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Alternative Approach and toolkits for Economic Valuation of Ecosystem Services of Wetlands: An Application to Farlington Marshes, UK

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Introduction:
Ecosystem Goods and Services

- **Ecosystem Goods and Services (EGS)**
  - Benefits delivered by nature -> directly or indirectly harnessed by human (De Groot et al. 2002).
  - Can be extrapolated to economic value (e.g. fisheries, tourism, etc.)
  - Key information for management purposes

The Challenge: Development Vs Conservation.

- **Wetlands:** Abused for development and other human activities (Ramsar Convention Secretariat, 2013).

Introduction:
Why we needed a new method?

- **Issues in Ecosystem Goods and Services (EGS) Studies:**
  - Lack of EGS studies on wetlands (NOT too many wetlands described)
  - Scarce valuation assessments ("NO" Economic value)
  - General Lack of resources for EGS assessment (NOT a simple task)

Also:

- The need for new approaches for Non-market related EGS

(e.g. carbon and nutrients dynamics, flood/storm assimilation, water quality.)

- Public willingness ≠ Real value
  - Cultural bias in estimations

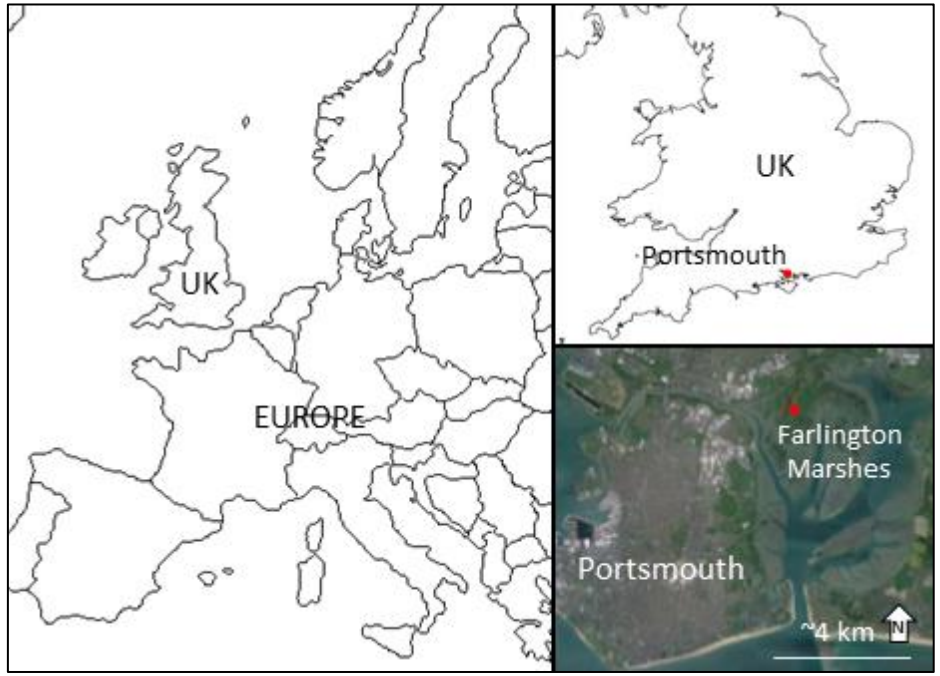
- **The Proposal:**
  - All-inclusive method, simple toolkits, easy to replicate

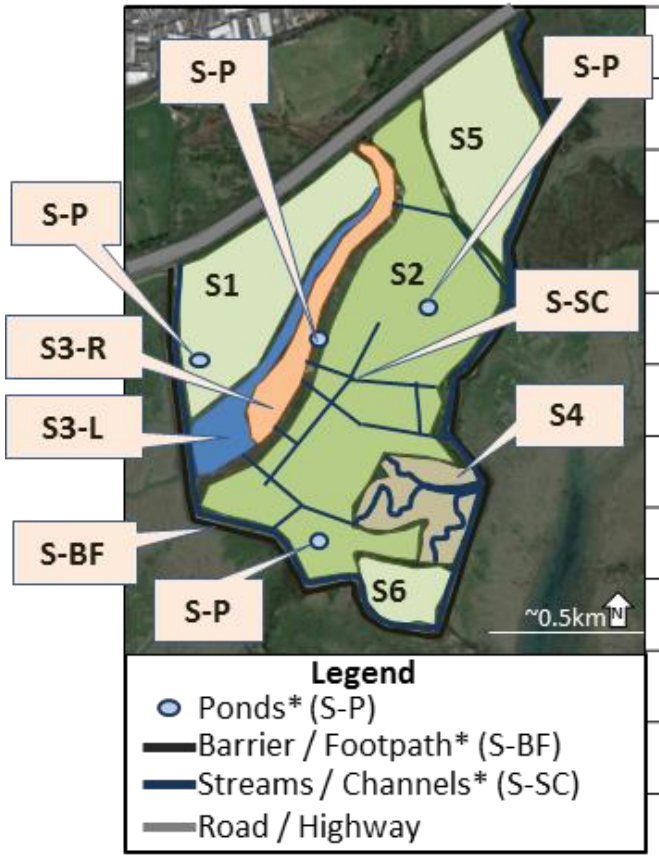
Objectives

- Design a new, innovative and evidence based methodology for realistic assessment and valuation of ecosystem goods and services (EGS).
- Test the new protocol on a real case study area.
- Use the LNR Farlington marshes (Portsmouth, UK) as our test site, and assess it's EGS.


