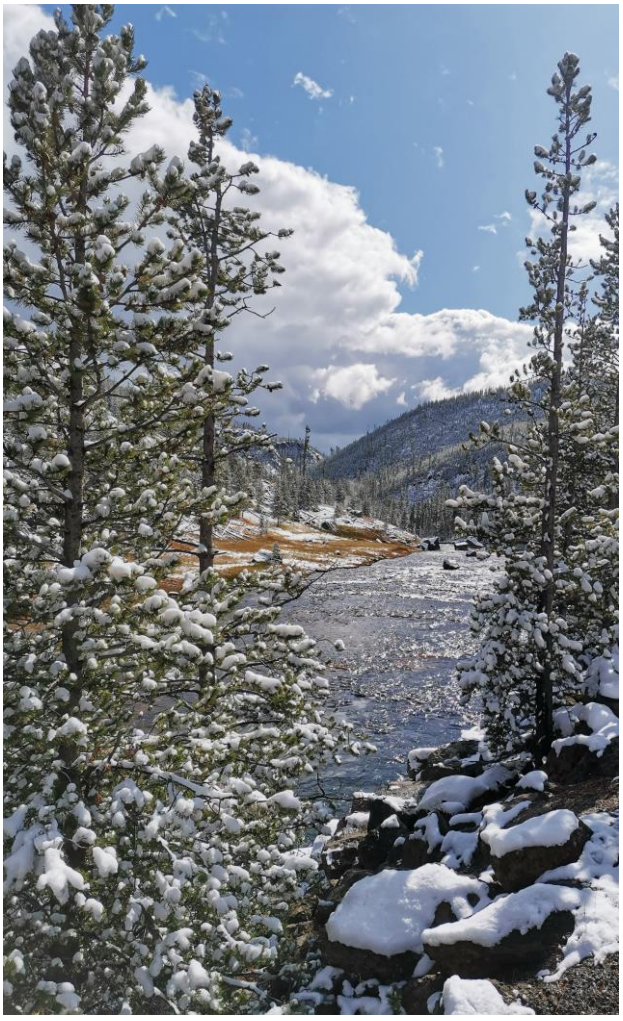

The Farmers Club Charitable Trust Agricultural Educators Award 2019

ABSTRACT

An investigation into the impacts of rewilding, with a particular focus on the impacts of re-introduced species on rural land use.

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Acknowledgements

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With thanks to The Farmers Club Charitable Trust for funding this investigation.

Also to my friends and colleagues at Hartpury and Brooksby Melton Colleges; Robert Gillies, Ralph Tallis, Mike Salotti, Julia Hart, Nicola Bywater, Jennifer Bevin, Carla Tewley, Meg Peberdy, Alex Gray, Lil Hammond and James Fryer for their support and for covering some lessons while I was away.

To Martin Guy for helping proof read and for being a great example and inspiration.

Also to Doug Smith of the Yellowstone National Park Wolf Recovery Project, Quentin Kujala and Justin Gude of Montana Fish Wildlife and Parks and Perry Cornelissen for their help with my enquiries.

And of course to my wife Sallie and children; Michael, Lillie, Peter and Jemima; for their encouragement, support and for tolerating my occasional absences.

Contents

What is Rewilding

Rewilding is a large scale and ambitious approach to conservation: It's main aims are to restore natural processes and ultimately to return ecosystems to a condition where human management and interference is not required.

Humans have spent centuries making the landscape more productive and easier to navigate and this has caused conflict with wildlife, particularly predatory species, as well as unintended environmental consequences which we are only just getting to grips with. For example, flooding exacerbated by straitened river channels and land drainage. Re-wilding reverses some of these damaging impacts and re-establish functioning ecosystems; at the extreme end of the scale that might involve and attempt to restore ecosystems to the state they were in as far back as the Pleistocene epoch. More commonly though rewilding projects don't go quite that far although they will still typically involve the encouragement of apex predators and key stone species either by encouraging natural re-colonisation where possible or by deliberate re-introductions.

It's these re-introductions that particular grabs the attention of the general public when rewilding is discussed and high profile projects like the re-introduction of wolves to Yellowstone National Park, the creation of the Oostvaardersplassen nature reserve in the Netherlands, Alladale wilderness reserve in the Scottish highlands and the proposed Pleistocene park in Siberia have excited and inspired a great many people. The do also cause concern and worry among some though particularly where they might conflict with agriculture and in the UK where apex predators have been absent for so long the thought of wolves, bears and other large carnivores roaming the countryside is quite shocking.

The concept of rewilding as well as being incredibly ambitious and complex in execution, is relatively new. While it has been widely recognised by conservationists that habitats should be restored, their fragmentation combated and that efforts should be made to improve and enhance biodiversity since the 60's the word re-wilding wasn't coined until over 20 years later by the radical environmental activist group Earth First and didn't appear in print for the first time until 1990.

A Brief History of Rewilding in the British Isles.

Since the last Ice Age there has been a long list of species that thanks to climate change, the impacts of non-native species, direct hunting for food, skins and sport and of course the changing landscape shaped by humans which have become extinct.

Well known examples such as the Dodo (*Raphus cucullatus*) or the Elephant Bird (*Aepyornis maximus*) are known to most school children and no matter how enthusiastic we are about re-wilding there is no bringing back these species which have been extinct on a global scale but where extinctions have only occurred locally there is a chance to re-introduce, or by careful habitat management allow such species to recolonise.

Until the idea of landscape scale rewilding and re-establishing functioning ecosystems was accepted though conservation and re-introduction of threatened species was often carried out, if it was carried out at all, on a piece-meal basis and focussed on individual species rather than whole ecosystems. That's not to say that there weren't attempts to restore biodiversity, carry out wildlife reintroductions and combat the degradation and fragmentation of habitats before, or that those efforts weren't effective in their own right, but those attempts were few and far between and as they focussed on

individual species rather than on whole ecosystems the overarching benefits that can be realised through rewilding were absent.

In the UK alone we can thank those historic re-introductions for the survival of roe deer: By the 18th Century English roe deer survived only in a few northern counties and there were none in Wales but reintroductions from Scotland and France in the 19th allowed roe populations to recover to the levels they are at today (Tegner, 1981). Red Kites are just one other example of a successful reintroduction and we are lucky to have a seen a remarkable recovery from just 20 breeding pairs surviving in Wales to over the span of just thirty years since the first reintroduction in 1989 (RSPB, 2020)

We even have a thriving, if somewhat small, population of reindeer in the UK, probably extinct in the wild around 8000 BC there are some records of them in Scotland in the 13th Century in the Viking 'Orkneyinga' sagas but it could be that these were imported deliberately and they were eventually wiped out by hunting . In 1947 Mikel Utsi a native of Swedish Lapland, and his wife Ethel Lindgren-Utsi (a Cambridge trained anthropologist of Swedish descent), were visiting Aviemore and the Cairngorms and noticed that the habitats they saw resembled the reindeer grazing pastures of Northen Sweden.

This similarity and an intention to use reindeer to relieve wartime rationing was the motivation for bringing reindeer to the Cairngorms. Originally seven reindeer were brought from Sweden to Scotland on the 12th of April 1952. Over the next few years a further eighteen animals were shipped over from Sweden and a herd was established that has since grown to around one hundred and fifty individuals (Guy, 2017). While they were not ever harvested for meat as was the original plan they have established themselves as an integral part of the Cairngorm national park.

