Natural England Commissioned Report NECR101

Valuing Ecosystem Services: Case Studies from Lowland England

Annex 4 - Knepp Castle Estate Re-wilding: Sussex

First published 15 August 2012

www.naturalengland.org.uk

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Valuing Ecosystem Services: Case Studies from Lowland England

Knepp Estate Rewilding

Preface

This report has been commissioned by Natural England under the contract reference number of 23092.

The work aims to present how a combined ecosystem services and economic valuation approach can be used to understand the implications of different environmental conservation plans. Guidance from Defra on ecosystem services and value transfer is followed (Defra, 2007, eftec, 2010). The approach is used to assess and, where possible, value the likely changes in ecosystem services resulting from an intervention.

The information thus generated can be incorporated into decision-making or support tools such as cost benefit analysis. This information could also inform the way in which the management and conservation projects are designed to maximise the ecosystem service generation.

This is one of the six case study reports prepared to illustrate the application of the ecosystem services – economic valuation approach.

The work has benefited greatly from the ideas, knowledge, data and critique provided by numerous individuals in Natural England and other organisations. These include:

Stewart Clarke, Julian Harlow, John Hopkins and Ruth Waters.

We know that some others have provided advice or data to those who helped us and though we cannot list these people here, our sincere thanks go to them too. And our sincere apologies to anyone inadvertently omitted from the list above. Needless to say, any remaining errors are the fault of the authors alone.

Dr Robert Tinch, Adam Dutton, Laurence Mathieu (authors) and Ece Ozdemiroglu (internal reviewer).

24 November 2011

Contents

1. The Decision Context

This case study uses a value transfer methodology to assess the costs and benefits of possible changes in ecosystem services from a rewilding project on a private estate in Horsham, Sussex (Figure 1). Following a loss of profitability as an arable and dairy farm, efforts to diversify the business have led the owners to rewild the estate using a mixture of grazing animals at low densities.

The Knepp Castle Estate lies on poor quality Wealden Clay in lowland England. It was only brought into agricultural production during WWII and up until then had been maintained as a park. Because of the owners' hunting interests the estate maintained small fields with hedgerows, even though this has reduced the profitability of the farmland. Without direct subsidy, farming the site quickly became un-economic.

The Knepp Castle Estate (or Knepp Estate) is run and owned by the Burell family. Ongoing management as a conventional agricultural concern is economically infeasible, and it is clear that intensive farming is not an option on this land. Other than rewilding, the main alternative management options are grassland rental, or no agricultural management. The Knepp Estate website points out that renting out grassland to tenant farmers had become difficult and increasingly uneconomic. The estate might have decided to leave the land out of agricultural use, and concentrate on revenues from other forms of diversified land-use, including the polo fields, farm buildings and shooting (which already exist). These options are being pursued currently in conjunction with the rewilding project. For the purposes of this study, we assume that grassland rental, though economically marginal, is probably the most appropriate choice for the baseline, along with existing non-agricultural land uses as noted above.

The actual management includes a range of agricultural-business diversifications. The rewilding project is one of these and will see extensive livestock rearing on the rewilded land. Educational visits, field sports and a historic park restoration on the remaining land will interact with the rewilding part of the project.

The estate explains the thinking behind the project (http://www.knepp.co.uk):

> *"The rationale of the Knepp Wildland Project is to restore most of our 3,500 acres of land to the state it enjoyed before intensive agriculture took its toll, and to allow the grazing animals to drive habitat changes by letting them roam as freely as possible with minimal human intervention."*

This case study is unusual in that it relates essentially to private decision making, even though Natural England is involved on the steering group of the project.

The project was the subject of an ecosystem services valuation by a team from Bournemouth University led by Dr K Hodder (Hodder et al, 2010). Information from that report is used in this valuation. However there are significant differences in our interpretations of the benefits of the project. This study also uses stated preference

valuations of other lowland grasslands work to estimate some of the non-market value of the work.

