Coastal Wetland Ecosystem Services
Seminar 1
6-7th February 2008
St William's College, York, UK

Coastal Wetland Ecosystem Services
1st Workshop 6-7th February 2008

GENERAL

Attendees

Jim Boyd	Resources for the Future
Mark Bulling	University of Aberdeen
Brendan Fisher	University of East Anglia
Jasmin Godbold	University of Aberdeen
Alison Holt	University of Sheffield
Meg Huby	University of York
Tiziana Luisette	University of East Anglia
Stephen Mangi	Plymouth Marine Laboratory
Laura Payne	Plymouth Marine Laboratory
Dave Raffaelli	University of York
Irene Ring	Helmholz Centre for Environmental Research
Jim Smart	University of York
Martin Solan	University of Aberdeen
Piran White	University of York
Jessica Wiegand	University of York

Draft plan for all workshops

Workshop 1) Map out the ecosystem services (ES) approach and identify gaps in knowledge
Workshop 2) Links between functions and services
Workshop 3) Look at spatial and temporal dispersions
Workshop 4) Indicators of ES sustainability in coastal wetlands
Workshop 5) Valuation of ES
Workshop 6) Proposals for the research agenda

Aims of 1st workshop

How to quantify an ES approach in the 'real world'
Role of biodiversity
Impact of environmental change e.g. sea level rise
Link between ecosystem services and public welfare
Assess whether ES approach is an effective policy for conservation

Talk 1: *Dave Raffaelli: Coastal Wetlands*

Five major wetland types (In bold are those in Europe that this seminar series will concentrate on):

Marine

- **coastal lagoons**
- **rocky shores**
- coral reefs

Estuarine

- **deltas**
- **tidal marshes**
- mangrove swamps

Lacustrine, Riverine, Palustrine

Characteristics and threats

'Wetland' type	*Characteristics*	*Threats*
Rocky shore	Species poor, robust, not much of a conservation problem, kelps have high primary productivity (twice that of mangroves)	No major threats – robust habitat
Coastal saltmarsh	High primary productivity, sea defence, wildfowl grazing/wader nesting	Flood defence works, erosion and sea level rise, land claim, cord grass (invasive), barrage construction
Estuaries	Quite low primary productivity but very high secondary productivity, support shorebirds, nursery for fish	Agricultural pollution, industrial pollution, sea level rise, land claim, invasive species, over-fishing
Mudflats	see estuaries	see estuaries
Coastal marshes	Limited agriculture, Important for breeding waders and over-wintering wildfowl	Flood defences, sea level rise (salinity), neglect
Saline lagoons	Specialised plants and invertebrates	Eutrophication, infilling, artificial control of water levels, coastal defence, sea level rise
Sea grass beds	Terrestrial grasses that grow in the sea (*Zostera* spp.), important for wildfowl,	Disease (loss of grass leading to loss of finer sediment – irreversible),

	restricted species – pipefish, red algae, high primary productivity	overgrazing e.g. due to brent geese, sea level rise, coastal defences

Wetland functions

- water storage
- storm protection/flood mitigation
- shoreline stabilisation and erosion control
- groundwater recharge/discharge
- water purification
- retention of nutrients/sediments/pollutants
- stabilisation of local climate (possibly on very large scales)

Wetland values

- water supply (quality and quantity)
- fisheries
- timber and building materials
- wildlife resources
- transport
- other products (e.g. herbal medicine)
- recreation and tourism opportunities
- cultural values
- religious beliefs
- aesthetic and artistic inspiration
- archaeological evidence
- wildlife sanctuaries

UK BAPS

- Define coastal wetland habitats on a much smaller scale
- (Need list)

DISCUSSION AFTER TALK

Need a topology - should we define wetlands on the basis of physical habitat, biology, or functions and services provided?

What units should we use when measuring ecosystem services?

Are there any common units?

To what extent are threats to wetlands a result of the overuse of other ecosystem services?

Talk 2: *Jim Boyd: "Ecodemiology"*

ES may be a new term, but is an old idea that has been around for over 50 years, so why has the concept not moved on?

Two main ways that the study of ES has been looked at

1) Site specific studies
- economics and ecology looked at together
- provides a $ figure at the end

Pros: publishable, rigorous, both ecology and economics looked at, uses the '$ language'
Cons: benefits transfer issue (not only with money, but with biophysical management aspects as well), not practical and managerial.

2) Accounting schemes
- broad studies over a state/nation
- managerial, not technical
- an index of values and trends rather than $ answers
- 'green GDP'

Pros: Broad trend, management/measurement consistency, more practical
Cons: Blunt, imprecise, academically under-appreciated

Third way…

3) Ecodemiology

Based on the idea that ecology remains insufficiently 'managerial', and that economics must be built on a sound ecological basis

Asks what can be controlled by society, and how does this management translate into the outcomes that we care about? Can we tweak the inputs to alter the endpoints?

