Can we successfully create saltmarshes?

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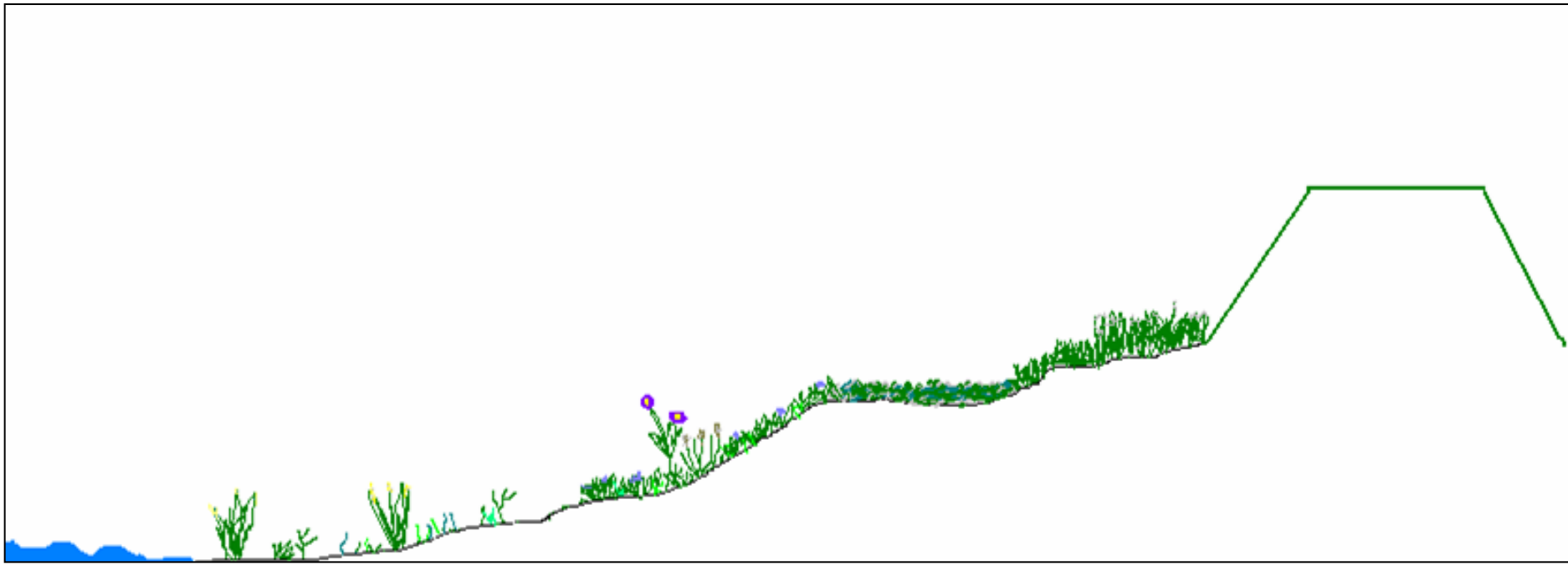
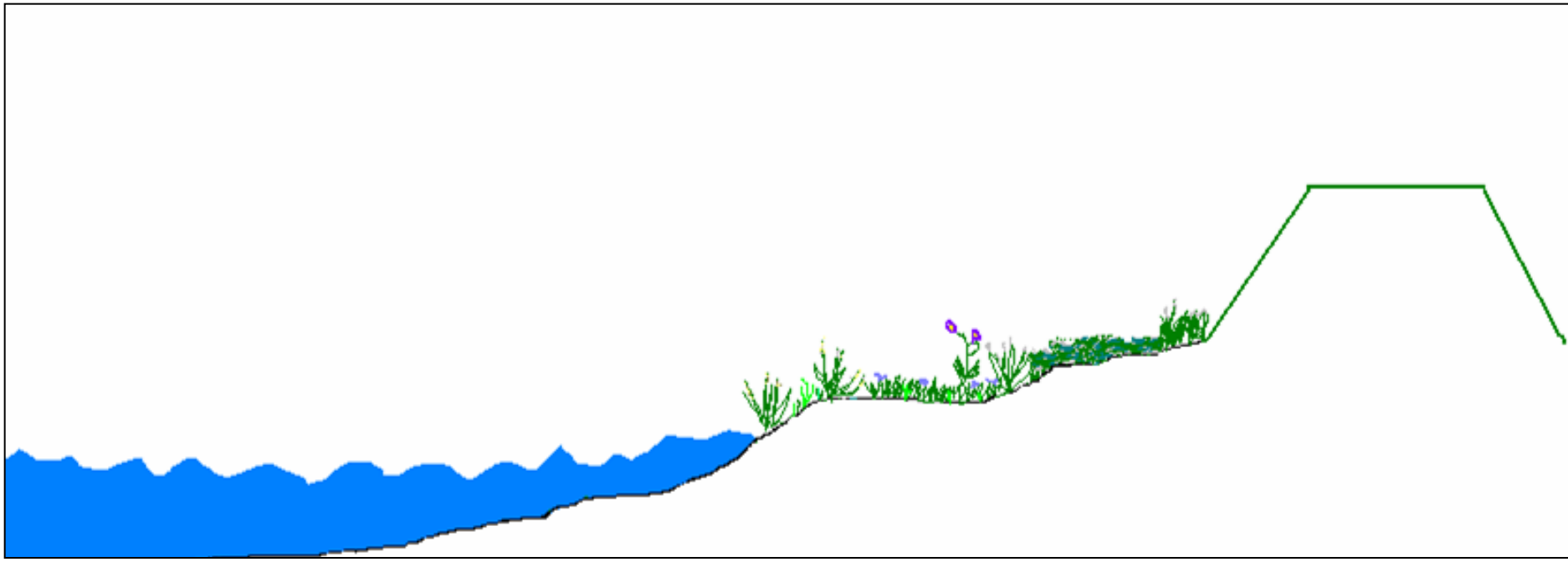
Why are we creating salt marshes?