Farlington Marshes

Location: Farlington Marshes





Code	Site Name	Dimensions		
		Area (m^2)	Area (%)	Length (m)
S1	The Bushes	131.184	12	NA
S2	Main Marsh	461.424	41	NA
S3-L	Lake	30.495	3	950
S3-R	Reed bed	76.729	7	
S4	The Deeps	57.097	5	NA
S5	Hay field	136.094	12	NA
S6	Point field	37.320	3	NA
S-P	Ponds* (>16 units)	15.000**	1	NA
S-SC	Streams / Channels*	NA	NA	7.000**
S-BF	Barrier / Footpath*	NA	NA	9.000**
	Whole area	1.117.348		

*Some features are not completely represented in the map.
(e.g. Additional ponds, footpaths and streams can be found across the whole area)
** Approximate values.

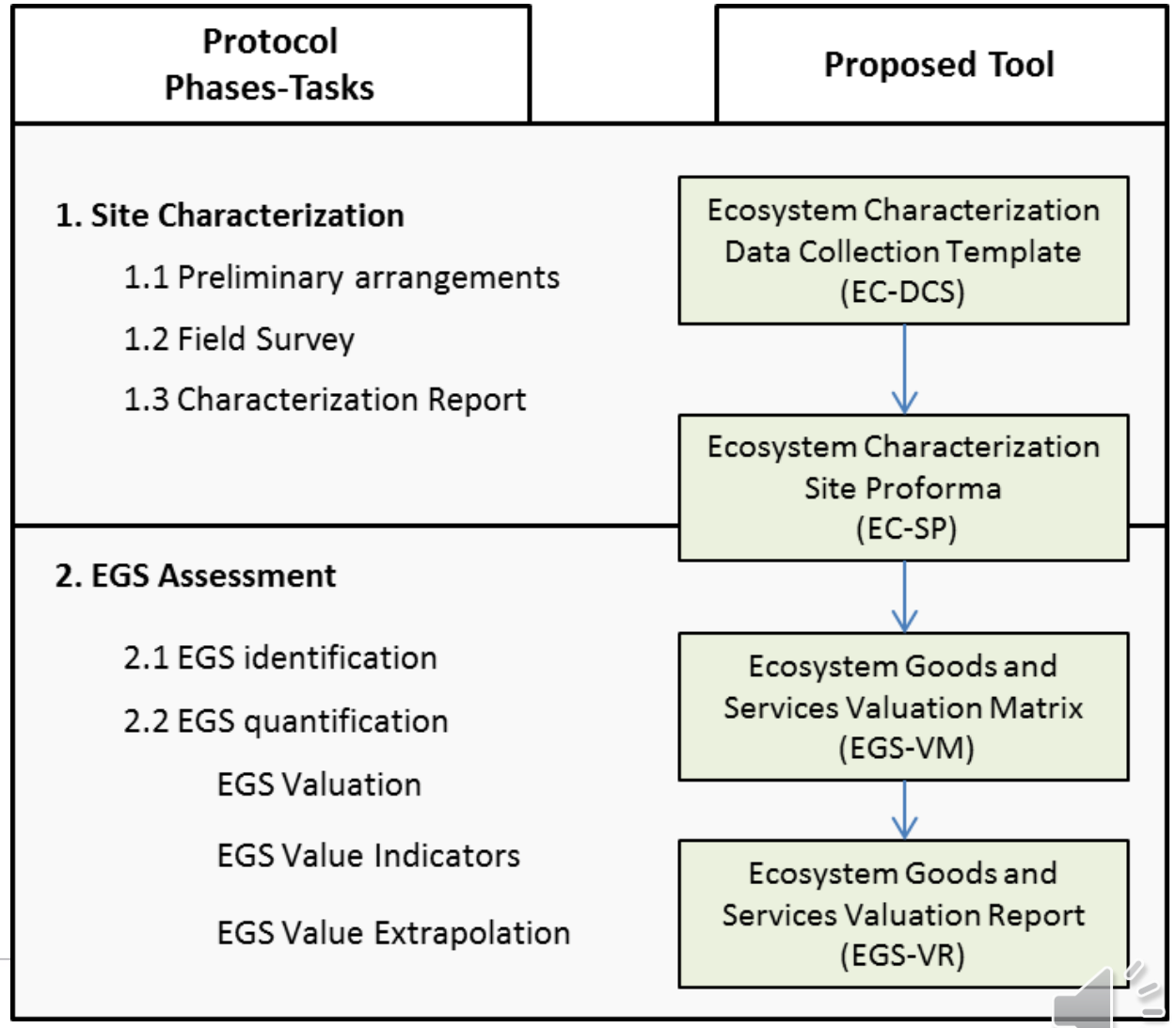
Site features:

- Habitats
- Coverage and length
- Infrastructure.

Methodology: Protocol's Design

Alternative Ecosystem Services Valuation Approach (AESVA)

- Two months to develop and test.
- Designed as a FAST Assessment Protocol
- Two prong-approach with four tools were design to deliver evidenced-based value of wetlands EGS assessment
- Products:
  - Simple Report
  - Detailed Report
  - Scientific Article



Scheme of the AESVA protocol.