So even before the potential of a joined up, landscape scale, ecosystem level approach to rewilding was considered there is a considerable history in the British Isles of successful reintroductions. There have been some tremendous attempts at true rewilding in the UK beyond these reintroductions and it's these and other projects from overseas which are the focus of this project as I hope to learn about the impacts of rewilding on agriculture, forestry and other land uses and to derive lessons from those projects which can help the next generation of farmers, conservationists and land managers prepare for their careers, to manage the impacts of an realise the benefits of rewilding.

Project Proposal

I aim to find the voice of farmers, foresters and wildlife managers involved in, or impacted by, re-wilding. The information, opinions and experiences I gather through my project will then inform the creation of a series of case studies. These case studies can then be used within the land-based education sector and land-based industry, to highlight the challenges and benefits of re-wildling projects to in, and preparing to enter the industry.

To gather these case studies, I propose visits to several rewilding projects to observe the effects of the rewilding and to engage with those managing the various projects and those impacted by the projects.

United States

The United States is home to 58 National Parks, unlike in the UK these parks attempt to maintain and preserve 'wilderness' environments. This means that many of those parks are still home to apex predators and a whole range of wildlife which are missing from UK National Parks. Yellowstone National Park in particular is not only well known for it's geothermal activity but for the success of a re-introduction of grey wolves in the mid 90's. As well as looking at the impacts of the wolf reintroduction in the park I aim to gather the opinions of farmers and wildlife managers in surrounding areas who may have been affected by this reintroduction.

Scandinavia

While agriculture and urbanisation have had an effect on the Scandinavian landscape, that effect has been much more limited than we have seen in the UK. In Scandinavia there are still relatively healthy populations of some large predatory mammals and while this is not strictly as a result of re-wilding, major conservation efforts have caused increases in their numbers and provide an excellent opportunity to study the impacts of predatory mammals and well-established strategies for mitigating those impacts of agriculture.

Netherlands

The Netherlands is home to the Oostvaardersplassen nature reserve; a 56 square kilometre Ramsar wetland and nature reserve created from polder reclaimed from the sea in 1968. Since it's management as part of a rewilding project it has been populated with Heck Cattle, Konik pony's and red deer and was hailed as a great success for re-wilding in its early days but has been the target of increasing amounts of criticism over the last few years over concerns for the welfare of grazing animals which are starving to death during winter because of depleted food resources. The original populations of 32 Heck cattle (and 20 Konik Pony's introduced during the 1980s and 54 Red Deer during the 1990s) have exploded to a total population which now numbers in the thousands.

As one of the better known re-wilding projects in the world and the inspiration for many others I hope to learn about the impacts of this project on surrounding farm land as well as get to grips with some of the negative press it has received recently.

UK

There have been some significant re-wilding attempts in the UK, as well as some accidental releases of species such as wild boar which would be a potential element of future re-wilding projects. Time constraints will force me to focus my efforts in the UK on a few specific projects these will include the wild boar population in the Forest of Dean, the Cairngorm Reindeer project where reindeer were

successfully re-introduced in the 50's and thrive today, and the ever increasing population of beavers with particular focus on the populations in the River otter catchment in Devon and Tay Catchment in Scotland.

Given sufficient time I propose further desk based research on UK rewilding efforts including The RSPB's Great Bustard project on Salisbury plain, Gloucestershire Wildlife Trusts re-introduction of Pine Martens in the Forest of Dean and the Alladale Wilderness Reserve in Scotland where a major rewilding proposal has suffered setbacks due in it's attempts to re-introduce predatory mammals.

Project Findings

The year of this project has seen some major steps for re-wilding in the UK: It has been discussed in parliament as a means of mitigating environmental degradation and of combating climate change. It has also received a deal of attention in the media thanks at least in part to the successful publication of books and documentaries touching on the subject. '*Wilding*' by Isabella Tree; an account of the transformation of a Sussex estate into a semi-wild state with free ranging herbivores as well as recovering populations of once common bird and invertebrate species has received a great deal of attention as has George Monbiots documentary '*Apocalypse Cow*' in which he advocates for the total abolishment of farming and also highlights the damage done by overpopulations of wild grazers unchecked by predators other than humans.

While these specific platforms have increased awareness of rewilding specifically this comes amidst a generally increased awareness of, and interest in, environmental issues thanks to the actions of people like Greta Thunberg and Extinction Rebellion. It is perhaps fitting then that I should be working on this investigation into rewilding, a word first coined by radical environmental activists, in a year when so much additional public attention has been focused on environmental issues by the action of similar groups.

Findings from each area of investigation will be set out over the following pages with additional attention given to further findings from desk-based research.

Project Timeline

- 26th April 2019; visit to Oostvaardersplassen Nature Reserve, Flevoland, Holland
- 6th-7th of July 2019; The Beaver Scotland's Ally Conference, Battleby Perthshire
- 29th September – 5th October; USA
    - 30th September; Grand Teton National Park and Jackson elk refuge.
    - 1st October; Interview with Quentin Kujala and Justin Gude from Montana Fish, Wildlife and Parks in Helena Montana.
    - 2nd October; Yellowstone National park and interview with wolf biologist Douglas Smith at Mammoth Hotsprings
    - 3rd October; West Yellowstone grizzly and wolf centre
    - 3rd October; BYU Idaho Agriculture and Biological Science Department
- 11th January 2020; visit to Tresticklans National Park, Västra Götaland , Sweden

The Netherlands

Figure 1; a view across a small part of the Oostvaardersplassen nature reserve

The Oostvaardersplassen nature reserve is in the Flevoland province of The Netherlands, even at 56 square kilometres is just a small part of the 430 square kilometre Polder Zuidelijk Flevoland. The Polder was reclaimed between 1959 and 1968, is just east of Amsterdam and is now home to over 200,000 people as well as agricultural land and of the course the Oostvaardersplassen nature reserve.

What became the reserve was originally earmarked for industrial or agricultural use but when it was not immediately utilised it soon became a wetland of open water and marsh vegetation and was visited within just a few years by thousands of wetland birds that hadn't been seen there before in such great numbers. Biologists working for the ministry of Infrastructure and Watermanagement (the organisation responsible for the design and construction of the polder) soon realised that the area was of major importance for wetland birds and in 1975 the area was given temporary nature reserve status.

In 1986 it was officially designated a nature reserve for the preservation of wetland birds and later as a special protection area for wetland birds according to the European Bird Directive and as a RAMSAR wetland site in 1989. In 2010 it became a Natura 2000 area for the protection of 31 wetland birds. In 1983 2000 hectares was added to the initial 3500 hectares reserve, this area was a 'dry' zone of grass and tall herb species, reeds, shrubs and trees and provided forage and nesting sites for some of the protected bird species present on the reserve such as geese, herons and spoonbills. This zone was managed to provide these specific habitats for the birds and formed a border around the reserve.

As well as the addition of this 2000 hectares 1983 was also the year the first of the larger herbivores were released into a small part of the reserve and the re-wilding began.