Ecological input → processes → endpoint

"Endpoints" are location specific, can be seen/felt, and are the direct things that are cared about

Observations:
- Prices are meaningless until quantities are defined. Clarifying Q will clarify the search for p
- There are no real prices, only maybe bundles of benefit indicators that move the values up and down. It is crude but easy to count. E.g. $p_i(I_1, I_2, I_3…)$

where p is price/value, and I is the measurement of value to people e.g. ecological endpoints, proximity of area to humans, scarcity etc. etc.

- Note the ability of geospatial information that can be translated into land use, and combine the social and the physical spatially.
- Need to value what is important to people. Valuing endpoints captures the value of everything else

DISCUSSION AFTER TALK

Comment about how open space can be highly valuable in the summer and not at all in the winter: temporal aspect to benefits.

Comment that uncertainty is the key issue in the endpoints, the linkages between processes and endpoints etc.

Comment that economists can do the accounting, but ecologists are needed to determine the linkages, and sociologists for the importance of the endpoints to people.

To what extent is systematic review applicable to ecosystem services – could this make a link between specific and general paradigms?

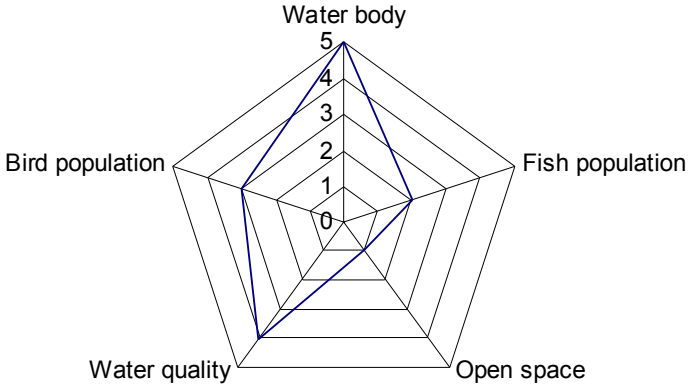
Definition of endpoints – what are they? what can be valued? how can they be valued?

Don't hold breath waiting for real prices for many services – better to focus instead on indicators – crude by easy to count, e.g. roads, proximity to population, numbers of households, number of users

Changing values over time complicates efforts to attach values to things. Desired endpoints may also change over time – we are making choices now based on our current value systems

Lots of different things are valued. How can we represent or weight these?

Talked about the use of amoeboid diagrams to represent the different aspects of an ecosystem that people care about



Thought this kind of diagram was good as it allowed a visual concept of the trade-offs between endpoints. Questions arose regarding the weighting of the axes.

Asking people to indicate weightings - participatory approaches

Neural network approach – mapping inputs to outputs – can be combined wiyth participatory techniques

Importance of geospatial information – combining social, ecological and physical in a spatial sense

Talk 3: *Jessica Wiegand: Defining ecosystem services*

Why take an ES approach? And what does a framework need to capture to achieve this?

- capture increases and decreases in both quality and quantity of service provisions
- capture geographically distant impacts of activities on services
  inc non-linearities
  inc spatial arrangements of components
- capture temporally distant impacts of activities on services
- enable thresholds of delivery to be explored
- enable both economic and environmental accounting
- ascertain whose needs or wants are counted
- encompass the bi-directionality of ES and human-well being
- ascertain what is 'human well-being'

Currently many different definitions:

Daily (1997)

- **Ecosystem services → Ecosystem goods**
- Ecosystem services are 'conditions and processes through which natural ecosystems sustain and fulfil human life; life support functions'
- Ecosystem goods are maintained and produced by ecosystem services eg food, forage, timber etc
- Harvest and trade of goods represent a familiar part of human economy

Binning *et al* (2001)

- **Natural asset → services → goods**
- Ecosystem services flow from natural assets (soil, water, systems, living organisms and the atmosphere) to provide us with financial, ecological and cultural benefits.
- Natural assets: stock of natural resources from which many goods are produced
- Goods: anything produced that had value to humans
- Services: inputs to production such as pollination OR maintenance of natural assets such as nutrient cycling

de Groot *et al* (2002)

- **Structures and processes → ecosystem functions → goods and services**
- Processes: the result of interactions between biotic (living organisms) and abiotic (chemical and physical) components of ecosystems through the universal driving forces of matter and energy
- Functions: the capacity of of natural processes and components to provide goods and services that satisfy human needs, directly or indirectly.

