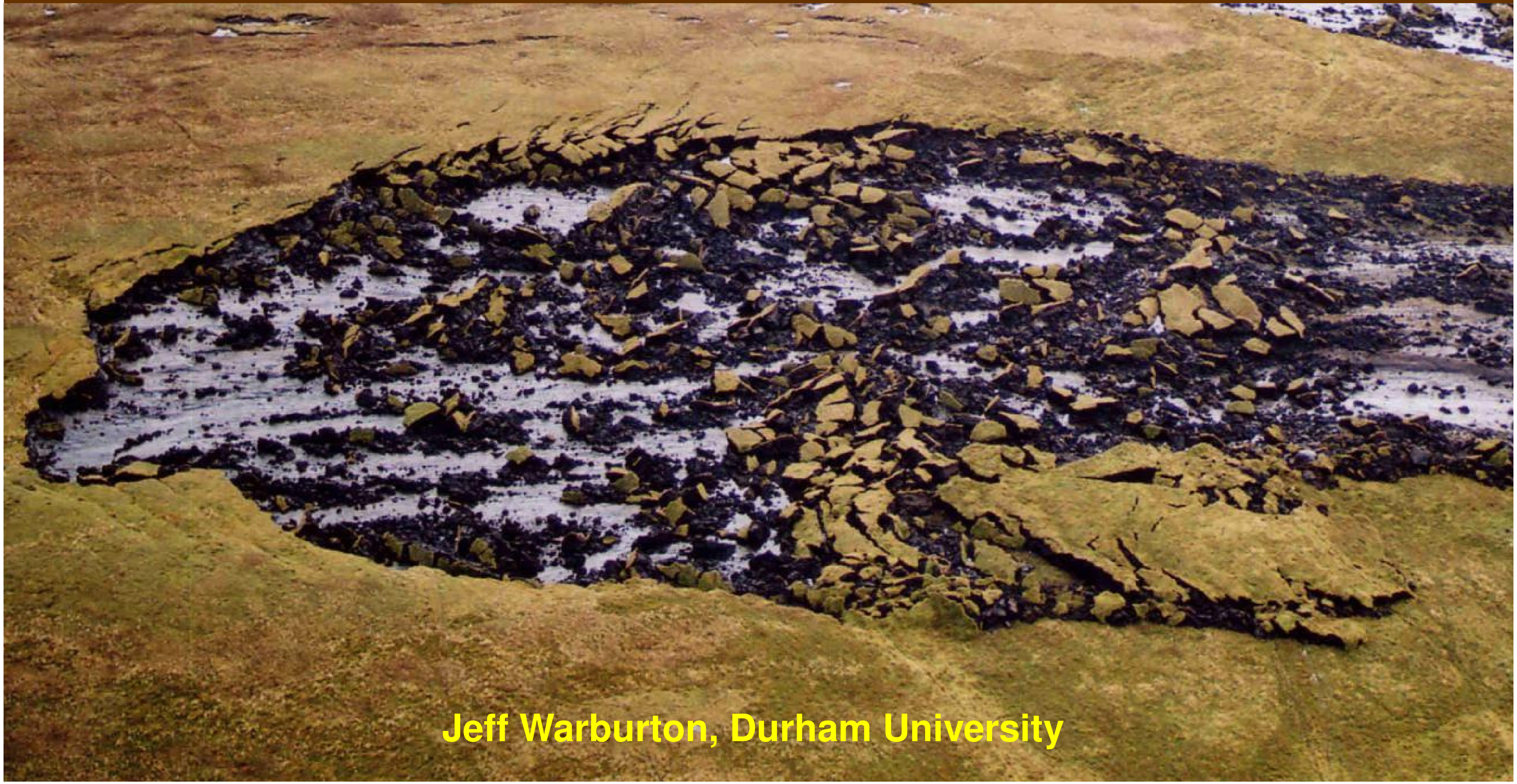
Peat Stability Seminar

Geological Survey of Ireland / Institute of Geologists of Ireland 7th October 2010

Upland Peat Loss



Jeff Warburton, Durham University

Outline:

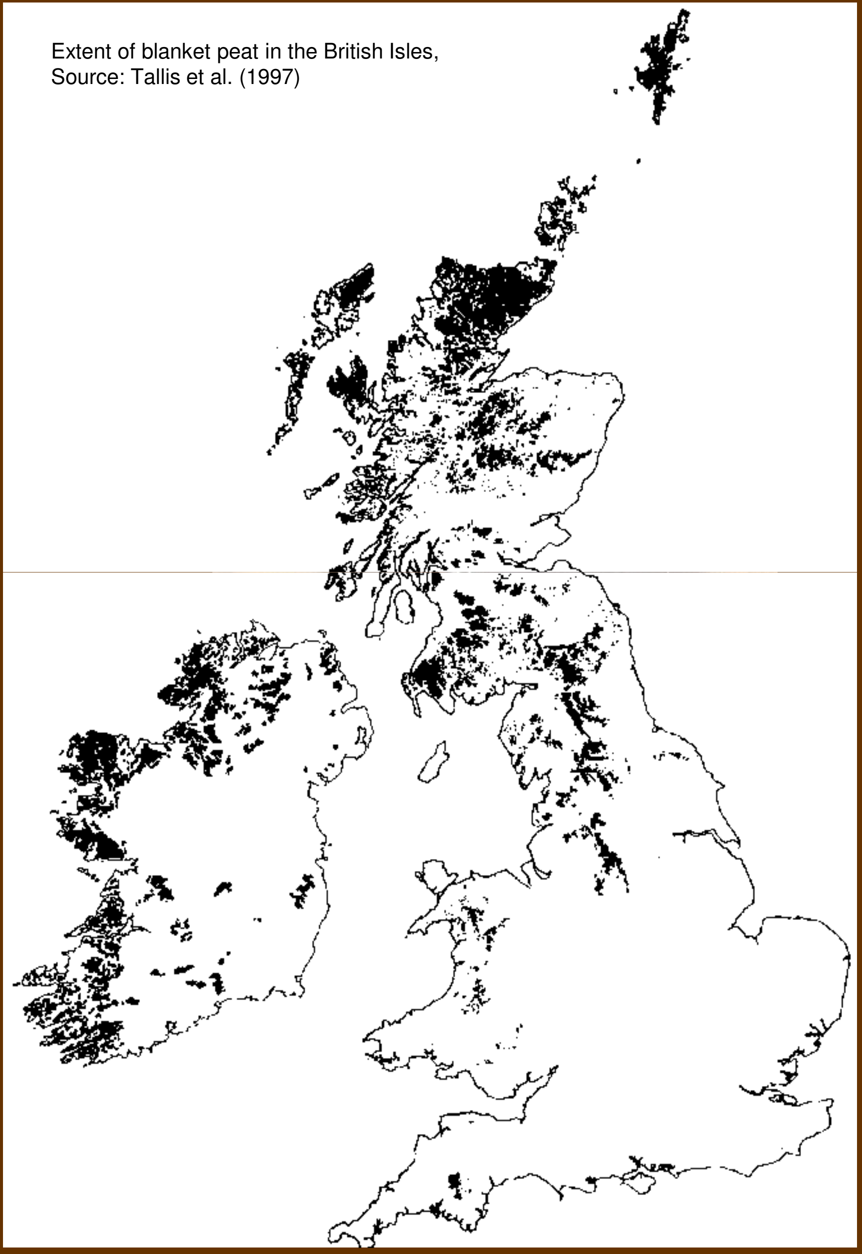
Upland Peat Loss

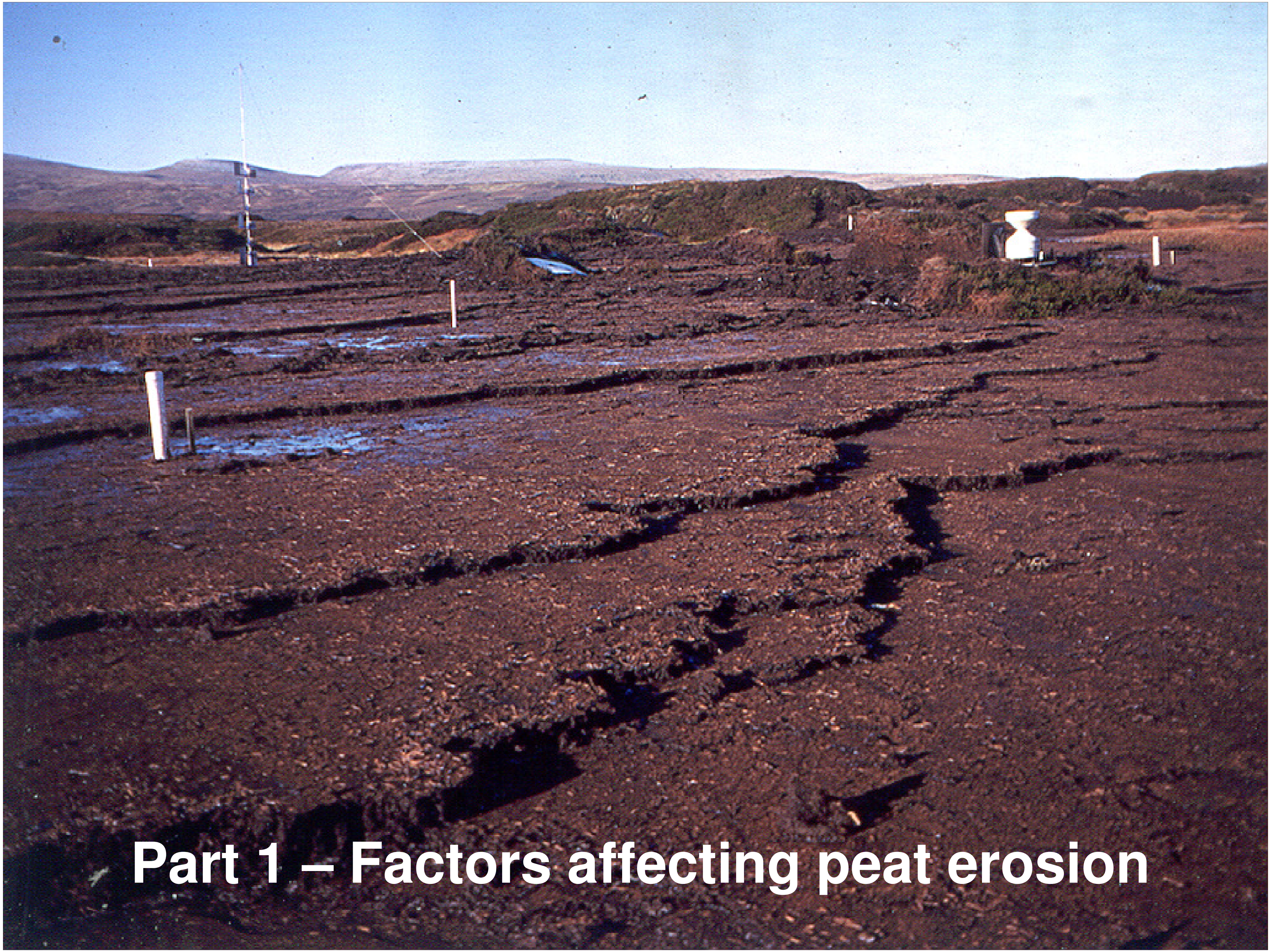
1. Factors affecting peat erosion
   - Wind
   - Frost
   - Rain