As the Oostvaardersplassen is an enclosed nature reserve there may seem to be a limit to the impacts it could have on agriculture or other surrounding land uses but there have been some significant concerns over the welfare of the free ranging herbivores that have been introduced there and on the number of geese which the reserve attracts to the area and the impact that they can have on local arable land.

I learned a great deal about the creation of the reserve as detailed above when I was able to pose some questions about these impacts and about the management of the Ooostvaardersplassen to Dr.

Perry Cornelissen a consultant ecologist for Statsbosbeheer, the organisation which manages the reserve, and who has worked at the reserve since 1991. Further findings from these questions are detailed here;

What was the expectation for the nature reserve when it was established, was there a particular climax habitat the was expected to emerge, if so, what was it and have those expectations been met?

Right from the very beginning it was clear that the reserve was a wetland and because of it's importance on a European scale it should be protected and managed as a wetland. There was no preconception about climax habitat types other than the understanding by management that succession could lead to the development of a peat bog or wetland forest but the reserve was managed to ensure it remained wetland. Until 1996 the reserve was managed by The Ministry of Infrastructure and Watermanagement and an important part of their management strategy was cyclic waterlevel management. This periodic deliberate raising and lowering of water levels protected reedbeds from overgrazing by graylag geese and allowed reedbeds to establish. Without this deliberate lowering of waterlevels the reedbeds would not have established and would probably have eventually been grazed away by geese. This management strategy was employed between 1987 and 1992 but when management passed to Statsbosbeheer in 1996 this management ceased in favour of allowing natural processes to run their course.

Since that strategy was adopted though it has become clear that it does not work and there has been a decrease in reed vegetation and some of the wetland bird species so a new regime of waterlevel management is due to begin. The dryer borders of the reserve were intended to be managed by the large grazing herbivores that had been introduced with the intention that a woodland pasture type habitat as described by Frans Vera (Vera, 2000) would form and that the grazing would contribute to a diverse landscape of open and vegetated water bodies, grass, tall herbs, reed shrub and woodland. The herbivores themselves were not intended to be managed by humans but by natural processes and it was expected that their numbers would be regulated by food availability, climate and competition. This did not occur either perhaps due to the particular circumstances prevailing at Oostvaardersplassen, the incomplete system and interference by humans (Cornelissen, 2017), and the diverse landscape that was hoped for has not fully emerged and the population of herbivores is now to managed to help achieve those landscape objectives.

Do the grazing mammals have access to the whole site or are they restricted to particular areas? Has this changed over time?

At the moment the large herbivores have access to the whole site. There is a difference in the way they use it. Red deer use the whole area including the dry border and the marsh, but the horses and cattle only use the drier areas and do not enter the marsh. To begin with when the cattle and horses were first introduced in 1983/84 they only had access to a small fenced 300 hectare part of the reserve but by 1996 they had access to the whole of the reserve. When the red deer were introduced in 1992 they were immediately given access to the whole reserve.

I know that culling has taken place but is there a management plan to keep grazer populations at a particular level through culling?

Until 2018 large herbivore numbers were regulated only by food supply, climate, competition and facilitation so there was no actual culling to regulate the population. To prevent unnecessary suffering due to starvation, injury or disease some animals were shot. In the case of starvation animals were monitored on a daily basis and condition scored and if animals were determined to be in very poor

condition indicating that they would die within a few weeks a decision could then be taken to shoot these individuals in poor condition where they were assessed to be likely to die anyway, this management policy was called 'early reactive culling management'.

The new management policy for the large herbivores now allows the population to be deliberately regulated through culling with the objective of allowing the desired diverse landscape to emerge. This cull plan and management strategy will be documented in the new management plan for the Oostvaardersplassen.

Are there any mammal predators in the nature reserve? Foxes, badgers etc…. Does the presence of large mammal grazers allow access to nesting sites by these predators? This is something I've noticed can be the case in the UK, grazers such as deer flatten paths through reeds which can then be navigated by foxes which then predate the nests of water fowl and waders.

There are mammal predators in the area (fox, otters and rats). In the marsh there is the possibility that red deer make paths in the vegetation that are also suitable for these small predators but foxes only use these paths when there is no water. So, in reed vegetation outside the marsh this could be a problem. However, the wetland birds breed mostly in the marsh where they have the protection of water. Problems can occur when the water level in the marsh is very low and the paths through the reeds become dry, when this occurs though most of the wetland birds move to the protection of water. When the water levels were lowered in the reserve between 1987 and 1992 most of the breeding birds moved to other areas in the reserve where there was still water or left the Oostvaardersplassen altogether. When the water levels were raised again in 1992 the birds returned to the marsh.

Could the reserve be expanded to include other local nature reserves/conservation areas and would an increased area potentially allow the introduction of once native large predators which could maintain grazer populations through predation?

The area can always be expanded given the appropriate financial support. It almost was a few years ago when a corridor was planned linking the Oostvaardersplassen to another large forested area in the polder and from there to even larger areas on the mainland. However, an economic crisis and a change in political focus to economic restoration rather than nature changed this radically and the planned linking of conservation areas never happened.

Reintroductions of predators are a possibility but not necessary as wolves are already present in the Netherlands. All we would have to do is give them access to the Oostvaardersplassen or other fenced off reserves.

Would having predator and pray in the same enclosure, even if it is very large like the Ootvaardersplassen, be allowed by Dutch law? In the UK there have been some suggestions that something like this would not be permitted (at the Alladale wilderness reserve for example) as having predator and pray in the same enclosure breaches zoo regulations.

I don't know if there is a law that would be relevant if we were to introduce wolves or other large predators but as introduction is not necessarily due to an existing population of wolves in the Netherlands and there would be no law that would apply to wild wolves accessing Oostvaardersplassen or any other reserve.

Was there any sort of planting regime of trees, reeds or other plants to get the Oostvaardersplassen to the condition it is in today?

The area was never planted until now. The shrubs and trees established naturally right after 1968. Reed also established naturally in the Oostvaardersplassen, but it was influenced by humans. After pumping water out of the polder in 1968 the area was seeded with reeds to help dry the soil. As the Oostvaardersplassen was the lowest part of the polder it remained wet when the reed seed was spread so the reed did not establish. Over time as the water levels were lowered reeds did colonise the Oostvaardersplassen.

The newest management regime does call for some planting though and there are plans to plant shrubs and trees to provide shelter for the herbivores as well as to establish the desired diverse landscape.

Have you experienced any conflicts with local landowners in regard to the nature reserve whether that relates to influxes of geese on agricultural fields which might damage farmers crops or due to perceived welfare issues regarding the grazers at the Oostvardersplassen?

Not conflicts as such, but complaints have been made to the local authorities about the possible effects of geese on crops and also on water quality as large numbers of geese can cause eutrophication of water courses. Similar complaints are made about animal welfare as farmers must abide by animal welfare legislation and standards which they perceive are not applied at Oostvaardersplassen where they believe there is no concern for animal welfare, this is of course not true.

The Beaver Scotland's Ally

Beavers have been extinct from England and Wales since the 12th Century and from Scotland since the 16th. They were hunted to extinction for their skins but there have since been some successful reintroductions, particularly in Scotland but also in Devon and a few other parts of the UK. 'The Beaver Scotlands Ally' conference held at the Scottish Natural Heritage's Battleby conference centre discussed these re-introductions as well as drawing on experience from the recovery of beaver populations in Germany.

