habitat modification behaviours are generally grouped into foraging (including the felling of mature trees), burrowing, and damming. These activities have the ability to change both abiotic features, such as hydrology (water availability and storage) (Westbrook et al., 2006; Hood and Bayley, 2008), geomorphology, water chemistry and quality (Naiman et al., 1986; Maret et al., 1987), temperatures, and other biotic characteristics such as the diversity of other plant and animal assemblages (Pollock et al., 1995; Gurnell, 1998). Beaver habitat alterations can provide key ecosystem services, especially in degraded agricultural landscapes which include the capture of sediment and pollutant runoffs; nutrient assimilation; the regulation of water flow (Puttock et al., 2017); and enhanced aquatic biodiversity (Law et al., 2016).

Beaver activities can create spatial heterogeneity and consequently complex microhabitats, including deep open pools, shallow marshes, shrub swaps, and flooded woodlands (Bush and Wissinger, 2016), the cumulative effects of which can generate incredible diversity in plants and animals (Wissinger and Gallagher, 1999; Wissinger et al., 2001). These changes are caused by beaver dams influencing ecosystem processes such as vegetation composition and succession (Johnston and Naiman, 1987; Terwilliger and Pastor, 1999; Hood and Bayley, 2008), sediment deposition and erosion (Butler and Malanson, 1995), nutrient cycling (Naiman et al., 1994), organic matter retention (Naiman and Melillo, 1984; Devito and Dillon, 1993), increased water storage capacity and reconnection of channels on floodplains (Collen and Gibson, 2001; Macfarlane et al., 2017), reduced flow velocity (Burchsted and Daniels, 2014) and improved water quality (Puttock et al., 2017). This leads to terrestrial habitats changing to wetlands and lotic to lentic ecosystems as dams function as water and sediment traps (Bigler et al., 2001; Westbrook et al., 2011). This can make beavers an important factor in landscape-restoration projects both directly, through their ability to regenerate rivers, create new wetland habitats, and improve riparian forest health (Law et al., 2017) and also indirectly by acting as a charismatic flagship species for conservation projects.

These variety of beaver-altered habitats create an array of opportunities for other species (Wright et al., 2002), particularly riparian communities. They also provide water provision for wildlife and livestock (Demmer and Beschta, 2008). Additionally, habitats created by beavers act as breakers for forest wildfires (Baldwin, 2015; Stewart, 2020) and protect against drought (Hood & Bailey, 2008; Fairfax & Small, 2018). The flooding of trees by beavers to increase their forage range creates standing and fallen dead wood that can be exploited by species such as woodpeckers, which in turn provides homes for species such as wood ducks which are incapable of carving such features themselves (Hilfiker, 1991). While some species are able to exploit beaver created features to their benefit, others may be reduced, displaced, or even lost, especially less-mobile species of conservation value (Willby et al., 2018). Despite this, a recent meta-analysis determined that, overall, beavers have a positive effect on biodiversity (Stringer and Gaywood, 2016).

The habitat modification abilities of beavers impacts on their feeding resources, and therefore plant communities and compositions, both directly through selective foraging and felling activities and indirectly via flooding (Hyvönen and Nummi, 2008).

Active beaver ponds when compared with other wetlands habitats typically have increased plant richness, largely generated by the higher disturbance factor of beaver activities such as water-level changes, foraging, and building behaviours (Willby et al., 2018). Amphibians are often one of the first vertebrates to arrive in new beaver ponds, with estimates suggesting that beavers are crucial determinants of amphibian species richness in headwater streams (which constitute 60-80% of temperate European water bodies) (Dalbeck et al., 2020). Additionally, the diverse vegetated edges of beaver habitats have been determined as important drivers of invertebrate abundance and species diversity, becoming increasingly significant as new beaver-dug channels mature (Hood and Larson, 2014). In turn these create optimal waterfowl-rearing habitats through increased numbers of invertebrates, along with safety of nesting, and refuge sites from predators (Nummi and Hahtola, 2008). Wetland utilisation by waterfowl and their densities increased with the expansion of beaver-created wetlands, though generally with a lag of one to several years as they mature (McCall et al., 1996). Beaver-generated landscapes have a positive impact on birds generally, with increased richness, diversity, density, and abundance of species, particularly through the creation of new wetland habitats and altered riparian structure, which enhances foraging, nesting, and breeding opportunities (Grover and Baldassarre, 1995; Brown et al., 1996; Rosell et al., 2005).

Numerous mammalian species utilise the wide variety of niche habitats, vegetation generation, and increased prey abundance provided by beaver-generated landscapes (Suzuki and Mccomb, 2004; Ulevičius and Janulaitis, 2007). Ponds created by beavers have been shown to have an 83% increase in mammal species richness compared to non-beaver created ponds (Nummi et al. 2019). Increased numbers of bats have been observed during the flooding phase (e.g., Nummi et al., 2011) and shelter is provided within the lodges for carnivores such as otter (Lutra lutra) (Conroy & Chanin 2000) and pine marten (Martes martes) (Rosell & Hovde 1998).

The restoration of beavers would likely be advantageous to thesurvival of water voles (Arvicola amphibious), one of the UK's fastest declining mammal species. In the Devon Wildlife Trust enclosed beaver site, a reintroduced water vole population stemming from ~40 individuals have persisted for several years in the beaver created mosaic of open, sunny, well-vegetated pools of different sizes and dimensions. At Wild Ken Hill beaver project in Norfolk, an existing water vole population which occupied a central pond dominated by common reed (Juncus effusus) is now moving out into formerly bare ditch and pool systems which are being impounded by beavers. At a third site on the River Otter at Danesmill Croft, Devon, where beavers have been allowed to create an extensive wetland, this has been completely recolonised by water voles from a reintroduced population over the course of 2 years (Newman 2019).

As well as supporting declining species, it is possible that beaver generated environments may allow the colonisation of currently non-resident or formerly resident European species. For example, in Belgium black storks (Ciconia nigra) were rare non-breeding vagrants 20 years ago, but an initial release of beavers in the Ardennes has created suitable habitats and feeding grounds for the storks. In Latvia the black storks expansion is significantly driven by beavers damming forestry ditches and creating suitable wet woodland habitat (Stradz 2011). As suitable beaver generated habitat in the form of woodland pool complexes becomes once again an available habitat black stork are a real candidate for natural restoration. This species, amongst others typically found in quiet wetlands with deadwood such as willow tits (Poecile montanus), could find suitable habitats for colonization within beaver wetlands.

Many native tree species across the northern hemisphere have a long evolutionary history with beavers and therefore have defences and reproductive strategies to readily protect against and deal with beaver activities and impacts (Basey et al., 1988; Johnston and Naiman, 1990). Beavers have been demonstrated to reduce the cover of dominant plant species within ponds, which in turn has been shown to improve macrophyte diversity three-fold (Law et al. 2014). Beavers will almost certainly change aspects of traditional river and woodland management in the highly managed UK landscapes. As such a range of practical management techniques have been developed to enable beaver presence and activity to be tolerated within accepted limits which would need to be applied to promote co-existence.

2.1.5. Socio-economic benefits

Ongoing studies of beaver damming activity in British contexts are demonstrating that in certain areas the creation of multiple beaver dams can help reduce the risk of downstream flooding through slowing down the flow of water (Brazier et al. 2020b; Puttock et al. 2017). Across multiple UK sites beaver dams have been found to be capable of reducing flood flows by an average of 60% (Puttock et al. 2021). There is a growing body of evidence supporting the use of beavers as a habitat restoration and enhancement tool. There is now extensive evidence from the US where beavers and beaver dam analogues have been used as a technique to restore incised stream

ecosystems, reconnecting floodplains and leading to habitat creation (Pollock et al., 2014, Bouwes et al., 2016).

Beaver dams also typically retain large amounts of sediment running off of farmland for example, and so can help improve water quality further downstream (Brazier et al. 2020; Puttock et al. 2018) and by capturing pollutants can become 'trickle filters' of organic carbon, nitrates and phosphorus (Čiuldienė et al. 2020). Heavy metal sequestration can be 2-4 times higher in beaver ponds compared with un-dammed streams while beaver ponds past the age of 8-10 years can be significant nitrogen sinks (Murray et al. 2021).

Wildlife tourism is a rapidly growing sector of the UK economy. Organised guided walks to try to see beavers have proved popular in Scotland and in the River Otter in Devon. This has had a positive economic impact on neighbouring hospitality businesses (Hamilton & Moran 2015, Auster et al. 2020). Landowners with the appropriate facilities may be able to offer hide-viewing opportunities if beavers are resident, particularly in the early phases of establishment. For example, the reintroduction of the Sea Eagle (Haliaeetus albicilla) by the RSPB on the Isle of Mull has been estimated to generate £1.69 million per annum for the local economy (Dickie et al., 2006). Beavers have been suggested to represent a totem of hope to combat 'eco-anxiety' and therefore could be argued to exceed the psychological benefit of any other species reintroduction (Gandy & Watts 2021). In Cornwall, means through which nature can improve mental health, such as immersion within existing beaver projects, are being explored at the Cabilla estate (Hanbury-Tenison 2021 pers comm).

2.1.6. Previous reintroduction experience from Britain & Europe

Following the near extinction of beavers in Britain and Europe, protective measures and legal protection were put in place, along with active reintroductions and translocations which saw this reversed (Halley & Rosell, 2002; Halley et al. 2020). Since the 1920s there have been over 205 successful reintroductions to over 25 European countries (Halley et al. 2012). The first official beaver reintroduction to Britain took place in Scotland in 2009 where five Norwegian beaver families were released to Knapdale Forest, Argyll (Scottish Beaver Trial (SBT) 2009-2014), (Gaywood 2018; Jones & Campbell-Palmer, 2014). In 2016, the Scottish Government announced that beavers could remain in Scotland, which also included the free-living beaver population in the Tayside catchment and in May 2019 the Eurasian beaver became a European Protected Species in Scotland (Gaywood et al. 2015; Jones & Campbell-Palmer, 2014). In England, this same protection was granted in September 2022.

Since the SBT there has been a further trial of free-living beavers on the River Otter in Devon from 2015-2020 and there are also a growing number of enclosed trials throughout Britain (Brazier et al. 2020a). The beaver population in the River Otter had been living for some years prior to their formal 'discovery' in 2014 as a result of escapes or illegal release but had gone largely unnoticed, bar by a small number of local people, as few built dams or demonstrated obvious signs of their presence. The communities' opposition to the Government's initial proposals to capture and place the

animals in captivity led to their retention in the wild. This widespread support led to the licensing of this wild population for a five-year trial which concluded in 2020 and permitted them to remain. This case study, while unique in that it formally licensed an unlawful restoration, emphasised the importance of local support in driving policy with regard to the successful restoration of a large mammal species.

The Cornwall Beaver Project at Woodland Valley Farm in Ladock is one of a number of enclosed beaver projects in England and was launched by the farm and Cornwall Wildlife Trust in 2017 with the intention of providing research on the ecological and physical benefits of beavers, such as the monitoring of peak flows both before and after beaver-driven habitat change, along with the opportunity to provide an educational venture in demonstrating the impact of beavers within a Cornish farming landscape to key stakeholders and the general public.

Whilst reintroductions have mostly been successful, they still pose human-wildlife conflicts and therefore reintroductions need mitigation strategies in place. Under the NatureScot's Beaver Mitigation Scheme a range of management support measures are available to landowners experiencing conflicts with the species in intensively farmed agricultural land. Under particular circumstances licences for lethal control can be issued. Translocation is also permitted under similar circumstances if licenced rehoming options are available.

2.2. Pine marten (*Martes martes*)

2.2.1. General Biology

The pine marten is a slim, medium sized carnivore in the Mustelidae family (Ruiz-Gonzales et al. 2013, Birks 2020). The species has a western Holarctic European range (Buskirk 1994) and although it is strongly associated with mature and old growth woodland habitats, pine martens can persist in more open landscapes containing fragmented woodland, scrub and rough grassland habitats (Clevenger 1994, Manzo et al. 2012, Balestrieri et al. 2018). They are territorial, with a male range typically overlapping the discrete territorial areas used by two adjacent females. However, their social system includes some toleration of mature offspring within territories (Twining & Tosh pers comm).

The pine marten shows clear adaptations for arboreal hunting with the litheness required to explore tree hollows and beneath boulder fields. It has particularly long articulated hind feet, broad feet (4-5 cm wide) with each of the five toes possessing a long 'semi-retractable' claw, muscular forelegs, a slim body with low fat reserves, and with balance in the tree-tops maximised by a long bushy tail (20-24 cm) (Corbet & Southern 1977). Sexual dimorphism is present (Dayan & Simberloff 1994) with females being at least 10% (up to 30%) than males (López-Martín et al. 2006, Nowak 2005) and with body weights between 1.3-1.6 kg and 1.6-2.1 kg recorded respectively.

Perhaps the most characteristic feature of the pine marten is the creamy pale yellow chest bib set against the dark chocolate body fur (Power 2015). The striking contrast is particularly useful as bib patterns are very varied and thus lend themselves to the field-identification of individuals (VWT 2020).

The skull dentition is described by Birks (2020) as 'unmistakeably carnivorous, with four sharp canines at the front and an impressive row of cutting carnassials behind'. In total the dentition on both upper and lower jaws consists of six incisors, two canines, eight premolars and four molars.

A review of European populations found that the pine marten is a generalist predator and varies its diet according to local and seasonal food availability (De Marinis & Masseti 1995). Diet consists of a range of small mammals, birds, birds' eggs, insects, fruits and carrion (Pulliainen & Ouinmaki 1996, Helldin 1999). Small rodents usually constitute over 50% of pine marten food biomass (Zalewski 2004). Field voles, when abundant, are especially prominent, but perhaps it is the relationship with the grey squirrel (Sheehy & Lawton 2014) that is now most well-known. Although pine marten will predate upon both native and introduced squirrel species (Twining et al. 2020a), the natural expansion of pine marten distribution is strongly correlated with declines in grey squirrel presence and patterns of red squirrel occupancy and recovery (Sheehy et al. 2018).

The species is largely nocturnal. However, in the summer months when daylight is longest it will frequently be active in the hours leading to darkness. During periods of cold weather in the winter months, activity is reduced as a means of reducing energy loss and well insulated den sites are selected (Zalewski 1997). Because the species carries little body fat, this selective denning behaviour is an important energy saving strategy. In addition to this, when larger prey items are found these are cached (hidden) often in places off of the ground and out of the prevailing weather so that the items do not decay rapidly and are unlikely to be found by other predators. Suitable sized nest boxes are readily used (Croose et al. 2016), especially by breeding females (Grabham et al. 2018).

Pine martens exhibit a delayed blastocyst implantation, known as dioplause, following successful summer mating. This means that implantation occurs in the February following mating, and pregnancy leads to litters being born in March and April. With a mean full-term gestation of 271 days (range: 265-279) and producing a mean of 3.4 (range: 1-4) young per litter (Amstislavsky & Ternovskaya 2000).

2.2.2. General Ecology

Adult pine martens are territorial and utilise a landscape area within which they do not tolerate the presence of any same-sexed individual (Powell 1979), however they will share the space with the opposite sex. This is known as an intra-sexual territorial system. A female territory will sit next to those of neighbouring females and will be overlapped by males which have larger (1.5-3 times as large) territorial areas that, similarly, will sit next to neighbouring male territories. Zalewski & Jedrzejewski (2006) observed pine marten territory fidelity was very high with mean shift between arithmetic centres of seasonal ranges of 0.25 km, and the ranges recorded in two consecutive seasons overlapping on average, by 87-90%. The authors recorded very little home range overlap between neighbouring male (mean 4-6%) or female (mean 6%) martens. It is postulated that high female territorial fidelity and their high survival rates make females a stable inter-year resource which has the effect of maintaining male territories even where there is significant food resource abundance that would otherwise make territory holding energetically redundant (Zalewski & Jedrzejewski 2006).

Territory size is a function of habitat quality and forest fragmentation. For females this will reflect prey and food abundance as well as the availability of suitable natal nest sites. Typically resource rich areas will mean a reduction in territory size. Because male martens are larger, they have greater energy needs than females so require a larger foraging area but this also allows overlap with more females (Birks 2020). Activity and ranging behaviour vary seasonally, between sexes and in relation to weather conditions. with males occupying typically larger areas than females e.g. 2.23 km^2 and 1.49km^2 respectively in old growth forest (Zalewski et al. 1995). Low winter temperatures reduce activity in both sexes (Larroque et al. 2015), with female ranging and activity greatest in April, reflecting the energetic requirements of lactation (Zalewski A & Jedrzejewski 2006).

Although pine martens may preferentially avoid large open areas such as forest clear cuts (Brainerd and Rolstad 2002), two studies, Caryl et al. (2012) (Scotland) and Mergey et al. (2012) (France) both demonstrate that pine martens benefit from a degree of woodland fragmentation, especially where it creates a matrix of rough grassland, scrub and deep overgrown hedgerow habitat. Moll et al. (2016) determined that pine marten ranges encompassed a wide range of habitat including forest, moorland, rough grassland and included activity around buildings, through an occupancy modelling approach. Similarly, Clevenger (1994) reports the use of open landscapes with scrub pockets. Martens appear to stay close to forest cover when venturing into open ground, which Pereboom et al. (2008) suggested indicates a degree of dependence on the presence of trees in the vicinity of these habitats. The authors (Pereboom et al. 2008) described how martens were not confined to large forests and made additional use of small wood plots with evidence suggesting they preferentially foraged in small woodland fragments, edge habitats and hedgerows. These and other studies have demonstrated the habitat selection of European pine martens are more flexible and varied than simply requiring extensive forested landscapes (Manzo et al. 2018).

Population densities show remarkable variation, with mean male and female territories of 3.04 km^2 and 2 km^2 respectively in lowland mixed coniferous woodland (Halliwell 1997), compared to 23 km^2 and 8.8 km^2 respectively in open mountain habitats containing scattered small woodlands (Balharry 1993). In Scotland, in two studies where woodlands were fragmented, each marten home range contained on average 1.9 km^2 (Halliwell 1997) and 2.3 km^2 of woodland (Balharry 1993). In extensive unbroken old growth European forest habitat, home ranges of martens contained on average 2 km^2 of woodland (Zalewski & Jedrzejewski 2006). Therefore, in the temperate forest zone, 2 $km^2$is suggested as the minimum woodland area which ensures survival and reproduction of an adult pine marten (Birks 2020). Pine martens' main predator is the red fox (Vulpes vulpes) (Zalewski 1997). In the UK fox predation of martens may be increased as a consequence of the low and fragmented woodland cover (Bright 2000).

Although pine marten diet is dominated by small woodland rodents and birds (Storch et al. 1990), it will opportunistically take advantage of an array of plant and animal matter. Forest-dwelling voles (Clerhrionoinys spp.) and meadow voles (Microtus spp.) are major prey items, especially the field vole (Microtus agrestis) (Putnam 1990, Caryl et al. 2012) demonstrating that the pine marten hunts in both woodland and adjacent open habitats (De Marinis & Masseti 1995). Other small mammals include the European water voles (Aruicola terrestris), shrews (Sorex spp.), mice and rats(Apodemus spp.) (e.g., Helldin 2000). Diet varies seasonally with fruits, insects and birds particularly important during summer and autumn periods, and small mammals during winter and spring (Zalewski 2005, Garbham et al. 2018). Earthworms, wasps and beetles are consumed whilst fruits include rowan (Sorbus aucuparia) and European blueberry (Vaccinium myrtillus) (Helldin 2000, Twining et al. 2019). The abrupt dietary switch to fruit in autumn suggests a frequency-dependent preference for fruit irrespective of the abundance of alternative prey (Caryl et al. 2012). During periods of cold winter weather scavenging of mammal carcasses increases (Selva et al. 2005) and it is notable that pine marten avoided large carcasses in open

areas and were less likely to attend carcasses when it was snowing or raining (which may be related to associated reduced detection of approaching predators).

At the Nietoperek bat hibernation site in Poland, martens predated bats, with a preference for Greater mouse-eared bats (Myotis myotis) perhaps because it roosts at a lower height than other cave dwelling bats such as the Natterer's (Myotis nattereri) and Daubenton's (Myotis daubentonii) (Power 2015). Studies suggest the predation impact was at a rate below population level effect. In the Bialowieza forest, Poland, woodland rodents such as bank vole (Clethrionomys glareolus) and yellow necked mouse (Apodemus flavicollis) represented 40-90% of the consumed prey biomass (Zalewski et al. 1995, Birks 2020). Marten diets appear to shift between voles and squirrels depending on their relative abundance; with an increase in squirrel populations and a decrease in vole population leading to an increased frequency of squirrels in martens diets (Lindstrom 1989). The squirrel does not seem to represent the most typical prey of the pine marten, in part because of the high energy needed to prey on this species. In a boreal forest in Finland, red squirrels made up 11.5% of the diet of the pine martens in some winters (Pulliainen and Ollinmaki 1996). When grey and red squirrels occur in sympatry, grey squirrels appear in martens diets at a higher rate (Twining et al. 2020, Sheehy & Lawton 2014).

Females usually give birth after around three years (VWT 2014). They preferentially choose dens that are high in trees (Zalewski 1997), although they will use a wide range of nest sites including nest boxes to rear young (Grabham et al. 2018). In areas where high tree den cavities were limited (9.8% of all dens), martens used sites associated with trees (44.3%), rocks (27.6%) and buildings (13.8%) (Birks et al. 2005). In Britain, preferences for alternate sites differed, with buildings being used most (44.3%), followed by trees (22.8%), other man-made structures (17.1%) and rocks (14.3%). A total of 69.6% of alternate dens were elevated and typically in structures offering limited shelter. This demonstrates that current pine marten habitats are sub-optimal in terms of natal den provision, failing to provide sites that are inaccessible to terrestrial predators (Webster 2001). This may elevate predation risks (see Zalewski 1997) as well as force animals to use less insulated sites (Birks et al. 2005).

2.2.3. Historical Presence in Britain & Cornwall

Current island populations of pine martens in Britain and Ireland are represented by the two main European phylogroups: central-northern European (CNE) and Mediterranean (MED) (Jordan et al., 2012, Ruiz-González et al. 2013). The authors postulate that a natural postglacial recolonisation occurred, but cannot disregard an anthropic origin via early Mesolithic trade routes that were established between south-west Europe and Ireland citing Searle (2008). Irrespective of the relative importance of CNE and MED as source populations, we can conclude that following the end of the last glaciations 9,500 years ago, the pine marten became widespread throughout Britain (VWT 2014).

In Britain and Ireland the species geographical range progressively shrank due to habitat loss and fragmentation along with predator persecution to protect domestic fowl and reared game birds (Langley & Yalden 1977, Jordan et al. 2012). Martens

were also prized for their furs from the early medieval period, where it is noted in Welsh laws from AD 940 that the king was to have the worth of marten furs, as they were of suitable quality to make the borders of his garments (Harting 1880). Vermin acts introduced in the 16th century, followed by the introduction of game estates, saw pine martens largely exterminated across southern and central England (where habitat was in shortest supply) by the 19th century (Lovegrove 2007). Naturalist records at the time also suggest that many of the martens recorded in England between the 16th and 18th centuries were actually another European species, the stone marten (Martes foina). However there remains uncertainty as to whether this was a native species or the result of escaped imports for the fur trade (Burton et al. 2018).

In the early 1900s the north-west Highlands of Scotland was the largest of only three remaining British refugia (Langley and Yalden 1977), containing an estimated 1,500 animals in comparison with 400 in northern England and 100 in Wales (Birks & Messenger 2010). Recovery in Scotland occurred as a result of a decline in game-keeping and legal protection along with habitat creation and expansion (Croose et al. 2013). The temporal pattern of Scottish expansion from the Highland stronghold is progressive (Velander 1983, Balharry et al. 1996, Croose et al. 2013) and was augmented with official (Shaw & Livingston 1994) and unofficial (Sheehy et al. 2018) translocation into Scottish Borders.

Cornish records indicate that the marten was once common and well-known within the Duchy. Childrey writes in reference to Cornwall in his 1666 Britannica Baconica “here are Martenes, Badgers, Otters…” (Raye 2021). Six Cornish parishes have known vermin bounties for martens between 1674-1826, with particularly high numbers in Lezant between 1755-1811 and Morwenstow between 1666-1695 (Lovegrove 2007). By 1854 it was believed extinct in the county, this was theorised to be at least partly due to the introduction of mineral coal among farming communities leading to the loss of neighbouring pollards which allowed hollow-tree den sites, with a last record suggested to be an individual killed near Liskeard in the first quarter of the 19th century (Clark 1906). Later marten sightings however included one that was pursued by hounds in the Glynn Valley in 1843 and the latest known record to date which consists of an animal caught in a gin trap in a Delabole quarry in 1878, although the latter was identified by the author as a beech marten (Martes foina) (Rodd 1878). A pine marten of local origin is present in the collection of the Royal Cornwall Museum (**Figure 2.1**), although it is unknown from which date or precise location it originates (Clark 1906, Morgan 2021 pers comm).

Figure 2.1 Taxidermy pine marten of likely local origin in the Royal Cornwall Museum (Image: The Royal Institution of Cornwall).

In recent years there have been a handful of verifiable sightings of pine martens in Cornwall in locations such as Kilkhampton, Goss Moor and Boscastle (Morris 2015, Webb 2021 pers comm). Other anecdotal reports of pine martens have been submitted by members of the public for this study, with sightings near Rosevine, on the A3078, Hallworthy and the Fowey River Valle. The population status of these animals is unknown and it is currently believed they have originated from informal releases as opposed to natural colonisation.

2.2.4. Ecological Benefits

Predators alter the behaviour and abundance of other species (Glen & Dickman 2014), so the reinstatement of pine martens will likely contribute to a more natural preyand rich baseline within the community (Bamber et al. 2020). Pine martens have a dietary plasticity that assists with population recovery in an environment where resources are scarce, and it underscores the species as opportunistic and hence likely to be robust to future habitat changes (Twining et al. 2019).

Martens eat fruit when available and especially in autumn (Jedrzejewski et al. 1993, Gurnell et al. 1994, Helldin 1999) and this likely facilitates long-distance fruit dispersal between isolated woodland habitats which is essential in the long-term viability of plant populations. Several fleshy-fruited species growing in forest stands are consumed by martens, especially blackerry (Rubus fruticosus), raspberry (Rubus idaeus) and rowan (Sorbus aucuparia) (Schaumann & Heinken 2002, Guitian & Munilla 2010). Additionally, European blueberry (Vaccinium myrtillus) germination rates have been

found to increase when the fruits have passed through the intestinal tract (endozoochorous transport) of pine marten (Schaumann & Heinken 2002).

In Ireland and Scotland a negative correlation between local pine marten presence (habitat use intensity) and grey squirrel occupancy has been recorded (Sheehy et al. 2018). In Ireland, the associated regional decline in grey squirrel population in the face of pine marten population recovery is marked by a landscape-level return of the native red squirrel (Sheehy & Lawton 2014). This scenario brings wider ecological benefits because the grey squirrel often strips tree bark causing significant damage (Kenward et al 1988, Mayle et al. 2007, Nichols et al. 2016). Damage to oak, beech, sweet chestnut and birch is typically high and this can alter the pattern of successional woodland change and the dominance structure in the high woodland that develops (Dutton 2015). The presence of grey squirrel and associated bark stripping threat in a landscape may be prohibitive in terms of active management of existing woodlands and the planting of new woodlands for economic or carbon sequestration objectives. Forest tree species richness and structure are important as both are positive in terms of wildlife biodiversity (Bohn & Huth 2017).

Before extrapolating ecological findings, it is important that we critically review and understand how subtle landscape factors may be involved with respect to the impact of pine marten on grey squirrel. Urban landscapes may offer a refuge for grey squirrels as such habitat may either be inaccessible or avoided by the pine marten (Twining et al. 2021). In addition, when field voles (a species absent from Ireland) are abundant, the pine marten will heavily predate on this species and pay less attention to squirrels, which may offer a temporal refuge for grey squirrels because the predator focus is elsewhere (Slade et al. 2022). Thus, the pattern of high vole years has implications for the rate at which ecological benefits of pine marten presence manifest in an environment, whilst habitat type will influence the geographical pattern of effect. Additionally, although McNicol (2020) observed that in Wales grey squirrel home range size increased where pine marten use of the landscape was high, the study could not exclude confounding effects of woodland habitat quality. Thus it is unclear how significant behavioural response to pine marten occurring at the local scale contributes to any grey squirrel decline.

Twining et al. (2021) observed spring peak in detection of grey squirel remains in pine marten scat which points towards predation of young. The grey squirrel is a tree cavity nesting species, and our landscapes are typically short of suitable cavities. Thus, it is possible that this makes drey nesting more common and animals (adults and dependent young) more vulnerable to predation (Shuttleworth et al. 2016). Should landscapes retain more older trees and increase cavity availability this may also act to reduce pine marten impacts.

Overall, the presence of the pine marten has the capacity to offer benefits to natural forest habitat functioning and successional change, the return of red squirrel as well as the improved trophic cascade which the occurrence of a missing predator represents.

2.2.5. Socio-economic benefits

The aforementioned potential grey squirrel population suppressive effect of pine marten presence could also contribute a socio-economic benefit. Reduced grey squirrel populations reduces the lower bark damage threat to timber crops (Gurnell 1996, Mayle et al. 2013). Bark stripping negatively affects timber values and leads to incremental growth rates where trees were established as carbon stores, so regulation of this behaviour through trophic mechanisms may provide indirect economic benefit.

Tourism benefits are highest where a species has a limited range and is an animal or plant that people have strong desire to see. With pine marten present in the Forest of Dean (Birks 2020) and a relatively new population in the New Forest, and plans for a future Devon translocation, there is likely to be increased presence to the east of Cornwall offering opportunities for the public to see the animals. However, this is a long-lived species with females typically aged three before they first conceive, and small single annual litters produced. It is therefore likely that it will take considerable time for populations to become widespread. Perhaps of more importance than people making a visit to Cornwall primarily to see pine marten are those people for which a potential encounter with the species is added value to a visit taking place anyway. However, wild populations of European pine marten showed stress physiological response (glucocorticoid metabolite levels (ng/g dry faeces)) induced by tourist pressures with an elevated response recorded during the reproductive season (Barja et al. 2007). As such encouraging tourism around pine martens at an early stage in translocation should be guarded against. An alternative form of ecotourism can be found where pine martens acquaint themselves with feeders established at venues including commercial hides (Macpherson et al. 2020). Once populations have become established, it is possible that similar enterprises could begin to appear.

2.2.6. Previous reintroduction experience in Britain & Europe

Sheehy et al. (2018) report on the appearance and expansion of pine marten in the Borders of Scotland, speculating that a proportion of what we might call ‘founders’ are animals being moved and released unofficially. In the absence of data on number of founders, sex ratios and ages, it is difficult to quantify the contribution unofficial releases made relative to natural southwards population range expansion. The discovery of pine martens in Shropshire (2015), the New Forest and on the Isle of Mull show that unofficial, and presumably unsupported, wild-wild translocation can result in an early-stage population establishment (although future viability remains unclear). In parallel, release in Gwynedd, North Wales of four captive animals with no experience of wild foraging resulted in 75% being detected in the wild six months later and 50% a year later (Balharry 1993). The animals used the wide suite of artificial (nest boxes) and natural (beneath brash, within boulder fields, squirrel dreys, tree cavity dens) denning sites.

The first documented modern translocation was a licenced release into Galloway forest park sites in Scotland (Caldons Wood, Glentrool & Backhill of Bush, Clatteringshaws) (Shaw & Livingston 1992). This translocation provides information on founder numbers and temporal release patterns but accurate survival rates remain opaque. Trapping at the Highland donor site was unselective and hence what was caught was translocated. This led to unbalanced sex ratios being released as the

twelve animals were only aged and sexed just prior to release in Galloway. Releases occurred between 30th January 1980 and 6th December 1981 with animals trapped post-mating (July/August) and prior to parturition (April). In a time before advances in remote telemetry and passive infrared cameras, monitoring was based on opportunistic sightings, nest box occupation and scat distribution. Despite the small number of founders, some 38 years later pine marten were still present in the forest with an estimated minimum population of 15 animals (7M:8F and with up to one third sub-adults) (Swift ecology 2016). There is no evidence that the population has ever been supplied with 'food dumps' and the only management input has been the provision of nest boxes. The study demonstrates that given suitable habitat, a small number of founders can result in long-term regional population establishment and persistence.

Given the paucity of modern pine marten records from England and Wales, and the increasing irrelevance of debates about genetic integrity of residual population in the face of the genetics of translocation source populations (see Bright et al 2000 and response from Birks & Messenger 2000), translocation from Scotland was planned by Vincent Wildlife Trust (VWT) into Ceredigon and Powys, mid-Wales (Macpherson et al. 2014). Extensive habitat assessment and associated social outreach led to 51 adult animals being translocated between 2015-2017 during the autumn so that females were more likely to be in embryonic diapause (suspended embryo development). Animals were trapped under licesne from donor populations in Scotland that were assessed as being large enough to withstand the loss of these individuals from the population and were soft-released in movable pens. The Gloucestershire Wildlife Trust, Forestry England, Forest Research and Vincent Wildlife Trust then collaborated on a project to reintroduce pine martens to the Forest of Dean and lower Wye Valley. In 2019-2021 they released 40 animals in the forest of Dean using similar methodologies to those in Wales (Stringer et al. 2018).

In Wales, VWT monitored the post release establishment of 39 wild-wild translocated pine martens (19 females, 20 males) (McNicol et al. 2020b). These included animals released in 2015 into a landscape containing no conspecifics and a second release in 2016 into the same area. For individuals where sufficient tracking data were recovered, they characterised two phases of movement: “exploration” followed by “settlement,” that differed between releases. In the first release, martens remained in exploration phase for a mean of 14.5 days (SE = 3.9 days) and settled at a mean distance of 8.7 km (SE = 1.8 km) from release sites. In contrast, martens released in year two, alongside resident conspecifics, travelled away from release sites at a faster rate, settling sooner, at a mean of 6.6 days (SE = 1.8 days), but further, at a mean distance of 14.0 km (SE = 1.7 km) from release sites. The presence of conspecifics appeared influential for settlement and site fidelity of translocated martens and was associated with more rapid but more distant dispersal of the second cohort. Releases of animals in close proximity appeared to promote site fidelity and rapid establishment of ranges in the recipient environment.

2.3. Red squirrel (*Sciurus vulgaris*)

2.3.1. General Biology

The red squirrel is a small native rodent with morphology reflecting adaptation to an arboreal forest environment e.g., bones are relatively light and hind limbs are disproportionately long and heavy (Shorten 1954, 1962). Feet have long toes and long curved claws. The tail is used for balance, thermoregulation, and for signalling in behavioural interactions (Shorten 1954, Lurz et al. 2005). There is no sexual size dimorphism or fur colour association with either sex (Wiltafsky 1973). The red squirrel is native to Western Europe and has a wide Palaearctic distribution (Lee and Fukuda 1999). There are a variety of recorded western European sub-species (Sidorowicz 1971) and in 2017 research demonstrated that available genetic and taxonomical evidence were sufficient to categorise Sciurus v. meridionalis (Italy) as a distinct sciurid species (Wauters et al. 2017).

Red squirrel diet is dominated by tree seeds and includes secondary food items such as tree flowers, tree buds, fungal fruiting bodies, insect larvae and occasionally bird's eggs and carrion (Mollar 1983, Krauze-Gryz & Gryz 2015).

Adult red squirrel body weights are typically 270-320 g (Tonkin 1983, Holm 1991, Lurz & Lloyd 2000, Wauters & Dhondt 1989ab). In deciduous forests animals may put on 10% body fat for winter (Kenward & Tonkin 1986, Gurnell 1991), although in spruce dominated upland plantations there may not be such an increase because of the need for animals to forage in the canopy for cones and associated need for low weight (Lurz & Lloyd 2000). In late winter within deciduous habitats, red squirrels are aloft in the treetops for only 18-53% of their active periods, whilst during the peak period of arboreal foraging in summer, this increased to 80-92% of the time (Kenward & Tonkin 1986). When compared with grey squirrels, red squirrels canopy activity is higher throughout the year at an average of 67% compared with just 14% for grey squirrels (Kenward & Tonkin 1986). Adult females can have two litters annually and young are typically born in either leaf dreys or tree dens (Tittensor 1970, Wauters & Dhondt 1990, Shuttleworth & Schuchert 2014).

Squirrel densities fluctuate with annual changes in tree seed abundance (Lurz et al. 1995; Wauters et al. 2008). Higher densities are found in habitats with lower annual variation of seed availability (Wauters et al. 2008). Body mass, winter survival and reproductive success are all correlated with tree seed production (Wauters & Dhondt 1989ab, Wauters & Lens 1995). The availability of supplemental food in the urban habitat, reducing foraging effort, but also restriction to movement imposed by higher fragmentation has led to reduced activity patterns compared with rural populations (Thomas et al. 2018). The ability for animals to use gardens and urban parkland along with the fact that the species is diurnal makes the species accessible to amateur wildlife enthusiasts. In urban areas road mortality can be significant (Fingland et al. 2021) but may be balanced by supplemental feeding enhancing survival of red squirrels (Magris & Gurnell 2002).

Red squirrels are vulnerable to habitat fragmentation and loss (Andrén & Delin 1994). However, in the United Kingdom and Ireland the introduction of the invasive North American grey squirrel (Sciurus carolinensis) has led to regional extinctions through direct resource-competition. Red squirrels exhibit lower breeding rates and depressed juvenile recruitment when sympatric with grey squirrels (Gurnell et al. 2004, Wauters et al. 2000) (see Romeo et al. 2021 for review of wider impacts in Italy). In addition to competition, the grey squirrel acts as an asymptomatic host of squirrelpox infection, with high population sero-prevalence (Sainsbury et al. 2000), and consequently the virus is spread to sympatric red squirrels where it produces epidemic disease and high mortality (Chantrey et al. 2014, Sainsbury et al. 2020).

2.3.2. General Ecology

The red squirrel is present across temperate forests of northern Eurasia. The species is present in both coniferous and deciduous habitats (Shar et al. 2008), within urban woodlands (Magris and Gumell 2002, Krauze-Gryz & Gryz 2015), and can be found occupying small woodland fragments of a few hectares (Wauters 1997). Tittensor (1975) reports a typical life expectancy from 6 months to around three years with a maximum longevity of six or seven years.

Dreys (squirrel nests) are around 30 cm in diameter and are situated close to the trunk of a tree or in branch forks. The outer layers consist of twigs, often with moss and grass on the upper surface. The inner cavity is lined with soft material such as grass, leaves, shredded bark and moss (Tittensor 1970). Individuals may have several dreys and use these interchangeably (Lurz 1995).

Red squirrels are a promiscuous species with no inter-sex pair bond. Communal drey nesting by animals can occur in the winter (Wauters and Dhondt 1990). Social organisation is based on dominance hierarchies with larger and older animals typically being dominant (Wauters and Dhondt 1989). Animals occupy overlapping home range areas and show no territoriality. Dominant animals have larger home ranges than subordinates and this contributes to the variation in range size. Range size is also related to habitat quality, temporal and spatial distribution of resources (food availability), season, and sexual activity (Lurz and Garson 1998; Lurz et al. 2000; Wauters and Dhondt 1992). Males tend to have larger home ranges than females e.g., on the island of Jersey 6.2 hectares vs 2.4 hectares (Magris & Gurnell 2002) and 20.4 hectares vs 6.2 hectares in conifer-dominated habitats in northern England. Home ranges may overlap especially when resource availability is high, however females with dependent young often reduce range their size and may have little overlap with others (Wauters and Dhondt 1985).

Gurnell (1987) reviewed red squirrel breeding. Male red squirrels have scrotal testes from the mid-winter through into late summer followed by a period of testicular regression. Females need to attain good body condition to enter oestrus, in Belgium this was 300 g (Wauters and Dhondt 1989). Females enter oestrus for a day and 1-5 males will follow her through the woodland in what is known as a mating chase. Larger and dominant males in woodland will account for a disproportionate amount of the mating (Wauters et al. 1990). Young red squirrels are born within either leaf dreys or

tree dens and begin to wean at 40-45 days (Tittensor 1975). Litter sizes are typically 1-6 with a mean of three young (Lurz et al. 2005). Young animals experience high mortality in their first six months with spring born young having a greater chance of surviving the first winter than autumn born young.

Red squirrel densities are seldom greater than two animals per hectare although there are notable exceptions e.g., Scots pine dominated Furzey Island (Kenward et al. 1998). Lurz et al. (2005) present average long-term densities of between 0.5 and 1.5 individuals per hectare in both conifer and broad-leaved forests, and stress that year-to-year fluctuation can be large and vary with weather and the availability of tree seeds, particularly in monoculture plantation forest (Wauters and Lens 1995). Northern coniferous forests, including Sitka dominated plantations, have low 0.02-0.2 numbers per hectare (Andren and Lemnell 1992; Lurz et al. 1995). A key study was undertaken by Lurz (1995) in Kielder forest, Northumberland. The research showed that animals would shift home range in response to spatial patterns of tree seed availability, shifting to Sitka spruce (Picea sitchensis) cones later in the winter when Scots pine seed became unavailable. Forest patch resource availability and inter-fragment connectivity both affect red squirrel dispersal. Wauters et al. (2010) reported a mean of 1 km and a maximum of 4 km dispersal distances between natal and breeding areas. In coniferous forest, dispersal distances up to 10 km were observed (Selonen & Hanski 2015). In urban areas roads were regularly crossed and in the forest environment fields did not prevent movement behaviour (Hämäläinen 2014). Selonen & Hanski (2015) in review stated that in agricultural-dominated areas where distances between forest fragments are less than 0.5-1 km, it seems unlikely that red squirrels will suffer from habitat fragmentation; if inter fragment distances are longer than this, fragmentation may affect red squirrel population size.

Red squirrels consume a wide range of tree seed and berries/fruits, tree buds, flowers and shoots, as well as fungi, bird eggs, nestlings and invertebrates (Moller 1983, Ognev 1940, Wauters & Dhondt 1987), with diet shows strong seasonal patterns (Shuttleworth 2000). Scatterhoarding of tree seed in the autumn and early winter occurs and fungal fruiting bodies are often collected by chewing through the stem before being cached within tree branches (Lurz and South 1998; Sulkava & Nyholm 1987). In one study it was observed that animals which partitioned significant time to cache recovery improved survival probability over winter and in the case of females, showed a tendency to have higher lifetime reproductive success - weaning more young than other animals (Wauters et a1. 1995).

Red squirrels suffer from a variety of infections and disease. Acute fatal toxoplasmosis due to infection with the intracellular protozoan Toxoplasma gondii has been described (Simpson et al. 2013a) and was the cause of death in 9.5% of red squirrels on the Isle of Wight. Enteric bacterial pathogens carried by red squirrel include Salmonella spp, Campylobacter spp, Yersinia spp. and Brucella spp (Sainsbury 2008). Francisella tularensis and Leptospira spp may also be carried by this species but are not reported as being associated with clinical disease (Meredith & Romeao 2015). Fatal exudative dermatitis (FED) associated with Staphylococcus aureus is documented in red squirrels from the Isle of Wight and Jersey (Simpson et al. 2013). Viral infections include enteric disease associated with rota virus (Everest et al. 2011) and adenovirus (Everest et al. 2014, 2017). Adenovirus is particularly significant and can be present

both as an asymptomatic or a pathogenic infection. The challenges of assessing asymptomatic infection led to the development of non-invasive PCR test using hair samples (Everest et al. 2019). Red squirrels can be killed by road traffic, drown in water-butts, die as the result of attacks by domestic dogs and cats (LaRose et al. 2010). Predators include Goshawk (Accipiter gentilis), Buzzard (Buteo buteo), red fox (Vulpes vulpes) and pine marten (Martes martes) (Lawton & Sheehy 2015).

Perhaps the most well-known infection of red squirrels is the squirrelpox virus which is only found in populations when sympatric with grey squirrels. Squirrelpox causes severe skin lesions leading to high levels of mortality (Sainsbury & Ward 1996, Tompkins et al. 2002, McInnes et al. 2013). Viral epidemiological and serological studies have advanced our knowledge of the impact of infection, including a key study by Chantrey et al. (2014). Inter-specific viral infection may lead to small outbreaks and limited mortality. In contrast, it may lead to a more widespread epidemic disease that accelerates the temporal pattern of regional red squirrel replacement by the grey squirrel. The presence of grey squirrels decreases summer breeding and juvenile recruitment in European red squirrels (Wauters & Gurnell 1999; Wauters et al. 2000). Research in Italy has also illustrated that adult red squirrels show higher stress levels, have reduced growth rates and can pick up novel infections from sympatric grey squirrels (Santicchia et al. 2018, Romeo et al. 2021). Grey squirrels also pilfer red squirrel cached seed, which results in a reduced energy intake in European red squirrels and a reduced body mass in spring (Wauters et al. 2002).

2.3.3. Historical Presence in Britain & Cornwall

Red squirrels have been native to Britain since at least the end of the last ice age, with the latest record from Binnel Point on the Isle of Wight radiocarbon dated to 4,480 ± 100 years ago (Preece 1986). It was once ubiquitous in Britain and was particularly abundant between 1890 and 1910, but the spread of the grey squirrel across the country through the course of the 20th century gradually led to its extinction in England, everywhere except parts of the north and some offshore islands (Gurnell 1991).

Red squirrels are referred to as being present in Cornwall by Richard Carew's 1602 survey (Raye 2021 pers comm) while more detailed records are known from the 19th century onwards. It was stated to be simply 'common' by Couch (1838), though in later years verified by the same author to be common in some parts of the county while rare or unknown in others (Couch 1878). This was further clarified by Clark (1906) who describes the red squirrel as abundant in the Truro and Falmouth districts but generally not occurring further west than Tehidy and otherwise scarce in the east of the county. Following the first reported arrival of grey squirrels on the Cornish border by the early 1950s however (Shorten 1953), red squirrels became rapidly rarer in Cornwall until their local extinction around 1984 (Groves 2013), although there are some records from Gweek as late as the 1990s (Gow 2022 pers comm). The recent presence of red squirrels within the Cornish landscape is supported by anecdotal reports contributed by members of the public to this report, with populations remembered from near Penzance and St Mawgan between the 1950s and 1980s.

Three taxidermy red squirrels are present in the collection of the Royal Cornwall Museum (**Figure 2.2**). Although they are not dated or located, they are assumed to be of local origin (Morgan 2021 pers comm).

Figure 2.2 One of the red squirrel specimens in possession of the Royal Cornwall Museum (Image: The Royal Institution of Cornwall)

2.3.4. Ecological Benefits

In mixed deciduous forests, red squirrels scatterhoard large numbers of large tree seeds (e.g., hazelnuts, Corylus avellana; chestnuts, Castanea spp.; beechnuts, Fagus sylvatica; acorns, Quercus spp.) in small caches in the ground in autumn and retrieve these seeds as an energy-rich food supply in winter and the next spring (Wauters & Casale 1996). Red squirrels caches are not all recovered by the animals and the residual seed may germinate; hence the species have an important tree seed dispersal role (Wauters et al. 2002, Lurz & Bosch 2012).

It is well documented that red squirrels consume fungi and will cache fruiting bodies in the tree canopy where the caps will dry out (Sulkava & Nyholm 1987, Lurz & South 1998). Bertolino et al. (2004) suggested that red squirrels, having large home range size and dispersal distances, are likely to play a major role as spore dispersal agents for hypogeous (underground) fungi. They examined faecal material for fungal spore presence and observed that whilst animals fed commonly on hypogeous fungi, they only rarely consumed epigeous (above ground) fungi, with two species detected in red squirrel faecal material. Lurz and South (1998) recorded an average of 42 fruiting bodies cached within an average home range, so the spatial use of fungi is wide. We can conclude that there is good evidence that red squirrel spore dispersal will form an important element of the forest decomposition system and associated nutrient turnover.

Red squirrels are also a common if often infrequent prey species of both avian and mammalian predators. For example, Kenward et al. (1981) recorded red squirrel as the most frequent goshawk prey species (33% of all kills). Penteriani (1997) similarly found red squirrels to provide considerable biomass to goshawks, although lower than wood pigeon (Columba palumbus) and jays (Garrulus glandarius). Prey encounter rate will be modified by habitat characteristics that affect density. In the Kielder commercial spruce plantation where red squirrel abundance is low, Petty et al. (2003) estimated 79 red squirrels wereto have been predated by goshawk annually, and suggested with annual red squirrel births of around 2000 – 9000, such predation was not a significant population impact.

Cagnacci et al. (2003) recorded red squirrels occurring in just 1% of 922 red fox scats andred squirrel infrequently appears in fox diet in Poland (Kidawa & Kowalczyk 2011) and Germany (Russell & Storch 2004); probably reflecting the durnal and arboreal ecology of the prey species reducing predator encounter rates. Pine martens are an arboreal predator and can chase red squirrel through the treetops (see Section 2.2). In Ireland, the frequency of red squirrel remains in pine marten diet ranged from 0.1 to 2.4% (O'Meara et al. 2014; Sheehy et al. 2014), whilst in Scotland it was 0 to 0.8% (Balharry 1993, Gurnell & Lurz 1997, Caryl et al. 2012). Thus, although red squirrel appears in the diet of many predatory species, there is no evidence to suggest that it is a key component of their diets and instead reflects local adundance and the availability of other marten foods.

2.3.5. Socio-economic benefits

Red squirrels are a popular species (Dunn et al. 2018) and their conservation increasingly involves citizen-scientists and local community involvement in regional applied conservation (see case studies in Shuttleworth et al. 2021a). Dunn et al. (2021) found those people living in red squirrel areas were significantly more knowledgeable about squirrels and their management and value than people living in areas where red squirrels were absent. TheirThe species has a value via green/niche tourism with assocaited societal well-being benefits. A key economic assessment was undertaken by Red Squirrels United (ERS 2020). The report quantified Willingness to Pay (WTP) to estimate a monetary value based on public attitudes towards the species and how much individuals would be willing to pay to ensure that conservation efforts are undertaken. On Anglesey/Gwynedd coastal area the 83,000 adult population were willing to pay £225k in a four-year period for red squirrel conservation, whilst in Northumberland 139,000 people would pay £373k for the same time period. The four-year tourism value (day visits and overnight stays associated with people coming to view red squirrels) was estimated as £10,303,000 and £1,903,000 for the two regions respectively.

Additional timber-protection benefits are derived if a landscape is cleared of grey squirrels in order to translocate red squirrels (ERS 2020). This is because grey squirrels are a major threat to hard-wood timber crops because of the risk of significant bark-stripping damage occurring (Kenward & Parish 1986, Nichols et al. 2016, Derbridge et al. 2016). Accurate financial benefit estimates in relation to timber crops rely upon an understanding of local timber crop age profiles, species composition and

management objectives. However, absence of the invasive species will be positive with wider benefits in terms of carbon sequestration rates in undamaged trees.

2.3.6. Previous reintroduction experience in Britain & Europe

Lawton et al. (2015) critically reviewed historical translocations in Western Europe with a focus upon studies in Britain and Ireland. Unsuccessful translocations were associated with the continued local presence of grey squirrels (due to insufficient control effort or control not being undertaken) e.g., Colwyn Bay (Jackson 1998), Thetford forest (Venning et al. 1997) and Goathorn peninsula (Kenward & Hodder 1998, Shuttleworth et al. 2014). In such situations, squirrelpox infection consequently led to pathogenic disease in released animals. It should be stressed that there was limited understanding at the time of these releases of the role of grey squirrels in the spread of squirrelpox, or the impact of associated disease outbreaks on red squirrel. Where grey squirrels were absent (Poole & Lawton 2009, Waters 2012, Dennis et al. 2011, Waters & Lawton 2011), or sustained and intensive control was undertaken (Schuchert et al. 2014) translocations were successful. However, there is a paucity of long-term data (50 years). This is particularly important in the context of several recent 'introduced' populations on small coastal islands (see Gurnell et al. 2015) e.g., Tresco in the Isles of Scilly, Holy island (Anglesey), Caldey Island and Mersea Island which have populations well below the 200 minimum viable population (MVP estimate suggested by Gurnell et al. (2002). Dyda (2020) studied genetic variability in the Holy Island population and demonstrated a loss in allelic diversity and a reduction in heterozygosity, with per-locus deviations from the Hardy-Weinberg equilibrium in generations. Within population inbreeding coefficients revealed high levels of inbreeding, 42% in 2011, which had accumulated to 56% by 2014, suggesting isolation and lack of gene flow.

