

Increasing wetness and rising sea level are the strongest early climate-heating signals in Moray Firth dune and saltmarsh

Dr Tom Dargie, Boreas Ecology, Sutherland tomd@boreasecology.com



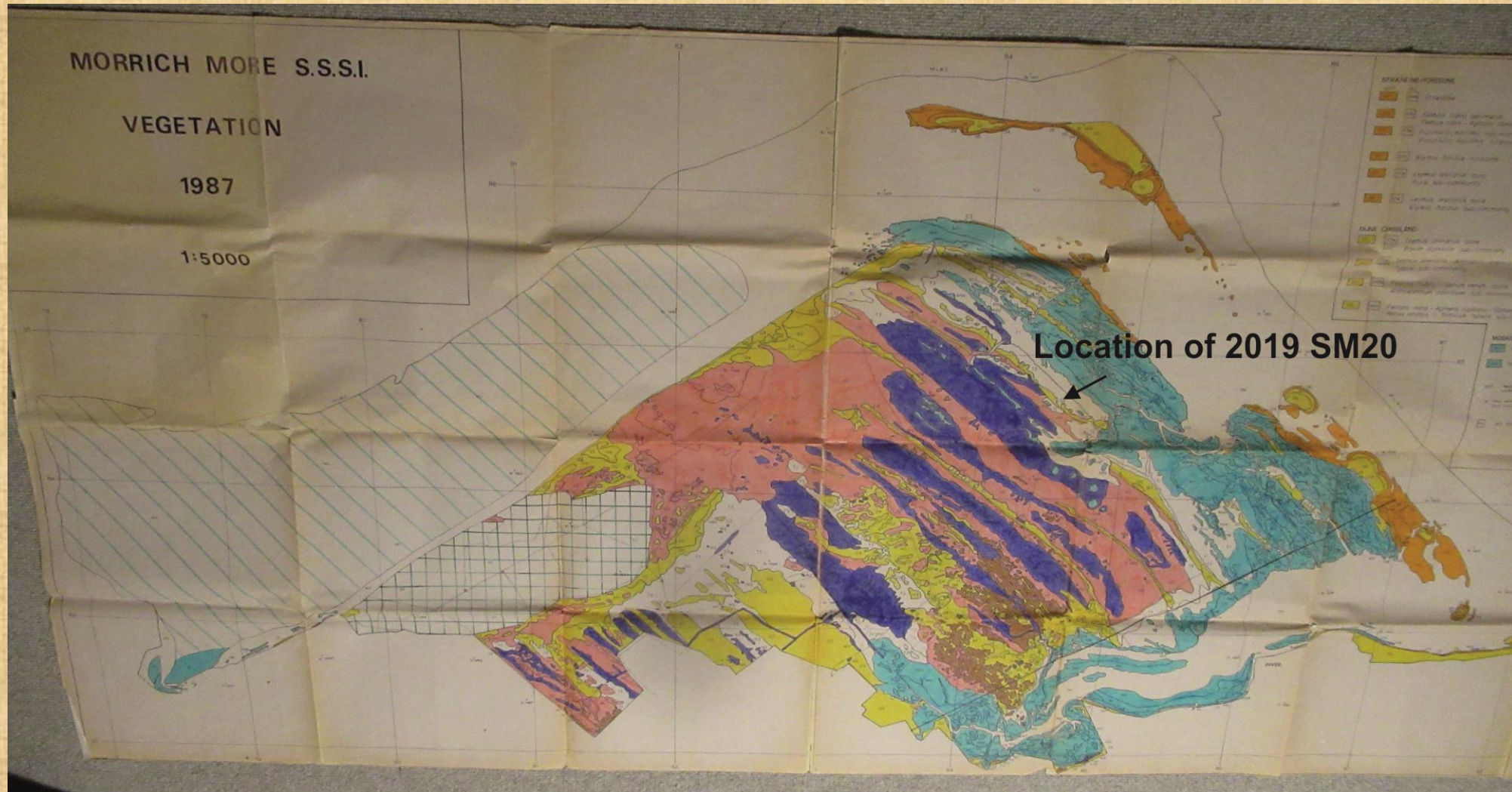
2019: SM20 Slender spike-rush *Eleocharis uniglumis* mixed with Saltmarsh flat-sedge *Blysmus rufus* and Black bog-rush *Schoenus nigricans* uppermost saltmarsh, Morrich More



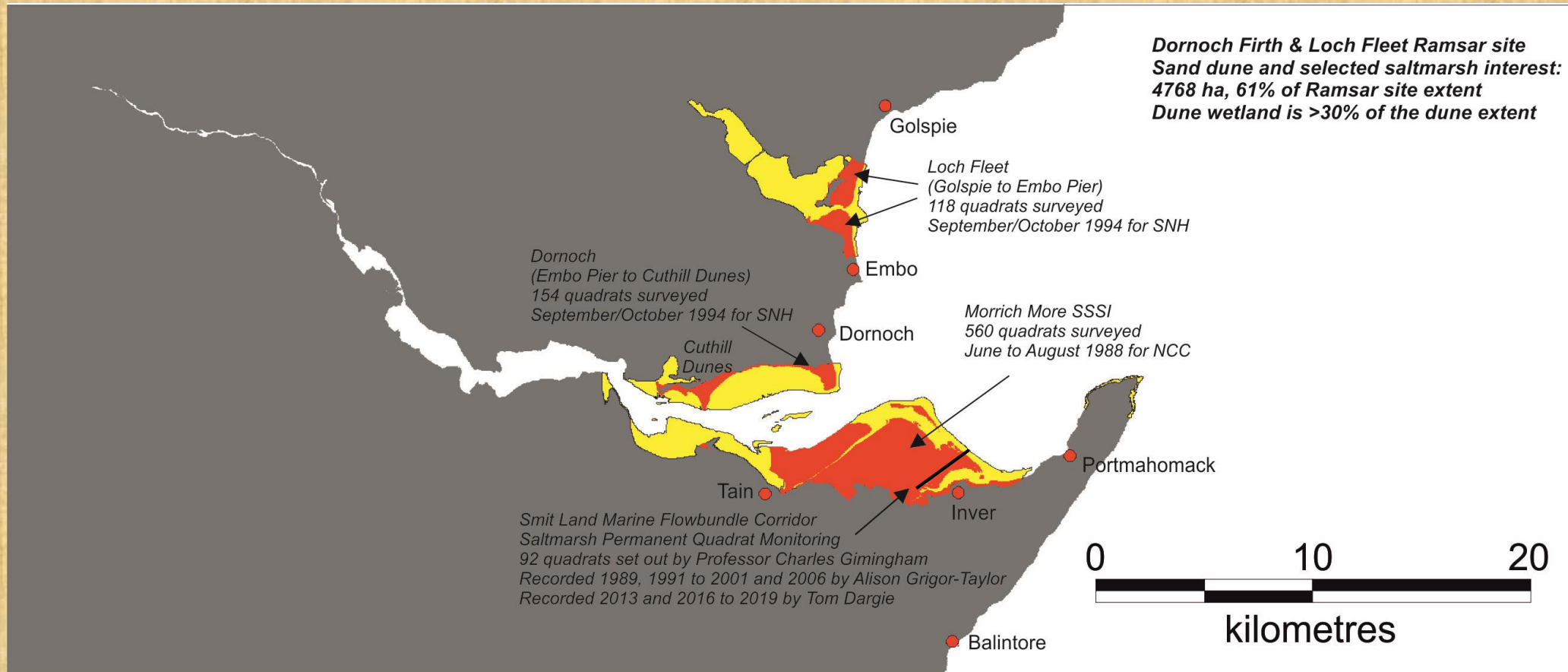
In 1988 the SM20 ground was mapped as SM16 Red fescue *Festuca rubra* upper saltmarsh with abundant Autumnal hawkbit *Scorzoneroide autumnalis*. An example of this SM16 type is shown above.

