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

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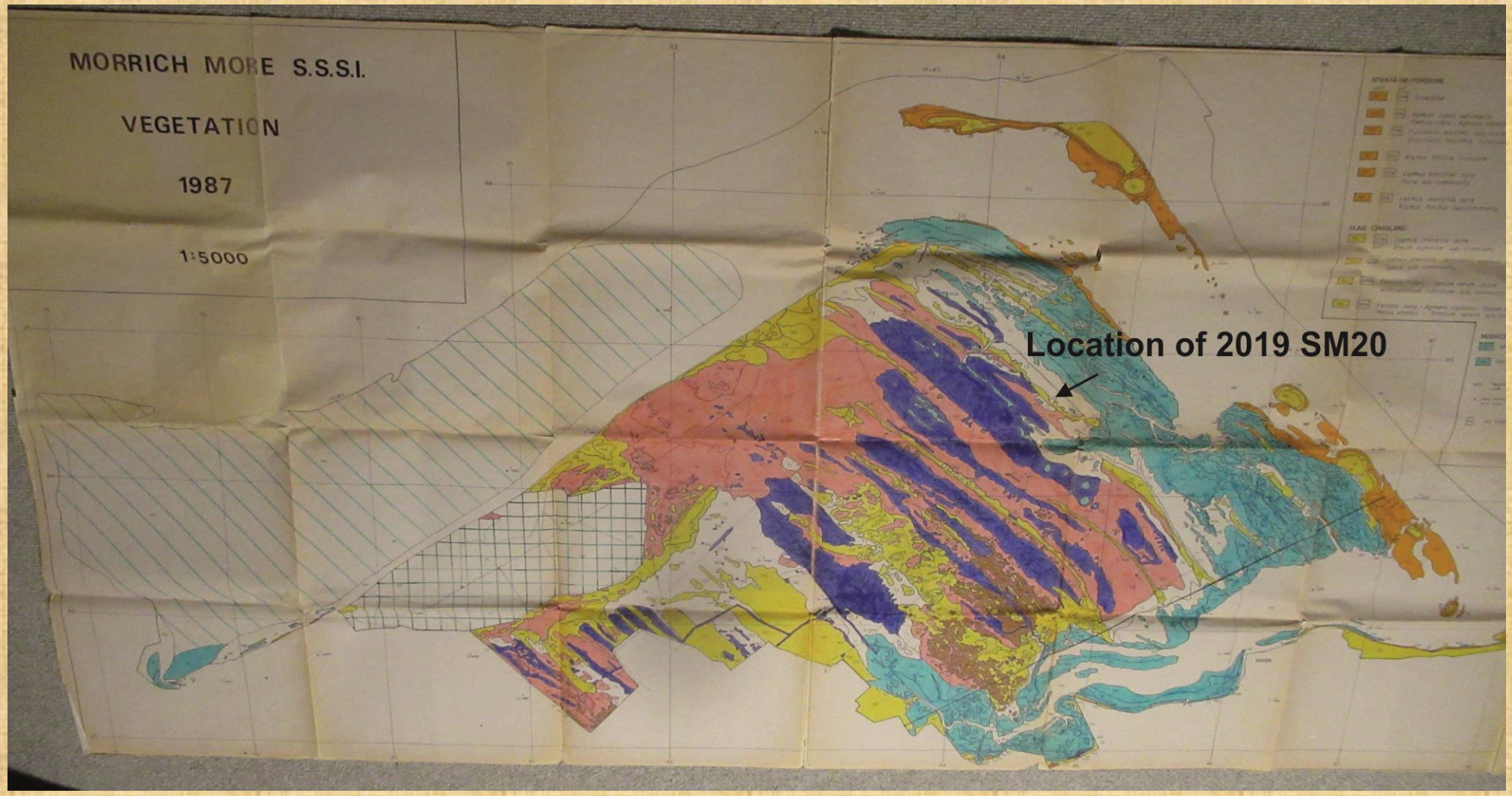
2019: SM20 Slender spike-rush *Eleocharis uniglumis* mixed with Saltmarsh flat-sedge *Blysmus rufus* and Black bog-rush *Schoenus nigricans* uppermost saltmarsh, Morrich More

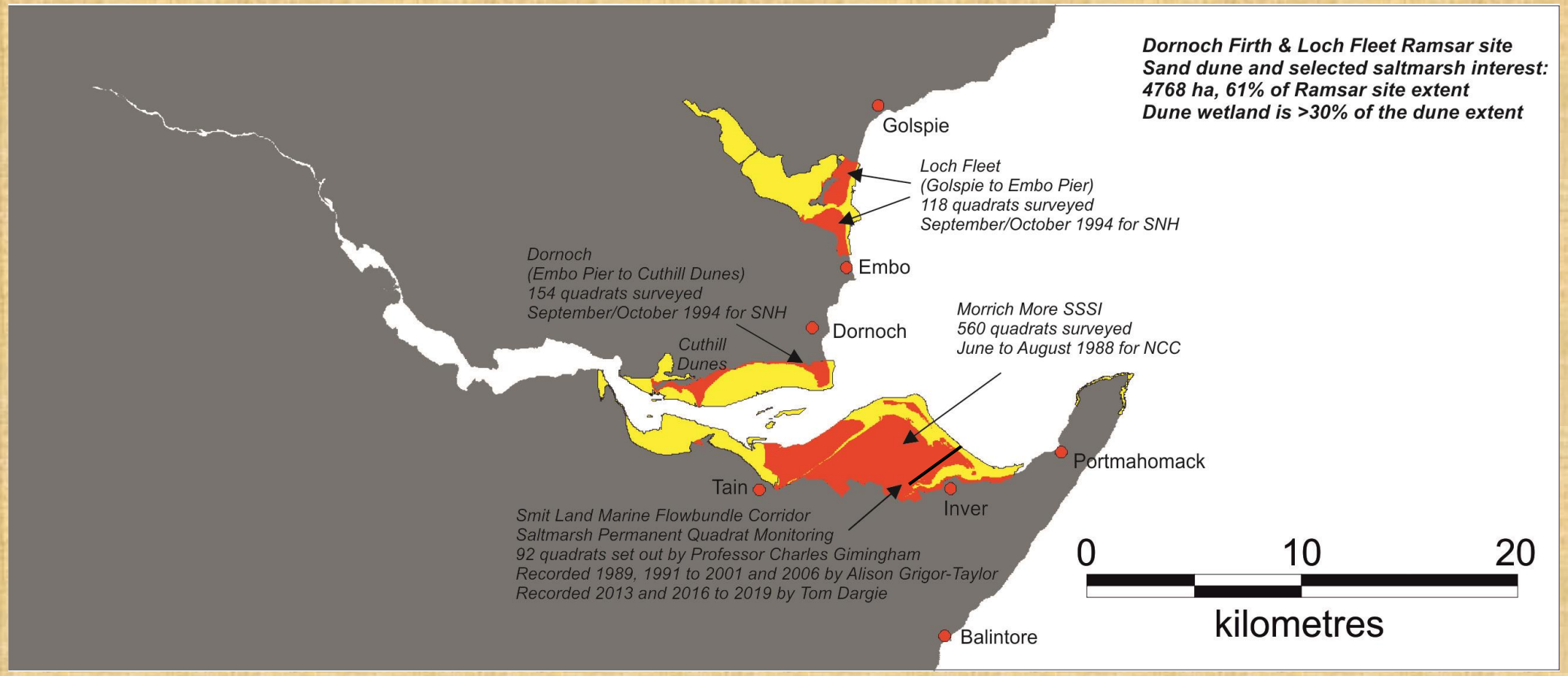
In 1988 the SM20 ground was mapped as SM16 Red fescue *Festuca rubra* upper saltmarsh with abundant Autumnal hawkbit *Scorzoneroides autumnalis*. An example of this SM16 type is shown above.