Where there has been sufficient woodland habitat, both soft and hard releases have led to wild population establishment. Where grey squirrels are absent, squirrelpox infection in red squirrel is absent and thus mortality during release includes predation (Bertram & Moultu 1986, Kenward & Hodder 1998), adenovirus infection (Everest et al. 2014, Shuttleworth et al. 2021b) and road traffic associated mortality.

The squirrelpox threat posed by grey squirrels has led to debate regarding whether the associated risks of mainland red squirrel translocation into defendable geographical areas can be acceptable (Shuttleworth et al. 2020) or whether translocations should not be undertaken until regional grey squirrel populations can be permanently removed (Sainsbury et al. 2020). Squirrelpox outbreaks can cause significant mortality (Chantrey et al. 2014, Shuttleworth et al. 2022) and accelerate the rate of replacement of red by grey squirrels (Rushton et al. 2006). Therefore, any mainland translocation project needs to put in place comprehensive plans for grey squirrel removal, early detection of movement into red squirrel areas and rapid removal of dispersing animals.

2.4. Water vole (Arvicola amphibius)

2.4.1. General biology

Water voles (Arvicola amphibius formerly terrestris) are the largest British vole species with body lengths of 20 cm plus tail lengths of 13 cm. Adult males are typically larger, weighing between 246-386 g and females 225-310 g. They can be recognised by a blunt nose; short, rounded ears; dense, chestnut brown fur (with black voles more common in Scotland) and a long, hair covered tail. British water voles are predominantly semi-aquatic and though they can swim and dive, they are not otherwise particularly adapted for water. They do not have webbed feet and their fur becomes waterlogged if they remain submerged for a long time.

Water voles are short lived (~2 years) and typically semi-aquatic, though terrestrial populations are recorded across Europe and within Britain. They can be prolific breeders, producing up to five litters each year with up to six young (Telfer 1999). The breeding season runs from April-March to August-October, although breeding through mild winters has very occasionally been reported from populations in particularly optimal, food-rich environments. The young are weaned at around two weeks and they are independent at around three weeks old, with those born earlier in the spring reproducing in their first summer (Woodroffe et al. 2008). They live in colonies within which are a series of territories, with breeding females being territorial while males have ranges which overlap with a number of females and other males. Territories are marked by latrines, which are a very visible field sign. Female territories range from 30-150 m in length, while males are typically 60-300 m in length, depending on habitat quality, population density and seasonality (Moorhouse & Macdonald 2005; Moorhouse & Macdonald 2008). In the winter water voles become more communal, living together in their burrows when food is less readily available before, although inter-communal conflict contributes to further mortality on top of the death and dispersal reulsting from decreased food availability.

Water vole colonies generally occur as a ‘meta-population’ with gene flow and fluctuations between patches of suitable habitat in a catchment (MacPherson & Bright 2001; Telfer et al. 2001). Greater distance generally exists between colonies in the uplands compared to the lowlands, due to more fragmented patches of optimal habitat leading to longer dispersal distances over land in the former of >1 km (Telfer et al. 2003a) and is likely to apply within fragmented lowland habitats. Notably, establishment of water vole colonies may be influenced more significantly by the presence of other water voles, over the quality of the habitat (Fisher et al. 2008).

2.4.2. General ecology

Habitat preferences include diverse and heavily vegetated riparian banks which are not dominated by trees. Slower flowing water, around 1 m in depth with earthen banks for burrowing are preferred (Woodall 1993; Strachan & Jefferies 1993). They will persist in upland habitats, but colonies are often far more fragmented due to patches of suitable habitat being separated by larger stretches of sub-optimal habitat features such as fast flows and rocky, impermeable banks (Aars et al. 2001). In southern

Britain, limits to habitat suitability also include tree cover and excessive livestock grazing. They prefer waterbodies with a fairly constant water level, so that their burrow systems are not flooded and that are ideally wide with tall and complex vegetation (Richards et al. 2014). Although this behaviour is rare in Britain, water voles will sometimes occupy grassland habitats and adapt a 'fossorial' lifestyle, as has been observed in the east end of Glasgow (Stewart et al. 2017) and islands in the Sound of Jura (Telfer et al. 2003b). These populations can reach densities 10x higher than those found in riparian habitats (Stewart et al. 2019) and are likely to have been historically more common in Britain (Cooper 2021).

Water voles eat a variety of plant species – up to 227 species have been identified in their diets (Woodroffe et al. 2008). They consume roughly 80% of their bodyweight in vegetation each day, mainly grasses, sedges, and reeds. They also consume fruits, roots, and in exceptional circumstances (usually observed in pregnant females) will also eat animal content including freshwater molluscs, fish and amphibians (Strachan 1997). Burrow entrances are sometimes surrounded by "lawns" of closely cropped grass, and small piles of chopped food. They do not hibernate in the winter and instead collect food in the autumn to store in their burrows for the winter.

Water voles excavate complex burrow systems into the banks of rivers, streams, and ditches, with resting chambers and underwater entrances to provide safety from predators. They also create "ball nests" in stands of vegetation. This can allow them to live in aquatic environments, such as reedbeds, where burrowing habitat is limited (Dean 2021). Water voles often stay among dense vegetation in order to avoid predation and will quickly dive into water in response to a perceived threat. Water voles deposit distinctive black, shiny faeces in latrines, which they use to mark their territories. They also mark their territories with scent by wiping glands on their flanks with their feet (Nazarova et al. 2016).

Water vole population distribution and sizes are influenced largely by habitat quality, with densities varying depending on habitat type and season. In freshwater habitats in southern England with plentiful food over a wide area density can be at least 5-6 voles per suitable 100 m area of habitat (Leuze 1976; Moorhouse et al. 2009), compared to 3.3 in upland catchments in northern England (Woodroffe 1988). The density of water vole populations is extremely sensitive to the amount of vegetation present at a site, since vegetation provides both food and shelter. This results in complex wetlands such as reedbeds and grasslands being capable of hosting high density populations of water voles that provide refuge from the significant predation impacts of non-native American mink (Carter & Bright 2003; Macpherson & Bright 2010; Stewart et al. 2019). However, areas with dense trees or shrubs are not suitable as they shade out the majority of plant species favoured for food and cover (Dean 2021). Long-term population survival requires riparian vegetation enhancement (MacPherson & Bright 2011), reduction in mowing and over grazing (Critchley et al. 1999; Frafjord 2014), and connectivity between existing and reintroduced populations (Aars et al. 2006). Beaver created wetlands can also provide optimal habitat that is importantly complex over a wide area, allowing for higher densities of water voles (Newman 2019).

2.4.3. Historical presence in Britain & Cornwall

Despite once being a familiar species nationally, water voles have undergone one of the fastest declines seen in a British mammal. Early concerns of a decrease in population were noted cautiously with local natural history records across the country gradually describing water voles as increasingly rare throughout the post-war period (Jefferies et al. 1989). These reports were corroborated by field surveys which revealed a nationwide decline over the course of the 20th century (Strachan & Jefferies 1993). Latest estimates suggest that nationally, water voles have undergone a 90% decline since the 1970s and a 30% decline between 2006 and 2015 (McGuire & Whitfield 2017).

The causes of the decline have been primarily linked to the loss, reduction and fragmentation of habitat and the introduction of a novel predator, the American mink (Neovison vison). The intensification of agriculture following the second world war led to a simplification of many riparian habitats, reducing the extent of natural vegetation and removal of cover by processes such as over-mowing and grazing, while expansion of urban environments frequently led to intensive engineering of banksides which made them unsuitable for burrowing. Such reduction in habitat scope and quality subsequently left water vole populations more vulnerable to the effects of mink predation. Following establishment in the countryside through the second half of the 20th century due to escapes and releases from fur farms, simplified water courses allowed mink to rapidly cause local extinctions of water voles, whereas populations appear more resilient in areas of non-linear and complex habitat (Carter & Bright 2003; MacDonald & Harrington 2003). These factors have resulted in small and fragmented populations of water voles across Britain, with the largest remaining populations present in catchments where enough high-quality habitat persists in the southern and eastern lowlands of England, islands such as Anglesey and Isle of Wight, and uplands such as the Cairngorms, Peak District and Snowdonia.

Water voles were formally widespread throughout Cornwall, though now considered extinct in the Duchy as well as most of Devon, apart from a few reintroduced populations. At the beginning of the 20th Century it was simply regarded as ‘Common in almost all suitable habitats across the county’ (Page 1906). Biological records from Cornwall provide 21 confirmed water vole sightings between 1965 and 1974, after which they become less frequent. A record from 1986 has an attached note which reads ‘formerly widespread, no recent records’. Following this are nine records, the last three all observed by one individual at Maer Lake near Bude in 1995. The 1989-1990 national survey implemented in response to indications of a decline found evidence of the species on the Skewjack stream near Lands End, at Marazion Marsh and on a tributary of the River Fal (Strachan & Jefferies 1993). No reliable records of water voles are present beyond the 1990s in Cornwall (Groves 2013) and it can be assumed the species went locally extinct around this time. Anecdotal reports from the Cornish public were submitted to this survey remembering water voles from between the 60s and 80s in locations such as Holywell Bay, the River Fal, the Penberth River and Stoke Climsland, although some more recent sightings were also reported.

Although no specific habitat studies were done during the time water voles were present, it has been theorised that possibly due to the relative patchiness of slow-flowing, open water bodies in relation to the more spate-prone nature of Cornwall’s rivers, the species may never have been as common locally, although this is contrary

to statements of previous accounts and its formerly wide distribution across the county. The metapopulation structure at which this species occupies landscapes, with larger colonies centred on core habitats with gene flow from dispersing youngsters into patches of habitat within less optimal conditions such as upland streams, suggest a model for how this species once lived across Cornwall. Local extinction may also have been made easier by Cornwall's peninsular nature making recolonisation from populations, themselves under pressure, more difficult following the introduction of mink. As small colonies may take years to reform following extinction due to the dependence on chance emigration of other water voles (Telfer et al. 2003a), this effect was likely exacerbated on a larger scale, especially if habitat quality and fragmentation were already locally significant issues before the arrival of mink (Gow 2012).

Water voles have since been reintroduced formally to two sites in Cornwall within the last decade, at the Bude Marshes and Canal; and Trelusback Farm near Stithians (see Section 2.4.6 for further details).

2.4.4. Ecological benefits

At high densities, water vole burrowing creates a more varied vegetation structure that can persist even if the water vole colonies that created such conditions are no longer present (Rosalind et al. 2013). Dominant grass species are reduced to lower densities not only through foraging but also through burrowing, allowing a greater variety of less competitive plant species to grow. Although there are yet to be studies to quantify this, field observation by the authors during water vole mitigation works has revealed that several different vertebrate taxa take shelter within water vole burrow systems including other small mammal species, amphibians and grass snakes. Kingfishers have been known to enlarge water vole tunnels to adapt them into nest sites (Morgan & Glue 1977). Given that water vole burrows can remain in-situ long after colonies which inhabited them are no longer present, it can likely be predicted that burrow systems can provide long-term refugia for other species in a similar way to the maintenance of diverse plant communities.

Due to their large size and rapid breeding, water voles form a significant prey-base for many small to medium-sized mammalian and avian predators, as well as pike (Esox lucius) (Woodroffe et al. 2008; Forman 2005). When the species is able to reach high abundance, it can become a crucial component of the diet of some species such as foxes (Vulpes vulpes) where it can make up to 50% of the recorded diet (Weber 1995), or an important alternative prey source in response to another species' decline, for example as new food supply for buzzards (Buteo buteo) during periods of field vole (Microtus agrestis) decline (Reif et al. 2009). Such benefits are more likely to materialise however if suitable complex habitat is provided that can allow water voles to reach the abundances that can support a wide suite of predators.

2.4.5. Socioeconomic benefits

Water voles are a popular British mammal with a strong cultural presence, such as the character of 'Ratty' in Kenneth Grahame's 1908 novel The Wind in the Willows. The species often elicits positive responses from members of the general public and is

frequently used as a flagship species in conservation projects given its high capacity to drive public engagement and donations towards these causes (White et al. 1997).

Although there are no direct links that can be made between water voles and economic benefits, the presence of the species in habitats accessible to the general public is likely to contribute to the general benefits of wellbeing. The public consultation survey undertaken as part of this survey revealed many individuals still retained fond memories of seeing the species in Cornwall in the past, while where water voles have been reintroduced into the Bude canal for example, it is reported that animals are frequently seen close to footpaths during the day. Such observations of normally elusive mammals can enhance the experiences of individuals in green spaces providing an overall benefit to mental health (Dick & Hendee 1986).

2.4.6. Previous reintroduction experience from Britain & Europe

Water vole reintroduction, using largely captive bred animals but with some wild translocations from mitigation sites, is now relatively well understood, with several high-profile projects taking place throughout Britain since the 2000s. Success is largely dependent on the absence of American mink and high habitat quality, with the latter in particular influencing longer-term survival following release (Moorhouse et al. 2009). As water voles generally occur at a metapopulation structure, releases should be carried out at different points along a catchment rather than using one sole release site. Projects of a greater scope and in combination with a variety of conservation and restoration objectives are also likely to contribute to a longer-term persistence of colonies, such as at the Chichester coastal plain partnership where water voles released in 2002 across 8,400 ha's in tandem with agri-environment schemes and strategic mink control has led to released populations expanding and linking with others (Gow 2007).

The threat of mink to undermine releases should not be underestimated, with one release leading to the extirpation of all water voles within three months due to the arrival of the species (Moorhouse et al. 2009). Monitoring, and if required removing, of mink should occur both pre- and post-release, unless there is high confidence post release of the absence of mink across the whole watershed. Best practice post-release activities also include monitoring of the water vole populations themselves and maintaining optimal habitat conditions if required. As such, this may require either long-term resourcing and/or a committed effort from volunteers in the local community.

The lead authors of this report (Derek Gow Consultancy) run the largest specialist facility based near Lifton in Devon for the holding and captive breeding of water voles for translocation projects. Breeding animals are kept in pairs in outdoor pens and can produce at least two to three litters per year; young born in the spring and early summer can be released at the age of natural dispersal, while young from litters born later in the summer can be kept on as breeding stock for the following year or released the following spring. Over the course of just over 18 years, at least 30,000 water voles have been captive bred for this purpose from the Devon facility.

Projects have been run across the whole country since the first releases at London Wetland Centre in 2001, including the largest reintroduction project to date in Kielder Watershed, the Meon Valley in Hampshire, Malham Tarn in Yorkshire, the Trossachs National Park in Scotland and the Holnicote Estate on the edge of Exmoor. Genetic screening work has revealed that reintroduced populations continue to persist in the south-east years after establishment and add new genetic lineages to local populations (Baker et al. 2020).

In Cornwall, a population of water voles has been re-established in the Bude Canal and Marshes, undertaken by environmental charity Westland Countryside Stewards. Following a feasibility study which determined the area provided suitable habitat for at least 10 colonies to establish (Gow 2012), 277 captive breed water voles from the Derek Gow Consultancy were released onto the Bude and Neet catchments in 2013 followed by an additional 200 animals in 2014. Although field signs were relatively sparse in 2014, the 2015 survey revealed a great abundance of field signs across the catchment, with water vole evidence in 11 of 14 surveyed transects (Hill 2015). Water voles continue to be seen across the area, with regular observation known to occur of the animals in daylight from public footpaths. Mink monitoring continues across the project area, supported by volunteers.

Another water vole reintroduction project in Cornwall is also ongoing at time of writing (November 2022) at Trelusback Farm near Stithians, led by Kernow Conservation CIC. Suitable habitat at the farm has been supplemented with additional habitat management to benefit the species including clearing and managing bankside trees to decrease shading and encourage the growth of favoured food plants, removing gorse from wetland habitat and restoring additional ponds. 166 water voles from Derek Gow Consultancy were released in September 2022 with an additional 80-100 animals planned for the following spring.

Following the success of water vole establishment in beaver-created wetlands at Danescroft in East Devon, it is hoped that population establishment here can help reinforce the importance of beavers in generating water vole habitat.

2.5. Wild boar (*Sus scrofa*)

2.5.1. General Biology

Wild boar are the most widespread suid (pig) species in the world, with a range extending across the whole Eurasian continent from the Iberian peninsula in the west through Europe and the Middle-East to central Asia, Japan, India and Indonesia (Goulding et al. 2008). They are closely related to domestic pigs which were domesticated from them independently in the Near-East and Asia over 11,000 years ago, with further introgression with wild boar occurring upon their introduction to Europe in the Neolithic period (Larson et al. 2007; Larson et al. 2010; Caliebe et al. 2017; Frantz et al. 2019). Wild boar generally differ from domestic pigs by possessing a dark, bristled coat that is thicker on the mane, a straight tail tasselled at the tip and a more elongated snout. Hybridisation can occur easily and relatively frequently with events going back centuries as well as more recently (Frantz et al. 2012; Goedbloed et al. 2013; Dzaialuk et al. 2017; Iacolina et al. 2018). Wild boar can weigh at an average of 30-35 kg for younger animals and 62-86 kg for adults older than two years (Moretti 1995). Weight is often dependent on food availability, as decreases in weight have been observed in winter in areas where boar live at low density, creating more evenly distributed resources (Groot Bruinderink et al. 1994).

2.5.2. General Ecology

The opportunist nature of wild boar means they are capable of surviving across a range of habitat types over their global range (Massei & Genov 2004), but populations occur at higher densities in natural, deciduous woodland where there is richer food availability and a greater degree of habitat complexity than in managed woodland such as plantations (Jedrzejewska et al. 1994). Some of the highest wild boar densities in Europe occur in landscapes that are fragmented by agriculture, which can provide abundant food in the form of crops, leading to seasonal home range averages as small as 4 km^2. Despite this, woodland configuration within these areas is still key to maximising success (Fattebert et al. 2017), both in terms of their productivity and as refuges from hunting pressure. Individual boars have been observed occupying home ranges that can vary from entirely woodland or farm fields to a mix of the two, with yearlings primarily ‘commuting’ between the two habitats while family groups fixate on one (Keuling et al. 2009).

Home range size can be dependent on a number of other factors, such as age and social configuration (Keuling et al. 2007), food availability (Keuling et al. 2009;), sex (Saïd et al. 2012) and population density (Massei et al. 1997). Although hunting may have some short-term effects on movement and rest-site selection, boar will largely maintain home ranges even in response to this disturbance pressure (Saïd et al. 2012; Sodeikat & Pohlmeyer 2002). Dispersal distances in Germany have been recorded at an average of 3.8 km and 1.8 km for males and females, but in exceptional cases boar have been observed dispersing distances as great as 500 km (Keuling et al. 2010; Jerina et al. 2014).

The diet is approximately 90% herbivorous, consisting largely of herbage, roots, seeds and fruits but they will opportunistically consume carrion, eggs and small animals at ground level (Goulding et al. 2008). The mast crop from beech and oak in Autumn is particularly critical and factors such as winter mortality, timing of birth and litter size are often linked to the earlier availability of this resource (Bieber & Ruf 2005; Maillard & Fournier 2004; Frauendorf et al. 2016). Broadleaved grasses are consumed in the summer, and they will forage widely on root and maize crops in bulk as they become seasonally available (Groot Bruinderink et al. 1994; Genov 1981; Schley & Roper 2003; Schley et al. 2008). Crop foraging can be a significant part of boar diets in managed and fragmented landscapes. Stomach contents have been recorded as consisting of up to 60% cultivated plants (Genov 1981) with economic costs in Europe that can amount to millions of Euros each year (Schlageter & Haag-Wackernagel 2012).

Social units or 'sounders' are composed of females and offspring over multiple generations, leading to a mostly inter-related composition, but mating will often occur with multiple different males that will conceive with the same social group, providing a greater level of genetic variability (Poteaux et al. 2009; Podgórski et al. 2014). These sounders can vary greatly in size depending on local contexts; unofficially reintroduced boar in the Forest of Dean average 3-4 boar per sounder (Gill & Ferryman 2015), to 6-8 in introduced feral populations in the US (Kilgo et al. 2021). The mean litter size of wild boar in Europe is 6.28 young (Bywater et al. 2010), but hybrid animals are capable of larger litters approximately 30% larger than wild-type animals (Fulgione et al. 2016) and are capable of reproduction throughout the year (Mauget 1982).

2.5.3. Historical presence in Britain & Cornwall

As a widespread European species, wild boar have been observed from the fossil record in at least three inter-glacial periods in Britain with the first historical remains dating to the Mesolithic from sites such as Star Carr in Yorkshire (Goulding et al. 2008). The species was one of the earliest wild animals to be mentioned culturally in Britain, appearing on ancient coins and in Celtic art (Harting 1880). The wild boar held symbolic value among the Celtic peoples as representing strength in battle, such as that seen in the design of the carnyx, a Celtic war horn shaped like a boar's head that would have been used to inspire fear in invading enemies (Giles 2022).

Wild boar remains from the Mesolithic are generally smaller than those from the Neolithic onwards, although numbers appear to begin to decline from this point (Alberella 2010). The species would've been widespread in Britain at the time when domestic pigs were introduced and grazed in woodlands where the former roamed wild. This can create some confusion in the archaeological records but it is almost certain there were many hybridisation events in Britain's past (Yalden 1999; Albarella 2010). It can be assumed with reasonable confidence however that wild boar were still present across Britain by the Anglo-Saxon period, not only by archaeological remains but written evidence that distinguishes the animal from domestic pigs (Albarella 2010). Wild boar were frequently recorded in surveys from the early middle ages across Britain and were regarded as a beast of the chase, where they would have provided an income to royal forests by providing meat and quarry (Rackham 1995; Harting

1880; Malins 2016). Place names in Britain related to wild boar can often be derived from their old English name Eofor, such as Eversholt ('wild boar wood') in Bedfordshire and Everton ('wild boar farm/settlement') in Lancashire. Place names with the element of 'Swin' (ie. Swindale in Cumbria; 'wild boar's valley') are common but may also be indicative of domestic pigs (Harting 1880).

Tracing the exact extinction of wild boar in Britain as a whole is difficult as it is likely to be confounded by hybridisation and introductions of boar for hunting purposes. It has been noted that due to the significant protection boar received following the Anglo-Saxon period, along with its hunting rights firmly reserved to the aristocracy, it was unlikely to be particularly common outside of royal forests by this point (Albarella 2010). It is generally agreed that wild boar became extinct in Britain in the 13th century with some lingering populations noted in the Forest of Dean and Essex towards the end of this period (Rackham 1997; Albarella 2010). Reintroductions to hunting forests such as Savernake, Windsor and the New Forest using imported European animals were conducted throughout the 16th and 17th centuries, although these were all eventually extirpated once again by local people by the 18th century (Yalden 1999; Goulding 2003).

In Cornwall, there is little direct evidence for wild boar, although it was almost certainly present at an earlier point in history while widespread across Britain. There are no confirmed archaeological records, with medieval-era bones recovered from sites such as Launceston Castle (Albarella & Davis 1996) and Tintagel Castle (Nowakowski & Gossip 2017) being domestic pig as opposed to boar, despite the fact that remains of regularly hunted wild animals such as deer and waterbirds are present at the former. It is possible that Cornwall may have been one of the earliest places where boar became extinct in Britain through a combination of a relative paucity of woodland outside of river valleys, and the peninsular nature of the region slowing the rate of natural recolonisation - making hunting and/or hybridisation pressure more effective at hastening local extinction. Perhaps the only written record for boar in the region comes from Tresco in the Scilly Isles, where Leland states in 1543 that 'wild Bores of Swyne' are present (Raye 2021 pers comm), however it is more likely that these were introduced animals.

2.5.4. Ecological Benefits

Wild boar have the potential to be ecological engineers due to their ability to significantly disturb soil and ground flora structure through their digging activity, largely as a result of 'rootling' for food (Welander 2000). There have been few studies that have sought to quantify this positive ecological impact, with most focusing instead on the impacts of introduced non-native boar on crop destruction (Massei & Genov 2004; Barrios-Garcia & Ballari 2012).

The few studies that have looked at ecological benefits find that the disturbance provided by boar may provide key opportunities for effectively 'refreshing' top-soil layers in a way similar to other human-driven ground preparation techniques for habitat restoration (Sandom et al. 2013). Plant species number, diversity, richness and percentage has been shown to increase significantly compared to non-rooted sites

across a variety of different habitat types including woodlands and alpine meadows (Welander 1995; Sims 2006; Palacio et al. 2013). Tree root growth can also be increased in areas affected by rooting (Lacki and Lancia 1986). By clearing the ground and providing bare soil, novel colonisation opportunities are presented for field weeds and smaller plants which are typically outcompeted by more dominant species, providing beneficial opportunities for insect species that will feed on their nectar or seeds (Everitt & Alaniz 1980; Dovrat et al. 2014; Welander 1995; de Schaetzen et al. 2018). This may provide opportunities for rare and declining species such as the turtle dove (Streptopelia turtur) which typically feed on arable weeds such as scarlet pimpernel (Anagallis arvensis) and mouse-ear (Cerastium fontanum) that can all be significantly more abundant in rooted ground (de Klee 2019).

While much of the focus of this limited research has been on vegetation, there are benefits to soil health through nutrient cycling as a result of rooting, as boar mix organic material with mineral bases that alter nutrient concentrations and stimulate microbial activity (Nannipieri et al. 2003; Mallik & Hu 1997). Wild boar disturbance has also been shown to result in higher soil carbon and nitrogen concentrations and microbial carbon biomass (Risch et al. 2010; Wirthner et al. 2012; Liu et al. 2020). Simulated boar activity did not show similar changes in soil carbon, but did increase the rate at which forest floor carbon was stabilised into mineral carbon (Don et al. 2019). Increased concentration and mineralisation of nitrogen has also been observed from boar rooting (Siemann et al. 2009; Bueno et al. 2013; Palacio et al. 2013). Rooting may also be able to increase water retention in the soil through reduction of run-off rates, increasing soil moisture content and reducing erosion (Pitta-Osses et al. 2020).

Beyond the effects of rooting, wild boar can be active agents in the dispersal of seeds throughout ecosystems. This process of deposition in the dung of herbivores, termed ‘endozoochory’, is possibly the main long distance dispersal mechanism for many wild plant species. Wild boar can potentially disperse seeds through faeces at distances of over 3 km (Pellerin et al. 2016), although viable seed content in boar dung has been observed to be relatively lower than those produced by ruminant dispersers (Heinken et al. 2002; Picard et al. 2015; Lepková et al. 2018; Karimi et al. 2020). However, the coarse hair of the boar’s coat is better suited for transporting attaching seeds of vascular plants than other herbivores such as red deer (Cervus elaphus) and can play an important role in the dispersal of such species found in open habitats into woodland systems which are then frequently deposited in areas close to wallows (Heinken & Raudnitschka 2002; Heinken et al. 2006).

There is growing evidence that wild boar may also play an important role in the dispersal of mycorrhizal fungus spores which can be critical to the establishment of novel complex woodlands in areas that are deprived of such fungal networks, including old agricultural land (Piattoni et al. 2014; Livne-Luzon et al. 2016; Soteras et al. 2017). Finally, wild boar can facilitate animal dispersal. Movement of freshwater invertebrate eggs such as rotifers and copepods can occur between bouts of wallowing at distances of at least 300 metres (Vanschoenwinkel et al. 2008). Although conjectural, it is not outside the realm of possibility that the loss of this dispersal mechanism between suitable pools is at least partly responsible for the very few populations of seasonal pond arthropods such as fairy shrimp (Chirocephalus spp.) and tadpole shrimp (Triops spp.) found in Britain compared to continental Europe.

The wallows created by wild boar are also likely to create key habitats for species favouring shallow, temporary pools such as some of the aforementioned invertebrates, although published research in this area is currently lacking. A study of wallows used by both boar and deer in Europe found that although pools not used by these types of animals (ungulates) contained fewer amphibians than those that were, the difference was not significant and where pools were larger, species number was higher in ungulate pools (Baruzzi & Krofel 2017).

Ultimately, the ecological benefits of wild boar are likely to be dismissed in highly modified environments where agricultural damage flows in an ever increasing arc in the absence of effective population management (Geisser & Reyer 2004; Barrios-Garcia & Ballari 2012; Davoli et al. 2022). A full breakdown of the associated risks with wild boar is presented in Section 4.5.

2.5.5. Socio-economic Benefits

Across their European range, the most direct economic benefit from wild boar comes from game hunting for their meat. Recreational hunting and/or formalised management can produce a surplus supply of meat that can be sold to local or national suppliers (Hein 2011; Dutton et al. 2015). Wild boar meat sourced from animals culled from the unlicensed population in the Forest of Dean were estimated to make a 30-40% profit margin for local butchers that sold them and an estimated income of £27,311 in 2014/15 from Forestry Commission when their meat was sold nationally; it should be noted that the lack of government-culled animals reaching local suppliers was not well perceived by the latter (Dutton et al. 2015) and should be a consideration in any other UK-based management programme. Despite the benefits of wild boar meat compared to traditional pork, such as improved nutrition and sustainability, the realisation of this economic benefit is still largely unfounded. The amount of wild boar meat which reaches the market from local hunters can be as low as 15% in Europe, likely as a result of a lack of formalised structure for the entry of game meat into the food chain (Wennborg 2021; Gaviglio et al. 2017).

In areas where wild boar are relatively novel, there is a possible benefit to tourism. A number of accommodation hosts in the Forest of Dean stated that some of their guests stayed with the intention of seeing wild boar during their visit, although there has not been any quantifiable analysis of visitor intention in the area (Dutton et al. 2015). At least one business has been known to have offered self-catering and guided tours to see wild boar of an unlicensed population in Sussex.

2.5.6. Previous Reintroduction Experience in Britain & Europe

In Britain, there have been no formal reintroductions of wild boar. Despite this, there have been several populations that have been established with varying degrees of success through escapes/deliberate releases from boar farms and illegal reintroduction. The oldest known is in the Sussex/Kent Weald which was established from escaped farm animals in the 1990s and was estimated to number an estimated density of 200 animals in the mid-2000s (Goulding et al. 2003; Sims 2006). This population has since declined due to overhunting and may no longer be viable (Lyons

2022 pers comm). Other populations originating from escapes and/or covert releases have been recorded from Dartmoor and Exmoor but these populations are now confirmed as, or are likely to be, extinct (Cooper 2019) with others persisting at low levels in areas such as Wiltshire. Wild boar populations which exist within networks of private landownership do not appear to fare for long due to persecution pressure.

The exception to this are the animals found within the publicly-owned Forest of Dean, which is now the largest free-living UK population. Originally descended from a small number of farm escapees in the 90s, after the deliberate illegal release of 40 animals in 2004 the population increased rapidly so that by 2018 it was at least 4x larger than Forestry England's (then the Forestry Commission) population management target of 400 animals. This was due to limitations on ranger staff time and numbers, a situation at least partly due to resignations as a result of abuse directed at rangers from animal rights activists (Cooper 2019). Following an increase in ranger capacity the population has been reduced to an estimated 937 animals as of 2021 (Gill 2021). The population in the Forest of Dean has been shown to significantly admixture with domestic pig genes (Frantz et al. 2012) which may also explain the rapid expansion of this population due to the larger litter sizes that can be produced compared to wild-type animals. The increasing boar population has led to conflicts with local residents, including rooting damage to areas such as gardens, picnic areas, playing fields and cemeteries, incidents of charging, injury to dogs and vehicle collisions (Dutton et al. 2015).

2.6. European wildcat (*Felis silvestris*)

2.6.1. General Biology

European wildcats are a small cat species and Britain's last remaining native wild felid. While superficially similar in appearance to domestic cats (Felis catus) they are a distinct species, the latter being descended from the African wildcat (Felis lybica), although European wildcats and domestic cats are very capable of inter-breeding (Kitchener et al. 2017, Pierpaoli et al. 2003). The form native to Britain, Felis silvestris silvestris, is a stocky species relative to domestic cats and is further distinguished by morphological characteristics that include a bushy tail with a blunt tip that is banded by completed dark rings, a vertical stripe along the back that runs from the nape to the base of the tail, 7-11 unbroken stripes on the body and four thick stripes on the nape (Kitchener et al. 2005). The skull is also distinctive from domestic cats being larger in size and with a broader cranium. Males weigh on average of 5.3 kg and measure 587 mm minus the tail, compared to females at 3.73 kg and 539 mm (Kitchener & Daniels 2005).

2.6.2. General Ecology

Wildcats are found across most of Europe, although not as far north as Scandinavia, where they will utilise habitats that are predominately distant from dwellings and infrastructure (Klar et al. 2008). They are primarily associated with natural broadleaved woodland, particularly females which benefit from access to features such as deadwood and thick vegetation that can be used as den sites (Sarmento et al. 2006, Freimbichler & Slotta-Bachmyr 2013, Oliveira et al. 2018). Despite this, wildcats are habitat generalists that appear to be more dependent on prey abundance than den site availability and are capable of utilising smaller, fragmented blocks of woodland if prey demands are well met, even in agricultural landscapes (Virgós et al. 2002, Silva et al. 2013, Migli et al. 2021). In central Spain for example, scrub-pastures are favoured habitats that are abundant in rabbit (Oryctalagus cuniculus) prey (Lozano et al. 2003). In fragmented landscapes, sex-based spatial organisation has been observed, with females positioning themselves within woodland blocks while males remain focused on the edges or outside them (Beugin et al. 2016). Den sites are typically at ground level in features such as deadwood (Jerosch et al. 2010).

Home range sizes are larger for males than females and can vary significantly in size according to habitat quality and prey availability. In prey-rich habitats of wet woodland, pastures and stream edges in Germany and Switzerland, home ranges can vary from 0.08-1.2 km^2 for females and 0.3-3 km^2 for males (Walsh 2020). This is much smaller than recent data from Scotland which suggested home range sizes of 15-25 km^2 in the Cairngorms (Campbell 2015) and 8-18 km^2 on the west coast (Kilshaw 2011). Provided there is suitable core habitat nearby, it is likely that smaller home ranges can be maintained even in apparently sub-optimal agricultural landscapes (Jerosch et al. 2017).

Wildcats are predators that utilise a primarily mammalian prey base that varies in species composition depending on what is locally available and abundant. In much of

its European range this mostly comprises small rodents such as voles (Biró et al. 2005, Apostolico et al. 2015, Apostolico et al. 2016). Where rabbits are present in good number these are preferentially taken over small mammals to form the bulk of the diet (Malo et al. 2004, Lozano et al. 2006). Other prey items such as birds and reptiles make up smaller and more likely opportunistic items within the diet (Biró et al. 2005, Széles et al. 2017), with scavenging large carcasses likely to be an important winter resource in some areas (Krofel et al. 2021).

Like most felines, wildcats are typically solitary with the male having little role in the rearing of offspring, and kittens dispersing from the mother once they have reached maturity, although they can live comfortably in a family unit setting in captivity. Home ranges of males will sometimes overlap with females, but ranges of the latter do not tend to do so (Corbett 1979). Little is known about social communication, but it is generally olfactory via scent marking on features such as trees and rocks or defecating on prominent structures such as tussocks (Kitchener & Daniels 2005). Vocal communication is rarely used between individuals and is mostly posture or blinking-based (Hartmann 2019 pers comm), although the exception is in the breeding season in winter when adults will yowl loudly to advertise themselves to mates or between mother and kittens (Kitchener & Daniels 2005, Daniels 1997). After an average gestation period of around 68 days, females give birth to litters of 2-4 kittens in the spring that are weaned by 3-4 months and reach independence between 6-10 months of age. Mortality across Europe is primarily associated with humans, with the leading cause being roadkill, with lower survival rates correlating with an increased density of high traffic roads (Bastianelli et al. 2021).

2.6.3. Historical presence in Britain & Cornwall

Historically wildcats were widely distributed across Britain. Bones dating as far back as 400,000 years ago and from the Mesolithic (20,000-8,000 years BP) indicate presence throughout successive inter-glacial periods (Yalden 1999). In medieval times their furs were valued as pelts and they were perceived as ‘beasts of the chase’, with many royal hunting licenses issued with their inclusion between the 12th and 15th centuries (Gow & Cooper 2019). As a preferential predator of rabbits where present, wildcats were heavily persecuted by those seeking to protect warrens for hunting means, which combined with the demands of the fur trade and woodland loss is likely to have led to its fairly early extirpation from much of south-east England by Tudor times (Clegg 2017). Vermin bounties passed in the 16th century appear to have driven persecution and extinction of wildcats across the rest of England and Wales by the 18th century, with the introduction of game estates further restricting its sole British range to the west of Scotland by 1915 (Lovegrove 2007, Kitchener & O’Connor 2010, Sainsbury et al. 2019).

Populations began to gradually re-expand eastwards following the first world war following the decline of gamekeepers and the creation of new habitat by the formation of the Forestry Commission (Tapper 1992, Jenkins 1962), but over the course of the 20th century this population has become significantly hybridised with domestic cats leading to genetic erosion of the population that is not witnessed on such a scale anywhere else in Europe (Macdonald et al. 2010, Senn et al. 2019, Tiesmeyer et al.

2020). Due to this level of Introgression, the IUCN has declared the wildcat to be 'functionally extinct' in Scotland and therefore Britain as a whole (Breitenmoser et al. 2019).

In Cornwall, the dearth of wildcat remains reflects the wider small number of fossils/sub-fossils nationally, although post-glacial and Holocene remains have been recovered from within the wider south-west region at Gough's Cave, Sun Hole Cave and Glastonbury in Somerset (Collcutt et al. 1981, Jope & Grigson 1965). At least five Cornish place names were attributed by Padel (1985) as containing the element Cath for 'cat'; Killigarth, Langarth, Longsongarth, Ponsongath and Polgarth. There is also the location 'Catshole Tor' on Bodmin Moor, although this may be due to the apparent cat-like appearance of one of the rocks as opposed to any prior association with wildcats.

More definitive records of wildcats become apparent in the last 1,000 years. In 1199, the population of neighbouring Devon were granted a hunting license to take wildcats alongside other mammals including roe deer, foxes and wolves (Gow & Cooper 2019). Clear Cornish records of wildcats are then found upon the passing of the 'Act for the Preservation of Grain' (sic) in 1566. In Liskeard Parish the wildcat was referred to by a very old form of name, 'Fayre Bade' with a payment in 1671 listing "four wild cats or bades" (Lovegrove 2007). The 'ancient countryside' that dominated Cornwall and the rest of the southwest seemed to have allowed wildcats to persist for longer than the south-east, for whereas bounty records were mostly absent in the latter after the early 16th century, high numbers were killed in Cornwall between the 17th and 18th centuries. Bounty listings for wildcats are known from the parishes of Boyton, Camborne, Linkinhorne, Liskeard, Morwenstow, St Mabyn and St Neot, with some of these being exceptionally high. 66 bounties were paid at Morwenstow between 1667-1725 and Camborne reports 37 individuals up to 1711 (Lovegrove 2007).

The geographic spread of these parishes suggests wildcats were widespread up until the 18th century, where like the rest of the south-west the records stop. It is possible that some relict populations may have persisted for longer, such as one that supposedly lingered at Broom Hill in Exmoor until their extirpation in the early 1900s (Bourne 1963), but by this point they would have almost certainly been ecologically defunct and possibly hybridised. The lack of wildcat persistence in Cornwall after the 1700s is further increased in likelihood by their absence from contemporary 19th century local records such as the Victoria County Histories.

2.6.4. Ecological Benefits

Several predatory mammal species have been known to indirectly create 'top-down' ecological benefits through predation effects that regulate the numbers and/or behaviour of prey. In turn this curtails negative effects such as over-grazing of ecosystems, impact of mesopredators or competition with native species (Beschta & Ripple 2019, Beschta & Ripple 2020, Fowler et al. 2020, Hollings et al. 2014, Sheehy et al. 2018). As predatory specialists of rodents and rabbits as opposed to the more opportunist hunting behaviour seen in domestic cats (Széles et al. 2017), wildcats may play a role in regulating numbers and/or behaviour of these species, however the

scope of this benefit is uncertain. Top-down ecological benefits provided by carnivores, referred to as 'trophic cascades' remain complex systems which can be confounded by other non-biological factors that are often highly contextual to the relevant ecosystem or community (Morgan et al. 2017, Comley et al. 2020).

With our understanding of predator-prey dynamics and its resultant ecosystem wide effects still in its relative infancy, it is likely that wildcats would contribute to the appropriate regulation of prey species, but with other predators in the community utilising the same prey base it would more likely be an additive as opposed to a novel benefit. It could be speculated that wildcats may have a population and/or behavioural mediating effect on the invasive grey squirrel, as has been seen elsewhere in the UK following the reintroduction of pine marten (Sheehy et al. 2018, Twining et al. 2020a). There is nowhere else globally where both species co-occur in significant numbers however, so any impact remains purely conjectural, although it is noteworthy that grey squirrels typically are active in the canopy only 14% of their annual forgaing time budget (Kenward & Tonkin 1986), so may be at much higher risk of wildcat predation.

There is a chance that displacement of domestic cats from natural habitats such as woodlands and subsequently a reduction of their impact on native wildlife could occur. Segregation between the two species is observed in much of their European range (Germain et al. 2008, Gil-Sánchez et al. 2015), although this is not always the case (Beutel et al. 2017). It is possible that foxes are a more effective agent of segregation as they are dominant over both wildcats and domestic cats, though this can also provide the beneficial effect of creating a buffer against hybridisation between the two (Rodríguez et al. 2020). An indirect benefit may also come from an effort to neuter pet and/or feral cats during efforts to restore and/or conserve wildcat populations, which may play some role in reducing the impact of domestic cats on native wildlife.

2.6.5. Socio-economic benefits

Known and possible prey species like field voles Microtus agrestis and grey squirrels can have a significant impact on forestry or new woodland plantation (Evans et al. 2006, Gurnell 1996) and it is tempting to speculate that an indirect economic benefit can be provided by wildcat predation, although for reasons stated above it should not be assumed that there will be a clear impact from this.

Reintroduced species can sometimes bring additional income to local areas through tourism opportunities (Molloy 2011, Auster et al. 2020). Given their elusive nature it is difficult to ascertain if wildcats could provide a similar opportunity, with evidence even suggesting that areas of high tourist footfall in wildcat habitat increases physiological stress (Piñeiro et al. 2012). There is however the potential to use wildcats as ambassador species for wider public engagement with the animal and the wild spaces it lives in, as has been demonstrated at the 'Wildcat Village' in Hanich National Park, Germany. Established by the nature conservancy organisation BUND, the village provides an exhibition, enclosure with captive animals and forest trail to spread awareness for the species among visitors (BUND 2021).

2.6.6. Previous reintroduction experience from Britain & Europe

There have been no formal reintroductions of wildcats within Britain and experience in Europe is limited, with the earliest known projects being several disparate releases in Switzerland with limited animals, data and known outcomes (Gow & Cooper 2018). A large-scale reintroduction project in Bavaria took place between 1984-2008 using 580 captive bred animals (Walsh 2020). Prior to reintroduction, 3-4 years of habitat assessment and social engagement took place to determine the suitability of potential release sites for wildcats (Hartmann 2019 pers comm). Initial releases were not believed to have been effective, using surplus zoo animals of varied age and hard release techniques that are thought to have resulted in many mortalities from starvation or road traffic accidents. In 1994 the project was reviewed and determined no meaningful sustainable population was being established (Stahl & Artois 1991). Later releases in the Spessart Forest used approximately 140 animals that were young individuals that had come from off-show settings where they had been prepared for essential life skills such as hunting. These wildcats were soft released in sibling groups using acclimatisation pens to encourage settlement (Gow & Cooper 2018).

Post-release data is limited for these animals, but 11 animals released in the later phase of the scheme were radio collared. Three died of vehicle collision in the first two weeks, likely due to the fact that the release took place in October when the cats' activity patterns coincided with peak evening traffic. Two individuals could not be traced, while the remaining six were followed until the transponder batteries ran out (Hartmann-Furter 2006). Recent genetic profiling shows that the reintroduced population remains established in the Spessart Forest, with some male-directed dispersal from the south of the reintroduction area (Mueller et al. 2020).

In the UK, the 'Saving Wildcats' initiative by the Royal Zoological Society of Scotland (RZSS) plans to reinforce wildcats in the Cairngorms National Park, Scotland using captive-bred animals from a specialist off-show facility at the Highland Wildlife Park, which was completed in 2021. Two other reintroduction projects in Wales and southwest England are in the early feasibility scoping stages, and are being respectively led by the Vincent Wildlife Trust and Wildwood Trust; and the Devon Wildlife Trust and Derek Gow Consultancy.

3. PRELIMINARY HABITAT ASSESSMENT

3.1. Introduction

Although much of the feasibility assessment of a reintroduction is provided through ground truthing within a specific project, at a broader scale habitat mapping can provide early indications as to the true extent of key habitats and the occupancy potential for different species relative to their ecological needs.

To assess this within Cornwall, a series of maps showcasing woodland cover and riparian extent were produced to highlight the potential habitat available for the different species considered in this study. It should be noted that these maps are a rough approximation of available habitat based on generalised data, and for woodland species the potential for generalised use of other non-woodland habitats such as scrub are not included. Therefore, specific habitat surveys and ground truthing would still be required in any proposed individual reintroduction project, with the data presented in this chapter used as an initial guide only, as opposed to a final consideration of habitat suitability.

3.2. Methods

3.2.1. Open Beaver Network (OBN)

The Open Beaver Network combines the Beaver Habitat Index (BHI) and the Beaver Dam Capacity (BDC) models. The BHI provides information about habitat suitability surrounding water bodies and riverbanks. The BDC model helps understand the maximum number of dams which could be constructed along a waterbody.

The full methods, along with a description of variables and the dataset inventory used in the Open Beaver Network is available in Appendix A.

Beaver Habitat Index (BHI)

The Beaver Habitat Index (BHI) classifies areas which contain vegetation suitable for for both dam construction and foraging. It uses multiple nationally available spatial datasets:

- The Centre for Ecology and Hydrology (CEH) 2019 landcover map (LCM) (Morton et al. 2020)
- Copernicus 2018 10 m Tree Cover Density (TCD) (Copernicus 2020)
- The National Forest Inventory (NFI) Woodland Map (Forestry Commission 2019)
- The OS VectorMap District (Ordnance Survey 2021)

Vegetation datasets were assigned suitability values (zero to five). Zero values were assigned to areas of no vegetation (e.g., buildings) and values of five were assigned to favourable habitat (e.g., deciduous woodland; see **Table 3.1** for full classification).

Proximity to a water body is an important factor in determining habitat suitability for beavers (Gurnell 1998). Beavers use water bodies both for security and to access foraging areas. It is thought that most foraging occurs within 10 m of a watercourse/body (Haarberg and Rosell, 2006), and rarely at greater than 50 m (Stringer et al. 2018).

Use of the Beaver Habitat Index (BHI)

The BHI provides a resource for quantifying beaver habitat suitability with national coverage. Its high (10 m) spatial resolution means it can inform detailed local decision making. The BHI mapping is presented in the Section 3.3.1. The BHI is overlaid on satellite imagery to reflect its ability to provide a useful classification of beaver habitat, based upon a vegetation suitability ranking and access to water (including both river network and waterbodies such as ponds and lakes). However, it is critical to note that BHI is a model rather than an absolute reflection of reality and so ground-truthing of specific sites is still recommended. A full list of caveats to consider when using the BHI is included in Appendix A.

Table 3.1 Definitions for the Beaver Habitat Index (BHI) values. A value of five represents vegetation that is highly suitable or preferred by beavers and that also lies within 100 m of a waterbody. Zero scores are given to areas that contain no vegetation or are greater than 100 m from a waterbody. It is important to note that the model considers terrestrial habitat, where foraging primarily occurs, and therefore watercourses themselves are also scored zero.

BHI Values	Definition	Habitats
0	Not suitable (no accessible vegetation)	Shingle and sand, buildings, rock, urban, freshwater and saltwater
1	Not suitable (unsuitable vegetation)	Heather, acid grassland, unimproved grassland and boulders, bog
2	Barely Suitable	Reeds, scrub and heathland and boulders, neutral grassland
3	Moderately Suitable	Coniferous woodland, scrub and unimproved grassland
4	Suitable	Scrub and marsh
5	Highly Suitable	Broad-leaf woodland, mixed woodland and scrub

Beaver Dam Capacity (BDC) models

An understanding of where dams are likely to be constructed is important to understand i) where benefits will occur and ii) to support effective management of conflicts.

An existing dam capacity model (Macfarlane et al., 2017) was adapted for use in Great Britain (Graham et al. 2020). The model calculates the number of dams that can be

supported by stream reaches (110 m ± 50 SD) across a catchment. It uses data such as the streams gradient, flow speeds and availability of dam construction vegetation.

Each reach was classified for dam capacity using five categories from “None”, defined as no capacity for damming to “Pervasive” where a maximum capacity of 15-30 dams could theoretically be constructed in a kilometre of channel (see **Table 3.2** for all classifications). It is important to note that the model outputs are for the maximum number of dams which could be supported by a reach and catchment if beaver populations were at maximum capacity. This is unlikely to happen under natural conditions, and so the actual number of dams is likely to be below the maximum numbers indicated.

In the context of this study, the BDC model also provides an approximation of potential water vole habitat. This is particularly the case where beavers modify flood-prone or shaded riparian corridors, which would otherwise be less suitable for water voles. Areas which have “None” to “Occasional” dam capacity are also likely to be suitable for water voles if surrounded by suitable vegetation complexes. Forage suitability could not be modelled in this study. Therefore, reintroduction projects would need to undertake ground truthing to assess forage suitability for water voles.

Table 3.2 Beaver Dam Capacity (BDC) classifications and definitions

BDC Classification	Maximum number of dams
None	No capacity for damming
Rare	0-1 dams/km
Occasional	1-4 dams/km
Frequent	4-15 dams/km
Pervasive	15-30 dams/km

Use of the Beaver Dam Capacity (BDC) model

The BDC model estimates the capacity of river systems to support dams at the reach-scale (approx. 110 m sections). The model also highlights reaches that are more likely to be dammed by beavers and estimates the number of beaver dams that could occur for a catchment at population carrying capacity.

However, it is important to remember that for all critical decisions, particularly at the local scale, outputs from modelling results should be supplemented by site visits. A full list of caveats to consider when using the BDC model is included in Appendix A.

3.2.2. Argos-Links: Woodland Maps for red squirrel, pine marten, wild boar and wildcats

Argos-Links is a framework for deriving potential habitat models for the terrestrial woodland species included in this study. The name Argos-Links was chosen because

the model works by calculating the relative distances/links between woodland ("Argos" in Cornish) patches.

The model produces two spatial polygon layers for each mammal: i) the viable habitat extent and ii) the zone that contains this viable habitat, limited by road boundaries. Roads are by no means a permanent barrier to animals, but they are a significant cause of mortality and do exert strong control over animal migration and movement (Glista, et al., 2009). Therefore, in this work we make the simplified assumption that A and B roads are a barrier to the movement of the considered species.

Viable habitat areas are defined as areas with sufficient woodland extent that is not intersected by A or B roads. This provides a useful indicator of which regions in Cornwall offer the best opportunities for releasing a given species. Zones that contain a greater woodland area should be considered to have a greater potential for species recovery/release success.

The model uses information on habitat preference, woodland area, patch size and gap distance. These are outlined below. The full methodology can be found in Appendix B.

Habitat preference

The only habitat type considered in this model is woodland. We define woodland habitat as continuous woody cover with a minimum area of 0.1 ha and a minimum canopy cover of 25%. The model only recognises woodland as either deciduous or coniferous, however in reality mixed woodlands exist. Where mixed woodland occurs, the area is given a score for both deciduous and coniferous. All three woodland types are included in **Table 3.3**. However, it is clear that all species can establish in either woodland type.