2. The upland peat geomorphic system
   - Contemporary sediment transfer
   - Landscape change

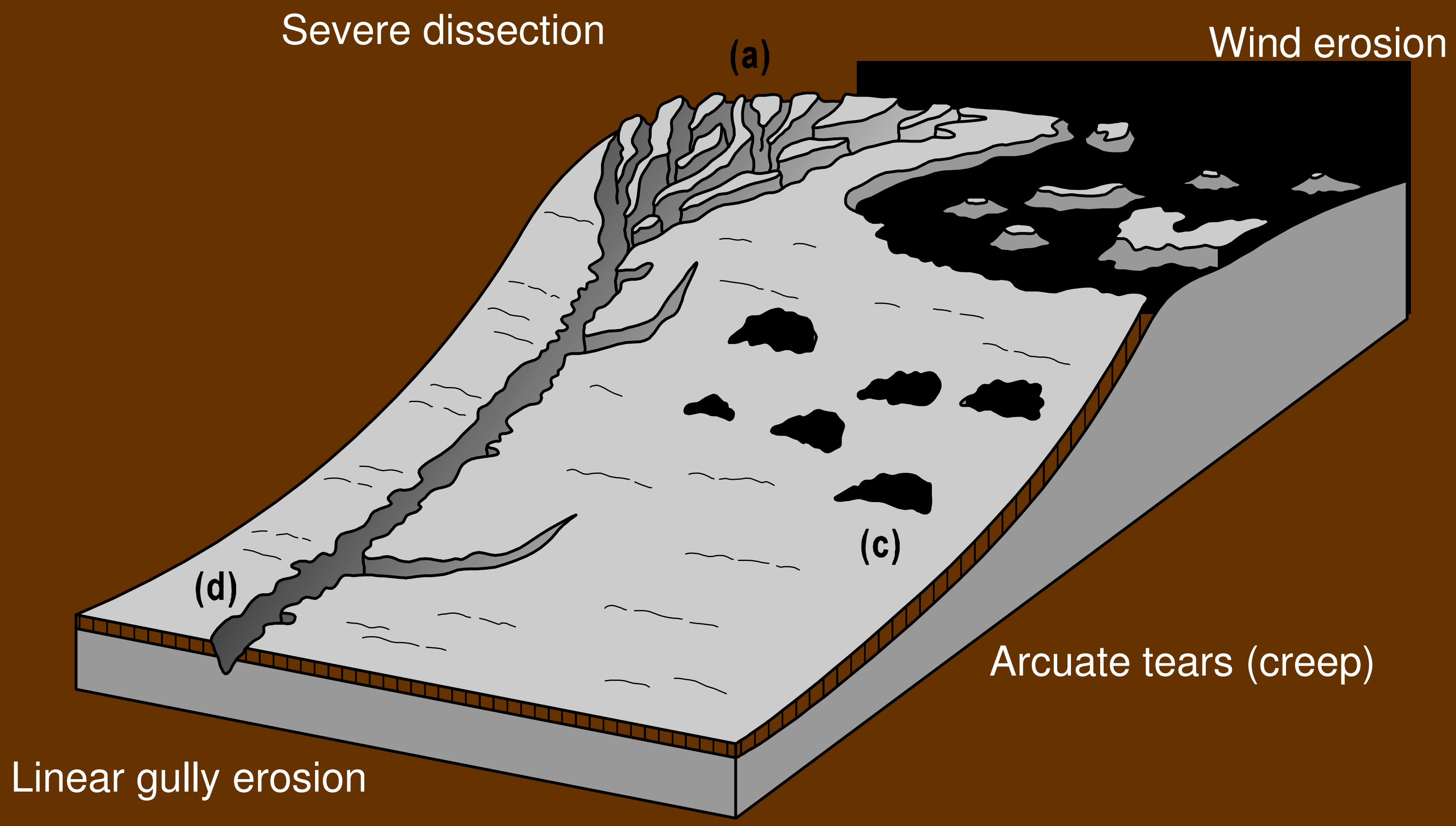
3. Impact of peat loss
   - Range of impacts
   - Significance of peat density

Extent of blanket peat in the British Isles,
Source: Tallis et al. (1997)




