LIFE Project Number

LIFE12 ENV/UK/000473

Progress Report

Covering the project activities from 1/7/2014 to 30/6/2015

Reporting Date

03/08/2015

LIFE+ PROJECT NAME or Acronym

NaturEtrade
[Redacted version]

1. Table of contents

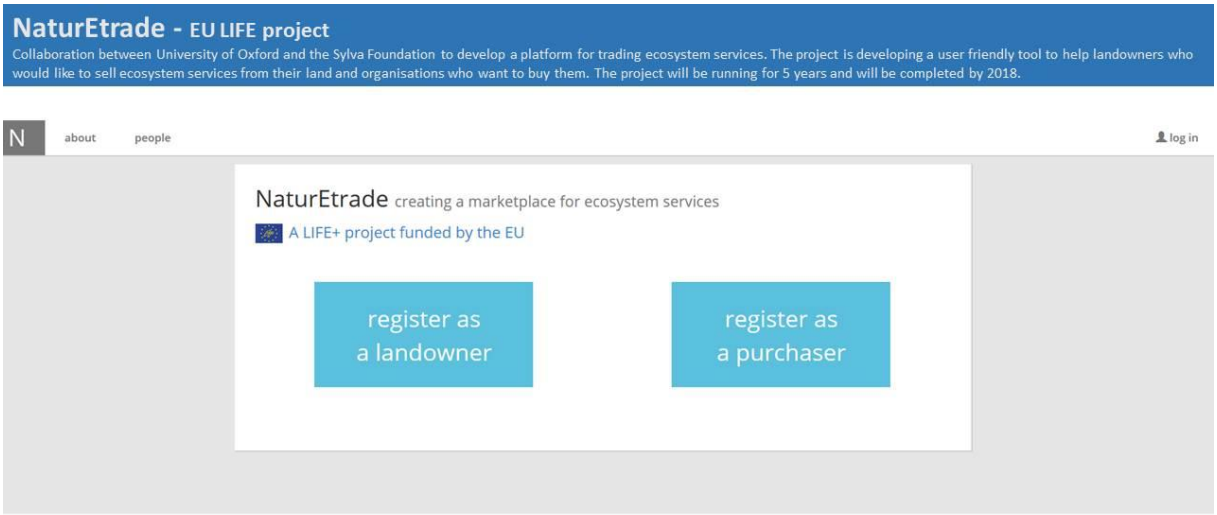
3. Executive summary

3.1 General progress.

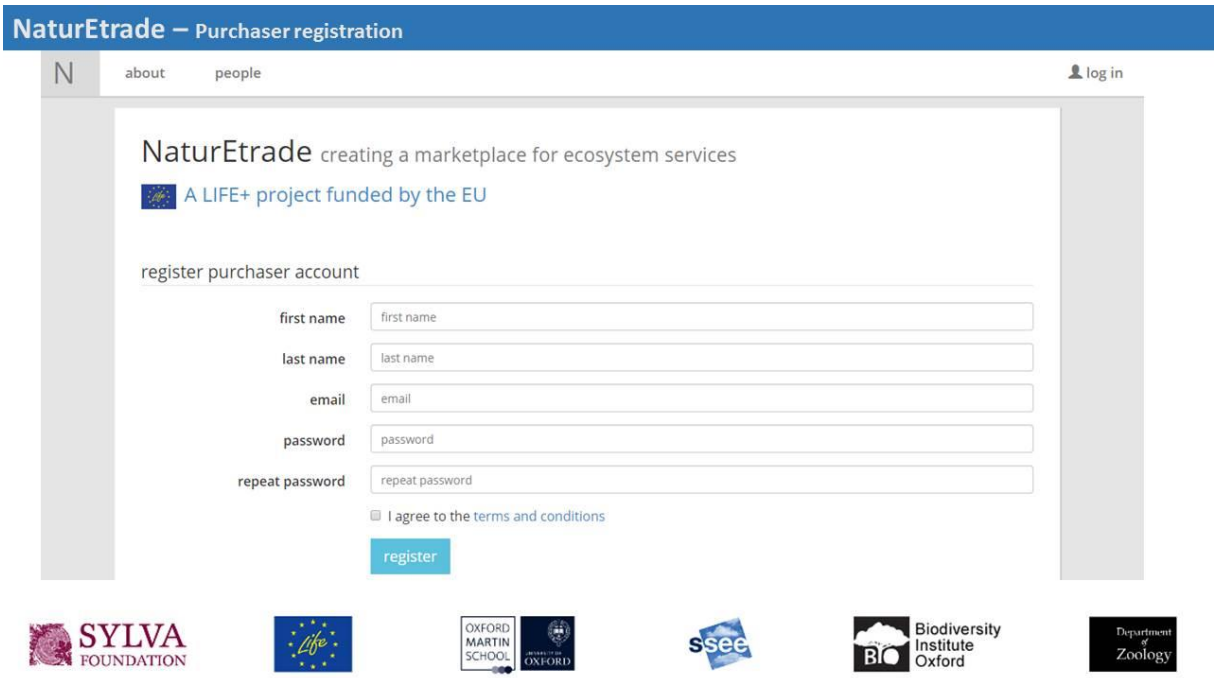
The project is broadly on track in terms of deliverables and on track with the anticipated budget. We have identified a need to change the status of one of our key collaborators and have sought advice about how we can alter the Grant Agreement to enable them to become an associated beneficiaries rather than a sub-contractor. The principal reason for this is realisation that we would be in breach of Article 8.2 of Common Provisions (2012) with respect to sharing UP from the project. Our original proposal makes it clear that we will jointly share the IP, having used IP from the Sylva Foundation for NaturEtrade, and it is an oversight that we did not explore how to work with them as an associated beneficiary. We will be requesting an amendment in our mid-term report. Reasons for this are set out below, but relate mainly to the issue of intellectual property rights and greater efficiency in delivering the project. The dynamic nature of the project has meant that deliverables (either original or amended in the Inception Report of 4/8/2014) continue to be reviewed, particularly where assumptions and beta versions of the user interface are tested with users and alterations agreed. There is also excellent group learning where individual interpretations of the tool are tested and subjected to critical appraisal. Small changes that have occurred to the timetable for milestones and deliverables are clearly identified in this Report and reflected in a revised GANNT chart.

The testing version of the user interface now enables users to create user accounts, map their land parcels and create searchable files containing information about the ecosystem services (ES) on these parcels and purchasers to look for land parcels and ecosystem services to 'purchase'. The following images provide a visual summary of the project to date.

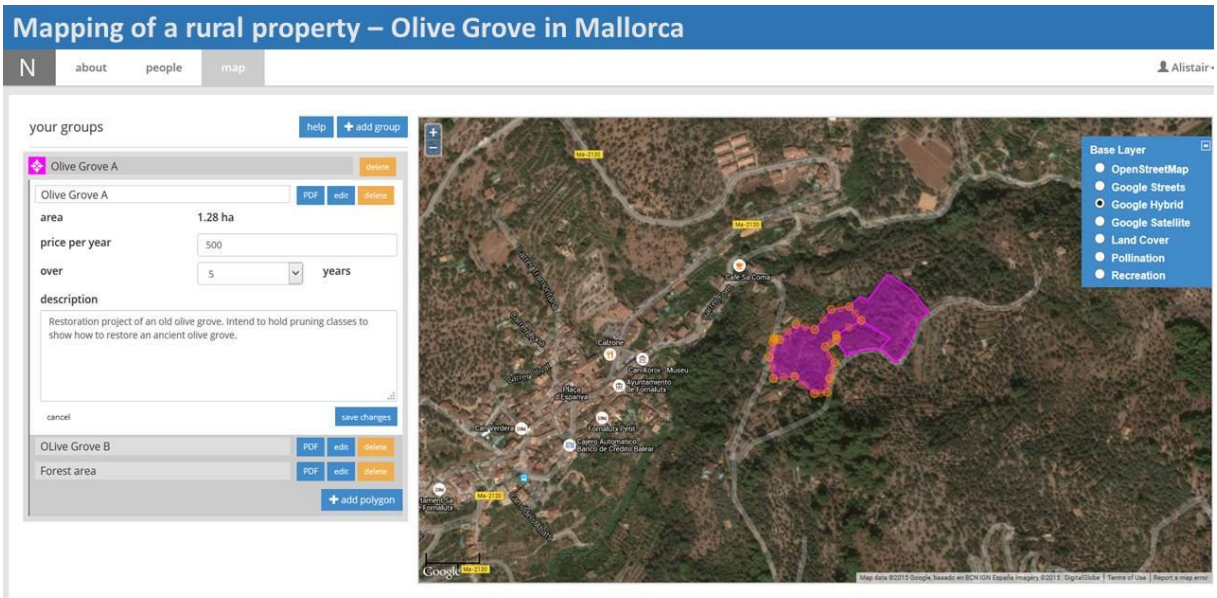
1 Registration



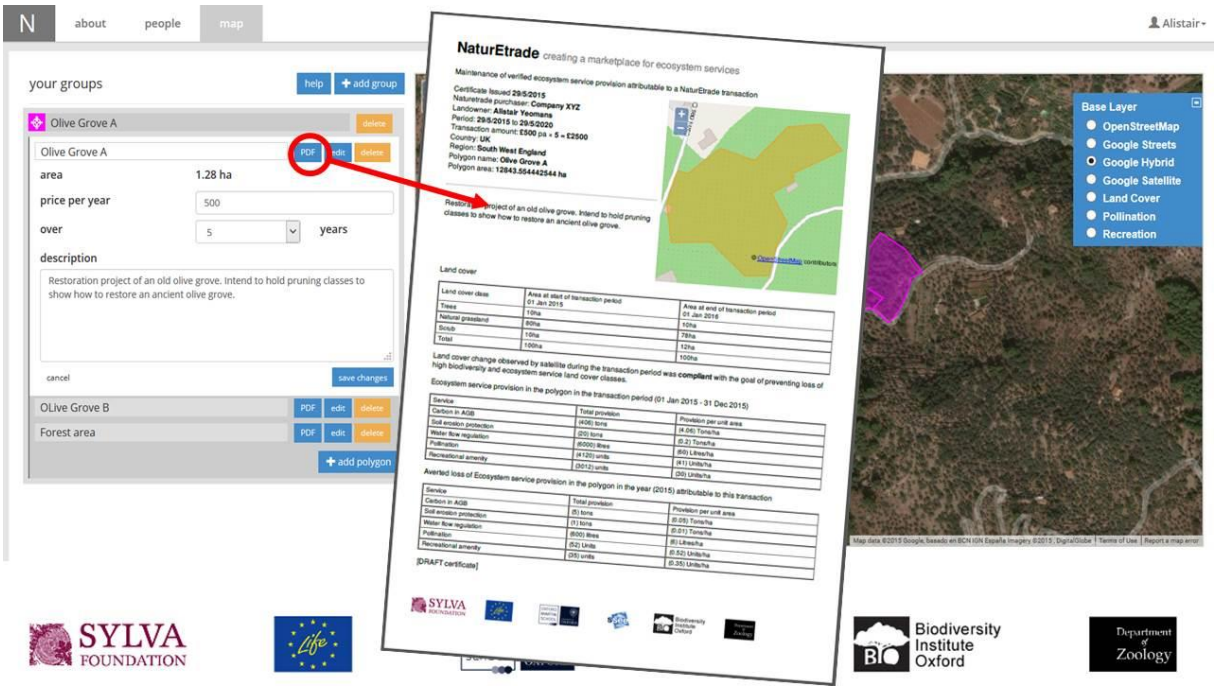
1. Registration (continued)