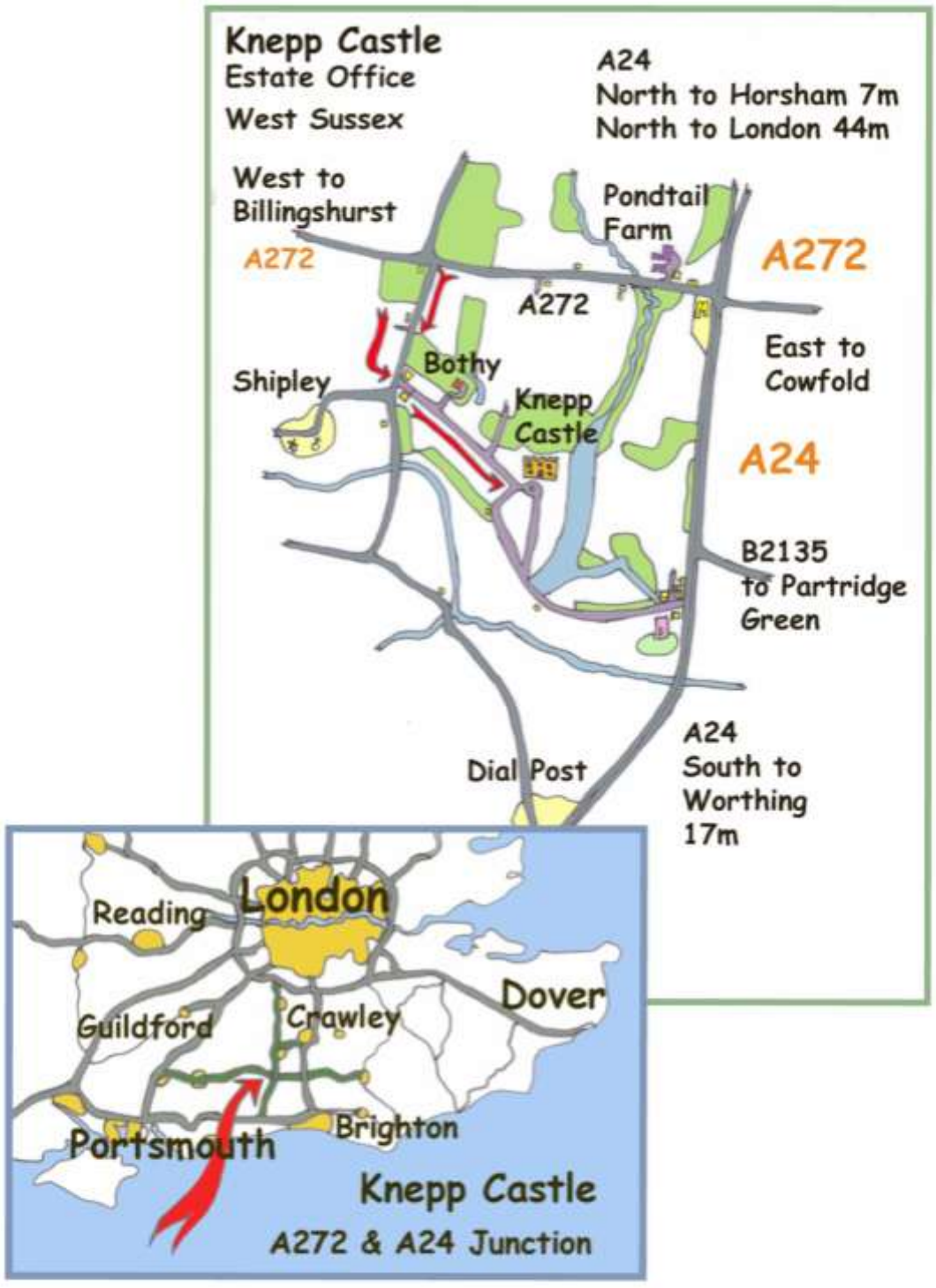

Figure 1: Map depicting the location of the Knepp Castle Estate (www.knepp.co.uk)

2. The Ecosystem Services and Affected Population

Rewilding is a process that involves reducing the intensity and changing the type of human intervention, and allowing natural processes greater freedom to operate. This is not the same as complete abandonment, either in practice or in principle, and in particular rewilding does not imply excluding people, though it does change the nature of the benefits derived from an area. This is both because landscapes and ecological communities have been so modified by humans that they need help to move back towards a more natural state, and because humans seek to derive valuable services from wildlands.

Rewilding requires both long-term commitments but active intervention can help speed the process up. A 20-year timeframe is envisaged, initially, for the Knepp project, though the full impacts of rewilding could occur over much longer periods.

2.1 Ecosystem services

The proposed management practices at Knepp were inspired by the work of Dr Frans Vera in the Oostvaaardersplassen in Holland. Dr Vera believes that much of Europe (before human agricultural changes began) was not forest but more of a savannah-like parkland shaped by large numbers of grazing animals (Vera, 2000). Practically, the rewilding option in the Knepp Estate initially involved stopping fertiliser and chemical application to the land, and an end to ploughing and intensive grazing. This stimulated the revival of many species of grass and wildflowers from the seedbank that had lain dormant in the soil for decades. As well as allowing seeds already in the seedbank to flourish, some areas were seeded with a grass and wildflower mix.

The further proposals involve:

- Fencing the outer perimeter of the Estate with deer fencing followed by the removal of most internal fencing and barriers;
- The provision of safe crossing points over the minor roads that cross the Estate, and over (or under) the A272;
- Minimally-managed herds of cattle, deer, ponies and pigs;
- Further expansion in the medium to long-term via the voluntary incorporation of additional land, especially to the north, west and south; and
- Eventual linkage to other wildlife corridors across West Sussex.

The Estate currently has herds of Longhorn cattle, Fallow deer, Exmoor ponies and Tamworth pigs. Exmoor ponies are as close as possible to ancient horses while still being safe in herds. When looking for a suitable alternative to the Old English Forest Pig a landowner might choose Tamworth pigs as the closest domesticated breed or wild boar. Wild boar would require fencing and a dangerous animals license and so Tamworth pigs are the more feasible option. The exact breed mix for the future is not known and is still under discussion but Table 1 gives one possible combination.