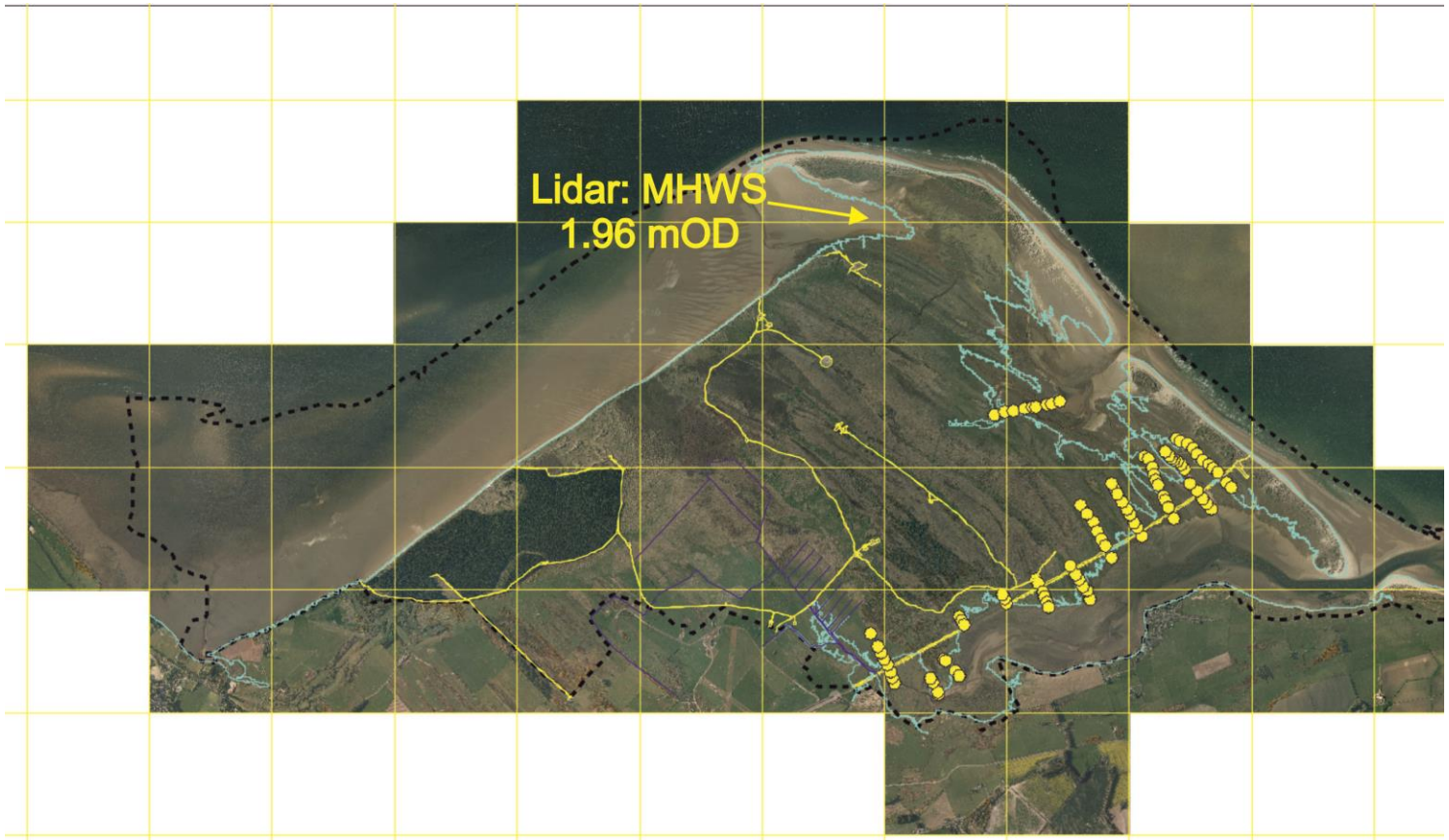
This talk will focus on the use of revisitation surveys and aquifer mapping in assessing evidence for coastal habitat change