1. Uneconomic to defend coastline
2. Massive losses in marsh area (UK >90,000 ha lost)
3. Loss of habitat continues
   - Reclamation for ports
   - Erosion and coastal squeeze

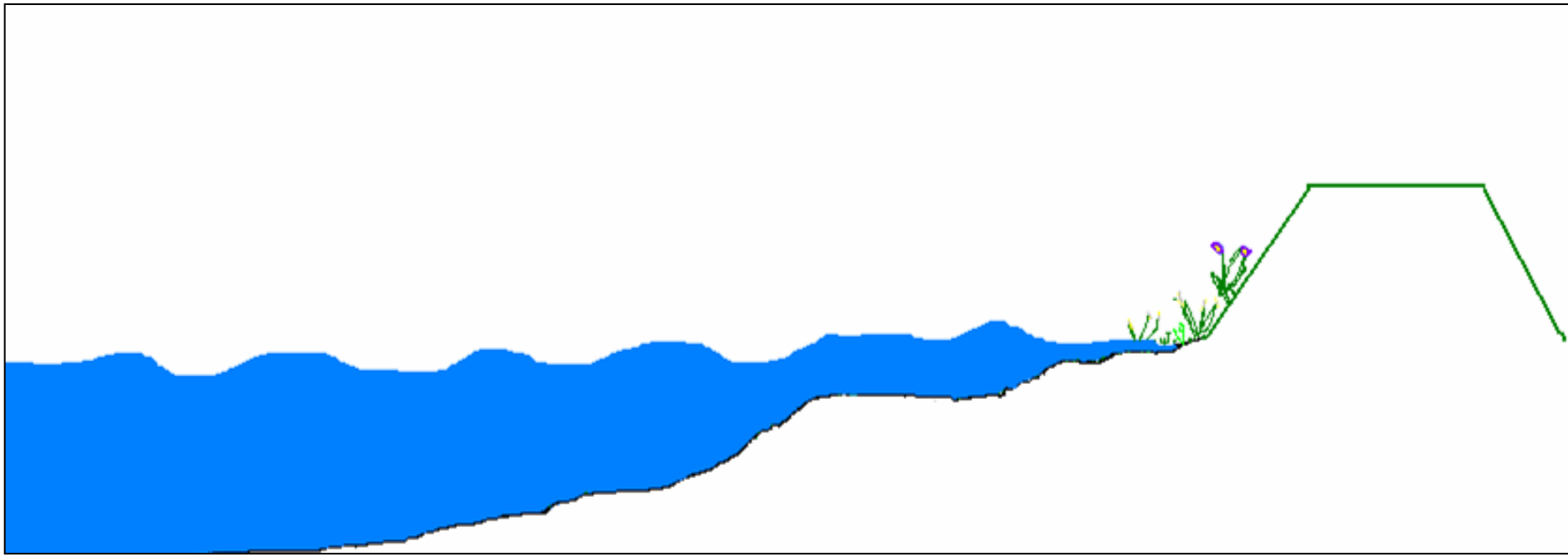
Coastal squeeze



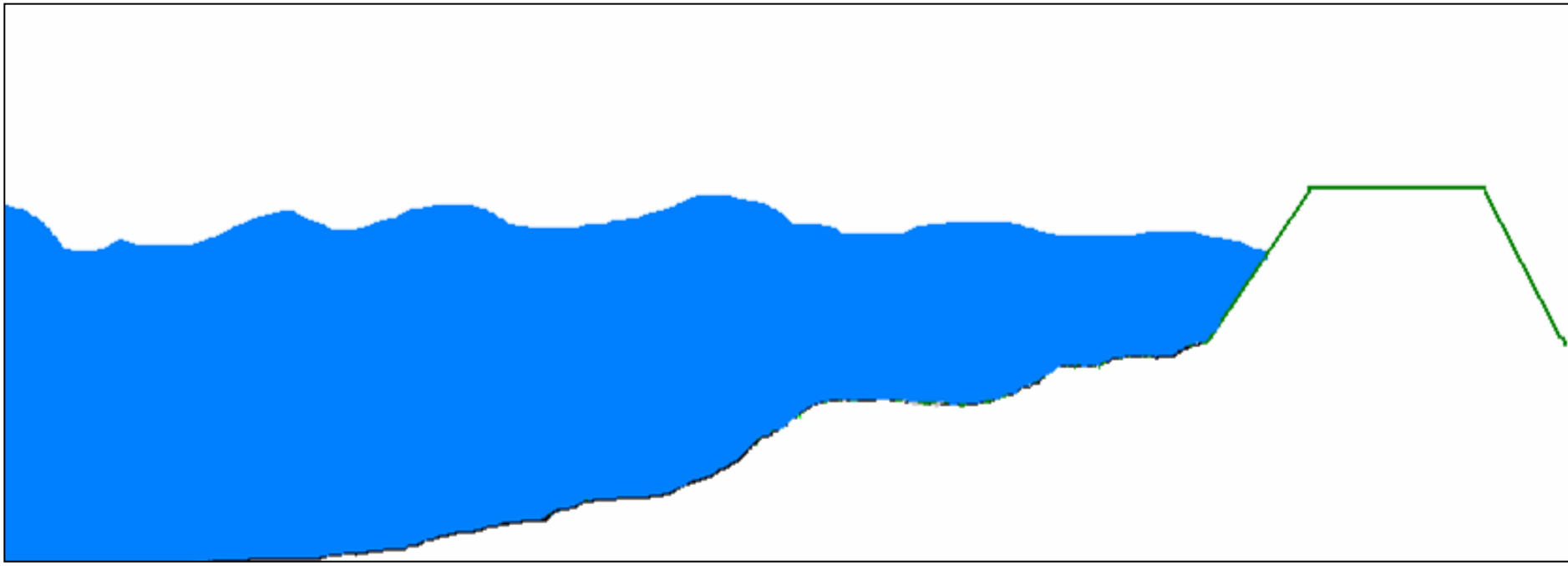
Coastal squeeze



Coastal squeeze



Coastal squeeze



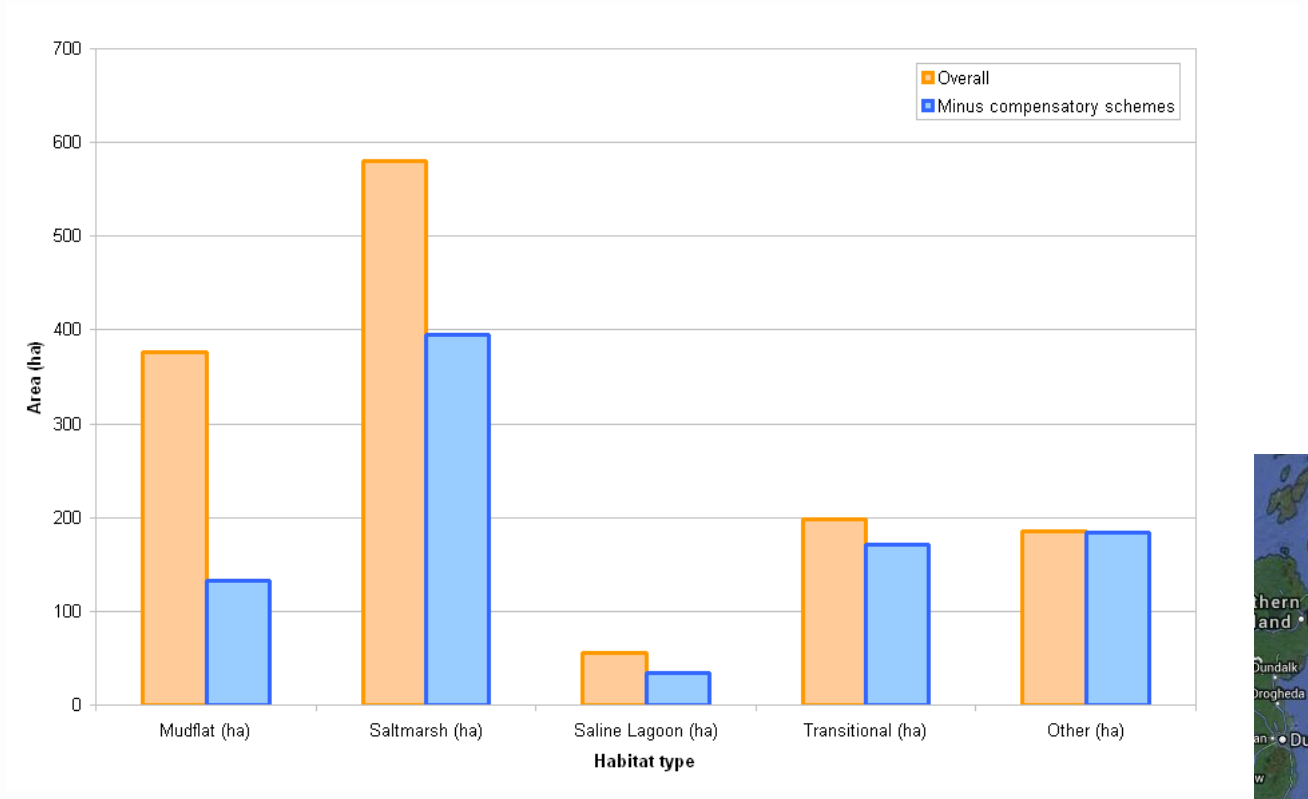
Why are we creating salt marshes?

4. EU Habitats Directive requires

   "**no net loss**"

   - So UK needs to create 140 ha/yr