Part 1 – Factors affecting peat erosion

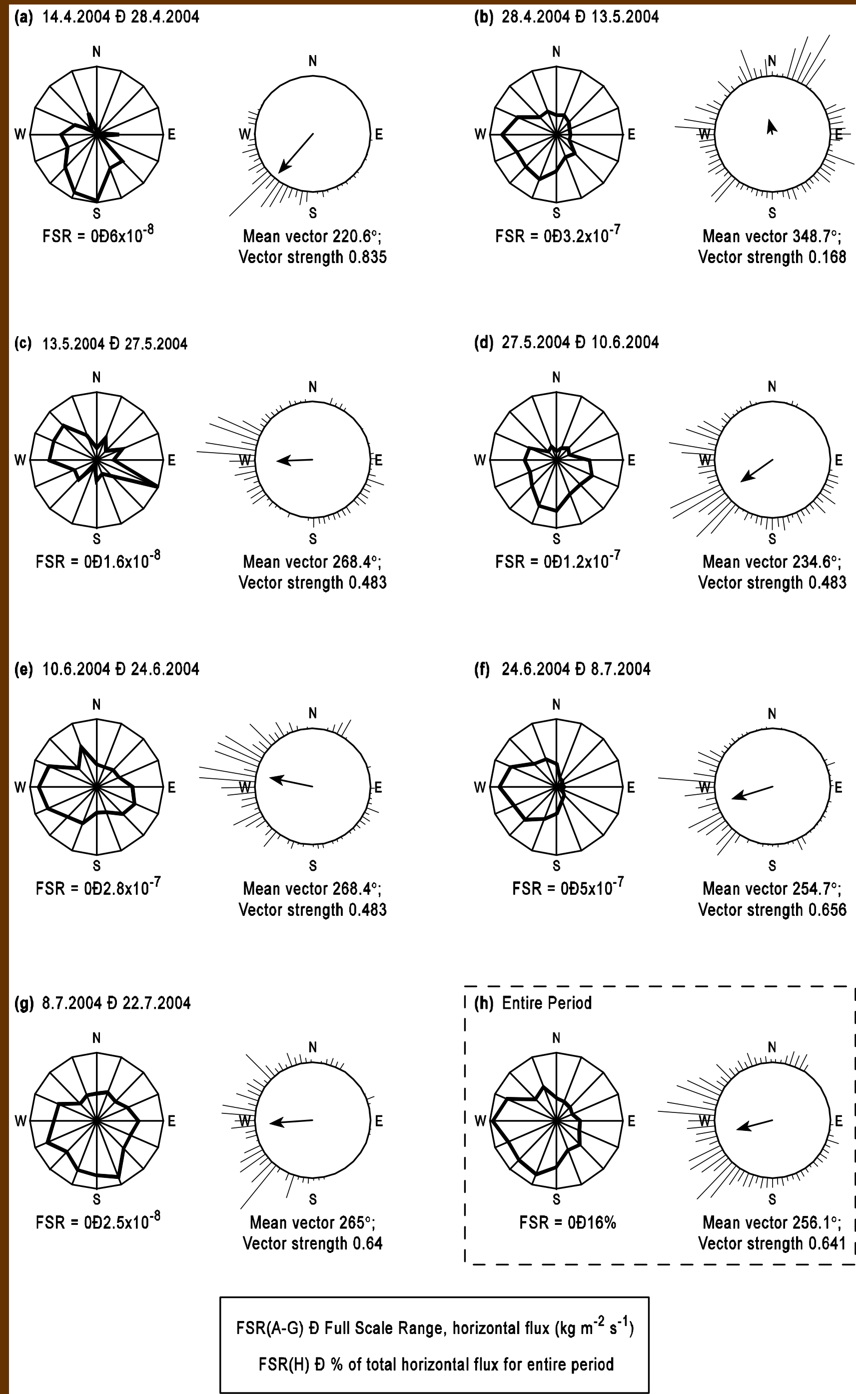
Schematic diagram of peat erosion after Radley (1962)