Although there have been some successful re-introductions of species in the UK there is perhaps no species with more potential for significantly impact its surroundings on a landscape scale than the beaver.

Figure 2; an example of some of the impacts of beavers at Tyresta national park in Sweden.

While the impacts beavers have are one of the biggest reasons for including them in a rewilding project because of the role they play as ecosystem engineers and the positive impacts they can have; slowing water flow to help reduce downstream flooding and reduce siltation and the channels, dams and wetland habitats that beavers create hold back water and release it more slowly after heavy rain (The Wildlife Trusts, n.d.). But these benefits are also the reason that their re-introduction is so controversial and divisive.

While a beaver lawn of naturally coppiced birch and aspen flooded in shallow water backed up behind a beaver damn might be a fantastic rich habitat but if those same floods impact arable crops or prime pasture, or if beavers start damaging crops or orchards that will start to cause friction in a landscape dominated by commercial agriculture such as is the case in the UK.

There are currently several populations of beaver in the UK, the first to become established is in Scotland. The 1992 European Habitat Directive was instrumental in paving the way for an eventual re-introduction (Scottish Government, 2017) (Robinson, 2019) and after several unsuccessful applications for a controlled release a project was finally approved in 2007 and is a joint effort between the Scottish Wildlife Trust, Royal Zoological Society of Scotland and Forestry Commission Scotland. The first beavers were introduced in 2009 and the project has proven successful so far with the first five years of monitoring concluding in 2015 and cementing the status of the beaver in Scotland (Scottish Natural Heritage , 2015). They have been granted protected status although mitigation for damage caused to agriculture via relocation to other approved sites, or in extremis by lethal means is allowed (Robinson, 2019). There are twelve animals at the site of the original authorised release in Knappdale and a much larger population of between 250 and 400 animals in the Tayside catchment thanks to illegal releases (Scottish Government, 2017). Full details of observed or potential impacts of beaver introductions are detailed in the Beavers in Scotland report (Scottish Natural Heritage , 2015).

Other UK beaver populations discussed at the conference were the ones in Devon and Cornwall;

The Devon beaver trial has been running since 2015 although it is suspected that wild population of beaver have been present since approximately 2007. The address at the conference by the Devon Wildlife Trusts Beaver Project leader Mark Elliot outlined the current status of the Devon population and the impacts and perceived impacts of the beavers in The River Otter catchment. The population

is limited to the River Otter catchment and as of March 2019 there were thought to be seven pairs of beavers in the catchment. Some of the impacts include damage to desirable tree species, fruit trees in particular seem to be a target. Damns have not proven to be a problem to surrounding landowners in deep water but damns in smaller streams and ditches have caused some flooding. The benefits of this damning though have included the creation of raised gravel beds for spawning and general improved water quality. Some opposition has come from landowners who's attitudes regarding badgers and Tb seem to have transferred to beavers and there has been opposition to granting them protected status for fear that they won't be able to be controlled if they were connected to Tb (Elliot , 2019).

In Cornwall the beaver re-introduction is being managed by the Wildlife Trust and farmer Chris Jones on his 'Woodland Valley' farm near Ladock. The beavers have been introduced to a fenced enclosure on the farm which is still accessible to and providing tolerable grazing for cattle, while it's true that some areas flood other areas of pasture have actually improved. The results of the project so far have slowed water flow through the farm and have reduce flood mitigation costs for Ladock from £1,000,000 to £350,000. Another benefit of the slowed water flow is that it filters agricultural pollutants and during drought water drains away from the farm slower and is still available for livestock and to irrigate dedicated pasture (Jones , 2019).

While the progress of British beaver re-introduction projects is interesting and the results so far are promising it's perhaps from the recovery of beavers in Germany that we have the most to learn. Thanks to the pioneering work of Amtman Behr who pioneered the recovery of beavers in Germany from a surviving population of just 200 individuals in the 1920's to around 40,000 today thanks to relocations and reclassification as a protected species rather than as game. Grant schemes provide some incentives and funding for beaver recovery and programmes of compensation and mitigation placate those farmers who do suffer losses. Relocations are carried out where necessary, for example when beavers take up residence in urban drains and sewage treatment works. Beavers can also be culled if necessary but farmers are encouraged to make space for and tolerate beavers. Losses are little more than might be expected from having to maintain 2m buffer strips along waterways except in some specialist crops, for example beaver damns have been known to flood parsley crops but in situations like that damns can be lowered or removed. No significant farm productivity issues have been recorded except in specialist crops as already mentioned (Schwab, 2019).

The conference did provide some excellent information on the impacts likely to be encountered by farmers dealing with beaver introductions, as well as making it clear that there are also many farmers in support of the re-introduction of beavers.

United States

Figure 3; a highlight of my fact finding in the United States; a sighting of a wild Grizzly bear in Yellowstone National Park.

Fortuitously my trip to the United States, while primarily aimed at investigating the impacts of wolf reintroduction in Yellowstone National Park, also allowed me to visit the neighbouring Grand Teton National Park, the West Yellowstone Grizzly and Wolf Centre to find out about the impacts of bears and wolves on the tourist industry, and interview representatives of Montana's Department of Fish, Wildlife and Parks. This broad investigation shed light on the wider impacts of the re-introduction, the legislation that made it possible and the general recovery of grey wolf populations and how farmers in particular have been able to respond to those impacts.

Media and advocates of re-wilding in the UK often focus on the success of the wolf re-introduction in Yellowstone and cite this success as something that can be applied in the UK. Something that became very clear through my interviews and research in The States though is that most of the benefits that have occurred since the wolf reintroduction can most accurately be described as happy accidents and could not have been predicted beforehand, nor necessarily replicated. Before discussing that reintroduction though it's important to understand how it came about and why it was considered necessary.

A History of Persecution

The wolf has long been considered an enemy of farmers and they have been persecuted the world over in an effort to reduce predation of livestock, as well as from general fear of them. The same was the case in Yellowstone, Montana and Idaho, the sites of my investigation.

The last wolves in Yellowstone were killed in 1926, in Idaho in the 1930's and in Montana in the 1940's and all with the encouragement of the government. In 1915 congress dedicated $125,000 dollars to the eradication of wolves and other predators such as coyotes in the Western States (Idaho Fish and Game, 2020). At the time eradicating pests and predators was the accepted wisdom and it was not until much later that the damage caused by the wholesale removal of apex predators from an ecosystem was realised. I learned a great deal about this deliberate persecution of predatory mammals, wolves in particular from Quentin Kujala and Justin Gude of Montana Fish, Wildlife and Parks. This interview took place at the headquarters of Montana Fish, Wildlife and Parks in Helena Montana and as well as providing some background on historic persecution of predators, particularly wolves, they were able to direct me to the Livestock Loss Board for precise figures of livestock depredation in the state including the cost of those losses to farmers. I was able to learn a great deal about the states approach to mitigating the predation of livestock and the opinions of farmers and hunters on the wolf reintroduction that has impacted Montana as well.

Interview with Qentin Kujala and Justin Gude of Montana Fish, Wildlife and Parks.