   - Habitat must be ***functionally equivalent*** to natural marsh or have ***same biological characteristics***

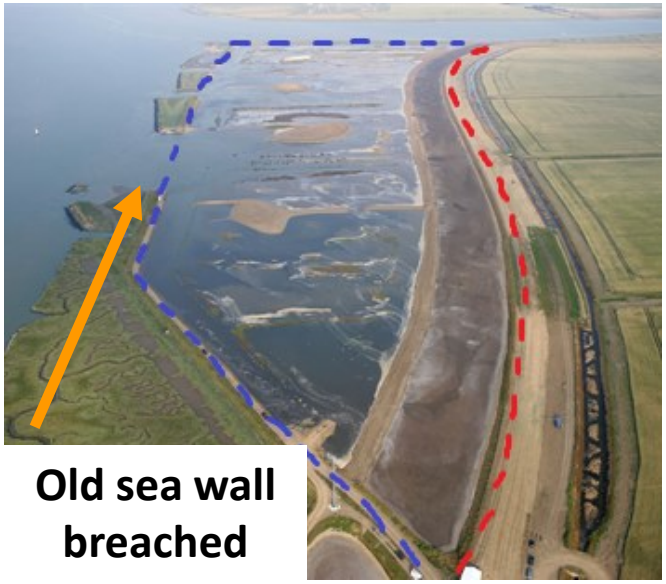
How much have we created to date?



Source: http://www.abpmer.net/omreg/

Salt marsh created through managed realignment

New wall is created inland



Old sea wall breached

Tides now flood and new saltmarsh establishes

Creating salt marsh: alternatives to realignment

Dredge dumping

Sediment recharge

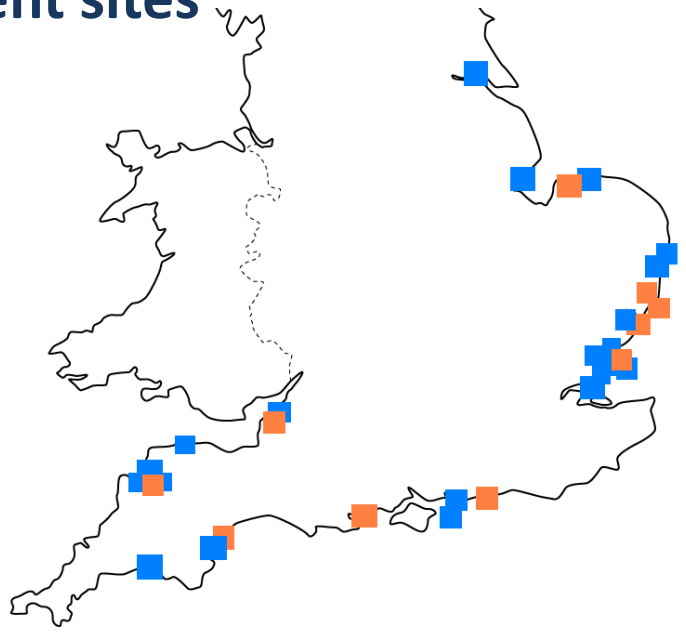
Lowering uplands!!!