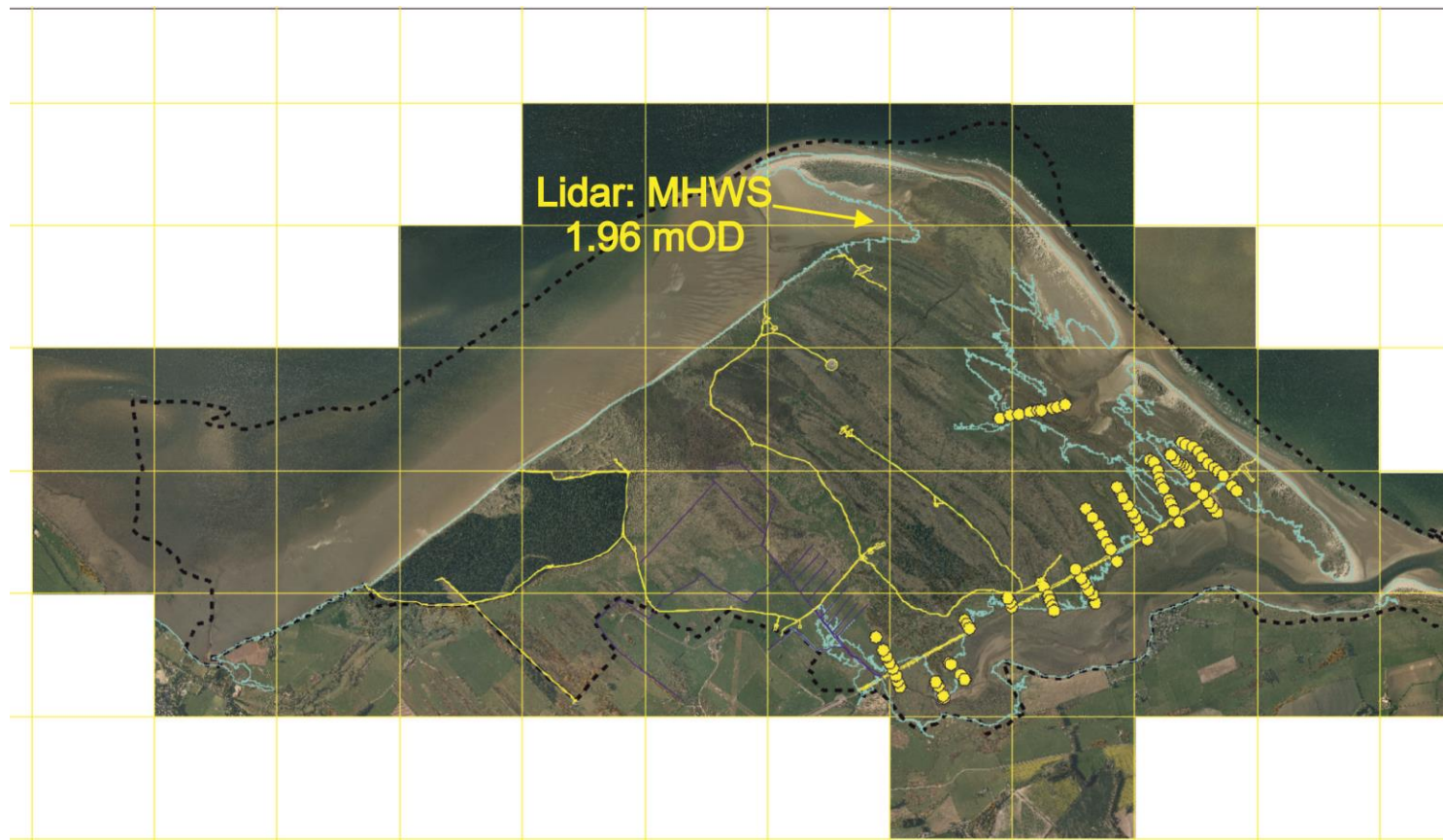
This talk will focus on the
use of revisitation surveys
and aquifer mapping in
assessing evidence for
coastal habitat change

But before we get technical, lets look at the site:
Morrich More – within the Dornoch Firth and Loch Fleet Ramsar Site