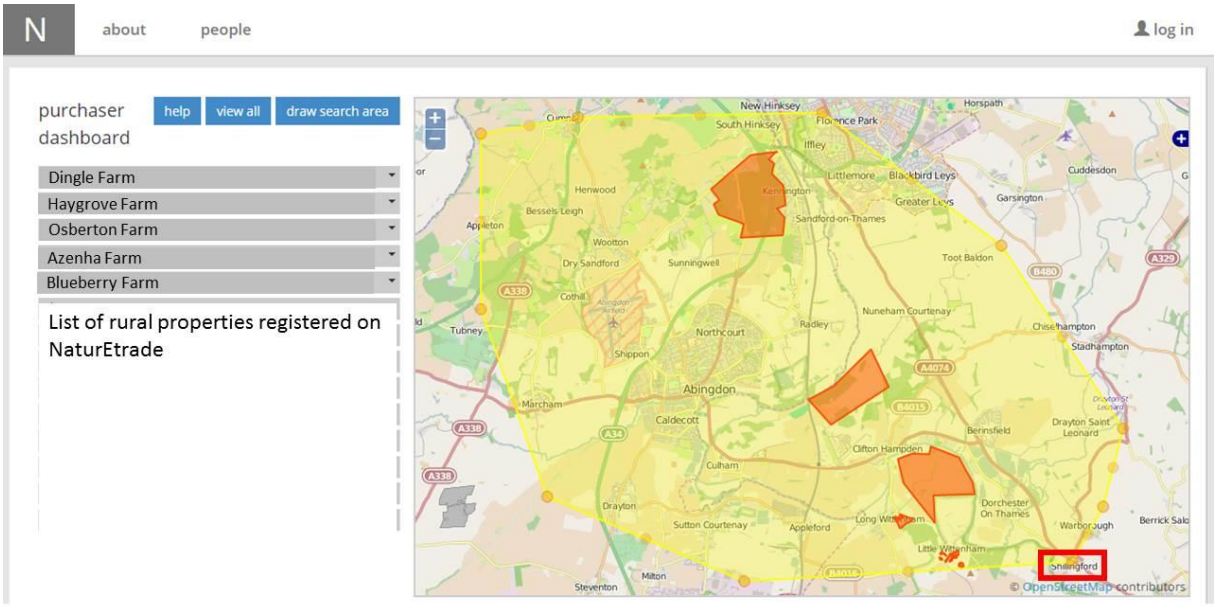
2 Landowners map land parcels



3 EcoSET computes ES information compiled into pdf report for parcel

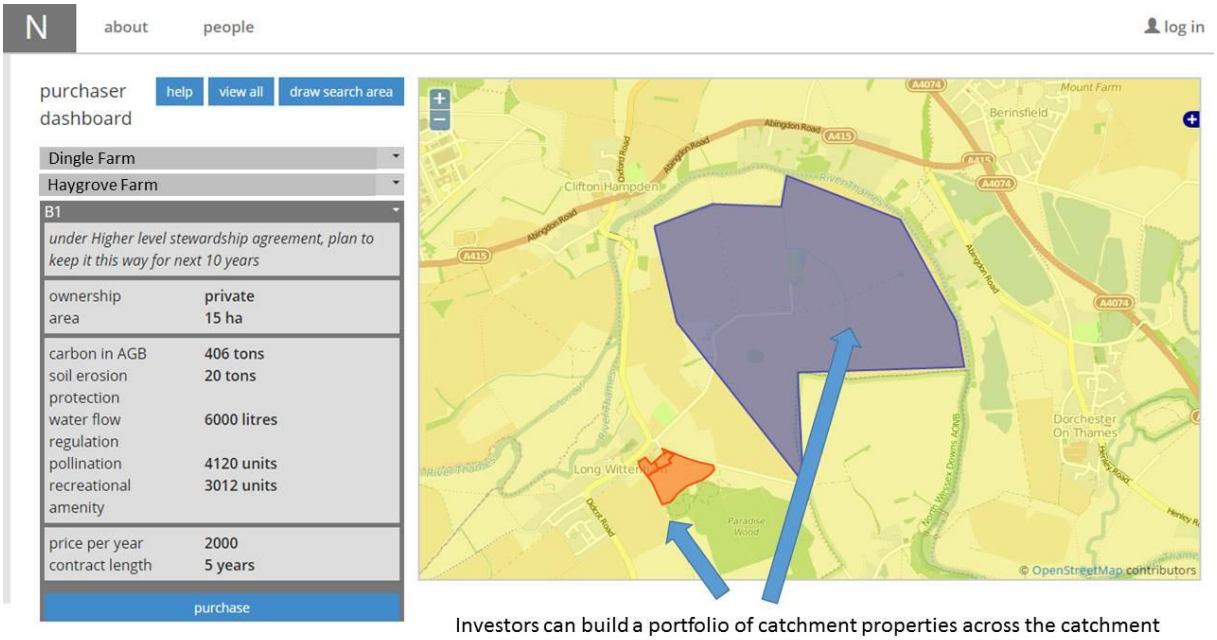


4. Purchaser searches for land parcels by geography (e.g. a water catchment of business interest) or particular ES attributes (e.g. pollination services for business or personal reasons)

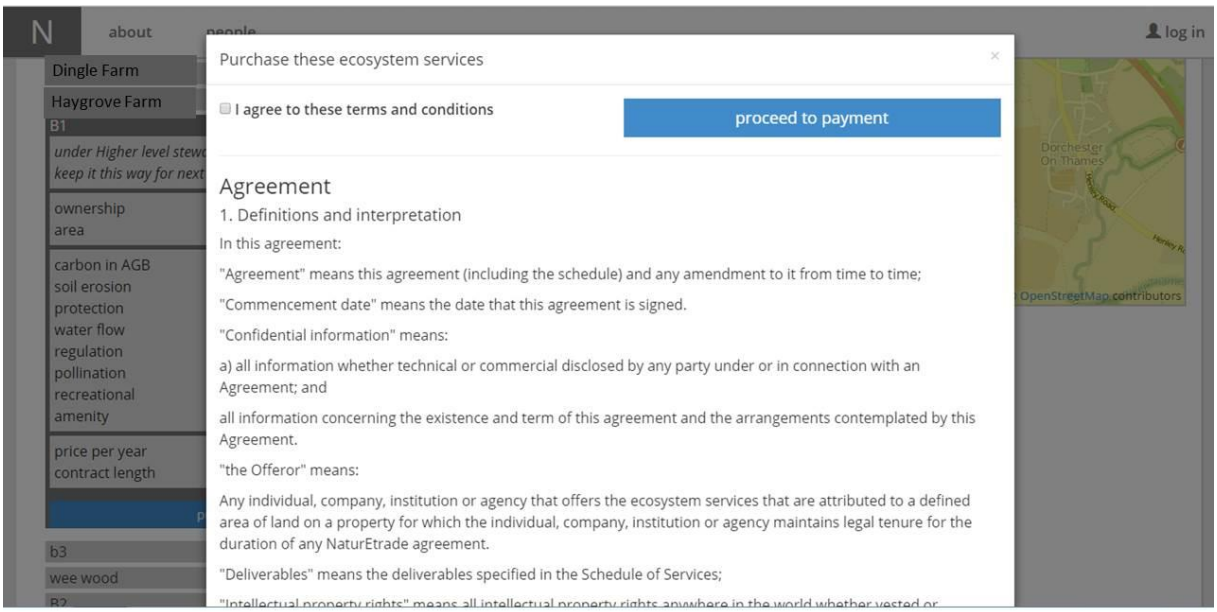


4. Searching for land parcels (continued)

5. Property attributes and purchase price displayed



6. Contracts agreed



Populating the reports with meaningful ES data is ongoing as is the content of the contracts between parties (see later in this report).

3.2 Assessment as to whether the project objectives and work plan are still viable.
At this stage the project objectives and work plan are viable. Changing the Grant Agreement to incorporate the Sylva Foundation as an associated beneficiary will improve project efficiency and enable us better to interact with potential end users. We will retain links with the Smith School of Enterprise and the Environment, but on a 'needs must' basis when elements of the trading platform are more fully developed, and when we need to link with their network of businesses with an interest in natural capital to supplement those we have developed with the Sylva Foundation. Given that NaturEtrade is a practical, not research, project, we do not feel justified in spending more time exploring the academic issues of this type of trade; the review of relevant literature having shown us the dearth of practical projects upon which to draw. The budget and human resources we feel is better deployed building the site and using Sylva's networks of landowners, land agents and CSR personnel to test elements of it iteratively.

3.3 Problems encountered.
The last 12 months' work has demonstrated the bottlenecks that can occur in data processing – both computer time and staff time. However, we have circumvented many of these by purchasing services from an SME computer development company, Tesella. They were not listed in our original submission as a cost item, but it is clear that the project team is better employed in problem-solving for the project and not in computer coding, which is better handled by a specialist company. This has enabled us to reschedule our original timetable somewhat, postponing due dates for a number of milestones and deliverables by 6- and 12-months to December 2015 and is the most cost-effective way of delivering some of the more

detailed JAVA programming that is required in the tool development. The money to pay for this has been obtained through cost-savings in other parts of the project; in particular, some of the tasks originally identified to be carried out by the Smith School of Enterprise and the Environment were found to be more effectively delivered by the Sylva Foundation when we developed the user-interface for the platform which gives us an economy of scale because of their familiarity with, and staff resources to work on, the interface between the technical aspects of the project and the stakeholder needs. This level of technical ability and practical expertise was not available in-house at the Smith School and it would have been inefficient to hire a post doc to work there divorced from the main body of work in the Biodiversity Institute and the Sylva Foundation.