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IMPLEMENTATION, RESULTS and DISCUSSION

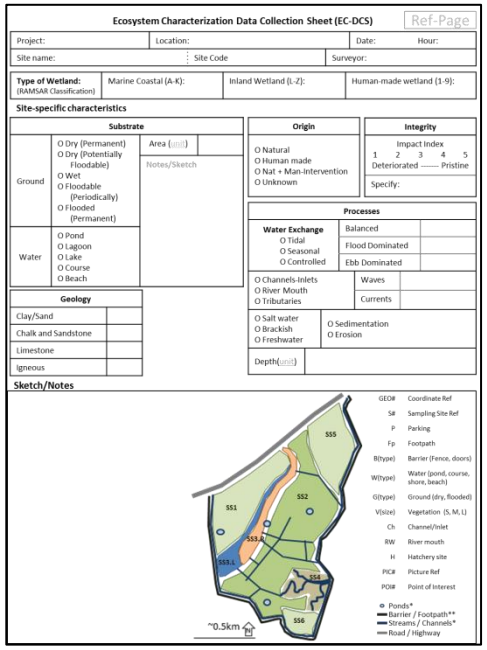
Implementation

Protocol Phases-Tasks	Proposed Tool
1. Site Characterization	
1.1 Preliminary arrangements	Ecosystem Characterization Data Collection Template (EC-DCS)
1.2 Field Survey	Ecosystem Characterization Site Proforma (EC-SP)
1.3 Characterization Report	
2. EGS Assessment	
2.1 EGS identification	Ecosystem Goods and Services Valuation Matrix (EGS-VM)
2.2 EGS quantification	
EGS Valuation	
EGS Value Indicators	Ecosystem Goods and Services Valuation Report (EGS-VR)
EGS Value Extrapolation	

Scheme of the AESVA protocol.

1) The Ecosystem Characterization data Collection template (EC-DCS) was used for the preliminary site description

- Printable template
- Holistic description to be applied on site
- Around 20 minutes per location.


Ecosystem Characterization Data Collection Sheet (EC-DCS)

Ref-Page

Project: Location: Date: Hour:

Site name: Site Code Surveyor:

Type of Wetland: (RAMSAR Classification) Marine Coastal (A-K): Inland Wetland (L-Z): Human-made wetland (1-9):

Site-specific characteristics

Substrate

Ground: O Dry (Permanent) O Dry (Potentially Floodable) O Wet O Floodable (Periodically) O Flooded (Permanent)

Area (unit)

Notes/Sketch

Water: O Pond O Lagoon O Lake O Course O Beach

Origin: O Natural O Human made O Nat + Man-Intervention O Unknown

Integrity: Impact Index 1 2 3 4 5 Deteriorated ——— Pristine

Specify:

Processes

Water Exchange: O Tidal O Seasonal O Controlled

Balanced

Flood Dominated

Ebb Dominated

O Channels-Inlets O River Mouth O Tributaries

Waves

Currents

O Salt water O Brackish O Freshwater

O Sedimentation O Erosion

Depth(unit)

Geology

Clay/Sand

Chalk and Sandstone

Limestone

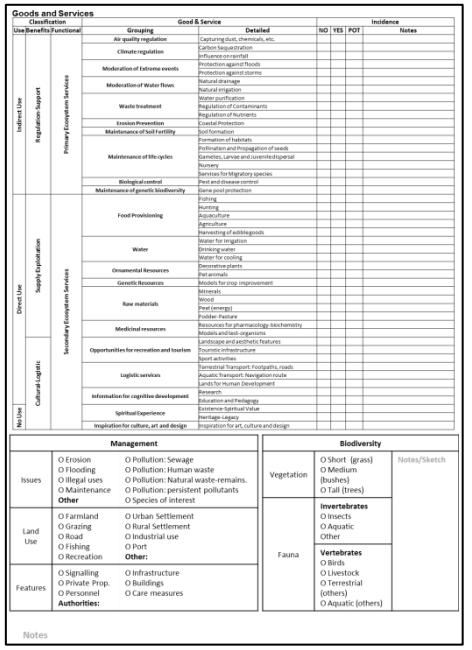
Igneous

Sketch/Notes

GEO# Coordinate Ref
S# Sampling Site Ref
P Parking
Fp Footpath
B(type) Barrier (Fence, doors)
W(type) Water (pond, course, shore, beach)
G(type) Ground (dry, flooded)
V(size) Vegetation (S, M, L)
Ch Channel/Inlet
RM River mouth
H Hatchery site
PIC# Picture Ref
POI# Point of Interest

Ponds*
Barrier / Footpath**
Streams / Channels*
Road / Highway

~0.5km


Goods and Services

Classification: Use	Benefits	Functional	Good & Service: Grouping	Detailed	Incidence: NO	YES	POT	Notes
Indirect Use	Regulation-Support	Primary Ecosystem Services	Air quality regulation	Capturing dust, chemicals, etc.				
			Climate regulation	Carbon Sequestration				
				Influence on rainfall				
			Moderation of Extreme events	Protection against floods				
				Protection against storms				
			Moderation of Water flows	Natural drainage				
				Natural irrigation				
			Waste treatment	Water purification				
				Regulation of Contaminants				
				Regulation of Nutrients				
			Erosion Prevention	Coastal Protection				
			Maintenance of Soil Fertility	Soil formation				
			Maintenance of life cycles	Formation of habitats				
				Pollination and Propagation of seeds				
				Gametes, Larvae and Juvenile dispersal				
				Nursery				
				Services for Migratory species				
			Biological control	Pest and disease control				
			Maintenance of genetic biodiversity	Gene pool protection				
Direct Use	Supply-Exploitation	Secondary Ecosystem Services	Food Provisioning	Fishing				
				Hunting				
				Aquaculture				
				Agriculture				
				Harvesting of edible goods				
			Water	Water for irrigation				
				Drinking water				
				Water for cooling				
			Ornamental Resources	Decorative plants				
				Pet animals				
			Genetic Resources	Models for crop improvement				
			Raw materials	Minerals				
				Wood				
				Peat (energy)				
				Fodder- Pasture				
			Medicinal resources	Resources for pharmacology-biochemistry				
				Models and tests-organisms				
				Landscape and aesthetic features				
			Opportunities for recreation and tourism	Touristic infrastructure				
				Sport activities				
			Logistic services	Terrestrial Transport: Footpaths, roads				
				Aquatic Transport: Navigation route				
				Lands for Human Development				
	Cultural-Logistic		Information for cognitive development	Research				
				Education and Pedagogy				
			Spiritual Experience	Existence-Spiritual Value				
				Heritage-Legacy				
No Use			Inspiration for culture, art and design	Inspiration for art, culture and design				