QUADRAT SOURCES FOR REVISITATION



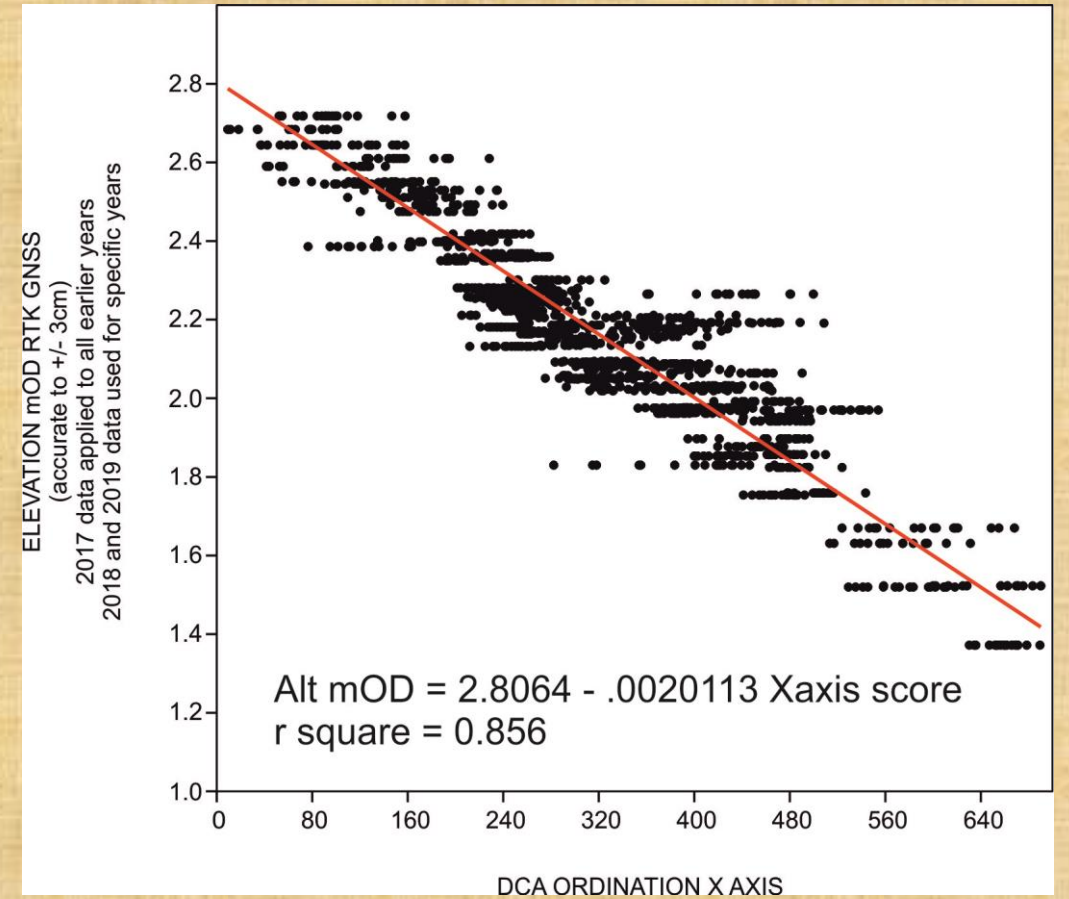
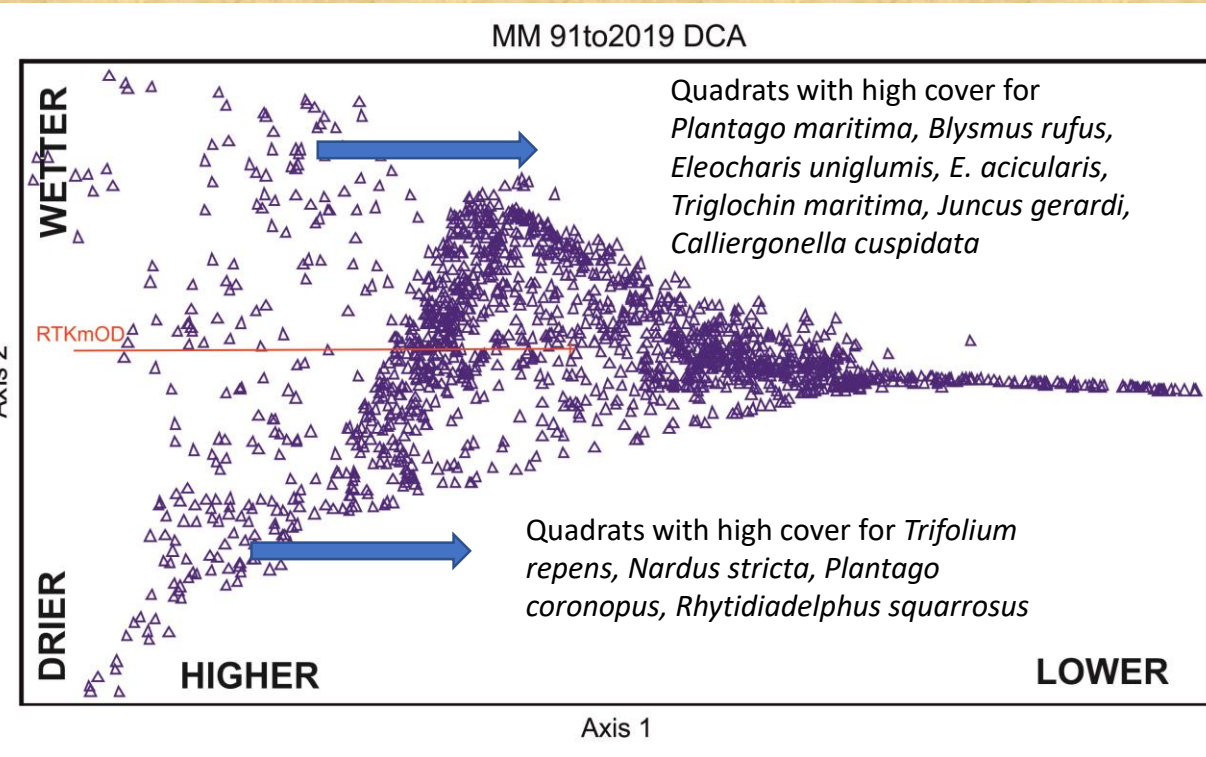


GIMINGHAM SALTMARSH QUADRATS

- **FLOWBUNDLE CORRIDOR**
- **92 quadrat total after losses**
- **4 erosion losses**
- **Summer-recording:**
- **Planning conditions**
- **1991 to 2001**
- **2006**
- **Research**
- **2013**
- **2016-2019**