4. Administrative part

4.1 Description of project management

4.1.1 Meetings

4.1.1.1 Project team meetings

The team continued the system of regular '30-minute meetings' attended by at least one member of the Biodiversity Institute and one member of the Sylva Foundation. In these meetings, rapid updates were presented and any problems discussed. Following a full team meeting on October 24th, it was agreed that the work of the Smith School of Enterprise and Environment (SSEE) would be put on hold at the end of 2014 as the milestones and deliverables fell more naturally into the package of work undertaken by the Sylva Foundation (see below for details of change of project structure).

Dropbox continued to be the main means of internal communication. Details of work progress, meetings attended, relevant academic papers, presentations, photographs, and discussion documents are posted there with full access to all. This has proved invaluable in making impromptu presentations of NaturEtrade during meetings where we had no official presentation slot, but took advantage of third parties' interest in our project.

4.1.1.2 Stakeholder meetings

22 Sept., 2014. The first Knowledge exchange workshop (Milestone 16) – reported at planning stage under Inception Report 5.1.5.4 Sub Action D1 was held at Little Wittenham Oxfordshire. Further details are reported below (5.1.5.1 Action D1), together with a table of meetings at which aspects of NaturEtrade have been presented.

4.2 Organigramme of the NaturEtrade project team and the project management structure (from October 2014)

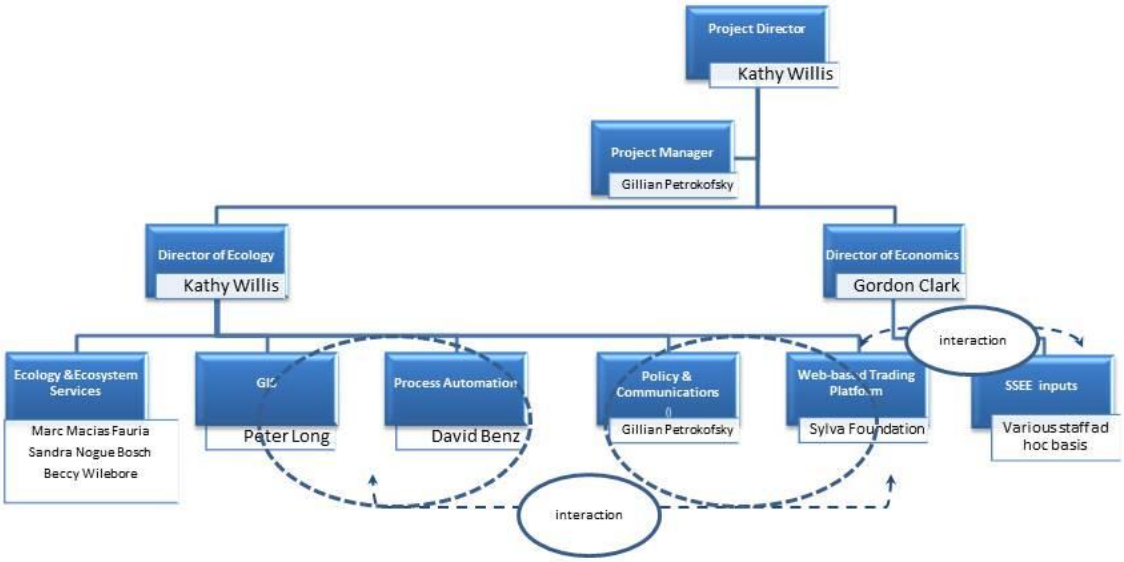


Figure 1 Organigram for NaturEtrade

4.3 Reports since start of project

Inception Report dated 04/08/2014, covering period 1/7/2013 to 30/6/2014 submitted.

5. Technical part

Around 1500 ha of biodiverse land are lost in the EU every day to changes in infrastructure and urbanisation, with serious implications. Land conversion directly affects key ecosystem services supporting climate change, natural infrastructure and sustainable use of natural resources. NaturEtrade will demonstrate a novel approach that will enable EU landowners rapidly to assess the ecological potential of their land using simple-at-point-of-use tools developed from complex data sets and then to trade (by leasing) the ecosystem services with other landowners, businesses and others who have a stake in land conservation. Landowners will be drawn from individuals and organisations that own land privately, or those responsible for publically-owned land. Types of traders and their aspirations will be assessed in stakeholder workshops in the four countries of the project: UK, Spain, Croatia, and Romania. Four interlinked Actions implement the project objectives.

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5.1 Actions

These are reported based on the milestones and deliverables in the Grant Agreement (amended in the inception Report) - see Annex 1)

5.1.1 Action 1: B1: Development of EcoSET

	2014			2015				2016			
Sub-Actions (Indicators of progress)	Jul	Oct	Dec	Apr	Jul	Oct	Dec	Apr	Jul	Oct	Dec
1 Data acquisition for ecosystem service layers	M1										
2Adaptation of the ecological layers from LEFT			(M2)				M2				
3Development of models, algorithms and datasets					(M3)		M3				
4Automation of the EcoSET tool									M4		
5Completion of GIS web-based tool (EcoSET)									D1		
6Production of report detailing design of EcoSET									D2		

NaturEtrade builds upon the Local Ecological Footprinting Tool (LEFT) and the Ecosystem Service Tool (Ecoset) developed by the Biodiversity Institute, Oxford. LEFT was described in detail in the inception report. It has been used and accepted by a wide variety of stakeholders including the oil and mining industries and environmental consultants because it is easy to use for non-specialists, and provides rapid, repeatable output in an accessible format which has been validated by ground-truthing. www.biodiversity.ox.ac.uk/left

The ecosystem services tool (Ecoset) shares much of the computer architecture of LEFT, but instead presents information on the provision of five ecosystem services: pollination, water flow regulation, carbon in above-ground biomass, soil erosion prevention and recreational amenity.

5.1.1.1 Sub Action B1 (1) Data acquisition for ecosystem service layers

Milestone 1 (M1) – started November 2013, due: July 2014. Milestone amended to July 2016. Status: ongoing

Sub-Actions for M1:

1. ***Acquire data for ecosystem service layers and develop tiling scheme for Europe.***
2. ***Establish spatial data granule databases, set up automatic geoprocessing servers.***
3. ***Prepare ancillary data sets across Europe which are needed for ecosystem service evaluation using open access digital elevation models and climate data.***

In order to calculate the provision of ecosystem services across Europe at regular time intervals, it is necessary to assimilate and process large volumes of satellite data. In particular, clear (cloud-free) observations of land surface reflectance in multiple wavebands and land surface temperature are required to make land cover classifications at regular time intervals and hence, with additional ancillary data, to calculate the provision of each of the ecosystem services across Europe in time-series using the algorithms we have been developing in this project.

This action is ongoing. However we have already been able to use the data in order to demonstrate the potential of NaturEtrade to stakeholders. Milestone M1 will be completed by July 2016.

We have developed a method to remotely estimate the distribution and type of vegetation cover using freely available data sources. To develop a global landcover classification map at

30m pixel resolution, we therefore obtained satellite data from the NASA Earth Information system. We downloaded images from both the Moderate Resolution Imaging Spectroradiometer (MODIS) instrument and Landsat 5,7,8 from years 2000-present. We then combined these to create a high spatial resolution estimate of seasonal surface reflectance and temperature at 3-monthly intervals We used a spectral classification tree procedure (Baraldi 2006) to covert these data to a land cover classification at 30m resolution. In the resultant land cover map, we distinguish the following classes: urban, water, wetland, snow & ice, bare soil, cropland, shrubland, deciduous forest, evergreen forest. We masked out the sea and created a clearly delimited coastline using the planet.osm database.

We are using a number of digital elevation datasets, including the recently released SRTM 1" data for Europe. Elevation, but also derived variables such as slope, aspect are used as inputs to modelling.

We have already set up an automatic C# script to collect Flickr records from across Europe in time-series for use in the recreational amenity algorithm.

We set a storage server with 80Tb space in Aug 2014 and have since added a further 40Tb to hold the data which will be required for calculating ecosystem service provision at high spatial resolution.

5.1.1.2 Sub Action B1 (2) Adaptation of the ecological layers from LEFT

Milestone 2 – started January 2014, due: December 2014. Amended due: December 2015. Status: ongoing.

In the course of developing the Local Ecological Footprinting Tool (LEFT), we have developed methods for calculating the pattern of several indicators of ecological value across landscapes at high spatial resolution. In NaturEtrade, these data will be presented to users to provide contextual information about the biodiversity value of land parcels which might become subject to transactions for ecosystem service provision. In this action, we are adapting the procedure which produces these data for LEFT to make the data layers usable within the NaturEtrade web interface.

This action was due to be completed by Dec 2014. This action has been delayed because of a bottleneck in the rate of bulk ordering, bulk downloading and bulk processing of very large numbers of Landsat granules which has taken longer than expected. However we have now successfully addressed these problems by using data-reduction methods and by using the Oxford supercomputing facilities to process satellite data. Additionally Tessella, a SME specializing in custom software development, have been contracted to support us in development of code for manipulation of GBIF records, styled map generation, geoprocessing to calculate summary ecological value, and uncertainty analysis. They were not included on the original project proposal (or associated budget) because we had anticipated doing the computer coding tasks in-house. They were selected on the basis of our prior knowledge of them working on very similar tasks for LEFT1, during which we developed a good working relationship with them, made easier by their proximity to Oxford. (Annex 2 is a schedule of work (an extension of LEFT tasks necessary to configure EcoSET/NaturEtrade) and accompanying contract from the University of Oxford).

Description of the ecological layers

Vulnerability

In order to produce a map showing the number of globally threatened terrestrial vertebrate and plant species potentially present across a landscape, we used a variety of databases.

First, we used the IUCN Red List of Threatened Species (IUCN 2014; http://redlist.org) to extract the list of the scientific names of species of amphibians, reptiles, birds, mammals and plants that are considered vulnerable (i.e. IUCN classes CR, EN, VU, or NT). Additionally, for each of the species we also extracted the list of countries and sub-national administrative regions considered by the IUCN to intersect the species natural range.

Second, to estimate the pattern of the relative number of globally threatened species of amphibians, reptiles, birds, mammals and plants across a specified landscape, we obtained georeferenced species occurrence records from the Global Biodiversity Information Facility (http://www.gbif.org/occurrence) of all those species on the identified IUCN species list. For each threatened species we also built a polygon using Global Administrative Areas database (GADM; http://gadm.org) of the set of sub-national administrative regions considered by the IUCN Red List to be within the natural range of the species and generated 10,000 random points within this polygon for each species. We then extracted the values of land cover, climate, and topography covariates at the location of each GBIF record from the relevant databases in order to build a 'samples-with-data' (SWD) file for each species. The covariates used were land cover class; 30-year climatology of mean annual temperature, temperature seasonality, total annual precipitation, precipitation seasonality (Hijmans 2005); Elevation and slope (Farr 2007).