Management			Biodiversity		
Issues	O Erosion O Flooding O Illegal uses O Maintenance **Other**	O Pollution: Sewage O Pollution: Human waste O Pollution: Natural waste-remains. O Pollution: persistent pollutants O Species of interest	Vegetation	O Short (grass) O Medium (bushes) O Tall (trees)	Notes/Sketch
Land Use	O Farmland O Grazing O Road O Fishing O Recreation	O Urban Settlement O Rural Settlement O Industrial use O Port **Other:**	Fauna	**Invertebrates** O Insects O Aquatic Other	
Features	O Signalling O Private Prop. O Personnel **Authorities:**	O Infrastructure O Buildings O Care measures		**Vertebrates** O Birds O Livestock O Terrestrial (others) O Aquatic (others)	

Notes

Results

STEP 1- EC-Data Collection Sheet

(Boyd & Banzhaf 2007).

Economic aspects
Barbier et al. 1997
Ledoux & Turner 2002

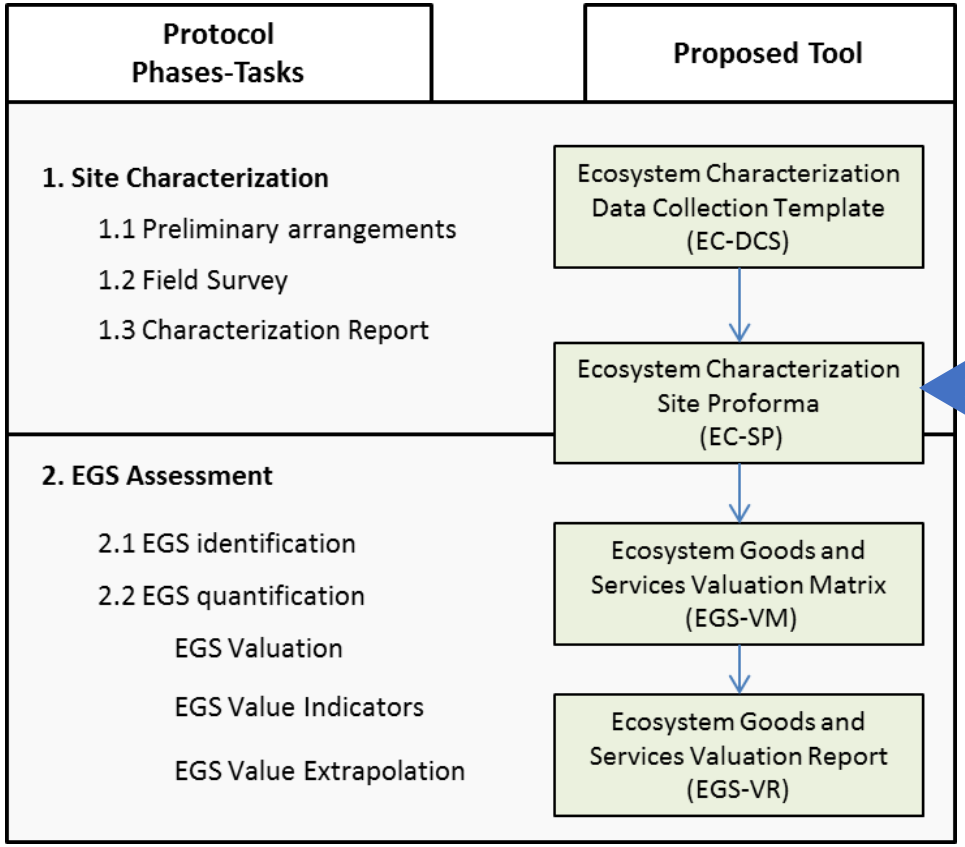
Ecological-functional features
De Groot et al. 2002;
Remoundou et al. 2009;
Potts et al. 2014

Mixed characteristics
Bockstael et al. 1995;
Barbier et al. 1997;
Hueting et al. 1998;
Liquete et al. 2013;
Potts et al. 2014

Goods and Services

Classification			Good & Service		Incidence			
Use	Benefits	Functional	Grouping	Detailed	NO	YES	POT	Notes
Indirect Use	Regulation-Support	Primary Ecosystem Services	Air quality regulation	Capturing dust, chemicals, etc.				
			Climate regulation	Carbon Sequestration				
				Influence on rainfall				
			Moderation of Extreme events	Protection against floods				
				Protection against storms				
			Moderation of Water flows	Natural drainage				
				Natural irrigation				
			Waste treatment	Water purification				
				Regulation of Contaminants				
				Regulation of Nutrients				
			Erosion Prevention	Coastal Protection				
			Maintenance of Soil Fertility	Soil formation				
			Maintenance of life cycles	Formation of habitats				
				Pollination and Propagation of seeds				
				Gametes, Larvae and Juvenile dispersal				
				Nursery				
				Services for Migratory species				
			Biological control	Pest and disease control				
			Maintenance of genetic biodiversity	Gene pool protection				
Direct Use	Supply Exploitation	Secondary Ecosystem Services	Food Provisioning	Fishing				
				Hunting				
				Aquaculture				
				Agriculture				
				Harvesting of edible goods				
			Water	Water for Irrigation				
				Drinking water				
				Water for cooling				
			Ornamental Resources	Decorative plants				
				Pet animals				
			Genetic Resources	Models for crop improvement				
			Raw materials	Minerals				
				Wood				
				Peat (energy)				
				Fodder-Pasture				
			Medicinal resources	Resources for pharmacology-biochemistry				
				Models and test-organisms				
	[illegible]		Opportunities for recreation and tourism	Landscape and aesthetic features				
				Touristic infrastructure				
				Sport activities				