Table 1: Possible Stocking Ratios

Animals	Numbers
Cattle	100 cows, 200 followers
Fallow deer	150 does, 300 followers
Ponies	20 mares, 25 followers
Pigs	70 sows, 350 followers (seasonal peak)
Red Deer	50 hinds, 90 followers

Due to the rather flat topography and business viability, driven shooting on the Estate came to an end in about 1997 and for several years there was no formal “shoot”. Following this, the last partridges died out, and this was one of the motivations behind re-starting a shoot in 2004. Native English partridges have been released and are breeding, and pure ring-necked pheasants have also been stocked. The aim is to move to as natural a regime as possible with minimal feeding and predator control.

2.2 Affected Populations

There are 655 households in Horsham who will also be the target market for the food produced at Knepp. In the wider West Sussex area, there are approximately 321,000 households. Some of these people, and some from further afield, may have some non-use values for the conservation benefits of the project. There will also be local and wider recreational interests, especially through the use of the Estate for weddings, field sports and other recreational activities, all of which may benefit from the aesthetic, cultural and biodiversity benefits of the rewilded landscape, though we have no quantitative estimates for these activities.

3. Ecosystem Service Changes

Here we summarise the likely effects the Knepp rewilding project may have on the ecosystem services provided in the area. The changes are the difference between what is provided now and will be provided in the future without the project, i.e. the baseline (Section 3.1) and what is likely to be provided when the project is implemented (Section 3.2). All quantitative information available is reported in Section 3.2 and the spider diagram at the end of that sub-section summarises the likely changes based on our analysis of the existing information.

3.1 Assessing the baseline

Based on the discussion in Section 1 and for the purposes of this study, we assume that grassland rental, though economically marginal, is probably the most appropriate choice for the baseline, along with existing non-agricultural land uses as noted above. The return to intensive agriculture is not envisaged.

While in the past the Estate employed several foresters, with the decline of the industry, there has been no forestry employment at the Estate since August 2002. Currently, very little woodland management is being carried out. The baseline would therefore not have any forestry activity and income.

3.2 Qualitative and quantitative assessment of the change

Food and fibre: Hodder et al (2010) compared the project to reversions to arable from grassland. However this may not be the most appropriate baseline since the estate's previous arable enterprise was loss-making and options for change were actively sought. This is a common story in recent dairy farming, with the industry indicating that farmers were regularly making a loss on milk. It may be that increased wheat prices in recent years would make it profitable once again.

Compared to conventional agriculture, the food production under the project would be a little lower, but of higher quality or value. Between 200 and 300 animals will be produced under rewilding each year. A medium stocking density might produce 10 lambs per hectare farmed which could be over 10,000 in total. But the change in type of animal and produce would result in higher unit value meat from traditional breeds, and there are options for high value niche marketing/branding associated with the rewilding project to enhance the unit value.

Timber: With the project, there will be little forestry income: further tree generation will be limited by grazing, and trees will become part of the wild landscape. Leaving dead trees standing rather than converting them to timber fits with the conservation objectives. However there will be continued thinning in some of the woods, to maintain ground flora and biodiversity, and some neglected coppice woodland has been brought back into rotation. These operations are likely to be uneconomic, so although there will be some timber value (logs and sawn timber are retailed and delivered) the net economic benefit can be assumed to be zero.

Renewable energy: Not relevant to the project.

Fresh water quality: In intensively farmed areas, a shift away from intensive grazing or arable would reduce nutrient inputs, prevent soil compaction and poaching and potentially lead to significant benefits. Here, however, the baseline does not involve intensive farming, only grassland letting. Reduced stocking levels will reduce pollution loads, and re-creating water meadows is likely to enhance water filtering and may improve water quality downstream. However the effect is likely to be minor and valuation is not possible at this stage.

Water flow regulation: Some impact is possible: re-creating water meadows and taller vegetation might both increase storage capacity for flood waters and hence reduce downstream flood risks. Hodder et al. (2010) point out that the project may provide significant flood mitigation. However without a more thorough understanding of the catchment, which would require complex hydrological modelling, we cannot estimate or value the extent of these changes.

Soil and erosion control: Not relevant for the project.

Climate regulation: Change in type/density of livestock will reduce emissions from livestock; increased woody biomass will enhance carbon storage in biomass.

In the baseline, 1400 hectares would be grazed at low density by sheep. Redman (2011) can provide estimates for stocking densities and production per hectare. Williams (2006) estimates emissions per tonne of deadweight produced. Multiplying the tonnes of emissions per unit of deadweight by production per hectare and then by the number of hectares provides an estimate for emissions in the baseline. We know that the new livestock regime will produce approximately 200 animals per year, estimating a deadweight loss for these of 0.4 tonnes (just under that for cattle) the emissions per deadweight tonne produced is approximately 6 tonnes of CO_2 equivalents for livestock. We can then use these figures to estimate the emissions from the rewilding livestock. This provides an estimated saving of over 2000 tonnes of CO_2 equivalent emissions per year.

For soil sequestration the figures presented by Cantarello et al (2011) for sequestration potential per hectare by habitat type are used as in Hodder et al (2010). The changes in habitat cover were taken from (Hodder et al., 2010) and multiplied by this per hectare sequestration estimate to calculate the total sequestration potential. Cantarello et al (2011) suggest a time period of 100 years over which this carbon would be sequestered and so this value was divided by 100 to provide a yearly value. We thereby estimated that 1,789 tonnes of CO_2 would be sequestered each year as a result of the new management.