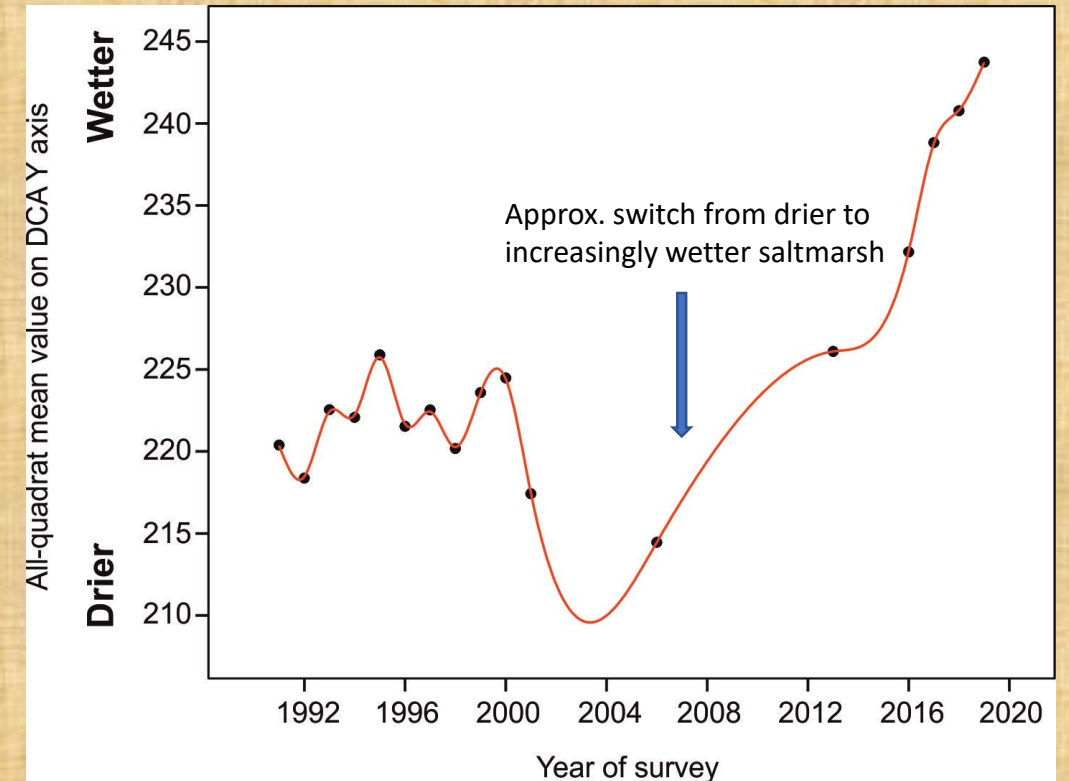
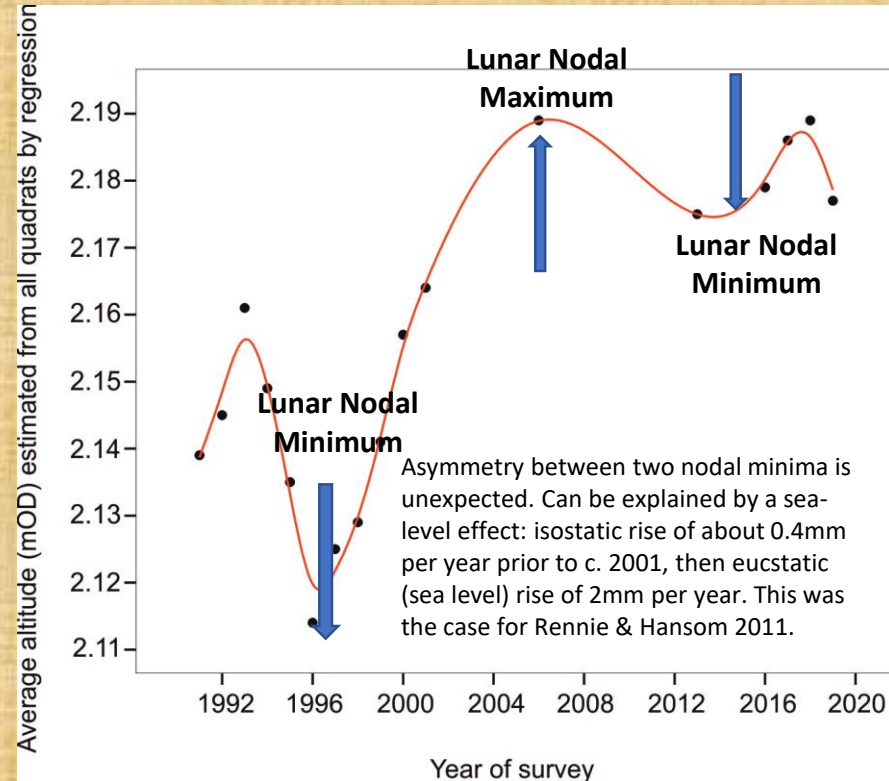


SALTMARSH ANALYSIS



SALTMARSH RESULTS

(smoothing splines for visual assessment,
see Dargie 2017, SNH Commissioned Report No. 927 for full details up to 2013)



Dune Wetland Samples (202 1988 & 2019 samples, 404 total)

Defined as at least one member of of a 1988/2019 pair with two species with Ellenberg F score of 7 or more
Quadrats re-located with 5 metre accuracy or better