Table 3.3 Woodland preferences for each of the terrestrial mammal species considered for reintroduction within the study.

Species	Woodland preference
Pine marten	No clear preference (Balharry et al., 2008), however deciduous broadleaved woodland likely offers greater dietary breadth (Twining et al., 2022).
Red squirrel	Coniferous, mixed and deciduous (Lurz et al., 1995; Cagnin et al., 2000; Hämäläinen et al., 2018) but preference isn't particularly strong. However, if considered in the context of pine martens, coniferous habitat likely less preferable when the latter present (Twining et al., 2022).
Wild boar	Deciduous, mixed and coniferous (Leaper et al., 1999; Labudzki et al., 2009).
Wildcat	Deciduous, mixed and coniferous (Sarmento et al., 2006; Oliveria et al., 2018).

Minimum total woodland area

The minimum total accessible woodland area required for a given species (**Table 3.4**) was selected based on home ranges in existing literature, from studies in similar habitats to those found in Cornwall. Only woodland patches that are within the specified gap distance (**Table 3.6**) of one another are included for each mammal.

Table 3.4 The minimum area of woodland that can support each species based on their home ranges.

Species	Minimum woodland area required (ha) (home range)	Evidence
Pine marten	20	• Mean home range in Bialoweiza Forest is 223 ha for males and 149 ha for females (Zalewski et al. 2004). • Minimum home range is 25 ha and 10 ha (mean 190 and 49 ha) for males and females in fragmented mixed woodland and agricultural habitat in the French Ardennes (Mergey et al. 2011). • Translocated martens in mostly coniferous forests in Wales have a mean range of 950 ha (range 20-6,560 ha) (McNicol 2020).
Red squirrel	1	• Minimum home range of 1.52 ha in large Belgian forests (Wauters & Dhondt 1990). • Densities of 0.5-1.5 per ha with large fluctuations recorded (Lurz et al. 2005).
Wild boar	100	• Mean home range sizes of 490 ha and 250 ha for males and females in Belgium in agriculturally dominated landscapes with some forest (Prévot & Licoppe 2013). • Minimum range size of 106 ha in Romania (mean daily home ranges of 60-125 ha) in agriculturally dominated landscapes with some forest (Fodor et al. 2018).
Wildcat	100	• Minimum home ranges of 8 ha for females and 30 ha for males in wet woodlands in Germany, minimum home ranges of 70 ha for females and 150 ha for males in Swiss mixed woodland surrounded by pasture and woodland patches (Walsh 2019). • Home ranges averaging 285 ha for females and 1,189 ha for males in German woodlands surrounded by

Species	Minimum woodland area required (ha) (home range)	Evidence
		agricultural landscape (Jerosch et al. 2017).

Minimum patch size

The minimum area of woodland required to support a single individual of each species. This is known as its patch size.

Table 3.5 The minimum amount of woodland (patch size) required to support a single individual of each species.

Species	Minimum patch size for a single individual (ha)	Evidence
Pine marten	20	Estimated density of pine martens is 0.8-2 per 100 ha in lowland linear riparian woods in Italy (similar habitat to Cornwall – wooded river valleys below agricultural landscapes) (Pereboom et al 2008).
Red squirrel	0.5	Minimum patch size on the Isle of Wight is 0.25 ha (Rushton et al. 1999).
Wild boar	25	Estimated 100 ha of woodland can sustainably support four boar in the context of Scottish reintroductions (Howells & Edward-Jones 1997) Expected density of 3-5 boar per 100 ha suggested by Leaper et al. (1999) based on various European populations.
Wildcat	7	Minimum individual core range within wider home range of 7 ha for females and 215 ha for males (maximum of 433 ha and 770 ha respectively) in woodland/agricultural landscape in Germany (Jerosch et al. 2017).

Gap distance

The distance that is likely to be travelled between individual woodland patches by a species within its home range.

Table 3.6 Maximum gap distance (in metres) likely to be travelled by a species between individual woodland patches.

Species	Maximum gap distance (metres)	Evidence
Red squirrel	51	Minimum dispersal distance 51 m in Belgium in fragmented habitats (mean 1,014 m) (Wauters et al 2010).
Pine marten	1,100	Minimum dispersal distance of 1,100 m (mean 8.7 km) for translocated martens in Wales (McNicol et al. 2020).
Wild boar	2,980	Mean dispersal distance 2,980 m in Belguim (Prévot & Licoppe 2013), direct distance between resting places varies between 0-700 m (Spitz 1986).
Wildcat	1,430	Unknown. Maximum mean distance moved by wildcats in a Portuguese study was 1,430 m (Matias et al. 2021).

The full methods and data inputs can be found in Appendix B.

3.3. Results

3.3.1. Open Beaver Network (OBN)

The results of the Open Beaver Network (OBN) are presented in the series of maps below. As the resolution can be compromised by the image size, more specific details may be harder to assess using this document.

Figure 3.1 demonstrates the outputs of the Beaver Dam Capacity (BDC) model, which can also be used to understand water vole suitability. This map shows that many of Cornwall's rivers are able to support between 15-30 dams per km. The creation of dams can also create suitable habitats for water voles, through creating complex vegetation structures and reduced flow speeds (Newman 2019). The Tamar, Fal, Camel and Fowey with their deeper waters and wider channels are the least able to support dams.

Figure 3.2 presents the results of the Beaver Habitat Index (BHI), indicating the vegetation complexity surrounding watercourses. As this does not discriminate the type of vegetation complex (i.e., between closed woodland or open emergent), this should be used in relation to suitability for beavers only as opposed to water voles. Areas of low forage suitability are particularly prevalent in northeast Cornwall. On the ground assessments would be needed to ascertain why this might be. Some of the tributaries for the River Fal have larger areas of moderate to preferred forage suitability. Similarly, areas around the Helford appear to have suitable forage.

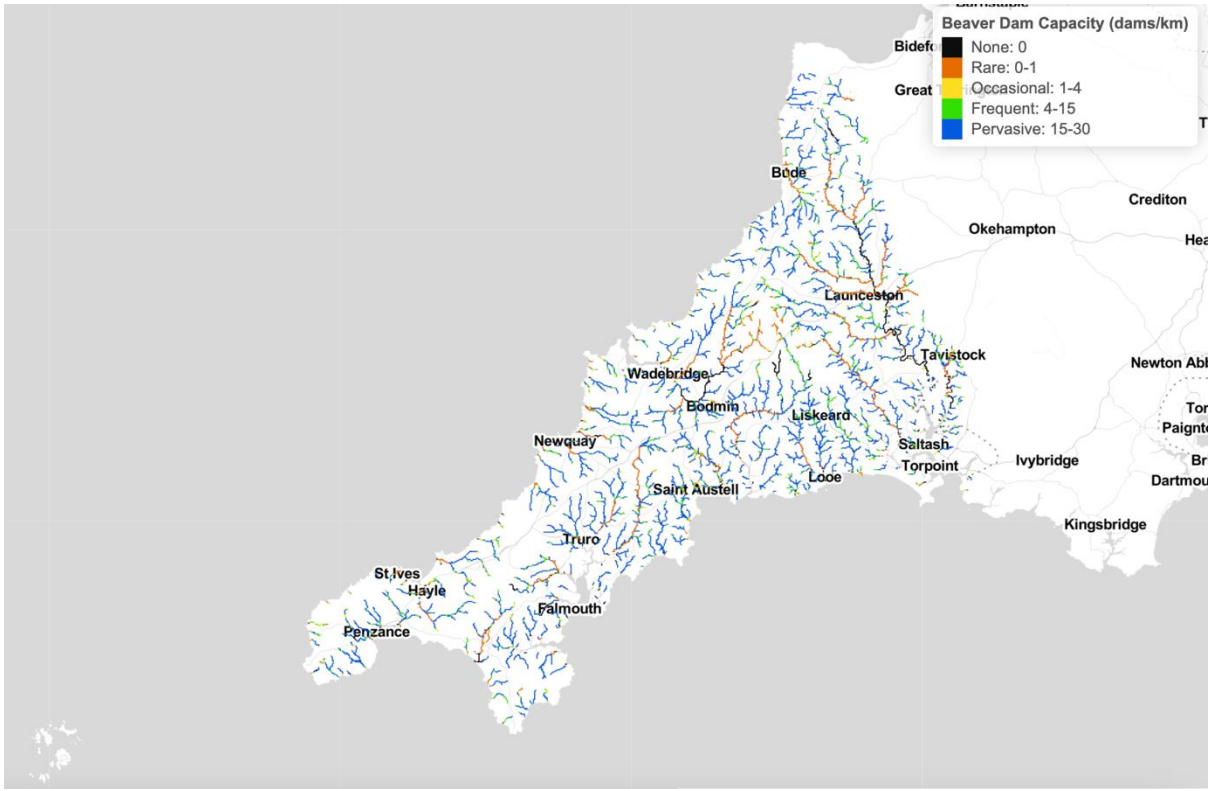


Figure 3.1 Capacity of rivers in Cornwall to support beavers and water voles, using the Beaver Dam Capacity (BDC) model.

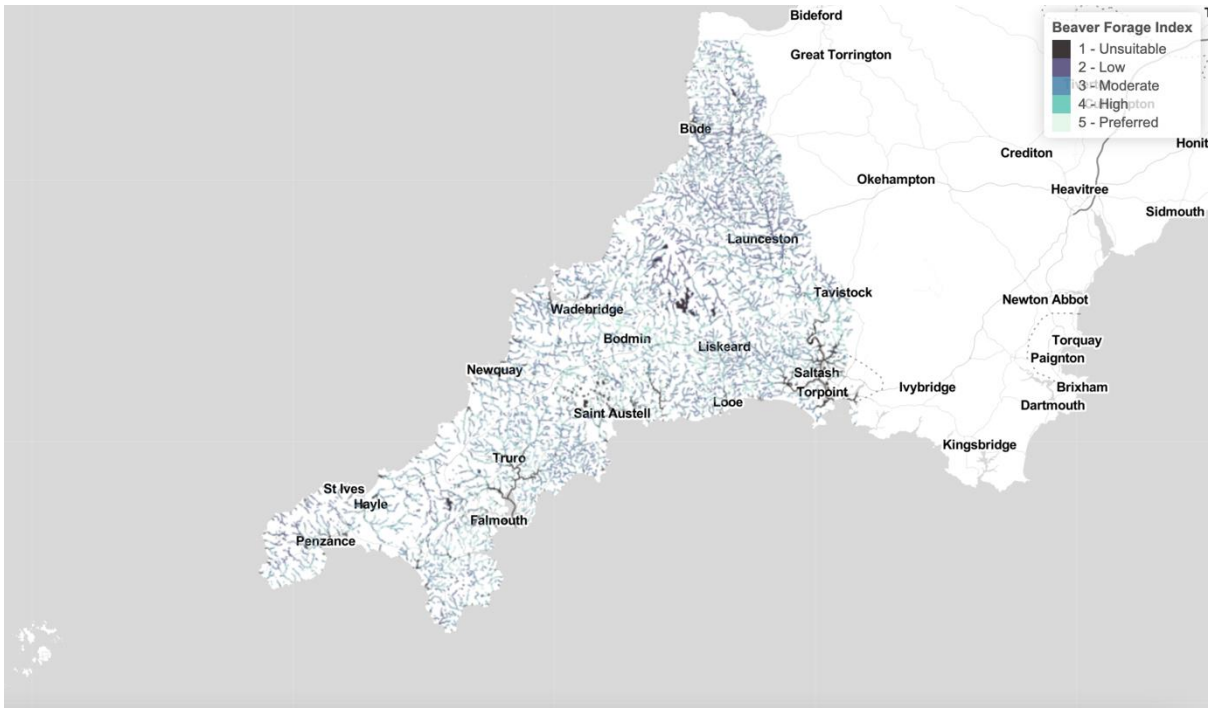


Figure 3.2 Suitability of forage surrounding watercourses for beavers. Generated using the Beaver Habitat Index (BHI).

3.3.2. Argos-Links

The Argos-Links maps are presented below in two formats per species; woodland blocks only and total zone areas which are not bisected by A or B roads.

Pine marten

Pine martens show a similar pattern of suitable woodland blocks to wildcats (**Figure 3.9**), although the zones are smaller given pine martens increased reliance on woodland cover (**Figure 3.4**). Large gaps are notable around Bodmin Moor and West Penwith (**Figure 3.3**) where woodland cover is very low.

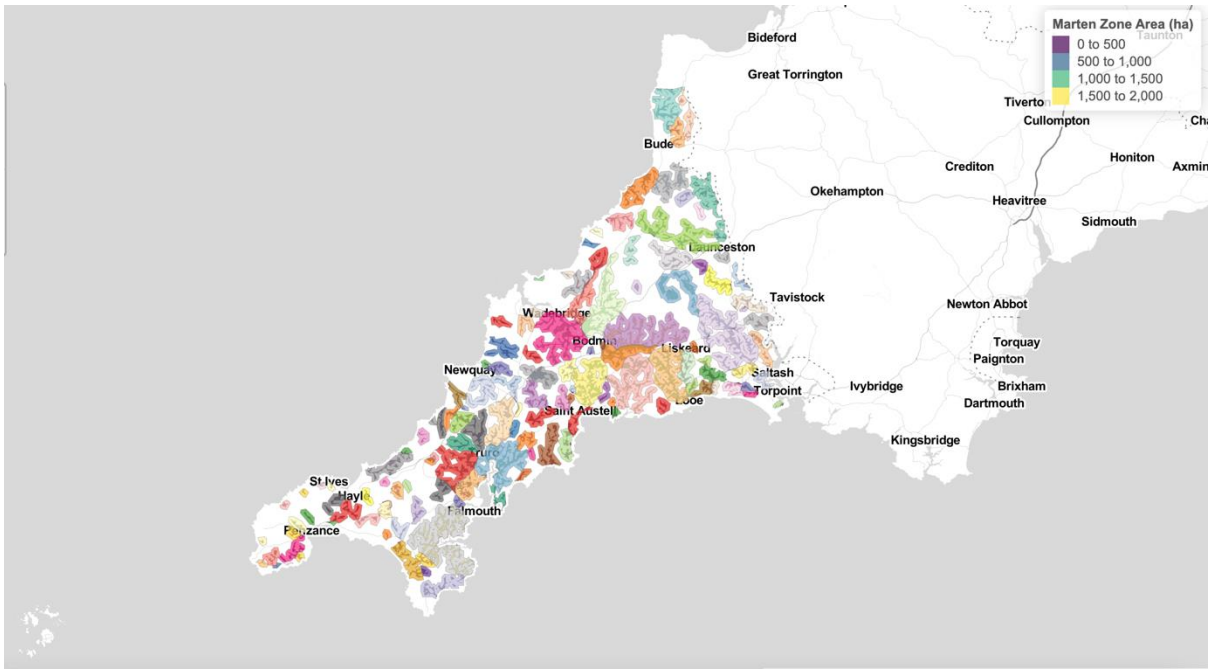


Figure 3.3 Woodland blocks capable of supporting pine martens, with woodland area (in ha) shown underneath (see **Figure 3.4**).

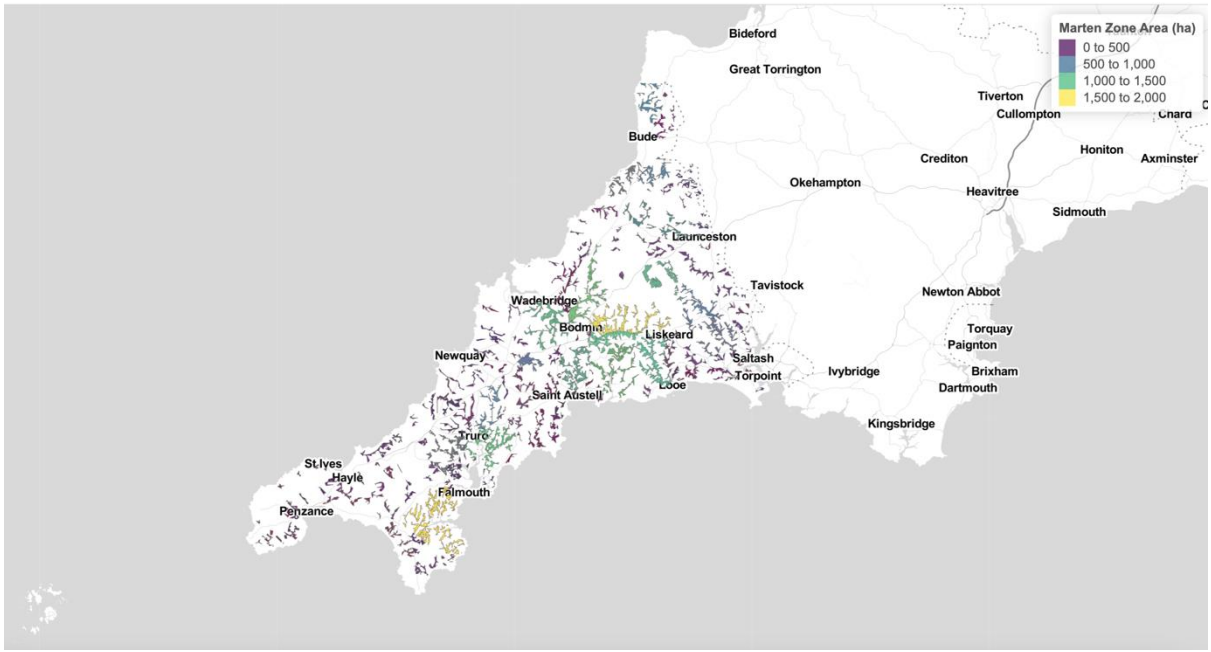


Figure 3.4 Size (in ha) of the woodland within each block (**Figure 3.3**) which are capable of supporting pine martens.

Red squirrel

Red squirrels are capable of inhabiting smaller blocks of woodland (**Figure 3.6**), meaning that despite shorter dispersal distances they would be theoretically capable of recolonising much of Cornwall's woodland (**Figure 3.5**).

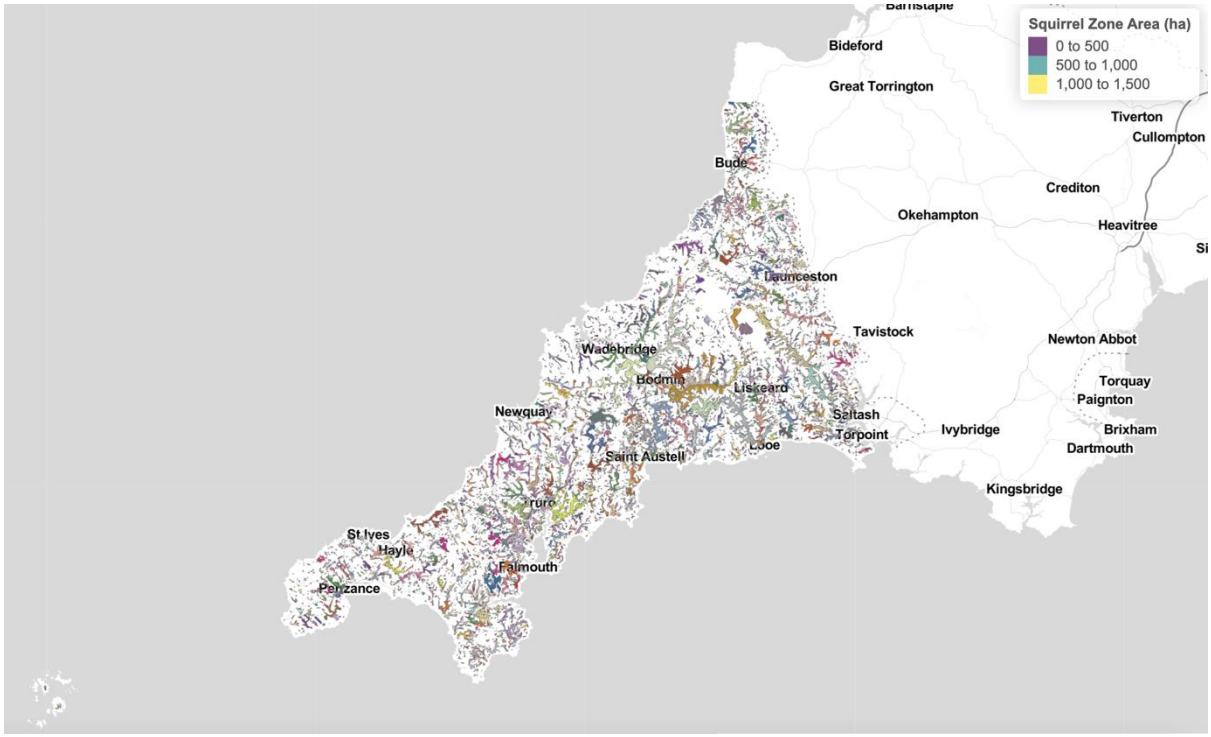


Figure 3.5 Woodland blocks capable of supporting red squirrels, with woodland area (in ha) shown underneath (see **Figure 3.6**).

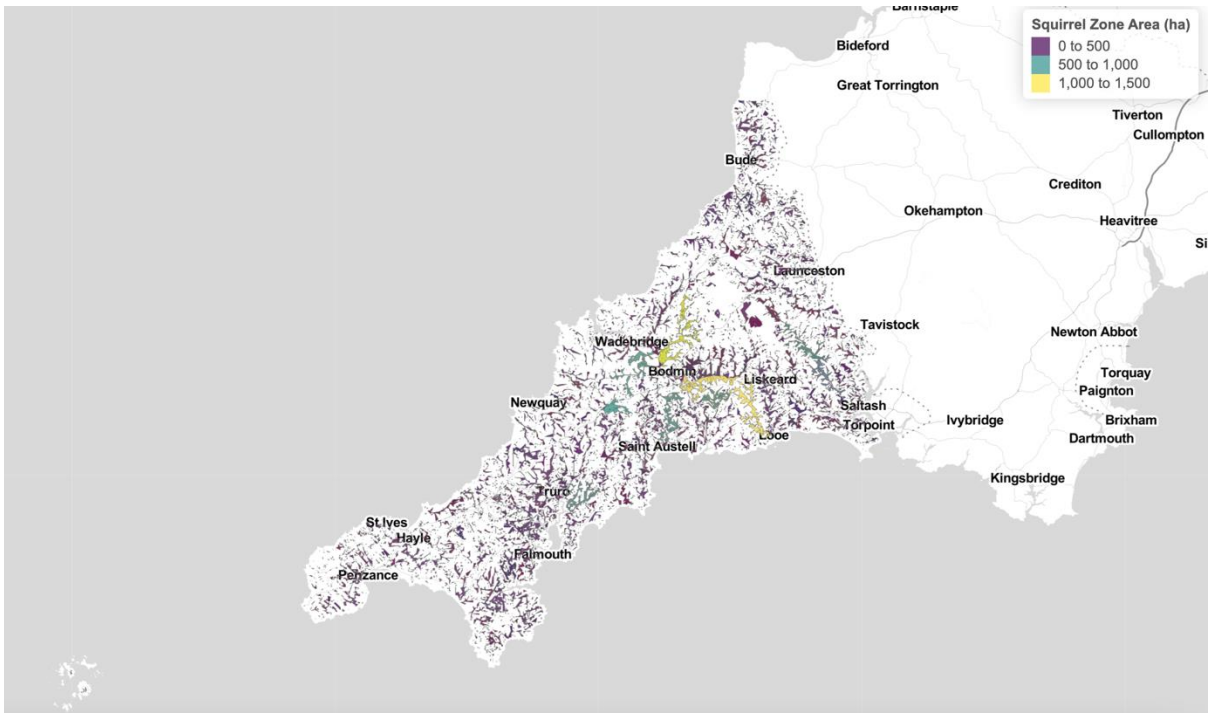


Figure 3.6 Size (in ha) of the woodland within each block (**Figure 3.5**) which are capable of supporting red squirrels.

Wild boar

Wild boar have relatively few woodland blocks of a suitable size available to them, although their wide dispersal capability would allow them to move between woodland blocks (**Figure 3.7**) with relative ease. This would mean however that much boar activity would be present within non-wooded areas, in particular farmland.

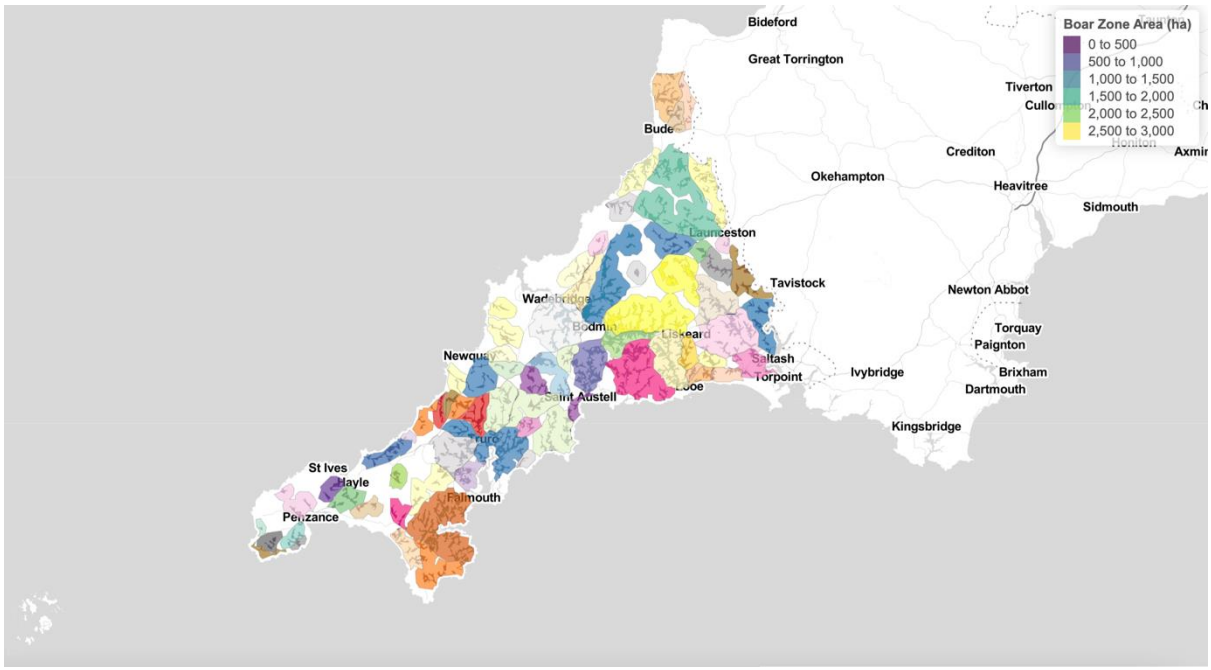


Figure 3.7 Woodland blocks capable of supporting wild boar, with woodland area (in ha) shown underneath (see **Figure 3.8**).

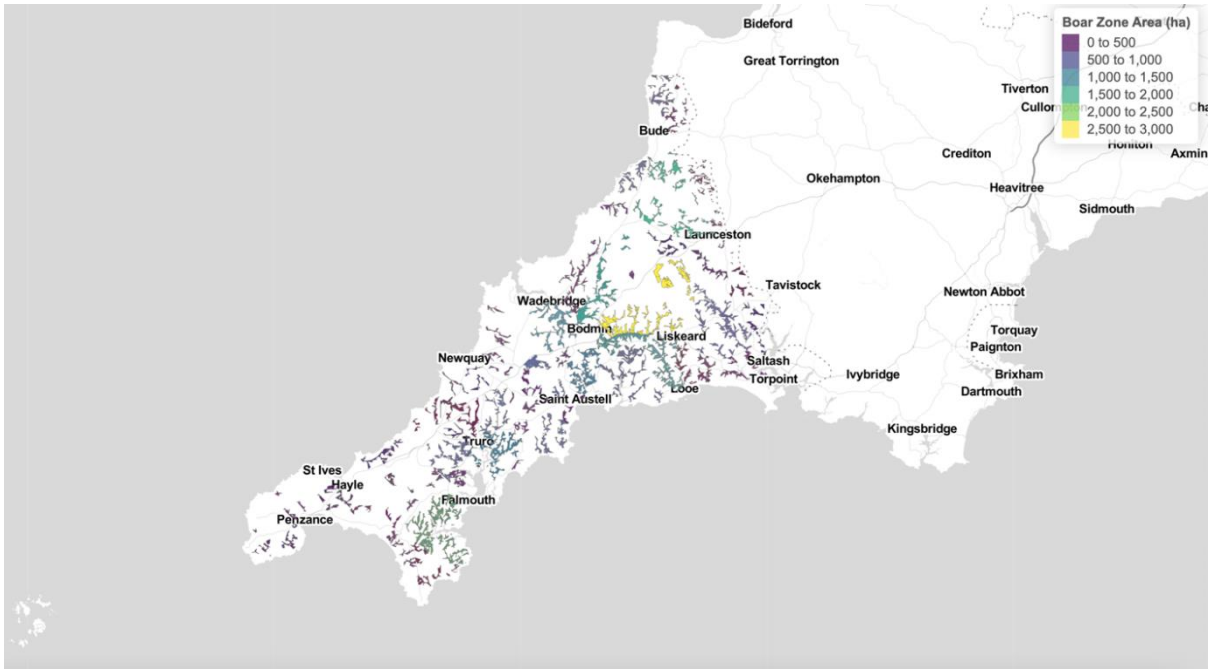


Figure 3.8 Size (in ha) of the woodland within each block (**Figure 3.7**) which are capable of supporting wild boar.

Wildcat

The suitability of woodland blocks for wildcats (**Figure 3.9**) is largely similar to wild boar (**Figure 3.7**), although as smaller blocks can be used wildcat zones can be more widespread across the county (**Figure 3.10**). One of the two largest zones in north-east Cornwall for example comprises many smaller blocks of woodland connected over a wide area undisturbed by major roads.

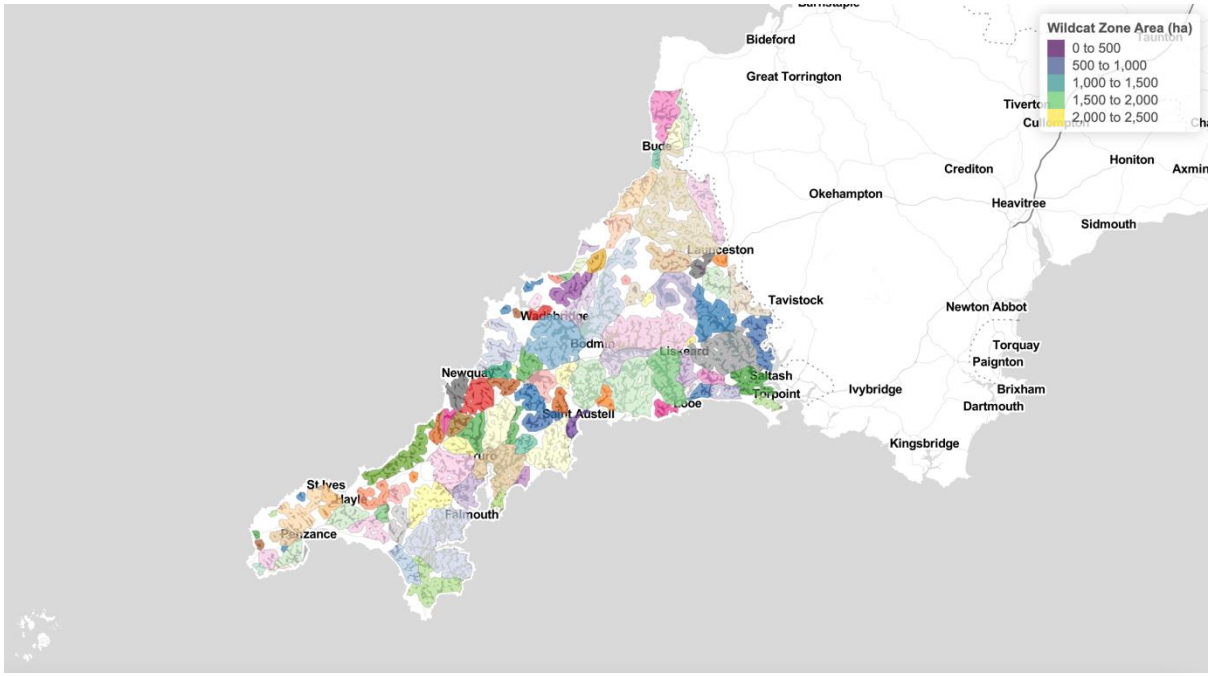


Figure 3.9 Woodland blocks capable of supporting wildcats, with woodland area (in ha) shown underneath (see **Figure 3.10**).

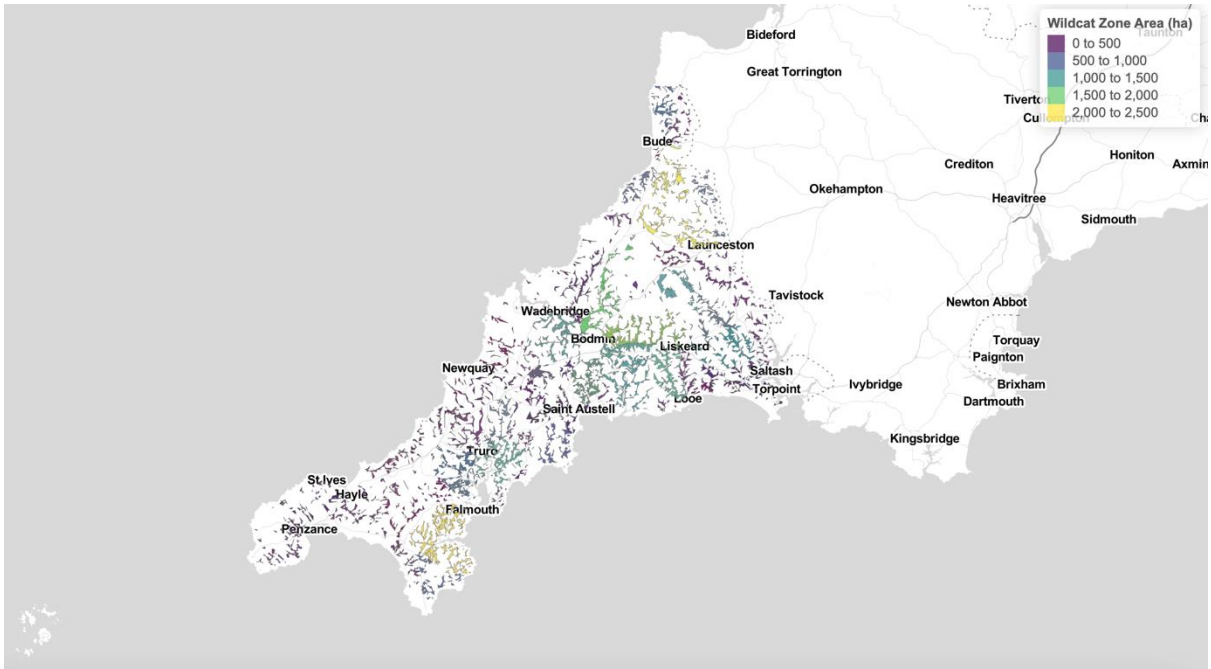


Figure 3.10 Size (in ha) of the woodland within each block (**Figure 3.9**) which are capable of supporting wildcats.

3.4. Conclusions

Both the Open Beaver Network and ArgosLinks mapping exercises provide an early indication of the landscape suitability across Cornwall for the six reviewed mammal species, giving some guide as to where the most suitable catchments and woodland areas may be in the event of a reintroduction.

The Beaver Dam Capacity model (**Figure 3.1**) shows that Cornwall's riparian networks lend themselves highly towards dam building. This is not surprising given the characteristics of many Cornish rivers and tributaries as fast-flowing narrow courses within steep valleys. This is opposed to the wider, deeper rivers where dam potential is limited or impossible, present in relatively few catchments such as the main channels of the Tamar, Fal, Camel and Fowey. Beavers will still readily occupy these areas where there is sufficient vegetation (as can presently be seen in the unlicensed population residing in the Tamar). In this regard, the watercourses in Cornwall remain of high suitability throughout the majority of their lengths. There is less suitability in the very uppermost reaches of the catchments and low to none available at the lowermost and tidal ends, and where watercourses flow through urban areas. It is not possible to apply the vegetation-based modelling (**Figure 3.2**) to water voles, as it does not discern between woodland and emergent vegetation types. However, the dam capacity model demonstrates that beavers may be able to create habitats for this species at a very wide scale in catchments where previously there may have been less optimal opportunities due to the high tree cover and flood-prone qualities of many Cornish catchments.

The degree of woodland habitat availability for the five species modelled using ArgosLinks is highly contextually dependent on the home range and dispersal capabilities of each species. Cornwall is one of the more sparsely wooded counties in England, with much of its woodland cover found within river valleys where historically the ground would've been too steep or rocky to clear for agriculture. Woodland in Cornwall is therefore very linear and more fragmented in nature. This presents a scenario where home ranges for the more widely roaming species, such as pine marten, wildcat and wild boar, are likely to be spread over a wider area of land, with the two largest woodland zones in Cornwall not fragmented by major roads covering wooded valleys across a great extent of the Upper Fowey catchment and the Helford/north-east of the Lizard peninsula.

Fewer patches of woodland are a suitable size for wild boar (**Figure 3.8**), although the wide dispersal capabilities of this species would still allow the species to move readily between different zones. Given much movement between woodland patches would likely be required by boar to create home ranges large enough to provide adequate resources, wild boar in Cornwall would likely be moving regularly and feeding on agricultural land that dominates the landscape, particularly permanent grassland, with road incidents likely to be frequent. Therefore, even if ecologically capable of surviving in the Cornish landscape, wild boar would likely be prone to relatively high levels of human-wildlife conflict. This should be a major consideration for any reintroduction proposal.

Similar zoning is apparent for wildcats (**Figure 3.9**) and pine martens (**Figure 3.3**), although these are more fragmented for the latter. The model does not however consider the impact of scrub and other open habitats of an ecologically complex structure, which can still provide den sites and abundant food supply. Increasing evidence demonstrates that although woodlands remain important predictors of wildcat occupancy and for denning females (Fusilo & Marcelli 2021; Oliveira et al. 2018), the species is more of a habitat generalist in this respect than previously thought. Wildcats have been found to make regular use of scrub-pastures and grasslands, indicating that food and shelter are more important predictors than the size of woodland (Lozano et al. 2003; Jiménez-Albarral et al. 2021; Portanier et al. 2022). Similarly, consistent occupation of open areas such as scrub and grassland has recently been observed in pine martens in Italy (Manzo et al. 2018). In Ireland, scrub, heath, sub-terranean and man-made structures are used as alternatives to trees for denning in open human-modified environments, although at a lower population density and recruitment (Twining et al. 2020b). In Cornwall, coastal and clifftop scrub could potentially offer a valuable resource in terms of foraging and cover for both species, as well as providing connectivity between woodland patches where river valleys flow towards the sea.

The capability of red squirrels to occupy much smaller woodland patches increases the potential for this species to have a much wider distribution of suitable habitat across Cornwall. However, without grey squirrel control and restoration of pine martens, habitat suitability is unlikely to be a viable contender on its own for progression with reintroduction schemes (Shuttleworth et al. 2020; Bamber et al. 2020).

As previously stated, these maps should be treated as a guide to potential key zones for each species as opposed to a verified guide on habitat quality, with any proposed project requiring specific ground truthing of proposed release areas as part of their feasibility phase. Failures in reintroductions can often be attributed to factors including insufficient habitat quality and release into areas with an insufficient carrying capacity for the species involved (Griffith et al. 1989; MacDonald 2009). Any reintroduction project should therefore not only ground-truth the assessment of suitable release habitats by looking at features such as woodland type, structure, prey bases and availability of den sites, but consider the size of the areas needed to support a viable population.

Population viability analyses were beyond the scope of this study and so any proposed reintroduction should consider these as a key component. What is clear, especially from the results for wild boar, is that the fragmented and small size of most individual woodlands in Cornwall would mean increased use of semi-natural and agricultural habitats. This would need to be factored into estimations as to how large a population a reintroduction area could support. For example, a desk-based feasibility study in Scotland found that even in suitably sized woodlands, none could support a viable population of 300 wild boar on their own (Howells & Edward-Jones 1997), so it is highly unlikely that natural habitat will be available in Cornwall to sustain a similarly sized population. Whilst sufficient riparian habitat exists in Cornwall for beavers and water voles, in the case of the larger woodland species the use of non-wooded natural

habitats and farmland would have to be considered in detail before a reintroduction was proposed.

4. RISK TABLES

All reintroductions carry with them an element of risk, which can be broadly categorised into those which primarily effect individuals of the species released, the release species as a whole, the ecology of the environment they are being released into (biological risks) or human interests (socio-economic risks).

The following tables break down the biological and socio-economic risks for each candidate species based on the evidence available in the literature and the authors' professional experience. Each risk is given a score of 1-5 on 'consequence' and 'likelihood'. These scores indicate:

- Very low to none
- Low
- Medium
- High
- Very High

4.1. Beaver

4.1.1. Biological Risks

Risk	Evidence of realised risk	Consequence	Likelihood	Possible Mitigation
Distance of translocation	Increasing distances between source population and release sites can increase stress and subsequent impacts on health and translocation success (Dickens et al. 2010). Beavers translocated from Germany to the Netherlands showed relatively high mortality from pathogens rarely or not reported in the species that were theorised to be a consequence of stress induced immune weaking from translocation (Nolet et al. 1997), although issues also arose from releasing beavers in established territories. However beavers coming from Scotland to England have survival rates approximating 86% (Campbell-Palmer 2022 pers comm).	4	2	Continue translocations from Scotland as the present most viable source. Possibility of captive bred animals in future or more local wild populations in much longer term.
Threat to source population	Beavers currently sourced from Scotland for release in England are those which would otherwise be selected for lethal control, therefore pose no threat to the source population.	4	2	Assess status of donor population and set agreed limit on number of individuals that can be sourced to ensure continued viability of the former.
Threat to genetic integrity	Tayside population from where animals for English release are currently sourced have a relatively diverse gene pool with mixed points of genetic origin although ultimately European	4	3	Scotland is the only realistic source site at present. To maximise chances of genetic diversity animals should be

Risk	Evidence of realised risk	Consequence	Likelihood	Possible Mitigation
	stock should be used more frequently in the future (Ritchie-Parker et al. 2021).			sourced from multiple locations across the country.
Lack of genetic or behavioural adaptation to release site	No examples known for beaver, likely due to broad similarity of release habitats to source populations and a wide adaptability. Animals sourced from European populations to Britain have adapted well to British landscapes (Ritchie-Parker et al. 2021).	2	1	NA
Habitat loss/reduction risk	Alteration of hydrological systems changes the depth, area and flow of previously established watercourses, but may have limited impact on habitat loss. Foraging activity and alteration of surrounding hydrology can alter vegetation community, particularly through change to a more open wooded structure and wetting of grassland and woodland. This may ultimately lead to localised loss/reduction in some important habitats such as hazel and aspen woodland (Stringer & Gaywood 2015). Although the type and structure of the previous habitat is changed, beaver wetlands are more heterogenous and generally support greater abundance and diversity compared to non-beaver engineered wetlands (Stringer & Gaywood 2015; Willby et al. 2018).	3	5	Consideration to release sites could be given where dam building and foraging may have a deleterious impact on priority habitats, with mitigation strategies such as outflows and exclusions deployed where this is deemed to be a significant risk. Individual trees can be protected with mesh guards or paste detterent. Ensure that projects work with Natural England to put in place necessary mitigation where dams are having a negative impact upon local environments.

Risk	Evidence of realised risk	Consequence	Likelihood	Possible Mitigation
Native species decline/loss	Alteration of riparian and woodland habitats may impact the presence, distribution and/or behaviour of species from the pre-modified habitat. This may include effects on fish such as impeded movement from dams, siltation build-up and reduced oxygen levels (Knudsen 1962, Kemp et al. 2012), although effects on fish movement are likely to be driven more by localised topography and anthropogenic modification (Campbell-Palmer et al. 2016). Reduction or change of habitats may lead to reductions of invertebrates which depend on faster flowing water or vegetation that is favoured by beavers. Opening of canopy and felling may impact fungi and bryophyte dependent on certain tree species and light conditions.	3	2	Whilst beavers have an overall positive influence on biodiversity, pre-release assements and local monitoring of key species that may be particularly threatened/specialised can assess the degree of impact caused by beavers. Mitigation can include tree protection, with translocation used as a last resort if significant negative impacts on key threatened species are being realised. Fish ladders can be deployed as a specific mitigation technique if it is felt a dam is significantly impeding movement (Campbell-Palmer et al. 2016).
Spread of pests and diseases	Beavers can acquire a range of pathogens that can crossover to wildlife, livestock and people (Girling et al. 2019). Pre-release disease risk protocols are established in Britain. A comprehensive assessment is provided in the biosecurity chapter.	4	3	See biosecurity chapter.

Risk	Evidence of realised risk	Consequence	Likelihood	Possible Mitigation
Spread beyond release site	Beavers live in family units and are highly territorial. Older offspring typically disperse after around two years to establish new territories of their own. This will result in spread beyond the release site in time.	4	5	Reintroductions should be considered at a catchment scale as opposed to site scale to account for impact of beavers at a landscape and social level.
Welfare concerns for released individuals - Persecution	Beavers can and have been subject to targeted persecution, particularly in unlicensed releases where tensions with stakeholders are likely to be escalated (Ward & Prior 2020).	5	3	Ensure that there is at least majority support from local people within release catchments and that a management strategy and prompt mitigation support system is established to respond to issues appropriately and proportionately should they arise. Ensure that habitat feasibility is assessed prior to release.
Welfare concerns for released individuals – Road traffic accidents	Road traffic accidents are a known minor cause of mortality in Britain (Campbell-Palmer et al. 2015).	3	4	Avoid releases close to major roads and/or where road density is high. If high risk areas appear, provide warning signage.

4.1.2. Socioeconomic Risks

Risk	Evidence of realised risk	Consequence	Likelihood	Possible Mitigation
Resistance to project by individuals/groups	Although wider communities and the public have generally shown to be largely positive in reaction to newly established beaver populations (Crowley et al. 2017), resistance can be particularly strong among certain stakeholder groups with ties to land management (Coz & Young 2020).	4	5	Ensure open dialogue with communities and stakeholders is initiated early in the projects delivery stages and is done professionally and sensitively. Provide well informed answers to questions and concerns and devise solutions/mitigation to potential issues that may result from the species' restoration.
Flooding of adjacent land use	Beaver dams can divert or impound water onto other land uses such as agriculture (Janiszewski & Hermanowska 2019; Wróbel & Krysztofiak-Kaniewska 2020; Yarmey & Hood 2021) with increased groundwater levels also creating waterlogging and impeded drainage of crops (Schwab & Schidmidbauer 2003) and forestry (Harkonen 1999; Schwab & Schidmidbauer 2003; Campbell-Palmer et al. 2016).	5	3	It is likely that impacts of beaver-created flooding in Cornwall will be relatively limited due to local geomorphology that leaves most dam-prone catchments within steep-sided valleys where there is often a natural buffer between the water's edge and surrounding land uses. Where this is not the case, ensuring there is a buffer zone between the water's edge significantly reduces the impacts of

Risk	Evidence of realised risk	Consequence	Likelihood	Possible Mitigation
				beavers on surrounding land uses (Schwab 2014). Pre-release site selection can be assisted with implementation of the Beaver Dam Capacity model (BDC) to determine whether dams are likely to occur close to areas of high conflict potential (Graham et al. 2020). A management strategy should also be in place to ensure mitigation is available for flooding problems that may occur. Specific mitigation actions can include installing bypass flow devices to drain beaver flooding and dam removal (Campbell-Palmer et al. 2012).
Burrowing damage to farmland and infrastructure	Issues can be caused by beaver burrowing damaging flood defences and forestry service roads (Campbell-Palmer et al. 2016). In farmland burrowing can lead to bank erosion and potential vehicle damage where farm machinery is caught	4	4	Ensure management strategy is in place to provide mitigation in areas where this may become an issue. Damage to flood defence unlikely to be a concern in

Risk	Evidence of realised risk	Consequence	Likelihood	Possible Mitigation
	in eroded ground (Schwab & Schidmidbauer 2003).			Cornwall as a result of local geomorphology. Specific anti-burrowing deterrents can be deployed in specific areas such as sunken sheet metal and welded wire fabric (Campbell-Palmer et al. 2016). Ensuring there is a buffer zone between the water's edge significantly reduces the impacts of beavers on surrounding land uses (Schwab 2014).
Foraging within agricultural crops	Beavers can and will feed on a wide range of agricultural crops and have been known to dam new areas in order to reach these more easily. This behaviour is generally seasonal and limited to areas within 20 m of the water's edge (Campbell-Palmer et al. 2016; Campbell et al. 2012).	3	4	Unlikely to be a significant issue in Cornwall compared to other regions of the country due to relatively little arable agriculture (21% of land use) and the geography of most watercourses locally. Ensuring there is a c.20m buffer zone between the water's edge significantly reduces the impacts of beavers on surrounding land uses (Schwab 2014).

Risk	Evidence of realised risk	Consequence	Likelihood	Possible Mitigation
				Where localised issues are present, mitigation strategies include temporary electric and permanent exclusion fencing (Campbell-Palmer et al. 2016).
Damage to forestry and ornamental/valuable trees	No nationally significant economic damage of woodland caused by beavers in woodland in Europe has been recorded (Reynolds 2000), but localised problems can still occur. Beavers can reside in commercial plantations where foraging on saplings and low-hanging branches and ring barking of mature trees has been observed. Although it is the damming of drainage ditches that may cause more significant loss through drowning of roots (Campbell-Palmer et al. 2016).	3	4	Where forestry and valued trees are located close to watercourses and recognised conflicts occur, applying wire mesh guards or deterrent paste to individual trees has been shown to be effective. Whole stands can potentially be protected with electric and permanent exclusion fencing. Where flooding of root systems is a high risk, appropriate mitigation such as dam removal, flow pipes or translocation can be undertaken.

4.2. Pine marten

4.2.1. Biological Risks

Risk	Evidence of realised risk	Consequence	Likelihood	Possible mitigation
Distance of translocation	Increasing distances between source population and release sites can increase stress and subsequent impacts on health and translocation success (Dickens et al. 2010). All pine marten translocations in Britain thus far have originated from wild animals in Scotland with potential for future translocations from wild European and captive UK sources (MacPherson & Wright 2021). It is therefore most likely that pine martens that were being released in Cornwall would travel considerable distances.	4	3	Ensure translocation is across as minimal a distance as possible. If coming from greater distances as is likely in the case of pine marten, ensure animals are appropriately treated medically and given veterinary clearance for inclusion in a translocation project. Undertake a soft release protocol that allows animals to settle and be remotely monitored prior to wild release.

Risk	Evidence of realised risk	Consequence	Likelihood	Possible mitigation
Threat to source population	A relatively small proportion of wild Scottish pine martens have been removed under license from the population for use in translocations thus far. It is best practice that only four animals are taken from any one forest block during each removal intervention (MacPherson & Wright 2021). This figure was based on a Population Viability Analysis which suggested that if 25% of animals were removed there was >90% probability the population will have returned to its original size in five years (Bright & Halliwell 1999). Currently, the captive population is small and in 2021 only produced two litters (each of n=3 young). Given the species low reproductive rate, studbook managers must manage the UK population carefully to ensure that adult numbers are not depleted. Captive martens are currently being released in Wales to augment the residual wild population.	4	3	Assess status of donor population and set agreed limit on number of individuals that can be sourced to ensure continued viability of the former, setting a five-year moratorium on collecting from sites that have been regularly used to source wild pine martens. Use well established populations as opposed to those in central/southern Scotland which have only recolonised relatively recently (MacPherson & Bright 2021). If using captive animals, use as supplementary to wild stock as opposed to sole source population. Maintain close co-ordination with the UK captive pine marten studbook

Risk	Evidence of realised risk	Consequence	Likelihood	Possible mitigation
				manager (currently Jason Palmer). Potentially conduct Population Viability Analysis of both wild and captive populations to assess the potential of using animals in co-ordination with neighbouring releases planned for Devon.
Threat to genetic integrity	Genetic assessment of this wild population has shown it to be of similar genetic variability to European animals and of higher variation than those in Ireland (MacPherson & Wright 2021). Captive stock is limited and therefore genetic management is a key consideration.	5	2	Continue to source wild Scottish animals from well spread-out locations. If using captive stock, ensure thorough genetic management of individuals within programme. The captive studbook will provide clarity with respect to relatedness, maternal haplotype and breadth of nuclear genetic diversity.