Air quality: Impacts on air quality are unlikely to be significant.

Recreation: Recreational use of the area will be enhanced through improved aesthetic quality, wildlife, more ‘interesting’/natural breeds of livestock, and the upkeep of paths and bridle paths along with the creation of “cool camping” facilities. Walking is thought to have already increased substantially (perhaps six fold (Hodder et al., 2010)) because of the improvements on the land, however the total number of walks is unknown. 650 day visitors including school children, 700 campers and 40

regular horse riders are expected each year (Kernon Countryside Consultants, 2007).

The land will continue to be used for field sports: increased scrub may provide better habitat for game birds, and the improved estate aesthetics may improve the shooting experience. Without the project, it is likely that the field sports interest would have been lost - indeed shooting had effectively ended between 1997 and 2004.

Education and knowledge: The Estate will offer educational trips. These trips may not present a *net* gain as alternative school trip destinations may be available. The marginal benefit of gaining a stronger understanding of agriculture over other educational trips is unlikely to be easy to value and neither would be the value of providing this extra choice.

Cultural and spiritual: The cultural and spiritual values of rewilded land could be significant, especially in the context of the south-east of England where such areas are vanishingly scarce. For the first areas to be rewilded, the marginal values of wild land could be very substantial. On the other hand, the use of the area for shooting, camping and so on, as well as the commercialisation of the livestock, could be seen as limiting the extent to which it could really be claimed as wild.

Landscape and aesthetics: Returning the landscape to its 'original' parkland state will enhance the aesthetic appeal as well as the biodiversity. 1400 ha of parkland will be removed from intensive farming.

Biodiversity/habitat: Significant improvements are expected due to the rewilding project. Hodder et al (2010) carried out an Ecological Impact Assessment (EcIA) for the area, finding a 622% increase in BAP priority habitats expected once the project changes are complete. Hedges will thicken and spread whilst within fields scrub and woodland will develop. Herbivores will prevent woodland covering the area, and instead a dynamic mix of grass and scrub will develop. In the Oostvaardersplassen this experiment has led to mixed woodland and grassland maintained by the grazing animals (Vera, 2000).

Figure 2 provides an overview of the relative changes in ecosystem services which we might expect from this project. This is eftec's assessment based on the information available about the project. It compares the baseline without the project with the situation with the reconnection. A scale of 0 to 5 is used where 0 means the service is not provided and 5 means the service is provided and is optimal for the site.

The key findings from the above assessment are that:

- It is particularly difficult to disentangle: "Cultural and spiritual; Landscape and aesthetics and Biodiversity/habitat" in this case study. Together, the changes in these categories represent the largest gains for the site.

- Food and fibre is more contentious since it depends on the baseline. In our baseline the Knepp Estate is able to make more money from the livestock than they would have in the baseline and so there is a gain. However, if rising crop prices were to make a wheat crop viable again (in the baseline), this may reverse the analysis so that the baseline becomes more profitable than the project.

- In the baseline, there was no activity for capturing the education and knowledge service and relatively little recreation was provided. In the project scenario a range of activities is to be provided including camping, riding and walking along with guided tours of the site and hence the analysis shows strong increases in these values.