Creating salt marsh through coastal realignment

Managed realignment sites

1-14 yrs since restoration

19 sites



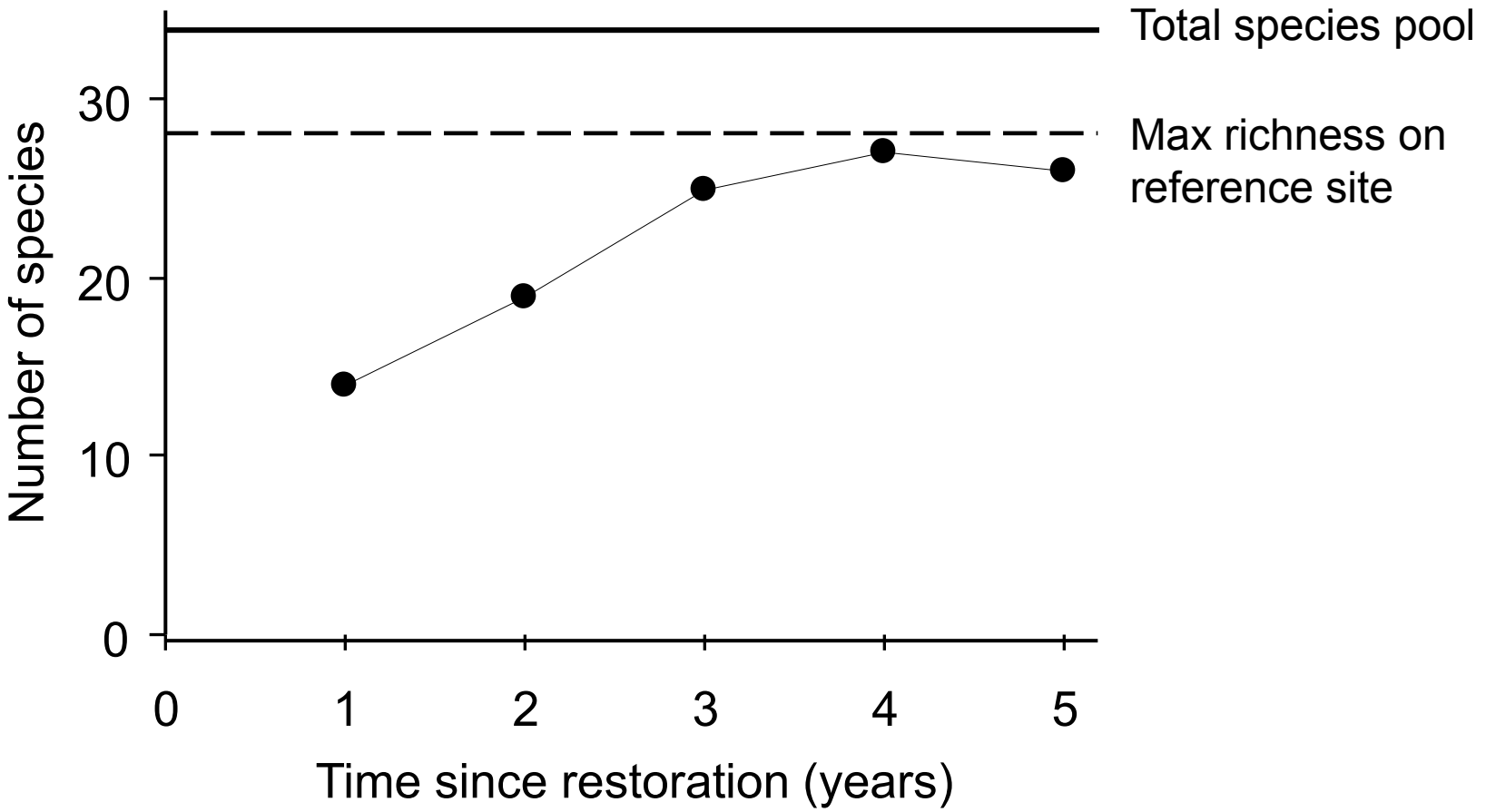
Natural marshes

Accidentally realigned sites

25-131 yrs since restoration

17 sites

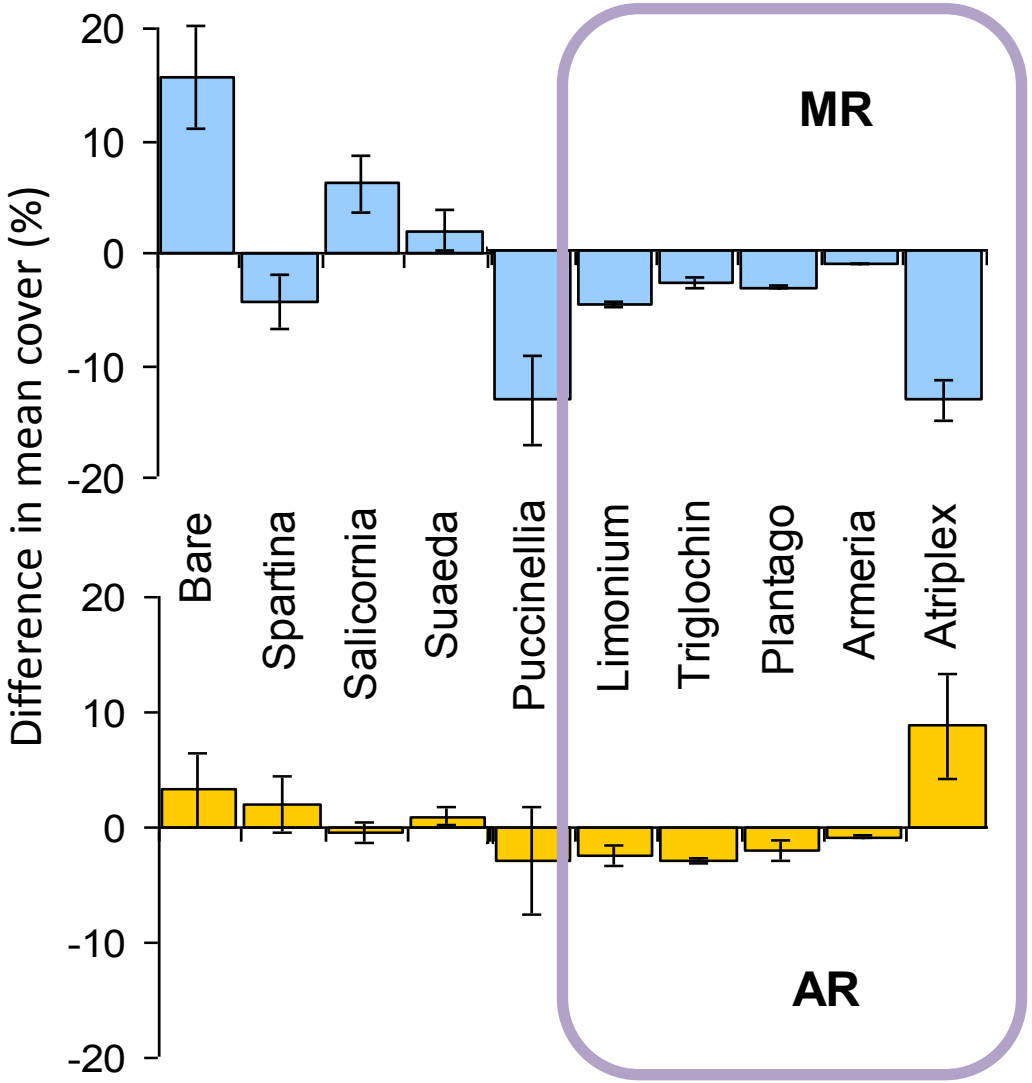
Plant species colonise rapidly



Data from Brancaster MR site

Mossman et al. 2012 Rest Ecol

But abundances of species are different



Difference in mean cover between natural salt marshes (38 sites) and restored sites (76)

Modified from Mossman et al 2012 J App Ecol

Does it matter that they are different?

YES! Salt marshes are important habitats:

- Biodiversity
- Coastal nutrient cycles
- Flood defence
- Recreation

- EU Habitat Directive: compensatory habitat must have **same biological characteristics**
- **So new marshes do not meet the legal requirements**

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Environment › Coastlines

Man-made English saltmarshes 'failing to meet European plant standards'