Third, a species distribution model (MaxEnt – Maximum entropy algorithm; Phillips et al., 2006) was fitted for all IUCN identified species with more than 10 unique occurrence records. Models for species which performed well (defined as having an area under the receiver operating characteristic (AUC) curve >0.7; Araújo et al., 2011) were retained and projected onto gridded covariates in the set of 1-degree tiles intersecting the potential range of each species. The tiles of modelled distribution maps for each species were hardened to presence/absence maps by reclassifying at a habitat suitability threshold of 0.5.

Finally, the maps of all successfully modelled species were added together to make a tiled map of the number of IUCN threatened species potentially present across the landscape. In the resulting output map, those parts of the landscape with the highest number of threatened species carry the highest ecological value.

Biodiversity of terrestrial vertebrates and plants

Richness can be thought of as a result of the combination of the total species diversity in a given place (habitat level – alpha diversity) and the diversity of habitats (beta diversity - Whittaker 1972). In an ideal world, there would be sufficient data to obtain a concrete picture of these two variables through assessing biodiversity on the basis of individual species occurrence data combined with species distribution models (e.g. Hirzel et al., 2002). For

many regions in the world, however, this is not possible given the paucity of the data. An alternative strategy in such situations, therefore, is to shift the focus of species distribution models from individual species to emergent properties of biodiversity (Ferrier 2002). With this approach, the limited information available from species occurrence data is linked to a suite of environmental variables for which we do have full spatial coverage to make statistical inferences about biodiversity in locations from which we know environmental characteristics but we do not have species information. We have adopted this latter approach to obtain a measure of biodiversity across landscapes.

To do this we calculated the pattern of beta-diversity of plants, amphibians, mammals, birds and reptiles using GBIF species occurrence records of all species in each group. We also used gridded covariates to represent land cover, climate and topography (as described above). Beta-diversity was then calculated using a generalised dissimilarity model (GDM) (Ferrier 2002; 2007).

In the resultant map of a landscape, those areas that have a highest beta-diversity are considered as being of higher ecological value. The calculation is performed individually for each taxonomic group and a single value of beta-diversity for each pixel is assigned to the final beta-diversity map by finding the maximum value calculated from all the groups (Willis et al. 2012; 2015).

Fragmentation

The ecological importance of intact habitat (patch size) and the impact of fragmentation of habitat (thus reducing patch size) on biodiversity has been well studied (see Fahrig 2003 for a review). In general, it has been demonstrated that the greater the patch size, the higher its functionality (greater diversity, more pollinators, greater complexity in food webs etc.). A key ecological feature to try and retain on any landscape, therefore, is large patches of intact habitat (Willis et al., 2012).

To remotely identify patches of intact habitat across landscapes, we used a method (FRAGSTATS) devised by McGarigal et al., (2002) where patch size across landscapes is determined by calculating proximity of similar vegetation types; thus, the more adjacent pixels that there are in a landscape indicating similar vegetation cover, the larger the patch size.

In developing a metric of landscape fragmentation, we adopted the same approach as FRAGSTATS (McGarigal et al., 2002) and used the land cover classification described in action B1.1 to develop a procedure which assigned each pixel to a group of neighbouring pixels when they were of the same land cover class. The area of similar pixels (the patch) was then calculated in hectares. In the resultant map, those areas that have a larger patch size carry a higher ecological value.

Wetland connectivity

Information on river corridors and/or wetlands is available globally (e.g. Hydrosheds stream channel database – www.hydrosheds.wwf; Lehner et al., 2008). Hydrosheds was used to

identify areas of wetlands and water drainage channels which might act as dispersal corridors across landscape – namely those pixels adjacent to stream channels (up to 100m) and thus representing areas such as gallery forests and flood plain corridor routes. In the calculation of this layer, these are scored as being of higher ecological importance (in terms of connectivity). All areas identified in our land cover classification procedure as either open water or wetland also have a higher value for connectivity.

Migratory species

We used the Global Register of Migratory Species (GROMS; www.groms.de; Riede 2004) which provides both a list of 4,430 migratory vertebrate species in digital format and digital maps detailing the migratory routes for >1,000 of these species. GROMS data can therefore be used to provide a first estimation of the number and migration path of a species across a given landscape (Willis et al., 2012; 2014). To achieve an estimation of density of migratory species across different parts of a given landscape, we added all species grids together resulting in a map of the number of different migratory species and the main migration routes across a landscape.

Vegetation resilience to climate perturbation

Resilience is an important ecological feature of any landscape, and areas that can maintain resilience despite climate/environmental disturbance are of high ecological significance (Holling, 1973; Folke et al., 2004). The current ability to measure resilience estimates over any given point in the world is limited by the availability of spatially complete long-term ecological and environmental records. Nevertheless, such approaches have been attempted with some success for some areas (e.g. Klein et al., 2009). We have devised a new measure of vegetation resilience to climate perturbations in the period 2000-2013. We estimated vegetation resilience using monthly time series of Enhanced Vegetation Index (EVI), air temperature, the ratio of actual to potential evapotranspiration (i.e. water availability), and cloud cover using MODIS products 2000-2013 (5 km resolution). Scheffer et al. (2009) identified two main properties – or early warning signals – in systems that may be close to critical transitions (i.e. non-resilient): high autocorrelation and high sensitivity to external forcing. Our resilience metric was based on these properties.

First, a PCA regression was performed between the z-scores of EVI and the three climate variables over the 14 years (at monthly intervals) to identify the strength of the relationship between each climate variable and vegetation productivity. Regression included a t-1 term, enabling the estimation of the importance of autocorrelation in each pixel worldwide. Next, a measure of variability in EVI and in each climate variable was calculated in the months when the relationship was found to be strong, and corrected for the observed dependency between the variability and the mean. Finally, a measure of sensitivity to each climate variable was calculated by separately dividing EVI variability by variability of each climate variable: this measures how much variation there is in EVI per variation in climate. The three sensitivity maps (temperature, water availability, and cloud cover) were then summed to produce a full sensitivity map. The combination of the t-1 map (autocorrelation) and the full sensitivity map produced a resilience map. Full details of this method are provided in Seddon et al., 2015

(submitted). In the resultant map for a landscape, those areas that demonstrate least resilience carry a higher ecological value.

Summary Ecological Value

In addition to maps of the landscape showing patterns of fragmentation, biodiversity, vulnerable species, connectivity and resilience, a single map of summary ecological value aggregating these metrics is also produced. This is accomplished by expressing the value of each individual layer as a standard score. We made the decision not to weight any layer as carrying more importance in terms of its ecological value; the map of summary ecological value (SEV) is therefore calculated as the mean of standard score of fragmentation, beta-diversity, vulnerable species, connectivity and resilience.

LEFT computing infrastructure

LEFT runs on dedicated servers and comprises several components: First, an Apache webserver runs a website written in Javascript and uses the Google maps javascript API to provide a the map interface. Second, there is a service-oriented interoperability (sif) middleware, which has been developed by extending GIMI (Simpson et al 2009), in order to co-ordinate the processing of user requests. Sif is complemented by a number of custom Java plugin applications which perform individual parts of a LEFT analysis such as data-subsetting, drawing styled maps using the Mapserver library, zonal statistics, listing intersecting features and generating the report in LaTeX and rendering a PDF. Third, a storage server holds pre-calculated spatial data, split into one degree tiles, and makes this available to the plugins which generate each report. Fourth, we maintain a local mirror of GBIF as an SQL database on a dedicated server which allows records to be queried during LEFT analyses more rapidly than through the public GBIF occurrence API. Fifth, LEFT uses a set of processing servers to pre-process a very large amount of raw data including satellite observations to produce each LEFT layer as tiled data held on the storage server. Geoprocessing is accomplished using open source software and libraries including GRASS ,gdal, proj4, LEDAPS, L8SR, R and Maxent. Finally all code and assets required for the whole system are maintained in a subversion repository and are edited and deployed using the IntelliiJ IDEA integrated development environment.

5.1.1.3 Sub Action B1 (3) Development of models, algorithms and datasets

Milestone 3 – started January 2014, due: July 2015. Amended due: December 2015. Status: ongoing

The models for soil erosion protection, recreational amenity and pollination have now been developed and are ready to be evaluated in action B1.4 across the whole of Europe at high spatial resolution using data produced in action B1.1. The necessary datasets have been identified and the algorithms have been developed for Carbon in above-ground biomass and for Water flow regulation, although these have not yet been converted into code ready for large scale geoprocessing. We anticipate this will be completed and milestone M3 will be reached by Dec 2015.

Carbon in above-ground biomass

Carbon in AGB will be estimated using an algorithm based on Saatchi et al (2008). We will use spatially sparse observations of waveform parameters at GLAS shot locations across Europe in the period 2003-2008 together with a set of published transfer functions which link Lorey's height derived from the GLAS waveform with AGB measured in forest plots. We will then use machine learning (Maxent) to estimate Lorey's height and hence AGB from time-series of synoptic satellite observations including Ku-band backscattering co-efficient, MODIS BRDF parameters, spectral surface reflectance, vegetation indices and land surface temperature.

Soil erosion protection

Development of the soil erosion protection algorithm is now complete. Our algorithm uses the Revised Universal Soil Loss Equation (RUSLE) together with land cover, precipitation, and elevation data. We are now able to evaluate this algorithm across Europe at high spatial resolution at regular time intervals as the spatial data, especially land cover becomes available (action B1.1).

Recreational amenity

We have developed an algorithm to estimate the conditional probability of a photograph being taken and uploaded to Flickr, a social media site, as a function of a set of environmental covariates. Flickr records are a sample of events on which someone took a photo in a given location and shared it through social media, possibly because they attach some significance to the location. We are using these records together with maps of environmental variables, such as elevation and land cover, to model the conditional probability of the event of a photo being taken and then submitted to Flickr occurring in a given location. This allows us to map the potential provision of the cultural ecosystem service of recreational amenity across Europe. We are currently using Flickr because it is a widely-used (global) system to upload pictures. The images on Flickr contain spatial and temporal data, which are compatible with those of other layers in EcoSET. We will in due course evaluate other similar services, e.g. Picasa, but the widespread use of Flickr make it highly suitable for NaturEtrade (see, for example Cha et al 2009). The workflow for cultural services is shown in Figure 3.We have further developed a model of the number of recreational visitors/year to an area as a function of the conditional probability of a flickr photograph as well as the number of people living within 4 different travel times from a location. This model has been parameterised and validated using a dataset on numbers of visitors to hundreds of national parks across Europe. We will be able to evaluate this model across Europe at high spatial resolution annually once land cover data is available.