- Eg weathering of rock is a ***process*** that contributes to the ***function*** of soil formation, that results in the ***service*** of the maintenance of productivity on arable land

Boyd & Banzhaf (2006)

- **Functions and processes → Services**
- Ecosystem services are 'components of nature, directly enjoyed, consumed or used to yield human well-being'
- Directly enjoyed: end product, not intermediate
- Components: things or characteristics, NOT functions of processes
- Functions and processes are intermediate to production of final service eg nutrient cycling. Not stating not valuable, just that value will be captured in the measurement of services. Avoids double counting
- Eg when angling, the services are the lake necessary for angling, the visual natural resources necessary for aesthetic enjoyment, and the fish population

Wallace (2007)

- **Asset → process → service**
- Asset: natural resources, capital etc
- Process: Interactions among biotic and abiotic elements of an ecosystem that lead to a definite result
- Services: the benefits people obtain from ecosystems, the outcomes of which are sought through ecosystem management

Fisher *et al* (In press)

- **Indirect service → direct service → benefit**
- Services: aspects of ecosystems utilised actively or passively to produce human well-being, including organisation and processes if utilised by humanity
- Functions: become services if there are humans that benefit from them. Without human beneficiaries there are no services
- Eg Nutrient cycling is a process that results in clean water
- If the clean water is consumed, then the clean water consumed is a ***benefit*** of the ***directly utilised service*** of clean water provision, which results from the ***indirectly utilised service*** of nutrient cycling.

Summary of Definitions:

In bold is the 'service' according to author's definitions

- Ecosystem services → Ecosystem goods
  water filtration → *clean water*
- Natural asset → services → goods
  river → ***water filtration*** → *water production*
- Structures and processes → ecosystem functions → goods and services
  water filtration and storage → *water supply* → ***potable water***
- Functions and processes → services
  purification of water → ***potable water***

- Process → service
  Water regulation → ***clean water***
- Indirect service → direct service → benefit
  Water purification → clean water provision → *clean water*

DISCUSSION AFTER TALK

Defining production functions – how much do we need to know about the shape of the production function for individual services since all service functions are multidimensional

Need to understand motivations behind people's behaviour regarding consumption/conservation

Correlation between people experiencing depleted ecosystem services and lacking the capacity to improve/conserve them - links between environment, wealth and welfare

Does it make sense to manage for ecosystem services because it is the goods themselves that can actually be measured most easily? Goods can be traded off easily, but trading off services is more difficult. Is it possible to manage for service provision?

Talk 4: *Irene Ring: Regional assessment of ecosystem services framework and policy gaps*

Challenges:

1) Linking the natural and social sciences
    a. Identifying ES in question, including boundaries
    b. Assessing ES in a way that will allow later integration of results
    c. Linking policy and politics with equity
2) Bridging science and society
    a. Need to consider stakeholders from the beginning
    b. Orienting project results and products towards the needs of users
    c. Participatory development of policy

Regional assessment of ecosystem services

1.) Screening phase and identification
2.) Scientific assessment of ES
3.) Integrating policy design and social impacts
4.) Scientific synthesis and science-policy dialogue

Framework

A complete ES framework isn't required, but must be agreed WITHIN a project, with clear distinctions made between functions, services and processes

Legislation

Need to know what ES are already regulated, and what policy instruments and measures already exist?

E.g. Water Framework Directive

It's rare that legal scientists are involved in ES assessment studies to provide the links between actual legal documents, their interpretation and the implementation of measures.

Fiscal equivalence:

Need to better match the benefits of ES conservation, those who pay for it and those who make the decisions concerning it.

Need to create a market for ecosystem services i.e. payments for the conservation of ES. However, do not use the term 'subsidy' as this implies getting something for nothing.

DISCUSSION AFTER TALK

Tradeoffs between conservation and equity – policies should contribute to poverty reduction

Criteria for environmental policy instruments – ecological effectiveness, economic effectiveness – but don't generally consider distributional or equity impacts – contrast with policies in other sectors

DISCUSSIONS *1st Breakout group session*

Aims of 1st set of discussions:

1.) Definition of ES framework to use for the rest of the series
2.) How do we define wetlands?
3.) Can we categorise wetlands according to the bundles of benefits they provide?
4.) What is the service providing unit?
5.) How does the service providing unit map onto the management units?

1) Definition of ES framework to use for the rest of the series

No single definition of the exact words to use to define ES was agreed, although the general concept underpinning the idea was the same

Group One
E.g. ***Many processes →functions → outcomes → benefits/disbenefits***

Bio perturbation → nutrient cycling → clean water → (price/utility etc)

Where 'outcomes' are the things that people care about. The term 'outcome' was used as it is neither positive nor negative. For example a wetland can provide flood protection but also a strong smell.

Group Two
Indirect service → direct service → benefit

Bio perturbation → clean water provision → clean water

Wanted to keep the term 'services' as it is already in the public domain and all the literature.

2) How do we define wetlands?

'Interface between land and water'
Kept RAMSAR and MA boundary definitions but fuzzy to enable them to be altered according to need

Seaward border defined by RAMSAR
Inland border defined as 'anything significantly influenced by anything marine e.g. tides etc

Agreement that wetlands should not be defined by the individual component habitats

3) Can we categorise wetlands by the bundles of benefits they provide?