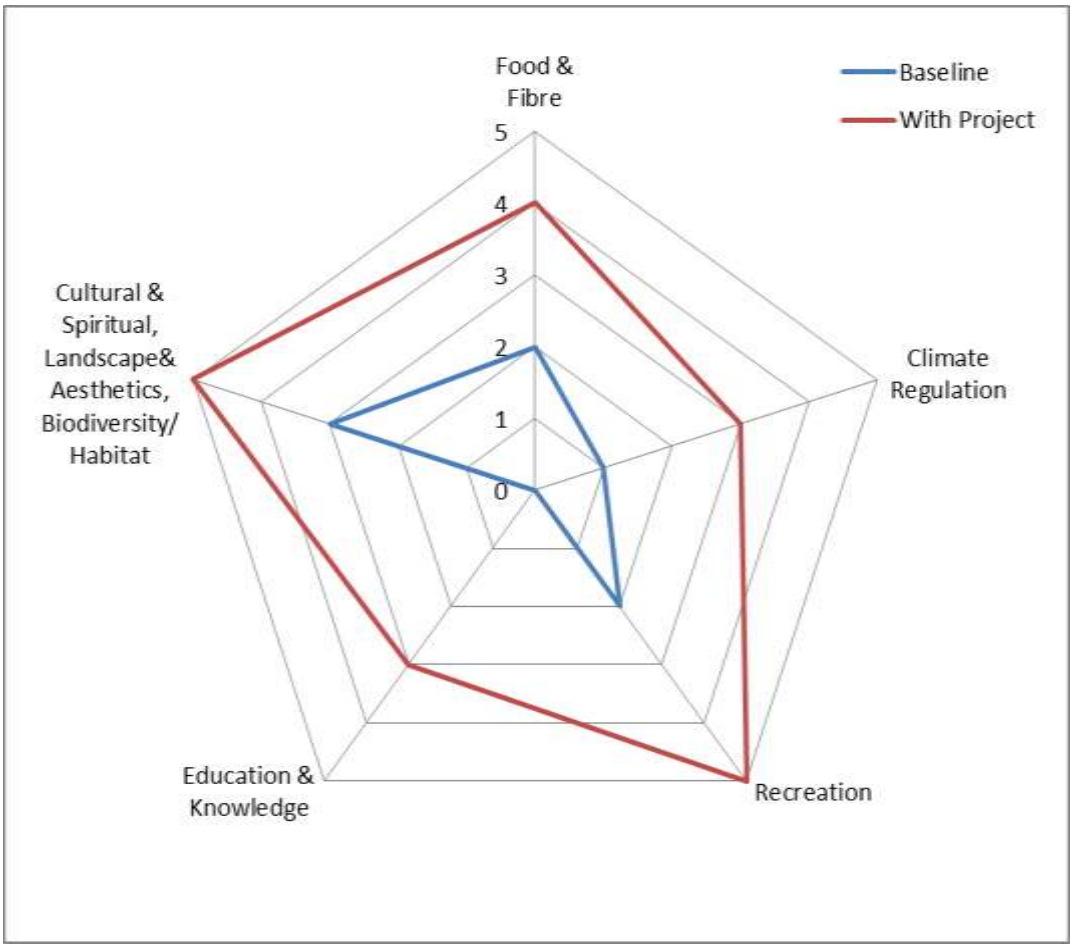

Figure 2: Spider diagram of relative changes in ecosystem service provision (eftec's assessment)

Table 2 summarises the key statistics from the above discussion.

Table 2: Key statistics of ecosystem service changes due to the Knepp project

Ecosystem service change	Value	Source
Climate regulation		
Net estimated CO_2 emissions avoided from grazing	>2000tonnes / year	(Kernon Countryside Consultants, 2007), Redman (2011) and Williams (2006)
Carbon sequestration with the project	1,789 tonnes/year	Estimated from (Cantarello et al, 2011) and estimated land cover changes (Hodder et al, 2010)
Recreation		
Horse riders	40 riders signed up to use the Estate	(Kernon Countryside Consultants, 2007)
Number of campsite visitors	700 visitors / year	(Kernon Countryside Consultants, 2007)
Number of visitors for educational trips	650 visitors / year	(Kernon Countryside Consultants, 2007)
Cultural and spiritual / Landscape and aesthetics / Biodiversity / habitat		
Are of land converted to low grazing (rewilding)	1400ha	(Kernon Countryside Consultants, 2007)

4. Identify and Select Monetary Valuation Evidence

Here we report the process of review and selection of the unit economic value estimate that is appropriate to the case study. The value evidence includes market prices, estimated premiums where relevant and estimates of willingness to pay (WTP) or willingness to accept compensation (WTA) for non-market goods and services.

The appropriateness is determined by similarities between the context on which the estimate is based and the context of the case study. The key factors that define this context is decision making context, place, ecosystem services and population affected. The estimates also need to be robust or at least variations explainable.

Table 3 shows the unit value estimates that are selected for further analysis. The same estimates are presented in bold throughout the text.

Table 3: Unit economic value estimates used in the analysis

Ecosystem service	Value	Reference	Key reason for selection
Food and fibre			
Livestock income projections	£11,000 -> £124,000	(Kernon Countryside Consultants, 2007)	Site specific data provided.
Gross margin/hectare (lamb)	£154	(Redman, 2011)	Standard Farm Income Text
Climate regulation			
Non-traded carbon price	£51.70 per tonne in 2010 to £268 in 2100	DECC, 2010	Standard UK carbon prices
Recreation			
Cost of access to bridle paths	£78/adult, £39.50/concession	(TROT, n d)	In absence of WTP estimates, only cost of access is available
Safari camping price	£120/adult, £60/child	(Coolcamping, n d)	
Education and Research			
The cost of an educational trip to a farm	£27.55 per child per trip	Estimated using HLS scheme costs and (Mourato et al., 2011)	Cost of providing educational trips – min measure for benefit
Cultural and spiritual / Landscape and aesthetic / Biodiversity / habitat			
WTP for overall rewilding per household	89 pence	Based on Garrod et al (1994)	Closest lowland value found even though different context

Food and fibre: Usually a marginal change in agricultural land use and output could be valued using the Nix Farm Management pocketbook (Redman, 2011) profit estimates per hectare. However this is not appropriate in this case for dairy or arable farming because the poor soils and small fields reduce the capacity for the landowners to take advantage of the economies of scale that can be achieved with large machinery on large fields. This led to a lack of profitability for these enterprises and their closure. Use of average values from the farm business handbook would provide exaggerated values in this case as they do not take account of the fixed costs of the whole farm business.

It is difficult to value the baseline of rented grazing. The most likely assumption might be low density sheep farming, the sunk costs of which are likely to be similar to those the Estate is paying in the rewilding project. We can use Nix (Redman, 2011) per hectare income net of variable costs to estimate the per hectare income and the project running costs to estimate the fixed costs. **We use a low marginal profit per hectare of £154 for low density sheep grazing from (Redman, 2011).**

For the rewilding project, Table 4 presents the income projections estimated in the feasibility assessment. These values take into account the premium available for selling organic produce form the Estate retailed through Rother Valley Organics.