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

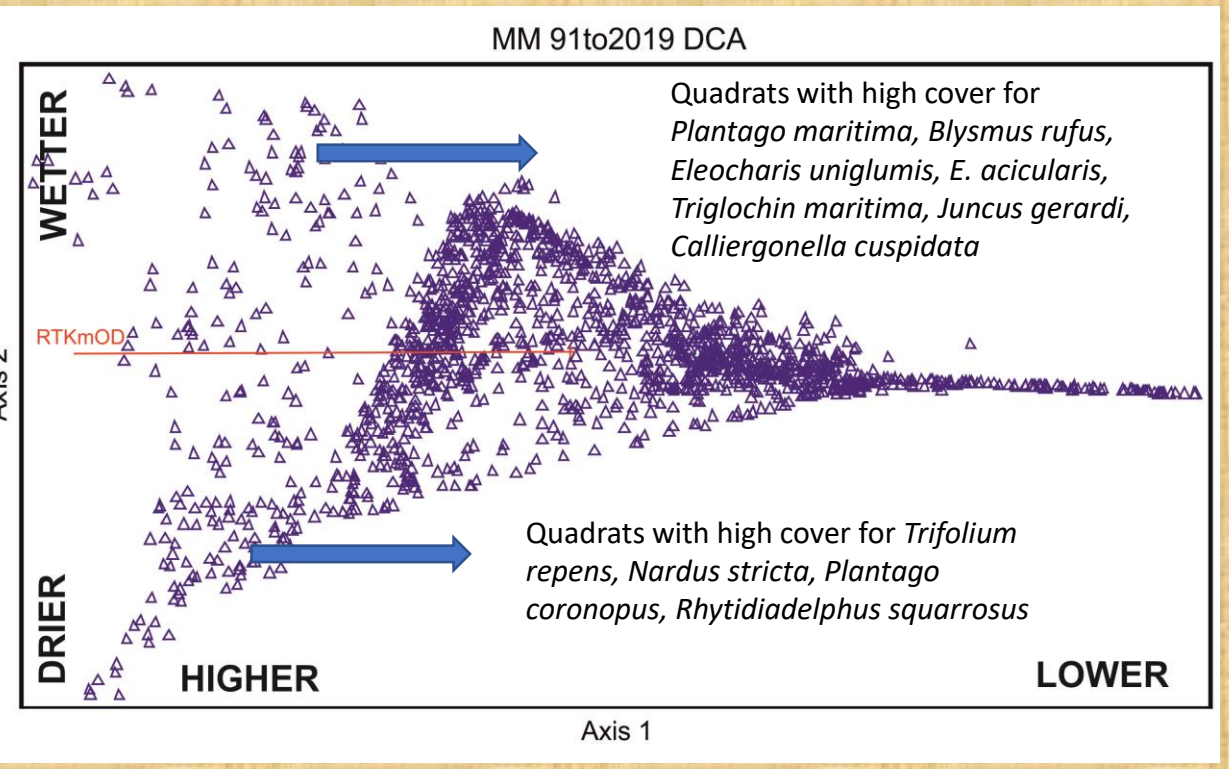
- FLOWBUNDLE CORRIDOR
- 92 quadrat total after losses
- 4 erosion losses

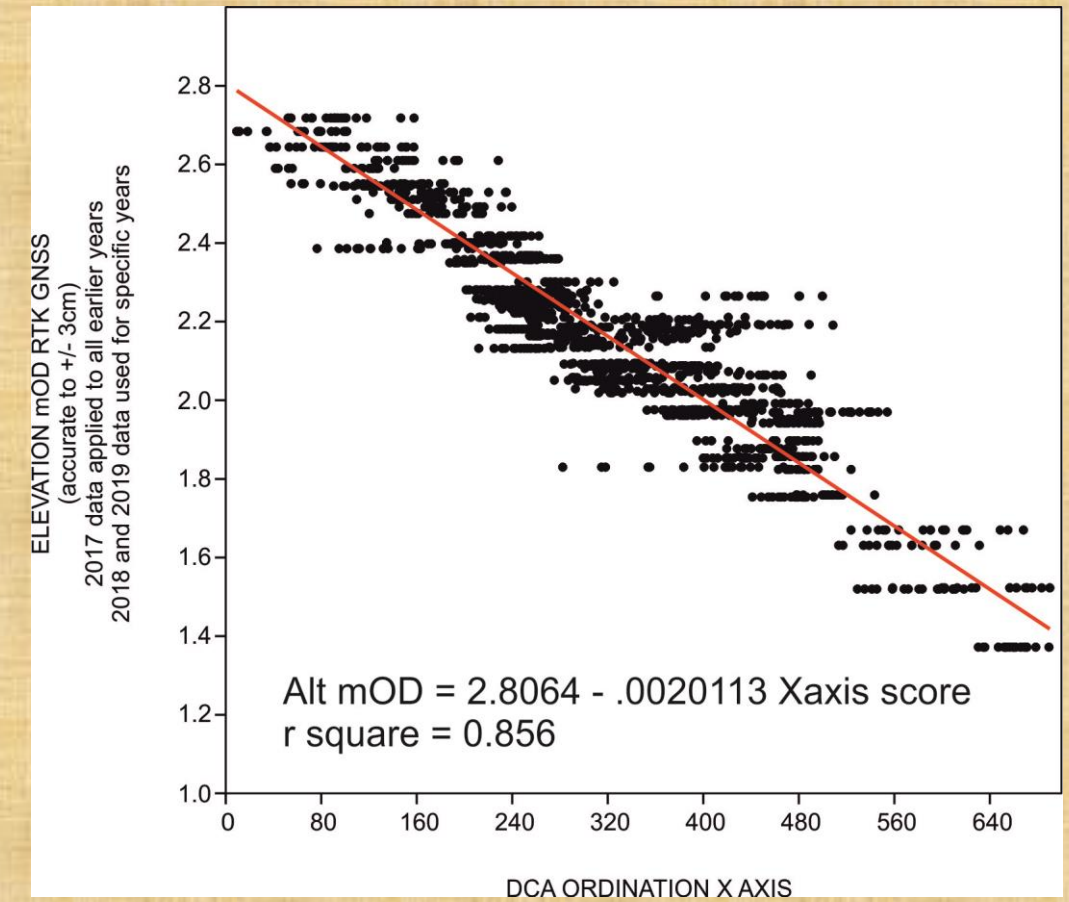
- Summer-recording:

- Planning conditions
- 1991 to 2001
- 2006

- Research
- 2013
- 2016-2019

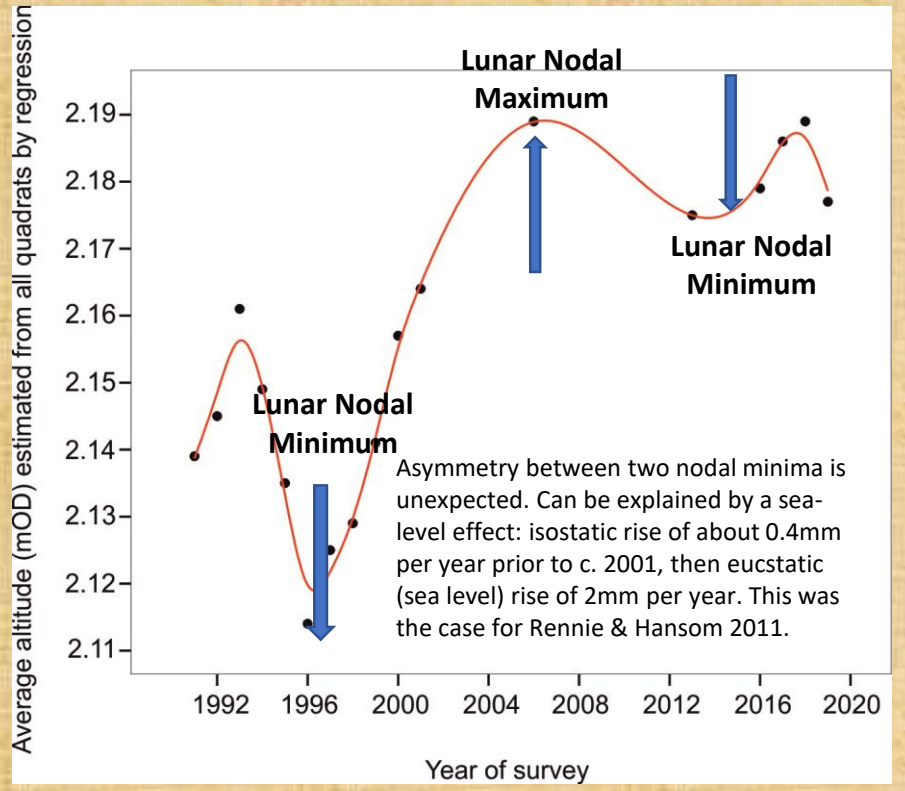
SALTMARSH ANALYSIS

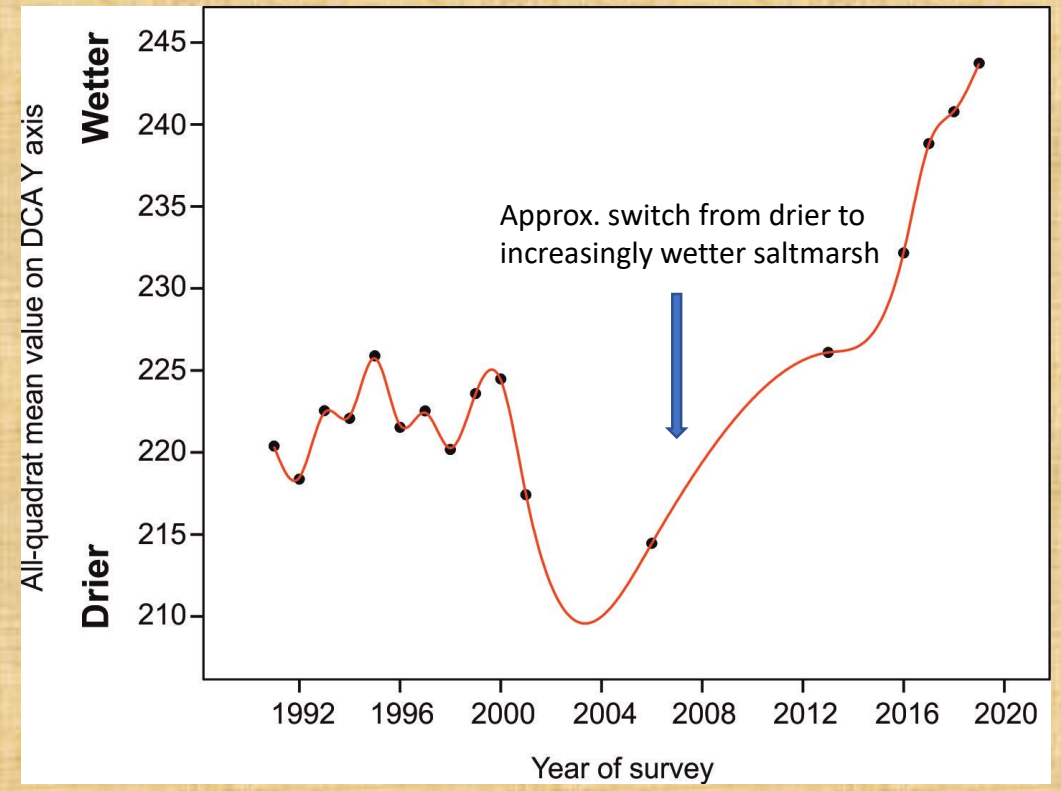




SALTMARSH RESULTS

(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)