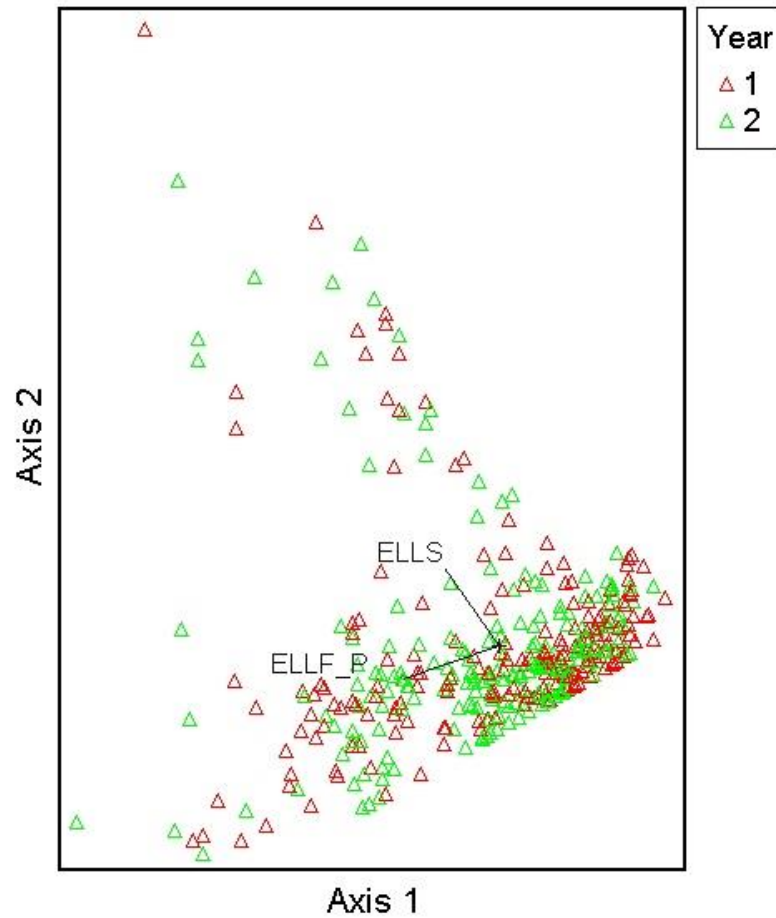
***Schoenus* and *Molinia* tussocks
(drier end of wetness gradient)**



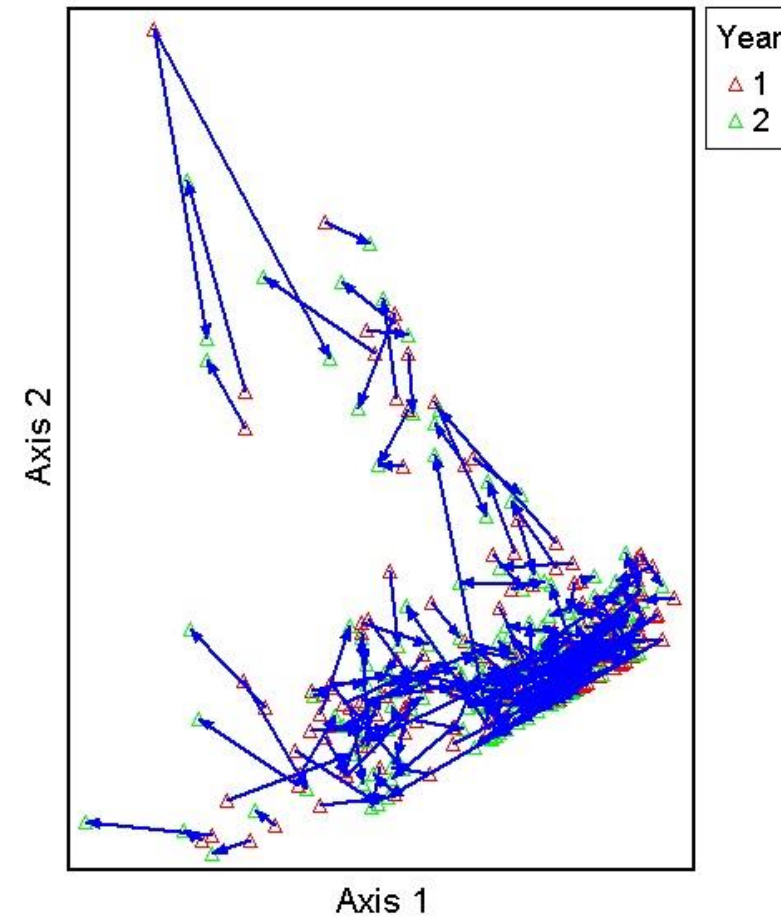
**S10 *Equisetum fluviatile* with *Chara* and
Potamogeton, the wet end of the gradient**

DUNE WETLAND ANALYSIS

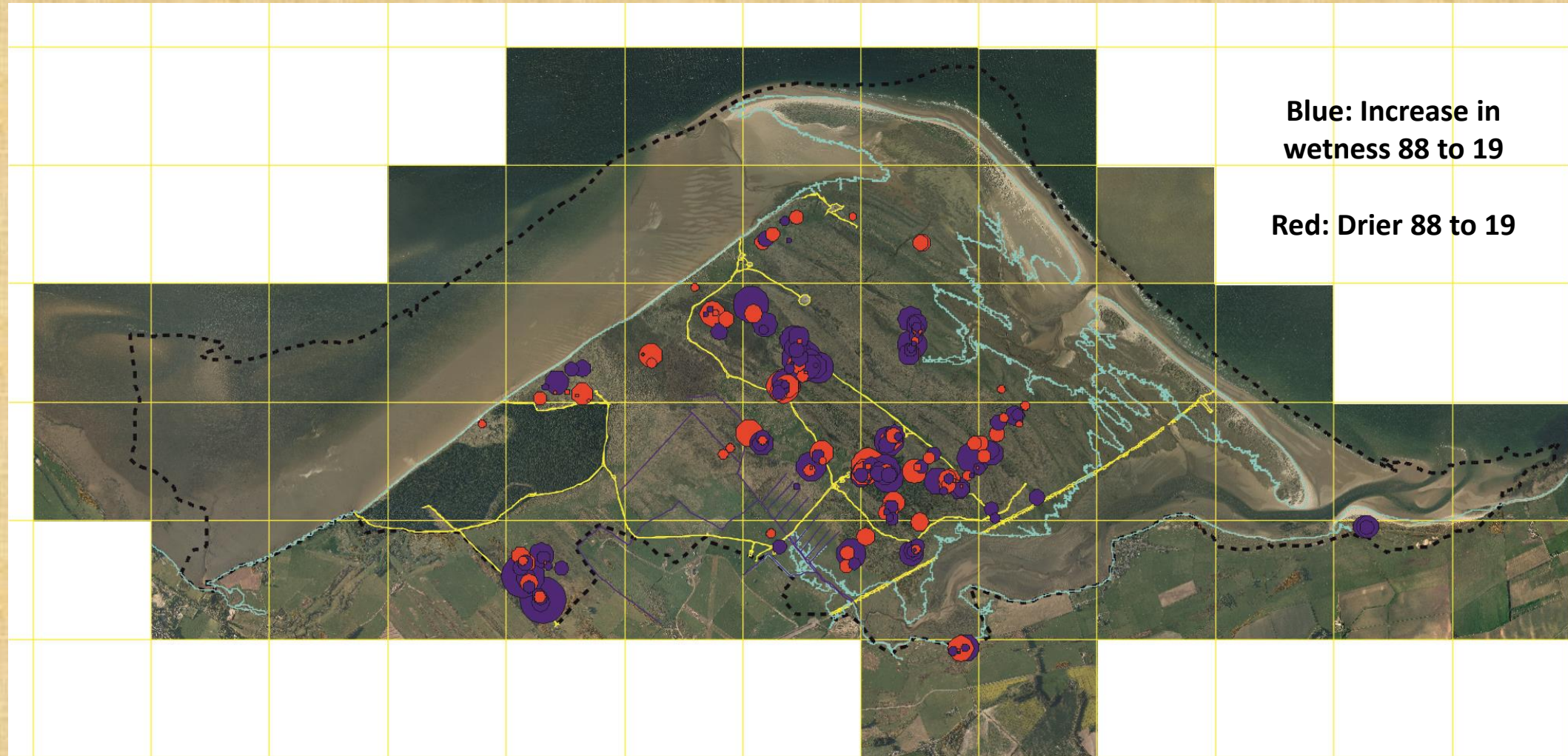
Subset 404 (202) x 276 species CCA2 ELIF S