Decided that wetlands cannot be categorised solely by the bundle of benefits they provide as many ecosystem types will provide the same benefits. Needs to be a joint benefit/biophysical definition

4) What is the service providing unit?

Two different spatial areas that need to be considered: the physical and the social.

The physical spatial area of ES is the scale at which the joint processes work to provide the functions on which the desired outcomes to society depend

The social spatial area of ES is the scale at which humans benefit from the desired outcomes. E.g. The flood protection will occur away from the actual wetland. Tourists will come from far to visit the area etc.

Therefore the scale at which management occurs will depend on society's preferred outcome that the wetland will be managed for.

5) How does the service-providing unit map onto the management units?

Can either manage starting from what people want from wetlands, and then work back to how to achieve these

OR Can start from the wetland itself, and then work out what people want from them

Interchangeable depending on need

DISCUSSIONS *2nd Breakout group session*

Aims of 2nd set of discussion

1) What benefits do wetlands provide?
2) What processes underlie these?
3) Role of biodiversity
4) What data are required to quantify these links?
5) To what extent can mathematical or statistical modelling be used to help quantify and value ES?
6) How detailed do we need to be in our knowledge of functional forms of relationships?
7) Is it correct to think about this as a linear process?

1) What benefits do wetlands provide?

a) Started from Declaration of Human Rights

Security (damage avoidance)
Rest and leisure (recreation)
Life (health, subsistence, water provision)
Work (commercial harvest)
Visual and aesthetic

b) How can wetlands provide these?

Flood protection, fishing, swimming, boating, birding, angling, pest regulation, waste sink, commercial harvesting, clean water provision, herbal remedy provision, open space

c) What components of wetlands contribute to provide these?

fish population, clean water, hydrodynamics, invertebrate species communities, bird population

2) What are the processes that give rise to these?

Nutrient cycling, bioturbation, etc. etc.

3) Role of biodiversity

The term ‘biodiversity’ was considered to be unhelpful due to its ambiguity as to whether it meant ‘species richness’, anything living occurring in the natural world, or all the biotic interactions as well. Hence the role of ‘biodiversity’ was deemed to be dependant on the desired outcome managed for, i.e. different species and interactions will be important for different things

4) What data are required to quantify these links?

Not really covered, other than to note the need to be able to deal with uncertainty and a lack of data

5) To what extent can mathematical or statistical modelling be used to help quantify and value ES?

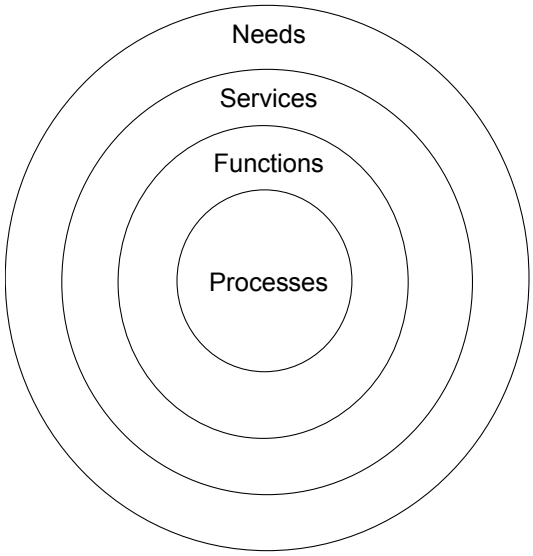
Will be required (see No 4)

6) How detailed do we need to be in our knowledge of functional forms of relationships?

Not much covered, uncertainty

7) Is it correct to think about this as a linear process?

Diagram devised that takes linear processes and linkages into account – mapping needs back to processes via services and functions



This could be used to highlight the interactions and show how managing for one service may affect the provision of other services

All the links within this schematic diagram create a network – could use a Bayesian approach to quantify it

Could be a tool for management/road map for decision-making or a means for highlighting most important links

Could also be used in an interactive/participatory way with stakeholders to prioritise concerns and identify inter-relationships within and between different levels (needs, services, functions, processes)

NEXT MEETING

- Hoisted by Oceanlab, University of Aberdeen (Martin Solan et al.)
- Incorporate Ythan estuary site visit (http://www.oceanlab.abdn.ac.uk/research/ythan.php)
- Same format… talks, then discussion in breakout groups
- Identify key services using the Ythan as an example, possibly map out links between ecosystem functions and services, note gaps based on the current situation
- Policy input for next meetings – e.g. invited participants from RERAD, EA, SEPA, SNH, RSPB
- Deliverable… review paper? Possibly have a rough draft by the next seminar to circulate for comments
- Consider collaboration/information sharing with other seminar series?