Risk	Evidence of realised risk	Consequence	Likelihood	Possible mitigation
Lack of genetic or behavioural adaptation to release site	No documented evidence for pine marten, possibility if animals of southern European stock are used. If captive animals are used then individuals should be housed in conditions that encourage natural behaviours. Wild as opposed to captive origin carnivores are more likely to be successful (Jule et al. 2008), however released captive pine martens have shown survival >2 years later (Shuttleworth 2022 pers comm).	5	2	Ensure animals are preferably from wild sourced populations within the UK. Captive stock should be kept within enclosures that promote natural features and behaviours such as foraging, with release of young animals preferred due to the likelihood of them having a fitter physique as well as more naivete to the captive environment (Sun et al. 2021).
Behavioural maladaptation	Pine marten diet is opportunistic and wild animals are often found exploiting supplemental foods at garden bird tables. Homeowners may deliberately try and attract animals into gardens and consequently wild animals may be habituated to close human proximity. Captive animals, especially if on public display, will also be habituated to human proximity. Such behaviours may prove unwelcome in early translocation phases as they bring animals quickly into contact with human habitation	4	2	When selecting wild donor populations it is important that patterns of supplemental feeding are understood, and where possible animals known to have attended gardens are not selected for translocation.

Risk	Evidence of realised risk	Consequence	Likelihood	Possible mitigation
	where there may be domestic fowl and garden housed pets.			Similarly, captive animals selected for release should be young and housed for several months away from public display. In short, a translocation programme should expect some animals to become habituated to garden feeding but should make an effort to ensure that such behaviours are not pre-quickly established in released stock.
Native species decline/loss	Although a native species for which natural prey are likely to have evolved a variety of avoidance adaptations over time, as a generalist opportunist pine martens have the potential to impact on populations of some species of mammal and bird that may be scarce/declining. The most apparent theoretical risk to bird faunas are rare woodland species such as redstart and wood warbler (MacPherson 2014). Modelling work has suggested that even if pine marten predation were to have a notable effect on common bird species, it would require birds	4	2	Pre-release site assessments for threatened small mammal, bat and bird species that may be at risk from pine marten predation, including consultation with local species specialists. Implement post-release monitoring of any species deemed to be

Risk	Evidence of realised risk	Consequence	Likelihood	Possible mitigation
	to make up at least 30% of the diet, which is rarely the case (Bright & Halliwell 1999). Another risk are to roosting bats which although rarely taken (Zalewski et al. 1995), if discovered can become a readily used food supply (MacPherson 2014). Habitat quality is a strong indicator of impacts on native prey, with greater predation effects for red squirrels in non-native conifer plantations as opposed to complex natural woodland (Twining et al. 2022). Therefore, negative impacts will be a reflection of underlying habitat limitations on prey species and other causes of decline.			particularly high risk and include options for adaptive management if an unacceptable risk is realised.
Spread of pests and diseases	Potential transfer of novel or zoonotic pathogens from movement of martens either from the wild or captivity. A comprehensive assessment is provided in the disease risk assessment.	4	2	See disease risk assessment.
Spread beyond release site	Pine martens are excellent dispersers that are capable of covering very large distances. Pine martens in the first and second phases of a release programme settled on average 8 and 14 km from the release site respectively with one individual travelling 103 km from the point of release (McNicol et al. 2020). However, dispersal and settlement patterns will be affected by the duration of pre-release	5	3	Although most animals are likely to settle close to the release site in early years, engagement measures should be geographically expanded prior to

Risk	Evidence of realised risk	Consequence	Likelihood	Possible mitigation
	confinement and the density of animals released within a local landscape.			population expansion in years following release. Remain aware of occasional sightings well beyond release site and provide support as necessary. There are clear opportunities to learn from public engagement undertaken in previous translocation programmes.
Welfare concerns for released individuals - Persecution	Illegal hunting can still be a significant driver of mortality in reintroduced carnivores (Heurich et al. 2018). Pine martens were historically made locally extinct through targeted persecution. Although fully protected, some stakeholder groups remain concerned over impact on poultry and game species (Bavin et al. 2020) and there remains the possibility that illegal persecution could occur again, for example in retaliation of real/perceived threats to livestock/game. It is also possible that accidental killing could occur as a result of legal control activities for other species e.g., foxes.	5	4	Ensure there is good community support for a reintroduction and provide targeted engagement with key stakeholder groups where persecution may be a concern. In order to avoid persecution due to misconceptions about the impacts of the species, ongoing

Risk	Evidence of realised risk	Consequence	Likelihood	Possible mitigation
				engagement is critical to avoid misconceptions becoming established. Do not proceed with release if it is deemed the risk from targeted persecution is too great despite engagement efforts.
Welfare concerns for released individuals – Road traffic accidents	Pine martens are vulnerable to road mortality, with the highest risk from major highways such as motorways and A-roads (Velander 1983; MacPherson 2014; Stringer et al. 2018), although not that there are no motorways present in Cornwall. In France road traffic accidents made up 35% of all recorded mortalities (Ruette et al. 2015).	5	4	Conduct road infrastructure assessments before selecting release sites, particularly in relation to major roads.
Welfare concerns for released individuals - Predation	Occasionally foxes can predate pine marten with notable effect on populations, as is seen in Sweden (Lindström et al. 1995), although in other regions such as Finland no such link could be observed (Kurki et al. 1998).	3	3	Release a suitable number of animals in each cohort to overcome natural effects of predation and monitor post-release to assess impact.

4.2.2. Socioeconomic risks

Risk	Evidence of realised risk	Consequence	Likelihood	Possible Mitigation
Resistance to project by individuals/groups	Substantive opposition towards pine marten restoration has been shown primarily among those working in farming, gamekeeping and estate management (MacPherson 2014). Detailed assessment shows those opposing pine marten reintroduction are apprehensive of the potential impacts (e.g., on wildlife, poultry and pheasants) and are in favour of more traditional predator management (Bavin et al. 2020).	4	5	Ensure open dialogue with communities and stakeholders is initiated early in the projects delivery stages and is done professionally and sensitively. Provide well informed answers to questions and concerns and devise solutions/mitigation to potential issues that may result from the species' restoration. For example, recommending methods to keep poultry secure from existing predators e.g. foxes.
Predation of poultry	Poultry are rarely preyed upon (Baudvin et al. 1985), with a study of free-range chicken predation in France with minimal protection found 2% of kills could be attributed to mustelids including pine martens (Stahl et al. 2002). However, as woodland is more fragmented in Cornwall there may be a greater risk of martens coming upon kept poultry than in more natural, continuous woodland.	2	3	Ensure poultry keepers in release areas are consulted on translocation projects and are informed on methods of keeping poultry secure, as is standard for mitigating the threat of other existing predators (e.g., foxes). Liaise with Natural England to evolve adaptive management protocols (e.g., licensed removal or lethal control) in significant cases.

Risk	Evidence of realised risk	Consequence	Likelihood	Possible Mitigation
Predation of gamebirds	Gamebirds are rarely preyed upon (Baudvin et al. 1985) and in Scotland low numbers of pheasants, woodcock and mallard were taken at numbers unlikely to affect populations (Halliwell 1997). Gamebirds may be predated more frequently in response to lessened availability of other abundant prey such as voles (Reynolds & Tapper 1996). More significant impacts would be expected if a pine marten were to enter an enclosed pen where multiple kills were more likely (Stringer et al. 2018).	3	3	Ensure enclosed game are kept secure from predators. In significant cases adaptative management measures such as marten-specific exclusion and licensed removal may be considered. The VWT have produced some excellent literature highlighting how local communities can live alongside martens. The literature should be shared with those voicing concerns about negative impacts and, where appropriate, bespoke local mitigation formulated.
Limiting pest control methods	The presence of pine marten in the environment is a factor limiting current spring/kill trap approaches to grey squirrel and predator control. Pine martens are legally protected and those deploying kill traps are obliged to act in a manner to prevent injury to this species, as pine marten are adept at exploring boxes and	4	2	It is important that translocation projects open dialoguedialogue with game keepers and others with regard to adapting approaches to pest control. This discussion should highlight the potential value of pine marten in reducing bark stripping damage and thus the environmental

Risk	Evidence of realised risk	Consequence	Likelihood	Possible Mitigation
	tunnel traps and there is a risk that animals will be caught as bycatch. For example, grey squirrels are often controlled using spring traps e.g. 'Fineren' Bodygrip Box & BMI trap which were not designed to preclude pine martens.			benefits of this predatorpredator return.
Residence within infrastructure	Pine martens are known to den within roof-spaces in Scotland on occasion, though it is possible this is due to a lack of natural den sites, as it is not a problem reported from the continent (Birks et al. 2005; Stringer et al. 2018). However, the presence of stone marten (Martes foina) in Europe which will more readily adapt to denning in infrastructure may provide an element of competitive exclusion that is not present in Britain (Stringer et al. 2018).	2	3	Possibility this denning behaviour can cause nuisances through noise and stored bodies of prey species as well as faeces. Adaptive management includes providing alternative den sites nearby or licensed removal.

4.3. Red squirrel

4.3.1. Biological Risks

Risk	Evidence of realised risk	Consequence	Likelihood	Possible Mitigation
Distance of translocation	Increasing distances between source population and release sites can increase stress and subsequent impacts on health and translocation success (Dickens et al. 2010). There are no quantifiable studies on the effects of stress in red squirrels from translocation distance. However, wild-caught animals held in captivity prior to release for 4-48 hours show significantly higher physiological stress than free-living or captive animals (Dantzer et al. 2016). Of note, red squirrels originating from a breeding facility in Surrey have successfully established from releases on Tresco, although the effect of translocation distance on stress levels was not recorded.	3	3	Use captive bred animals ideally sourced from facilities within the south-west region. Captive breeding facilities for release of red squirrels already exist at Paradise Park in Hayle and the Trewithen and Trelowarren estates.

Risk	Evidence of realised risk	Consequence	Likelihood	Possible Mitigation
Threat to source population	Red squirrels sourced for British releases have either originated from healthy wild populations in Scotland and Ireland (Dennis et al. 2011; Poole & Lawton 2009) or managed captive populations. Provided source populations are robust, return to carrying capacity can occur within 2 years where 20% of the population is removed for translocation (Poole 2007).	3	2	Given the lack of local wild populations, preferentially utilise captive populations that are managed to ensure a responsible harvest of animals that does not reduce the viability of the source population.
Threat to genetic integrity	Isolated wild populations show little genetic diversity (O'Meara 2018). Though red squirrels selected for reintroduction in Wales showed high genetic diversity, the initial small number of individuals released threatened long-term genetic integrity without later supplementation (Ogden et al. 2005).	3	4	Undertake genetic screening of source populations prior to reintroduction. Supplement with new founders after initial reintroduction if populations are likely to remain isolated.
Lack of genetic or behavioural adaptation to release site	Populations sourced from both captive and wild animals established and bred successfully which suggests that the former remain well adapted to wild living, provided they are raised in settings which allow expression of natural behaviours and a soft release method is used to acclimatise	4	2	Continue to source animals from established donor populations ideally in captivity but maintained in natural environments. Wild sourced animals should be from environments as similar as possible to release sites.

Risk	Evidence of realised risk	Consequence	Likelihood	Possible Mitigation
	animals to the site (Lawton et al. 2015). Hard release can be used with wild translocated animals (Dennis et al. 2011) which may alleviate some of the previously described stress risks with holding them in captivity (Dantzer et al. 2016). Wild sourced animals from a predator-free island failed to establish in a mainland release, with most killed by predators and those that survived longer relocating to habitats similar to the point of origin (Kenward & Hodder 1998).			
Native species decline/loss	Although largely a seed and fruit eater, red squirrels will on occasion take the eggs and chicks of songbirds (Shuttleworth 2001a; Yu et al. 2021).	2	2	Likely to be low risk given relative lack of importance in diet, but consider pre-release site assessments if particularly threatened tree-nesting songbirds are present. Provide bird nesting boxes with gap <4.5 cm to mitigate against red squirrel predation (Yu et al. 2021).
Spread of pests and diseases	Potential spread of novel pathogens from animals sourced from external locations. The key infection adversely affecting translocated	3	2	See disease risk assessment.

Risk	Evidence of realised risk	Consequence	Likelihood	Possible Mitigation
	captive populations is adenovirus (Everest et al.2014). A full breakdown is provided in the disease risk assessment.			
Spread beyond release site	Young squirrels show strong natal site fidelity where habitat quality is high, with dispersing individuals usually settling within a kilometer of the natal site (Lurz et al. 1997; Wauters et al. 1994),	3	3	Continue grey squirrel management in areas surrounding release site ahead of dispersal.
Welfare concerns for released individuals - Predation	More than half of red squirrels in one release programme were killed/scavenged by predators, mostly foxes, within four months of release (Kenward & Hodder 1998). Predation by pine martens is exacerbated in conifer plantations as opposed to more complex native broadleaved woodland (Twining et al. 2022). This would be an important factor to consider if also proceeding with a pine marten reintroduction project, along with consideration of sightings of this species recently made in Cornwall.	2	4	Release non-habituated animals into complex suitable habitat (i.e., broadleaved woodland) in numbers sufficient to withstand predation mortality.
Welfare concerns for released	Presence of grey squirrels (Sciurius carolinensis) results in lower population fitness of red squirrels including lower summer breeding	5	5	Crucial that a long-term management to control grey squirrels both within and around the release site is implemented.

Risk	Evidence of realised risk	Consequence	Likelihood	Possible Mitigation
individuals - Competition	and recruitment (Gurnell et al. 2004) and food competition dominated by the greys (Wauters et al. 2002; Wauters et al. 2005). Combined with disease (see below) this usually leads to local extinction.			Pine marten reintroduction prior to a release may also reduce the prevalence and behaviour of grey squirrels (Sheehy et al. 2018; Twining et al. 2020a) although these benefits will be more likely to materialise in broadleaved woodland (Twining et al. 2022). Pine marten reintroduction should be considered as supplementary and not instead of direct control, especially as urban areas can continue to act as refuges for grey squirrels (Twining et al. 2021).
Welfare concerns for individuals - Disease	Particular risk from squirrelpox virus transmitted from grey squirrels which has led to the red squirrel's extinction across most of England (Collins et al. 2014; Darby et al. 2014; Sainsbury et al. 2020). Reintroduction only likely to be successful if effective grey squirrel management is implemented to keep squirrel pox transmission low (Schuchert et al. 2014; Shuttleworth et al. 2020).	5	5	Crucial that a long-term management to control grey squirrels both within and around the release site is implemented. Pine marten reintroduction prior to a release may also reduce the prevalence and behaviour of grey squirrels (Sheehy et al. 2018; Twining et al. 2020a) although these benefits will be more likely to materialise in broadleaved woodland (Twining et al. 2022). Pine marten reintroduction should be considered as supplementary and not instead of direct control,

Risk	Evidence of realised risk	Consequence	Likelihood	Possible Mitigation
				especially as urban areas can continue to act as refuges for grey squirrels (Twining et al. 2021).
Welfare concerns for released individuals - Persecution	Historically the red squirrel was persecuted due to perceptions as a forestry pest that were realised following the species' reintroduction in Scotland in the 19th century (Holmes 2015).	5	1	Red squirrels very unlikely to be persecuted in early to mid-phases of population establishment and are a protected species. In the long-term if greys are fully eradicated/controlled from a wide area there is a possible risk that attitudes may shift against the species with some stakeholders (e.g., foresters).
Welfare concerns for individuals – Road traffic accidents	Road casualties can be a significant cause of mortality for red squirrels (Magris & Gurnell 2002; Seiler et al. 2004; LaRose et al. 2010). They have been observed as accounting for 65% of adult mortality, with the overwhelming majority in Autumn coinciding with more time spent on the ground foraging (Shuttleworth 2001b).	4	5	Avoid releasing in areas with high road density. Provide warning signage in high-risk areas.

4.3.2. Socioeconomic Risks

Risk	Evidence of realised risk	Consequence	Likelihood	Possible Mitigation
Resistance to project by individuals/groups	Unlikely that the majority would be opposed, as public consultation work completed by this report found that red squirrels are one of the favoured species suggested. It is more likely that opposition would come from those concerned for the biological welfare of the species in regards to grey squirrel competition/disease and the resources required for it. Resistance also possible from some who are against grey squirrel control (Barr et al. 2002).	3	3	Conduct thorough habitat assessments and implement grey squirrel management programme to justify cause.
Damage to commercial forestry/ornamental trees	Occasionally cause damage to commercially valuable trees by bark stripping, and are a local nuisance to orchards and horticultural crops (Lurz et al. 2005, Shuttleworth & Gill 2019).	3	2	Avoid releasing in commercial plantations. Consider adaptive management if local issues persist, though this is unlikely until well established.

4.4. Water vole

4.4.1. Biological Risks

Risk	Evidence of realised risk	Consequence	Likelihood	Possible Mitigation
Distance of translocation	Increasing distances between source population and release sites can increase stress and subsequent impacts on health and translocation success (Dickens et al. 2010). Water vole populations have been successfully established across the country from captive stock moved large distances (i.e., Devon to Northumberland), although it is not known what if any effect of stress there has been.	4	1	Ensure translocation is across as minimal a distance from source as possible. In the case of this species, the UK's largest captive breeding operation and holder for wild release (Derek Gow Consultancy) sits close to the Cornish border and is no more than two hours travel distance from anywhere in the county.
Threat to source population	None known. Most water voles used in UK projects are captive bred from a large genetic pool of animals or are of wild origin collected under license from commercial mitigation projects which compromise the future of the source population.	3	2	Ensure that the captive population is well managed with a large enough base population in which to source significant numbers of genetically diverse individuals.
Threat to genetic integrity	Continual use of captive animals with no new founders, or sourcing from small/isolated wild populations, can lead to increased numbers of inbred individuals (Witzenberger & Hochkirk 2011). Using too few animals in a release and/or from a narrow gene pool can compromise the long-term genetic health of a wild population. However, captive water vole populations in Britain have shown stronger	5	4	Provide fresh founder individuals into captive breeding populations on an at least semi-regular basis and use a broad genetic base. Use large numbers of animals from a diverse range of bloodlines in releases to maximise chances of

Risk	Evidence of realised risk	Consequence	Likelihood	Possible Mitigation
	genetic diversity than has been observed in the wild (Kirkland & Farré 2021). Wild populations of water voles can maintain high levels of genetic diversity with relatively few breeding adults, provided individuals can readily disperse between colonies (Aars et al. 2006).			establishment of a viable population. Ensure animals are released within clusters across a wide area to establish a metapopulation structure.
Lack of genetic or behavioural adaptation to release site	No known cases specifically from this species. Water voles sourced from wild environments significantly dissimilar to release sites may not be as well adapted to local habitats, especially if sourced from a fossorial population going into a riparian context and vice versa. Captive animals that are older and/or have been subject to many prior generations in captivity may not be behaviourally suited to complex wild environments (Frankham 2007).	3	4	Release young animals that have spent minimal time in captivity and are at the natural age of dispersal and ensure that animals are at least 120 g in weight. Ensure captive population is supplemented with new genes from wild populations on a regular basis.
Native species decline/loss	Vegetation composition may be altered through water vole feeding and tunnelling, but although there does not yet appear to be published evidence to assess this, it is likely a net benefit is created for more specialised species that are usually shaded out by more dominant grasses.	2	1	Monitoring of species composition as part of general post-release monitoring.
Spread of pests and diseases	Water voles can carry pathogens that have zoonotic potential, such as Leptospirosis (Gelling et al. 2014). A comprehensive assessment is provided in the biosecurity chapter.	3	2	See biosecurity chapter.

Risk	Evidence of realised risk	Consequence	Likelihood	Possible Mitigation
Spread beyond release site	Many young water voles will disperse on average 2.10 km from the natal site (Sutherland et al. 2014). Translocations show that upon release most young voles stay within 500 metres of the release point (Dean et al. 2016).	2	5	Practice releases at a scale with multiple release sites across a catchment to form a metapopulation. This is likely to encourage movement between colonies within a suitable area of habitat as well as improve genetic viability. Provide local landowners with relevant guidance on water vole friendly site management throughout the release catchment.
Welfare concerns for released individuals - Predation	Water voles are predated by a wide range of native mammal and bird predators, but these do not pose as great a threat as non-native mink (Woodroffe et al. 2008). If American mink (Neogale vison) have not been adequately removed or reduced from a catchment these can have a severely detrimental effect on water vole populations, which can lead to local extinction particularly in simplified habitats (Barretto et al. 1998; Carter & Bright 2003).	5	5	Essential that mink presence is monitored within the release site and catchment prior to water vole release. Release should only proceed if confident the catchment is mink free. If detected, trapping should begin instantly with traps placed at a density of at least one per 2 km (Martin & Lea 2020). If mink are found much later after eradication, responsive 'mink police' can be used to cull individual mink.

Risk	Evidence of realised risk	Consequence	Likelihood	Possible Mitigation
Welfare concerns for released individuals - Persecution	Although no known cases in the literature, it remains a possibility that water voles are misidentified as rats and illegally persecuted or poisoned.	1	1	Very unlikely to occur except in slight risk of confusion with rats, however water voles are unlikely to occupy areas of human land use where control is more likely to occur. Ensure that local communities are aware of water vole reintroduction within the release site.

4.4.2. Socioeconomic Risks

Risk	Evidence of realised risk	Consequence	Likelihood	Possible Mitigation
Resistance to project by individuals/groups	None recorded from water vole projects so far. Possible objections may be on grounds of disease spread and of planning complications from the re-establishment of a protected species.	2	1	Provide adequate communication and open lines of dialogue with key stakeholders within the release area.
Burrowing damage to farmland and infrastructure	Although this is known to occur in the terrestrial population in Europe (Meylan 1977), there are virtually no documented cases of this occurring in recent times in Britain.	4	1	Adaptative management protocols such as mitigation or translocation by licensed individuals.

Risk	Evidence of realised risk	Consequence	Likelihood	Possible Mitigation
Foraging within agricultural crops	Although this is known to occur with the terrestrial population in Europe (Thorvaldsen & Carlsen 2017), this is very rarely reported in Britain due to the more riparian nature of the species. Especially unlikely in Cornwall where relatively little arable crops compared to the rest of the country.	4	1	Adaptative management protocols such as mitigation or translocation by licensed individuals.
Damage to forestry and ornamental/valuable trees	Although this is known to occur with the terrestrial population in Europe (Somano et al. 2017; Suchomel 2022), this is very rarely recorded in Britain due to the more riparian nature of this species.	4	1	Adaptative management protocols such as mitigation or translocation by licensed individuals.

4.5. Wild boar

4.5.1. Biological Risks

Risk	Evidence of realised risk	Consequence	Likelihood	Possible Mitigation
Distance of translocation	Increasing distances between source population and release sites can increase stress and subsequent impacts on health and translocation success (Dickens et al. 2010). As stress increases with transport time in domestic pigs (Saco et al. 2012; Aradom et al. 2012), it can be assumed that long transportation distances would create similar issues in wild boar, with potential impacts including immunosuppression (Kojima et al. 2008).	3	3	Reduce transportation time by sourcing from as local sites as possible. Depending on the source population used, captive animals could come from modified farm or zoo facilities within the south-west. The nearest known wild population is in the Forest of Dean around 3-4 hours drive from Cornwall. Provide a soft release method that allows monitoring of the condition of animals prior to a full release.
Threat to source population	Possible risk if using relatively small populations in Britain such as those in the Forest of Dean, although given rapid reproductive rate of wild boar (Croft et al. 2020) this is unlikely to be high risk unless the source population is under significant pressure from human control or persecution. It is possible that significant surpluses may also exist from populations becoming	2	1	Determine a set number of animals to take from a wild or captive population that will have least effect on that population's integrity.

Risk	Evidence of realised risk	Consequence	Likelihood	Possible Mitigation
	difficult to manage, reversing this issue. If using captive animals, taking too many animals for release without leaving enough founders may cause issues (Earnhardt 2010), but it is unlikely to be significant in wild boar given relative abundance and reproductive rate.			
Threat to genetic integrity	Wild boar in the Forest of Dean appear to be from a combination of domestic pig and wild boar ancestry, possibly affecting the legitimacy of using it as a source population (Frantz et al. 2012). Relatively high genetic diversity occurs in wild boar populations in Europe (Scandura et al. 2011; Vilaça et al. 2014) but is still influenced heavily by domestic pig genetics due to past introgression events (Goedbloed et al. 2013).	4	3	Identify appropriate populations of British free living and captive wild boars to consider best founder populations. Possibility of using wild caught animals from Scotland.
Lack of genetic or behavioural adaptation to release site	Possible that captive-origin may have genetic or behavioural disadvantages compared to wild-type boar, however the successful establishment of captive origin boar in populations across Britain suggest this is unlikely to be the	4	2	Source wild-type animals as preference and if captive stock are used, ensure release animals are kept within a naturalistic complex with limited human contact.

Risk	Evidence of realised risk	Consequence	Likelihood	Possible Mitigation
	case. A greater risk may come from wild boar that through habituation have come to associate humans with providing food, which may lead to animals less fearful of people and more likely to be aggressive (Milner et al. 2014).			
Hybridisation	Introgression with domestic pigs can readily occur (Goedbloed et al. 2013; Dzialuk et al. 2018; Anderson et al. 2021). European wild boar are largely hybridised from historical cross-breeding events (Goedbloed et al. 2013). There is no industrial scale pig farming in Cornwall but small farms and hobby keepers may be at risk.	4	2	Ensure that pig keepers are consulted, and that fencing is maintained to prevent boar entry as well as pig escape.
Native species decline/loss	European plant communities have co-evolved with wild boar and the species can promote more diverse plant faunas (see species profile). Negative impacts of the species on flora is almost exclusively reported outside their native range in the literature (Barrios-Garcia & Ballari 2012). However, excessive wild boar rooting where the species is not predated/managed and/or confined to small areas can cause notable reductions in vegetation	5	4	A management plan should be in place to maintain wild boar densities at low enough numbers to reduce impacts on localised, dispersal-limited native species while extolling benefits of wild boar to ecological processes. Local-specific assessments should be made of key risk areas and mitigation and adaptive management such as exclusion or culling implemented as necessary.

Risk	Evidence of realised risk	Consequence	Likelihood	Possible Mitigation
	such as woody seedlings (Ickes 2001) and in the short-term reduction of woodland flower cover, although this can rapidly re-establish provided it has the chance to recover (Sims et al. 2014). As an opportunist omnivore, there are a variety of small ground dwelling animals that are vulnerable to predation, including small mammals and reptiles (Schley & Roper 2003; Mori et al. 2020) which may include locally threatened species in Cornwall such as dormice (Muscardenius avellanarius) while in torpor. Declines and local extinctions of adders (Vipera berus) have been linked to wild boar through direct predation, prey competition and habitat loss in absence of sufficient boar management and predation (Gratison et al. 2019). The species can be a significant concern to the conservation of ground-nesting birds due to the consumption of eggs and chicks (Oja et al. 2017; Mori et al. 2021) or waterbirds			

Risk	Evidence of realised risk	Consequence	Likelihood	Possible Mitigation
	during moulting stages (Giménez-Anaya et al. 2008). Provided boar are at low densities they appear unlikely to have severe impacts on local ecological communities (Harmer et al. 2011), but certain rare species with limited dispersal can evidently be put under greater risk if wild boar densities are too high.			
Spread of pests and diseases	Wild boar can potentially harbour and spread serious diseases of domestic pigs such as African swine fever (Sauter-Louis et al. 2021). A full breakdown is provided in the disease risk assessment.	5	3	See disease risk assessment.
Spread beyond release site	Wild boar can disperse large distances, within the tens of kilometres (Truvé & Lemel 2003; Keuling et al. 2010). However, in Britain dispersal from populations originating from escapes/illicit releases such as in Kent and the Forest of Dean have not spread beyond these areas due to intensive control from land managers on the edges.	4	5	Consultation prior to a reintroduction would need to be at a wide regional scale, i.e., South-west as opposed to Cornwall. A management strategy should be in place to not only to maintain numbers of animals that are sustainable within the regional context but to ensure that dispersing animals are not culled out before they can establish.

Risk	Evidence of realised risk	Consequence	Likelihood	Possible Mitigation
Welfare concerns for released individuals - Persecution	Most re-established wild boar populations in England since the 1980s have been wiped out or are at very low numbers, with the primary cause thought to be persecution (Cooper 2019). It appears that this is the major barrier to the establishment of wild boar in Britain (Goulding et al. 2003).	5	5	Critical that extensive stakeholder and community consultation is undertaken and that a management strategy is implemented prior to release, to ultimately determine whether to proceed with a project.
Welfare concerns for released individuals – Road traffic accidents	Wild boar are frequently killed and injured in road traffic accidents, which increase with higher populations, proximity to foraging areas and longer nights (Lagos et al. 2012; Thurfjell et al. 2014; Saint-Andrieux et al. 2020).	5	3	Avoid releases in areas with major roads. Provide warning signage in high-risk areas.

4.5.2. Socioeconomic Risks

Risk	Evidence of realised risk	Consequence	Likelihood	Possible Mitigation
Resistance to project by individuals/groups	Very likely to be significant resistance to reintroduction of this species. Many residents of the Forest of Dean show negative and fearful responses to wild boar following increases in their population (Dutton et al. 2015; Bearman-Brown & Saunders 2018a; O'Mahony	5	5	Devote significant time within the project to community and stakeholder engagement. Do not proceed with the project if the majority of stakeholders and communities remain against the project.

Risk	Evidence of realised risk	Consequence	Likelihood	Possible Mitigation
	2022). Similarly, the results of the stakeholder and public consultation as part of this study shows the species to be the least well received out of the six included as part of the scoping project. As a degree of acceptance is critical to the ongoing survival of free-living wild boar in Britain, this is likely to be a key determining factor in a project's approval.			
Rooting and foraging disturbance to farmland, amenity land and other green space	Very common occurrence wherever wild boar inhabit areas shared with human land use in high density (Frackowiak et al. 2012; Cappa et al. 2019), particularly as crops can make up the vast majority of wild boar diets in mixed woodland-farmland landscapes (Herrero et al. 2006; Merta et al. 2014). As such, disturbance is more likely to occur where land uses are within or adjacent to woodland (Wilson 2004; Amici et al. 2012; Rutten et al. 2020). However, rooting damage to permanent grassland is more frequent and severe than to crops (Schley et al. 2008), which presents particular implications in a Cornish context where this form of agriculture is more common. In the Forest of Dean rooting disturbance has appeared in a variety of contexts	5	5	Ecological feasibility should be conducted to assess farmland cover in relation to woodland in Cornwall. Management plans to be put in place to control numbers before higher densities are reached. Mitigation such as boar-proof fencing and adapting agricultural practices to change grassland characteristics, such as the use of organic as opposed to inorganic fertilisers, may potentially reduce rooting probability (Rutten et al. 2020). Regardless of mitigation and culling, it remains very likely that impact on agriculture would remain significant.

Risk	Evidence of realised risk	Consequence	Likelihood	Possible Mitigation
	including gardens, playing fields, picnic areas and cemeteries (Dutton et al. 2015).			
Damage to forestry and ornamental/valuable trees	Rooting occurs in plantations though it has been observed to have negligible effect on mature plantations (Haaverstad et al. 2013). In younger plantations with high boar densities however, up to 80% of young trees have been reported as being damaged in one case (Skoták et al. 2021).	3	3	Management plan in place to control numbers before higher densities are reached. Mitigation such as boar-proof fencing.
Injury from falls caused by rooting	24% of the 531 people surveyed in the Forest of Dean mentioned having fallen due to wild boar rooting (Dutton et al. 2015).	3	4	Provide warning signage in areas of public access with high boar density and encourage the use of footpaths.
Attacks - People	While attacks are rare, they are occasionally reported from Europe and are more likely to occur in the rutting season between November and January (Gunduz et al. 2007). Deaths are even rarer (Manipady et al. 2006; Tumram et al. 2015). 23% of the 531 survey respondents in the Forest of Dean mentioned being chased by boar, mainly those with dogs although the circumstances of these were largely unknown (Dutton et al. 2015). One recorded attack has been reported from	5	3	Implement a management plan to keep densities at low levels to reduce chances of conflict. Provide education on how to act around wild boar, especially during November-January, with particular focus on dog walkers. Discourage feeding which may lead to animals that are less fearful of people.

Risk	Evidence of realised risk	Consequence	Likelihood	Possible Mitigation
	the Forest of Dean where a man with a dog had the end of his finger severed (Morris 2018).			
Attacks - Pets	Although rare, attacks on pet dogs have occurred in the Forest of Dean including some fatalities (Dutton et al. 2015; Forestry England 2022). 25% and 4% of survey respondents with dogs in the Forest of Dean reported having dogs chased and injured by wild boar respectively (Dutton et al. 2015). Dogs are overwhelmingly more likely to be chased or attacked if they are off the lead (Bearman-Brown et al. 2018).	5	3	Implement a management plan to keep densities at low levels to reduce chances of conflict. In areas where boar are present advise dog walkers on keeping dogs under control and ideally on a lead.
Spooking/injuring of horses	11% of survey respondents in the Forest of Dean mentioned having horses spooked by boar, but only two cases of injury (Dutton et al. 2015).	3	2	Implement a management plan to keep densities at low levels to reduce chances of conflict.
Motor collisions	In Sweden where boar are common and widespread, at least one person is injured per every 100 wild boar road accidents and one killed per every 200 accidents (Jägerbrand & Gren 2018) with combined injuries and vehicle damages at an estimated expected cost of £74,000 per year (Gren & Jägerbrand 2019).	5	4	Implement a management plan to keep densities at low levels. Provide warning signage on roads passing through high-risk areas.

4.6. Wildcat

4.6.1. Biological Risks

Risk	Evidence of realised risk	Consequence	Likelihood	Possible Mitigation
Distance of translocation	Increasing distances between source population and release sites can increase stress and subsequent impacts on health and translocation success (Dickens et al. 2010). No evidence exists on the effect of translocation distance on wildcats, but it can be assumed that shorter distances are preferred.	4	2	Source from captive bred facilities ideally within the region. Captive breeding for release facilities have been developed at the Derek Gow Consultancy and Wildwood Escot, both in Devon.
Threat to source population	Captive populations remain the only source of British-origin wildcats to use and is already managed as a studbook by the Royal Zoological Society of Scotland (RZSS). Careful management of captive stock is required to ensure there are still enough genetically viable founders in captivity to source animals for wild releases.	4	3	Sourcing of animals from carefully managed studbooks designed to maintain genetically viable captive populations, i.e., The RZSS UK studbook.
Threat to genetic integrity	Animals within the UK studbook are managed to maintain genetic diversity with a captive population of >80 individuals. However new	5	3	Utilise animals that are part of the managed UK studbook with clear records of lineages. Assess options for

Risk	Evidence of realised risk	Consequence	Likelihood	Possible Mitigation
	bloodlines from European populations likely essential to sustain in the long-term.			importing new genetically viable founder animals from European sources.
Lack of genetic or behavioural adaptation to release site	Captive carnivores can be susceptible to reintroduction failure as a result of poor behavioural adaptation to the wild, such as a lack of hunting skills (Jule et al. 2008). Initial releases of wildcats into Bavaria are believed to have failed largely because of the unsuitability of the animals used, having been sourced from random ages in zoo enclosures (Gow & Cooper 2018).	5	3	Release animals that are well adapted to a wild environment, reared in enclosures that allow expression of natural behaviours and social arrangement, are off-show and ideally include pre-release hunting training.
Hybridisation	Wildcats are functionally extinct in Scotland as a result of a 'hybrid swarm' from inter-breeding events between wildcats and domestic cats, with multiple back-crosses between species (Beaumont et al. 2001; Senn et al. 2019; Breitenmoser et al. 2019). In Europe, hybridisation is less prevalent where strong populations remain in good quality habitat at an overall continental rate of 10% and as low as 3.9% in Germany with less-hybridised	5	4	Conduct assessments of both habitat quality and domestic cat presence prior to release. Encourage neutering of pet cats and free-living cats if found to be living at considerable density. If a release is deemed viable, release large enough numbers of wildcats over a long-time scale (i.e., 20 per year over 20 years (Hartmann 2019 pers comm) to create robust populations. Continue genetic monitoring of populations post-release. Releases should be a rolling programme that expands around edges of released animals.

Risk	Evidence of realised risk	Consequence	Likelihood	Possible Mitigation
	animals more likely to be found in temperate conditions with high forest integrity (Steyer et al. 2016; Matias et al. 2022). Hybridisations are more likely to occur during expansion into unoccupied ranges (Nussberger et al. 2018) but is likely to be kept at low levels provided there is regular recruitment from core populations (Breitenmoser 2019 pers comm). Subsequently, although it is likely some hybridisation would occur in a Cornish reintroduction, hybrid swarms are not inevitable provided healthy populations of wildcats can be maintained in high quality habitat.			
Native species decline/loss	Wildcat diet primarily consists of rabbits (Oryctolagus cuniculus) or abundant small mammals such as field voles (Microtus agrestis) (Malo et al. 2004; Silva et al. 2013; Apostolico et al. 2016). Wildcats do not take as great a variety of prey as domestic cats (Széles et al. 2018) and rarely take birds (Sarmento 1996; Biró et al. 2005; Germain et al. 2009). However, there may be local cases where	3	2	Conduct local assessments of potential prey species (small mammals, birds and reptiles) that are threatened and may be at higher risk. Consider adaptive management if needed.

Risk	Evidence of realised risk	Consequence	Likelihood	Possible Mitigation
	rare or dispersal limited species may be threatened.			
Spread of pests and diseases	Potential to spread novel pathogens if being introduced from a novel environment. A full breakdown is provided in the disease risk assessment.	4	2	See disease risk assessment..
Spread beyond release site	Wildcats can cover large distances with an average dispersal distance of 10 km (Klar et al. 2008), therefore dispersal is likely to occur across a wide area beyond the release site.	5	5	Encourage wildcats to stay close to release sites during the initial settlement phase through a soft release with multiple individuals. Setting up a core population in good quality habitat is likely to be especially important as a buffer against hybridisation in the population's establishment phase. Develop long-term engagement programmes across a wider area as wildcats begin to spread.
Welfare concerns for released individuals - Persecution	Persecution is still a threat to wildcats in Europe generally due to the perceived threat posed to livestock or through illegal hunting, although the threat has lessened compared to the past (Lozano et al. 2012; Bastianelli et al. 2021). In Scotland it remains a threat, particularly given likely confusion with free living cats in	5	3	Provide an engagement and communication programme ahead of a release,

Risk	Evidence of realised risk	Consequence	Likelihood	Possible Mitigation
	predator control programmes (MacDonald et al. 2010) which would not be an issue in the Cornish context.			
Welfare concerns for individuals - Predation	although there is no direct evidence of foxes predating wildcats, the latter has been shown to avoid foxes if possible (Ruiz-Villar *et al.* 2021) and it is likely kittens are at greater risk. However, wildcats appear to avoid locations at the time foxes are active (Rodríguez et al. 2020).	3	2	Ensure soft release pens are predator proof. Monitor animals post-release, including signs of mortality.
Welfare concerns for released individuals – Road traffic accidents	Roadkill is the main source of recorded mortality in wildcats, with decreasing survival in areas with high densities of major roads (Bastianelli et al. 2021). Many early releases in Bavaria saw increased road mortality from wildcats released in Autumn as activity coincided with the busiest times on the roads (Hartmann 2019 pers comm).	4	5	Plan release sites away from major roads as a priority. Avoid releasing animals during periods when high traffic and wildcat activity overlap, although this is likely to be the time of highest prey availability and so site specific assessments should be undertaken. Provide warning signage in high-risk areas.

4.6.2. Socioeconomic Risks

Risk	Evidence of realised risk	Consequence	Likelihood	Possible Mitigation
Resistance to project by individuals/groups	Wildcat reintroductions are likely to be contentious among stakeholders and communities, particularly where the species has been extinct within living memory. Concern for game, poultry, wild birds and hybridisation risk among likely issues to be raised.	4	5	A social feasibility phase is essential prior to a release (Hartmann 2019 pers comm). Design engagement to provide informed details about the species and allow for understanding of rational concerns.
Predation of poultry	Poultry is very rarely predated by wildcats, as they regularly avoid human habitation (Klar et al. 2008). One case is known of a wildcat which revisited a chicken coop on multiple occasions to hunt (Hartmann 2019 pers comm). Possible that risk would be elevated in more fragmented agriculturally dominated landscapes.	3	2	Provide advice on predator proofing for poultry pens within public engagement. Consider adaptive management if problem cases occur.
Predation of gamebirds	Unlikely to be a large part of the diet. Where it does occur, gamebirds are more likely to be predated in woods used for shooting where pheasants are abundant, with problems likely to be more severe if access is gained to a rearing pen. Pheasant and woodcock consisted of 3.5 and 1.8% respectively of wildcat diet in Hungary (Biró et al. 2005).	3	3	Provide advice on predator proofing for pheasant pens within public engagement. Consider adaptive management if problem cases occur.

Risk	Evidence of realised risk	Consequence	Likelihood	Possible Mitigation
Predation of pets	Possible threat to free roaming cats with domestic cat remains reported to have been found in wildcat scat in Hungary, although it is unclear if it was predated or scavenged (Biró et al. 2005), . Whilst they are very unlikely to approach houses (Klar et al. 2008), there is the potential for them to pose a threat to contained smaller animals (e.g., rabbits and guinea pigs), with this risk being elevated in more fragmented agriculturally dominated landscapes.	4	2	Encourage cat owners to keep cats inside. Provide advice on how to ensure outdoor small animal pens are sufficiently predator proof.

5. HEALTH SCREENING AND DISEASE RISK MITIGATION

5.1. Introduction

Wildlife reintroductions can assist species' survival, ecosystem restoration, and increase biodiversity, and while there is often widespread public support for the concept of wildlife reintroductions it is also important to recognise that these introductions do carry some important risks to human and animal health.

Just as the movements of domestic animals can result in the introduction or spread of important animal and human diseases (with examples including bovine TB in cattle, and the pet passport system to limit the risks of rabies and Echinococcosis entering the United Kingdom), so too do the movements and reintroduction of wild animals carry their own risks. Wildlife reintroductions can introduce or increase the incidence of diseases transmissible to humans (zoonosis); spread infections of importance to domestic animals and livestock, with important economic implications; or introduce diseases to other native wildlife, with adverse wildlife population and ecological effects. The International Union for the Conservation of Nature (IUCN) has well established published guidelines for both wildlife reintroductions as well as the disease risk analysis process. The IUCN (2013) recommends that "the level of attention to disease and parasite issues around translocated organisms and their destination communities should be proportional to the potential risks and benefits identified in each translocation situation". Disease risk assessments should be applied to evaluate whether important health-related risks are associated with a proposed translocation of wild animals, and pre-release health assessments are essential to ensure that UK animal health and welfare legislation is complied with.

The physical act of moving, testing and releasing wild animals in new and unfamiliar locations and habitats can also impact their individual survival. The stress associated with this process can also result in a degree of immunosuppression (from prolonged elevations in stress hormones such as cortisol), further compromising their health, welfare and ability to survive. Many wildlife species, especially prey animals, will hide symptoms of ill health, or may carry infections without showing any symptoms. Not only can these pose a risk to humans and other animals, but may be exacerbated by the stress of translocation to manifest in ill health and compromise the individual animals' welfare, or ability to survive.

Wild animals of all the species considered here, if trapped, or kept in an enclosed area or enclosure, such as for translocation and release are deemed "under the control of man" and hence subject to the provisions of the Animal Welfare Act (England) 2006, or Animal Health and Welfare (Scotland) Act 2006 in Scotland. This mandates that keepers have a positive duty of care, to provide the five basic welfare needs, which also includes protection from pain, suffering, injury and disease. The release of any captive animal (even if only temporarily captive for the purposes of translocation or reintroduction) that is not fit to be released, would constitute an offence under the

Animal Welfare (England) Act 2006. It is also important to recognise that any wildlife subject to a soft-release program, or kept in even a large enclosed area, would still legally be deemed to be “under the control of man”, and hence subject to the Animal Welfare Act and its provisions during this period.

5.2. Purposes of a Disease Risk Analysis

This section is an initial guide for consideration before the reintroduction of any wildlife species to the region. The following are NOT intended as a formal or comprehensive Disease Risk Analysis suitable for reintroduction purposes, but instead a steering document to highlight the main considerations needed for the process. Any planned reintroduction will need a formal disease risk analysis performed, and this will be based on current and emerging disease threats, which change over time, in conjunction with any additional licencing requirements, and considerations of the source population of the animals and best current evidence and knowledge on their diseases and risks. It is essential to realise that no disease risk analysis and subsequent disease testing and screening can entirely eliminate all risk. The purpose is to limit risks as far as is practically possible using scientific evidence as guidance.

The purposes of disease risk analysis and mitigations are to:

- Promote the health and welfare of the individual wild animals that are released
- Prevent introduction of disease-causing pathogens
- Ensure that reintroduced individuals are fit for release
- Provide practical health and disease mitigation protocols for the reintroduction process
- Mitigate stressors in the translocation process as far as possible
- Provide current evidence, peer-reviewed literature and experiences for best practices

5.3. Disease Risk Analysis Process

As described by the IUCN, a disease risk analysis usually consists of the following elements:

- Problem description: Outlines the background and context of the problem, identifies the goal, scope and focus of the DRA, formulates the DRA question(s), states assumptions and limitations and specifies the acceptable level of risk.
- Hazard identification: Identifies all possible health hazards of concern and categorises them into ‘infectious’ and ‘non-infectious’ hazards. Establishes criteria for ranking the importance of each hazard within the bounds of the defined problem. Excludes hazards with zero or negligible probability of release or exposure, and constructs a scenario tree for the remaining, higher priority, hazards of concern, which must be more fully assessed.
- Risk assessment: Assesses for each hazard of concern:
    - the likelihood of release (introduction) into the area of concern:

    - the likelihood that the species of interest will be exposed to the hazard once released;
    - the consequences of exposure. On this basis the hazards can be prioritised in descending order of importance
- Risk management: Reviews potential risk reduction or management options and evaluates their likely outcomes. On this basis decisions and recommendations can be made to mitigate the risks associated with the identified hazards.
- Implementation and review: Formulates an action and contingency plan and establishes a process and timeline for monitoring, evaluation and review of risk management actions. The review may result in a clearer understanding of the problem and enable refinement of the DRA.

5.4. Summary overview of risks across all species

Some detail is given in the individual species sections below, but an overview of highlights across all species is also briefly provided below, as not all disease risks carry the same importance or implications.

5.4.1. Key Disease Risks

The most significant disease risks in terms of impacts are likely those related to the reintroduction of wild boars. As evidenced from the situation in European countries, these carry not only the risk of introducing zoonotic diseases of human health importance such Trichinella spiralis, but is also the species with the main risk of introducing legally notifiable animal diseases of significant agricultural importance, such as African swine fever. Even if wild boar do not themselves introduce African swine fever they pose the future risk that should a poorly controlled outbreak occur (after importation of contaminated pork products or other routes) there is the risk that the diseases could enter the wild population and become established, which would be difficult to control, and pose ongoing threats to domestic pig farming in the region.

5.4.2. Sourcing Animals

Animal sourcing needs to strike a balance between disease risks (captive bred and housed animals, especially if from approved premises, carry lower disease risks, and provide increased ease of disease screening) versus potential genetic advantages and possible increased survival of adult animals sourced from wild populations with pre-established survival skills. For species such as wild boar sourcing from captive bred populations would be strongly advisable, as would it be for wildcats and water voles, where disease screening and captive protocols are already well established and tried and tested. When possible, it is preferable to source animals from premises approved by the Animal and Plant Health Agency (APHA) under Council Directive 92/65/EEC (Balai Directive) to limit disease risks (due to surveillance), as this will reduce costs and ease logistics. Captive sourced animals would be more difficult to acquire for red squirrels and pine martens, due to a lack of easily available source animals in the UK. All efforts should be made to source animals from within the UK, due to lower disease introduction risks, and ability to avoid mandatory quarantine (if from non-approved

premises). If animals did have to be sourced from outside the UK, this would be more costly, and animals should only come from rabies free countries.

For beavers wild caught animals from Scotland are the preferable source, being regularly trapped, quarantined and tested as part of a mitigation strategy to limit the application of lethal control (shooting) to conflict situations. The over 100 individual wild beavers already translocated in the last three years have shown excellent post-release survival and long-term health screening of the populations has shown low levels of disease risk with well-established health screening protocols.

5.4.3. Mitigation strategies

Individual animal welfare will be best protected by utilising current best practice trapping, husbandry, and release practices, as already established by other wildlife reintroduction projects in the UK and Europe, as well as current techniques used by the main wildlife rehabilitation centres in the UK. Full disease risk analysis for the individual species using the current IUCN guidelines and the currently already established beaver disease risk analysis guidelines for beavers, will best mitigate disease risks. These will direct disease testing, with the additional health and welfare safeguard of veterinary examinations of animals during the process before release. Archiving or biobanking of residual blood, faeces and other samples would help to allow retrospective testing of samples for any additional diseases of concern highlighted after release, without the need to re-trap or cull animals. These can also be valuable in preventing any legal challenge should an agricultural disease outbreak occur which farmers could blame on the re-introductions, to demonstrate that the disease was not present in the wild animals at the time of reintroduction.

5.5. Beaver

5.5.1. Key Disease Risks

One of the main considerations in the diseases of significance in beavers are those pathogens that could pose a risk to human or animal health associated with waterways. Beavers are also notably affected by one notifiable disease.

Notifiable disease:

- Echinococcus multilocularis This is the most significant risk, if sourcing beavers from outside the UK, due to difficulty and expense in ante-mortem diagnosis, and the fact this zoonotic parasite is not present in the United Kingdom.

Other diseases of significance:

- Salmonella and Yersinia spp. enteric bacteria (zoonosis)
- Eimeria spp. coccidia
- Giardia spp (zoonosis)
- Cryptosporidium spp. (zoonosis)
- Leptospira species (zoonosis)
- Francisella tularensis (zoonosis)
- Streptococcus castoreus

- Neostichorchis subtriquetrus
- Emmonsia crescens
- Trichinella spp.
- Brucella spp. (zoonosis)

5.5.2. Sourcing Animals

Wild free-living beavers from the river Tay catchment in Scotland would be the ideal source. Beavers are regularly trapped under licence from NatureScot as a mitigation measure in conflict scenarios, as an alternative to lethal control, with an excellent adult survival rate of 93% for the first year after trapping currently reported for over 100 translocated beavers. This population has had extensive disease screening, post-mortem examinations and testing and is known to carry a low risk of significant disease. This population has no evidence of any presence of Echinococcus multilocularis.

5.5.3. Mitigation strategies

Beavers should not be sourced from mainland Europe due to the risk of importation of Echinococcus multiloccularis, previously estimated as having a prevalence as high as 5% in the population in countries such as Germany. This serious zoonotic parasite of human health concern is currently not present in the UK, and testing of live beavers is difficult, invasive and costly (Campbell-Palmer et al, 2015). Beavers should not be sourced from England outside of the River Otter catchment, as these populations may have animals originating from Europe and have not been screened for the presence of E. multiloccularis. As a nocturnal and shy prey species, assessment of an individual beavers health and welfare may be difficult as they hide signs of illness. Haematology and serum biochemistry testing as part of pre-translocation screening can help to address this. Adult beavers in conflict areas may also benefit from radiography to screen for lead shot/bullet injuries, as skin injuries may have healed, yet injuries that will adversely affect survival in the wild and hence viability for translocation can otherwise be missed.