Pollination

Development of the pollination algorithm is now complete. A manuscript describing pollination services in Europe is in review at the journal Environmental Economics (Nogué *et al.*). We modelled the distributions of 12 pollinator species in Europe and developed a

method to characterize the degree to which a piece of land provides nesting habitats for pollinators which is within flying distance of these species from pollination dependent crops. We are now able to evaluate this algorithm across Europe at high spatial resolution at regular time intervals as the spatial data (action B1.1) becomes available.

Water flow regulation

Work on the hydrological modelling for water-related services began in March 2015 and is ongoing. We report relevance to European Water Framework Directive 1 and the European Floods Directive2 in section 5.3 below.

A distributed rainfall-runoff hydrological model for the study area will be built, based on the Regional Land-Surface Model called JULES (https://jules.jchmr.org). The model uses information about soil type and depth, vegetation cover, slope, precipitation, and position in the landscape to predict the quantity of surface and subsurface runoff generated from rainfall (Figure 2). Runoff is calculated separately for each grid cell across the study area, and will differ depending on the land cover class. A routing model is then used to predict the route taken by this runoff across the landscape, and generate synthetic hydrographs of river flow at key locations in the catchment downstream. Flood risk is associated with the size and timing of peak flows in rivers. Using JULES, the contribution of each grid cell to the risk of flooding or low flows can be modelled, as well as an estimation of how much these risks are mitigated or exacerbated by changes in land cover within individual grid cells. Since the impact of land cover on hydrology is often small compared with other processes such as precipitation and topography, the results will indicate relative values rather than absolute contributions to flooding. This is also because predictions will need to be made in ungauged catchments where field measurements do not exist to validate or parameterise the model. The output of the model can be mapped using a technique known as ‘information tracking’ to highlight areas in the catchment that contribute most to peak flow in rivers. Land cover changes in areas that contribute highly to peak flow will have the largest impact on flood risk.

Progress has been made toward building the JULES model, and work is now beginning on the preparation of input data files for the model.

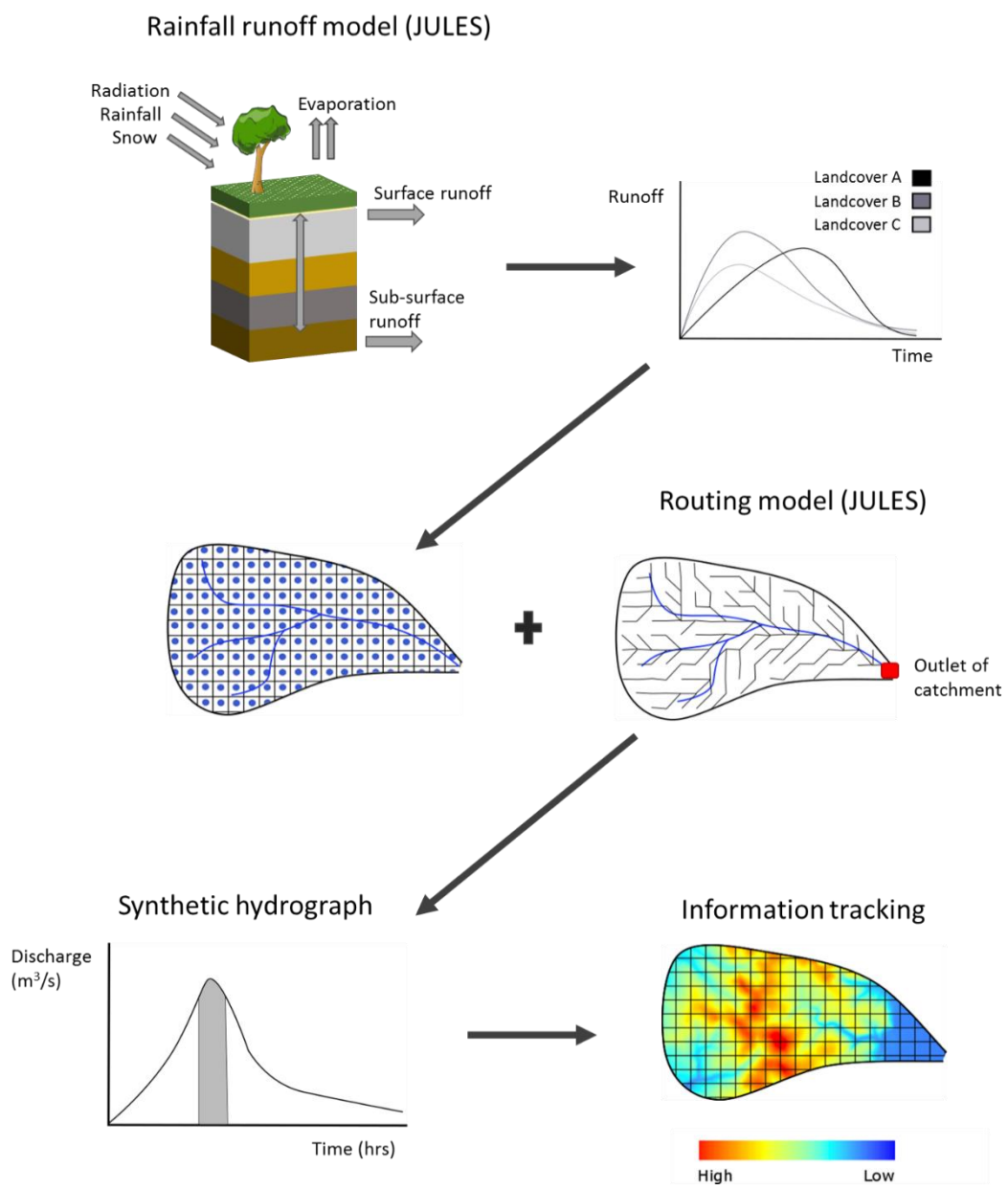

Figure 2 Rainfall runoff model (JULES), adapted from O'Connell et al. (2007), Dadson et al. (2011) and Gao et al. (2010)

5.1.1.4 Sub Action B1 (4) Automation of the Ecoset tool

This action involves the automatic large scale geoprocessing of data produced in action B1.1 using algorithms developed in action B1.3. As such it depends on the completion of these actions.

Action B1.4 can be understood as two sequential tasks:

(i) setting up computer infrastructure and scripting to enable large scale data processing;

(ii) bulk geoprocessing of data using this infrastructure to produce the final high spatial resolution data on ecosystem service provision across Europe in time-steps.

We have already made considerable progress in task (i) although it is partially dependent on completion of some remaining code for algorithms (hydrology and carbon) from action B1.3. Specifically we have set up a cluster of processing servers and a storage server, as well as installed relevant software libraries and build data granule databases which will be used to schedule processing by scripts. This processing is also amenable to being undertaken on the Oxford supercomputer facilities and we have been exploring setting this up too.

Task (ii) has a more strict dependency on completion of actions B1.1 and has not yet started, however we do not anticipate any difficulties in this task. M4 is due to be completed by Jul 2016. We think we are still on schedule to reach M4 by Jul 2016.

5.1.1.5 Sub Action B1 (5) Completion of Ecoset

We are on schedule to produce deliverable D1 by Jul 2016. By this time, land cover, all ecological layers and all ecosystem service layers will have been calculated for the whole of Europe and integrated into the NaturETrade web interface so that they can be viewed by users.

5.1.1.6 Sub Action B1 (6) Report detailing the design of Ecoset

We are on schedule to produce this report, deliverable D2, by Jul 2016. We are documenting Ecoset as we are building the tool.

5.1.2 Action 2: B2: Creation of NaturEtrade

	2014			2015				2016			
Sub-Actions (Indicators of progress)	Jul	Oct	Dec	Apr	Jul	Oct	Dec	Apr	Jul	Oct	Dec
1Design and set-up of NaturEtrade website											
2Development of mobile data capture device	D4										
3Development of NaturEtrade database structure	M6										
4Linking EcoSET and NaturEtrade								M7			
5Interface system linking sellers & buyers								M8			
6Pilot tests of NaturEtrade									M9		
7Modifications to NaturEtrade after feedback											

The NaturEtrade web interface is at the heart of this project. The website will be an 'ebay' for ecosystem services, allowing landowners access to detailed information about ecologically important features of their land and ecosystems service provision on their land. It will permit landowners (sellers) to offer to manage a parcel of their land for a period of time and ensure that undesirable land cover changes do not occur. If they do so, we expect that the provision of each of a set of ecosystem services on that land will be maintained for the period of time. Potential buyers will be able to search the set of land parcels which landowners are offering to manage in this way and enter into transactions to pay landowners to maintain ecosystem service provision by preventing undesirable land cover change. Satellite remote sensing will detect land cover change (land verification tool) and confirm to buyers whether landowners have complied with the terms of their contracts

5.1.2.1 Sub Action B2 (1) Design and set-up of NaturEtrade website

Deliverable 3 Completed.

Website maintained and updated periodically as needed throughout project.

Table 1 NaturEtrade.net web statistics

Month	Unique visitors	Number of visits	Pages	Hits	Bandwidth
Apr 2014	74	82	108	255	1002.32 KB
May 2014	332	502	601	2,513	5.60 MB
Jun 2014	322	481	606	1,944	3.87 MB
Jul 2014	343	548	677	2,316	4.13 MB
Aug 2014	387	647	798	2,924	7.66 MB
Sep 2014	394	690	869	3,590	4.38 MB
Oct 2014	390	704	862	3,802	5.13 MB
Nov 2014	402	665	980	5,023	5.71 MB
Dec 2014	434	641	769	4,834	6.41 MB
Jan 2015	380	600	709	4,010	7.19 MB

nb - a significant breakdown at the Network Provider which hosts the Sylva Foundation servers in March 2015 resulted in webstats being switched off during their rebuild. We did not realise the webstats had not been switched back on after all the data had been successfully rebuilt. We switched the stats back on again in June 2015.

5.1.2.2 Sub Action B2 (2) Development of mobile data capture device

Deliverable 4 Completed.***5.1.2.2 Sub Action B2 (3) Development of NaturEtrade database structure***

Milestone 6 Completed

5.1.2.1 Sub Action B2 (3) Development of NaturEtrade database structure

Milestone 6 Completed

5.1.2.4 Sub Action B2 (4) Linking EcoSET and NaturEtrade

Milestone 7 - started April 2014, due: April 2016. Status ongoing

In order for the high resolution data on estimated provision of ecosystem services to be incorporated into NaturEtrade and visible to users, the data first needs to be converted from geotiff tiles into tiled-map-service (TMS) compatible folder structures of PNG images, with a custom palette applied and a legend. We have already developed a procedure to accomplish this using the GDAL software library and have generated example TMS data for some layers for the whole of Europe. These TMS data have been included in the NaturEtrade map interface. Users can pan and zoom the slippy map and toggle between viewing different layers and base data.