In answer to my first questions regarding general predation of livestock, whether there were certain species which were most responsible for it and if there was any data on the financial loss caused by depredation I was directed to Montana's Livestock Loss Board and you will find data from them in the next section but I also learned a great deal of important background information on the issue of livestock depredation by predatory mammals. A key element of this question was whether patterns in predation have changed since wolf numbers have increased.

Larger mammal predators present in Montana include black bears, grizzly bears, wolves, mountain lion, coyotes and in very small numbers lynx. Of these predators' grizzlies are by far the most variable in terms of their impact on livestock from year to year and along with wolves and mountain lion attract a compensation payment if depredation of livestock is confirmed. Other species including black bears and coyotes which attract no compensation payment and as such there is less data available on their financial impact on farmers and ranchers. They tend to have more of an impact on poultry farms, small holdings with chickens and other poultry, and black bears in particular can be a nuisance to apiarists and around grain stores. Depredation of livestock by lynx is considered insignificant.

Wolves and lynx are the only predatory mammal amongst those discussed in the context of this interview likely to be re-introduced to the UK as part of any re-wilding efforts, grizzlies and black bears are of course not native to the UK although some comparison could be drawn with European brown bears which have been discussed as a potential species for re-introduction to the proposed Alladale wilderness reserve (Express KCS, 2015). Of all the species discussed wolves are also the only one to have been deliberately re-introduced, to Yellowstone and Idaho in 1995 and 1996. Both areas border Montana and have contributed to the rise of wolf populations in the state with the first wolves dispersing from Yellowstone into Montana in 1999. However these re-introductions were not he first efforts to conserve and encourage the recovery of wolf populations. The US Endangered Species Act demands that those species listed on it not only be protected but that efforts be made to facilitate the recovery of their population (United States Federal Government, , 1973) and therefore efforts have been made to conserve wolves since the act was passed and populations were naturally colonising from Canada so even before the reintroductions the appearance of the first breeding pair of wolves

at Magic Peak in flathead county, the first breeding wolves in Montana since the 1940's was celebrated by the public in the 1980's.

While wolves and grizzlies might take centre stage as the charismatic megafauna of North America their contribution to an ecosystem, or to depredation of livestock and damage to farms, can't easily be separated from the other predator species. The figures available from the Livestock Loss Board which you will see in the next section support this and one of the recurring themes of my investigation has been that the impacts and outcomes of any re-wilding project don't ever come about due to a single species.

There is an argument often used to support the re-introduction of lynx to the UK that they will only hunt deer and will not only not take livestock but that they will help with the issue deer overpopulation . This assumption however while not impossible is not supported by evidence from Scandinavia which records relatively high predation of sheep by lynx. Whilst the argument may be there that lynx, and perhaps wolves and other large predators, are conditioned to take deer as prey rather than domestic livestock, a lynx would normally eat smaller deer species such as roe, and none of the material I have read put out by the Lynx UK Trust, the body advocating for the re-introduction of lynx, makes this distinction and rather groups all 'deer' together as potential lynx prey. If lynx are to prey on 'deer' in general surely they will as easily adapt to eating sheep and other domestic livestock just as they would have to adapt to take other deer species which they would normally not prey on, due to their size, or even ever encounter in their typical range due to the four non-native species which have been artificially introduced since the extinction of lynx from the UK. If we are to assume that lynx or any other re-introduced predator will largely leave livestock unmolested there will surely be some evidence of that from other countries:

Is there any truth to the argument that wolves and other predators are 'imprinted' to only prey on wild prey such as deer?

Wild prey does make up the majority of the diets of large mammal predators but there is also significant evidence, both anecdotal and objective, documenting the depredation of livestock by large mammal predators. For Montana some of this evidence is accessible through the livestock loss board and will be presented later in this report.

What measures are in place to allow farmers and other landowners to protect their livelihoods, 'farmers defence' or 'skydsjakt' (programmes in Scandinavia exist for the control of predatory mammals including wolves and translated as 'protection hunting') programmes/policies, assistance with funding for mitigation and protection, compensation etc…?

The Fish Wildlife and Parks department as well as the Livestock Loss board offer advice to farmers on protecting crops and livestock but also engage the services of specialists who can assist with mitigating livestock depredation up to and including relocation and lethal control under the appropriate circumstances.

Measures allowed for protection of livestock depend on the status of the predator in question, species without protection of the Endangered Species Act can be controlled far more severely than those with it's protection. Due to significant recovery of wolf populations wolves were de-listed in August 2007 and as such can be controlled under conditions determined by the state. This means that in Montana hunters can have up to 5 licences per year to take wolves and farmers and producers can take up to 100 wolves on their land per year and are allowed to remove almost complete wolf packs if they are nuisance. The upper number of 100 is never fully taken advantage of though and it is rare for any one farmer to take more then 12-15 on their land each year and many take none at all. The licence to take

them though seems to instil confidence in farmers and landowners that they can at least do something to protects their stock and livelihoods. In addition to lethal control of wolves by farmers and recreational hunters some success has been had with the use of 'fladdry' more likely to be known as sewling in the UK, a series of small flags on rope, to deter wolves.

Beekeepers are a surprising victim of damage caused by predators, black bears being the culprit for this damage, losses of $150,000 were recorded between 2012 and 2017 (Marketplace, 2017), with £8,000 losses per bear recorded by a single producer in 2017 (Binns, 2017). The state will assist with the cost of protecting hives from black bears and electric fences have proved very successful, with the state contributing up to $500 per fence system to protect hives. Electric fencing has also proved effective at protecting poultry but is ineffective at protecting larger areas of land for livestock. Beekeepers can kill black bears in defence of their hives if necessary but as black bears are not protected exact figures aren't kept of how many bears are killed by keepers in protection of their hives but according to state employed bear managers between one and five black bears are killed in each region of Montana each year in defence of bee hives (Hegyi, 2017). Additionally, recreational hunting for black bear is allowed but there is no concern for the population of black bears and they appear to be thriving.

Lethal control, while its availability placates farmers and producers who want to feel that they have the ability protect their own land and stock has only proven to be temporarily effective. As well as measures taken by individual farmers and producers to protect their livestock and farms there are ten bear mitigation officers and wolf management specialists employed by Fish, Wildlife and Parks and landowners can engage the services of federal bear and wolf experts who are authorised to trap and relocate nuisance animals if necessary. Relocations are particularly relevant to grizzlies which are still federally protected and can't be hunted in Montana.

Are complaints regarding depredation by farmers, foresters etc…. common?

While the initial recovery of wolves in Montana through migration from British Columbia was celebrated the later involvement of the Federal Government and the resulting re-introductions which have significantly sped the recovery of wolves in Montana has been met with opposition as it was felt that a too rapid recovery of wolf populations would harm livestock, and reduce numbers of deer and elk available to hunters.

Additionally, there are some who still remember wolves as a the vicious predators they were made out to be in the early part of the 20th Century and before and may have memories of parents and grandparents who were involved in the eradication of wolves from the state.

As farmers and producers are permitted to defend their livestock and crops from predation and damage it is hunters who are the most vocal in complaining about the reintroduction and subsequent recovery of wolf populations. This is due to the perceived impact of wolf predation on deer, and particularly elk populations, despite the fact that elk populations have actually been on the rise in the state since the 70's and that damage to improved arable land has been increasing along with the elk population.