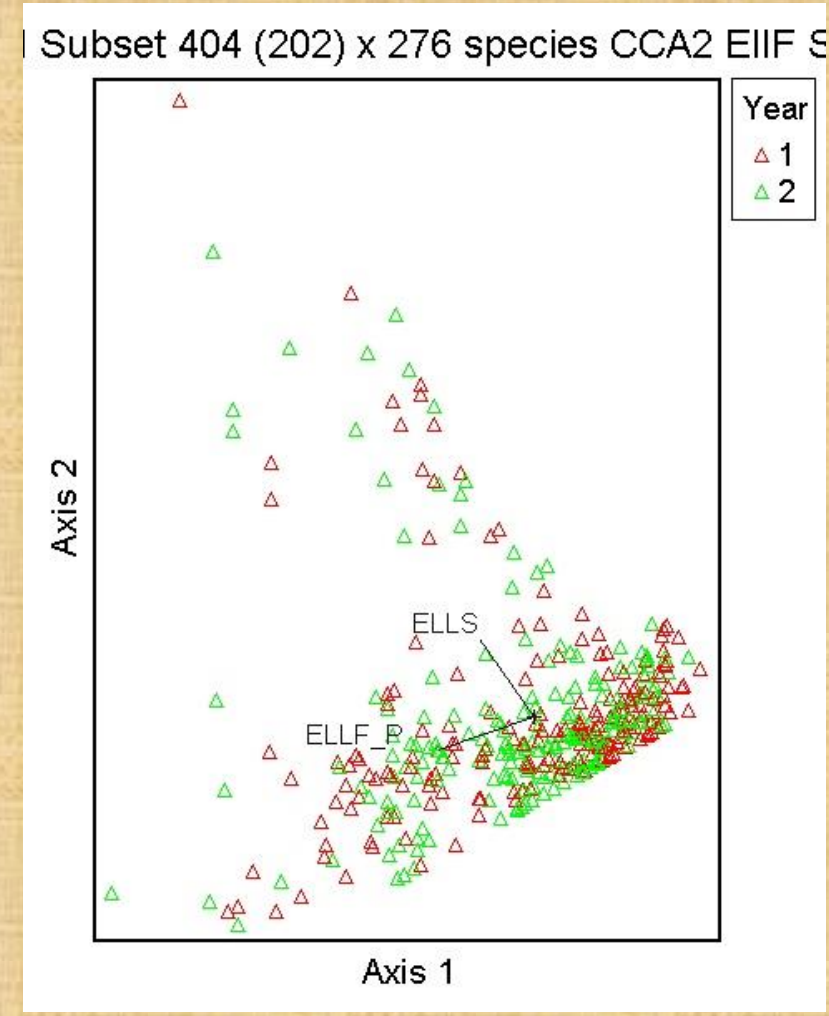
Defined as at least one member of of a 1988/2019 pair with two species with Ellenberg F score of 7 or more

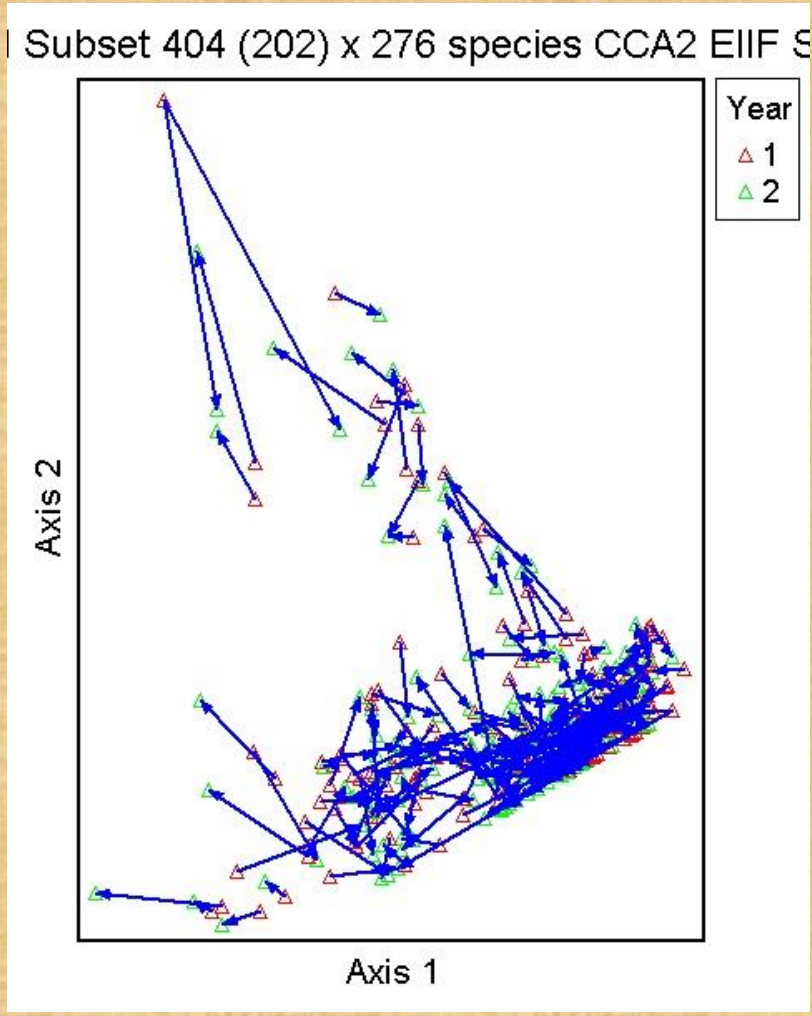
Quadrats re-located with 5 metre accuracy or better