Secondly, it is going to be necessary to implement on-the-fly zonal statistic calculations for the various ecosystem service data layers within user-generated polygons representing land parcels. This will be accomplished by writing the geotiff tiled ecosystem service data into a raster array database (rasdaman). The zonal statistic calculations will then be performed on the webserver on each of the polygons stored in a PostgreSQL database as soon as they are written to the database by making a call to PostGIS. A java function will be used to poll the database and pass a command to PostGIS and then write the zonal statistics results into the database.

This action is ongoing. The first task is completed; the second task has been planned in detail, but not yet implemented. We are on schedule to complete this action and reach milestone M7.

5.1.2.4 Sub Action B2 (5) Interface system linking sellers & buyers

Milestone 8 - due: April 2016. Status: Ongoing

Much progress has been made in the last six months in developing the NaturEtrade web interface. There are now separate web interface entry point for landowners (sellers) potential purchasers. The interface for landowners has been improved, including context sensitive help and custom generated reports on parcels of land. The interface for potential purchasers has also been developed. New features include the ability to make faceted and spatial searches of land polygons in the database, in order to identify landowners with ecosystem service provision to be transacted in particular locations, as well as land which is important for particular services.

5.1.2.4 Sub Action B2 (6) Pilot tests of NaturEtrade

Milestone 9: due July 2016

We are piloting developments of NaturEtrade as we go with a small group of interested parties who attended the first knowledge exchange workshop (see below). We are on track to pilot this with a broader set of buyers and sellers in the UK by July 2016. We strongly believe that piloting in one country will not provide sufficient feedback for other countries in our target set. We will therefore add milestone M9a to pilot in each of the target countries and this will extend beyond July 2016 for logistical reasons, to July 2017.

5.1.3 Action 3: B3 Standard contracts/verification tool

	2014			2015				2016			
Sub-Actions (Indicators of progress)	Jul	Oct	Dec	Apr	Jul	Oct	Dec	Apr	Jul	Oct	Dec
1Existing contracts for ES reviewed	M10				M10b						
2Governance arrangements devised							M10c				
3Develop & market testing of pilot contracts				M11	(D5)		D5				
4Contracts integrated into NaturEtrade						M12	D5a				
5Automated land verification system developed									D6		
6Database linkage between NaturEtrade and land verification system									D7		

After October 2014, work on governance arrangements and contracts was moved to the Sylva Foundation as it was felt to be a better fit with their suite of tasks for NaturEtrade and their close association with landowners in the UK through a land management tool they devised (myForest). We have been working with people with experience as estate managers and property lawyers on their staff and Board of Trustees to develop contracts and governance arrangements for NaturEtrade.

5.1.3.1 Sub Action B3 (1) Review of existing contracts for ecosystem services

Milestone 10 completed

Milestone 10b – due July 2015. Status: complete

Because the literature review of web-based ecosystem services revealed no schemes that were similar enough to our concept for NaturEtrade we broadened our search for similar platforms in other fields (M10b). These schemes were not discussed at the knowledge exchange/stakeholder meeting in September 2014 as planned, given the preference of the group to discuss the project more broadly and to understand the science in more detail than anticipated. The property letting agency Purple Bricks (https://www.purplebricks.com/tenants4u) has many of the attributes we are aiming to build into NaturEtrade and their practices guided our discussions to date on contract development appropriate for our likely stakeholders.

5.1.3.2 Sub Action B3 (2) Governance arrangements devised

Milestone 10c – due: July 2015. Status: ongoing Amended end date: December 2015

A working draft of the governance arrangements is appended (Annex 3).

5.1.3.3 Sub Action B3 (3) Develop and market testing of pilot contracts

Milestone 11/Deliverable 5 –Due July 2015. Amended end date: December 2015 Status: ongoing

This is a work in progress, benefitting from discussion with land owners/ managers and stakeholders who attended the first knowledge exchange workshop in September 2014. A working draft is appended (Annex 4). Opinion was divided during these discussions and in internal project team meetings about the relative benefits of 'bundling'ecosystem services in EcoSET and trading them as a single aggregated entity. Our original project proposal was slightly ambiguous on this point, but we are now clear that we should trial with stakeholders both unbundled and single services. The review of ES contracts completed in 2014 found that most broadly-similar schemes tend to involve single attributes, notably carbon and water. Economic theory also points to the benefit of maximising the market by allowing multiple products to be derived from a single parcel of land. Against this is the novelty of a scheme that sells promises of 'no degradation' based on a set of attributes that can alter with landuse change. Testing these two types of trading has implications for the contracts and careful pilots will be carried out before the second knowledge exchange workshop and during that workshop.

The progress made in developing the form of the contracts has required a careful balance between what is technically feasible to monitor using our automatic systems as well as providing a 'product' which will likely be attractive to potential users of NaturEtrade. The following key design decisions have been made:

- Landowners will submit a parcel of land and the provision of ecosystem service on that land will be estimated, and expressed in quantiles relative to a European baseline.

- Landowners will commit to maintain the same land cover classes on a polygon of land for a period of time

- Ecosystem services will be unbundled: Purchasers will be able to pay for the maintenance of all ecosystem services on a parcel of land or any individual service or set of services.

- At three monthly intervals, land cover will be assessed using satellite data and if no significant land cover change has occurred, the landowner will be approved as compliant with the agreement to maintain land cover. The logic is that, all else being equal, ecosystem service provision will be maintained if land cover is maintained by the landowner.

- At three monthly intervals, ecosystem service provision will be re-calculated across Europe, taking account of new land-cover data: all other variables, such as elevation, climate, human population used to calculate ecosystem services will be held constant (this is because these variables change very slowly or not at all and because they are outside the control of landowner).

5.1.3.4 Sub Action B3 (4) Contracts integrated into NaturETrade

Milestone M12 due: October 2015. Status not yet started. Deliverable D5a due: December 2015. Satus: Not yet started.

This action has not yet started. However placeholder text exists in the website, to be replaced by the final version of the standard contract text when it has been finalized as deliverable D5. Integrating the contract text into the website will not therefore be a technically-difficult task.

5.1.3.5 Sub Action B3 (5) Automated land verification system developed

Deliverable D6 due: July 2016. Status: ongoing.

In this action we will develop a system for comparing land cover maps at two time points in order to be able to determine whether unacceptable land cover changes have occurred on a parcel of land subject to a NaturEtrade contract over a particular period of time.

The land verification tool uses a time series of land cover maps, which will be produced automatically for the whole of Europe on a rolling basis. The spectral classification procedure identifies 10 different land cover classes (labelled 0-9). For each time interval, the land cover maps from times t1 and t2 will be combined to make a map of change classes during that time interval. This will be accomplished by multiplying the t1 class digital numbers (0-9) by 10 (to yield 0-90) and adding to the t2 digital numbers (0-9). The result will be a map of 100 change classes (0-99). We will then zonally query the map of delta (change) classes for each time interval by every land polygon in the NaturEtrade database such that we know the frequency of every change class in every land polygon.

In an ideal scenario, over a time interval, all transitions will be on the diagonal of the transition matrix (ie transition from a class at t1 to the same class at t2). However we have to take account of the fact that the spectral classification tree procedure is not perfectly accurate. Users' accuracies of the order of 0.95 are to be expected for a single date classification, and therefore users accuracies of the order of 0.95^2 =0.90 are to be expected for delta classes. However users' accuracies will likely differ between classes and classification errors will likely be correlated in time, so we will need to conduct a validation, probably using high spatial resolution images such as are available in Google Earth.

We will then develop a decision rule which can be applied automatically in the NaturEtrade database to determine whether or not any significant land cover change has occurred on a land polygon during a transaction period, taking account of the expected error in the delta classification procedure.

5.1.1.6 Sub Action B3 (6) Database linkage between NaturEtrade and land verification system

Deliverable D7, due: July 2016. Status: not started

This action will be accomplished in the same way as task 2 of action B2.4. Once M7 of B2.4 is reached in Apr 2016, then completion of action B3.6 will follow, as the same code will be used to link the periodic results from the land verification system to the PostgreSQL database holding the land parcel polygons and hence into the NaturETrade web interface. This action depends on completion of action B3.5 deliverable D6 in Jul 2016; action B3.6 deliverable D7 will also be completed by Jul 2016.

Next steps for Actions 2 and 3

Figure 3 summarises the steps we plan to take over the next two years to develop a functioning NaturEtrade

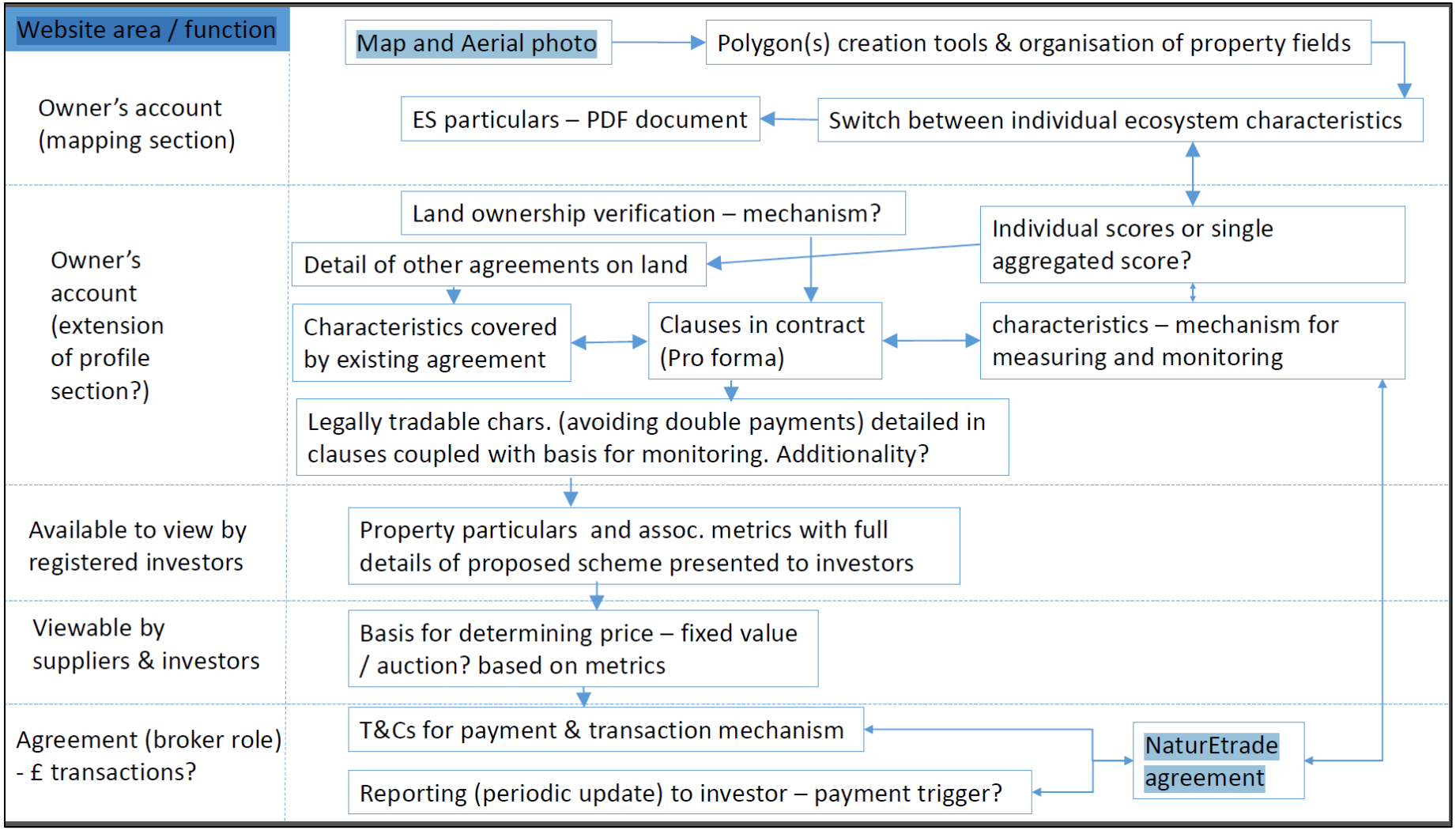

Figure 3 Next steps for Action 2 and 3.