Has increased predator numbers changed deer habits and caused them to interfere with crops?

I was expecting increased damage to arable land to be blamed in some respect on wolves which had changed migration patterns of deer and elk and perhaps moved them out of unimproved wilderness areas and into farmland but this interview revealed that not to be the case as while pressure from

wolves appears to make elk more mobile within their range due to wolf pressure their migration patterns have remained the same.

Data from Montana's Livestock Loss Board

Montana's livestock loss board has been operating since 2007 to address economic losses caused by wolf predation and to create incentives for producers to take proactive, preventative steps to decrease the risk of loss. Furthermore they state that their purpose is to;

"acknowledge the importance of economic viability and sustainability of individual livestock operators in Montana who are negatively affected by wolves, grizzly bears or mountain lions."

They list their purpose and aims as;

- To provide financial reimbursements to producers for losses caused by wolves, grizzly bears or mountain lions based on program criteria.
- To proactively apply prevention tools and incentives to decrease the risk of wolf, grizzly bear or mountain lion caused losses.
- Develop a compensation framework that integrates with the overall Montana wolf, grizzly bear and montain lion programs.
- Develop an incentive program that integrates with the overall Montana wolf, grizzly bear and mountain lion programs.
- Recognize the importance of economic viability and sustainability of individual livestock operators in Montana.
- Recognize the complex interactions between livestock, wolves, grizzly bears and mountain lions.
- Seek a broad range of funding sources to meet the needs to provide long-term, viable "compensation" solutions.
- Work with federal and state agencies to develop a broad spectrum of options to reduce conflicts and potential depredations.
  (Department of Livestock, n.d.)

Since the establishment of the board in 2007 they have been keeping records of losses to livestock caused by mountain lions, grizzly bears and wolves and of the payments made to owners to mitigate their losses. In 2019 a record breaking $260,838.45 was payed out to 133 livestock owners for losses to cattle, sheep, goats, llamas, horses and guard dogs. 76 of these losses were caused by wolves.

Losses were only attributed to specific predators in the loss boards records since 2014 (and even then not all predator kills were tied to specific predators) so it is difficult to quantify any change in predation patterns due to wolf population increases until that point and as wolf numbers were well established and had been present in the state in increasing numbers for well over two decades by that point it is difficult to say at exactly what point wolf impacts on livestock started to really make themselves felt.

Compared to 2014, when 23 livestock kills were positively identified as being down to wolves and 2019 though wolf depredation as recorded by the board has increased by three times and pay-outs to owners has doubled. Since the board's records began in 2008 pay-outs have almost tripled (Livestock Loss Board, 2020).

This approach to the management and mitigation of damage by predatory mammals, including re-introduced species may well be relevant to future strategies for mitigating losses caused by rewilding in the UK and something similar has been suggested by the Lynx UK trust to offset losses to farmers by re-introduces lynx (Chance & Eagle, 2015) and can also be related to localised mitigation of the impacts of beaver reintroduction in the UK and in Germany.

Yellowstone National Park

Yellowstone National Park became a perfect example of the sort of damage that could be done by eradicating wolves and other predators. The Park itself was established as a National Park by President Ulysses S Grant in 1872 and was the first National Park in the United States, and probably the first in the world. It's new status as a National Park granted it certain protections and over the following century management strategy went through three distinct phases (Wagner, 2006). This management relates specifically to North American Elk (Cervus canadensis) which were present in great numbers in the park. Prior to its designation as a National Park the elk in Yellowstone had been hunted by Native Americans for generations but after their eviction and the establishment of the park the first phase of this management was one of protection. All hunting of elk in the park was prohibited from its creation subsistence and recreational hunting was disallowed and in 1877 commercial market hunting was also prohibited. Additionally, predators were controlled and ungulates including elk were fed during winter. This protection had the inevitable effect of increasing the elk population, the northern herd alone was estimated to number up to 30,000 individuals and was tending to spend winter within the park boundaries, a shift from previous habits due to pressure from settlers and hunting outside of the park.

This significant increase in population had a direct impact on vegetation within the park and these impacts were obvious and noticeable by 1915 when a report was submitted to the US Forest Service detailing the degradation of vegetation in the park. From then the next phase of management 'herd control' began with elk trapped and relocated to 30 different states as well as Canada and Mexico to restore populations there throughout the 20's and later also shot by park rangers from the 30's. Shooting by rangers within the park and hunters outside of the parks boundaries and exportation of captured elk accounted for roughly 80,000 elk being killed or relocating between 1923 and 1968. By 1968 a winter census recorded the population of the northern herd as 3,172 individuals.

The next stage of management was to shift to a 'natural regulation policy' based on the suggestion that winter weather, competition and other natural factors would limit elk populations without the need for human interference. In 1969 all culling and relocation ceased and this policy of natural management began.

After culling stopped carrying capacity of elk in the parks habitats was quickly reached and lots of elk left the park and were shot regularly on the borders due to public and government opinion that the population was too large and to prevent damage outside of the park. Within the park the habitat degradation was severe and perhaps due to hunting at the borders more elk remained in the park and caused significant damage. This policy of effectively allowing the elk to do so much damage has been heavily criticised.

The official name of the management policy was 'natural regulation', I had been incorrectly referring to it as self management and in an interview with Doug Smith project leader for the grey wolf restoration project in Yellowstone National Park he agreed that this was a more accurate term as elk do not naturally regulate and will 'eat themselves out of house and home' something we can observe in the UK as well.

Between 1969 and 1996 'natural regulation' saw huge increases in elk populations and significant habitat degradation but while it is popularly believed that wolves redressed this the fact of the matter is that it was a combined effort between wolves and other predators, some of which had suffered similar devastating levels of persecution as wolves.

Black and grizzly bears as well as mountain lions, coyotes and to a lesser extent lynx have also contributed to the checking of elk populations and it took roughly 15 years since the introduction of wolves for impacts on the elk population to be observed.

The primary objective of the wolf re-introduction was as a tool for managing herbivores other well publicised habitat improvements were not necessarily considered or expected before the project began and while these coincidental improvements have been significant, they have also been very slow and localised but there have been big gains. Twenty-five years into the project and herbivore numbers are down 60% but the habitat improvements are harder to quantify so far although some evidence exists that reduced elk numbers are even influencing river courses:

By the 50's there were no beaver in the Yellowstone river but there have been gradual recoveries, one colony in 1996 has grown to mid-teens but they are isolated in one area. With beavers being absent for so long and without they impacts they have on slowing river flow and creating beaver lawns and floods rivers have become deeper, faster and straighter which beavers then struggle to re-damn so recolonization of other areas of the park is slow. Declines in elk population have allowed a recovery of beaver food plants but they can't always capitalize on this newly available food due to the new geomorphology of the rivers and catchments. While wolves, in combination with other predators have helped reduce elk numbers the changes reported in rivers would not have been possible without the beavers.

If wolves were to be re-introduced to the UK it would be difficult to compare the potential results directly with the success seen in Yellowstone. For them to impact red deer populations in the UK to get the initial reduction it would need to be combined with hunting/culling for quite a while and then hunting could be cut back. This process could take decades and within a fenced enclosure, even if it was massive, you wouldn't get the wider habitat and ecosystem benefits that you see in an unrestricted release like in Yellowstone.

