# Research for the Future of the Broads Resilient Peatland

27 June 2017

## *Notes from SESSION 1: Fen Research Presentations*

***Venue: Dragonfly House, St James Place, Norwich NR3 1UB***

***Steering Group: Broads Authority, Natural England, supported by Mike Harding (Hummingbird)***

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### 1 Introduction and aims of the day

Andrea Kelly welcomed delegates to the workshop and gave a presentation outlining the main issues, strategy areas and the aims for the day, along with main 10 insights:

(1) The Broads – richest for biodiversity in UK.
(2) Elements of river quality have improved but this has stabilised.
(3) Clear evidence of negative change (over decades).
(4) Better routine monitoring of vegetation change needed.
(5) Only long-term data collation is hydrology monitoring and river water quality.
(6) Limitations of data in micro-environments of wetland.
(7) More strategic approach to collation of new long-term data needed.
(8) Appears to be less research in Broadland Fens vs lakes.
(9) Fen grazing and the effects on substrate and community not well understood.
(10) Adaptation, natural function needs consideration (and applications site based).

## 2 Presentation - The vegetation: Inventories of Calcareous Fens with Cladium, alkaline fen and transition mire

Iain Diack, Chief Scientists Directorate, Natural England, gave a presentation on 'The vegetation: Inventories of Calcareous Fens with *Cladium*, alkaline fen and transition mire' (see full presentation slides attached).

**Summary points:**

- Classifications of priority habitat types (EC Annex 1 habitiats and BAP habitats) drives work, but for wetlands these are not very well defined and this makes reporting, protecting and advising difficult.
- In 2012 a desk based/GIS project began reviewing historical survey data along with more recent data to make inventories of Annex 1 habitats in wetlands.
- NVCs were used to allow robustness and results maps were produced for each Annex 1 classification. Maps and data were produced and these highlight the complexity of the Broads influence.
- Issues arose with varying survey methodology creating difficulties with mapping Broads datasets.
- Comparison of datasets showed some correspondence but also some anomalies creating confidence issues for some data.
- The presentation contains the detail of the Annex 1 communities with Calcareous fens with *Cladium mariscus* and *Caricion davallianae* species occurring mainly in the Broads in the UK.
- Pressing monitoring issues in the Broads were identified as community stability, successional change (effects from climate change, water abstraction etc.), diffuse pollution, hydrological regimes, specific targeting.
- **Monitoring recommendations:**
- Nationally, base-line surveys needed to check extent and quality of stands of vegetation of particular conservation importance e.g. BDc/BS5, PPc/M9-3..
- Good data exists for Broads, use this to identify the areas of priority habitat types and management.
- Methodology: transects useful for tracking change across boundaries objectively.
- Select good examples of type – samples across Broads and permanent monitoring.
- Select areas vulnerable to change and record the hydrology/water quality.

## 3 Presentation - The water: surface water hydrology

Chris Bradley, Birmingham University, gave a presentation on 'The water: surface water hydrology' (see full presentation slides attached).

**Summary points:**

- The recent public enquiry at Catfield Fen highlighted the wider complexities involved beyond just water levels.
- Unsaturated processes, how water moves through different wetland substrates, and significance of prolonged water shortage need better understanding and enquiry.
- Being aware of local controls: 1st order: precipitation, 2nd order: hydrological/geology settling, 3rd order: local micro-environment, 4th order: environmental changes over time (succession and management).
- Literature often claims surface water dominated systems maintained by precipitation and flows in/out of river systems but ecology shows groundwater effects that are not always recognised.
- **Monitoring recommendations:**

- Considering the period of the year and the antecedent conditions (history of the water budget)
- Other influences: plant communities used to locate monitoring, inland fen compartments and hydrological gradients, constraints of ditch network.
- Note: Erin Payne's work on electrical conductivity with depth as an insight into antecedent conditions
- Catfield Fen – complicated system, lateral flows and upward flux meaning that water is not static, diverse habitats and evolution over time.
- Revisiting Brian Wheeler (1995) work focusing on plants as hydrologists and the interface between groundwater and depth and precipitation at the surface linked to the effects of plants (e.g. leaf litter, sphagnum).
- Looking at ground and surface water interface with a focus on sources of water vs evapotranspiration. Examples given of a. infiltration experiments and b. the effect on electrical conductivity, or stable isotopes and mass balance, although expensive could be used to assess groundwater contribution and summer evapotranspiration and the wider water balance through electrical conductivity. There may be potential for Knowledge Transfer Projects for b. above to develop and assess low cost sensor networks. The 4th order control of environmental changes over time would be an interesting topic for research.
- Modelling needs to look at a finer scale and how water moves through systems and flows through unsaturated zone.
- Use of existing data to look at thresholds for change.