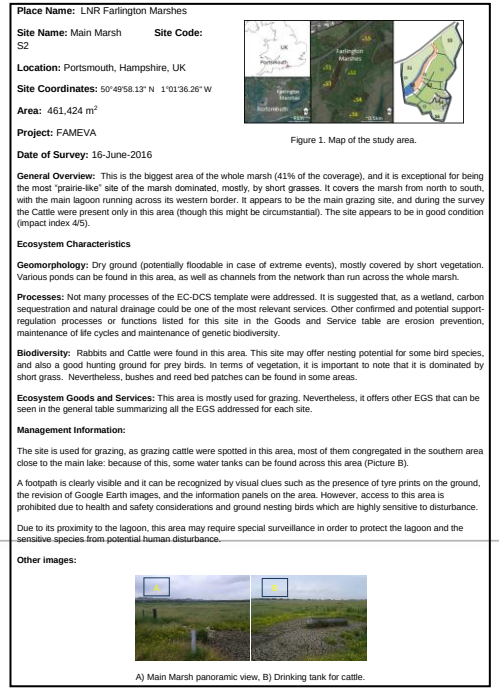
Implementation



Scheme of the AESVA protocol.

2) The Ecosystem Characterization Site Proforma (EC-SP) was used for the general description of the ecosystem.

- Digital template.
- Multiple <u>written</u> sections addressing the main descriptive characteristics of the ecosystem.



Place Name: LNR Farlington Marshes

Site Name: Main Marsh S2 **Site Code:**

Location: Portsmouth, Hampshire, UK

Site Coordinates: 50°49'58.13" N 1°01'36.26" W

Area: 461,424 m²

Project: FAMEVA

Date of Survey: 16-June-2016

Figure 1. Map of the study area.

General Overview: This is the biggest area of the whole marsh (41% of the coverage), and it is exceptional for being the most "prairie-like" site of the marsh dominated, mostly, by short grasses. It covers the marsh from north to south, with the main lagoon running across its western border. It appears to be the main grazing site, and during the survey the Cattle were present only in this area (though this might be circumstantial). The site appears to be in good condition (impact index 4/5).

Ecosystem Characteristics

Geomorphology: Dry ground (potentially floodable in case of extreme events), mostly covered by short vegetation. Various ponds can be found in this area, as well as channels from the network than run across the whole marsh.

Processes: Not many processes of the EC-DCS template were addressed. It is suggested that, as a wetland, carbon sequestration and natural drainage could be one of the most relevant services. Other confirmed and potential support-regulation processes or functions listed for this site in the Goods and Service table are erosion prevention, maintenance of life cycles and maintenance of genetic biodiversity.

Biodiversity: Rabbits and Cattle were found in this area. This site may offer nesting potential for some bird species, and also a good hunting ground for prey birds. In terms of vegetation, it is important to note that it is dominated by short grass. Nevertheless, bushes and reed bed patches can be found in some areas.

Ecosystem Goods and Services: This area is mostly used for grazing. Nevertheless, it offers other EGS that can be seen in the general table summarizing all the EGS addressed for each site.

Management Information:

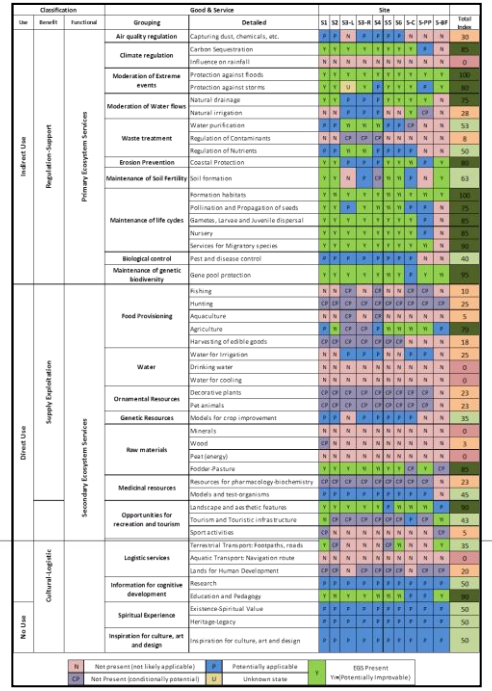
The site is used for grazing, as grazing cattle were spotted in this area, most of them congregated in the southern area close to the main lake: because of this, some water tanks can be found across this area (Picture B).

A footpath is clearly visible and it can be recognized by visual clues such as the presence of tyre prints on the ground, the revision of Google Earth images, and the information panels on the area. However, access to this area is prohibited due to health and safety considerations and ground nesting birds which are highly sensitive to disturbance.

Due to its proximity to the lagoon, this area may require special surveillance in order to protect the lagoon and the sensitive species from potential human disturbance.