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

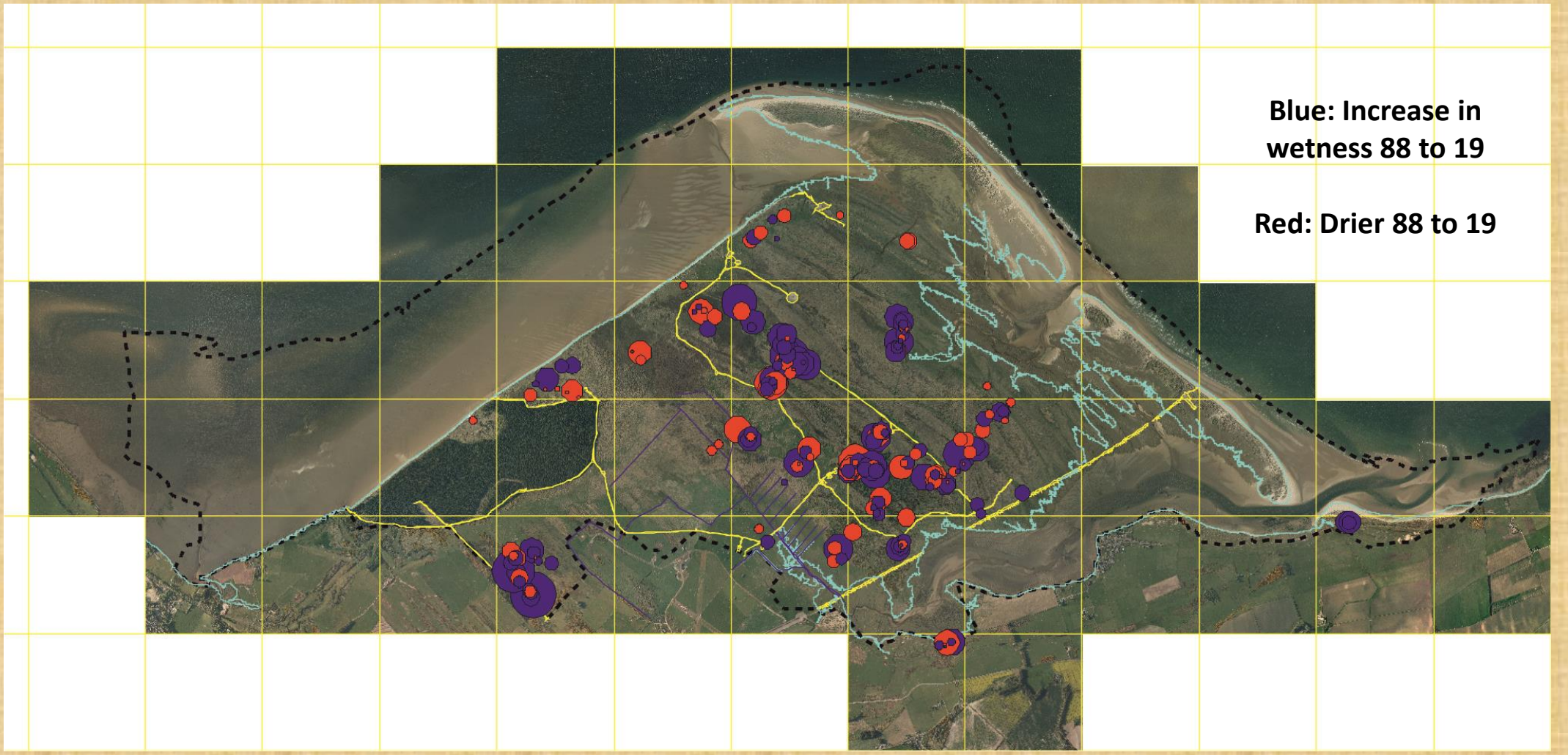
S10 *Equisetum fluviatile* with *Chara* and *Potamogeton*, the wet end of the gradient