5.1.4 Action 4 (C1: Monitoring of impact of EcoSET & NaturEtrade)

	2014			2015				2016			
Sub-Actions (Indicators of progress)	Jul	Oct	Dec	Apr	Jul	Oct	Dec	Apr	Jul	Oct	Dec
1Rates of land-use change determined					[M13]		M13				
2Regions for workshops selected					[M14]		M14				
3Workshops run in selected regionsfor landowners											
4Report on workshops										D8	
5Assessment of land-use change & trading											
6Monitoring of social impact & equality											
7Monitoring success of trading and update											

In this set of actions we will engage with potential users of NaturEtrade, who will enter into transactions to maintain land such that ecosystem services are protected, and ultimately reduce the loss of 'biodiverse' land in Europe.

5.1.4.1 Action C1 (1) Rates of land cover change determined

Milestone 13 – due: July 2015. Status: Ongoing

We will prepare satellite data for the whole of Europe for the 10-year period 2003-2013 and perform a land cover classification using our spectral classification tree procedure. This will allow rates of loss of 'biodiverse' land cover classes (water, wetland, natural grassland, shrubland, deciduous forest, evergreen forest) over the 10 year period to be calculated by sub-national administrative regions across Europe. Land cover classification for Europe in 2013 is near completion and processing of 2003 data will start shortly. We need this information in order to select the administrative regions for workshops in Sub Action C1(2).

5.1.4.2 Action C1 (2) Regions for workshops selected

Milestone 14 – due: July 2015. Amended Dec 2015. Status: Ongoing

We will identify the administrative region with the greatest rate of loss of 'biodiverse' land cover classes in each region- UK, Spain, Romania and Croatia. These regions will be selected as NaturETrade demonstration regions and we will hold NaturETrade workshops in the selected regions. This action depends on the results of action C1 (1). It has not yet started, but will be a trivial task once the results are available.

5.1.5 Action 5 D1: Dissemination and communication

	2014			2015				2016			
Sub-Actions (Indicators of progress)	Jul	Oct	Dec	Apr	Jul	Oct	Dec	Apr	Jul	Oct	Dec
1Web-based survey created											
2Articles published in relevant media outlets										M15	
3Establishment of stakeholder database	[M15a]						M15a				
4Workshops run for potential buyers of ES											
5Knowledge exchange workshops run		D4a			[D5a]		D5a		D6a		

5.1.5.1 Action D1 (3) Establishment of stakeholder database

No milestone or deliverable assigned in original project description table (pages 53 & 54), but due date set at 30 June 2014 in the technical description. This activity has now been given a Milestone M15a for the revised GANNT. Status: revised to December 2015 to compile single database from several disparate databases. There are more than 2500 people registered on the Sylva Foundation's myForest database of users, which we have from the outset considered to be our first testing bed for NaturEtrade. We have no concerns about failing to reach 400

registered with an interest in NaturEtrade, but we have considered it potentially damaging to try to sign people up before there is an attractive useable site with enough EcoSET data to test some land parcel simulations. We will reach this stage by December 2015 and create a dedicated database of registered users using myForest users and those added to our database of interested parties met at meetings.

5.1.5.1 Action D1 (5) Knowledge exchange workshops run

Deliverable D4a – due: Oct 2014.First workshop completed. Status (of other workshops, D5, (moved to December 2015): Ongoing

The first workshop was held on 22 September 2014 for 14 external people representing business, wildlife trusts, local government, academic research, and land management (including large state management). The 14 external participants were all invited to attend, either based on their interest in our project expressed in earlier meetings, or because they are already working with members of the NaturEtrade team on closely related projects. See Annex 5 for report of the event. The most important outcome of the meeting was great interest in the project and a commitment from all attendees was a willingness to engage with us as we develop the initiative. Their feedback on developing contracts has been particularly useful and we continue to consider a sub-set of them as extended members of the project group.

5.1.5.2 External meetings

Members of the project team have presented NaturEtrade in meetings in the UK and elsewhere (Table 2):

Table 2 External meetings at which NaturEtrade was presented/discussed. (Those funded by LIFE+ are in blue italic font)

Date	Meeting	Place	Presenter	Objective	Outcomes
8-10 Sep 2014	Eco**2: Application of ecological and economic ideas, London School of Economics	UK, London	Kathy Willis	Keynote & discussion - present NaturEtrade as alternative to business-as-usual biodiversity conservation	Positive reception of NaturEtrade to c. 200 delegates.
8 Sep 2014	Conference, Next Research Generation (NRG) BESS: Early career network for the NERC Biodiversity & Ecosystem Service Sustainability programme	UK, Southampton	Sandra Nogue	Discuss EcoSET tools with the NRG-BESS network (following keynote on long-term data for conservation)	NRG-BESS contacts added to database of potential beta users of NaturEtrade
10 Sep 2014	Towards a Framework for Protected Area Asset Management meeting	London	Kathy Willis	Share experiences developing NaturEtrade tools with the Project for Protected Area Resilience conservation, which similarly examines how more value for ecosystems can be realized through new investment	Positive contact with colleagues in Smith School of Enterprise & the Environment, hitherto not connected with NaturEtrade and with members of their Advisory Board

14 Sep 2014	FOSS4G 2014 [annual global conference focused on open source geospatial software]	USA,Portland	Peter Long	Exchange knowledge about architecture and infrastructure of software for large-scale, web-based geoprocessing with international developers.	Learning experience for NaturEtrade architecture options. Good feedback on algorithms under development and names added to our mailing list of people willing to provide future feedback/testing.
9 Oct 2014	International Union of Forest Research Organizations (IUFRO) conference	USA, Salt Lake City	Gillian Petrokofsky (GP) [Side Event presentation delivered on behalf of GP – absent due to illness]	Expose largely European forestry delegates to NaturEtrade as alternative to business-as-usual sustainable forest management through grants.	30 people in attendance. Interest expressed (and reinforced from Croatian delegates with whom we will work as key region). Names added to mailing list.
3 Nov 2014	Norwegian Polar Institute meeting on Assessing vulnerability	Norway, Tromso	Peter Long	Demonstrate Proof of Concept of EcoSET	20 people in attendance. Positive feedback from largely Norwegian audience. Names added to mailing list for future testing, though not use of NaturEtrade.
6 Nov 2014	Meeting with UK Forestry Commission	UK, Oxford	Gillian Petrokofsky	Explore potential for sharing GIS knowledge and collaboration with FC networks of regional forests (not private)	Limited sharing but network possibilities later in project.
25 Nov 2014	Ancient woodland meeting with Woodland Trust	UK, Helmsley	Gillian Petrokofsky	Explore possibility of using network of ancient woodland advisors and owners as users of NaturEtrade in UK	Network possibilities. Great interest in EcoSET among c 30 attendees

15 Nov 2014	Royal Geographical Society meeting: Integrating technologies and Field Work	UK, London	Peter Long	Exchange knowledge about use of big data for conservation. Demonstrate NaturEtrade and gain feedback.	200 people in attendance. Positive feedback on NaturEtrade. Names added to mailing list.
9-12 Dec 2014	British Ecological Society-Société Française d'Ecologie (BES-SFE) Annual joint meeting	France, Lille	Peter Long	Present algorithms and receive feedback to broad-based ecology and conservation field-based practitioners	100 people attended the session and provided useful feedback on the robustness of the algorithms. Added names to mailing list for future contact/testing.
30 Jan 2015	'Natural Capital' Workshop, convened by Coca-Cola, WWF & Smith School of Enterprise & Environment	UK, London	Kathy Willis	Introduce companies involved in retail and foodservice to concept of NaturEtrade	Great interest from c 70 people attending. Contacts added to database. http://www.smithschool.ox.ac.uk/research-programmes/sustainable-economics/Natural%20Capital%20Workshop%20Invitation%20v2%5B1%5D.pdf
24 Apr 2015	*A Natural Capital Investment Strategy for Surrey*	*Surrey Wildlife Trust, Guilford*	*Alistair Yeomans; Gillian Petrokofsky*	*Propose NaturEtrade as an option for County Councils and Wildlife Trusts when identifying potential PES business models*	*Interest shown in the potential of the tool not only for trading but as a monitoring instrument. Contact made with Defra personnel – to be followed up*
13 May 2015	Meeting with Atkins (working with Thames Water)	Little Wittenham	Alistair Yeomans; Paul Orsi	Demonstrate NaturEtrade to David Gasca of Atkins as a potential user.	Great interest particularly in the water layer for water companies to sponsor (purchase) landuse management to maintain water flow and quality. Name added to database of testers and potential users. Subsequently used as a 'critical friend' during testing.