5.6. Pine marten

5.6.1. Key Disease Risks

The following diseases are of health significance to pine martens themselves:

- Canine distemper virus
- Feline Panleucopenia/Infectious Enteritis (Feline Parvovirus, FPV)
- Aleutian disease (Carnivore amdoparvovirus 1)
- Skrjabingylus nasicola (nematode in the nasal sinuses)
- Troglotrema acutum (fluke in Europe, but not the UK)

The following disease may be carried by pine martens, but are more of significance as zoonosis or threats to domestic animal health:

- Mycobacterium avium sbsp. paratuberculosis (Johne's disease)
- Sacrocystis spp.
- Salmonella spp.
- Campylobacter spp.
- Leptospira species
- Angiostrongylus vasorum

5.6.2. Sourcing Animals

Recent reintroduction of pine martens to Wales to bolster the population have shown the suitability of wild caught pine martens from Scotland as a source of animals for further reintroductions, with good survival, dispersal and breeding all reported. Wild trapped Scottish pine martens appear the best source of animals for a translocation.

5.6.3. Mitigation strategies

Although pine martens pose few disease risks of notable human and domestic animal concern that are unique to the species, determining their individual health status (and protecting animal welfare) may likely be assured by haematology and serum biochemistry testing as part of disease screening.

5.7. Red squirrel

5.7.1. Key Disease Risks

The main diseases of significance to the health, welfare and survival of individual translocated red squirrels, and a released population are:

- Squirrelpox virus (SQPV)
- Adenovirus
- Leprosy (Mycobacterium leprae and Mycobacterium lepromatosis)

Aside from leprosy, there are a number of other zoonotic agents that can afflict or be carried by red squirrels of significance:

- Salmonella spp.
- Leptospira species
- Borrelia burgdorferi (Lyme disease)
- Campylobacter spp.
- Toxoplasma gondii
- Capillaria spp.
- Yersinia pseudotuberculosis and Y. enterocolitica
- Erysipelothrix rhusiopathiae
- Francisella tularensis

5.7.2. Sourcing Animals

The likely best source of red squirrels would be trapping, testing and translocation of wild individuals from Northern Scotland or other regions that are lacking grey squirrels. This should allow a good genetic basis, individuals that already have wild survival skills, and a low likelihood of exposure to squirrelpox virus. Captive bred UK animals may carry an increased risk of having been exposed to squirrelpox virus if grey squirrels occur in the area. However, to date there have been no cases of captive red squirrel being translocated within a release programme whilst carrying the infection.

5.7.3. Mitigation strategies

The main threat to red squirrels remains squirrelpox virus transmitted from grey squirrels. Some authors have been of the opinion that red squirrel translocations in the UK are bound to fail unless grey squirrels can be completely eliminated and recent research has shown that squirrelpox is transmitted within a red squirrel population despite the lack of grey squirrels following an initial inter-specific cross-infection. However, opinion is that well-conceived red squirrel translocations into suitable geographic areas is viable, especially in combination with pine marten restoration. A degree of sustained grey squirrel control is highly recommended, but failure to completely eliminate grey squirrels from a region does not preclude local red squirrel reintroduction.

5.8. Water vole

5.8.1. Key Disease Risks

The following poses the main disease risk to humans from the presence of water voles:

- Leptospira spp.

While Leptospira remains the main zoonosis disease risk from water voles and their presence in water ways and exposure to sewage, there are a number of other diseases, mainly of significance due to their zoonotic or animal health potential rather than a significant health concern to the water voles themselves:

- Salmonella spp.
- Campylobacter spp.
- Cryptosporidium parvum and C. muris
- Toxoplasma gondii
- Yersinia pseudotuberculosis and Y. enterocolitica
- Mycobacterium spp.

5.8.2. Sourcing Animals

Captive bred animals, as currently used for other reintroduction programs should be the preferred source, in order to avoid reintroduced individuals inadvertently acting as

carriers of diseases of domestic animals during the translocation process. Screening is best done at a population level, rather than on individual animals, and this is best done by achieving a low disease risk from captive bred individuals.

5.8.3. Mitigation strategies

Water voles sourced from long-established captive breeding populations with long-term health screening carry the lowest disease risks. As comprehensive screening of each individual is limited due to their size, aside from faecal testing, other disease screening is best done at the population level by post-mortem examinations and sampling of a sub-set of animals if needed.

5.9. Wild boar

5.9.1. Key Disease Risks

Wild boar carry the most significant potential disease risks of all the species considered here. These include a number of notifiable animal disease (of significant agricultural economic significance). Several diseases of significance that can be transmitted from wild boar are however not currently present in the United Kingdom.

Notifiable diseases:

- African swine fever
- Classic swine fever (Hog cholera)
- Foot and mouth disease
- Swine vesicular disease

Other UK notifiable diseases that can affect wild boar, although these are of lesser concern being less likely to be carried, or not currently being present in the UK. These include:

- Anthrax (Bacillus anthracis) (zoonosis)
- Brucella suis - not currently in UK, but in wild boar in other regions of Europe
- Aujeszky's disease (pseudorabies, Suid herpesvirus 1) - not in UK, but in other regions of Europe
- Vesicular stomatitis
- Porcine epidemic diarrhoea
- Surra (Trypanosoma suis) – not currently in Europe
- Teschen disease (Teschovirus)

Non-notifiable wild boar diseases of concern to domestic livestock or human health:

- Erysipelothrix rhusiopathiae
- Salmonella and other enteric bacterial pathogens (zoonosis)
- Porcine respiratory and reproductive syndrome virus (PRRSv)
- Brachyspira hyodysenteriae (swine dysentery)

- Mycoplasma hyopneumoniae (enzoonotic pneumonia)
- Swine influenza virus
- Leptospira species (zoonosis)
- Hepatitis E virus (zoonosis)
- Trichinella spiralis (a zoonotic parasite that is a risk if meat from an infected boar is eaten, and a significant health concern in many European countries) – not currently in the UK
- Mycobacterium bovis (tuberculosis)

5.9.2. Sourcing Animals

Wild boar for reintroduction should come from captive bred stock already in the United Kingdom, to limit the risk of disease, facilitate testing, and ensure the process before the release is low stress for the individual animals. The UK is currently free of African Swine Fever, and importation of European animals is not advisable. The importation of even captive animals from Europe will incur additional costs due to certification, transport and importation procedures, and also carries more risks to individual animals of injury, stress and compromised welfare due to the longer transportation needed. Ideally animals should be sourced from premises approved by the Animal and Plant Health Agency (APHA) under Council Directive 92/65/EEC (Balai Directive) to best facilitate this.

5.9.3. Mitigation strategies

Vaccination of wild boar with commercial vaccines for domestic pigs for diseases such as Erysipelothrix rhusiopathiae, Porcine respiratory and reproductive syndrome virus (PRRSv), and Mycoplasma hyopneumoniae (enzoonotic pneumonia) may be considered. While these diseases may not be of particular importance to the translocated wild boar themselves, vaccination may help assure local farmers of risk limitation to their livestock, and act to limit the risk of these diseases inadvertently entering the wild boar population after release (from domestic pig exposure) and limit wild boar later acting as a potential reservoir for disease, even if wild boar were originally tested and found to be negative prior to translocation.

5.10. Wildcat

5.10.1. Key Disease Risks

Wildcats are subject to the same diseases as domestic cats, which does include a small risk (due to limited scope for human contact) of zoonotic diseases. The main disease risks are to the reintroduced wildcats themselves, particularly those posed by feline viruses. A comprehensive disease screening protocol is already well established for many years for the Scottish wildcat captive breeding program, and it likely this would be suitable for use without the need for major modification. The main diseases of concern are:

- Feline Panleucopenia/Infectious Enteritis (Feline Parvovirus, FPV)

- Feline Leukaemia virus (FeLV)
- Feline immunodeficiency virus (FIV)
- Feline coronavirus (FIP)
- Feline calicivirus (FCV)
- Feline Rhinotracheitis (Feline Herpesvirus, FHV)
- Chlamydophila felis
- Toxoplasma gondii (zoonosis)
- Salmonella and Campylobacter spp. enteric bacteria (zoonosis)
- Faecal parasites, including Giardia spp., Toxoascaris leonina

5.10.2. Sourcing Animals

Due to the risk posed from feline viruses, which even young kittens may be exposed to, and some of which (such as Feline herpesvirus) may be lifelong infections, captive bred wildcats are strongly recommended.

5.10.3. Mitigation strategies

Vaccination of all source wildcats (preferably as kittens) in accordance with the vaccine manufacturers recommendations for domestic cats would be essential, due to the high viral challenge posed from feral unvaccinated cats. A killed vaccine is recommended that should include Feline Panleucopenia/Infectious Enteritis (Feline Parvovirus, FPV), Feline Rhinotracheitis (Feline Herpesvirus, FHV), Feline Calicivirus (FCV), and Feline Leukaemia Virus (FeLV) to maximise the health, welfare and the viability of reintroduced wildcats.

5.11. Conclusion

This document gives an overview of the importance of disease risk analysis (DRA) to wildlife introductions in England, what a DRA seeks to achieve and the key factors for consideration. This document is not itself a DRA, but an overview to inform initial decisions and allow understanding of any future DRAs formulated prior to an introduction.

6. SPECIES LEGISLATION & LICENSING

6.1. Introduction

Many habitats and species in the UK are protected under local, national and/or international legislation that protect them from undue destruction, harm, disturbance, exploitation or other such means that would threaten their status at the scaled level of the legislation concerned. When considering conservation translocations, legal protection should be considered both in terms of what the species concerned will be covered under upon release, but also in terms of licensing the translocation project itself. Subsequently, even projects being run with good intentions can be considered unlawful if the correct licensing procedures are not followed during the process.

All six mammal species considered in this scoping study are covered under two or more items of legislation **Table 6.1**. This chapter will provide a summary of each species' legislative status and the implications for any proposed translocation project.

Table 6.1 Legislation which applies to the species considered in this report. Correct as of February 2023.

Scope	Legislation
International	The Conservation of Habitats and Species Regulations 2017
National	Wildlife & Countryside Act 1981 Animal Welfare Act 2006 Wild Mammals (Protection) Act 1996 Natural Environment & Rural Communities Act 2006 Dangerous Wild Animals Act 1976

6.2. The Conservation of Habitats & Species Regulations 2017

The following reviewed species are covered under this legislation:

- Beaver
- Pine marten
- Wildcat

For these species, it is therefore an offence to commit the following:

- Deliberately disturb - this includes any action likely to impair their ability to survive, breed or rear their young
- Deliberately injure, capture or kill
- Damage or destroy the breeding site or resting place

It is also an offence to:

- Possess, control or transport
- Sell or exchange
- Offer for sale or exchange

This applies whether the animal is alive or dead and includes beaver parts and derivatives.

6.3. Wildlife & Countryside Act 1981

6.3.1. Schedule 5

The following reviewed species are covered under Schedule 5:

- Pine marten
- Red squirrel
- Water vole
- Wildcat (Section 9.4 and 9.5 only)

For the pine marten, red squirrel and water vole, it is an offence to:

- Intentionally kill, take or injure
- Possess or control while alive or dead

The wildcat is also protected against the following in addition to the pine marten, red squirrel and water vole:

- Intentionally damage or disturb any structure or place used for resting or protection
- Obstructing access to any structure or place used for resting or protection
- Sell, or offered for sale alive or dead, whole or part
- Being published or advertised as being for sale

6.3.2. Schedule 6

The following reviewed species are covered under Schedule 6:

- Pine marten
- Red squirrel
- Wildcat

For the pine marten, red squirrel and wildcat, it is an offence to:

- Kill or take under certain methods: self-locking snares, bows, crossbows, explosives (other than ammunition for a firearm), or using live decoys
- Additionally, it is also illegal to kill or take under the following activities: trap, snare or net, electrical device for killing or stunning, poisonous, poisoned or stupefying substances or any other gas or smoke, automatic or semi-automatic

weapon, device for illuminating a target or sighting device for night shooting, artificial light, mirror or other dazzling device, sound recording, and mechanically propelled vehicle in immediate pursuit.

6.3.3. Schedule 9

The following candidate species are considered under Schedule 9:

- Beaver
- Wild boar

For the beaver and wild boar, it is an offence to:

- Release into the wild without a licence

For the beaver, it is an additional offence to:

- Release into an enclosure (except for zoo or other artificial enclosures) without a license.

6.4. Natural Environment & Rural Communities Act 2006

The following reviewed species are included under Section 41 of the Act:

- Water vole

It is therefore a legal duty to:

- Publish species and habitats of principal importance to inform public bodies, landowners and funding bodies on nature recovery.

6.5. Dangerous Wild Animals Act 1976

The following reviewed species are included under the Act:

- Wild boar

It is therefore an offence to:

- Keep the species except under the authority of a licence granted in accordance with the provisions of this Act by a local authority.

6.6. Animal Welfare Act 2006

All six reviewed species are covered under this legislation. The Act provides protection from unnecessary suffering while they are under the control of man or not living in a wild state.

6.7. Wild Mammals (Protection) Act 1996

All six reviewed species are covered under this legislation. This includes protection from acts such as mutilation, beating, impaling or drowning.

6.8. Implications for translocation

6.8.1. Beaver

It is illegal to release beavers either into the wild or a wild-type enclosure without applying for a licence. It may also be necessary for a competent authority (i.e., a public body or individual) to undertake a Habitat Regulations Assessment (HRA) if a European protected site may be affected. All release sites require permission from landowners which may include written permits on state-owned land or designated land such as SSSIs.

Once released into the wild licensing would also be required to manage animals, for example in the event of a land use conflict. Natural England has currently provided three class licenses for beaver management:

- Modify or remove beaver dams – for farmers, landowners, fishery managers, foresters, land or water managers, and their advisers or consultants
- Modify or remove beaver burrows, lodges and dams or possess dead beavers or their body parts – for employees of public bodies or authorities, fishery managers, land and water managers, and their advisers or consultants
- Capture, transport and re-release beavers, modify or remove burrows, lodges and dams or possess dead beavers or their body parts – for beaver management groups, experts and specialists

An individual licence can be applied for if none of these cover action that may need to be taken, such as lethal control.

6.8.2. Pine marten, red squirrel, water vole and wildcat

It is illegal to release or keep indidivuals of these species sourced from the wild without applying for a licence. This does not apply for animals that are captive bred, although release of such animals without sufficiently assuring for their future well-being may be an offence under the Abandonment of Animals Act 1960. It may also be necessary before a release for a competent authority (i.e., a public body or individual) to undertake a Habitat Regulations Assessment (HRA) if a European protected site may be affected. All release sites require permission from landowners which may include written permits on state-owned land or designated land such as SSSIs.

Once released into the wild, it is illegal to conduct activity that will directly harm or disturb individuals or their resting places. If such activity is required, an individual license will need to be applied for. Protected species class licenses can be applied for the following:

- To kill, take, disturb or possess a protected species for survey, research or conservation work
- To sell or possess dead specimens of protected species legally taken from the wild before 30 October 1981

Additionally, two specific class licenses apply to water voles:

- Displacement for development projects
- Displacement for work on flood defences, water courses and drainage systems

6.8.3. Wild boar

It is illegal to release wild boar under any scenario into the wild without a license. It may also be necessary for a competent authority (i.e., a public body or individual) to undertake a Habitat Regulations Assessment (HRA) if a European protected site may be affected. All release sites require permission from landowners which may include written permits on state-owned land or designated land such as SSSIs.

Any holder of captive wild boar being used as a source population would require a Dangerous Wild Animals (DWA) license to be applied for to the local authority with its granting dependent on a formal inspection by a veterinary professional. Exemptions on requiring a DWA licence would occur if the holder already possessed a zoo licence.

Once released into the wild, there is currently no legislation that protects wild boar from factors such as persecution, disturbance or movement.

7. ADMINISTRATION COSTS OF MAMMAL REINTRODUCTION PROJECTS

7.1. Introduction

Reintroduction projects can have numerous benefits in terms of restoring the range of lost species, contributing to healthier ecosystem functioning, and arguably more notably compared to other conservation methods, raise engagement among the general public towards the environment with potential benefits to overall wellbeing.

Despite these benefits, reintroductions generally incur higher financial costs within the suite of actions that can be used to conserve and restore biodiversity. This is in large due to the long-term nature of many projects which is required to ensure higher chances of success in at least three stages. The timeframes for each phase are highly dependent on the species and scale being considered in each project.

- **Feasibility phase.** Approx. year 1 to 3. During the feasibility phase, the steering body for the reintroduction uses employed, existing and/or sub-contracted staff to assess biological feasibility (i.e., habitat surveys, prey base surveys, inter-species conflict potential), social feasibility (i.e., stakeholder consultation, public workshops, meetings and conferences, online communications) and assessment of potential donor populations.

- **Delivery phase.** Approx. year 3 to 5. Preparations of the release site are undertaken if required. Additional field staff may be employed. Movement of animals from captive and/or wild source populations to release site via quarantine facilities (if required), followed by either hard release (released directly into the wild) or soft release (released into a pen with gradual acclimatisation prior to release). Communications ongoing.

- **Monitoring phase.** Approx. year 3 to 10, often concurrent with delivery phase if releases occur over multiple years, and advised to continue for at least 5-10 years following the conclusion of the delivery phase. Project officer and field staff continue biological monitoring of species to determine success of project in terms of survival of released animals, successful breeding, establishment, health and viability of populations. Communications ongoing and adaptive management may be required with some species. In exceptional cases, it may be determined to deploy an exit strategy if there are significant biological and/or social concerns following the reintroduction.

Recommended timescales for the reviewed species are provided below as average estimations based on the species' biology and potential for socio-economic conflicts. Factors such as the scale of a reintroduction area, or established protocols as reintroduction experience with a certain species grows, may make these timescales shorter or longer as required (**Table 7.1**).

Table 7.1 Number of years recomended for each phase of a reintroduction project for each of the mammal species considered in this study.

	Reintroduction delivery phase (years)		
Species	Feasibility	Monitoring/delivery	Post-release monitoring
Beaver	1-2	2-4	4-10
Pine marten	1-2	2-3	5-10
Red squirrel	1-2	3-5	3-5
Water vole	0.5-2	2-5	3-5
Wildcat	2-3	2-4	5-10
Wild boar	2-3	2-4	5-10

Table 7.2 Breakdown of estimated costs in £000s per annum. Note that there is generally overlap between delivery and first years of monitoring phase; monitoring phase costs should be interpreted as indicative of post-delivery phase.

	Feasibility Phase		Delivery Phase		Monitoring Phase	
	Lower (£000 pa)	Higher (£000 pa)	Lower (£000 pa)	Higher (£000 pa)	Lower (£000 pa)	Higher (£000 pa)
Staff	£15	£60	£50	£100	£50	£100
Animal Capture, Husbandry & Health	£10	£90	£13	£100	£0	£20
Research	£5	£30	£5	£30	£5	£30
Comms & engagement	£5	£20	£5	£15	£5	£15
Governance	£5	£10	£5	£10	£5	£10
Capital Infrastructure	£10	£250	£0	£10	£0	£0
Non-salary staff costs	£5	£20,	£5	£20	£5	£20
Total annual cost	£58	£480	£83	£285	£70	£195

7.2. Staff

Significant costs incurred by reintroductions are generally related to employed and sub-contracted staffing, construction of captive breeding and/or soft-release facilities, upkeep of animals in a captive and/or soft-release state, veterinary bills, transport, communication and mitigation.

Based on experience from previous and on-going projects, a summary of the possible costs that could be incurred by a reintroduction for each of the candidate species in

this study is provided (**Table 7.3**). This aims to give an approximation to aid design of any proposed project. It should be noted that the funding required for such schemes are highly context specific on factors such as scale, species and pre-established expertise. Therefore, these budgetary estimates should not be used as a definitive example of the costs that are likely to be faced in any individual project but rather a guide, with any proposed scheme designing their own budget that is adapted to its context.

Among the different candidate species, staffing costs are likely to increase with the scale of the project, the conflict potential of the species, the required longevity of the different phases and whether the animals are sourced from captive populations. Significant savings can be made if the practicing organisation(s) can deliver key elements of the project through existing staff and use of contractors for selected elements; this is easier in particular for projects that are smaller scale and have established protocols, such as water voles, red squirrels and increasingly beavers, where centralised support from a Natural England employed national co-ordinator is now available.

For other species where projects are taking place over a larger scale, reintroduction experience is lacking and there is higher potential for conflict, such as wildcat and wild boar, significant staffing is a higher priority.

Table 7.3 Estimates of staff requirements, numbers and salaries required for different phases of a reintroduction project.

Role	Project phase	FTE and salary
Project co-ordinator (at least one required) Smaller scale projects may be carried out competently by an existing staff member from the project lead organisation as one of their added duties, but most schemes are likely to require a dedicated individual(s) for the role	All three phases	£25,000 - £35,000 FTE This may be part-time, but for species requiring significant degrees of communication, engagement and management, such as beavers and wild boar, full-time staff are preferable
Field staff (one or more depending on scale of project) Required to implement releases (particularly under soft-release protocols), monitor animals post-release through techniques such as field sign survey, remote tracking and/or recapture-release trapping,	Delivery and monitoring	£19,000 - £27,000 FTE This work may be seasonal depending on the ecology of the species considered and/or the existing staff capacity

Role	Project phase	FTE and salary
and provide adaptive management responses where necessary		
Husbandry staff May be employed specifically for the project or are sourced from a participating organisation's existing body of staff, where a financial contribution allocated to account for staff time related to this project may need to be sourced	Captive bred and/or quarantine	£18,000 to £25,000 FTE

Other areas of expertise are likely to be out-sourced to contractors, such as researchers, vets and those undertaking grey squirrel control or other fieldbased practical tasks Prospective rates for these are included in other elements of accounting below.

7.3. Animal Capture, Husbandry & Health

Translocation from the wild will require skilled staff to obtain individual animals for release in a method that minimises impacts on welfare and the viability of the source population. Costs associated with this include staff time and subsistence, equipment, travel and care of the animals during transport and potentially quarantine and soft release (c.£10,000 – £50,000 pa), with an even higher cost associated with captive bred animals (c. £10,000 - £80,000 pa). In both scenarios, veterinary costs for disease screening are required, along with treatment if necessary (c. £3,000 – £10,000 pa).

7.4. Research

In the feasibility phase research should, at the minimum, include a study which assesses the viability of the intended release site(s) for the species within ecological (e.g., habitat suitability, prey availability, anthropogenic impacts, possible impacts on habitat and biological community) and social parameters (e.g., community and stakeholder consultation). In the delivery phase, the minimum research requirement should be post-release monitoring of the animals ideally over at least five years. Other elements of research that can increase the impact of a project within the wider knowledge base for similar schemes may include welfare, behavioural and health assessments of release animals, community and stakeholder responses throughout the delivery phase, post-release health assessments and genetic monitoring.

Such research may be undertaken by project staff, researchers from academic institutions, or a combination of the two. Research costs are likely to be estimated at £5,000 - £30,000 pa.

7.5. Communications and engagement

While all reintroduction projects should seek to provide outreach regarding the work, this becomes particularly important for the success of a reintroduction for species which may prove contentious among some individuals or groups. Communication and engagement resources include meetings, consultations and workshops, webpages, publications and signage, as well as time for existing staff if specialised communications staff are not already being employed. It is likely that costs would be higher during the feasibility phase (£5,000 - £20,000 pa) due to the focus on social feasibility, perhaps dipping slightly during the delivery phase (c.£5,000 - £15,000 pa).

7.6. Governance

In projects within medium to large organisations, a proportion of funding will need to be allocated to the support of higher governance and management towards the project delivery team, for example from a Conservation Manager and/or Director. This contribution is likely to cost an estimated £5,000 - £10,000 pa.

7.7. Infrastructure

Capital infrastructure costs are generally only required if captive bred animals are being used and new facilities are being purpose built, for the construction of release pens or if offices or other specific premises are being built for a project. Initial costs can be large, between £10,000 - £250,000 pa, but are likely only to be required over one year of a project given this primarily covers the cost of new buildings if required.

7.8. Non-salary staff costs

This includes all costs associated with the necessary requirements to allow staff to perform their duties throughout the course of a reintroduction project. This includes equipment (such as monitoring devices, laptops, mobiles, office materials), staff training and development, vehicles and mileage, and office rent and utilities. This equates to approximately £5,000 - £20,000 pa.

7.9. Conclusions

While reintroductions are inherently costly, the administrative impact varies considerably depending on certain key factors:

- **The species considered and their ecology.** This can affect the scale of the project and the number of years required to effectively assess feasibility and establish and monitor a population. Water vole and red squirrel projects will on average cost less than species that are highly dispersive with or require higher levels of social feasibility/engagement work, such as wildcat and wild boar.

- **The scale of a project.** While single release sites are cheaper, many species require releases co-ordinated at scale across landscapes or catchments, increasing administrative impacts through factors such as the number of years

required for delivery, the extent of monitoring and the pool of social engagement.

- **Existing staff and infrastructure.** While expenditure towards staff time is required, costs can be reduced if projects are overseen by existing staff within an organisation, and with the use of contracted expertise for key elements. For projects working at significant scale, with species that require significant management investment and/or where reintroduction experience is limited, forgoing the use of specifically employed staff is not recommended. The costs of a reintroduction are also significantly reduced if capital costs, such as the construction of captive breeding or office facilities, are not required.

- **Experience of reintroductions.** As the numbers of reintroduction schemes for a particular species increase, practice and knowledge become more streamlined and efficient, reducing the financial costs such as staff numbers, developing new breeding programmes and intense research programmes.

Financing of reintroduction projects can come from a variety of sources; most funding for such schemes is generally received from private donors, foundations and grant schemes including Heritage Lottery funding. Statutory funding may be available, particularly if a project meets the aims of local or national nature recovery programmes, while crowdfunding is becoming an increasingly used supplementary source of fundraising.

8. PUBLIC & STAKEHOLDER SURVEY

8.1. Introduction

While the biology and ecology of reviewed species is an important consideration in whether a reintroduction can be successful, support from wider groups and individuals is increasingly realised to be a vital component in the success of these schemes. This is of particular importance if the species concerned carry a strong real or perceived impact on factors such as local ecology, landscapes, industry or people and have been absent from the local area for a long period of time e.g., beyond cultural memory.

Surveys were undertaken online and in-person to give key stakeholders (i.e., conservationists, landowners, farmers, foresters, etc.) and the wider Cornish public the chance to be heard and provide an unbiased perception of which mammal species would be more likely to be tolerated as part of any proposed reintroduction plan in the future. The survey was also an opportunity to understand how much people know about the six reviewed species and allow people to either support or refute their proposed reintroduction. Questions used in the surveys and stakeholder workshop can be found in Appendix C.

The findings aim to showcase the unbiased views of those who participated in this survey, without any influence from the authors beyond the provision of basic scientifically validated facts regarding each species' ecology. As such, these responses can provide a guide for any potential future reintroduction projects as to where practitioners would be best placed to focus their attention regarding social feasibility. Whilst a large sample of individuals were surveyed, it cannot be stated that the results of this survey provide a statistically representative view of the people of Cornwall. Therefore, any future reintroduction projects would need to undertake their own social surveys relevant to its specific local context.

8.2. Public Survey

Residents of Cornwall were invited to take part in a voluntary online survey using the platform 'Let's Talk'. All questions were optional to answer and were the same for each species. All participants remained anonymous.

8.2.1. Participants

The public survey received a total of 943 responses from members of the public.

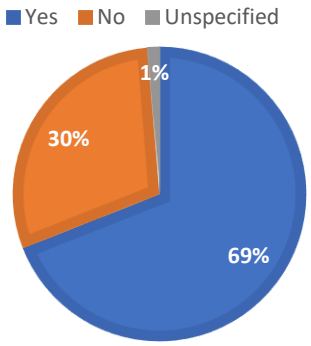
Occupational backgrounds

Participants were asked to select from a list the category which best described their primary occupation. The following table provides an overview of the occupations reported. The table is presented in descending order by number of participants per occupational background.

Table 8.1 Survey participants occupational backgrounds, ordered from most to least.

Occupational Background	Number of Participants	% of Total Respondent Pool
Retired	258	27.4%
Other	123	13.0%
Environment, Nature & Wildlife	100	10.6%
Healthcare, Community & Social Care	95	10.1%
Farming & Agriculture	52	5.5%
Local Government	52	5.5%
Arts, Sport & Media	43	4.6%
Business & Finance	40	4.2%
Retail, Hospitality & Sales	39	4.1%
Architecture, Energy & Engineering	35	3.7%
Office & Administrative Support	29	3.1%
Tourism	28	3.0%
Student	24	2.5%
Building, Construction & Maintenance	20	2.1%
Mining	3	0.3%
Fisheries & Aquaculture	2	0.2%

Participants involved in nature-based activities



Participants were asked whether they were currently involved in any nature-based activities. This could include within the participants' job, or through volunteering, membership of an environmental group, or helping wildlife thrive in their outdoor space. 69.03% of respondents answered 'Yes', 29.69% answered 'No', and 12 respondents did not specify an answer.

8.2.2. Summary of overall public response to all species

In this questionnaire, respondents were asked about six mammal species. For each, a short summary of each species and their historical presence was given, accompanied by a photograph. Respondents were then asked the following three quantitative questions about each species in turn:

1. Prior to this questionnaire, were you familiar with this species?
   Possible answers:
   Yes, good knowledge
   Yes, moderate knowledge

Yes, limited knowledge
No, I had not heard of this species before
Unspecified

2. Prior to this questionnaire, were you aware that this species used to be in Cornwall?
   Possible answers:
   Yes
   No
   Unspecified

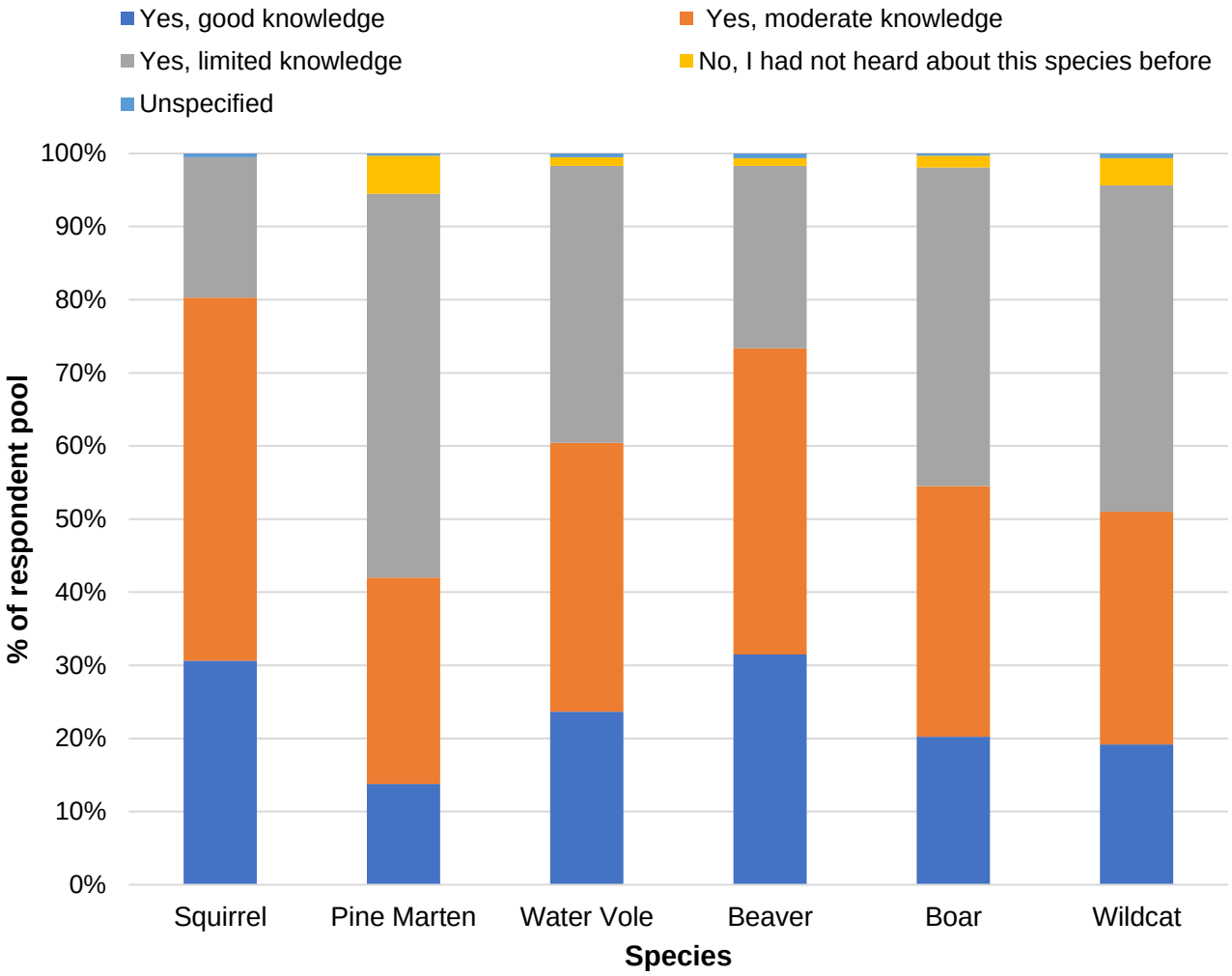
3. With your current level of knowledge, would you support the reintroduction of this species to Cornwall?
   Possible answers:
   Strongly support
   Support
   Neutral / no opinion
   Oppose
   Strongly oppose
   Don't know
   Unspecified

In this section of the report, the overall responses to these three questions for all species collectively are presented.

Familiarity with species

Question: "Prior to this questionnaire, were you familiar with this species?"

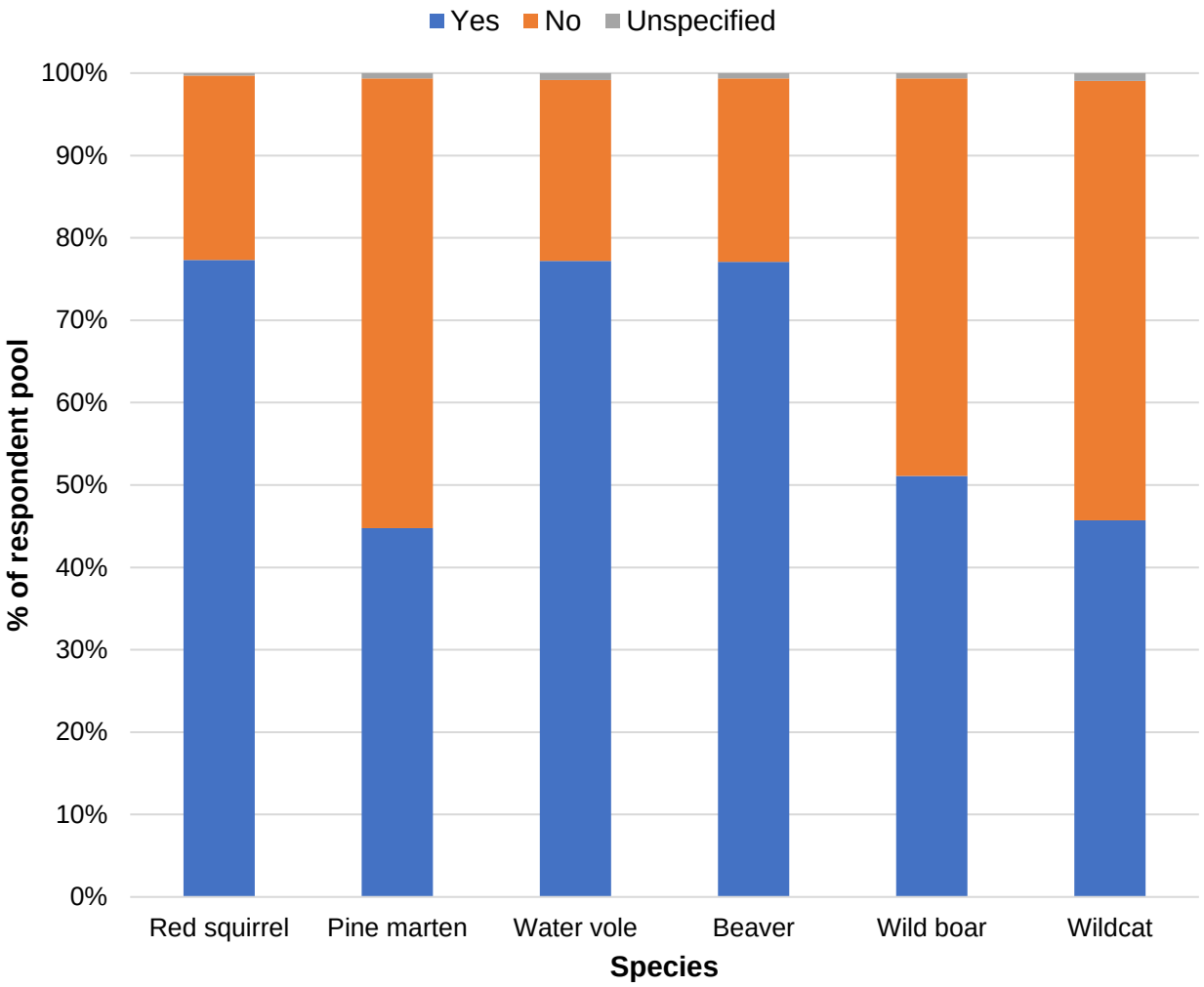
The following graph visualises the responses received. The species which respondents felt they were most familiar with (either answering good or moderate level of knowledge) was the red squirrel (80.28%), followed by Eurasian beaver (73.38%), then water vole (60.45%), wild boar (54.51%), wildcat (51.01%), and finally the pine marten (41.99%).



Awareness of species' historical presence in Cornwall

Question: "Prior to this questionnaire, were you aware that this species used to be in Cornwall?"

The following graph visualises the responses received. The species that most respondents indicated they knew used to be present in Cornwall was the red squirrel (73.31%), followed by the water vole (77.20%), then the beaver (77.09%), followed by wild boar (51.11%), wildcat (45.71%), and finally the pine marten (44.75%).



Level of support for reintroducing species to Cornwall

Question: “With your current level of knowledge, would you support the reintroduction of this species to Cornwall?”

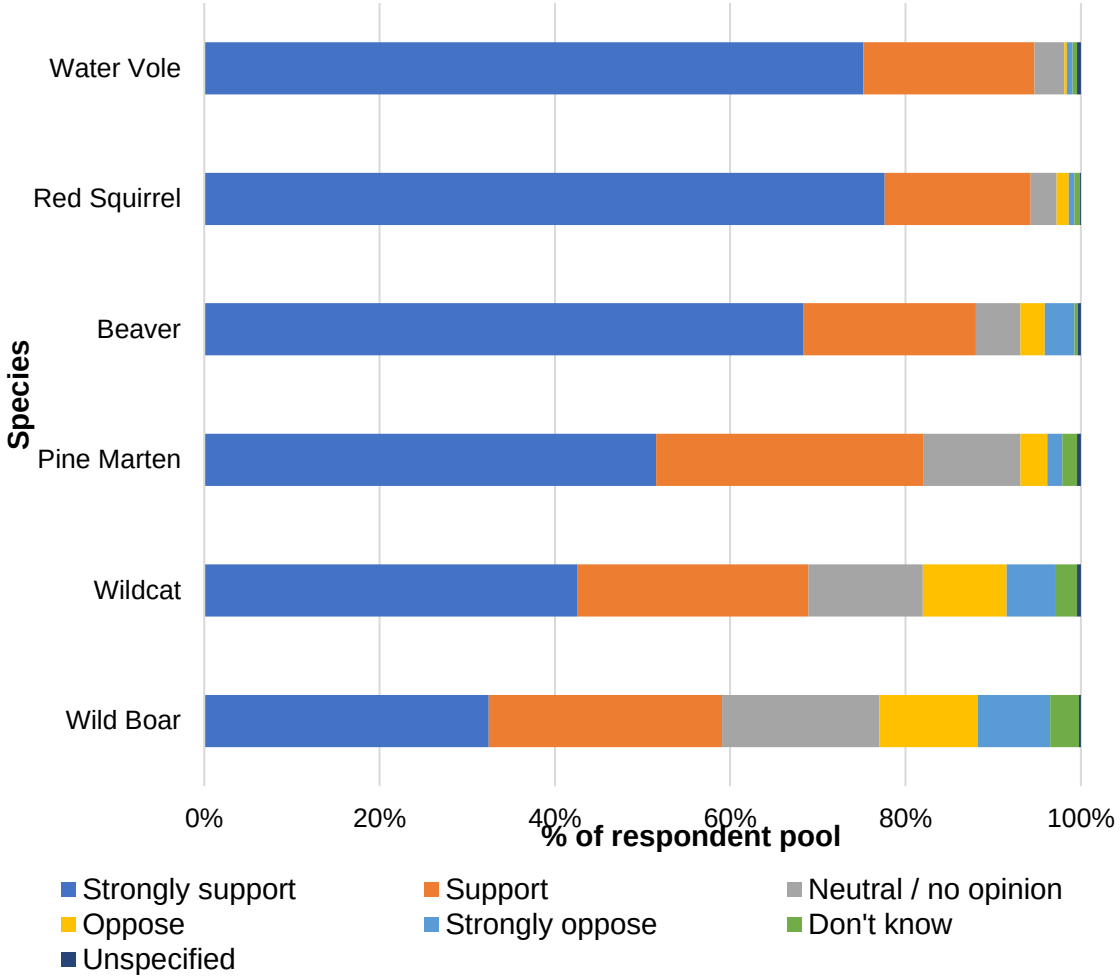
The following graph visualises the responses received to the following question, presented in descending order from the species for which most respondents took a position of support (whether ‘strongly support’ or ‘support’), through to the least supported species.

The species for which most respondents took a position of support was the water vole (94.70%), followed by the red squirrel (94.27%), then beaver (88.02%), pine marten (82.08%), wildcat (68.93%), and finally the wild boar (59.07%).

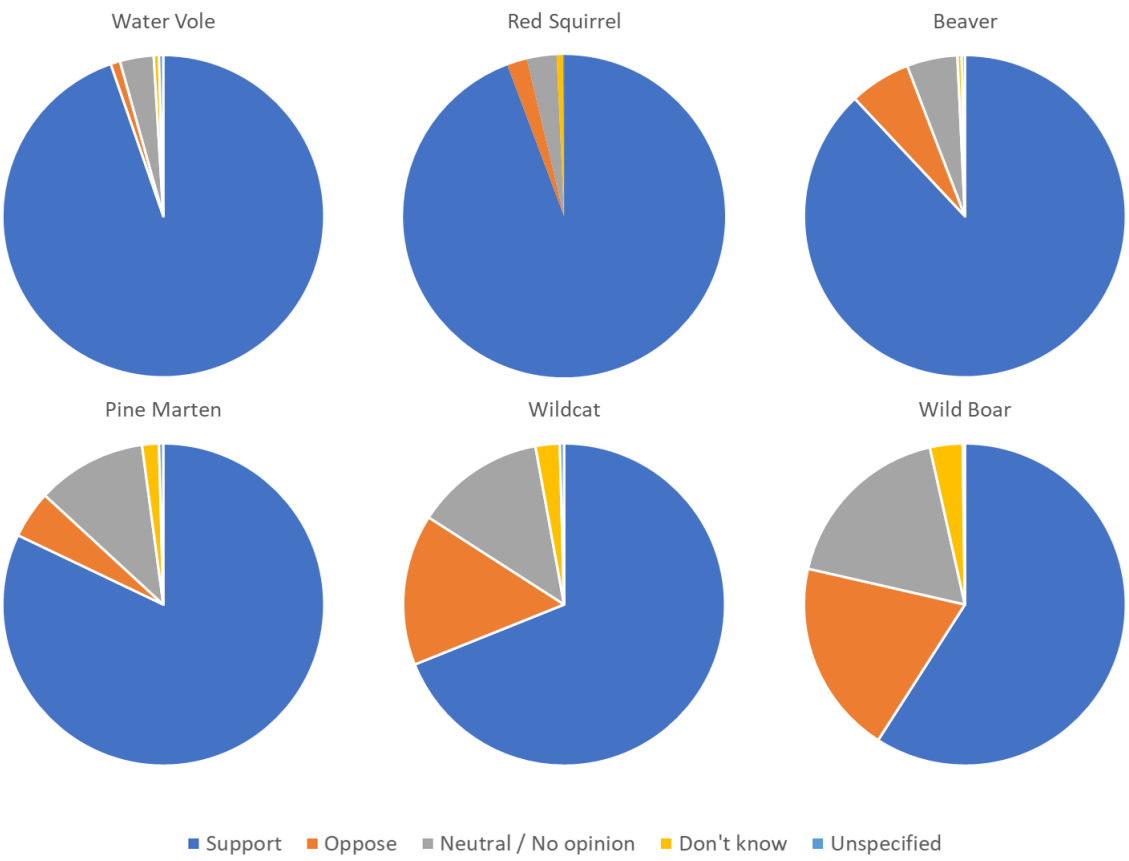
Just looking at those who showed strong support for reintroduction, this was over 70% for water vole and red squirrel. For beaver this was over 60%, and for pine marten this was over 50%. Fewer than 50% strongly supported wildcat reintroduction, and fewer than 40% strongly supported wild boar reintroduction.

The species for which most respondents took a position of opposition (whether ‘strongly oppose’ or ‘oppose) was the wild boar (19.51%), followed by the wildcat (15.16%), then beaver (6.15%), pine marten (4.77%), red squirrel (2.01%), and finally the water vole (0.95%).

For all species, fewer than 10% of respondents strongly opposed reintroduction.

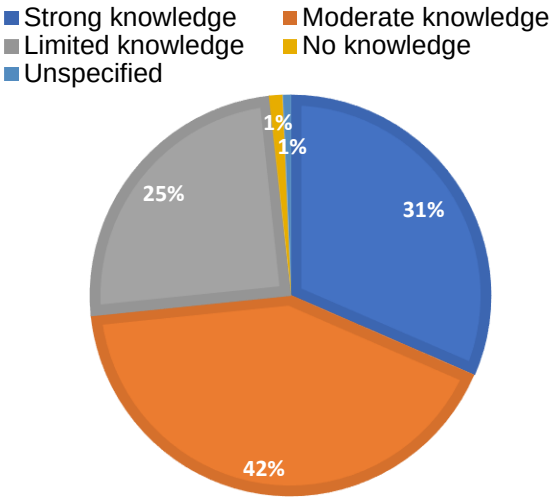


The following is a set of pie charts which offer an alternative presentation of this same data. These pie charts show the data with positions of support combined (‘strongly support’ and ‘support’), and positions of opposition combined (‘strongly oppose’ and ‘oppose’).


Water Vole
Red Squirrel
Beaver
Pine Marten
Wildcat
Wild Boar
Support
Oppose
Neutral / No opinion
Don't know
Unspecified

8.2.3. Beaver

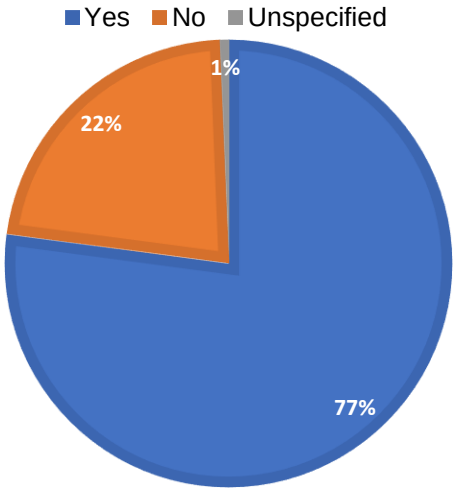
Familiarity with species



31.50% of respondents reported they had a strong knowledge of beavers prior to the questionnaire, and 41.89% reported that they had a moderate knowledge of the species. 24.92% reported having limited knowledge, and 1.06% reported having no knowledge of the species. 0.64% of respondents did not specify an answer.

Awareness of species' historical presence in Cornwall

77.09% of respondents reported being aware that beavers used to be present in Cornwall, and 22.27% reported that they were not aware of this fact. The remaining 0.64% of respondents did not specify an answer.



Level of support for reintroduction

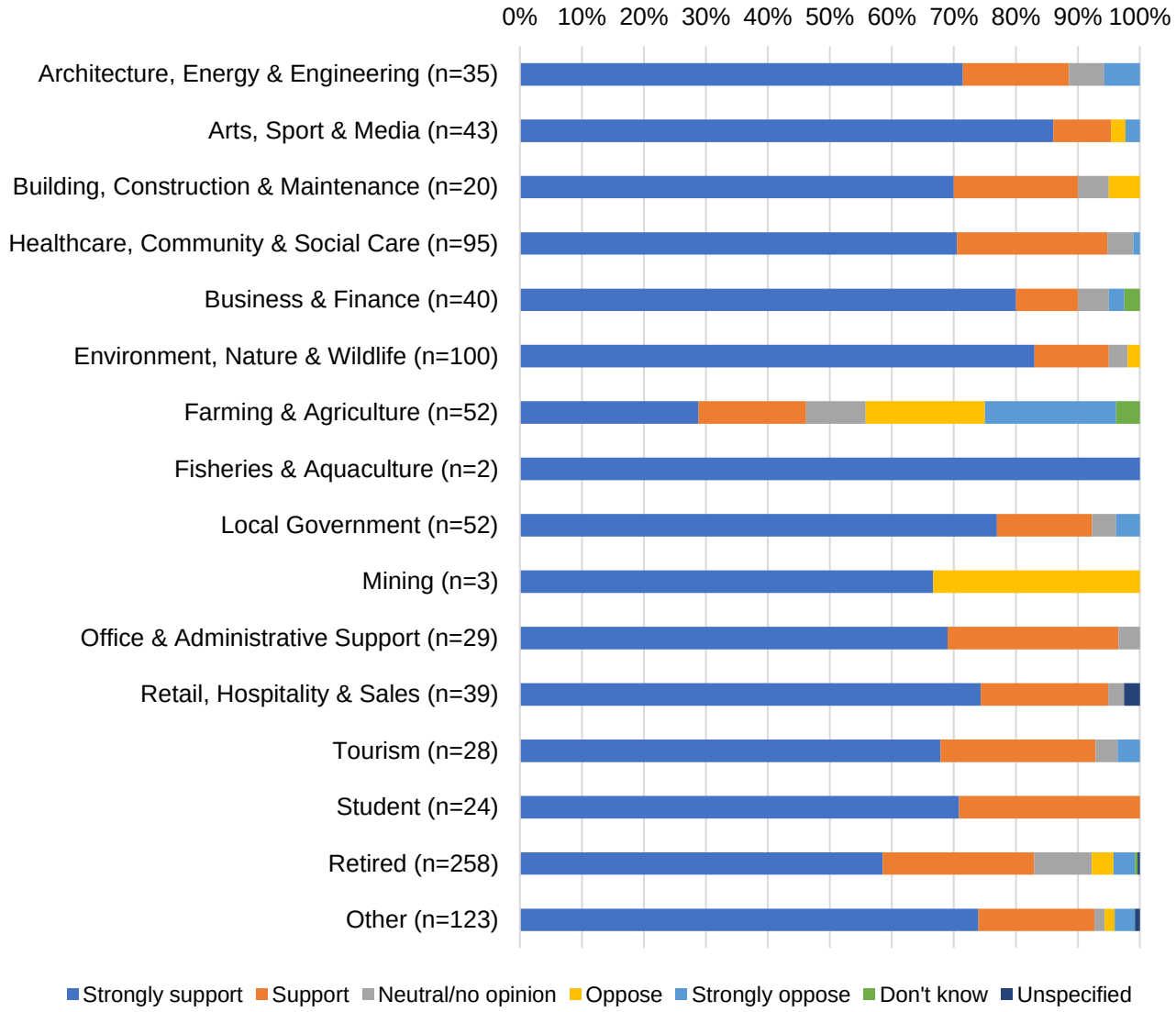
Total level of support

Overall, 88.02% of respondents took a position of support (68.29% strongly support, and 19.72% support). 6.15% of respondents took a position of opposition (3.39% strongly oppose, and 2.76% oppose). 5.09% indicated they were neutral or had no opinion, 0.42% did not know, and 0.32% did not specify an answer.