Table 4: Income projections from livestock sales from Knepp

	2007/8	**2010/11**	**2013/14**	**2016/17**	**2019/20**
Cattle	5	48	63	72	76
Ponies	0	0	0	1	1
Pigs	3	6	14	28	36
Red Deer	0	0	2	3	5
Fallow Deer	3	2	2	4	6
Total	11	56	81	108	124

Total Sales Figures, rounded, in and to nearest £'000. (Kernon Countryside Consultants, 2007)

Figures of £11,000 rising to £124,000 from (Kernon Countryside Consultants, 2007) **were used to estimate project income.** We then assumed that in the baseline the land was rented out for low density sheep farming. We also included the sunk costs from the project's work on livestock farming in the baseline value for sheep farming. In this way we estimate whole farm incomes for both the project and baseline rather than just the marginal income per hectare.

Climate regulation: Can be valued using DECC guidance figures for carbon values. In this case, the relevant figures are those for non-traded carbon (DECC, 2010). **The mid-range values rise from £51.70 per tonne in 2010 to £268 in 2100 (DECC 2010).**

Recreation: The most common unit value of informal recreation is expressed in terms of £ per visit and estimated through individual willingness to pay by stated preference and travel cost studies. Estimates in terms of £ per visit can be applied to current and future number of visits. This assumes that the quality of each visit (and hence its value) is the same. So this project would only be valued in this way if it leads to increase in the number of visits since the evidence is too coarse to pick up the value increase due to increase quality of a given visit. Alternative units used in the literature are £ per type of access, £ per household or £ per hectare.

Alternatives to WTP estimation include direct use of wage rates (opportunity cost of time) or assessment of trip expenditures, but neither of these methods results in economic value estimates.

We used actual online prices for camping ("Tented Safari") of £120 per adult and £60 per child (www.tollrides.co.uk Accessed July 2011). We also valued the horse-riding using values from the TROT scheme which the Estate was signed up to. This is a scheme which helps landowners hand out access licenses for horse riding (www.tollrides.co.uk Accessed July 2011). Minimum prices for access to restricted bridle ways are £78/adult/year and £39.50/child/year (www.tollrides.co.uk Accessed July 2011).

These values are prices, not willingness to pay values, and do not include consumer surplus. Nor do they include the added value to the existing rights of way walkers, nor new walkers (numbers believed to have increased six fold due to the aesthetic improvements from the scheme). Previous studies have found rambling groups willing to pay around 50p for each extra mile of access and the site has 26 km of pathways. If this were *an additional* 26 km, walkers may be willing to pay in the region of £8 each for the access.

Shooting values could contribute to the economic performance of the estate. Rough shooting in England can be quoted at from £150 per gun per day[1]. Mixed game days where a decent bag is expected can range from £240 - £290 per gun per day[2].

Education and knowledge: In principle education services could be valued using willingness to pay methods, but for practical reasons this is difficult. An alternative proxy is to use the costs of engaging in education activities. Mourato et al. (2011) value educational trips made by schools to the London Wetland Centre and the Hanningfield Reservoir in 2009 and bird watching activities for the RSPB-organised Big School Birdwatch.

[1] www.cervus-uk.co.uk
[2] www.countrysports.co.uk/sheets/walked_up_mixed_game_and_rough_shooting.htm

The value of educational trips is the sum of transport costs, value of teachers' time, value of student time based on the cost to government of keeping students in education and (if applicable) the cost of HLS payments to the farmers who receive education trips.

Mourato et al (2011) estimate the above (with the exception of the cost to farmers) as follows:

- Transport costs: The average cost to parents of a primary and secondary school day trip in the UK was used to value transport costs = between £7.75 and £16.18 per child per trip.
- Teachers' in-vehicle travel time: was valued using 'wage rate' – 125% of their wage (estimated at £35,000 per annum, to reflect the cost of their time and labour overheads).
- Student time: was valued at the cost to government of students in education (about £5,140 per student per year).
- Time spent travelling in the vehicle was calculated using GIS from the postcode locations of each school. The 'excess time' - time spent waiting or walking to and from school buses - was valued at 200% of in-vehicle travel time costs, following standard procedures in transport analysis.

The final values were £628 per educational trip or £19 per child for the London Wetland Centre, and £839 per educational trip or £30 per child for the Hanningfield Reservoir.

For this case study, the landowner costs can be estimated using agri-environment Higher Level Scheme payments (Natural England 2010). These come as a base payment (£500 for a minimum of 4 visits) per year and a per trip payment (£100) which is equivalent to £8.55 per child (assuming a class size of 26.3).

Thus, the value of an educational trip in this case study based on the student and school costs (£19) and farmer income £8.55) is **£27.55 per child per trip**.

Cultural and spiritual; Landscape and aesthetics and Biodiversity/habitat: Contingent Valuations were carried out for English lowlands in the Somerset levels ESA **(£17.53 / household /year)** (Garrod, 1994) and for the Culm grasslands (£12.50 / household / year)(Burgess et al., 2004). The Somerset Levels valuation was carried out in 1993 and looked that the value of designating the area as an ESA and providing agri-environmental payments to encourage good stewardship. The Culm valuation was carried out in 2003 and was for a 10% increase in the total coverage of Culm grasslands over a 10 year period within the Culm grassland area in Devon and Cornwall.