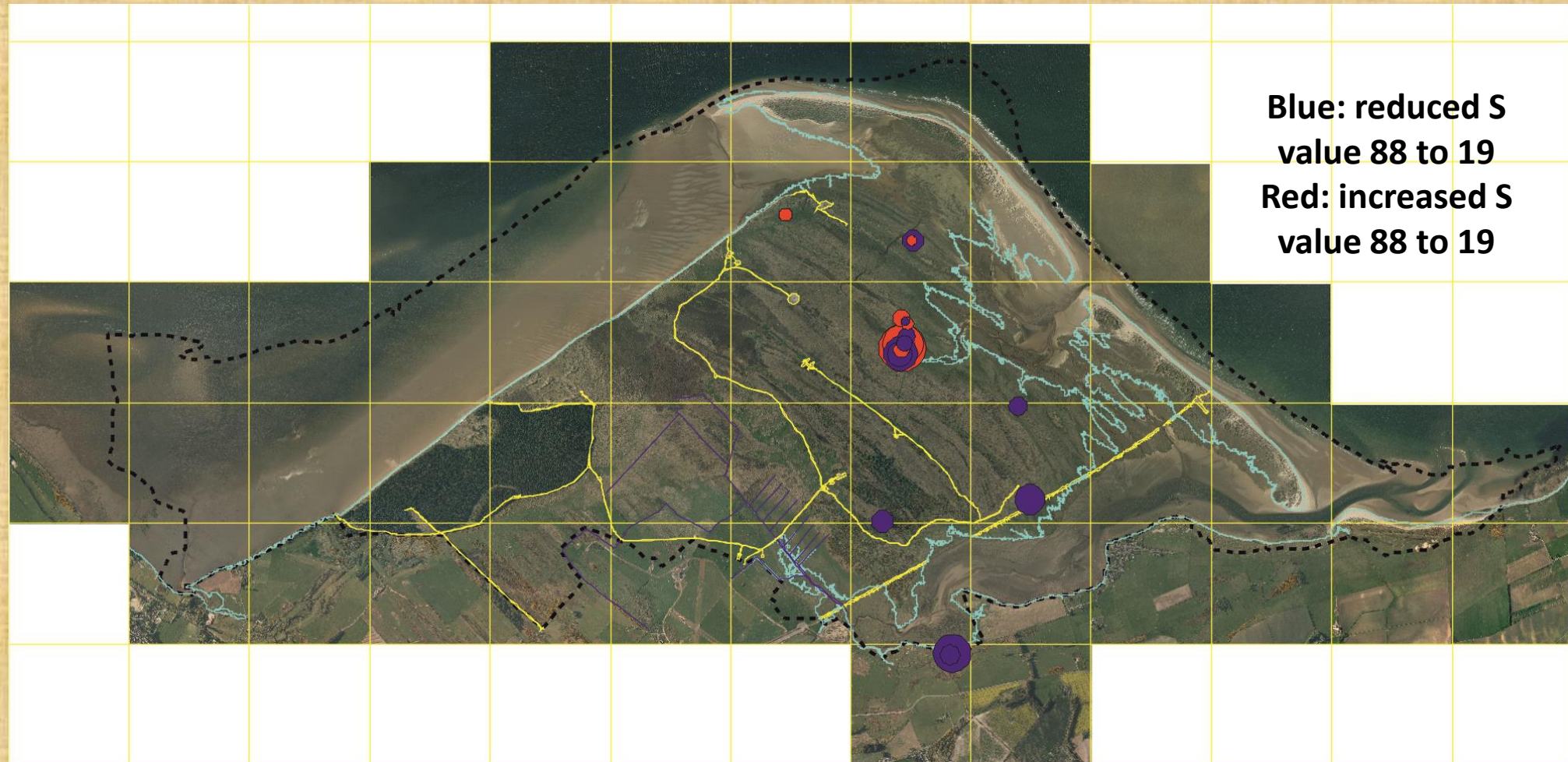
Subset 404 (202) x 276 species CCA2 ELIF S