Other images:

A) Main Marsh panoramic view, B) Drinking tank for cattle.



Results

STEP 2- EC-Site Proforma

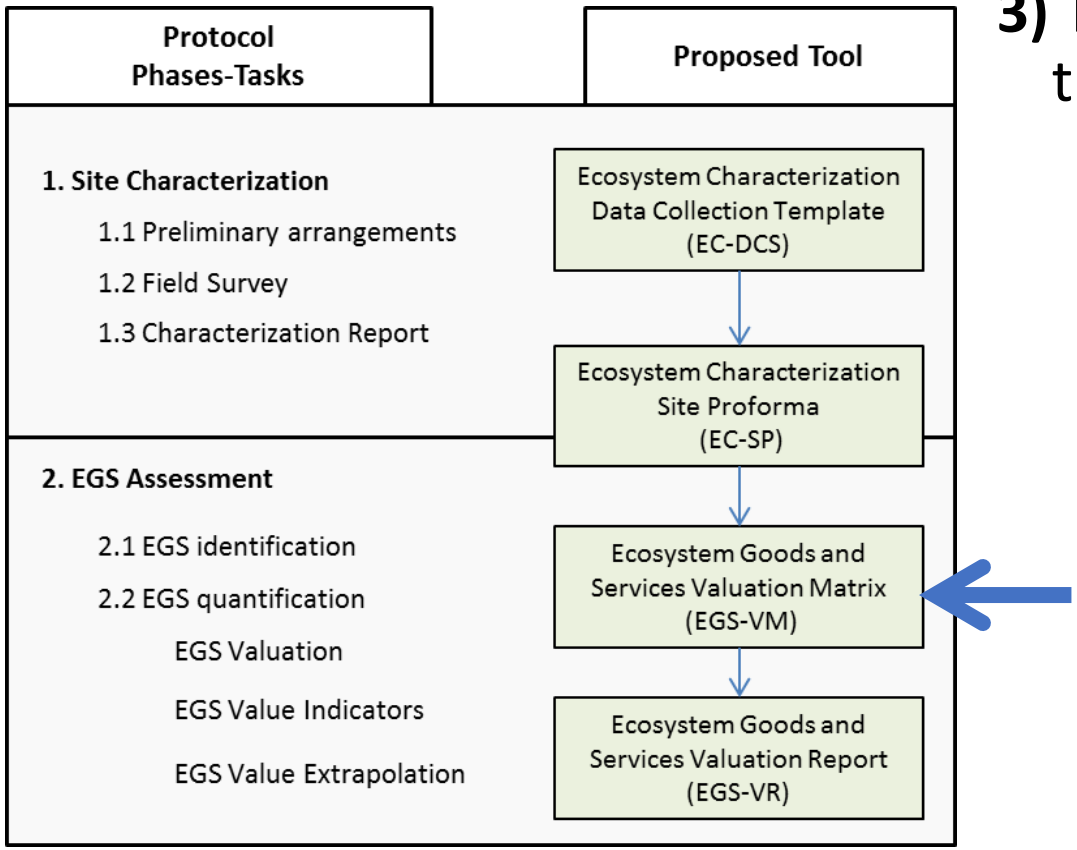
Scoring for EGS Relevance

EC Site Proforma **EGS Pre-Assessment**

Classification			Good & Service		Site										
Use	Benefit	Functional	Grouping	Detailed	S1	S2	S3-L	S3-R	S4	S5	S6	S-C	S-PP	S-BF	Total Index
Indirect Use	Regulation-Support	Primary Ecosystem Services	Air quality regulation	Capturing dust, chemicals, etc.	P	P	N	P	P	P	P	N	N	N	30
			Climate regulation	Carbon Sequestration	Y	Y	Y	Y	Y	Y	Y	Y	P	N	85
				Influence on rainfall	N	N	N	N	N	N	N	N	N	N	0
			Moderation of Extreme events	Protection against floods	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	100
				Protection against storms	Y	Y	U	Y	P	Y	Y	Y	P	Y	80
			Moderation of Water flows	Natural drainage	Y	Y	P	P	P	Y	Y	Y	Y	N	75
				Natural irrigation	N	N	P	P	P	N	N	Y	CP	N	28
			Waste treatment	Water purification	P	P	Yi	Yi	Yi	P	P	CP	N	N	53
				Regulation of Contaminants	N	N	CP	CP	CP	N	N	N	N	N	8
				Regulation of Nutrients	P	P	Yi	Yi	P	P	P	P	N	N	50
			Erosion Prevention	Coastal Protection	Y	Y	P	P	P	Y	Y	Yi	P	Y	80
			Maintenance of Soil Fertility	Soil formation	Y	Y	N	P	CP	Yi	Yi	P	N	Y	63
				Formation habitats	Y	Yi	Y	Y	Y	Yi	Yi	Y	Yi	Y	100

N	Not present (not likely applicable)	P	Potentially applicable	Y EGS Present Yi=(Potentially Improvable)
CP	Not Present (conditionally potential)	U	Unknown state	

Implementation



Scheme of the AESVA protocol.

3) The EGS valuation Matrix (EGS-VM) was used for the quantification of EGS

- Interactive spreadsheet where the user puts the economic values of the EGS.
- Designed in a smart way that allows:
  - Inclusion of the contribution per area unit (e.g. £/hectare)
  - The automatic estimation of the total value, The fixed contribution for the whole area (e.g. a fixed value such as land value) or the variable contribution (e.g. yearly rates of contribution as £/year).