DUNE WETLAND ANALYSIS

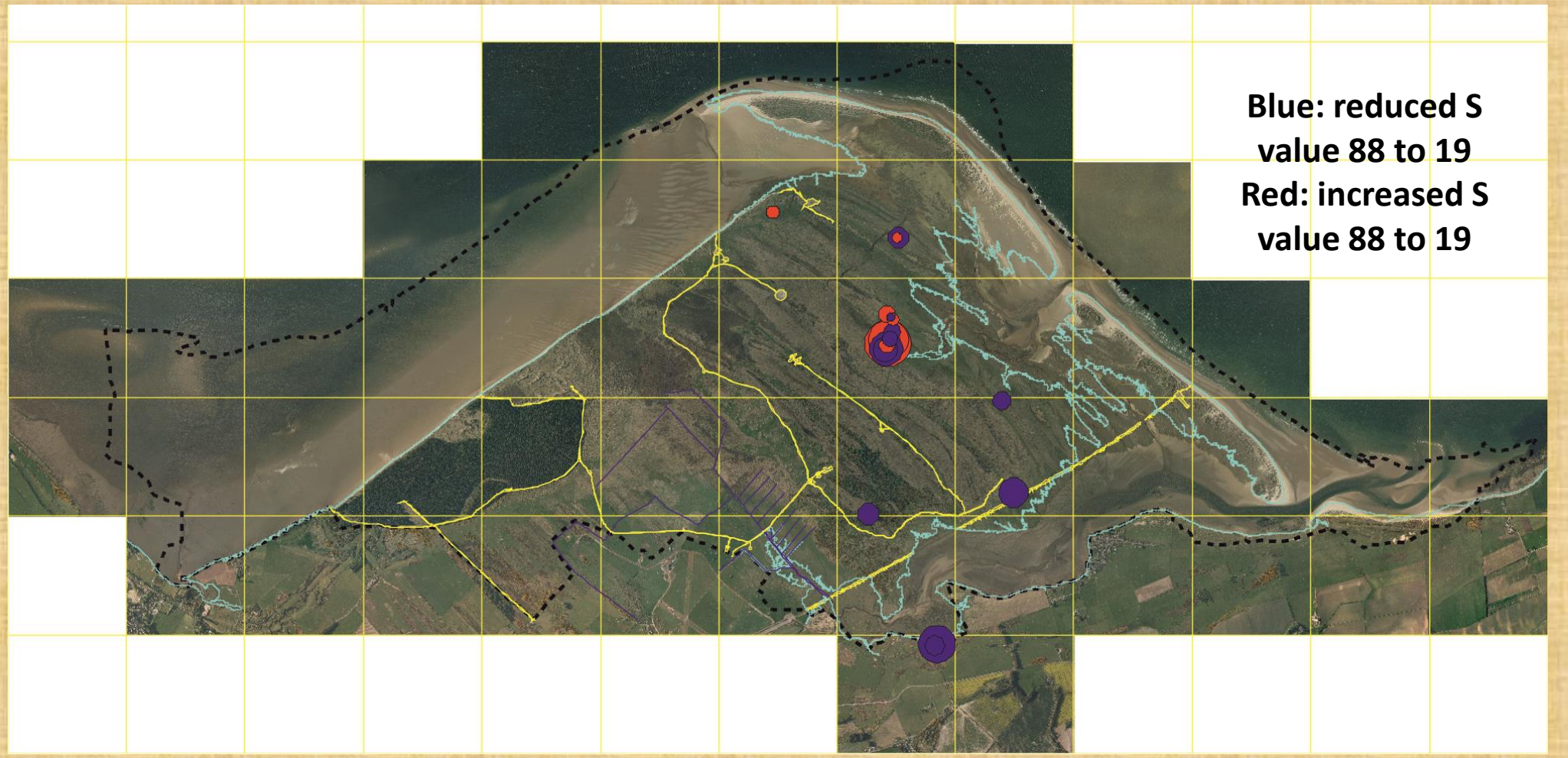




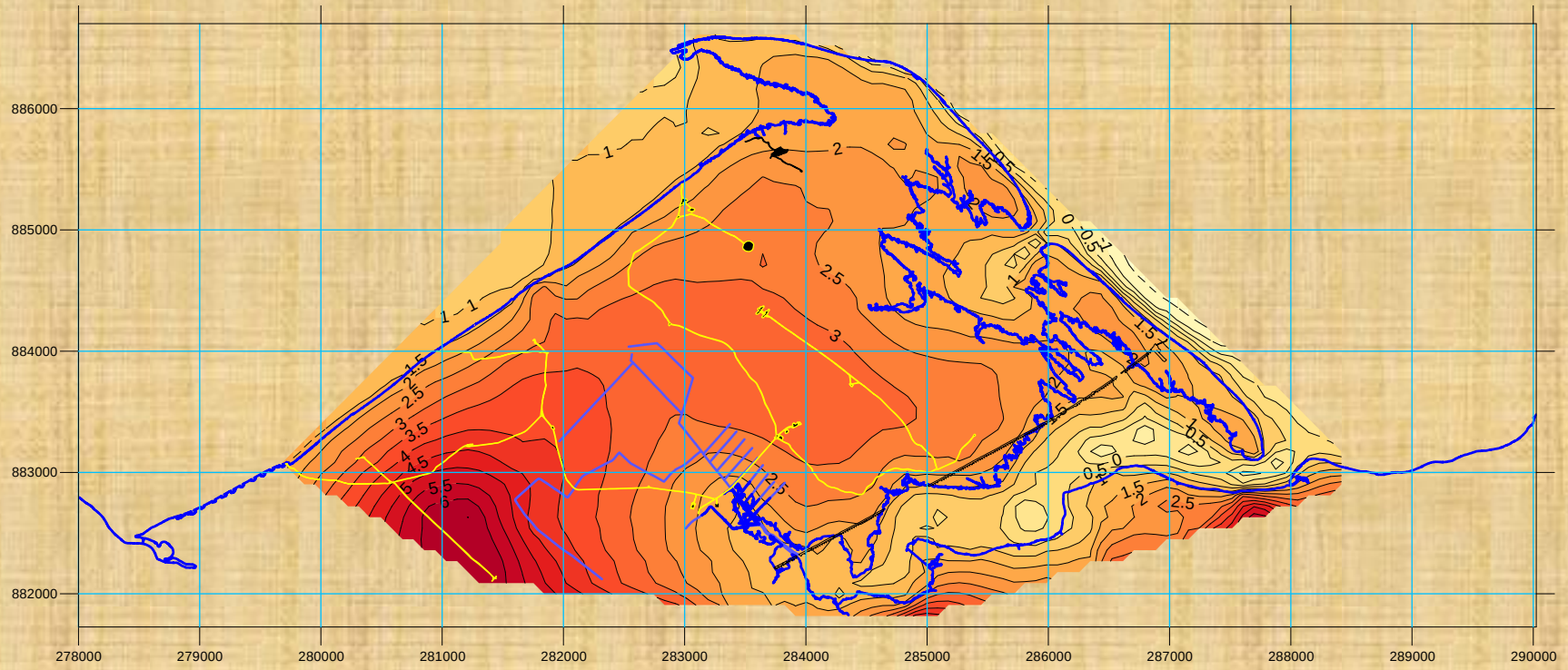
WETLAND RESULTS: ELLENBERG F CHANGE



WETLAND RESULTS: ELLENBERG S CHANGE

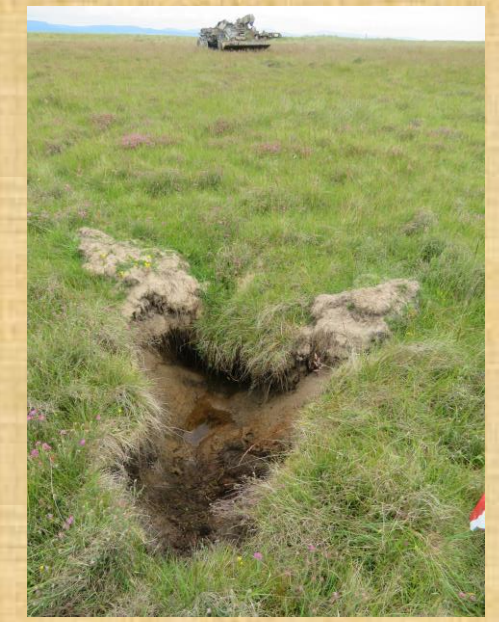


UNDERSTANDING CHANGE: THE DUNE AQUIFER

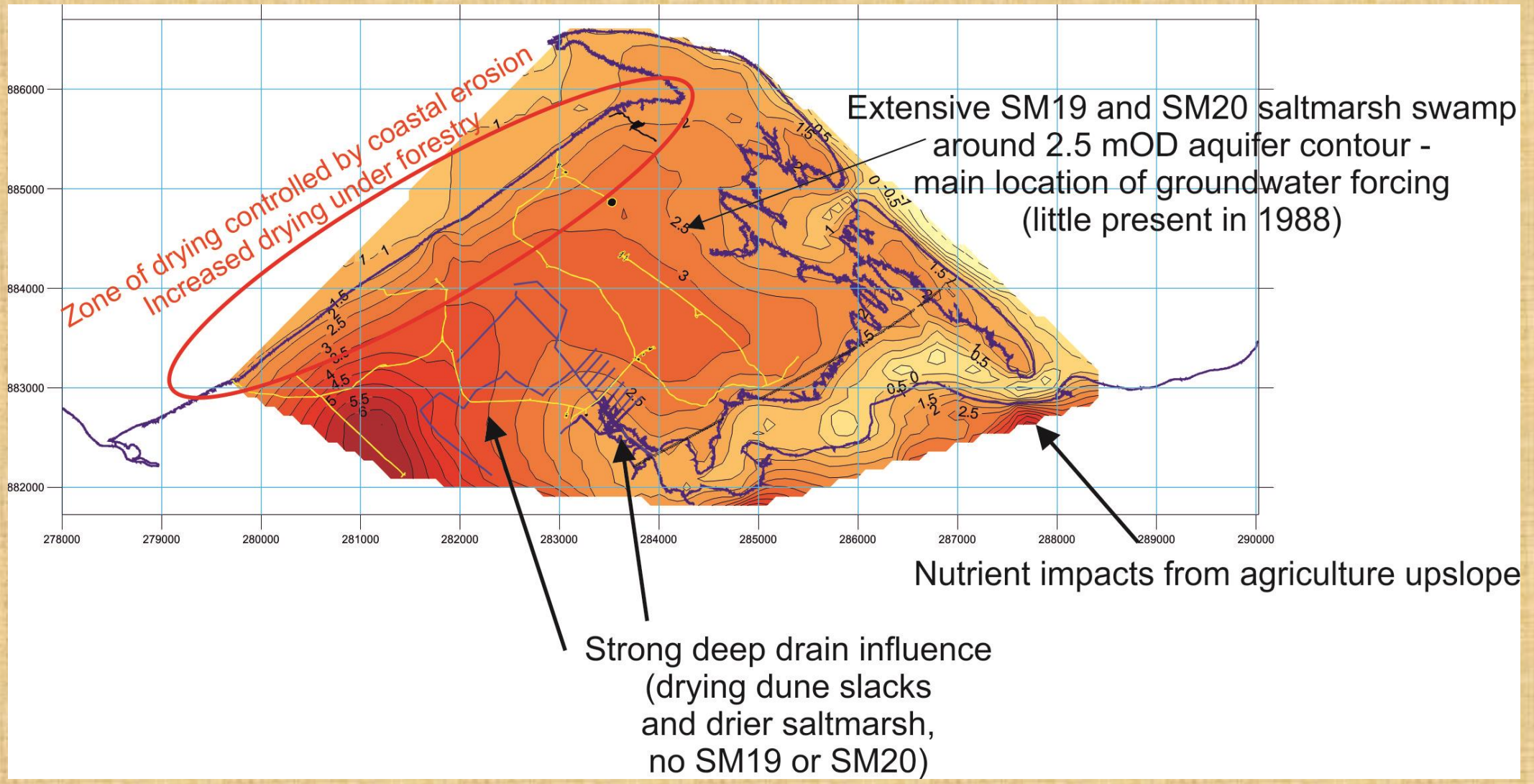