These contingent valuations are for broader schemes over a larger landscape. Even correcting for relative areas, Knepp is a relatively isolated area and may be valued rather differently. It may not benefit from synergies / economies of scale as part of a

larger conservation project – although there are plans to extend activities in cooperation with neighbouring landowners.

Despite these drawback, the Somerset ESA study is still the most relevant. For value transfer analysis to the Knepp case, we assume that willingness to pay is linearly related to area covered, when scaling down from a larger study. While it is not possible if such a linear relationship does in fact exist, this is the only assumption that can be made. The assumption allows us to estimate the willingness to pay per hectare and transfer benefits from larger scale projects. We used the Somerset Level's valuation as these are relatively dry grasslands (Garrod, 1994).

The value attributed to Somerset Levels ESA was converted to a per hectare figure (total value for Somerset divided by are of Somerset Levels values), resulting in an estimated WTP of **89 pence per household per year** for the conservation at Knepp Estate.

Costs of management: The costs of the rewilding project are provided in the feasibility report as: £1,242,000 for initial works and £84,975 per year for annual management (Kernon Countryside Consultants, 2007).

The total cost of the project may be higher if we include the set up costs for a camp site and maintaining improved bridleways. A campsite of 15 tepees would cost approximately £30,000 for the tepees (at roughly £2,000 each[3]) suggesting total set up costs would be under £40,000. Within a total set up cost of in excess of £1 million this extra cost is negligible. We might also assume that the running costs of both bridleways and the campsite would be small relative to the ~ £90,000 of the rewilding project (Kernon Countryside Consultants, 2007).

[3] www.tipis.co.uk or www.hummingbird-tipis.com

5. Monetary Value of Ecosystem Service Changes

Having selected (or assumed) the appropriate unit value estimate, here we aggregate this to the affected ecosystem service and/or population. In many cases, this is a simple multiplication of the unit of change (from Section 3) and the unit economic value (from Section 4).

Table 5 summarises the results and the rest of this section explains the process behind these. The unit estimates from different years are converted to 2010 £ using the Retail Price Index and Consumer Price Index (Note the Consumer Price Index only began in 1996).

Table 5: Summary of Values for Likely Ecosystem Service Changes

Ecosystem service	Environmental Change	Economic Value	Net value £/Year
Food and fibre			
Livestock income	As stocking increases	Total values provided	£11,000 rising to £124,000
Opportunity cost of the sheep farm	1400 ha	£154/ha minus running costs per year ~£90,000/site	£130,625
Climate regulation			
Carbon sequestration with the project	3790 tonnes/year	Yearly carbon price as in DECC (2010) guidance	£196,000 (2010)
Recreation			
Cost of access to bridle paths	40 riders	£78/Adult, £39.50/concession	£3,120
Safari camping price	700 visitors	£120/adult, £60/child	£63,000
Education and Research			
Educational Visits	650 students	£27.55 / student	£17,910
Cultural and spiritual / Landscape and aesthetics / Biodiversity/habitats			
WTP for overall rewilding	~321,000 households	89 pence / household	£369,823

Food and fibre: We use per hectare income net of variable costs to estimate the per hectare income and the project running costs to estimate the fixed costs. If we ignore fixed costs we overestimate the value of farming the estate. To calculate the net benefit per hectare income is multiplied by the number of hectares and the fixed cost estimate is subtracted from this sum. Sheep farming income for the baseline is based upon variable per hectare incomes for low density sheep farming of 1400 hectares.

Estimates based on expected stocking densities and sale prices from the feasibility assessment (Kernon Countryside Consultants, 2007) suggest £11,000 rising to £124,000 per year from livestock under rewilding, compared with ≈£215,000 per year for sheep farming in the baseline.

Climate regulation: The total yearly change in emissions from livestock rearing was multiplied by DECC estimates for the un-traded Carbon Price (DECC, 2010).

Recreation: Prices for UK tented safaris were multiplied by estimates for the number of visitors. We also used the price of the TROT scheme to estimate total income from the 40 people signed up for horse riding each year. Shooting values have not been estimated as lack data on gun-days.

Education and knowledge: The total number of day visitors was multiplied by our estimate of the per student costs of a school trip to a farm.

Cultural and spiritual / Landscape and aesthetics / Biodiversity/habitat: The value chosen to represent the non-market biodiversity and cultural values was taken from a valuation of the Somerset levels ESA. The unit estimate is multiplied by the number of households in West Sussex and the size of the Knepp Estate.

6. Aggregation

The benefits identified above can be summed over time to give a comparison of the baseline (grassland rental) and the project scenario (Table 6). Income from livestock was based on increasing yearly estimates up to a maximum. Other than for the livestock income we are assuming that yearly benefits for all other services begin immediately. The values are estimated on a year-by-year basis over 10, 50 and 100 years, discounted at the HM Treasury Green Book (2003) rate declining over time: 3.5% for years 1-30; 3.0% for years 31-75; and 2.5% for years 76-125.