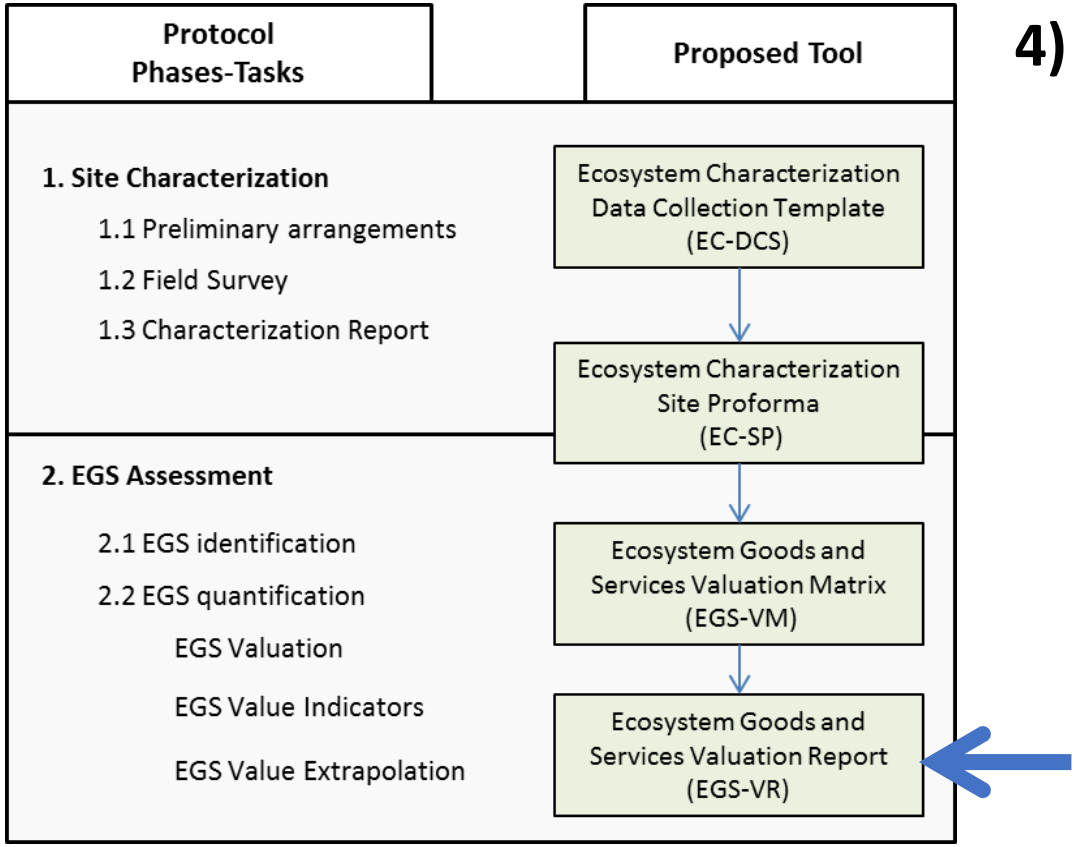
Results

STEP 3- EGS-Valuation Matrix

		Economic Contribution per						
EGS	**TSI**	**Area unit (£/m^2)**	**Area unit (£/acre)**	**Total area Variable value (£/year)**	**Total area Fixed Value (£)**	**Length unit (£/m)**	**Total Length of the addressed features (£)***	**Observations** Give information about the economic values assigned to each of the EGS, including detailed calculations and notes that can make this and self-explanatory table. Include citation of the sources of gathered information. Include appropriate explanations when the EGS is not addressed or not applicable for the study case, or if its valuation is being considered or merged into another category.
Water purification	53	0.18		200,340				These services are likely to be occurring as the presence of the meadows, reed bed patches and other features aid to keep water bodies clear of excess of nutrients and even other contaminants. However, in this case, the surrounding areas are not under an specific pressure of this kind and it could be said that these features do not play an special depurative role despite that of keeping balanced their own habitat's quality (if compared with other well-known examples where natural and artificial wetlands are used as green filters for sewage water treatment). In this case it could be said that the value of these features is related to the cost of restoration-replacement to provide or maintain the same environmental quality. **Estimation from previous studies:** Water quality improvement **1,793 – 2,676 £/ha/yr** (Morris and Camino 2011)
Regulation of Contaminants	8							
Regulation of Nutrients	50							
Coastal Protection	80					2,000	2,800,000	-Price of alternative measures to protect the shoreline against erosion from sea. Several examples can be used. For this scenario the Gabion revetment was selected as a suitable option, and its value is **2,000-5,000 £/meter.** UK Environment Agency (2015). Cost estimation for coastal protection.

- Automatic fields
- Requires size data from characterization section.

Implementation



Scheme of the AESVA protocol.

4) The EGS valuation Report (EGS-VM) was used to report the valuation data.

- Interactive spreadsheet derived from the previous EGS-VM.
- Aggregation by categories
- Customizable fields depending on the purpose.

RESULTS: EGS ASSESSMENT

STEP 4- EGS-Valuation Report

EGS Type	Value(£)	%	Main EGS Categories
Regulation-Support	5,124,956	66	Carbon Sequestration, Protection against floods, Protection against storms, Natural irrigation, Water purification, Coastal Protection, Formation habitats, Services for Migratory species
Supply Exploitation	144,917	2	Agriculture, Fodder-Pasture
Cultural-Logistic	2,484,621	32	Landscape and aesthetic features*, Tourism and Touristic infrastructure*, Lands for Human Development, Education and Pedagogy*

	Value(£)	%
Fixed Value	6,180,682	80
Variable Value	1,573,813	20
Total value	7,754,495	

* Some categories may be redundant with others, so certain application may require detailed analysis of data to avoid double accounting.