Level of support by occupation

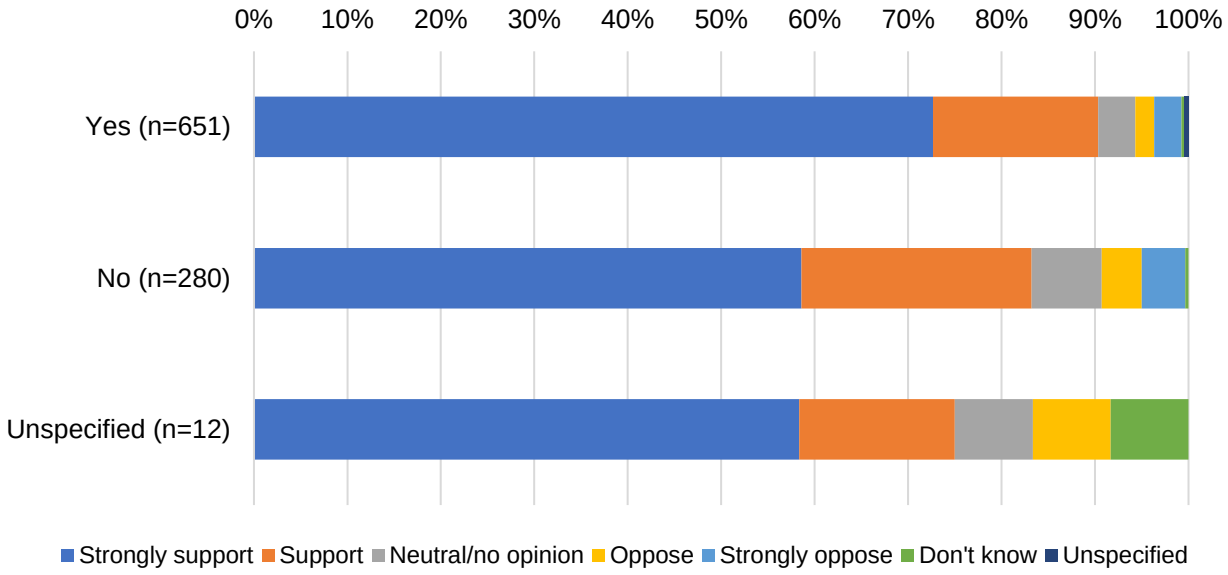
The following graph breaks down the levels of support for beaver reintroduction by the respondents' occupational backgrounds. For most groups, a position of support was taken by over 80% of participants, except for participants with a background in Mining (noting that n=3) or Farming and Agriculture. In the case of the latter of those

occupational groups, only 46.15% took a position of support, and 40.38% took a position of opposition.



Level of support by whether participants are involved in nature-based activities

The following graph breaks down the level of support for beaver reintroduction by whether respondents are involved in nature-based activities.


0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Yes (n=651)
No (n=280)
Unspecified (n=12)
Strongly support
Support
Neutral/no opinion
Oppose
Strongly oppose
Don't know
Unspecified

Reasons for support, neutrality or opposition to reintroduction

691 written responses were provided to explain respondents support, neutrality or opposition to reintroduction of beavers into Cornwall. Participants were able to give more than one reason for their answer. The following tables summarise the reasons that were given, broken down into whether they were reasons for their support, opposition, or neutrality towards reintroduction, or for why they felt they did not know.

Reason for support	Further detail	Example quotation	Count
General comment of support		"Amazing animals, unique" "Good for the environment"	56
Keystone species		"Keystone species, crucial to natural restoration of riparian habitats" "Like water voles these are a keystone species whose presence is vital to the survival of these waterways but with an even greater impact if reintroduced successfully"	27
Benefits to biodiversity	- Increase diversity	"Increasing biodiversity and their positive effect upon flooding" "Fast increase in biodiversity, water purifier and best flood defence"	106
Flood management	- Prevent flooding downstream - Manage/reduce flood risk - Flood protection	"Beavers provide natural flood defence" "Nature based solutions to flooding"	285
Waterway management	- Wetland creation/management - Watercourse management	"Great natural management of watercourses"	192

Reason for support	Further detail	Example quotation	Count
	- Clean waterways - River/stream management - Increase health of watercourses	"They are good for keeping rivers healthy"	
Ecosystem services	- Habitat creation - Ecosystem engineers - Benefit ecosystem - Rewilding - Restore balanced ecosystem - Mitigation against climate change	"Ecosystem engineers that create new habitats for a wide range of taxa like warblers, insects, and other rodents" "Has meaningful change on the ecosystem improving carbon sequestration and helps reduce flooding"	129
Iconic species	- Iconic - Charismatic	"Wonderful iconic mammal and in the right habitat can do so much to increase general biodiversity and could make a substantial impact by reducing flood risks" "Charismatic, fun etc."	5
Knowledge of other projects	- Already being introduced elsewhere/in Cornwall - Successful reintroductions - Evidence shows benefits	"Enclosed introductions have shown great success" "They have already proven their worth at controlling flooding at Ladock and North Devon and improved biodiversity"	68
Ethical motivation	- Humans eradicated species so should bring them back	"Because our over hunting led to their demise so they should be reintroduced to rebalance the mammal species in Cornwall" "Cornwall should be back to the way nature intended it before humans messed it up"	13

Reason for support	Further detail	Example quotation	Count
Native species	- Native - Indigenous - Endemic	"I'd like to see native species return" "They are one of our indigenous species and as such should be reintroduced and protected"	63
Cornwall is suitable	- Suitable habitat	"Cornwall has appropriate habitat" "Porkellis lower moor would be so suitable for beavers and probably beneficial to the moor"	3
Opportunity for public engagement	- Tourism - Engage interest in conservation	"Popular species that can introduce public to concept of rewilding, provide ecosystem services and habitat creation" "I think introduction of native species would bring educational opportunities and interest to the areas they are reintroduced into"	8
Pose little/no threat	- Harmless - Low risk	"Harmless river loving creatures" "Help to prevent flash floods. Low risk as they were here before"	3
Concern over feasibility	- Conflict with landowners - Only controlled reintroductions so far - Need to be carefully controlled/managed	"I have slight reservations considering beavers were introduced elsewhere only to be controlled; otherwise I think they will have net positive impacts" "Love the idea, just slight concern re interaction with resident species"	11

Reason for neutrality or no opinion	Further detail	Example quotations	Count
Concerns over feasibility	- Not enough habitat - No suitable locations	"Not sure we've got enough trees to support a viable population!" "I don't know of any suitable locations in which to release Beavers"	4
No benefit		"No real benefit in re-introducing them. Possible harm to trees & waterways"	1
Unknown consequences		"This reintroduction would maybe help with flood mitigation, it could also be an unmitigated disaster, you have no idea"	4
Lack of knowledge	- Insufficient information on the species	"Don't know enough about them" "Insufficient knowledge of pros and cons"	13
Destruction/damage	- Tree felling - Block rivers - Bad reputation - Farmers unlikely to want them present on their land	"I"m worried about the destruction they can cause, especially to our already fragile ecosystem" "They have a reputation for destruction & damage"	13
Flood management	- Flood prevention - Aquatic habitat creator	"They would help slow the flow of water through the waterways and reduce the risks of flooding in certain localities"	5

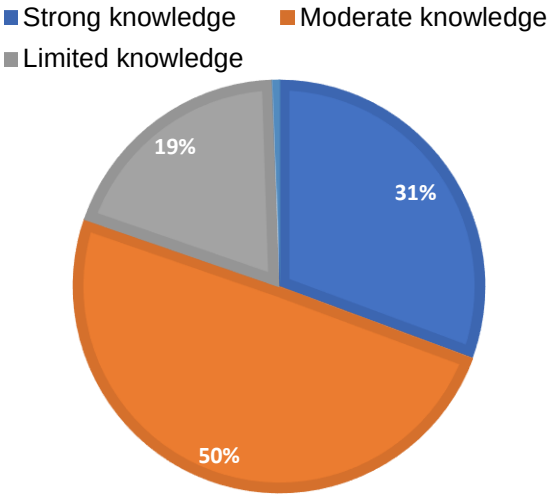
Reason for neutrality or no opinion	Further detail	Example quotations	Count
Already here	- Successful introductions elsewhere	"They have been re-introduced successfully in other parts of the country, so let's see how it goes longer term"	3
General	- Favourable species - Long time since present in Cornwall - No danger to humans	"It is a longer time since the beavers were last in Cornwall"	4

Reason for opposition	Further detail	Example quotations	Count
Waste of time and resources	- Costly - Waste of time	"Not good use of council tax"	3
Unknown consequences		"I am putting oppose although in principle I don't dislike the idea, but we need habitat restoration and proper surveys. Look seriously at consequences for bryophyte and lichens. Data shows the consequences are often negative"	3
Concerns over feasibility	- Unsuitable modern habitat - Containment issues - Difficult to manage	"Potentially incompatible with the modern rural environment" "We are talking about six centuries ago, when last present, with the population miniscule and no major roads or infrastructure"	6
Concern for trees	- Damage to trees	"Landscape disruption owing to their tree-felling"	18

Reason for opposition	Further detail	Example quotations	Count
	- Not enough trees	"I tend to oppose because I understand they destroy trees. If that is true, it is not good"	
Damage to rivers/flooding	- Flooding upstream of dams - Destruction to watercourses - Blockage of migratory fish (e.g., salmon)	"Small rivers, when dammed, may flood upstream" "As a riparian owner of a river with SSSI status for Atlantic Salmon and valuing the grazing for our dairy cattle there would be a conflict of interests for the free passage of Salmon and raising the water table will have an effect on our pasture"	21
Uncontrollable expansion	- No major predators - Need control over expansion	"Need strict control over expansion" "Species has been extinct in Cornwall for centuries. Ecosystem balance has changed significantly. No obvious top predator exists to manage population"	4
Destructive species	- Destructive species - Interfering with nature	"Destructive to the environment" "Interfering with nature"	7
General comment of opposition		"Overrated benefits of beavers" "They would compete with other animals and, lovely though they are, I can see no advantage in reintroducing them"	8

8.2.4. Red squirrel

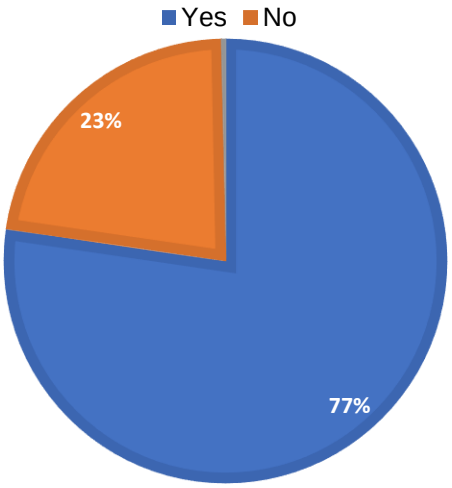
Familiarity with species



30.65% of respondents reported they had a strong knowledge of red squirrels prior to the questionnaire, and 49.63% reported feeling as though they had a moderate knowledge of the species. 19.19% reported having limited knowledge, and no respondents reported having no knowledge of the species. 0.53% of respondents did not specify an answer.

Awareness of species' historical presence in Cornwall

77.31% of respondents reported being aware that red squirrels used to be present in Cornwall, and 22.38% reported they were not aware of this fact. The remaining 0.32% of respondents did not specify an answer.



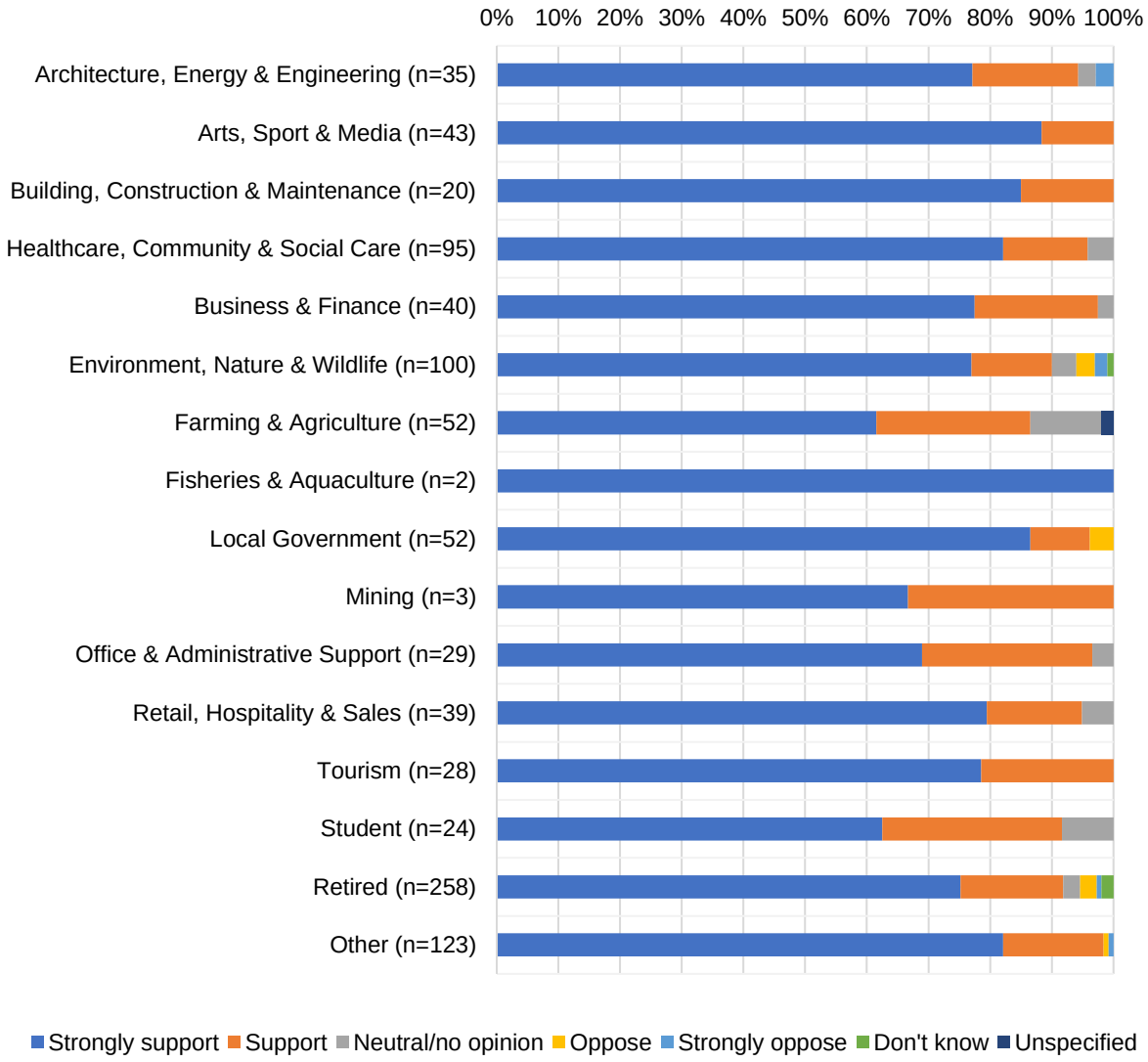
Level of support for reintroduction

Total level of support

Overall, 94.27% of respondents took a position of support (77.62% strongly support, and 16.65% support). 2.01% of respondents took a position of opposition (0.64% strongly oppose, and 1.38% oppose). 2.97% indicated they were neutral or had no opinion, 0.64% did not know, and 0.11% did not specify an answer.

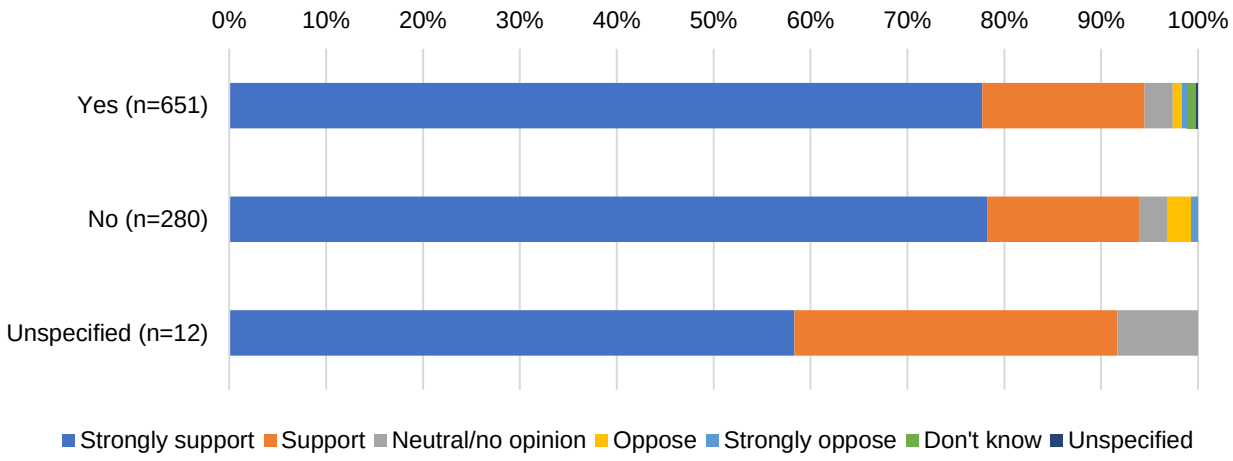
Level of support by occupation

The following graph breaks down the levels of support for red squirrel reintroduction by the respondents' occupational backgrounds. In all groups, over 80% of respondents take a position of support, and fewer than 10% take a position of opposition.



Level of support by whether participants are involved in nature-based activities

The following graph breaks down the level of support for red squirrel reintroduction by whether respondents are involved in nature-based activities.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100%
Yes (n=651)
No (n=280)
Unspecified (n=12)
Strongly support
Support
Neutral/no opinion
Oppose
Strongly oppose
Don't know
Unspecified

Reasons for support, neutrality or opposition to reintroduction

768 written responses were provided to explain respondents support, neutrality or opposition to reintroduction of red squirrels into Cornwall. Participants were able to give more than one reason for their answer. The following tables summarise the reasons that were given, broken down into whether they were reasons for their support, opposition, or neutrality towards reintroduction, or for why they felt they did not know.

Reason for support	Further detail	Example quotation	Count
General comment of support		"Beautiful animals to see" "I'd like to see red squirrels survive" "I care about nature"	110
Native	- Native to UK - Native to Cornwall - Indigenous species - Natural species - They used to be here	"It is our native species" "Good to see native species return to Cornwall"	287
Conservation of threatened species	- Threatened - Endangered - Avoid extinction	"This is a critically endangered species that deserves to be brought back home to Cornwall" "We should help this animal to avoid it becoming extinct."	11
Benefits to biodiversity / ecology	- Increase diversity - Restore biodiversity - Natural balance - Rebalancing nature - Restore natural ecosystems - Rewilding	"Biodiversity gain" "The more diverse our wildlife the better it is for the environment" "They are an important part of the ecology"	113
Preference over grey squirrels	- Greys are pests - Driven out by greys	"Not a pest like the grey species"	101

Reason for support	Further detail	Example quotation	Count
	- Less harmful than greys - A want to eradicate greys	"Not as destructive as grey squirrels" "They should replace the invasive grey squirrel"	
Cornwall is suitable location	- Appropriate habitats - Suitable location	"Cornwall's geography should help protect and encourage spread" "I come from the Lizard, where the Helford River could be an ideal barrier against encroaching grey squirrels - it should work!"	20
Knowledge of successful reintroduction		"I used to live on Scilly and have seen the successful establishment on Tresco" "It has already been reintroduced in Cornwall, on the Lizard!"	14
Ecosystem services	- Aid reforestation - Seed dispersal - Restore ecosystems - Tourism	"…They serve an ecological function in seed dispersal and as a prey source" "Our only native breed of squirrel, they aid reforestation"	47
Pose no threat/ problems	- Harmless - Low impact - No threat to humans or other wildlife	"Cannot see any harm so why not?" "Few conflicts of interest with other threatened species or risk to landowners/stakeholders"	26
Ethical motivation	- To combat human races negative impact - Sense of obligation - Morally correct thing to do	"We owe it back" "It was extinct because of human behaviour, we have an obligation to correct this"	24

Reason for support	Further detail	Example quotation	Count
Iconic species		"It would be great to reintroduce the red squirrel generally as it is the iconic squirrel picture and feels very British"	8
Opportunity for public engagement	- Attract tourism - Local interest - Increase interest in rewilding	"Attractive to locals and tourists" "I believe it would be a great catalyst for increasing interest in rewilding as it is such a charismatic species."	12
Nostalgia	- Memories from childhood - Experience seeing red squirrels in the wild	"I remember seeing them as a child" "Such beautiful creatures. We used to have them in our garden in Scotland. It would be incredible to see them back in Cornwall"	45
Concern over feasibility	- Is there appropriate habitat? - Difficult to manage greys - Won't survive greys	"Fine being reintroduced but how do we stop the grey killing them off again?" "How would you ensure disease in grey squirrels wouldn't infect new reds?"	31
Concern for grey squirrels	- Concern over culling	"Support only as long as doing so does not mean killing grey squirrels"	4

Reason for neutrality or no opinion	Further detail	Example quotation	Count
Concerns over feasibility	- Current management of grey squirrels - Chances of success - Predation	"Will need to eradicate the grey squirrel before the red will thrive." "Can't see the ecological relevance if Grey Squirrels still inhabit Cornwall and will continue to outcompete them"	15
Time and resources	- Waste of time - Other species of higher importance - Costly - Better ways to spend resources	"…habitat and plant restoration should be a much higher priority than reintroducing a mammal in my opinion." "Requires continuous & ongoing management of grey squirrels (costly & labour-intensive intervention that is perhaps not the best use of conservation funding)"	4
Ecosystem services	- Ecotourism	"Ecotourism"	1
No danger to humans		"If they are not dangerous to humans I have no objection"	1
Lack of knowledge	- Lack of information on the subject	"Not sure of the environmental benefit." "Not sure it would be a good thing for them. I would like to see them though."	4
Already present		"it is here already"	1
There is a reason they are not present	- Interference - Natural	"If they no longer exist in Cornwall, it is not due to man. Let nature take its course. We must stop interfering."	1
Concerns over grey squirrels	- Culling of grey squirrels - Fondness of grey squirrels	"I like grey squirrels and do not see the need to replace them with red squirrels"	6

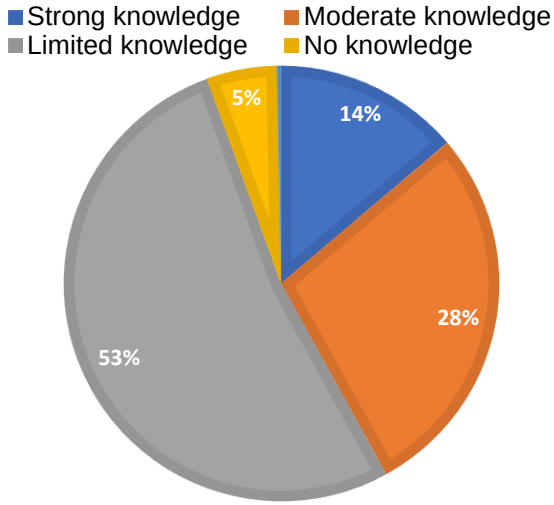
Reason for neutrality or no opinion	Further detail	Example quotation	Count
		“If introducing Red Squirrels means eradicating Grey Squirrels then I am against it. If a way could be found to allow both to live aside each other then I would strongly agree”	

Reason for opposition	Further detail	Example quotations	Count
Waste of time and resources	- Money better spent elsewhere - Costly	“Better things to spend council tax money on” “Pointless waste of time”	5
Support for grey squirrels	- Displacement of grey squirrels to allow reds to thrive	“Not happy if it means exterminating grey squirrels who’ve given me a lot of pleasure” “In other areas the reintroduction of this species has involved brutal slaughter of the delightful grey squirrel, described as an "invasive species" which may be historically true, but this is the squirrel I have known and appreciated for all my 66 years! “	5
Concerns over feasibility	- Management of greys not feasible	“I do not believe that a reintroduction would be successful as I do not believe that it is possible to successfully eradicate grey squirrels (this would be very costly and is unlikely to be a success). I also do not think that Cornwall has suitable habitat” “Too difficult to keep the grey squirrel away from them”	7

Reason for opposition	Further detail	Example quotations	Count
General comment of opposition		“An extra rodent should not be introduced because it's cute.” “Interfering with nature”	3

8.2.5. Pine marten

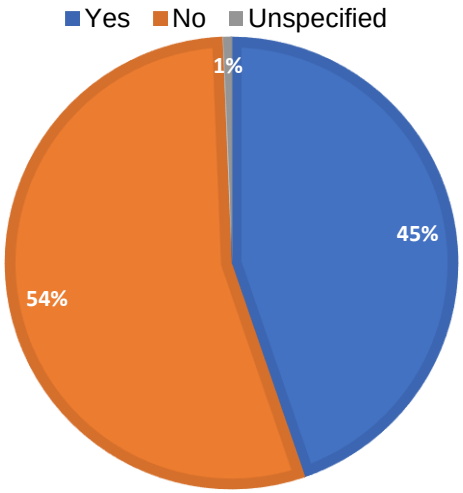
Familiarity with species



13.79% of respondents reported they had a strong knowledge of pine martens prior to the questionnaire, and 28.21% reported feeling as though they had a moderate knowledge of the species. 52.49% reported having limited knowledge, and 5.20% reported having no knowledge of the species. 0.32% of respondents did not specify an answer.

Awareness of species' historical presence in Cornwall

44.75% of respondents reported being aware that pine martens used to be present in Cornwall, and 54.61% reported they were not aware of this fact. The remaining 0.64% of respondents did not specify an answer.



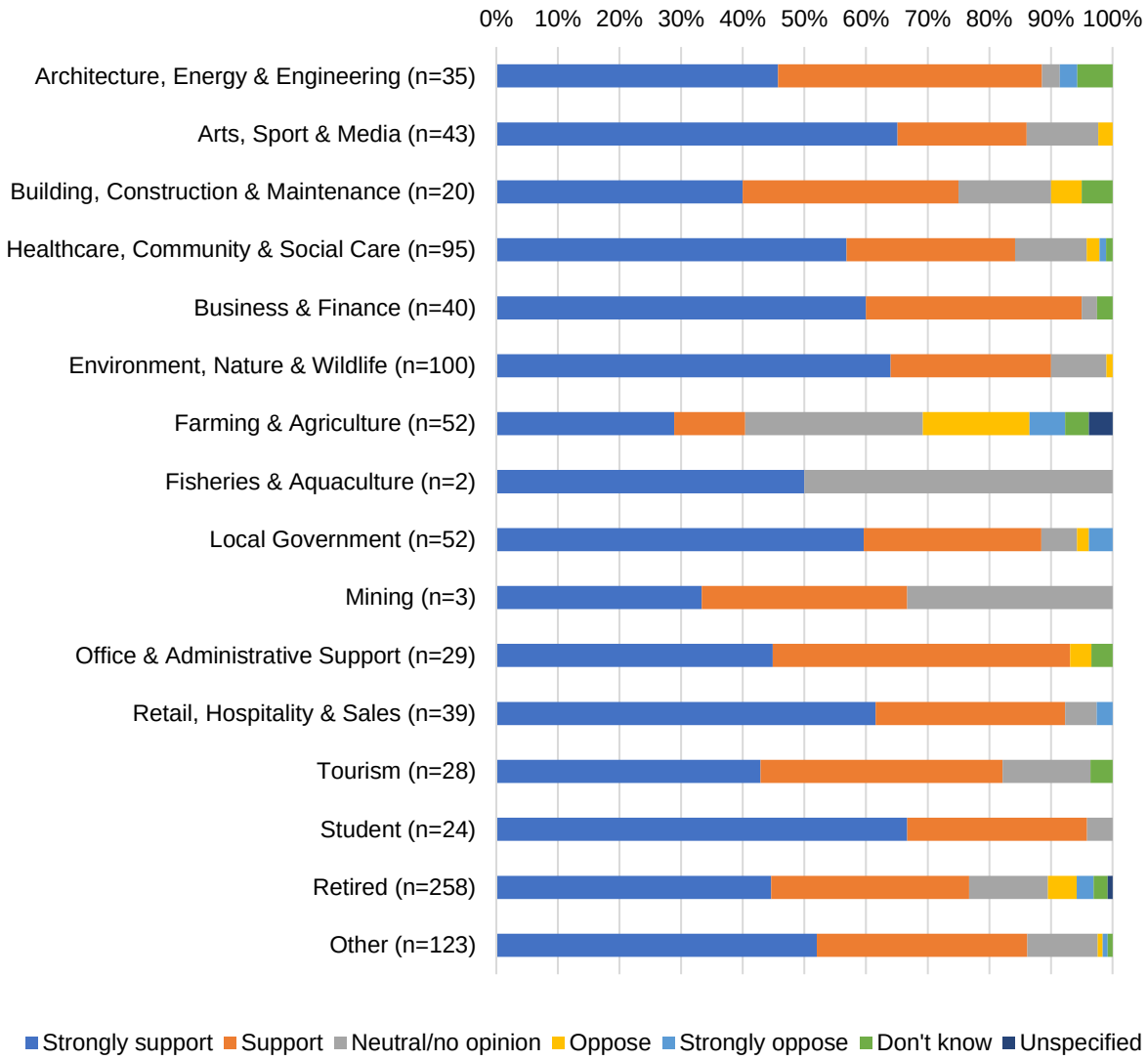
Level of support for reintroduction

Total level of support

Overall, 82.08%% of respondents took a position of support (51.54%% strongly support, and 30.54% support). 4.77% of respondents took a position of opposition (1.70% strongly oppose, and 3.08% oppose). 11.03% indicated they were neutral or had no opinion, 1.70% did not know, and 0.42% did not specify an answer.

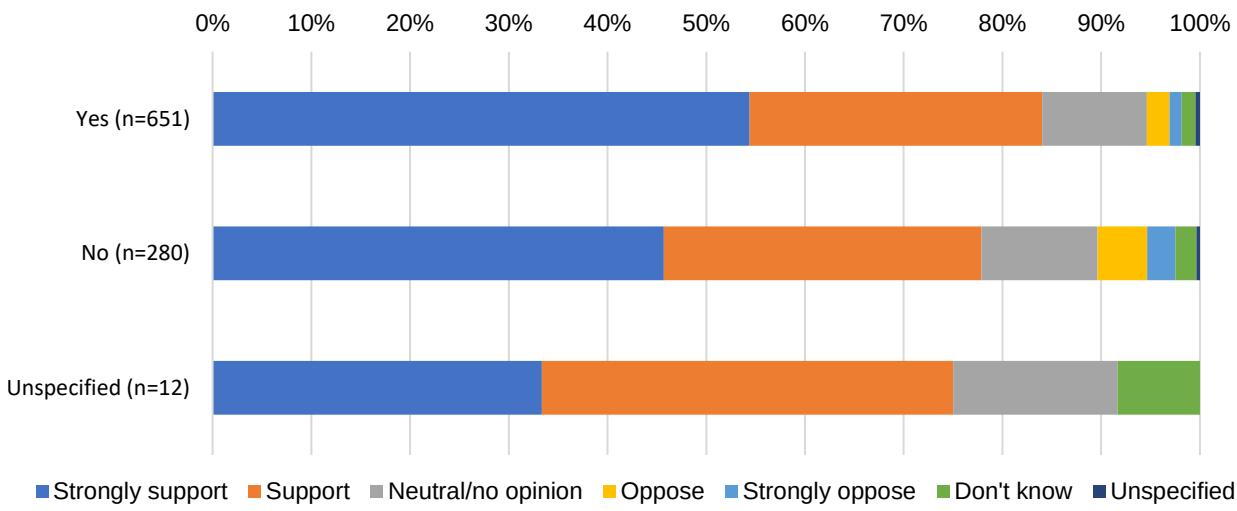
Level of support by occupation

The following graph breaks down the levels of support for pine marten reintroduction by the respondents' occupational backgrounds. Levels of support are varied, but in most groups, over 60% of respondents take a position of support. However, this figure is only 40.38% for those who indicated an occupation in 'Farming & Agriculture', with 23.08% of that group taking a position of opposition.



Level of support by whether participants are involved in nature-based activities

The following graph breaks down the level of support for pine marten reintroduction by whether respondents are involved in nature-based activities.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Yes (n=651)
No (n=280)
Unspecified (n=12)
Strongly support
Support
Neutral/no opinion
Oppose
Strongly oppose
Don't know
Unspecified

Reasons for support, neutrality or opposition to reintroduction

684 written responses were provided to explain respondents support, neutrality or opposition to reintroduction of pine marten into Cornwall. Participants were able to give more than one reason for their answer. The following tables summarise the reasons that were given, broken down into whether they were reasons for their support, opposition, or neutrality towards reintroduction, or for why they felt they did not know.

Reason for support	Further detail	Example quotations	Count
General comment of support		"All wildlife needs support" "Because they are pretty"	59
Keystone species	- Keystone - Key species	"It's a keystone predator and helps keep the balance of the local food chain" "They are an essential key species, to ensure a healthy biodiverse native flora and fauna"	3
Benefits to biodiversity	- Increase diversity - Variation of species	"Diverse wildlife benefits everyone" "To reintroduce species variety "	95
Nostalgia	- Childhood memories - Experience seeing species in wild	"I have seen these in Ireland, and they are beautiful" "Again, I am familiar with the species from time as a child in Scotland..."	14
Already here		"Pine martens have already been sighting in Cornwall" "I believe there have been sightings on Goss Moor already"	8

Reason for support	Further detail	Example quotations	Count
Ecosystem services	- Habitat creation - Ecosystem engineers - Benefit ecosystem - Rewilding - Restore natural balance - Mitigation against climate change	"Pine martens support the structuring of native woodland ecosystems" "Again they are part of the ecosystem. All parts are vital"	64
Iconic species	- Iconic - Charismatic	"I think that it would be very exciting to have such a charismatic mammal in the area again" "They are fantastic iconic mammals"	5
Knowledge of presence elsewhere	- Already being introduced elsewhere - Already present in wild elsewhere	"They are in Devon. They should be in Cornwall" "Previous reintroduction has been successful (e.g. Forest of Dean / Wales). Low risk of human-wildlife conflict. Potentially some ecological benefits (e.g. grey squirrel) control"	9
Ethical motivation	- Humans eradicated species so should bring them back - Moral sense	"Any animal hunted to extinction in an area should have every right to return no matter what the issues, this world is theirs just as much as ours" "Undoing the damage done by human activity"	13
Native species	- Native - Indigenous - Endemic - They belong here	"Reintroducing a once native species" "Would be great to reintroduce them - if they were here before they should be here now"	156

Reason for support	Further detail	Example quotations	Count
Opportunity for public engagement	- Tourism - Engage interest in conservation/rewilding - Wildlife enthusiasts	"I think introduction of native species would bring educational opportunities and interest to the areas they are reintroduced into" "It will hopefully encourage people to take more care & interest in nature spaces in the county"	18
Pose little/no threat	- Cause little problem - Low risk - Don't see why not	"As far as I am aware the reintroduction of this species would have no adverse effects on others" "No reason they shouldn't be reintroduced"	23
Concern over feasibility	- Need to be carefully controlled/managed - Sufficient habitat - Species interactions - Potential impact on birds/poultry	"Do we have sufficient habitat for them here?" "Support with caveat. Full study on the effect on local poultry farmers, particularly more rural eco ventures"	22
Time and resources	- Better uses of resources	"Happy for any species to be reintroduced, provided funding isn't diverted from building enough homes for the humans who live in Cornwall"	1
Threatened species	- Lost species - Rare species - Threatened - Prevent extinction	"Wonderful species which was driven to extinction in England and should be here" "Diversity and preservation of species"	16
Natural predator	- Pest control - Predator to rodents/rats/rabbits/	"Natural predator bringing balance"	45

Reason for support	Further detail	Example quotations	Count
	- Mesopredator	"This would help maintain control over pest species"	
Squirrel populations	- Preference for reds - Control grey population - Management of greys - Support reintroduction of reds	"Good predator of the grey squirrels, which could aid reintroductions of red to be more successful" "Helps to eradicate grey squirrels"	103

Reason for neutrality or no opinion	Further detail	Example quotations	Count
Concerns over feasibility	- Need to be controlled/managed - Need to be kept away from rare species - Habitat loss leading to more competition	"It's competition for habitat which is shrinking for species already there" "The pine marten is a predator that would need to be controlled if brought back"	4
No benefit	- Unsure of benefit of reintroduction	"I am not sure what benefit the Pine Martin will bring" "See no reason for reintroduction"	5
Unknown consequences	- Species interactions - Predation on birds/cats/small mammals	"Some reservations about the effect its presence would have on other wildlife, such as birds and small mammals" "Will it predate on domestic cats, small dogs and small livestock?"	30

Reason for neutrality or no opinion	Further detail	Example quotations	Count
Lack of knowledge		"I don't know enough about the pros and cons to have a strong opinion" "I would need to know more about impacts and requirements and likely success rates including overall benefits to wildlife in Cornwall as a whole"	72
Suitability of Cornwall	- Lack of habitat - Won't fit into modern Cornwall	"Don't know how they would fit modern Cornwall" "So little suitable habitat in Cornwall it seems like a tough ask"	8
Already here		"They are already here but in small numbers" "There have already been sightings including photographic evidence of Pine Martens in Cornwall and it is likely that they will successfully recolonise without intervention"	2
General comment of neutrality		"I thought it was a northern species" "Looks a bit fierce"	3
General comment of support	- Management of grey squirrels - Indigenous - No objection	"Because they"re lovely to look at and great to have more varied species in the wild" "I am unsure about the implications. If however they are useful in controlling grey squirrels and boosting red squirrels (did I read that?) then yes, pine martens could be welcome"	10

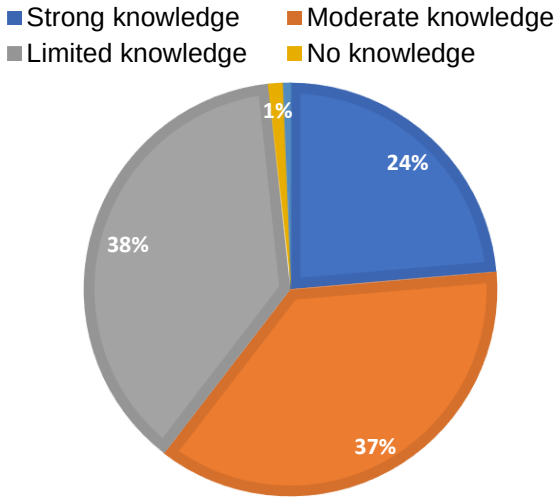
Reason for neutrality or no opinion	Further detail	Example quotations	Count
Knowledge of other projects	- Negative views of other projects	"Let nature take its course. They are not hunted and at the moment choose to live in the quieter north. The Forest of Dean trial is not actually working very well"	1
Time and resources		"Limited resources, time"	1

Reason for opposition	Further detail	Example quotations	Count
Waste of time and resources	- Money spent better elsewhere - Waste of time	"Pointless waste of time" "Rather council tax spent in feeding and housing the needy people"	2
Unknown consequences		"Interbreeding with the cat population, feral and domestic which are not spayed" "They would be at risk from hunting"	3
Concern over feasibility	- Unsuitable modern habitat	"Potentially not compatible with the modern rural environment"	1
Predator/destructive species	- Destructive species - Predation on birds/chickens/red squirrels/small mammals	"Pine Martens are active predators and would have a significant impact on other species and human activities" "I worry about the effect on our small birds and mammals. Our birdlife is already in decline and is subject to so many predators"	29

Reason for opposition	Further detail	Example quotations	Count
General comment of opposition	- No benefit	"No benefit in re-introducing them. May be harmful to other species"	2
Interference with nature		"Interfering with nature" "Upset of established equilibrium of habitat - marginalisation of existing species"	3
Suitability of Cornwall	- Unsuitable habitat	"We haven't got enough area for them in Cornwall they would spread into towns and villages killing a lot of tame cats/pets" "Southern England, including Cornwall, is already too densely populated for pine martens to be re-introduced - it wouldn't be fair to them, or to the existing indigenous birds and animals on which they'd predate"	3

8.2.6. Water vole

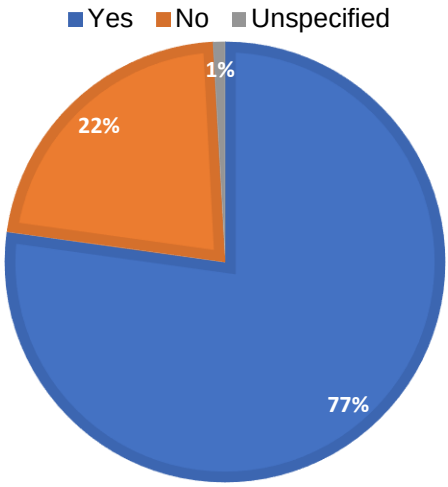
Familiarity with species



23.65% of respondents reported they had a strong knowledge of water voles prior to the questionnaire, and 36.80% reported they had a moderate knowledge of the species. 37.86% reported having limited knowledge, and 1.17% reported having no knowledge of the species. 0.53% of respondents did not specify an answer.

Awareness of species' historical presence in Cornwall

77.20% of respondents reported being aware that water voles used to be present in Cornwall, and 21.95% reported they were not aware of this fact. The remaining 0.85% of respondents did not specify an answer.



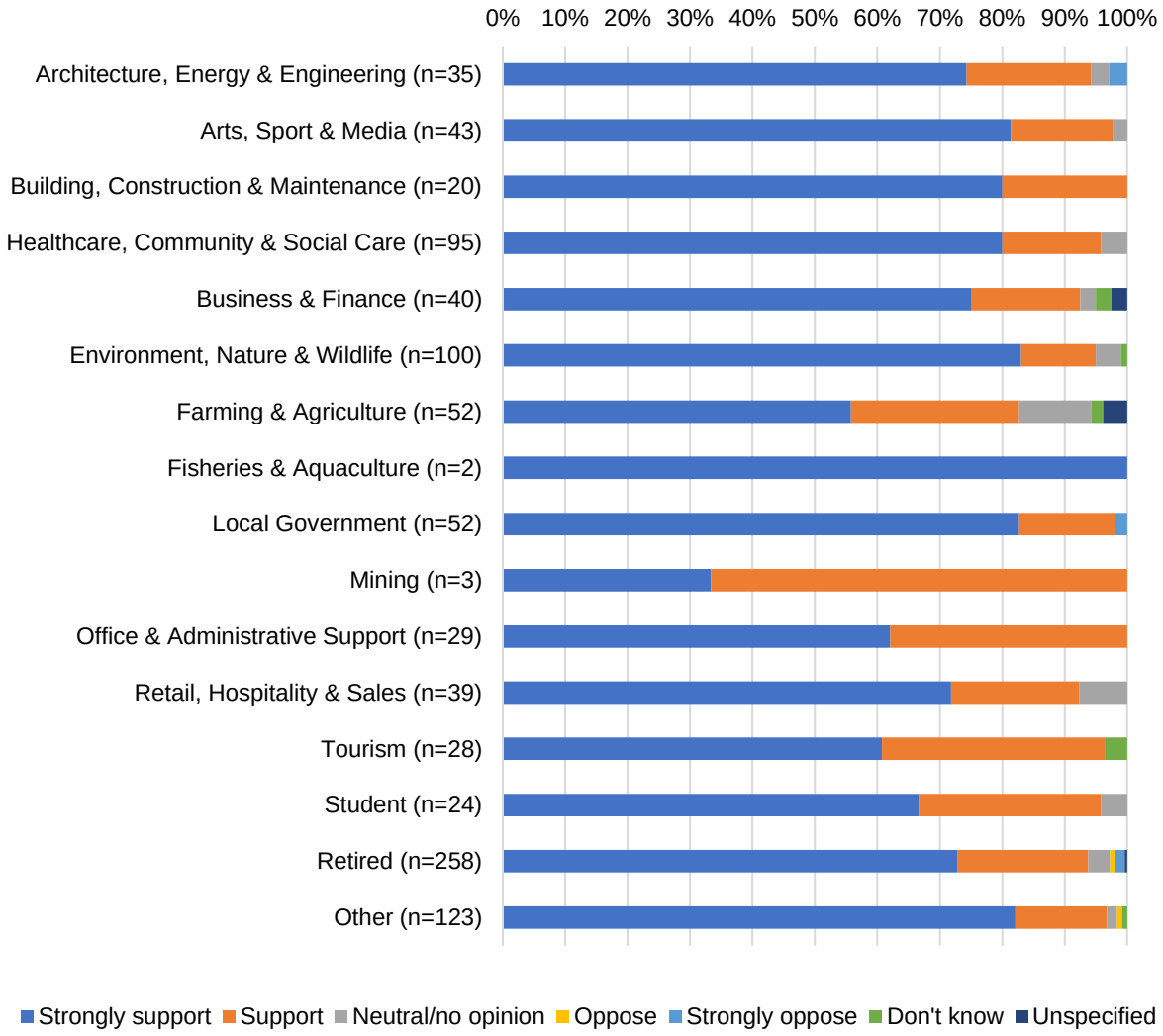
Level of support for reintroduction

Total level of support

Overall, 94.70% of respondents took a position of support (75.19% strongly support, and 19.51% support). 0.95% of respondents took a position of opposition (0.64% strongly oppose, and 0.32% oppose). 3.39% indicated they were neutral or had no opinion, 0.53% did not know, and 0.42% did not specify an answer.

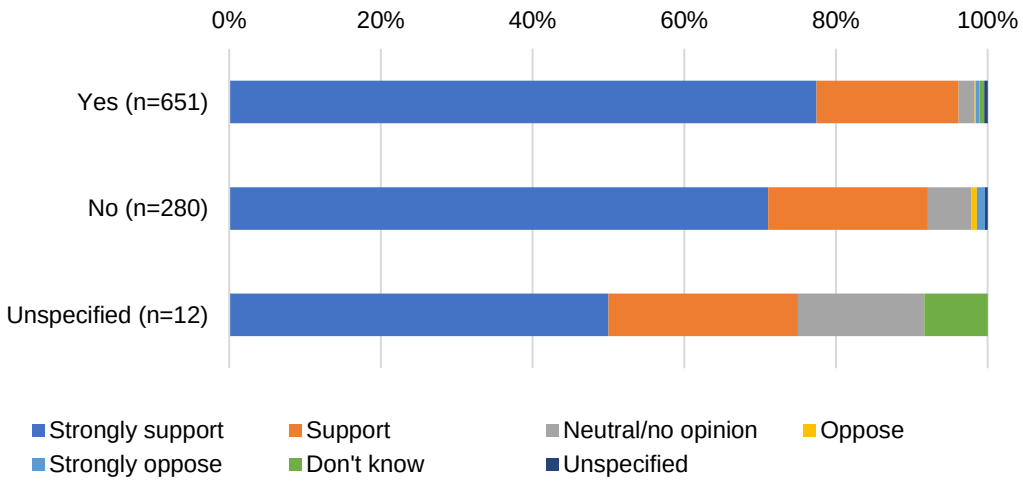
Level of support by occupation

The following graph breaks down the levels of support for water vole reintroduction by the respondents' occupational backgrounds. In all groups, over 80% of respondents took a position of support, and fewer than 10% took a position of opposition.



Level of support by whether participants are involved in nature-based activities

The following graph breaks down the level of support for water vole reintroduction by whether respondents are involved in nature restoration activities.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Yes (n=651)
No (n=280)
Unspecified (n=12)
Strongly support
Support
Neutral/no opinion
Oppose
Strongly oppose
Don't know
Unspecified

Reasons for support, neutrality or opposition to reintroduction

663 written responses were provided to explain respondents support, neutrality or opposition to reintroduction of water voles into Cornwall. Participants were able to give more than one reason for their answer. The following tables summarise the reasons that were given, broken down into whether they were reasons for their support, opposition, or neutrality towards reintroduction, or for why they felt they did not know.