Wolf reintroduction on it's own would not have the effect currently demonstrable at Yellowstone National Park as these results depend on the actions of other predators as well as wolves.

Another factor which makes it difficult to compare Yellowstone with a UK re-introduction is the fact that Yellowstone is 100% public, there is no commercial farming, forestry or other land-based industry, if you don't have that sort of site for release and the landscape is dominated by human activity a release is not likely to work, or even go ahead in the first place. Large fenced enclosures, such as suggested by Paul Lister at the Alladale Wilderness Reserve, is feasible but it would be necessary to manage any introduced wolf population.

Public land is key but there is The American Prairie project near the Missouri river in Montana which is a private re-wilding project relies on buying up land and allowing it to re-wild, the hope is that wolves and grizzles will eventually recolonise.

When hunting elk wolves fail 85% of the time while with livestock they perhaps only fail 5-10% of the time so they can become habituated to taking livestock but they still need to learn that they are prey. Outside of Yellowstone wolves are actively shot to prevent the killing of livestock before any conflict or depredation occurs where possible.

There is a project for the recovery of wolves in Arizona and New Mexico but without an equivalent to Yellowstone they are really struggling to get wolves established. Similarly, wolves leaving Yellowstone and heading into Wyoming are not establishing breeding populations as there is no limit to shooting and hunting. Conversely the Yellowstone and Idaho releases were successful because

they were introduced into areas without commercial agriculture and therefore there was no major conflict initially.

Outside of the park there are fairly liberal attitudes to hunting and killing wolves but in most places this hasn't limited the general expansion of wolf populations in some areas as people are generally bad at hunting wolves and because people don't take full advantage of permitted quotas.

Scandinavia

There have been no deliberate releases or re-introductions of predatory mammals in Scandinavia which distinguishes Scandinavia from most of the other sites I investigates and from the UK which I hope to compare these case studies to and learn from. While no release was made of predatory mammals into Scandinavia that is not to say they have not suffered persecution.

By the 1960's the Wolf population in Scandinavia was functionally extinct due to persecution by humans (Wabakken , Sand , Liberg , & Bjärvall , 2001), with 30-40 individuals left in Sweden after wolf bounties were discontinued in 1965 declining further to ten individuals by the 1970's (Linkowski, Kvarnström, Westin, Moen, & Östlund, 2017). Other large mammal predators present in Scandinavia include the Brown bear, lynx and wolverine, all of which have suffered similar persecution for the same reasons that have motivated almost all persecution of predatory mammals; fear, concern for livestock and, of course, also the value of hides (Wild Sweden, n.d.).

Shortly after these declines wolves were protected in Sweden and Norway and less than 20 years later a migrant from the surviving populations of wolves in Finnland/Russia started the process of repopulation (Vilà, et al., 2003). This recovery now means that there are roughly 340 wolves in Sweden and 65 in Norway, with at least an additional 25 which cross between the two countries (Wild Sweden, n.d.) based on 2017-18 figures. The other predators of Scandinavia received similar protection throughout the 20th Century and since receiving protected status they have all seen significant recoveries in their populations. With those increases there has also been an increase in the predation of livestock (Vilà, et al., 2003). While a key ecological principal which drives efforts to allow reduced large predator numbers to recover, at least in Sweden, is the fact that culling, by humans, does not mimic, and can't replace the effects of predation (Svenska Rovdjursforeningen) but while natural predation of wild prey species is a desirable outcome of recovering predator populations there will always be concerns, and actual financial losses when predation impacts livestock.

Losses due to predation in Europe were quantified in a report to the EU's AGRi Committee in 2018, while the scope of this report included wolverines and brown bear which were once present in the British Isles, they are not currently candidates for re-introduction while plans for wolf and lynx reintroductions are relatively advanced.

Wolf predation between 2012-16 was recorded as follows and it should be noted that the level of predation in Norway alone almost doubles the figures for Europe. Additionally, the omission of any figures on predation of reindeer in Sweden is significant as the protection of the free ranging Sami reindeer herds is a major motivation for culling in both Sweden and Finland. In fact, the Finnish management plan for the wolf populations in reindeer grazing zones in Finnish Lapland required the Finnish government to make a case for exemption from Annex IV of the European habitat directive (Finnish Government, 1990).

Country	Sheep	Goats	Cattle	Horses	Dogs	Reindeer	Others
France	7511	370	61	7	8	-	6
Greece	3450	2194	606	33	-	-	0
Norway	2211	1	1	-	5	51	-
Portugal	1967	1510	940	407	7	-	125
Croatia	1787	477	170	22	114	-	29
Italy (Apennines)	1739	173	300	156	-	-	-
Estonia	767	3	14	5	5	-	-
Slovenia	548	49	21	12	-	-	-
Lithuania	499	38	141	-	-	-	3
Germany	427	6	21	-	-	-	59
Sweden	374	1	12	2	32	-	-
Slovakia	368	7	25	-	-	-	-
Switzerland	261	4	1	-	-	-	
Italy (Alps)	222						
Latvia	149	5	5	-	2	-	-
Finland	95	-	10	1	41	623	-
Czech Republic	21	-	-	-	-	-	-
Denmark	10	-	1	-	-	-	-
Netherlands	1	-	-	-	-	-	-
Total	**22,407**	**4,837**	**2,329**	**645**	**214**	**674**	**222**
Total EU[1]	**19,935**	**4,833**	**2,327**	**645**	**209**	**623**	**222**

1. Excluding data from Austria, Poland, Spain, Bulgaria and Romania for all livestock species, and for Sweden for reindeer.

Figure 4; European livestock depredation by wolves (LINNELL & CRETOIS, 2018)

Based on the fact that Finland has seen an increase from 50 reindeer killed by wolves in 1995 to almost 600 in 2002 (Ministry of Agriculture and Forestry, 2005), while that seems to have declines since the 2002 high based on the figures above (LINNELL & CRETOIS, 2018). The similarities between the reindeer production systems in the two countries make it safe to assume that this pattern of increased reindeer predation by wolves is representative of Sweden as well. Additionally, while reindeer range over much larger distances than any livestock in the UK their largely unsupervised existence is comparable to hill farming in some parts of the UK such as the Scottish Highlands, parts of Wales and some of the upland areas of England.

The other species featuring in the EU report which is most applicable to re-wilding attempts in the UK is the Lynx, it's impacts are insignificant in all European countries except Norway where predation of both sheep and reindeer is very significant. The Lynx UK trust state that this is due to the Norwegian system of sheep production being incomparable to British agriculture (Chance & Eagle, 2015).

Country	Sheep	Goats	Cattle	Reindeer	Dogs	Horses	Others
Norway	5296	2	1	6207	-	-	-
Sweden	145	1	1	-	-	-	-
France	102	-	-	-	-	-	-
Finland	32	-	2	678	2	1	3
Estonia	30	-	1	-	-	-	-
Switzerland	19	9	-	-	-	-	3
Czech Republic	16	-	10	-	-	-	-
Germany	5	-	-	-	1	-	6
Slovenia	1	-	-	-	-	-	1
Latvia	2	-	-	-	-	-	-
Slovakia	1	-	<1	-	-	-	-
Lithuania	0	-	-	-	-	-	-
Croatia	0	-	-	-	-	-	-
Total	**5646**	**12**	**14**	**6885**	**3**	**1**	**13**
Total EU[1]	**341**	**6**	**13**	**678**	**3**	**1**	**13**

1. Excluding data from Austria, Spain, Poland, Bulgaria and Romania for all livestock species, and for Sweden for reindeer.