Study finds artificially created saltmarshes built to slow coastal erosion are not as rich in plant life as natural wetlands

Why are they different?

- Elevation and topography
- Sediment characteristics
- Species can’t disperse to the site
- Species competition

Are sites too low for plants to colonise?

Are sites too low for plants to colonise?

But Brancaster NOT too low for saltmarsh

Bare ground occurs at all elevations

Brancaster MR, 4 yrs since restoration
Davy, Brown, Mossman, Grant 2011 J Ecol

Redox, Drainage & Waterlogging

Plants are intolerant of waterlogged soils

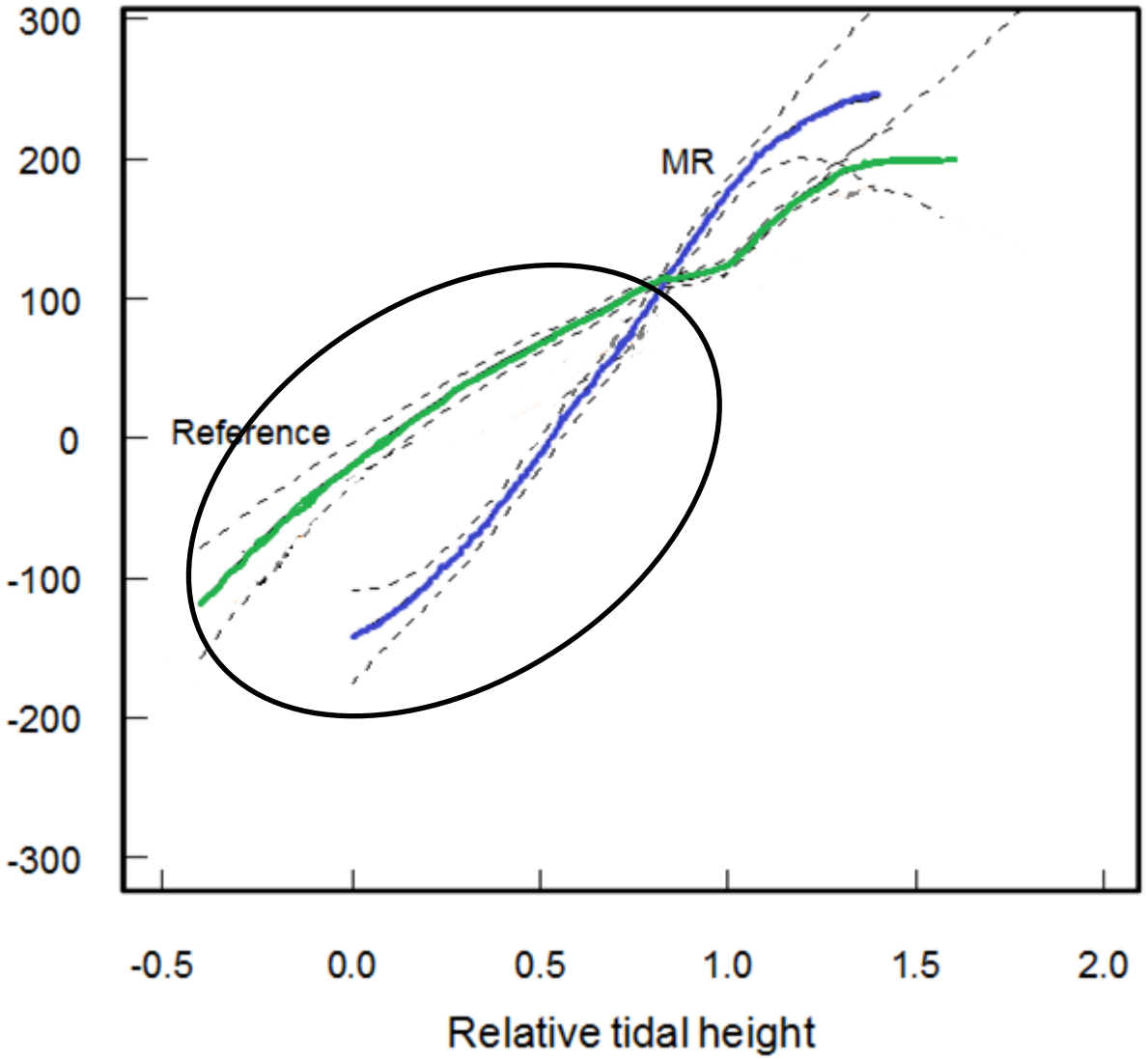
- Low oxygen conditions
- Reduction of ions – some toxic

Waterlogging is caused by:

- Frequent flooding
- Poorly draining soils

LOW redox potential – indication of waterlogging

Redox potential lower on restored sites



Modified from Mossman et al. 2012 J App Ecol

Reasons for poor drainage

Too few creeks?