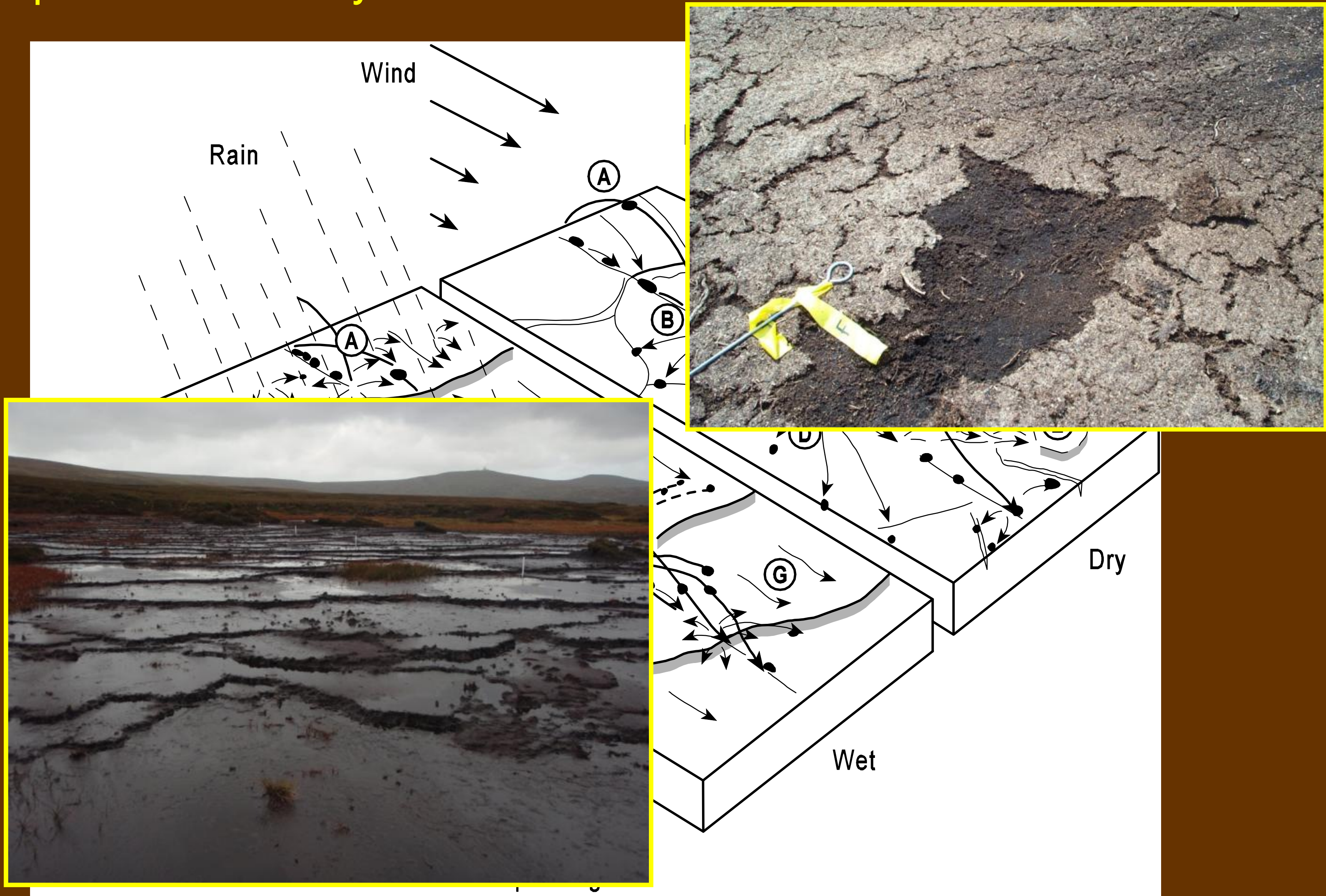
How significant is water versus wind?
What is the empirical evidence base?