Reason for support	Further detail	Example quotations	Count
General comment of support	- Wildlife is important - Reintroduction should be supported - Why not - Admiration/beauty	"They are a wonderful species who have a great place in the ecosystem"	69
Native	- Endemic - Ecosystem balance - Were once part of the ecosystem	"They belong here" "I believe in the reintroduction of indigenous species" "I'd like to see native species return" "Native species should be re-introduced wherever possible" "They are an important native species that used to thrive all over the UK"	87
Conservation of threatened species	- Some around but low numbers - Threat from mink - 95% decrease in 25 years - Real possibility of extinction - Endangered species	"Combat humanity's detrimental effect on the environment" "Endangered species due to predation by mink" "Species is generally under threat. Good if it regained a foothold in Cornwall"	41

Reason for support	Further detail	Example quotations	Count
Ecosystem restoration	- Restore biodiversity - Diversity - Lack of wildlife in rivers - Restoration of balance - Good for environment - Positive impact on local flora and fauna - Important for food chain - Creating space for rare species - Food source - Restore food chain - Ecosystem engineers - Beavers	"Nature needs nature" "Fascinating and necessary part of our ecosystem" "Reintroduction of any species can only make the ecosystem stronger" "Our environment is carefully balanced, and this balance is disrupted without the complex ecosystems created by all our native species" "We need to bring back the 95 indigenous mammals as they help to create balanced ecosystems. Water voles help to promote plant diversity." "Restore ecological balance"	99
Ecosystem services	- Natural flood defence - Water quality - Health of wetlands - Add to ecosystem value - Ecotourism - Ecosystem engineers - Maintain grassland - Food source for predators	"Diverse wildlife benefits us all" "Water voles are a strong barometer of water quality in our river & streams" "Water voles are a great food source for many predators such as birds of prey and meso-predators. They also provide an ecological function in changing micro habitats in their feeding and burrowing practises that benefit other wildlife." "They maintain waterways and habitat around them and will benefit as waterways rise"	109
Ethics /responsibility	- Should not have been allowed to become extinct	"Increase population decimated by human activity"	21

Reason for support	Further detail	Example quotations	Count
	- Human driven extinction - A shame that driven by poor management - Undo damage from intro of American Mink - Pressure to clean up waterways	"Any animal hunted to extension in an area should have every right to return no matter what the issues, this world is theirs just as much as ours" "I'd like to think that re-introduction might help put pressure on farmers and businesses to clean up the waterways and reduce pollution"	
Iconic species	- Beautiful species - Would like to be seen again - Wind in the willows	"Beautiful natural member of our ecosystem" "I am appalled by the dwindling numbers of this wonderful, inspiring, once widespread creature. I follow several people on TV who are involved with them. That they are in such decline is a sad indictment of the state of our water habitat & ways." "I have not seen water voles anywhere in the wild for years and yet they are a well-known part of our wetland and river fauna" "People love the wind in the willows, and so reintroducing "ratty" would be a great boon to the rewilding scheme."	31
Return of species to Cornwall **Only recently lost**	- Heritage - Seen as a child - Good for ecosystem - Used to be here - Recently extinct	"I remember seeing some as a child" "I grew up in the West Country in the 60s and 70s and swam in rivers that supported water voles - I would love them to be able to live here again" "As noted it is only relatively recently that the species became extinct in most areas of Cornwall. I believe their introduction could add to river management"	54

Reason for support	Further detail	Example quotations	Count
Knowledge of successful reintroduction	- Successful reintroduction in Bude - Would work well - Replicating success in Bude	"We should be helping support the good work carried out in Bude and replicate it across the county" "If they survive around Bude they could be introduced into other parts." "I have seen the reintroduced water voles and they seem to be doing well in Bude."	21
Pose no threat/problems	- 'Because why not' - No issues with increasing numbers - Harmless - Not destructive	"Because why not" "They are lovely creatures and would do no damage to the natural environment or wildlife."	48
Existing suitable habitat	- Fit well into existing ecosystem - Belong in original habitat	"Should be reintroduced to where they once prospered." "They are great contributors to riverbank ecology. Iconic as Kenneth Graham used the upper reaches of the Fowey as inspiration for "The Wind in The Willows." The Fowey is fairly inaccessible towards Golant, so they might thrive there." "Cornwall has appropriate habitat" "Plenty of waterways which with suitable vegetation along margins could support water voles"	12
Already present / didn't know were extinct	- Sightings - Here in small groups	"They are an indigenous species and they are currently present in parts of Cornwall." "Didn't know they had become extinct locally! And so recently!"	33

Reason for support	Further detail	Example quotations	Count
		"I never realised it had become extinct in Cornwall and wish it to be back" "I believe there are already water voles in some areas. I think mink populations are reducing as otter numbers increase, so hopefully water voles will thrive." "There is a very small population living at the ponds near where I live. They are interesting creatures and don't seem to disturb the landscape very much."	
Education /outreach	- Educational opportunities and interest in area	"I think introduction of native species would bring educational opportunities and interest to the areas they are reintroduced into" "I think it would be good to get this species back to Cornwall as it's a shame it is extinct here compared to other parts of the country. Also good for children to be aware of different species" "It will hopefully encourage people to take more care & interest in nature spaces in the county"	3

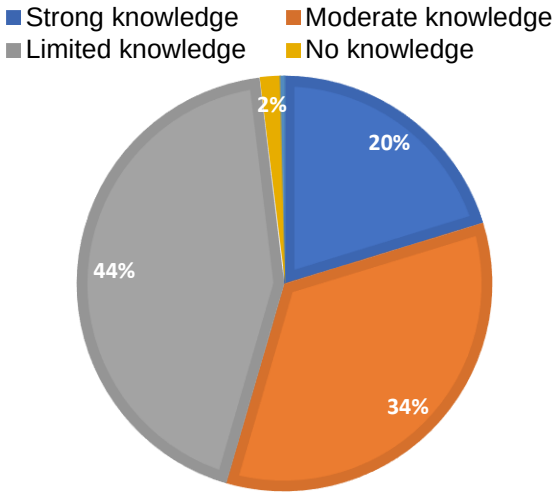
Reason for neutrality or no opinion	Further detail	Example quotations	Count
Uncertainty / lack of knowledge	- Unsure of scientific evidence - Unsure of ecological advantage	"I don't know the environmental benefits, but I"m assuming they would have a positive impact?"	13

Reason for neutrality or no opinion	Further detail	Example quotations	Count
		"Don't know enough about them to know their ecological benefit if reintroduced"	
No opinion			1
Existence of predators that may affect reintroduction success	- Presence of foxes - Presence of mink	"I would love to see the water vole back, with all the other wildlife mentioned as a matter of fact. The primary predator of the Water Vole is the fox I believe, hunting is now banned and other forms of control are perhaps not cost effective"	3
Time and resources			1
If safe for humans /communities		"If they are not dangerous to humans I have no objection"	1
Already present	- Bude	"They"re in Bude so not too far away"	3
Other species more important	- Threatened species more important	"Not opposed but the reintroduction of other similar animals may be more important"	2
There is a reason they are not present	- Choice - Few places that they can burrow	"As with a lot of wildlife there is a reason that they do not habitat in Cornwall. One it is their choice as they were never hunted. Two is that there are few places where they can burrow into river banks without hitting rock. Unlike Somerset levels."	1
Disruptive	- Upset of existing ecosystem	"Upset of established equilibrium of habitat - marginalisation of existing species"	2

Reason for opposition	Further detail	Example quotations	Count
Damage to ecosystem	- Explosion of Bude population - Hard to control population - Flooding	“We have had water voles reintroduced in Bude. The population has exploded and caused massive damage and problems to our canal banks. Because they are protected they are very tricky to control and manage. Our environment is not suitable for water voles.”	1
Waste of time and resources	- Public money - Unaware of benefits		3
Community impacts		“Blocking rivers that will flood homes” “The built up environment has exponentially increased since beavers were around. Would only add to flooding issues around the country”	1
Unsure		“Interfering with nature”	1

8.2.7. Wild boar

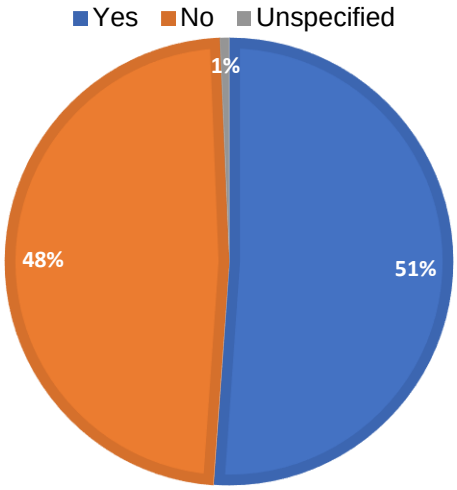
Familiarity with species



20.25% of respondents reported they had a strong knowledge of wild boar prior to the questionnaire, and 34.25% reported feeling as though they had a moderate knowledge of the species. 43.58% reported having limited knowledge, and 1.59% reported having no knowledge of the species. 0.32% of respondents did not specify an answer.

Awareness of species' historical presence in Cornwall

51.11% of respondents reported being aware that wild boar used to be present in Cornwall, and 48.25% reported they were not aware of this fact. The remaining 0.64% of respondents did not specify an answer.



Level of support for reintroduction

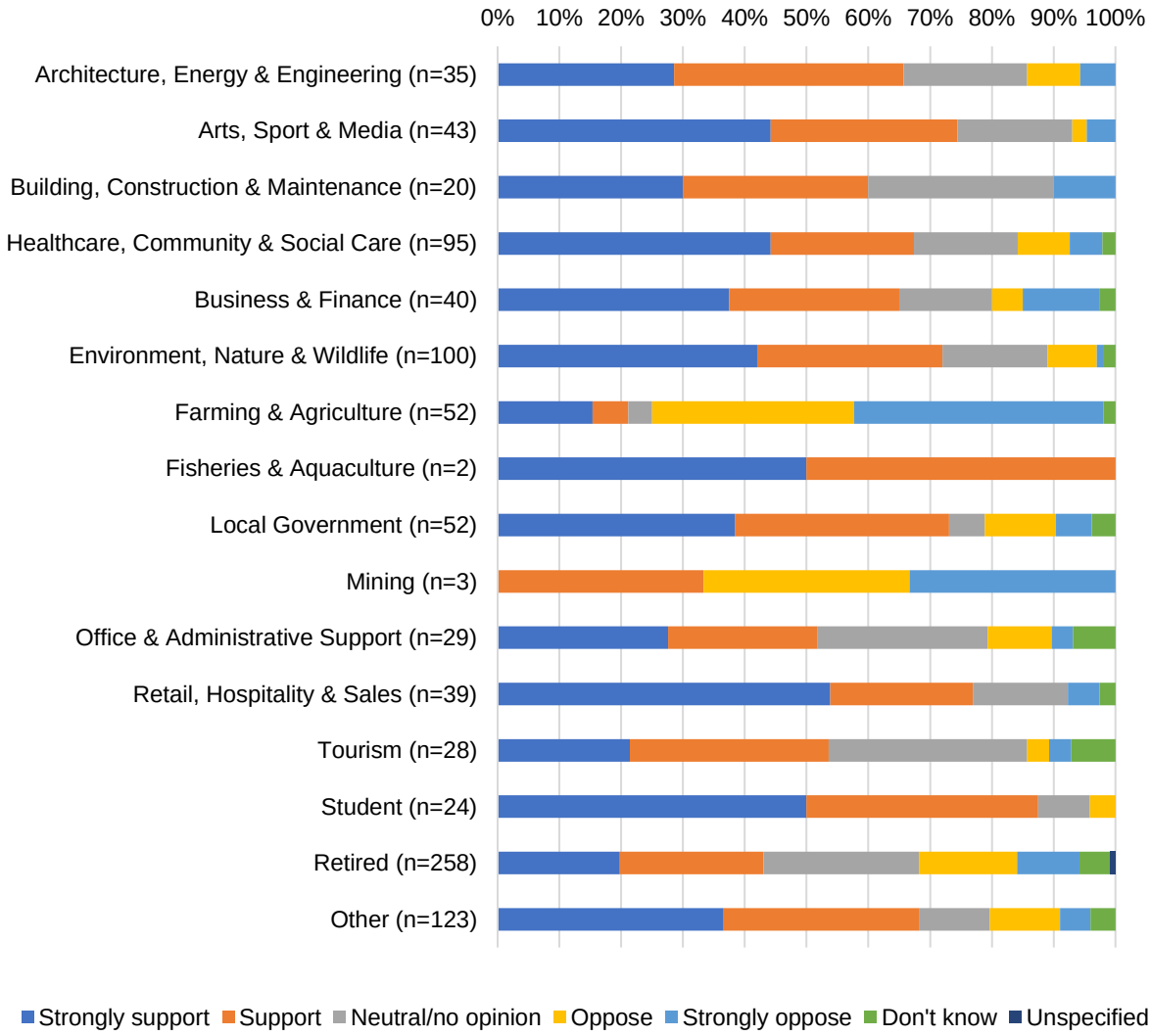
Total level of support

Overall, 59.07% of respondents took a position of support (32.45% strongly support, and 26.62% support). 19.51% of respondents took a position of opposition (8.27% strongly oppose, and 11.24% oppose). 17.92% indicated they were neutral or had no opinion, 3.29% did not know, and 0.21% did not specify an answer.

Level of support by occupation

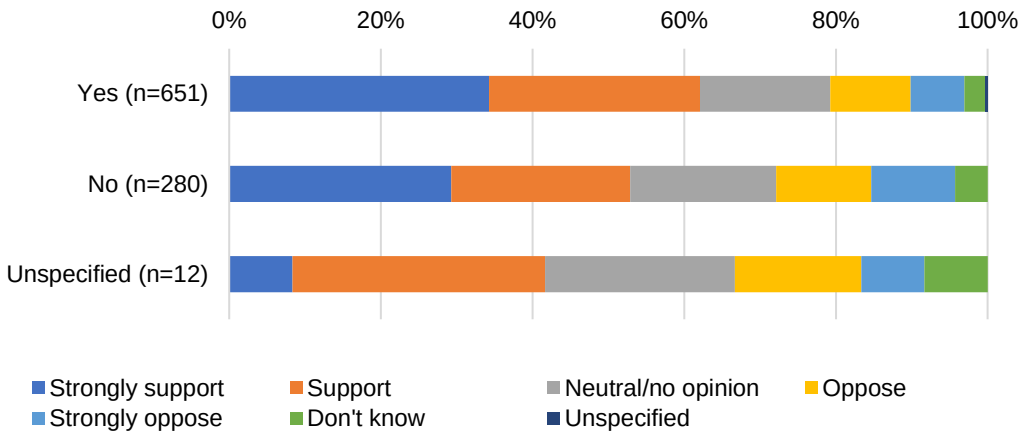
The following graph breaks down the levels of support for wild boar reintroduction by the respondents' occupational backgrounds. Levels of support for reintroduction are much more varied than for the other species. The occupational group in which fewest

participants took a position of support was Farming & Agriculture, with only 21.15% doing so and 73.08% taking a position of opposition. The occupational group in which most participants took a position of support was Retail, Hospitality & Sales, with 76.92% doing so, and 5.13% taking a position of opposition.



Level of support by whether participants are involved in nature-based activities

The following graph breaks down the level of support for wild boar reintroduction by whether respondents are involved in nature-based activities.


0%
20%
40%
60%
80%
100%
Yes (n=651)
No (n=280)
Unspecified (n=12)
Strongly support
Support
Neutral/no opinion
Oppose
Strongly oppose
Don't know
Unspecified

Reasons for support, neutrality or opposition to reintroduction

941 written responses were provided to explain respondents support, neutrality or opposition to reintroduction of wild boar into Cornwall. Participants were able to give more than one reason for their answer. The following tables summarise the reasons that were given, broken down into whether they were reasons for their support, opposition, or neutrality towards reintroduction, or for why they felt they did not know.

Reason for support	Further detail	Example quotations	Count
No reason given			208
General positivity about wildlife/nature	- Wildlife and nature seen as generally positive - Wildlife seen as good for humans - Many respondents interested in the animal itself	"As much wildlife as possible should be reintroduced" "Awesome animals, charismatic megafauna, would just really love to have boars back"	287
Native	- Moral argument that humans caused extinction - Link to Cornish heritage	"They are part of our natural heritage" "Moral duty to reintroduce a species wiped out by us and one that is a very important part of healthy woodland ecosystems."	89
Positive for ecosystem restoration	- Improve biodiversity - Improve woodland habitats - Improve soil turnover - Grazing - Bracken destroyers - Good for rewilding degraded land - Reverse human activities/impact - Increase habitat 'value'		165

Reason for support	Further detail	Example quotations	Count
Mammal is harmless/would have no impact	- 'harmless woodland inhabitants'		4
Reintroduction supported with consideration/ management/ caution	- Must be managed introduction due to them being dangerous - Can cause 'issues' - May overpopulate so need predators - Aggressive/violent, including when have young - Concern over ways in which their populations will need to be controlled	"This is a trickier one because this species can be quite destructive and can also breed quickly. Ideally they should be returned as part of a healthy ecosystem but ideally need predators to control numbers and prevent too much damage to woodlands etc"	38
Ecotourism	- Ecotourism benefits - Could be 'hunting revenue'	"Imagine having a mammal that big back. Dream for tourism. Nature'd be happy to have em back. Restores a sorely missing piece. Would be amazing to have. Rooting in the ground from these guys exposes bare soil for trees to grow."	6
Already spotted in Cornwall		"I've already seen them in Cardinham woods"	4
Potential food source	- Seen as a way to control population/manage	"Ultimately they'd be nice to eat"	9
Potential pest control		"Cornwall is over run with slugs, bore would really help farmers with these pests without using damaging chemicals"	1
Seen elsewhere with positive impacts	- Forest of Dean; Wye Valley; Knepp Estate; Poland; Sussex; France - Positive	"Seen a family of boar with there in young the forest of Dean. Which was amazing. The wider and more diverse our habitats are the stronger and healthier they become."	17

Reason for neutrality or no opinion	Further detail	Example quotations	Count
No reason given			77
Lack of knowledge/ information on mammals/impacts	- Unsure over impacts such as coexistence with humans, impact on environment, how to manage	"I don't know enough about the impact of wild boar on other species and habitats"	36
Aggressive/ dangerous	- Concerns over impact on humans - Concerns over impact on other animals - Anecdotal evidence of other attacks on animals	"Large, can be aggressive creatures" "They can be dangerous so would need to be carefully managed"	29
Lack of available habitat	- Lack of woodland in Cornwall - Woodland not large or secluded enough	"Unsure on this - I believe they could have benefits but the landscape is now highly different"	27
Difficulty managing elsewhere	- Forest of Dean example - Cannot be contained elsewhere	"I am more cautious in my response - a larger species that would be harder to manage and I have seen bad press of these being a nuisance in other parts of the UK"	8
Unsure if feasible	- No reason given as to why	"I"m not sure if this is feasible or desirable."	1
Mammal would need to be managed/contained, which would prove difficult	- No apex predator - Difficult to contain within their areas	"Difficult to keep within their dedicated areas" "How will you control numbers as no natural predators"	11
Wouldn't be welcomed by residents of Cornwall	- Farmers (due to crops being destroyed) - General public	"I have seen wild boar overseas and I think I would support a reintroduction, but I don't know enough about any potential negative consequences. My understanding is that a reintroduction is likely to be successful, but there may be concerns from the public"	3
Destructive to habitats/ other environments	- Damage to agricultural areas, urban areas, residential areas - Linked to other examples (Forest of Dean)	"I love the idea of wild boar in the countryside but am aware that there are issues concerning damage to farmland and verges. We do not have much forest in Cornwall and I am not sure if we can provide good habitat."	17

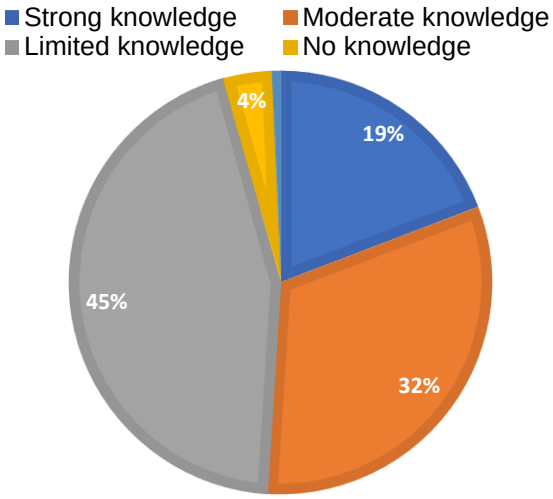
Reason for neutrality or no opinion	Further detail	Example quotations	Count
Can't see any benefit to mammal		"Boar are a lovely native species, and reintroduction could be great, but I don't know what benefits they bring to woodlands. These woodlands are often over-grazed by deer already."	3
Concerns over safety of mammal	- Linked to lack of space for mammal	"Unsure about the effect on a crowded county with regard for the welfare of humans and animal."	3

Reason for opposition	Further detail	Example quotations	Count
No reason given			25
Mammal multiplies quickly/ cannot be contained easily (or would have to be culled)	- Breed rapidly - Cannot be contained in spaces - Lack of apex predator	"Impossible to contain" "Without an apex predator to control them, I would expect the population to have the potential to explode"	196
Lack of habitat available for mammal	- Concerns over damaging other habitats/ being dangerous to humans - Insufficient woodland habitat in Cornwall	"There are not enough really large habitats available for them, where they will not come into conflict with people"	204
Mammal is dangerous/aggressive to humans and animals	- Dangerous/threat to humans and domesticated animals (particularly during mating season/ when protecting young) - Spread disease (swine flu, foot and mouth, hep E) - Haven't been around for a long time - Illegal to release them into the wild	"They can cause serious damage and I believe can be dangerous. They have seriously damaged farmland and breed prolifically. I believe they also carry diseases. They haven't been here for 600 years and we haven't missed them."	205

Reason for opposition	Further detail	Example quotations	Count
Destructive to habitats/ other environments	- Damage to habitats/environments (including those that are not the intended space for the mammal) - Damage to crops - Damage to woodland - Damage to wildlife - Damage to gardens, public spaces - 'Pest' - Damage to livelihoods (farming) - Damage without benefits	"Destruction of crops, particularly Maize Potatoes etc. Disease risk to Pig producers. Impacts on ground nesting birds e.g., Grey Partridge" "Can be very damaging to habitats" "Take over and damage football pitches and village greens"	121
Mammal has caused destruction elsewhere	- New forest - Forest of Dean - France - North Devon - Spain - Poland - Linked to being unable to control population, aggression, destructive nature	"Look at the problems in the New Forest and Forest of Dean."	13
Other priorities should be considered first	- Put money elsewhere	"Rather council tax spent looking after people in need"	1
Mammal already exists in Cornwall	- Linked to lack of space	"We already have boar that have escaped. Not sufficient habitat or space to allow them to thrive without causing issues for landowners and habitats"	3
Concerns over safety of mammal	- Would need to be hunted - Might be vulnerable to attacks from other animals	"I would like to say support but I have concerns regarding conflict in other areas. They are also vulnerable to disturbance/mauling by offlead dogs"	2

8.2.8. Wildcat

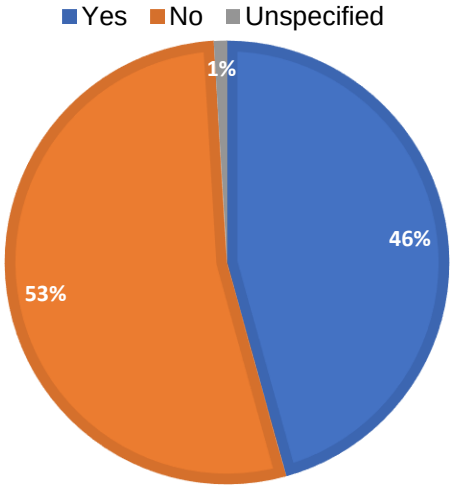
Familiarity with species



19.19% of respondents reported they had a strong knowledge of wildcats prior to the questionnaire, and 31.81% reported they had a moderate knowledge of the species. 44.64% reported having limited knowledge, and 3.71% reported having no knowledge of the species. 0.64% of respondents did not specify an answer.

Awareness of species' historical presence in Cornwall

45.71% of respondents reported being aware that wildcats used to be present in Cornwall, and 53.34% reported they were not aware of this fact. The remaining 0.95% of respondents did not specify an answer.



Level of support for reintroduction

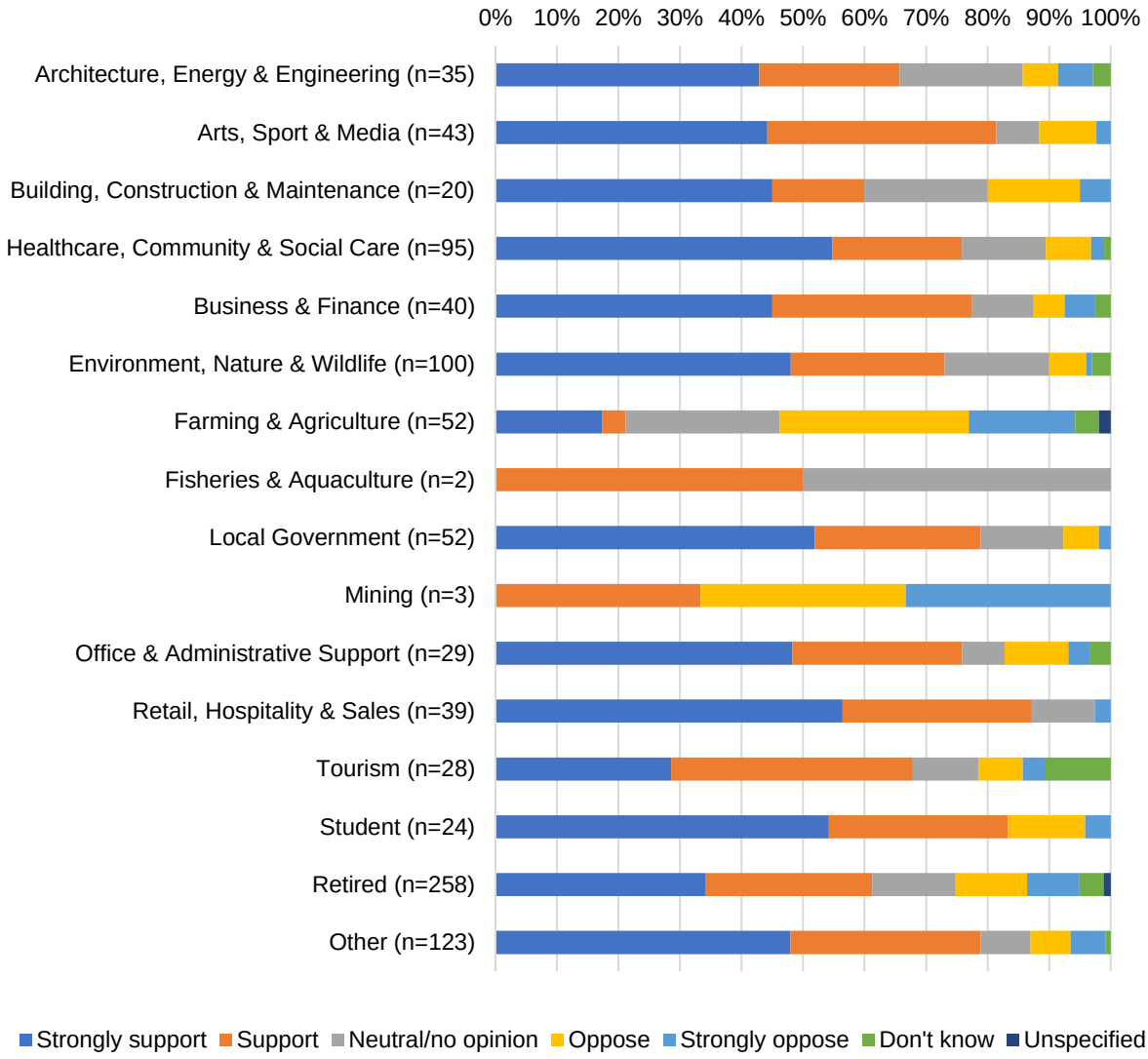
Total level of support

Overall, 68.93% of respondents took a position of support (42.52% strongly support, and 26.41% support). 15.16% of respondents took a position of opposition (5.62% strongly oppose, and 9.54% oppose). 13.04% indicated they were neutral or had no opinion, 2.44% did not know, and 0.42% did not specify an answer.

Level of support by occupation

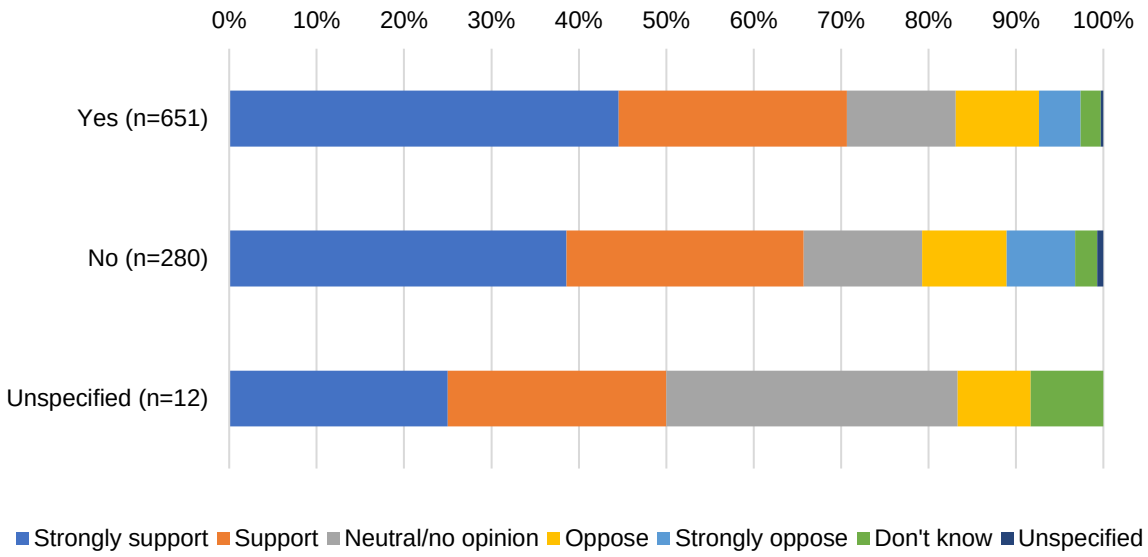
The following graph breaks down the levels of support for wildcat reintroduction by the respondents' occupational backgrounds. Similarly to wild boar, the levels of support for reintroduction are more varied than for other species, though with perhaps

marginally higher levels of support than were exhibited for wild boar. The occupational group in which fewest participants took a position of support was Farming & Agriculture, with 21.15% of respondents doing so and 48.08% taking a position of opposition. Those who indicated their occupation as Retail and Hospitality demonstrated the highest level of support, with 87.18% of respondents doing so, and 2.56% taking a position of opposition.



Level of support by whether participants are involved in nature-based activities

The following graph breaks down the level of support for wildcat reintroduction by whether respondents are involved in nature-based activities.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60%
70%
80%
90%
100%
Yes (n=651)
No (n=280)
Unspecified (n=12)
Strongly support
Support
Neutral/no opinion
Oppose
Strongly oppose
Don't know
Unspecified

Reasons for support, neutrality or opposition to reintroduction

681 written responses were provided to explain respondents support, neutrality or opposition to reintroduction of wildcats into Cornwall. Participants were able to give more than one reason for their answer. The following tables summarise the reasons that were given, broken down into whether they were reasons for their support, opposition, or neutrality towards reintroduction, or for why they felt they did not know.

Reason for support	Further detail	Example quotations	Count
General comment of support	- Wildlife is important - Affection towards wildcats - Iconic species - General support of rewilding	"As much wildlife as possible should be reintroduced" "Really cool animals, charismatic, ecosystem niche" "I just like them and would love to see them roaming the moors of Cornwall" "Be nice to see this natural species return to our county!"	55
Native species	- Heritage	"I would love to see more native species within Cornwall" "We should not lose our native species where it is possible to retain them"	80
Knowledge of successful reintroduction	- Scotland	"The introduction of wild cats in Scotland has been a success to date"	1
Ecosystem restoration	- Biodiversity - Improve food chain - Improving ecosystem balance - Natural predators - Spread seeds	"They are part of a healthy wildlife habitat which works in balance with the rest of the ecosystem. Recreating this equilibrium is vital to the planet, wildlife, and to us humans." "Natural member of ecosystem - and crossbred descendants still found in more remote areas."	96
No harm	- Elusive	"I can't see that they would cause any harm, I imagine that they will be secretive and keep to themselves"	9

Reason for support	Further detail	Example quotations	Count
		"Completely harmless and extremely elusive. Very rarely likely to be encountered my humans."	
Suitable habitat	- Enough room to not impact domestic animal populations - Rural county - Moors, clay pits	"I think there is enough room in rural areas to be able to reintroduce wildcats safely with minimal impact on domestic / farm cat populations." "The geography of Cornwall lends itself to the effective control of feral cats"	26
Endangered species	- Most kinds of wild cats are globally threatened - Protect genetic diversity	"They need all the help they can get" "Completely harmless and extremely elusive. Very rarely likely to be encountered my humans."	23
'Domestic cats are the problem'		"Domestic cats are the problem. wild ones are part of the solution"	1
Predators / Control of populations other species	- Pests - Rodents - Would benefit from an apex predator - Keeping other populations healthy - Land management	"They would be a natural means of pest control." "Adds another predator into the space occupied by fox, buzzard and feral cats. Balancing the pressure between these species will prevent undue dominance by any one"	88
Ethics / responsibility	- Hunted to extinction - Reverse negative human impacts	"Cornwall should be as nature intended before humans messed with it." "Any animal hunted to extinction in an area should have every right to return no matter what the issues, this world is theirs just as much as ours" "They were native and only went locally extinct because of human impact. We have a responsibility to reverse our negative effects on the world."	14

Reason for support	Further detail	Example quotations	Count
Good to have in Cornwall	- Already present (Fowey River Valley)	"Cornwall needs wildness" "They look amazing, it would be great to have them in Cornwall"	4
Outreach / tourism	- Ecotourism - Education	"I think introduction of native species would bring educational opportunities and interest to the areas they are reintroduced into"	7
Support with caution	- If enough space - If enough food - Breeding with domestic cats - Impacting bird populations - Will need a lot of support	"An iconic species but one which requires lots of wild land to support it. It will require extensive rewilding in the county which I"m all for bit which has financial and cultural implications" "I would support but only very cautiously. Any programme would be expensive and possibly detrimental to some mammals and birds. There is also the possibility that they may interbreed with resident domestic cats which would defeat the object of the program"	35

Reason for neutrality or no opinion	Further detail	Example quotations	Count
Uncertainty / lack of knowledge	- No knowledge of pros and cons - Unsure of environmental impact - Unsure of potential risks - Unsure if a population could persist - Unsure of benefit - If good for ecosystem	"I'd need to understand the environmental impact of their reintroduction and how dangerous they are. What would happen to the populations of birds and mammals they feed on. Would they help with vermin control, or reduce the populations of birds." "If it were easy to do successfully I would be all for it but I don't know enough about their benefits and their suitability	35

Reason for neutrality or no opinion	Further detail	Example quotations	Count
		to a county with so little wilderness. I have doubts a sustainable population could persist in Cornwall's current wild areas."	
Already too many domestic / feral cats	- Address the number of cats first - Impossible to prevent interbreeding/hybridisation - Too crowded - Attacking domestic cats	"We already have a domestic cat problem. Too many birds killed by domestic cats. Control of domestic cats needed first" "I understand that the main threat to the wild cat in Scotland now is cross-breeding with feral domesticated cats. I imagine there would be a similar problem if these animals were reintroduced into Cornwall."	25
Concern for prey	- Impacts on small mammals - Birds, already impacted - Livestock - Fox cubs	"Perhaps our small mammals already have enough survival problems" "With the prevalence of domestic cats in Cornwall/ the UK and the impact this has on birds and small mammals, I would worry about introducing a wild predator that prey on the same things. I am not sure I see the benefits of reintroducing the wild cat."	28
Too extreme			1
Not enough suitable habitat / prey	- Very shy - Needs wilderness - Not enough natural woodland - Competition for prey with feral cats - Upset balance	"I don't think there are enough natural woodlands in Cornwall to support reintroduction" "Marginal impact on ecosystem. However, hasn't been present in Cornwall for a long time, so likely to upset balance of established habitat.	8
Already present	- In Cornwall - In Scotland	"We already have big cats in Cornwall"	2
Depends on management	- Careful consideration - Collaborate with farmers	"It would depend on how well the Wildcat population could be managed"	2

Reason for neutrality or no opinion	Further detail	Example quotations	Count
		"A hard call, as wild cats are picturesque (if you happen to see one) and it would be nice to say that they are in Cornwall. But very careful thought and research are needed, eg how far they range in pursuit of prey, what kind of threat to lambs. The views of farmers are crucial in deciding IF as well as where cats might be introduced. The cats would need to be assured of a livelihood without compromising other species. They are NOT pussy-cats!"	
Cause of extinction	- Caused by humans - Depends on cause of extinction	"I believe they were persecuted and killed by man, and/or left due to loss of habitat."	2
No harm	- Feral cats cause few problems	"I can only assume this species would be very similar to feral cats and they cause very little problems in Cornwall."	1
Favour another species that would be more successful		"I do not have the knowledge to make an informed choice but I understand conservation of the species is difficult. Perhaps it is better to use hard-pressed funds for another species that may have more success."	1
Neutral		"I am neutral"	1

Reason for opposition	Further detail	Example quotations	Count
Risk to other animals	- Domestic cats - Prey e.g., birds, small mammals - Endangered birds - Competition for food with birds of prey - Livestock - Upset balance	"Our bird populations need protection not more predators, they do not bring any benefits to our countryside and there are enough cats around as it is!" "I believe they could threaten other mammalian species - including re-introduced red squirrels, as well as birds and	59

Reason for opposition	Further detail	Example quotations	Count
		other wildlife. They may also threaten domestic pets and farm livestock such as lambs." "Birds and small mammals are already under threat from domestic and feral cats. Introduction of a wild species would be foolhardy."	
Ecosystem has changed too much	- Habitat loss - Domestic cats - Loss of prey - Would end up in urban areas - Not enough space - County too crowded - Would suffer - Conflict	"They are predators and require lots of space, once again does Cornwall have it? The way Houses are being built any suitable land is getting smaller?" "I don't think it will benefit the UK population which is low. They need big wild areas and are shy. I don't think we have the habitat they require. I don't think it will benefit wild cats."	17
Dangerous	- Wildlife - Humans - Pets - Fear - Conflict with farmers and game keepers	"These animals can be dangerous for small domestic pets - and young children." "Aggressive, called a man killer until the sixties when no doubt the numbers were so low as to make them less of a problem."	12
Domestic/feral cats	- Breeding with domestic / feral cats - Would not be sustainable - Interbreeding after Scottish reintroduction - Already too many cats - Domestic/feral cats have replaced wildcats	"The dangers of interbreeding with domestic or feral cats is the reason I am opposed to this. Populations in Scotland are still so fragile I feel efforts would be better concentrated there" "We now have too many domestic cats, which aside from causing their own ecological disaster, would make maintaining a healthy population of pure wildcats, pretty much impossible."	35

Reason for opposition	Further detail	Example quotations	Count
Waste of time and money **No advantage**	- Better spent on social issues - Focus on remaining populations in Scotland - Negativity	"Rather council tax spent on people in need" "It will be a waste of time and money" "I don't see what wider advantage there may be in its reintroduction. I can see that there might be a lot of negativity which might impact on people's views on nature conservation, and reintroduction, in Cornwall."	6
Interfering with nature		"Interfering with nature"	1
Might be persecuted / hunted	- Seen as a threat by people	"I love cats, they would suffer so so much in Cornwall, far too much traffic, far too many dogs. I would HATE to see them targeted. People I know are already horrible towards feral cats. Please no." "I think they would be hunted and they would end up probably in urban areas like the foxes"	3
Dislike of cats		"I don't like cats"	2

8.2.9. Conclusions – Public Survey

On participants and backgrounds

The public survey received a good level of response (N = 943). Except for two occupational groups, there were at least 20 respondents who identified with each of the occupational backgrounds. It is unfortunate however that there was a minimal response from individuals with a background in 'Fisheries & Aquaculture', with only 2 respondents. Whilst proposed projects will need to engage with publics and stakeholders generally, further outreach is needed to specifically understand the views from the Fisheries and Aquaculture sector, particularly for water-based species such as the beaver, where studies elsewhere indicate that diverse views exist within this group.

On levels of knowledge and awareness of historical species in Cornwall

It appears that respondents were more familiar with water vole, red squirrel and beaver than the other species being reviewed, and that a higher number of respondents were aware that they used to be in Cornwall. Perhaps this is linked to the fact that water vole and red squirrels went extinct in Cornwall more recently than the others (within the living memory of some of the older participants) and are currently still present elsewhere in the UK. For beaver, there has arguably been much more in the way of awareness raising and press attention on this species recently as their reintroduction has been taking place throughout Britain – and there are now four beaver enclosures in Cornwall.

There appeared to be less familiarity with pine marten, wild boar, and wildcat, and fewer people were aware these species used to be in Cornwall. If reintroductions of these species are proposed, perhaps this is indicative that projects may first need to invest further in familiarising the public with the species and their historical presence in the area, which may subsequently help to build support for a project or help people and practitioners understand what living with these species may entail.

On levels of support for reintroduction

Among the respondent pool, there were very high levels of support for reintroductions of the red squirrel and the water vole, which held true across participants of all occupational groups. This is indicative that reintroductions of these species are likely to be socially acceptable in Cornwall.

Levels of support for reintroduction of the Eurasian beaver were reasonably high, and consistent with figures reported in studies elsewhere across Great Britain in the past three decades, which have generally ranged between 63 and 93%. However, it is notable that respondents who identified their occupation as within Farming and Agriculture were much less supportive when compared to other occupational groups, exhibiting split levels of support or opposition towards beaver reintroduction.

Although still garnering reasonably high levels of support, fewer people were in favour of the reintroduction of pine marten. This was similar for the wildcat, although levels of support were a little lower again.

Whilst as a total respondent pool there was still a majority in favour of wild boar reintroduction, this was the species which exhibited the most diversity in opinion, with variance in levels of support between occupational groups. In particular, reintroduction of this species was opposed by over twice as many as took a position of support among the Farming & Agriculture group.

Therefore, if a project is proposed for beavers, pine marten or wild boar, then our findings suggest that higher investment in understanding concerns and consideration of any management implications thereof will be required, particularly within the Farming & Agriculture group.

8.3. Stakeholder Survey and Workshop

Understanding stakeholder perspectives is key to reintroduction programmes, as their views will help to inform ways of garnering support for reintroductions, highlight areas where conflict could arise, and indicate where education might be needed to prevent the spread of misinformation.

Targeted surveys were conducted with stakeholders such as farmers, landowners and conservationists in which they were asked to provide reasons as to why they were either for, neutral, or against the reintroduction of each reviewed species. They could also provide clarification if they felt they didn't know enough regarding the species in question. Responses for each mammal are presented in the below tables.

Additionally, an in-person workshop was held with 45 representatives from various stakeholder organisations, including farmers, landowners, representatives of environmental groups, and others. During the workshop views were sought on what management factors they thought should apply to each species. They also discussed the ways in which they would like to be engaged as part of a reintroduction project. Tables summarising the principles of engagement are not separated for each species, as the responses are relevant for all reintroductions. The tables are therefore presented after all of the individual species tables (see Section 8.3.7).

8.3.1. Beaver

The following tables presents the opinions of stakeholders who responded to the survey. These are independent opinions and are not meant to represent the views of the report authors or Cornwall Council.

Reasons for support, neutrality or opposition to reintroduction

Reason for support	Further detail	Example quotations
Ecosystem service benefits	- Resilience to drought and wildfire - Flood reduction (in flashy catchments; in the right place; reduced flow rates; natural flood management; flooding is a problem in Cornwall) - Improved water quality (reduce silt; filtration; filtering of toxic chemicals from farming) - Carbon storage - (Eco)Tourism potential - Reduced soil erosion - Provision of habitats - Resilience to climate change (drought and flood resilience)	"Beaver dam complexes also filter water, reduce silt and water flow that can reduce the impacts of flooding downstream. Also potentially sequester carbon."
General comment of support		"More beavers please!"
Beavers are already in Cornwall		"I have four beavers on my farm already. They're wonderful."
Native species		"As a past native, probably wiped out by man, there is no reason that they should not be re-introduced."

Restoration of nature	- "Ecosystem engineer" or "Keystone species" - Fundamental to a healthy ecosystem - Restoration of natural river function - Creation of habitats (increasing biodiversity)	"Beaver are a cornerstone species in the landscape which create conditions suitable for other species to thrive"
Public engagement	- In nature recovery agenda	"Engagement & eco-tourism potential & benefits."
Seen benefits of beavers elsewhere		"Beaver activity increases biodiversity where they live. I have been to Canada many times and seen the incredible habitats they produce there."
Sense of ethical motivation	- Sense that they 'belong'	"As with all my answers, they belong here. I would love to see them back and I think our countryside needs them."
Outstanding issues	- Is there enough habitat? - Ability for management	"I think they could have a very positive place but could have a serious unintended impact so as with all these species there has to be a built-in ability to control numbers if become excessive or in the wrong place."

Reason for neutrality or no opinion	Further detail	Example quotations
Need more information	- On the relationship with existing native species - On habitat suitability	"Need to know more about how the[y] fit in with our existing native species."
Not bothered		"Will not bother me"
Reintroduction is unnecessary		"The species has been extinct in Cornwall and reintroducing seems unnecessary. That said, limited introduction (well monitored) does not suggest a problem."
Will require management	- Ensure they don't overpopulate - Help ecosystem but can cause localised flooding	"They are a large mammal that will need correct management to ensure they do not overpopulate and cause widespread destruction of flora"

Supportive in enclosed areas		"Ok in enclosed areas"

Reason for opposition	Further detail	Example quotations
Environment has changed since they were last here	- Suitable habitat is limited in Cornwall - Beavers are not suitable for Cornwall	"Beavers have been extinct in this country for 400 years. I feel the landscape and human population has changed so much in this time there is not room for them."
Negative impacts	- Damage or destruction - Blocking of rivers (causing flooding; impeding salmonid migration) - Observed negative impacts elsewhere (e.g., in Europe) - River users already seeing negative impacts - Riverbank damage - Tree loss (when need to plant trees) - Troublesome outside of enclosures - Impact of wetlands on food production	"Beavers are destructive to native trees and our riverbanks. Reintroduction in other parts of the EU has led to mile wide swamps, with dead trees and mosquitoes."
Beavers are controversial		"Beavers are a highly controversial species. Whilst providing benefits in the right place they can also dramatically alter the landscape of previously carefully managed land"
No evidence of the need		"No evidence of need."
Other controllable solutions are available	- For flood management	"If main reason for reintroduction is creation of wet habitat i.e., random dams, then other less conflicting and more controllable solutions available which could help with energy and flood management"
Sceptical of the motivation		"I would question what the true motive is behind reintroducing some species such as beavers."

Management factors to consider

Stakeholders were asked what management issues would need to be considered if beaver reintroduction was to take place in Cornwall. The following table summarises the management issues that were raised in their responses.

Management Factor	Further detail	Example quotations
Need the ability to manage negative impacts	- Availability of funding - Implications of legal protection - Have the will to manage negative impacts - Need support for landowners	"They will certainly become a nuisance in some locations and circumstances. But provided we are prepared to manage this, there is no reason not to introduce them."
Compensation	- For damages - For setting land aside for conservation	"Seriously, this would need tens or hundreds of millions a year to compensate for the damage it would cause to others' property - both direct and indirect damage."
Disease risk	- Liver fluke - TB	"There are also concerns about liver fluke as a consequence of wetter ground and the potential for the beaver to spread bTB . Control measures must be maintained."
Negative ecological impacts	- Impeded salmonid migration. - Damage to woodlands - Tree damage - Waterlogged areas (can cause greenhouse gas emissions) - 'Alien species'	"Cornwall salmonid rivers are not the same as slow moving flatland rivers such as the tamar. They rely on spared to flush debris and encourage migration of salmonid. Beavers introduce blockages into the system and cause widespread damage to trees."
Education	- To address concerns (e.g., landowner or farmer concerns) - To dispel myths - To respond to negative perceptions	"Needs a programme to raise awareness and dispel myths."
Habitat suitability	- Need wild space - Need corridors	"Ensure adequate space and right sized trees"

Management Factor	Further detail	Example quotations
	- Availability of trees - Habitat protection - Not all watercourses are suitable due to land use	
Interaction between beavers and land use or infrastructure	- Impacts on heritage sites - Compulsory 20m buffer zone (to reduce conflicts with beavers) - Culvert blockage - Localised flooding of agricultural land - Localised flooding of roads, building, and other infrastructure - Burrowing activity - Crop grazing	"Needs to be managed well so that localised dams do not flood agricultural land, roads, buildings etc. Landowners should be paid to have beavers on their land as they are beneficial in so many ways."
Issues are already well known	- Management techniques are available	"Beavers can cause flooding in the wrong place, for example if they flood a culvert or road. This is easily mitigated, check out the beaver trust. They have loads of brilliant ways to prevent beaver human conflict."
No management required	- Self-regulating - Already breeding - No significant issues observed in trials	"No management at present as they seem too be out and breeding already ..we do not need more let out"
Population management and control	- Beavers have no natural predators in Cornwall - Including lethal control (with robust cull management; with detailed population growth statistics; as part of initial plan to prevent conflict escalation from perception) - Population control by translocation (away from conflict sites). - Deter establishment in particular locations.	"Controlling numbers and the effect of uncontrolled numbers on streams, rivers and other animals."
Protection for beavers	- From persecution	"Firstly, it should be made illegal to harm beavers. I can see a few farmers reaching for the shotgun!
Don't know		"Not enough knowledge"

Management Factor	Further detail	Example quotations
Stakeholder engagement	- Robust liaison with landowners - Expectation management of those opposed to beaver reintroduction - Recognition of perceptions	“No management at present as they seem too be out and breeding already ...we do not need more let out”
Release locations	- Agreement of local landowners - Consult neighbours - In suitable enclosures (to restrict negative impacts)	“Areas of release need to be carefully considered due to conflict but good understanding amongst the poplace will increase tolerence and acceptance. People are afraid of what they don't understand”
Won’t last		“They wouldnt last”

8.3.2. Pine marten

The following tables presents the opinions of stakeholders who responded to the survey. These are independent opinions and are not meant to represent the views of the report authors or Cornwall Council.

Reasons for support, neutrality or opposition to reintroduction

Reason for support	Further detail	Example quotations
General comment of support		"Would be nice to see reintroduced"
Potential role in grey squirrel control	- Grey squirrels are non-native - Pine Marten prey on grey squirrel - Pine Marten help to suppress grey squirrel numbers - Supportive of woodland regeneration (by reducing negative impacts from grey squirrel) - Supportive of red squirrel reintroduction (reduced grey squirrels reduces competition; help reds establish; cost effective approach to long-term grey squirrel management)	"In addition to being a former native pine martens may have ecological benefits in controlling grey squirrel numbers, thereby reducing damage caused to woodland regeneration and also allowing red squirrel populations to survive and grow."
Role in ecosystem restoration	- Restore natural balance - Part of the ecosystem - Natural population control of other species [excluding grey squirrel] (predator-prey interactions; regulate small mammal populations) - Contribute towards biodiversity increase	"Pine Martin's help support and manage wildlife and control small rodents"
There are good opportunities for pine marten reintroduction	- Pine martens were only lost from Cornwall recently - There have been recent sightings in Cornwall - Will be supported by woodland creation projects	"Pine marten are already back in Cornwall with several records from recent years."
Native species		"As a past native there is no reason why it should not be here."

Reason for support	Further detail	Example quotations
Few or no negatives	- No significant impact on environment - Unlikely to have impacts on designated sites	"They used to be here and could fit into the countryside here without causing problems"
Public engagement opportunities	- Engagement in nature recovery agenda	"The re-introduction of an iconic native mammal fits well the Nature Recovery agenda. The re-introduction would be a great opportunity for public engagement around the agenda."
Iconic Species	- Iconic - Charismatic - Attractive to people (opportunity for local tourism)	"They are also attractive to people and would have good tourist value"
Sense of ethical motivation	- Sense they belong - Should not have been allowed to die out	"They should never have been allowed to die out"
Outstanding issues	- Is there enough suitable habitat? - Effects of predation on vulnerable species?	"I would be concerned about the predation on its food species, which are also struggling in a great many places."

Reason for neutrality or no opinion	Further detail	Example quotations
Lack of knowledge		"Not enough knowledge to have an informed opinion"
Risk to other species		"They will prey on species that are already in decline and struggling to hold on in a human overpopulated area"
Questions and uncertainties	- What is impact on other species? - Unsure if there is sufficient habitat - Unsure of the benefits of reintroduction	"Not sure on the impact on other species. Do they eat birds eggs?"
There are higher conservation priorities		"I think there are higher conservation priorities."
Balance between reason for and against reintroduction	- May predate small mammals or bird but help control grey squirrels	"Pine martens could help to control grey squirrels, but do our other mammals and birds need another predator on top of domestic cats?"

Reason for opposition	Further detail	Example quotations
Predation of vulnerable species	- Threat to other species that are already threatened - Threat to small mammals (e.g., dormice, baby hedgehogs) - Threat to birds (e.g., ground nesting birds, woodland birds) - Wildlife already threatened by domestic cats - Net negative impact on other species	"Woodland bird species are already in steep decline here. Numbers need to recover before another predator is brought back."
Risk to farming	- Threat to poultry/chickens	"Will terrorise chickens"
Landscape has changed over time	- Less wild habitat available than when they were last here	"The landscape in Cornwall is thinner than 150 years ago"
Higher priorities for wildlife conservation		"Money is better spent on preventing destruction of what we already have."
Greater understanding of impacts needed		"We need to have a better understanding of the benefits and challenges of re-introducing this mammal back into Cornwall landscape when it has been absent for so long."
Not a native species		"Not a native species"

Reason for 'Don't know'	Further detail	Example quotations
Uncertainties	- Impact on field grown vegetables. - Is there sufficient habitat?	"I would be concerned that they might be a pest to field grown veg?"

Management factors to consider

Stakeholders were asked what management issues would need to be considered if pine marten reintroduction was to take place in Cornwall. The following table summarises the management issues that were raised in their responses.