Aquitards

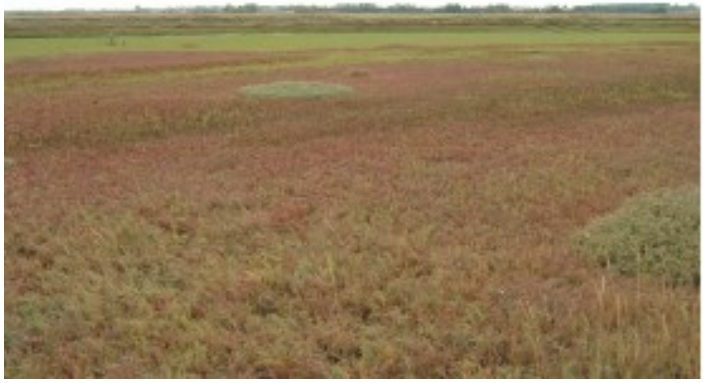
- Impede downward drainage
- Prevent creek formation

Soil compaction

- Earth moving equipment

Lack of microtopography

Microtopography: are restored marshes too flat?



Brooks, Mossman, Chitty, Grant *in revision;*
Mossman et al *in prep*

1. Can we adapt sites to over come drainage issues?

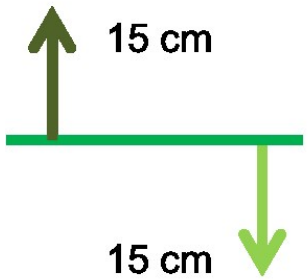
2. Can we manipulate drainage by making small-scale changes to topography?

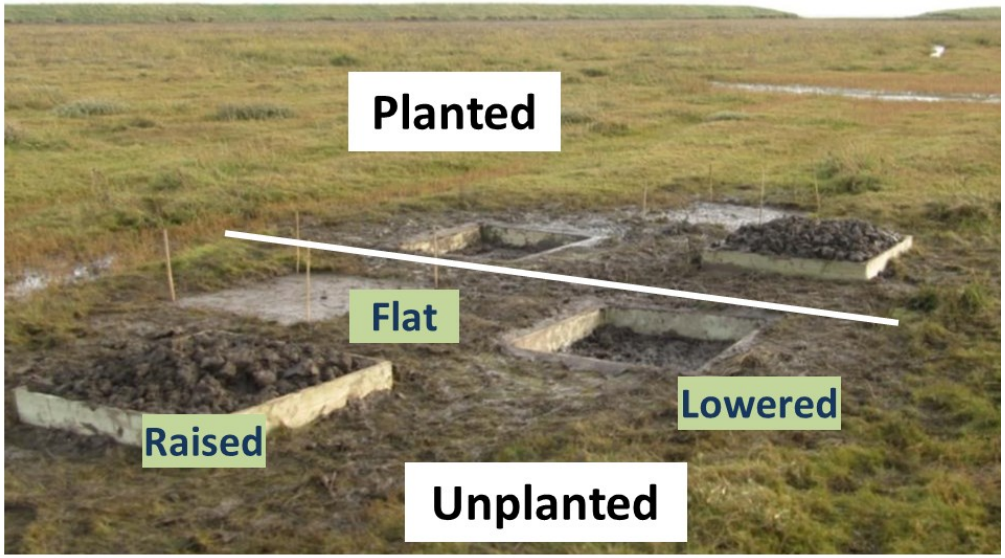
3. Are there consequences for plant colonisation and survival?

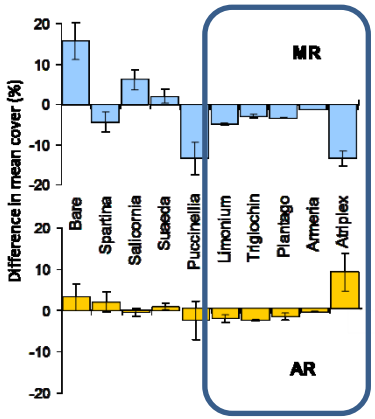
Large field experiment to:

1. Disentangle the effects of elevation and redox

2. Suggest improvements to new marshes





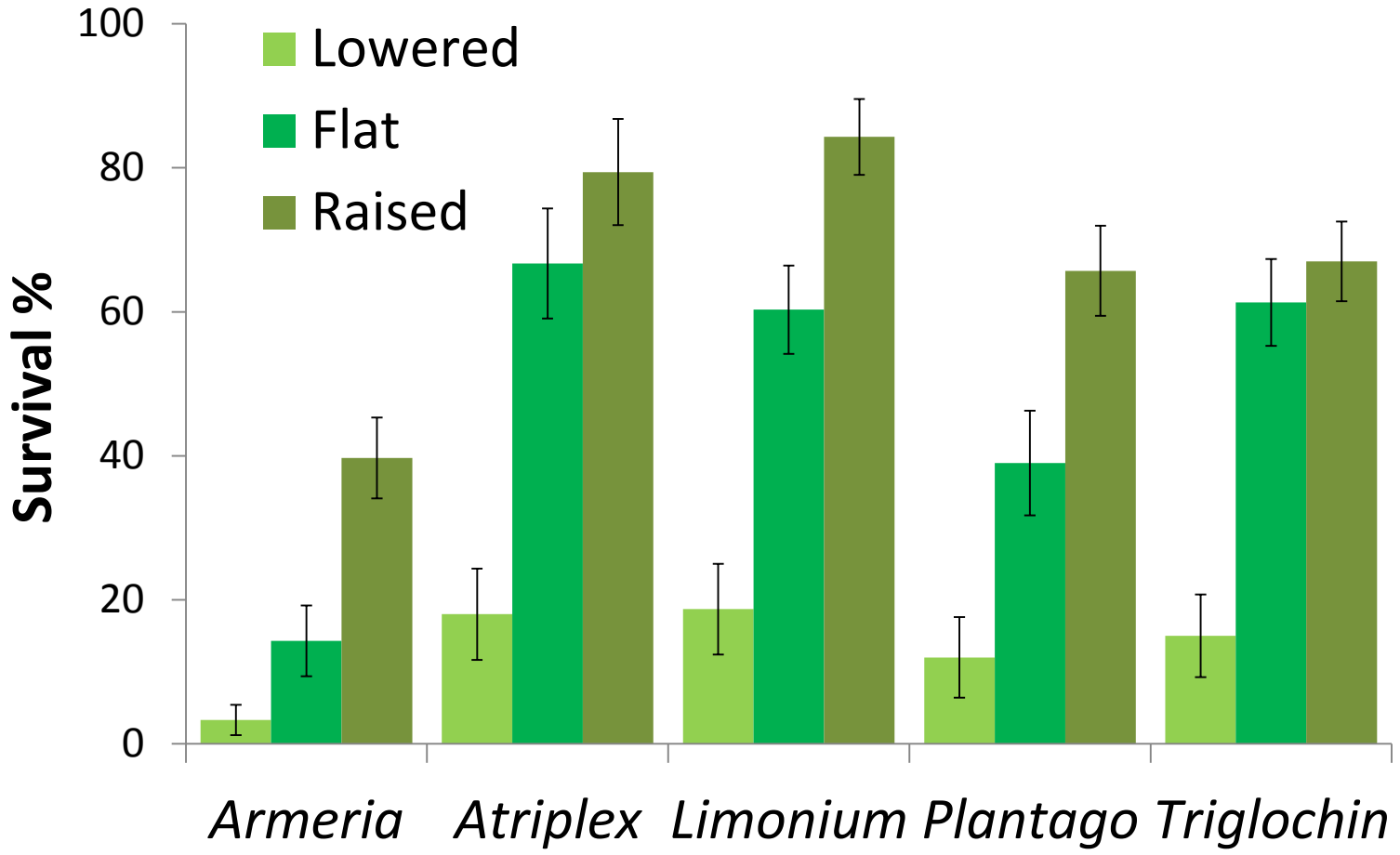


lanted: *Atriplex portulacoides*, *Limonium vulgare, Triglochin maritima, Armeria maritima, Plantago maritima*

nplanted: natural colonisation

Esmée Fairbairn FOUNDATION

Planting works…if you get the elevation right



Pooled results from 3 sites, Oct 2012

No natural colonisation by target species

Armeria, Limonium, Triglochin, Plantago

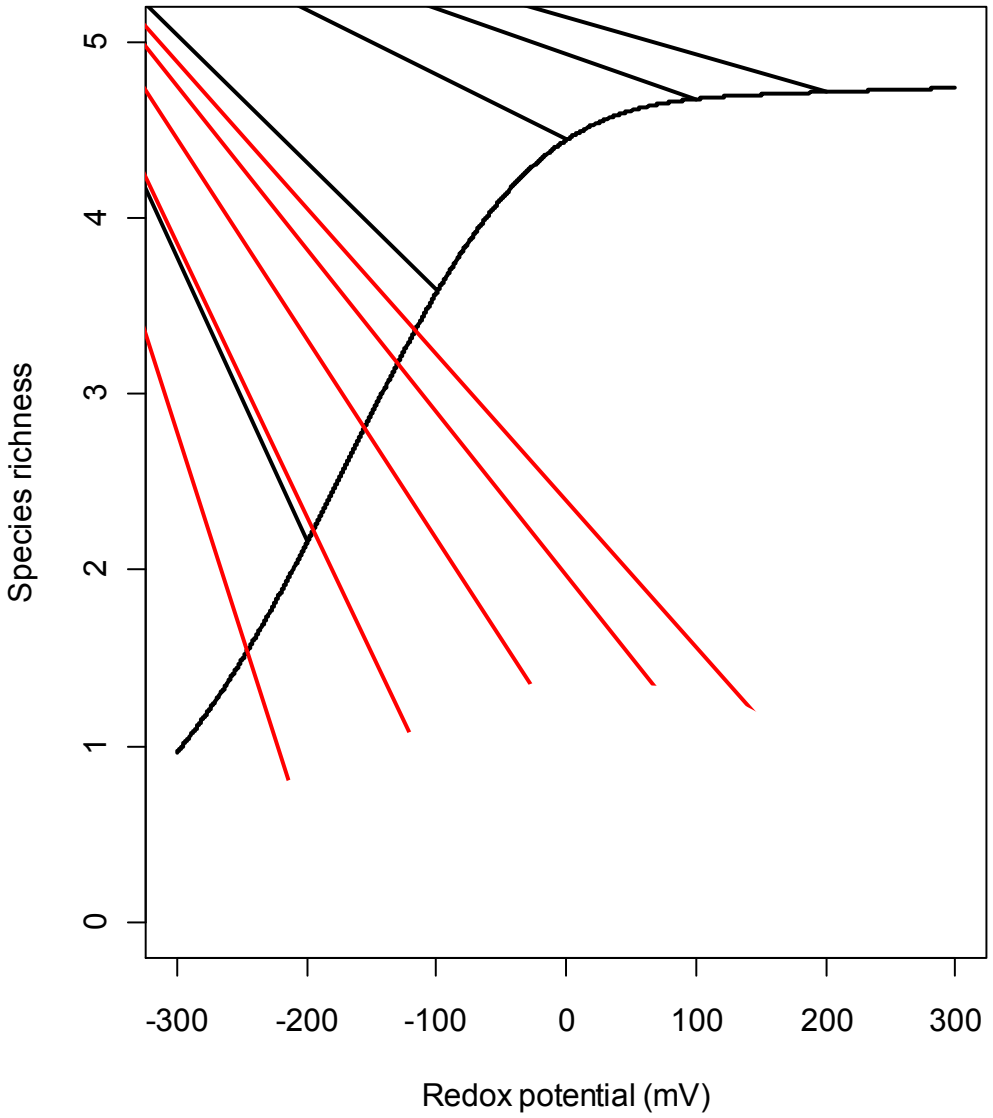
- **No evidence of natural colonisation**
- Planted individuals of all species flowered by 2nd yr
- *Limonium* and *Plantago* seedlings within planted plot

No colonisation problems for Atriplex!