1-3 Jun 2015	*Water-Energy-Food Nexus workshop*	*USA, Washington DC*	*Beccy Wilebore*	*Rapid overview of what is currently going on in water and land management public-private sector collaborations) at local, national and international levels using earth observations integrated into policy & practice tools*	*Good overview of projects with whom we could potentially collaborate on water layer in particular, but also our other landuse algorithms. Large international audience. Many interested in NaturEtrade concept. Useful contacts made. [Important to stress that this was the first important meeting of its kind following appointment of Beccy Wilebore and chosen as a way of rapid exposure to work in this field]*
30Jun-1Jul '15	*Joint UK Land Environment Simulator (JULES) workshop*	*UK, Reading*	*Beccy Wilebore*	*Learn about JULES model for water layer. Demonstrate NaturEtrade to technically-expert modellers.*	*Excellent training. Useful feedback received on integrating the water layer into EcoSET.*
23 July 2015	Association of Areas of Outstanding Natural Beauty meeting	Little Wittenham	Alistair Yeomans; Paul Orsi	Demonstrate NaturEtrade with David Dixon, who runs at PES project with farmers in the South West of England	Great interest in the GIS capability and the potential for NaturEtrade for UK farmers. Added to database of users.
2-6 Aug 2015	ICCB - 27th International Congress for Conservation Biology 4th European Congress for Conservation Biology	France, Montpellier	Peter Long	Demonstrate NaturEtrade and receive feedback to ecology and conservation researchers, policy people and field-based practitioners	100 people attended the session. Positive feedback from live demo. Names added to mailing list for future contact.

Figure 4 Professor Kathy Willis presenting novel aspects of NaturEtrade tools at Eco2: Application of ecological and economic ideas, London School of Economics.**

5.2. Envisaged progress until next report.

The following milestones and deliverables are all on track to be completed within the next 12 months (Table 4).

Milestone 2 – originally due Dec 2014, postponed until Dec 2015 (Sub Action B1(2) Adaptation of the ecological layers from LEFT

Milestone 3 – due: July 2015, postponed until Dec 2015 (Sub Action B1 (3) development of models, algorithms and datasets

Milestone 4 - due: July 2016 (Sub Action B1 (4) Automation of the EcoSET tool)

Milestone 7 – due: April 2016. Sub Action B2 (4) Linking EcoSET and NaturEtrade

Milestone 8 - due: April 2016 (Sub Action B2 (5) Interface system linking sellers & buyers

Milestone 9 – due July 2016 (Sub Action B2 (6) Pilot tests of NaturEtrade

Milestone 10c – due Dec 2015 (Sub Action B2 (2) Governance arrangements devised

Milestone 13 – due: July 2015 (Sub Action C1 (1) Rates of land-use change determined

Milestone 14 – due: July 2015 (Sub Action C1 (2) Regions for workshops selected

Milestone 15a – due Dec 2015 (Sub-Action D1 (3) Establishment of stakeholder database)

Deliverable 1 – due: July 2016. Sub Action B1 (5) Completion of GIS web-based tool (EcoSET)

Deliverable 2 – due: July 2016. Sub Action B1 (6) Production of report detailing design of EcoSET

Deliverable 5 – due: Dec 2015 (Sub Action B2 (3) Develop and market testing of pilot contracts

Milestone 12- due Oct 2015 (Sub Action B2 (4) Contracts integrated into NaturEtrade

Deliverable D5a – due Dec 2015 (Sub Action B2 (4) Contracts integrated into NaturEtrade

Deliverable 6 – due: July 2016 (Sub Action B2 (5) Automated land verification system (LVS) developed

Deliverable 7 – due: July 2016 (Sub Action B2 (6) Database linkage between NaturEtrade and LVS

Deliverable D5a – due: Dec 2015 (Sub Action D1 (5) Knowledge exchange workshops run

Table 3 Planned actions for the next 12 months

		2014			2015				2016			
Action	Sub-Actions (Indicators of progress)	Jul	Oct	Dec	Apr	Jul	Oct	Dec	Apr	Jul	Oct	Dec
B1:Development of EcoSET	1 Data acquisition for ecosystem service layers	M1										
B1:Development of EcoSET	2Adaptation of the ecological layers from LEFT			(M2)				M2				
B1:Development of EcoSET	3Development of models, algorithms and datasets					(M3)		M3				
B1:Development of EcoSET	4Automation of the EcoSET tool									M4		
B1:Development of EcoSET	5Completion of GIS web-based tool (EcoSET)									D1		
B1:Development of EcoSET	6Production of report detailing design of EcoSET									D2		
B2: Creation of naturEtrade	1Design and set-up of NaturEtrade website											
B2: Creation of naturEtrade	2Development of mobile data capture device	D4										
B2: Creation of naturEtrade	3Development of NaturEtrade database structure	M6										
B2: Creation of naturEtrade	4Linking EcoSET and NaturEtrade								M7			
B2: Creation of naturEtrade	5Interface system linking sellers & buyers								M8			
B2: Creation of naturEtrade	6Pilot tests of NaturEtrade									M9		
B2: Creation of naturEtrade	7Modifications to NaturEtrade after feedback											
B3: Standard contracts/verification tool	1Existing contracts for ES reviewed	M10				M10b						
B3: Standard contracts/verification tool	2Governance arrangements devised							M10c				
B3: Standard contracts/verification tool	3Develop & market testing of pilot contracts				M11	(D5)		D5				
B3: Standard contracts/verification tool	4Contracts integrated into NaturEtrade						M12	D5a				
B3: Standard contracts/verification tool	5Automated land verification system developed									D6		
B3: Standard contracts/verification tool	6Database linkage between NaturEtrade and land verification system									D7		
C1: Monitoring of impact of EcoSET & Natur	1Rates of land-use change determined					[M13]		M13				
C1: Monitoring of impact of EcoSET & Natur	2Regions for workshops selected					[M14]		M14				
C1: Monitoring of impact of EcoSET & Natur	3Workshops run in selected regionsfor landowners											
C1: Monitoring of impact of EcoSET & Natur	4Report on workshops										D8	
C1: Monitoring of impact of EcoSET & Natur	5Assessment of land-use change & trading											
C1: Monitoring of impact of EcoSET & Natur	6Monitoring of social impact & equality											
C1: Monitoring of impact of EcoSET & Natur	7Monitoring success of trading and update											
D1: Dissemination and communication	1Web-based survey created											
D1: Dissemination and communication	2Articles published in relevant media outlets										M15	
D1: Dissemination and communication	3Establishment of stakeholder database	[M15a]						M15a				
D1: Dissemination and communication	4Workshops run for potential buyers of ES											
D1: Dissemination and communication	5Knowledge exchange workshops run		D4a			[D5a]		D5a		D6a		
D1: Dissemination and communication	6Report on result of networking activities											
D1: Dissemination and communication	7Report on effectivness of communcation & dissemination activities											
D1: Dissemination and communication	8Regular additions to database and tool uptake											
E1: project mgt & monitoring	1Project milestones completed											
E1: project mgt & monitoring	2Project reports delieverd	D14				D15				D16		

5.3. Impact:

Nature & Biodiversity: *Indicate as appropriate for each site of the project and overall, the impact of your project so far on the species/habitats targeted, and on the other/species/habitats present on the site(s).*

Sites yet to be selected (see 5.1.4.2 Action C1 (2) Regions for workshops selected - Milestone 14 – due: July 2015. Amended Dec 2015. Status: Ongoing)

Environmental Policy & Governance: *Indicate as appropriate the impact of your project so far on the environmental issues tackled. Indicate your estimations as to what the impact of your project could be if other stakeholders applied your approach/technology.*

We think there is considerable potential in using EcoSET outside the trading platform as a rapid, cost-effective monitoring tool at scale. We will explore in 2016 the possibility of a parallel project to develop this component as a policy instrument.

The hydrological outputs of the NaturEtrade tool have notable relevance for the European Water Framework Directive 1 and the European Floods Directive2. The Water Framework Directive aimed to achieve 'good status' of the ecological and chemical components of waters within the EU by 2015, but this target has not been met. The outputs of the hydrological model used for NaturEtrade will not provide detailed information of water quality and pollution, but may be used to produce risk maps of pollution sources, particularly linked with changes in land cover. In accordance with the Aarhaus Convention, Article 14 of the Directive requires the encouragement of interested parties to be actively involved in the implementation of the Directive. NaturEtrade is well-placed to provide access to information about the biological status of habitats within the EU, the impact of private land-management decisions on the environment, and also provide a mechanism of public participation.

The degree to which changes in land cover can affect the quantity of rainfall runoff and peak flows in rivers is of particular relevance to the European Floods Directive, which is now in the third phase of implementation and requires that member states to develop Flood Risk Management Plans by December 2015. The NaturEtrade project matches the goals of the Directive to allow active involvement of interested stakeholders, with a focus on flood prevention. Many factors affect the risk of flooding, of which land cover within a river basin is just one. However, the outputs of the NaturEtrade tool can be used in conjunction with other tools to improve Flood Risk Management Plans, as well as allowing them to meet their requirement of taking account of the relevant environmental objectives of Article 4 of the Water Framework Directive.

NaturEtrade provides a unique spatial tool to link ecological and chemical status of waters with their management for reducing flood risks.

Information and Communication: *Indicate as appropriate the impact of your project so far on the main target audience and the environmental problem targeted. Please indicate whether this impact is in line with the expectations as indicated in the proposal.*

We are pleased with the impact to date on the landowners and potential purchasers of ES through NaturEtrade who attended the Little Wittenham workshop (see 5.1.5.1 Action D1 (5) Knowledge exchange workshops run). Attendees are part of an informal network of people willing to test and bounce ideas off. We have similarly been pleased with the positive impact of our demonstrations of NaturEtrade at meetings reported in Table 2 (see 5.1.5.2 External meetings). Interested parties at these meetings are also part of our network for sharing ideas. We cannot assume that the raised awareness of Ecosystem Services amongst people in our networks is wholly due to our communication efforts in NaturEtrade, but we think that we have contributed to their increased awareness of some of the practicalities and benefits of the approach. Useful feedback from landowners has indicated that the tool may be used in ways we had perhaps not anticipated, namely checking neighbours' listings on NaturEtrade to compare their own ES values against theirs. With due acknowledgement of the need for data security and confidentiality, we think this will in fact be an additional benefit of the approach to encourage biodiversity protection through novel 'trading'. We will continue to collect feedback such as this to complement feedback on pricing issues and the impact of government grants and subsidies.

Indirect impacts: *Indicate any indirect impacts of the project (e.g. local authorities near the project may have been inspired by the project to invest time/money or adopt the project's approach to the conservation/environmental issue in question)*

We are continuing discussions with Surrey Wildlife Trusts to assess whether they could use the non-trading EcoSET components (see above) in addition to pursuing them as potential landowning traders on NaturEtrade/

5.4.Outside LIFE: *Summarise the different actions taking place outside the framework LIFE project (i.e. not financed by LIFE) but that are complementary to the project and add to its impact (if applicable).*

Finalising the LEFT2 project has had ramifications for most of the actions within B1 and there has been considerable cross-fertilization of ideas and techniques. The user brochure guiding people through the process of setting up a Left account and making sense of the outputs will be used as a template for our NaturEtrade guidance. It is being tested by LEFT users and feedback from them will be used to help us develop jargon-free (within the confines of the technical language needed to describe ecological monitoring) help online and in print form. Appendix 6 is the brochure.