## 4 Question and answer session on presentations

1) Comparison of data sets over time: Methodology and sites need consistency and permanency. This is easier to accomplish with GIS now. S4 and S24 examples – interpretation of NVC difficult (no indication of quadrat size used).
2) Importance of measuring water fluxes not just levels: Tendency to measure levels as this is easy, fluxes are more difficult but are needed for an accurate model for system – long way off from this in Broads.
3) Characterising ecology and effectiveness of this approach: Common language to describe vegetation classification. NVC based on large data set allowing mapping, assigning of importance, allows characterisation of environment and builds picture of what we place value on.
4) Vegetation inventory vs change and drivers of change: Remember there are no hard boundaries/transitions in the field. Loss of species due to change needs detailed monitoring/interventions. Inventories are useful at a high level, for example to choose what you are interested in studying in more detail.

5) Adaptation to changing environment, protecting rare species and prosperity from natural services requires planning ahead. It is worth bearing in mind that not all of the Broadland fens are owned by conservation organisations. So the adaptations need to work across these ownership boundaries.

## 5 Presentation - Re-naturalisation via catch dykes

Mike Harding, Hummingbird, gave a presentation on 'Re-naturalisation via catch dykes' (see full presentation slides attached).

**Summary points:**

- Re-naturalisation via catch dykes produce hydrological and ecological impacts.
- Catch dykes provide a 'line' in the landscape providing a separation from farmed land. Without this diffuse seepage and ground water flushing on slopes would occur with resultant changes in vegetation.
- Catch dykes are essential in keeping the Broads intact. Groundwater is hugely overlooked, particularly at margins.
- Carlton Marshes: coring surveys punctured layers in peat resulting in 1/2m water level rise demonstrating the difference in exchange of water that occurs in areas of the grazing marshes. There may be a need to re-think grazing marshes hydrological function, lack of hydrological data.
- Barriers to progress: lack of evidence, need to carry out restoration work and test results, how to manage is not well evidenced.

**Question and answer session on presentation**

1) Boundaries of catch dykes, ideal if conservation organisation owns other side to that of agricultural land, but this is not often the case. Cost of purchasing arable land is huge, but landowners are responsive to buffering measures via agri-schemes. Best practice schemes such as Trinities need highlighting. Following existing trials that are planned, a risk/opportunity strategy needed for purchase of such land.
2) Scheme to drain where water appearing, surprise at extent of impact and how groundwater not considered in the Broads generally. Vertical and lateral flow models imply groundwater fed. Broad assumptions are often made quickly and this may prevent further investigation into alternative causes, new narratives needed.
3) Highlights lack of knowledge of water budgets and assumption may therefore be incorrect. High spatial variability.
4) Strategically which catch dykes locally need to be considered, risk analysis needs definition and refining. IDB influence needs consideration.
5) Positive effect of catch dykes in protection from agricultural inputs: Evidence of nutrient and pesticide input needed prior to catch dyke restoration. Intensive farming is not usually possible in wetter areas. Funded catch dyke work and more monitoring work to come.
6) Natural England have a suite of reports due for publication soon and these will be widely available. To be circulated.

## 6. Presentation - Carbon in the Broads fens

Kate Heppell, QMUL, gave a presentation on 'Carbon in the Broads fens' (see full presentation slides attached).

**Summary points:**

- Two PhD students, Kieran Stanley and Eleanor Webster have been looking at carbon storage in fens as ecosystem service (2012-13).
- Carbon dioxide and methane fluxes affect the carbon balance. Methane occurring via active transport by plants, diffusion or ebullition (bubbles).
- Set areas of Sutton Fen (nutrient poor) and Strumpshaw Fen (nutrient rich) were used for Kieran's research. Measurements were taken of peat, foliar nitrogen/phosphorus content, vegetation heights and biomass, water levels.
- Findings: Sutton – net carbon source. Strumpshaw – net carbon sink. Methane flux is similar at both sites but CO2 very different, thought to be due to reed growth. Water levels are an important control on carbon and methane fluxes. Methane fluxes higher in wet fens compared to drained lowland peatland

where carbon loss is greater. Open water probably has higher methane loss. Role of fen as net carbon sink or source is dependent on nutrient status vs high plant biodiversity. Water levels and management of nutrients critical to ecosystem services.

- Set areas of Wheatfen and Strumpshaw Fen were used for Eleanor's research. Rates of carbon sequestration and vertical accretion were studied. Tidal surges, water levels and electro conductivity studied.
- Environmental drivers: plant growth, salinity, nutrient availability, cutting regimes, species competition.
- These PhDs are part of a wider Defra lowland peat project, some sites studied are arable/farmed, some conservation sites.
- Key finding 1: On a per unit area basis Broads fens store more carbon than tropical forest biomass, so they represent a dense carbon stock. Research need: To improve quantification of the total stock of carbon in the Broads by including more data points (peat type and carbon density).
- Key finding 2: The role of the Broads fens as net C sinks or source may depend on nutrient status (which influences productivity of *Phragmites* sp.) Research need: To understand whether fens with different vegetation classifications act as net C sinks or sources.
- Key finding 3: Current vertical rate of accretion in the Broads fens may not keep pace with future predictions of an increased rate of sea level rise. Research need: Accretion rates only determined for *Phragmites*-dominated fen so further measurements required in different habitat types, and to consider management initiatives designed to increase accretion rates.