A work in progress – contours here based on >2700 RTK elevation records. Now have permission to core to watertable in Tain Range and this will increase accuracy

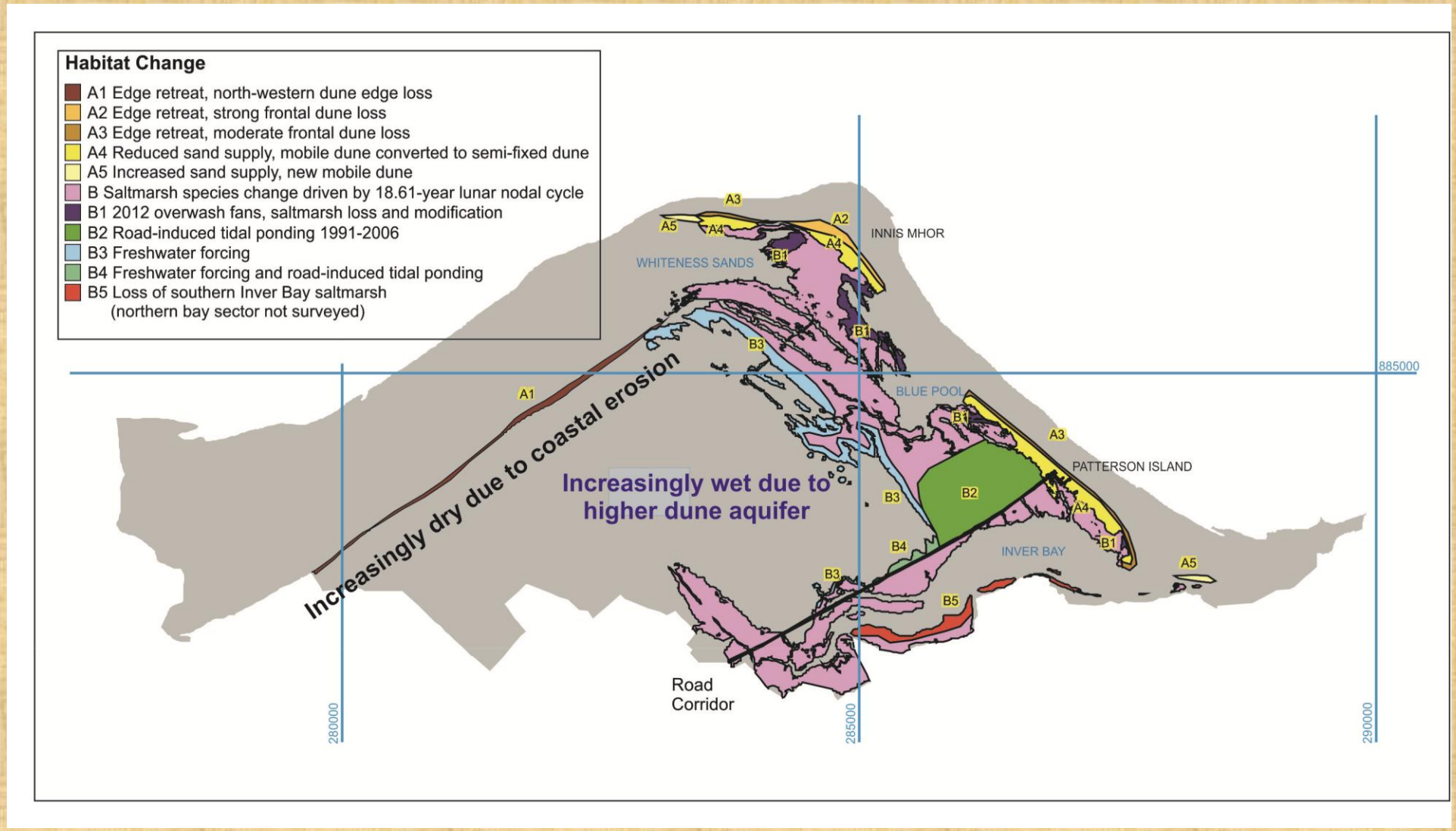
Water level recorded in bomb craters



UNDERSTANDING CHANGE: CURRENT THINKING



MULTIPLE SPATIAL CHANGE



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