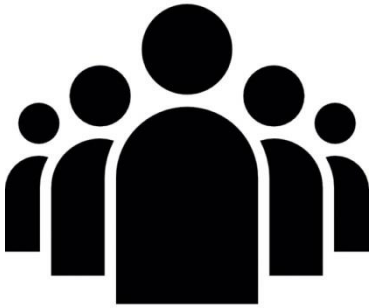
- **EGS Economic Value Summary**
- Aggregated by “type of benefit” categories
- Different output configurations are possible

DISCUSSION: Performance

- The AESVA is an adaptable and useful approach that can be applied to conduct a full EGS valuation.

- It is time and budget friendly. It takes less time (2-3 weeks) compared to other approaches which can takes months or more

- AESVA was developed to be used for multiple scenarios (e.g. different kinds of habitats, information sources, or users).



- We will share resources trough Research Gate.

DISCUSSION

Ideas for future development:

- Fine tuning with potential users and experts
- App software to make it simple
- GIS integration + Drone surveying

In the search of funding, testers and collaborators:

- Follow project online https://www.researchgate.net/project/Alternative-approach-for-the-economic-valuation-of-Ecosystem-Goods-and-Services

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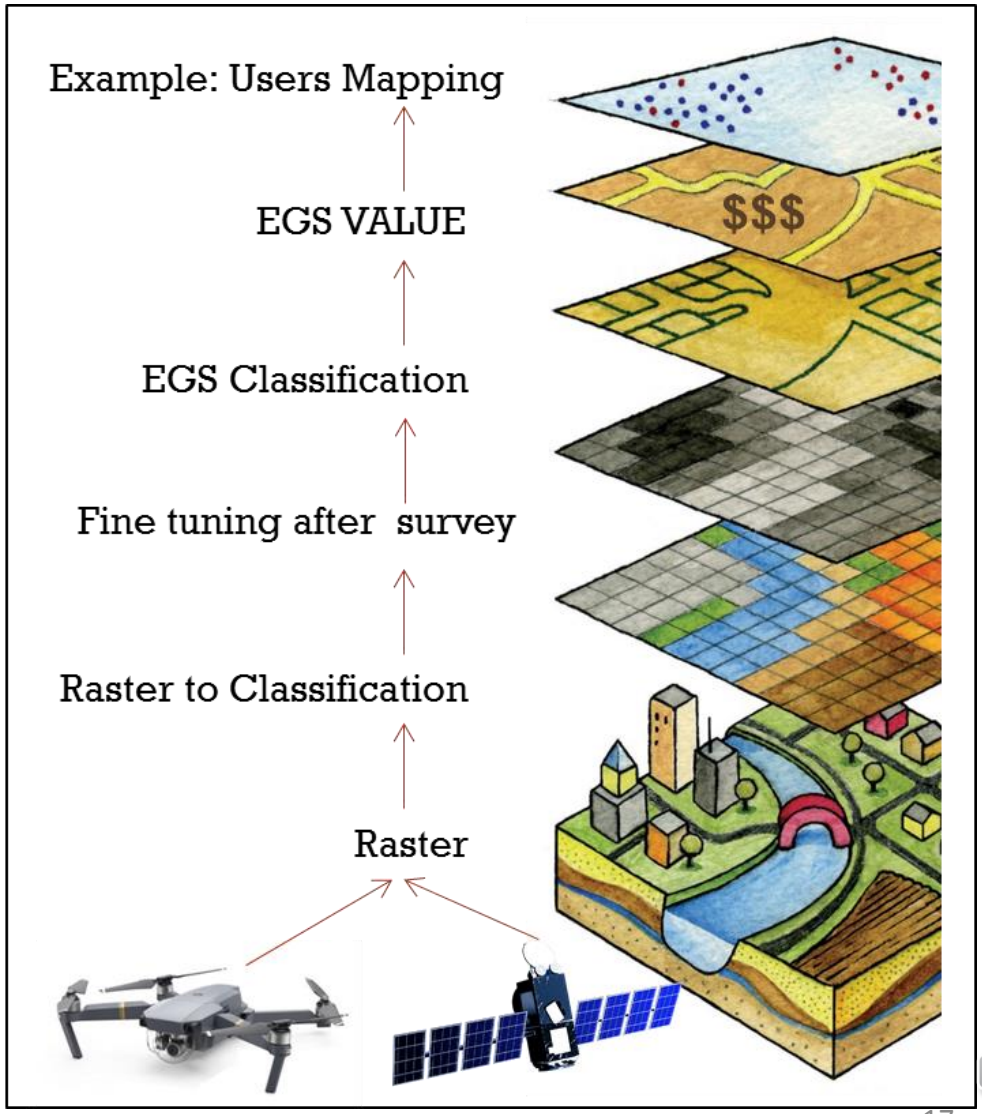

Conclusions

- The AESVA is a versatile and easy to use method to achieve **reliable valuation of EGS**.
  - Exceptional for its simplicity and the inclusion of innovative traits.
  - Can be used as ready-to-use framework or modified to fit different purposes.

- The EGS assessment of Farlington Marshes was successful for both pre-established purposes:
  - Serving a as a case study to run, test and fix the protocol.

  - Contribute to the knowledge of the local natural reserve.

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AESVA PROJECT updates and resources

Research Gate:
https://www.researchgate.net/project/Alternative-approach-for-the-economic-valuation-of-Ecosystem-Goods-and-Services

Thank you

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