Figure 5 European livestock depredation by lynx (LINNELL & CRETOIS, 2018)

It is the free ranging nature of Norwegian sheep production that is often cited as the reason for predation being so high but there are other factors such as sheep farming overlap with roe deer populations leading to incidental depredation of livestock (Odden, Herfindal, Linnell, & Andersen, 2008). A key management suggestion to reducing depredation by predators in Norway is to reduce opportunities for predators to access prey (MABILLE,, et al., 2015), this would involve bringing free ranging livestock into lower lying pasture earlier and keeping them there longer and would constitute a major change from traditional farming practice.

Due to these impacts some hunting is permitted of predatory mammals in Scandinavia to limit the impacts of predation, particularly in reindeer grazing areas. While policies allowing hunting of predators is extremely controversial, attracting the attention of various conservation organisations as well as private individuals and even the EU (European Wilderness Society, 2015) it is an important part of mitigating livestock losses, and perhaps more importantly allowing land and livestock owners to feel that they can protect their livestock.

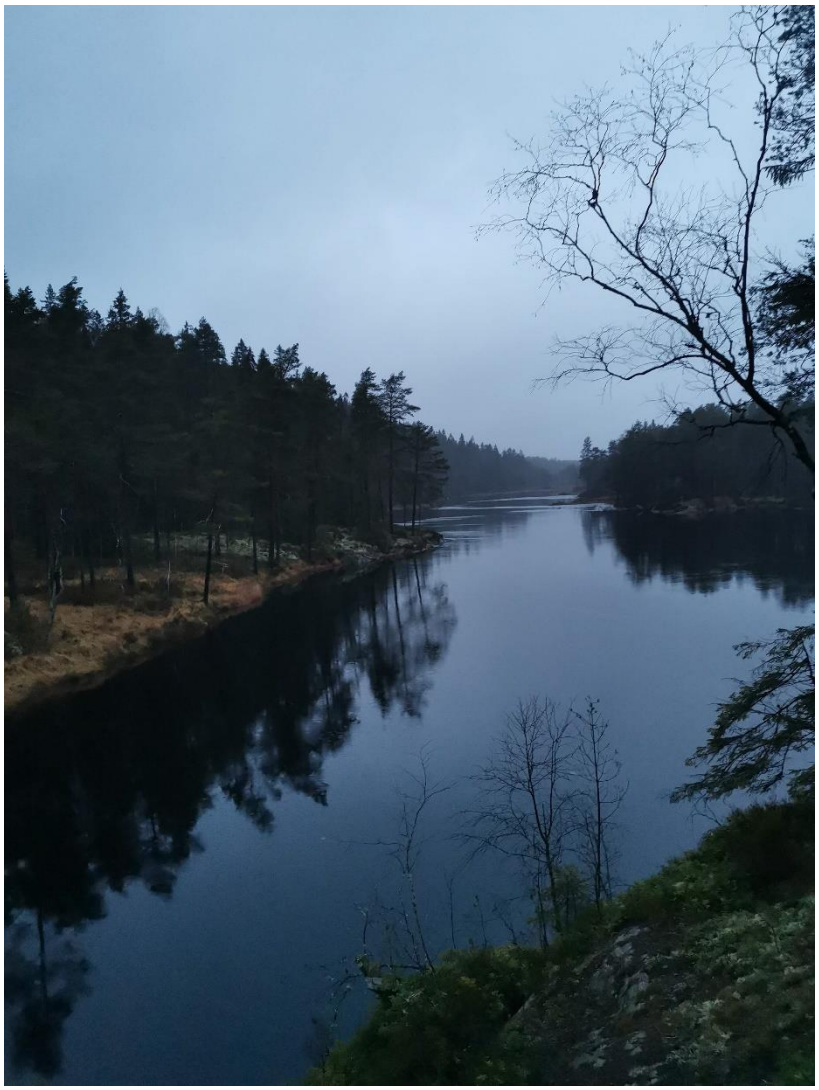

Figure 6; Trestickland National Park, Sweden

Recolonization and population expansion

A point made during my interview with Doug Smith in Yellowstone National Park was that a wolf re-introduction probably wouldn't have been possible in an area which wasn't wilderness or free of commercial farming or forestry due to the likely opposition and backlash from farmers due to actual or perceived impacts.

As mammal predator numbers are deliberately being encouraged to expand, there must be space for them to expand into. While wildlife management policies in Scandinavia do allow for culling and hunting of predators it helps that National parks in Sweden are, similarly to the United States, wilderness reserves rather than the UK model which often preserves a vaguely Victorian landscape including the agriculture and industry associated with those areas. Where wilderness areas still exist though the conflict between agriculture and predators is a moot point and likely to be more successful, or at least suffer less opposition.

The Future

Re-wilding and the associated re-introduction of apex predators is objectively a positive pursuit. To engineer, or at least allow, to re-establishment of wilderness ecosystems and landscapes is commendable and certainly a positive thing for wildlife as well as the environment in general. However what is clear from my investigations is that while we might understand a lot more about ecology and ecosystems than we did when apex predators were being persecuted to extinction in the UK we can't accurately predict or forecast what the impacts of re-introductions would be.

Successful re-wilding is not a case of just stepping back and letting nature take its course, nor of re-introducing key species such as beavers or predators and hoping for the best. It's important also to realise the differences between places where successful re-introductions have already occurred and the prevailing conditions in the UK where there is no true wilderness and recolonization is impossible and re-introductions would rely on the grant of licences, significant funding and the enthusiasm of willing landowners.

This enthusiasm is not in short supply in the UK and beavers are now present in the UK in ever growing numbers, pine martens have been re-introduced to the Forest of Dean and other projects aiming at joining and restoring habitats such as The National Forest and Great Fenn Project are proving popular and growing. Also since I began this investigation the Knepp estate has had significant success in establishing a 'wilded' (Tree, 2019) estate of free ranging grazers and diverse bird and invertebrate populations as well as remaining a profitable enterprise, more profitable in fact that the dairy and arable enterprises previously present on the estate.

Key here is the word 'wilded' rather than 're-wilded' though. Similar to the Dutch term 'new nature' using the word wilding rather than re-wilding recognises the fact that even with deliberate, well thought out re-introductions and management the results aren't always be predictable. Unfortunately, this does mean that some of the assumptions about the positive, as well as the negative, impacts of re-wilding and the introduction apex predators are probably completely wrong.

What should be recognised as well is that of the lack of any true wilderness in the UK will exacerbate any impacts of any re-introductions as re-introduced species will immediately come into conflict with farmers and other land-users. From farmers to casual hill walkers everyone will have an opinion, just as they do on windfarms and other contentions environmental issues.

Re-introductions of apex predators, if they occur in the UK, should be very carefully considered, and should be accompanied by proper policy on mitigation and compensation for loss or damage and it must be recognised that these impacts will occur and that we can't count on the same outcomes observed in Yellowstone and other parts of the world.

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