Wind Erosion

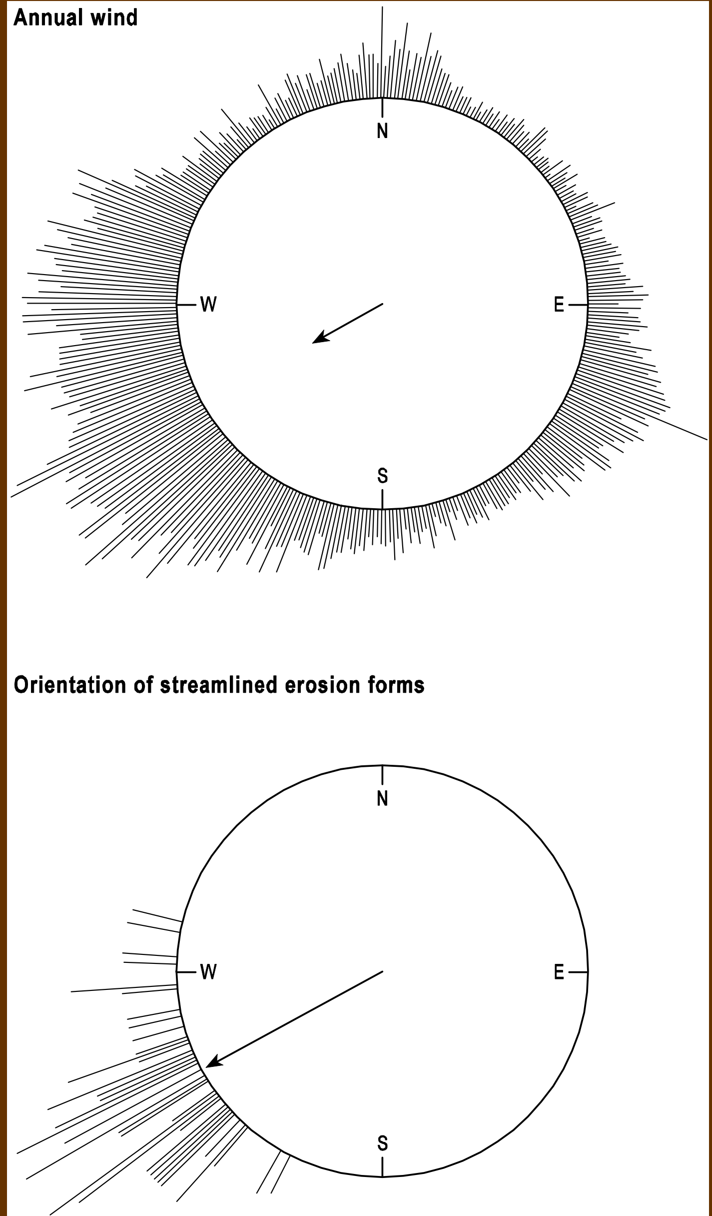
Wind rose and flu
diagram showing
wind direction for



Schematic diagram showing differences in aeolian transport processes in dry and wet conditions.