Management Factor	Further detail	Example quotations
Habitat suitability	- Connectivity - Dispersal - Availability of woodlands (woodland restoration) - Large areas needed - Prey availability	"They need large amounts of woodland as a habitat so their reintroduction would be limited to places in Cornwall that have thousands not hundreds of acres of woods."
Impacts on agriculture and game-shooting	- Availability of compensation for damages - Disease risk (risk of bovine Tb) - Need ability for lethal control if there are negative impacts - Protection of poultry and game birds (engagement with stakeholders; pine marten-proof fencing or coops)	"Pheasant coops, hen houses etc would need to be made marten proof"
Predation of vulnerable species	- Impacts on birdlife (select habitats to minimise impact; locate where there are healthy bird populations) - Protect SSSI bat roosts - Could lead to food shortage for other species	"They are predators, we must be certain they do not prey on already vulnerable prey species"
Public engagement	- Address misunderstandings - Education and awareness (e.g., familiarise with animal; understand the role of predators) - Respond to negative attitudes towards pine marten (e.g., engagement for sensible resolutions)	"Pine martens were made extinct due to them eating game birds and potentially poultry. Education on the benefits of restoring predators to our eco-system would need to occur. Stakeholder negotiations to come to sensible practical resolutions"
Predator control already limited for apex predators		"Too many apex predators already with little/nothing to control them"

Management Factor	Further detail	Example quotations
Population monitoring	- Cull to manage numbers if they are successful - Population stability (dispersal from other growing populations)	"Numbers must be monitored closely"
Protection from persecution	- Enforcement of legal protection	"Persecution from humans who aren't [knowledgeable about] the species"
Disturbance from dogs		"Create wildlife havens with minimum disturbance especially from dog walkers in suitable habitat."
Risk of road traffic incidents		"Road traffic"
Confine to remote areas		"Remote areas only"
Consideration of licensing requirements		"Consideration of licensing requirements"
No management needed	- Nature should balance numbers	"I don't believe there will be many management issues. If anything they will help manage a balanced ecosystem."
Impacts on human and wildlife health		"Human and wildlife health"
Risk to small pets		"They may prey on domestic animals such as cats, poultry, thus public education and choice of location would be important."
Unsure		"I have no idea ..."

8.3.3. Red squirrel

The following tables presents the opinions of stakeholders who responded to the survey. These are independent opinions and are not meant to represent the views of the report authors or Cornwall Council.

Reasons for support, neutrality or opposition to reintroduction

Reason for support	Further detail	Example quotations
General comment of support		"The red squirrel could be reintroduced to some of the fractious pockets of habitat now in parts of Cornwall."
Red squirrels are a native species (or native to Cornwall)	- Part of the natural ecosystem - Sense that the species belongs - They are adapted to the local environment	"The red squirrel is a native UK species once widely distributed throughout. It is well adapted to the climate, and other native species."
To conserve a threatened species	- Disappeared following appearance of grey squirrels	"When I came to Cornwall in 1962, grey squirrels had not crossed the Tamar and there were red squirrels on my farm. Once the greys arrived, the reds vanished." "If red squirrels [aren't] helped they will be extinct within a couple of generations."
To restore the ecosystem	- Ecosystem restoration requires restoration of key species - Adds to local biodiversity - Restore natural balance	"If we are to recover nature in the UK we need to restore lost species and ecosystems"
Preference for red squirrels, rather than grey squirrels	- Reds have less negative impact on woodlands - Red squirrel reintroduction will require management of greys - Greys are non-native	"Red squirrels would be much more suited to our county than [grey], who decimate trees and nut crops."
Cornwall is a suitable location	- Suitable habitat - Complementary to other named nature projects in Cornwall - Only recently went locally extinct	"It would be wonderful to see red squirrels back in Cornwall and I think Cornwall is ideal as we are virtually an island so with careful management they could potentially thrive"

Reason for support	Further detail	Example quotations
		"Because this species was present here so recently, it is a prime candidate for reintroduction."
Projects successful elsewhere		"The red squirrel has been successfully reintroduced in several areas so it could be replicated in Cornwall"
Ecosystem Service benefits	- Tourism value - Role in woodland regeneration - Indicator species of woodland health - Help address climate change	"Red squirrels contribute [critical] ecosystem services and are a sign of a healthy woodland ecosystem."
Red squirrels have little or no negative impacts	-	"Reds do little or no harm"
Sense of ethical motivation	- Undo negative impacts of humans - Duty to look after the environment	"We have a duty to increase the bio-diversity of native species and maintain it."
Iconic species	- Attractive or beautiful	"An attractive and iconic mammal."
Opportunity for public engagement	- Joy to see	"The re-introduction would be a great opportunity for public engagement around the agenda."

Reason for neutrality or no opinion	Further detail	Example quotations
Concerns about risk of introducing diseases		"I am always worried about reintroducing wildlife species as we don't know what diseases they may bring with them."
Question effectiveness of resource use	- Resource intensive - Ongoing resource for grey squirrel control	"Nothing against the idea just think the resources required to do so will be huge"
Red squirrels have a neutral impact on the environment		"I don't believe that they either give or take away from the natural environment as it is in the present day."

Support is conditional	- On grey squirrel control - Uncomfortable with eradication of grey squirrels - On there being monitoring of impact on trees	"So long as introduction is monitored to ensure no further damage to trees etc"
The threats to red squirrels still exist		"Re-introductions shouldn't occur where the threat to populations still exists. The threat to reds still exists in many parts of Cornwall (greys). Thus I imagine re-introduced populations on the lizard would be fairly small, maybe not worth the money"

Reason for opposition	Further detail	Example quotation
Use of resources	- Expensive to reintroduce - Ongoing investment to manage greys not sustainable - Money better spent on preserving what is already present	"Reintroducing the red squirrel to Cornwall would not be sustainable. It would require constant, long-term control of Grey squirrels and therefore set an unsustainable indefinite resource requirement."
Unknown consequences	- Limited evidence of need to reintroduce or potential benefits	"No-one knows what will happen if this species is reintroduced. I have seen no evidence presented of the need for re-introduction, or actual benefits to the current landscape, other than it looks cute."

Management factors to consider

Stakeholders were asked what management issues would need to be considered if red squirrel reintroduction was to take place in Cornwall. The following table summarises the management issues that were raised in their responses.

Management Factor	Further detail	Example quotations
Grey Squirrel control	- Reduce risks of competition, or disease risk (squirrel pox) - Ongoing management - Culling or eradication required - Public may find culling controversial - Reintroduce pine martens to suppress grey squirrel numbers - Use of contraceptives to reduce numbers - Control without cruelty - Resource requirement (reported as time consuming or costly)	"An eradication strategy for grey squirrels would be needed. They [are] a non-native species that spread squirrel pox, damage trees and predate nestlings and birds' eggs. Red squirrels do not. [It] would also be helpful to reintroduce pine martens"
Habitat suitability	- Choose best sites for reintroduction - Connectivity - Restoration of woodland - Grey squirrel control may be easier on a peninsula	"Connectivity of suitable habitat."
Education for the public	- Including need for grey squirrel control	"Public education would be required, especially relating to removal of greys"
Reintroduction costs	- Cornwall is in need of a new hospital and transport links	"The cost of reduction and management of the reintroduction"
Coordination with other environmental projects		"I also strongly believe the reintroduction would work alongside rewilding projects"
Project licensing		"Consideration would need to be given to the licensing of the re-introduction"
Risks posed by predators		"Must be protected from predators"
Protection of trees		"Protection of trees"
Removal from buildings if burrowing		"Possible need to remove from buildings if burrowing (this happens in the States)"

Management Factor	Further detail	Example quotations
Persecution		“They will be [...] possibly hunted/trapped by humans”
None		“None”

8.3.4. Water vole

The following tables presents the opinions of stakeholders who responded to the survey. These are independent opinions and are not meant to represent the views of the report authors or Cornwall Council.

Reasons for support, neutrality or opposition to reintroduction

Reason for support	Further detail	Example quotations
General comment of support		"OMG - what's not to like????"
Water voles are a native species (or native to Cornwall)	- Recollections of seeing water voles in Cornwall	"I can recall seeing water voles living in this area in 1990's."
To conserve a threatened species	- Threatened by mink predation - Mink will need to be controlled - Threatened by habitat degradation - Reintroduction in Cornwall will bolster populations - European Protected Species	"With its current status within the UK reintroducing the species to Cornwall would further support its future nationally."
Water voles are a key species	- Needed to restore ecosystems - Ecosystem engineer (riverbank ecology; cycle nutrients; improve soils; improve plant diversity) - Enhance wildlife (restore natural balance; adds to biodiversity; creation of habitat mosaics; food resource for other species)	"Keystone species that provide opportunities for other species. Cycle nutrients through high levels of grazing which improves soil quality and increases plant diversity. Also provides food for other species such as barn owl, kestrel, otter, stoat, weasel"
Relationship with River/Watercourse Health	- Water voles an indicator of healthy rivers (or riparian habitat) - Water voles have a role in natural flood management - Water vole presence will encourage better river management/ improvements	"They are a fantastic indicator of healthy ecosystems and water quality"

Reason for support	Further detail	Example quotations
Water voles are an easier species to reintroduce	- Only a recent local extinction - Thought water vole were still present - Fast lifecycle aids establishment - Successfully reintroduced elsewhere	"Surely one of the easiest animals to reintroduce."
There is suitable habitat in Cornwall	- Rivers, streams, leats - Beaver activity is improving habitats for water vole - Already returned to multiple sites	"Lots of small rivers and streams so ideal"
Water voles are an iconic species	- Attractive - Literary connection	"They are iconic riverbank species with strong literary connections which would make them attractive for tourists and residents alike"
Water voles have little or no negative impacts	- Considered harmless - No issues for farmers - No obvious negatives	"Unlikely to cause problems with other species or us"
Sense of ethical motivation	- Sense that they belong in Cornwall - Should never have been allowed to die out - Only not here due to impacts of humans	"They belong here in Cornwall"
Opportunity for public engagement in nature recovery		"The re-introduction of an iconic native mammal fits well the Nature Recovery agenda. The re-introduction would be a great opportunity for public engagement around the agenda."

Reason for neutrality or no opinion	Further detail	Example quotations
Uncertainties or Questions	- Unsure of the benefits - Unsure how widespread they were - Unsure if good value for taxpayers - Has the reason for their local extinction been addressed? - Wish to know more about interaction with natural flood management approaches	"I'm not really sure how widespread they used to be in the southwest, and whether they give much real benefit to the eco system"

Reason for neutrality or no opinion	Further detail	Example quotations
Lack of need for human intervention	- Belief there is already a healthy population - Will spread naturally	"If they are successful in Bude, they'll spread without Cornwall Council's cash."
Other countries consider water vole to be a pest		"They're considered a pest in many countries"
Support is conditional		"Provided suitable habitats are identified, landowners are willing to support a re-introduction and lethal control measures are available if damage to livestock and property occurs "
Respondent only commenting on forestry-related issues		"I respond here only on forestry issues"

Reason for opposition	Further detail	Example quotations
Use of resources	- Money should be spent on what we already have - Seen no evidence of the need or benefits	"Money is better spent on preventing destruction of what we already have."
Risks	- Flood risk from damage to land drainage systems - Damage to trees	"Danger of flooding - the water vole is known to damage land drainage systems"

Management factors to consider

Stakeholders were asked what management issues would need to be considered if water vole reintroduction was to take place in Cornwall. The following table summarises the management issues that were raised in their responses.

Management Factor	Further detail	Example quotations
Habitat suitability	- Availability of habitat (including restoration) - Habitat connectivity - Complemented by beaver reintroduction (due to habitat creation) - Habitat protection - Watercourse management (reduce canalisation; water quality/pollution from sewage or agricultural run-off; catchment sensitive initiatives; river restoration) - Riparian management (removal of Himalayan balsam; remove access for cattle to the watercourse, riverbank management)	"Water quality [...] issues need to be addressed and also riverbanks protected from intensive agriculture and grazing"
Mink control	- Eradication - Suppression - Long term management	"American Mink. Would require a landscape scale approach to mink eradication for any hope of retaining water voles in the area."
Predation risk (excluding mink)	- Predation by native species - Release high numbers of water vole to be resilient to predation - Predator reduction/control	"A buzzard caught the vole we saw. Natural predation but good to support the numbers to make them more resilient to hunting."
Management processes	- Timescale of licensing procedures - Willingness to intervene if water vole are a nuisance - Availability of funding support for those who are negatively affected	"This would require a significant fund to compensate those who suffer losses as a result of the damage they will do."
Tree damage	- Ability to protect trees - Ability to reduce numbers	"Tree damage can take place so means to control numbers must be maintained"
Influence of legal protection on asset management	- Legal protection may reduce ability to manage flood risk	"Flooding due to [organisations] not willing to undertake works because water voles may live there. Look at how badger setts are protected, it can make things very awkward and counterproductive"
Public Education	- About disturbance from dogs - Respond to public perceptions of damage	"Public education about leaving water voles undisturbed by dogs, etc, would be needed."

Management Factor	Further detail	Example quotations
Disturbance	- From tourism	"Maintaining suitable habitat and peace for them especially with tourism in the summer"
Impacts on riverbanks		"Needs to be carefully located and managed, this animal can do great damage to banks and is a big problem for the Bude Canal"
Population monitoring		"Breeding monitoring"
Demonstration of the need for water voles		"Demonstrate a need for this first thank you."
None required	- No management necessary - Native predators will keep numbers in check - Pine marten and wildcat would cap numbers	"Don't think [population management is] necessary as other wildlife would manage them"
Don't know		"Not knowledgeable on this"

8.3.5. Wild boar

The following tables presents the opinions of stakeholders who responded to the survey. These are independent opinions and are not meant to represent the views of the report authors or Cornwall Council.

Reasons for support, neutrality or opposition to reintroduction

Reason for support	Further detail	Example quotations
'Keystone species' or 'Ecosystem Engineers'	- Soil turnover (soil aeration; seed dispersal; increase plant diversity; nutrient cycling) - Scrub clearance (opening up habitats) - Create niches for regeneration - Habitat creation through disturbance - Habitat management and improvement - Improves biodiversity - Part of woodland ecology	"Wild boar root around and turn over soli, which allows seeds to germinate."
Educational opportunity	- Public engagement in nature recovery - Engage young people	"Larger mammal reintroduction and rewilding projects offer large benefits for educational opportunities - If education around these programmes happen - generations to come are likely to inherit them and protect them."
Economic benefit through hunting		"Potential economic benefits via hunting opportunities...?"
Benefits seen elsewhere		"It seems on balance they do more support than good. I have good friends who live in the Forest of Dean and they are mainly favourable to them apart from when they invade their garden!"
General comment of support	- Support for 'rewilding'	"I'd love to see these majestic animals return to Cornwall"
Positive on balance	- Can cause some issues	"Can cause damage to farmland though so would need to be managed carefully. On balance a positive though."

Sense of ethical motivation		"This species belongs in the landscape."
Start Trial to identify management issues		"There is an urgent need to start trials that would identify any management issues that are specific to Cornwall"

Reason for neutrality or no opinion	Further detail	Example quotations
Balance between reason for support and potential conflicts		"In principle, yes should be here, but from seeing the level of impact in Forest of Dean (a much more boar accommodating landscape than Cornwall) they would cause conflict. Perhaps Cornwall is too tame a landscape for them - better in full on rewilding"
Can be problems	- Damage is unlikely to be publicly acceptable - More problems than benefits - Problematic species	"During the 1980s I farmed up to 450 wild boar. We were careful none escaped, as they can cause a lot of damage. I would be cautious about re-introduction but, as with beavers, they will probably arrive here soon anyway"
Difficult in the Cornish landscape	- Not enough space - Reproduce quickly - Suspect there is little support for reintroduction	"Difficult to support this one in a landscape like Cornwalls. Would love to see them here but not enough space for them, they multiply very quickly without any predators and cause a lot of damage which would likely not be tolerated by … farmers"
Don't know enough		"More information to make a decision, specifically on impacts on landscape and local businesses"

Supportive only in a few areas		"Only in a few areas such as Bodmin moor"

Reason for opposition	Further detail	Example quotations
Boar are dangerous	- Aggressive or vicious - Dangerous when young - Dangerous when with young - Risk to people (especially children) - Risk to dogs - Risk to livestock - Would affect access to land (and not help rural tourism)	"Public safety - boar are omnivores and can attack humans and are no respecters of boundary fences"
Damage to land, gardens and agriculture	- Crop damage - Damage to lawns or pasture - Damage to earthworks and archaeology - Risk to ground-nesting birds	"There have been groups that have escaped into the general environment and they do a lot of damage to crops and grazing areas"
Difficult to control	- No natural predators - Population will increase	"This mammal is difficult to control and can cause considerable disruption and damage"
Disease risk	- For domestic animals or livestock - Foot and mouth - Porcine disease - Disease reservoir - Question about whether they spread Tb	"We have small herds of outdoor domestic pigs in Cornwall which would have their health compromised by free ranging wild boar"
Risk of failure influencing future reintroductions	- Can't imagine it working - Farmer's not receptive and would resist - Potential conflicts between stakeholders	"I can't imagine it would work, would face too much opposition. If re-introductions fail it gives re-introductions as a whole a bad reputation and creates conflicts between stakeholders."
Habitat suitability	- Different landscape to when they were last here (loss of woodland) - Not enough habitat available	"I do not think there is enough undeveloped land left in Cornwall for the wild boar to roam through. Reintroduction behind fences seems to defeat the object and without

Reason for opposition	Further detail	Example quotations
		fences they would likely end up being culled by worried landowners/farmers."
Damage observed elsewhere		"Look at the damage done in New Forest and following wild boar let out around East Anstey Devon few years back thy ruin pastures and they are dangerous"
Road traffic collisions		"Cornwall is full of tourists and cars which will not mix well with boar. [...] There will be traffic deaths."
No reason for reintroduction		"Where would they live and what would be the point?"

Reason for 'Don't know'	Further detail	Example quotations
Question about available space		"Is there enough space for them?"
Potential risks		"I am concerned that these animals can be aggressive to people and that populations could rapidly build to problematic levels whereby they become capable of causing ecological damage"
Restore biodiversity		"Restore biodiversity"

Management factors to consider

Stakeholders were asked what management issues would need to be considered if wild boar reintroduction was to take place in Cornwall. The following table summarises the management issues that were raised in their responses.

Management Factor	Further detail	Example quotations
Support land managers (including farmers, foresters and people with gardens)	- Protection of crops/turf from damage - Disease risk for livestock (e.g., swine flu) - Careful stakeholder engagement - Compensation for damages - Population control (see below) - Restrict boar to locations away from people - Installation of protective gates and fences - Boar may compromise woodland establishment	"Interaction with agriculture will need to be managed"
Do not release	- Do not agree with reintroduction - Difficult to control	"They should not be released"
Don't know enough	-	"I don't know enough to comment"
Containment	- To avoid damaging heritage sites - Must have high spec fencing	"Containment; they are very good at escaping from enclosed areas."
Containment	- To avoid damaging heritage sites - Must have high spec fencing	"Containment; they are very good at escaping from enclosed areas."
General issues		
Habitat suitability/sufficiency	- Few areas are suitable - Need a large area - Different environment to the 14th century - Need woodland to be away from people	"I don't think that there is sufficient empty space, particularly in the summer to allow peaceful co-habitation"
Learn to live with boar	- Help people get used to living with boar - Get used to verges being turned over - Need to understand disruption	"People just need to get used to them, like deer"
Implications of legal protection		"Licensing may prove troublesome with landowners."
Negative perceptions	- Potential to be viewed negatively - Education is essential - Fear is unnecessary	"Guaranteed to get bad press. Education for people would be essential."
Population control	- No natural predators (need predators) - High reproduction rate - Intelligent so may evade hunters - Detailed management plan needed	"Wild boar will require a much closer management than the other species mentioned here due to their potential impact on forest ecosystems and humans. Lack of predator will require active population control."

Management Factor	Further detail	Example quotations
	- Utilisation of culling - Eat excess boar	
Risk on roads	- Vehicle collisions	“They will cause traffic accidents.”
Some hunting potential	- Economic potential - Potential for controversy	“I don't like the idea of people shooting large animals for fun which could result”
Danger	- Risk to people/walkers (especially children) - Risk to pets - Restricts access to countryside	“They would be a risk to walkers, dogs and cats etc”

8.3.6. Wildcat

The following tables presents the opinions of stakeholders who responded to the survey. These are independent opinions and are not meant to represent the views of the report authors or Cornwall Council.

Reasons for support, neutrality or opposition to reintroduction

Reason for support	Further detail	Example quotations
Conserve a threatened species	- Species of conservation concern in the UK.	"Scottish wildcats are one of the most endangered cats in the world, why wouldn't we want to do something?"
Ecosystem restoration	- Benefit biodiversity - Add to biodiversity - Nature recovery - Resilience to climate change	"Wild cats would have a significant beneficial effect on the biodiversity"
Native species	- Lost part of native ecology	"As a part of our original fauna, every effort should be made to effect reintroduction."
Education for general public	- Engagement in nature recovery - Understanding domestic cat predation	"I would love to see a balance between domestic cats and Wild cats and again education for general public on this."
General comment of support	- Involved in a project	"This would be a FABULOUS thing"
Charismatic species	- Iconic	"Charismatic species"
Limited to certain locations	- In remote areas - Need trials to identify management issues - Suitable habitat in the moors	"Urgently need trials to identify management issues in an area away from population centres for example on Bodmin moor"
Tourism potential		"I would welcome tourists wanting to see and learn about them"
Welcomed where they exist elsewhere		"They seem to be a welcome where they exist and I haven't heard any negative comments on them."
Need for predators	- Ecosystem balance (rebalance/re-establish food chain)	"We have no terrestrial tertiary predators and they would help fill this niche, they would help with rabbit population management in places!

Reason for support	Further detail	Example quotations
	- Help manage other species (manage rabbits; manage vermin; natural control for small mammals) - Reduction of non-native species will help other species recover - Fewer issues than with lynx	
Outstanding questions	- Is there enough habitat? (Woodland) - How to stop cross-breeding with feral/domestic cats? - Reservations about impact on bird life	"I support the reintroduction but how would we stop crossbreeding with feral and pet domestic cats."

Reason for neutrality or no opinion	Further detail	Example quotations
Don't know enough		"Am not informed enough to comment"
Potential for hybridisation with domestic cats	- Can't see how population would be maintained.	"They will just hybridise with domestic cats as in Scotland and we will end up with a large population of voracious feral cats destroying a lot of wildlife"
Need more information	- Habitat requirements - Impacts on landscape - Impacts for landowners	"Limited evidence that Cornwall would be a suitable site for reintroduction"
No pressing need	- Domestic and feral cats filling ecological niche - Unlikely to be a big pay-off	"Neutral on this one. Would love to see it but no pressing need as far as I can see. Plenty of feral/domestic cats filling this niche."
Potential attacks on domestic animals		"While I support some predator reintroduction, I am wary of possible attacks on domestic animals"

Reason for opposition	Further detail	Example quotations
Negative impact on biodiversity or vulnerable species	- Birds and/or small mammals are already threatened by domestic cat predation (e.g., hares; wading and water birds) - Risk to species of conservation concern - Would have no species predating on wildcat - No known benefit to biodiversity - Threat to vulnerable species (not sure how predators help when other species are already in decline)	"Feral and domestic cats kill millions of birds and small animals, all creatures in serious decline. The last thing we need is another feline predator before populations of birds and animals recover."
Hybridisation with domestic cats	- Won't breed true (not the same species) - Potentially lead to increase in hunting behaviour - Difficult to monitor - Currently happening in Scotland	"Major problem in Scotland is the interbreeding with domestic cats. This would certainly be a problem here in Cornwall given higher human population density"
Not suitable habitat	- Not enough prey due to impact of domestic cats - Too predatorial for modern landscape	"The needs of this animal cannot be met in modern Cornwall"
Risk for livestock	- Risk for lambs - Risk for chickens - Risk for domestic animals - Disease risk (potential vector for Tb)	"Large cats won't only kill foxes and rabbits. They will predate domesticated animals."
Waste of resources		"Waste of money"

Reason for 'Don't know'	Further detail	Example quotations
Don't know enough about species		"Don't know enough about the species"
Only possible in some areas		"Only possible in certain areas like Bodmin moor"

Management factors to consider

Stakeholders were asked what management issues would need to be considered if wildcat reintroduction was to take place in Cornwall. The following table summarises the management issues that were raised in their responses.

Management Factor	Further detail	Example quotations
Conflict with livestock	- Impact on poultry flocks - Ability for lethal control if there is damage to farming - Risks to wildcat from landowners (initial containment for protection; need legal protection) - Disease risk (carriers of sheep abortion infections; risk of Tb transmission) - Stakeholder engagement	"As another predator I would be concerned about the potential impact on free range poultry flocks as well as farmland and woodland birds"
Conflict with household pets	- Risk of being predated by dogs	"Potential of conflict with owners of domestic stock and possibly household pets"
Difficult to manage	- Rapid breeders - Very predatory	"I cannot see how these animals could be managed"
Don't know enough		"Unknown due to more information required see above. Education programme required"
Do not reintroduce		"Heard of the phrase, like herding cats? Just don't do it!"
Education	- Ahead of reintroduction - Could be mistaken for domestic cats (raise awareness)	"Likely to need good public education prior to reintroduction"
Habitat requirements	- Connectivity (for genetic diversity) - Large range needed - Need to be away from people (away from farming; away from recreation; away from disturbance from people or dogs) - Limited habitat is available in Cornwall	"Large ranges required [...] Is our landscape too small scale compared with Cairngorms? Suitable habitat availability?"
Impact on other species	- Careful plan for release locations - Impact on woodland and farmland birds - Need to protect what we have left	"Could cause problems for wildlife habitats that rely on rabbit grazing (like Upton Towans)"

Management Factor	Further detail	Example quotations
	- Impact on red squirrels	
Interbreeding with domestic cats	- Careful messaging for cat owners - Control of feral or domestic cats (keep cats indoors; neutering; release on peninsula where castration program can take place) - Potential risk of increased hunting behaviour in hybrid cats - Management of domestic cats may be unpopular with public	"Feral domestic cats need controlling otherwise they will dilute the genetics of the wildcat population. People living near wildcats should keep their cats indoors/build a cat aviary (which would help with predation and cats being killed by cars too)"
Limited or no management needed	- Secretive species - More about people management	"None, leave them to it. People need [educating], good PR etc. Diversifying tourism and farm incomes etc."
Need more evidence before reintroduction	- Demonstration of the need (value for Cornwall) - On ecosystem benefits - On viability	"Would need to evidence eco-system benefits."

8.3.7. Principles of stakeholder engagement

Engagement principles

During the in-person workshop a discussion around ways of engaging with stakeholders identified the following nine principles which would constitute effective engagement: justification, inclusivity, empowerment, collaboration, honesty, commitment, invitation, approachability and preparation.

The following table presents the views of real people as they were articulated during an in-person workshop, and we encourage them to be read with respect for the participants' opinions. These views are independent opinions and are not meant to represent the views of the report authors or Cornwall Council.

Engagement principles	Points raised	Suggestions or Further detail	Example quotations
Justification	Explain why reintroduction is being considered and what potential benefits there could be.	- Reintroductions could help with other environmental objectives (e.g., suggestion that **pine marten** may help support woodland regeneration).	"…one of the things I'm interested in hearing about is why is it a good idea? What are the benefits?"
	Communicate evidence on the potential impacts.	- Including risks.	"How can a project actually justify itself from a scientific standpoint in order for it to stand up against the scrutiny and to allay the concerns that people have? Where does the science and the social science support what you are doing?"
	Demonstrate that the reintroduction will abide by IUCN Guidelines.	- Demonstrate level of habitat suitability (or whether habitat restoration will need to come first). - Communicate whether the threats that led to local species extinction still exist, and whether they remain a risk.	"We must remember that there are IUCN Guidelines on reintroduction. That's something that any reintroduction project that is done properly has to go through." "What I'm saying is they went locally extinct for a reason. If you reintroduce **red squirrels**, they're just going to get killed again for the same reason they went locally extinct in the first place."

Engagement principles	Points raised	Suggestions or Further detail	Example quotations
	Explain reintroduction process.	- Manage expectations that not all individuals will survive.	"I think also you need to be fully aware that the first cohort that you put out there are very vulnerable, and those are the ones that are unlikely to survive for very long, and you need to be prepared for the backlash that will come. But the animals that have survived are a fantastic foundation for the next population." "People need to realise that it's not easy, there are going to be setbacks, and you need to have all these guidelines in place so that you can demonstrate a chain of actions."
Inclusivity	Seek to engage with everybody, and a wide range of voices.	- Involve rather than alienate the voices of those that may be opposed to a reintroduction. - If possible, be apolitical.	"I think for wild mammal reintroduction you've got to have it at that local level, that you're just talking to everybody in your parish as far as you can. It's really important to get a wide range of opinion." "Don't just talk to the converted."
	Give attention to who may be most directly impacted.	- E.g., Impacts on livestock through predation. - E.g., Impacts on livestock from disease risk (e.g., such as risk of African swine fever from **wild boar** affecting domestic pigs)	"We have some significant disease threats to the pig population in this country. Tamworths, there's 240 sows left and 60 boars, they are near extinction. If there were an outbreak of African Swine Fever or something, we would lose a lot. Those kinds of concerns are ones that I think I would expect to be engaged with or want to hold to account somebody who wanted to reintroduce a wild population of pigs."
	Consider both the benefits and the concerns associated with a reintroduction.		"You don't want to look like you're steaming ahead with an idea. Say this is why we might be reintroducing, here are the benefits, we fully acknowledge that there will be concerns. Something that seems really receptive to put out into the local community."
	Question of how to balance views of concerned people with those who are less	- Further question on what the impact of opposition voices can mean for a reintroduction project.	"The people who are impacted the most, the farmers and landowners, they should have the loudest voices". "The challenge is how you weight individual opinions. There are some that are going to be more impacted than others."

Engagement principles	Points raised	Suggestions or Further detail	Example quotations
	interested or more favourable.	- Views of farmers and landowners seen as important.	"You have to weigh up someone's opinion and actual scientific evidence." "People who are going to be impacted the most should be where most effort is given."
	Acknowledge that there can be nuance, rather than a simplistic for or against position.		"There is a lot more nuance around this rather than people being for or against, when there's actually about five different views on the scale of what people feel about re-introductions."
Empowerment	Seek to engage from the project outset (in advance of reintroduction) to identify and address issues early.	- Let people know what to expect.	"If it's a journey, you want to start at the beginning if you're going to arrive at the right destination." "I'm interested to know how the six species were picked. That would have been interesting, to have discussed that!" "Everyone's situation is different and if you do too much work on an assumed context, it's not going to fit everybody. So if you get everybody in at the beginning you'll see all the things, what the details are before they become a problem later."
	Ensure individuals feel their voices are being heard and there is two-way communication.	- Engage without having made your mind up in advance. - Build trust (which can take time).	"The best engagement is open, honest, two-way engagement". "It must be a fully consultative and engaged process where peoples' voices will be heard."
	Include engagement in approaches to species management.	- There may be uncertainty about future ability to manage, including the potential application of legal protection.	"How are we going to manage the problems that they're going to cause?"
	Community led projects may encounter fewer issues.	- There can be issues of trust with who is proposing a project.	"I think a great deal depends on who is the instigator of a project or a proposal. I think if it's coming from a community, a lot of the potential angst is neutralised somewhat."

Engagement principles	Points raised	Suggestions or Further detail	Example quotations
			"A lot of funding I've been looking into has big elements of wanting a project to be community led, which I think is the best way to do it anyway."
	Where possible, statutory agencies should have a role that is close to the project, thereby facilitating decisions that can reflect context.		"Natural England are going to be the licensing authority. There is a view that Natural England should be part of this process. They should be embedded in the whole process because they are the licensing authority, and they need to be close to the process rather than sitting in judgement once you get to the license application."
Collaboration	Collaborative projects can build trust between parties.		"I trust things when there is collaboration. So if I saw the Council engaging with Cornwall Wildlife Trust and the NFU, I would feel it was a bit more of a well-structured project that was listening to all of those voices."
	There is a desire to form relationships and collaborate.	- Provide opportunity for interested landowners to get involved.	"I think it would be very nice to have a path to what reintroductions might mean and how we can get involved with them. I have a small area in Cornwall that I would love to put aside and be involved in whatever rewilding species would work in that situation." "You [a fellow participant] mention doing a **water vole** reintroduction and my ears go 'ah', because I'm interested in a bit of land that is near there that may be of interest to you but, other than today, how would we ever have come across each other?"
	A management group involving different local voices could provide some oversight.	- Including the most affected as well as other parties. - Could include trained individuals in local settings to address management concerns. - Can be used in localised approaches.	"I went to the meeting talking about the Otter Valley **Beaver** Management Group, and I was really impressed, really impressed, by what a small group of people could do to make it work well. Where the potential bad feelings were coming in, they were going in and doing some professional work to do something, either to explain or trying to compensate, or just to mitigate by taking the dam out where it's needed. I think that would be really, really good to have

Engagement principles	Points raised	Suggestions or Further detail	Example quotations
			that for all species, to know where to go to get some help now."
Honesty	Be transparent about both the benefits and risks associated with a reintroduction.	- May ease engagement with those who are opposed. - Be genuine.	"I often feel that in the initial stages of engagement, the information that goes out is often very pro. I think there is a potential bias. The potential negative impacts aren't often spoken about in these engagement events. To get a truly balanced view then there should be an effort made on that side of things as well. I think that will also engage the people that are more against those reintroductions. Both sides of the story are being presented to everybody and then I think potentially you're not putting peoples' backs up straight from the off."
	Demonstrate how decisions have been made.	- Be transparent about how engagement has taken place and been responded to.	"I think a really important part of it is feeding back how you've engaged, what you've heard because often if stakeholders get engaged and give their views, very loudly and clearly that they are either very pro it, or very anti it, and then the opposite of what they wanted actually happens. It can seem like they weren't listened to. But if you make sure you audit what that stakeholder engagement's been and you feed that back, then they can say 'ok, alright, my voice was, for example, anti it, but all these other people were pro it and that's why this has happened, despite my engagement'."
Commitment	Engagement will need to continue in the long term as there may be unforeseen impacts, or opinions may change over time.	- Reintroduction is a long-term issue. - There will likely be questions about long-term accountability / funding for management actions.	"Keep it ongoing. The thing is, when you start a reintroduction project, peoples' attitudes might change. It's really important to keep stakeholders engaged all the way through a project. Because you might have some unforeseen impacts which need to be mitigated. Create an adaptive management strategy which has stakeholder engagement at the core of it."
Invitation	Mixed method approaches will enable outreach to different groups.	- Be creative and 'think outside the box'.	"You've got to go for mixed routes of engagement." "[Regarding when to hold talks] Dairy farmers won't get to you until late morning. You've then got these sort of farmers

Engagement principles	Points raised	Suggestions or Further detail	Example quotations
			won't do evening, other people have got 95 jobs. So you've got to have a variety." "Think outside the box."
	Direct approaches would be welcomed.		"For myself I don't like emails, but I think email would be fine. Or better still, on headed paper from the quango managing the release, to my home address. On proper headed paper with a first-class stamp, I think that would demonstrate a little etiquette."
	Some suggested measures may work well on the local level but could be more challenging on a larger scale.	- Letters, door knocking, stalls at local events, leafleting, talks in local pubs, in person meetings, notices in local area, emails.	"There's two levels to it. There's the regional strategy, and there's the large scale, and then there's project by project basis. So, at the smaller scale, going and pinning notices on gates is probably what you are going to just have to do."
	Conversations about other environmental issues may facilitate discussion of opportunities for reintroductions.		"There are various projects going on about solar on agricultural farms, food waste collections those sorts of things. But actually, starting those conversations could be a good way to start to explore opportunities for species reintroductions."
Approachability	A clear contact point will be required so people can easily find who to go to when they have an issue.	- Suggestion of a central page hosted by an organisation such as Cornwall Council to help direct enquiries.	"There need to be places that people can go for information very obviously." "I think it would be really important to have a really clear point of contact, a phone number, so for any potential project is going on you have one name and number where, if you have any enquiries, you can go to. I think that can potentially allay fears, or at least you know that it's in hand and you have been listened to."
Preparation	Engagement should involve enabling people	- Including this in education for school age children will help (including by reaching their	"If this could be an educative process… That would be wonderful. That's what we want."

Engagement principles	Points raised	Suggestions or Further detail	Example quotations
	to understand what living with a species will mean.	parents, and in the long term as they grow older). - Opportunities for jobs in public engagement around reintroductions and nature-based solutions.	
	Education will be required to address misinformation (and to encourage engagement in nature recovery)	- May promote better landscape management.	"Myth busting is really important."
	Engagement should include neighbouring communities as well as that which is within a project site, to prepare them for when a species may spread.	- This may include having a conversation on a larger county or nationwide scale, depending on the species. - Assess neighbouring risks. - Manage expectations that a reintroduced species will spread so that more can be done to mitigate challenges earlier.	"Obviously animals don't define a border between Devon and Cornwall, so I think we are going to need to go outside the local areas fairly early on so that people realise, if these species reintroductions are successful, they will travel." "If you've got **beavers** and they escape, clearly they're going to affect other people." "The difficulty is identifying the impact of the reintroduction. You could get a situation where you think the impact is going to be quite local, but actually it does spread further out. That does depend on what species you're talking about because some species can travel a long way, others can't. But I think it needs to be as wide as practical, based on expert advice."
	There may be different requirements for the level of engagement required for different species.	- Some species may have lesser impacts for people, whereas other species may have greater levels of impact. - On a site focused project, information can be more easily disseminated on a local level.	"The spectrum of species that we are looking at on this list is pretty broad, and there are animals on there that I cannot imagine anyone very much being concerned with at all. I can't imagine anyone having a campaign to prevent **water voles**, for example. Whereas there are others that would be very impactful. So maybe we should stratify from the ones that are dead easy to the ones that are problematic."

External influences impacting engagement

In addition to the principles of engagement, three external influences were identified which impact engagement approaches: past experience, magnitude and limitations.

The following table presents the views of real people as they were articulated during an in-person workshop, and we encourage them to be read with respect for the participants' opinions. These views are independent opinions and are not meant to represent the views of the report authors or Cornwall Council.

External influence	Points raised	Suggestions or Further detail	Example quotations
Magnitude	Projects may need to be coordinate with other projects.	- Need to think about how species will naturally spread. - Learn from experiences elsewhere (between projects and regions). - Most of the six species present in some way elsewhere in Britain.	"Some of these species have been reintroduced in this country, whether deliberately or by releases. One of the aspects of engagement should be to seek to take some of that knowledge of what's worked, what hasn't worked, pros and cons, to feed into consultations." "Shared experiences from project to project need to be shared. All too often we work in silos, and there is an assumption that everything is shared, but actually it doesn't happen. So I think there is a role for countywide engagement."
	Individual viewpoints will be influenced by different knowledges, experiences and values in landscapes, ecology, environmental management, and nature.	- Different experiences of or views on the management of present species, such as badgers and Tb. - People may not understand how degraded ecosystems are, or what is required for them to function.	"The general public has a love/hate relationship with nature. People like the idea of a landscape that's 'nature' but then the reality of it is actually something different and they want it controlling. I guess what I'm trying to say is I think there's that whole thing around really understanding what nature is and how we can live with it, and what peoples' objections to the full impact of having a natural environment surrounding you to a lesser or greater extent."

		- Some may see present day environment as different to that of the time of the species' former presence. - Different social groups may feel that other social groups do not understand realities of their sector.	"They came from an environment which is not the environment we have today. We are today a heavily populated island, and that was not the case initially. So you know, things evolve." "You've only got to look at the deer population and the challenges around that. We're all keen to plant trees in Cornwall, but our deer management is not good."
Prior experience	Views on engagement will be influenced by previous experiences in related issues or projects.		"Could I suggest that it's already too late. We've gone too far into the whole idea of 'nature recovery' without enough consultation. Now we're going into one of the potential tools of nature recovery without actually having got an army of support behind the whole idea of nature recovery in this county." "We've had some very good examples of government surveys recently in the agricultural community where you know they've made their mind up before they asked you. Talk about disengagement! That's the ultimate because we've really struggled to get farmers involved in some things. 'They weren't listening so I can't be bothered to waste my time.' There's been a lot of that going on recently, and you might find that you're tainted with that."
	Topics of discussion may interact with existing environmental controversies.	- Such as differing opinions of population control measures, or the application of legal protection for species.	"Why should ordinary people, whether they are homeowners or farmers, some who have ways of life they cherish, or be keeping chickens, maybe farming them or whatever, be turned into potential criminals for trying to manage their property?" "By definition you're going to have to protect the reintroduced species, and [another attendee's] point is that they don't want to end up criminalised because they've got chickens and suddenly find you've got **pine martens**."
	Experiences or observations of previous reintroduction		"If you look at the experience of reintroduction of **wild boar** into Forest of Dean, starting with small numbers of releases in the 1990s to where they are now, you've got a great

	experiences may influence perspectives and trust in the reintroduction process.		example not very far away of what can happen in a temporal space, and also a physical space." "You've only got to go to the Forest of Dean to see the impact of **wild boar**. Very, very difficult to control."
	Engagement can be demanding on resources for both proponents and stakeholders (who will also have other demands on their time).	- Demand on financial and time resources. - Suggestion that representative bodies could help (e.g., National Farmers' Union and Commons Council). - Creative engagement may not need as much financial resource.	"It takes a lot of resources to knock on every single door in an area." "Make sure that you factor in that you will have to put a significant amount of resource into stakeholder engagement." "Unfortunately, there's very few people in this country today that are productive. Those of us that are productive are running around chasing our tails, in ever decreasing circles, being ever more regulated. And that's one of the reasons why we never get a fair hearing; because we're busy! I think the promoters of change, whatever the change might be, should take better account of that. We're just busy, busy, busy!"
Limitations	Time pressures may interact with the level of urgency in an ecological crisis.		"We are sitting within the collapse of our natural systems, there's no question of that. Now I'm not saying for one second 'open the traps and let the **wild boar** go', but I'm saying let's not stop doing things that we know from Europe can really work, and let's try and exploit that, provided it is socially acceptable."
	It can be difficult to compel people to get involved.	- Some stakeholders may not wish to be involved. - Some may not wish to engage where it may be publicly exposed. - Some people are hard to reach in the first instance (e.g., people with moderate views rather than polarised).	"I find with engagement, say a planning proposal for example, we get a lot of people commenting, commenting, commenting on social media and the likes. But when it comes to actually commenting and stating your views legally on the Planning Portal, nobody does it. So how would you work around that, actually getting people to type in the appropriate place their views?"

	It may be difficult to identify or obtain contact details.	- There is no central place to find contact details. - Town and Parish Councils may be able to help disseminate information in local settings, which may be trickier in larger areas (including with the suggestion of a central list of contacts). - Sharing contact details must comply with GDPR requirements.	"I think with data protection it is very hard to get an email list. You have to have somebody volunteer to give you that data. So, it is a lot of footwork and slog; arranging meetings, putting up posters, talks in village halls."

8.3.8. Conclusions - Stakeholder survey

On levels of support for reintroduction

Stakeholder support for each of the reviewed species largely reflected that seen in the public survey, with high levels of support for red squirrel and water vole reintroduction. Reasons for this include the conservation of a threatened species and the fact they would likely have little impact on existing land use. The limited number of responses against these species were generally perceived to be around whether their reintroduction would be a valuable use of resources, along with the potential for some land use conflict. Likewise, responses to beavers were generally positive, once again primarily citing the benefits of the species to ecology and flood mitigation, but an almost equally wide range of views were voiced against, not only in regard to the potential impact on ecosystems and land use but also in view that other alternatives to natural flood management were available and with distrust towards the motivation for reintroduction.

Of the two considered carnivores, positive responses towards pine martens focused on their place as rightful native species, the engagement and education potential there was for the general public and their role in regulating ecosystems, particularly grey squirrel control in the case of the pine marten. Views against were primarily focused on the potential predation risk posed to existing native species and livestock and a potential lack of habitat, along with the specific risk of domestic cat hybridisation for the wildcat.

While several benefits were attributed to wild boar reintroduction, including the positive effects as an ecosystem engineer and potential hunting opportunities, there were a significant number of reasons provided against, most notably on the danger they could pose to people, pets and livestock, the damage inflicted through rooting on land use, difficulty in controlling numbers and disease risks to livestock. It is highly likely therefore that any proposed project with this species would require a significant investment in stakeholder engagement and would be largely dependent on the outcome of this to determine if it were to go ahead.

On management factors to consider

A wide range of views were expressed on the management requirements for reintroduction projects. The overwhelming observation with red squirrels was on grey squirrel control, citing methods such as sterilisation, culling/eradication and pine marten reintroduction as key elements to factor in a release's success. Habitat suitability and mink control were the main management priorities associated with water voles, with other considerations including the impact of protected species status on managing habitats, potential damage to trees and the impact of burrowing on riverbanks.

Many management considerations were put forward for beavers, with the chief among them being to ensure there was management and compensation in place to deal with negative impacts such as flooding, with specific concerns on the availability of funding, the implications of legal protec tion and the will to actively manage impacts. Other key management implications included mitigation of disease risk, negative effects on ecology, habitat suitability and population management, although others emphasised there wouldn't be a need for the latter due to self-regulation.

The highest considerations for management attributed to pine martens was the extent of suitable habitat, the impact on agriculture and game bird shoots and predation on native species. Some stakeholders expressed concern over the lack of predator control and suggested monitoring to determine whether to cull if necessary, while others emphasised the need for reinforced protection from persecution. The primary management concern with wildcats was conflicts with livestock and domestic pets, although it was notable that the matter of unfamiliarity with this species was highlighted, with emphasis on the education that would be required to reverse this in the minds of the public.

For wild boar the most significant management concern was ensuring there would be support in place for farmers and landowners with measures including population control, exclusion and mitigation, whilst also highly valued was the simple answer given of not releasing wild boar in the first instance. Conversely, a minority of views suggested more emphasis should be placed on learning to live with the species in a similar manner to present day co-existence with deer.

9. OVERALL CONCLUSION

As part of local nature recovery in Cornwall, mammal reintroductions can undoubtedly play an important role in several different key areas;

- Improving the status of species diversity in the Duchy, through reintroduction of locally extinct species (such as wildcat) or reinforcement of species which have already started to return (such as beaver and water vole).

- Aid the restoration of more complete, dynamic ecosystems, helping to fulfil key processes such as habitat creation, natural flood management, plant diversity and nutrient cycling, top-down regulation of invasive species and provision of prey bases.

- Enhance the connection to nature among local people, providing a greater sense of well-being and potentially contributing to ecotourism.

Risks, like any high-input project, are undoubtedly present and evaluation of the cost/benefits of these will be dependent on the species considered. Provided there is thorough investment, many biological risks and disease concerns can be managed with prior ecological scoping, appropriate sourcing, health screening and invasive species management, with many species backed up by prior exemplar reintroduction schemes in Britain where such protocols can be replicated.

Some of the greatest challenges are met with socio-economic risks, particularly as responding to such conflicts requires careful and grounded understanding between a huge diversity of public and stakeholder groups. While other reintroduction projects in Britain have demonstrated that some degree of consensus and trust can be reached with species that can elicit strong reactions such as beaver and pine marten, those with little precedent of formal reintroduction programmes such as wildcat and wild boar would require a much more challenging degree of investment in social feasibility.

Based on the findings of this report, the following summaries can be made for each species' reintroduction potential to Cornwall.

9.1. Beaver

Beaver reintroductions already have precedent in Cornwall, with family groups established in four enclosed projects and a further unlicensed wild population currently living in the Tamar catchment. These and other beaver projects across Britain have shown that the species has a positive impact on improving ecological diversity and abundance through the creation of wetlands, as well as providing nature-based solutions through flood management, supporting the climate emergency through carbon storage and improving people's connection to nature. The many small catchments across Cornwall are likely to be well-suited to be beavers where it is probable many wetlands would be created by the animals given their hydrological character. Beavers are currently best sourced from populations in Scotland as have

been used in projects across England, which also reduces the potential of significant animal health issues.

Overall, public and stakeholder reception to beavers in Cornwall is positive. However, their ability to modify the environment can also bring in notable land use conflict issues. Therefore a key consideration with re-establishing this species should be to ensure there are systems in place to mitigate issues with beavers where they arise; an issue reflected in the more specific concerns from farmers and landowners regarding impacts from dam building and tree felling. A beaver reintroduction would therefore require support for mitigation when such impacts occur which increases the cost of the project. Given this and the high level of social engagement reuired, beavers can be one of the more costly species to reintroduce.

9.2. Pine marten

Our public and stakeholder surveys highlighted a generally positive reception from public surveys to the re-establishment of pine martens, particularly regarding the potential impact they may have on grey squirrels. Further re-establishment of this species could assist in invasive species control and for many, provide a greater sense of wildness in the landscape even if it would be rarely seen. As a predator species, there would however still need to be a careful degree of social engagement should a project be undertaken with particular attention to the impact on native species. With pine marten reintroductions planned on Dartmoor and Exmoor however, when coupled with the animal's rapid dispersal it may be that natural recolonisation of this species advances in pace.

9.3. Red squirrel

Support was particularly high for the reintroduction of red squirells among the public and stakeholders. This is perhaps unsurprising given this species is one of the more recent extinctions, and therefore being in the living memory of many Cornish residents. It is also a charismatic species and is perceived to cause little conflict with humans. Using the principles and learnings from other UK red squirrel reintroductions, projects are already in the development stage to reintroduce this species to areas of Cornwall such as the Lizard, following their establishment on Tresco on the Isles of Scilly. Giving a clear indication that the will to restore this species is already present.

However, significant management issues remain with the control of grey squirrels, which is required at a significant scale of investment, as well as in disease control to prevent the spread of squirrelpox to red squrirels. Therefore, any project that wishes to restore this species at a landscape scale would likely require a long-term resourcing strategy to account for this, and may be better placed following the re-establishment of the pine marten.

9.4. Water vole

Like the red squirrel, as a recently extinct and perceived 'unproblematic' species, water voles would likely be a well-received candidate for reintroduction. Establishment of a

reintroduced population at Bude Marshes and the inception of two further reintroductions in the south of Cornwall suggests that optimal habitat is still available or can be created in Cornwall, especially if beaver-created wetlands in upper catchments become more commonplace. These can allow water voles to fulfil a key prey base for larger predators and provide microhabitats through burrowing and foraging activities. The primary issue projects would need to meet is ensuring there are enough resources in place to monitor for mink and eradicate if present. The isolated nature of Cornish catchments is likely to make the latter easier if control is robust enough. Ensuring restoration of wide-scale complex wetlands will also improve the chances of establishment following reintroduction.

9.5. Wild boar

Despite demonstratable ecological benefits to wild boar due to their rooting and wallowing activity and their ability to adapt readily to human-dominated landscapes, wild boar received the most controversial responses from a public and stakeholder point of view. This is unsurprising given their high levels of human-wildlife conflict in terms of aggression towards people and dogs, their significant status as an agricultural pest especially among permanent grasslands and the disease risk they pose to commercially reared pigs. Given the primary land use of Cornwall, it is therefore very likely there would be significant impacts on agriculture.

As such, any reintroduction project would require significant stakeholder engagement and veterinary assessment to consider attempting a reintroduction (of which there is no formal precedent in Britain). Given the low density of woodland and high level of permanent grassland in Cornwall, it is likely that other locations in the UK with higher proportions of broadleaved woodland are better suited for the reintroduction of this species.

9.6. Wildcat

Like the pine marten, the wildcat has potential to restore predator guilds and exert top-down influence on ecosystems whilst acting as a publicly engaging symbol for restoring wildlife. While support for this species was mainly positive among the public and stakeholders, it was the second least well received species after wild boar. This was largely due to unfamiliarity with the species, perceived threats to pets and livestock and hybridisation with domestic cats. Even though the south-west has been deemed one of the best ecologically suited areas for reintroducing this species, a high level of engagement work would be needed to raise awareness amongst the public and stakeholders of this largely unfamiliar species. Feral cat surveys would need to be a crucial component of ecological feasibility and domestic cat owners and groups consulted in social feasibility. With wildcat reintroduction projects entering feasibility stages in Devon at the time of writing, it is likely that animals from this project (should it go ahead) would disperse to Cornwall within a short-time frame. Additional releases could be undertaken in the County supplementary to this scheme if it goes ahead.

9.7. Overall

Overall, while reintroductions can be challenging and costly, they can also provide wider benefits for ecosystems beyond the simple reinstatement of a species. The overall positive responses from the public surveys to each of the reviewed species in this particular study demonstrates that support for these projects and the capacity to raise awareness of conservation in the local environment is large. Subsequently, mammal reintroductions have the capacity not only to reach nature recovery targets, but increase connection with local communities to wildlife too.

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11. REFERENCES

For a full list of alphabetised references, see Appendix D.

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