Table 6: Present values of service changes at Knepp Estate (£ millions)

Ecosystem service	**Present value**		
	10 years	**50 years**	**100 years**
Benefits			
Food and fibre	£0.92	£6.08	£12.29
Climate Change	£1.76	£8.83	£14.50
Recreation	£0.62	£1.68	£2.13
Education	£0.17	£0.46	£0.58
Cultural and spiritual / Landscape and aesthetics / Biodiversity/habitats	£3.45	£9.42	£11.94
Cost			
Set up and running	-£2.03	-£3.41	-£3.99
Opportunity Cost (income from rented grassland in baseline)	-£1.22	-£3.33	-£4.22
Net present value	**£3.67m**	**£19.70m**	**£33.20m**

We might have chosen to include the “Opportunity Cost” in the aggregate estimate for food and fibre. We have separated the value out here in part because of the uncertainty over what the baseline ought to be. In this way it allows readers to substitute the lamb production we assumed for other farm enterprises more easily.

7. Sensitivity Analysis

The most significant values arising are from the composite of biodiversity, cultural and landscape services and the GHG emission reductions. There is high uncertainty regarding the physical and monetary measures of these services. The carbon emission reductions are based on a range of assumptions regarding the farming practices and the subsequent emissions which may not hold.

The WTP for the composite service valuation is based on landscape scale valuations. We assumed that the marginal value of a hectare of lowland managed for biodiversity is equal to the average value per hectare of a landscape scale conservation effort. A relatively small area under management, isolated from other habitats, will not have the same ecological benefit as a landscape scale project. So our values may be too high. However given that this is a relatively ecologically poor area it might also be reasonable to assume that local willingness to pay may be higher than elsewhere.

Even over the shortest period of analysis for 10 years the benefit:cost ratio is approximately 2:1 and so if the total benefits were half those estimated the project might still break even. There is therefore significant scope for a positive cost benefit analysis even if there are significant over estimates. Moreover, in the longer term the income from the businesses associated with the rewilding are more profitable and able to outweigh the running costs alone.

Changing the baseline to be agricultural production (instead of rental grasslands) is not realistic. The Estate has made it very clear that agricultural alternatives are unprofitable on this land. The alternative baseline of land abandonment is equally doubtful. Nevertheless, when considering the costs and benefits of this project, it is worth considering the project with and without the sheep farm opportunity costs: we have counted these costs, but in the ‘real’ baseline they might not have arisen.

Similarly, if the land had been left un-managed it is possible that carbon storage would be similar to, or even greater than, under the project’s management.

8. Conclusions

Carbon sequestration and biodiversity/landscape benefits are significant in this assessment as they often are. Including these benefits and good management, the business case (including a positive net present value) becomes more likely.

Over 50 years the profits from livestock and visitors may well outweigh the costs without recourse to the inclusion of non-market benefits. However this would assume that market prices for foodstuffs remain the same. As wheat prices rise it may well reach a price at which the Knepp Estate would have made considerably more money from intensive farming.

It is also interesting to compare the value transfer here with the analysis by Hodder et al (2010). It is expected that assessments based on different assumptions or interpretations of the impacts will lead to significant differences in overall value. In many cases the process of assessment (as also outlined here) is at least as important and useful for project design as the final value. The comparison of the two studies can be summarised as follows:

- Comparing our results to those of Hodder et al. (2010) is problematic since we are uncertain as to the timescales over which the Hodder results are estimated.
- If we assume that the carbon values are considered over 100 years, then our results are very similar for carbon sequestration. However, while the values reported here were discounted, we could not find any evidence in Hodder et al (2010) that discounting was used. This leads to very significant variance.
- The assumptions used for losses from food and fibre are very different between the two studies and this is borne out in the final values. Some of this can be explained given our attempts to assume relatively low incomes per hectare for farming. Hodder et al. (2010) were told by the estate that wheat farming would be the most likely alternative. However this clashes with statements on the website that wheat farming was given up many years back due to unprofitability. This is why in this study we assumed that a low input-low per ha income farming enterprise would be used in the baseline. The second difference is in Hodder et al.'s use of per hectare variable income rather than whole farm income. If a farm were to give up a few hectares of arable land but maintain an arable farm then the change in the fixed costs for the farm would be likely to be very small and per hectare variable income would be most appropriate. However in this case we argue that a more significant change is occurring and so an estimate for whole farm income is more appropriate.
- The assumptions used by the two studies for recreation are different. There was significant uncertainty over the number of visitors who used the public access routes. We chose to ignore benefits where we could not measure the difference between the baseline and the project. While Hodder et al. (2010) instead used some reasonable assumptions in order to measure the non market recreation

benefits, we concentrated on estimating the market values from the TROT scheme and the potential camping venture.

Summary

The Knepp Estate is a private estate in Sussex which found the agricultural business increasingly unprofitable. As they began to alter land management in favour of biodiversity conservation they found that both their own quality of life (as residents and land managers) and their income potential improved. The Estate is now embarking on a rewilding of much of the estate based on extensive grazing.

This case study is particularly interesting as another valuation has already been carried out Hodder et al (2010). We use some of the data gathered by that study but have significantly different views on some of the assumptions used. Rather than being a confusing clash of expert opinion, we believe that this provides a greater opportunity to fully understand the potential for variation between studies. In many cases it is the process of valuation which shines more light on the benefits of the project than the final values produced. We would urge readers to read both valuations and so gain a broader understanding of what might be happening at the Knepp Estate in terms of environmental benefits. Ultimately, both studies predict significant benefits for the environment.

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