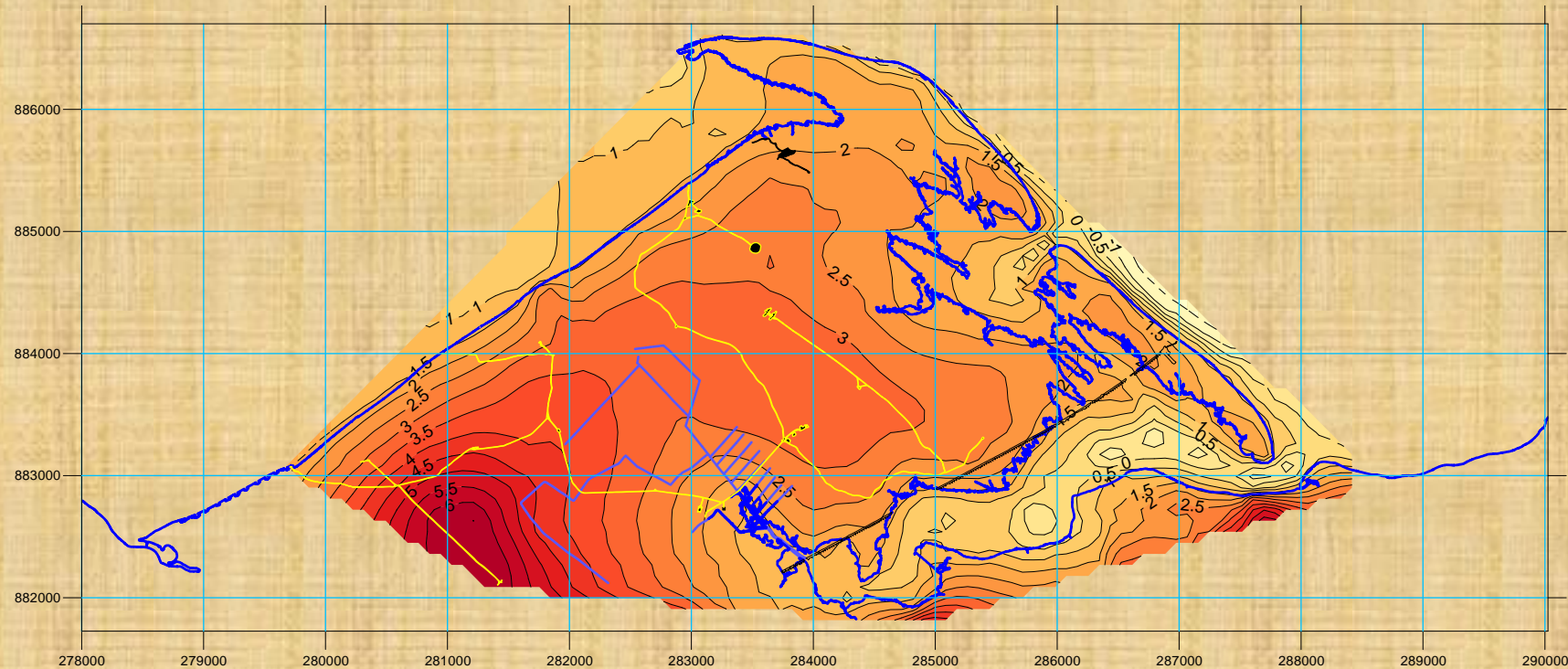
WETLAND RESULTS: ELLENBERG F CHANGE



WETLAND RESULTS: ELLENBERG S CHANGE

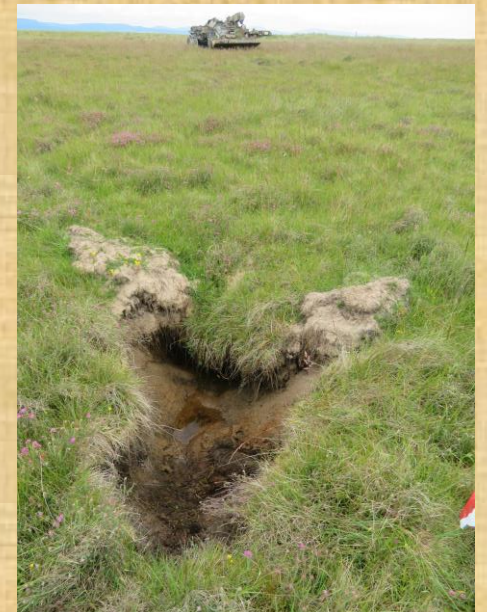


UNDERSTANDING CHANGE: THE DUNE AQUIFER

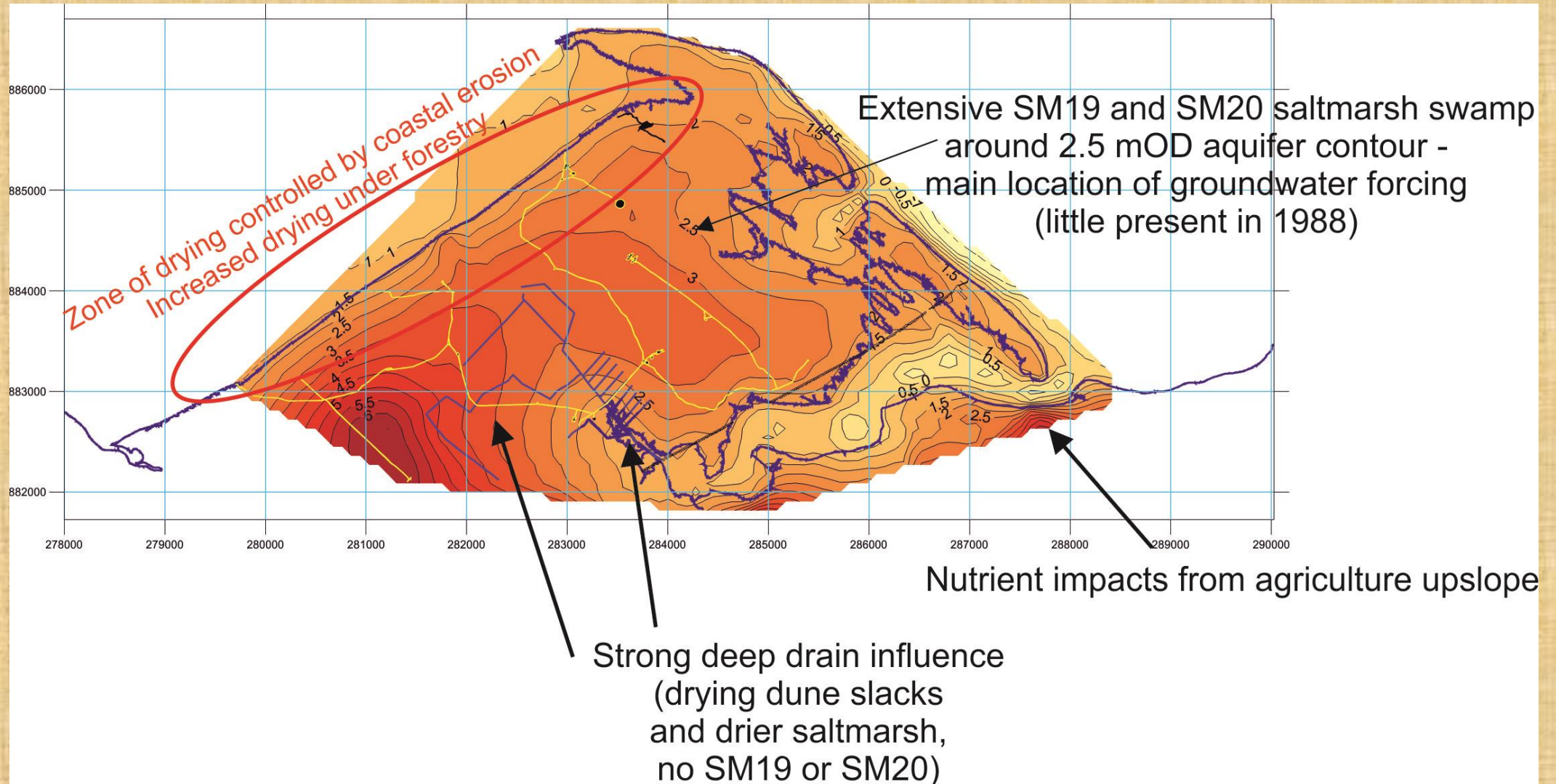


A work in progress – contours here based on >2700 RTK elevation records. Now have permission to core to watertable in Tain Range and this will increase accuracy

Water level recorded in bomb craters →



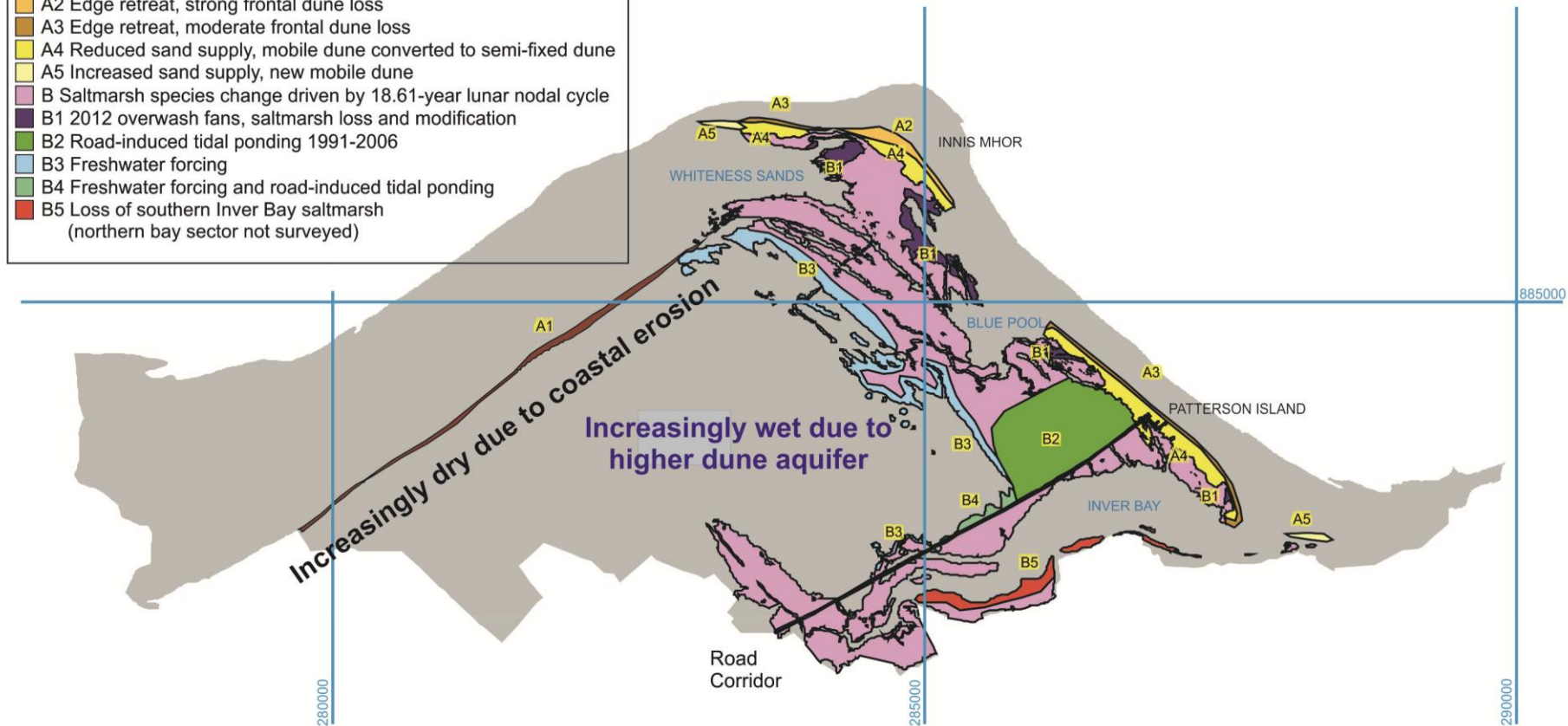
UNDERSTANDING CHANGE: CURRENT THINKING



MULTIPLE SPATIAL CHANGE

Habitat Change

- A1 Edge retreat, north-western dune edge loss
- A2 Edge retreat, strong frontal dune loss
- A3 Edge retreat, moderate frontal dune loss
- A4 Reduced sand supply, mobile dune converted to semi-fixed dune
- A5 Increased sand supply, new mobile dune
- B Saltmarsh species change driven by 18.61-year lunar nodal cycle
- B1 2012 overwash fans, saltmarsh loss and modification
- B2 Road-induced tidal ponding 1991-2006
- B3 Freshwater forcing
- B4 Freshwater forcing and road-induced tidal ponding
- B5 Loss of southern Inver Bay saltmarsh (northern bay sector not surveyed)



**CONCLUSION: CHANGE IS EVERYWHERE,
OFTEN SUBTLE, WITH SEA LEVEL RISE AND
MAYBE INCREASING SUMMER RAINFALL BEING
THE UNDERLYING DRIVING FACTORS**