Atriplex

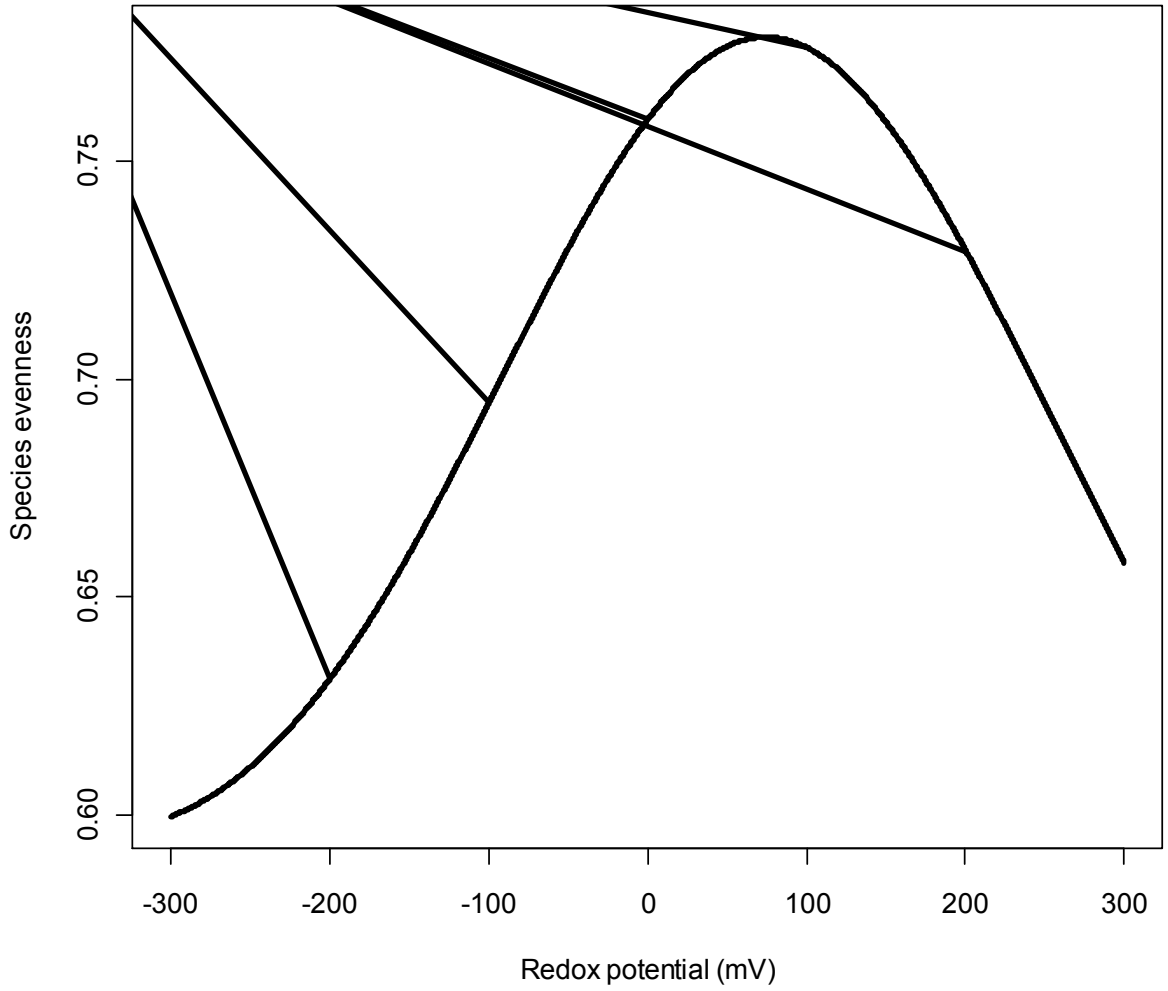
- All surviving individuals flowered
- Lots of seedlings
- Rapid growth – dominant species by yr 3

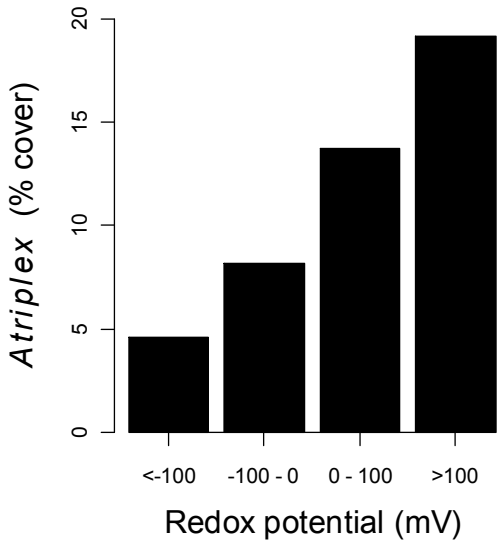
Plants do better with higher redox



Mossman et al *in prep*

Dominant species thrive at high redox





Data from MR, AR and Reference sites.
N=3600

Mossman et al *in prep*

2012 – two years after planting

So is Atriplex bad?

If dominant, likely to reduce species diversity

But, may have good sea defence properties…?

Creating variation in topography may increase species diversity

Next steps…

Large-scale manipulation of topography and planting

- Need a site
- And some funding…

Conclusions and implications

- Sites must be at the correct elevation
- Small-scale changes in topography significantly alters soil oxygenation
- Leading to more marsh at the ‘right’ redox range
- Planting assists establishment of rarer plants

But….

- What to do about *Atriplex*? It can become dominant quickly and shades out other plants. It has colonised unplanted plots and grown very quickly.
- How do we prevent this happening?



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