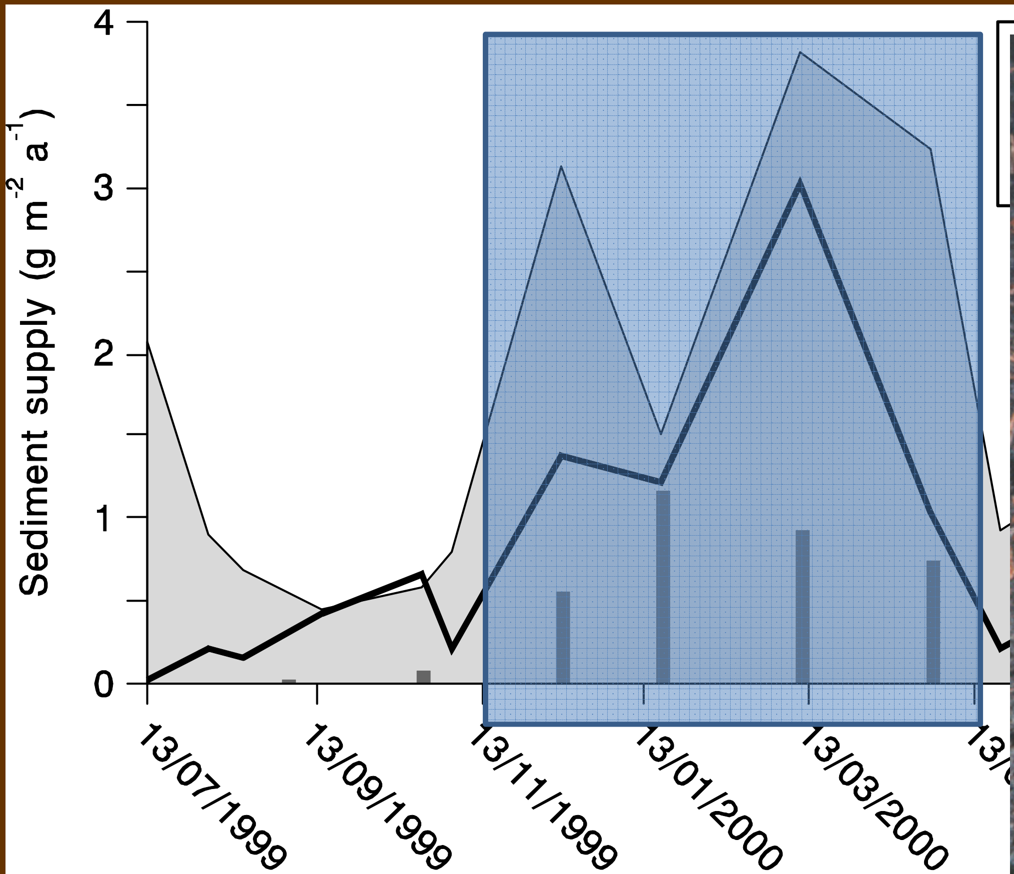


Wind eroded hummocks



Crynovial (Frost) action in peat

Frost action and sediment supply – Rough Syke, North Pennines



Frost Events

Reported rates of surface retreat measured on bare peat using erosion pins

Location	Context	Period (years)	Surface retreat rate (mm a^{-1})	Reference

Rates are a result of a combination of frost, wind and rain (plus other factors)

	Wind	Rain	Frost
Material production	Entrained by wind shear	Detachment by rain	Frost heave detachment
Mass transfer	Aeolian transport	Splash	Freeze/thaw

Rates are spatially and temporally highly variable depending on the *condition* of the peatland

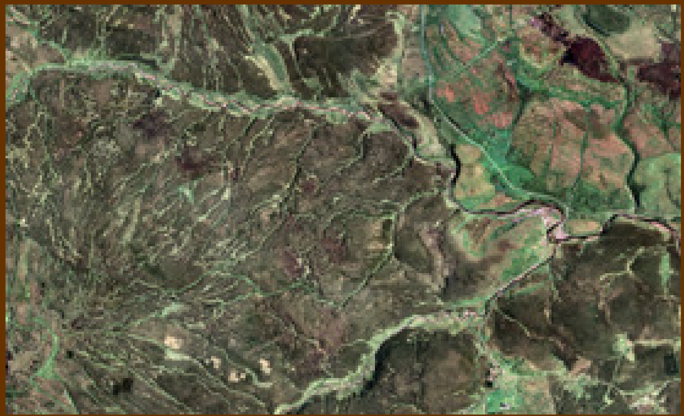
Doctors Gate	Low angled eroded face	2	9.6	Tallis and Yalden, 1983
Plynlimon,	Peat faces	2	16	Francis, 1990
	peat	1	20.4	Mackay 1993

Rates vary: 7.8 to 73.8 mm a^{-1}

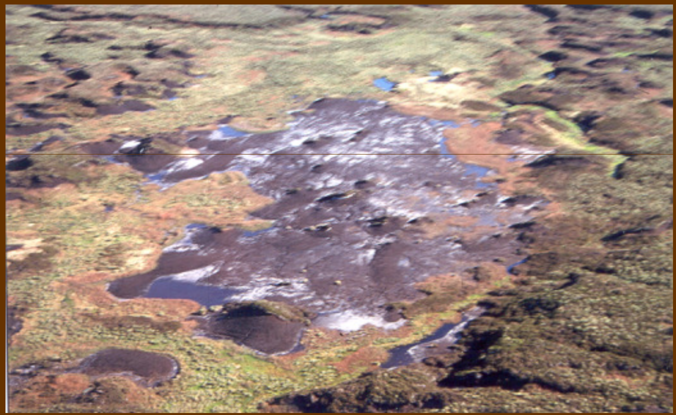

Part 2 – The upland peat geomorphic system

Scale, process and form – three main scales

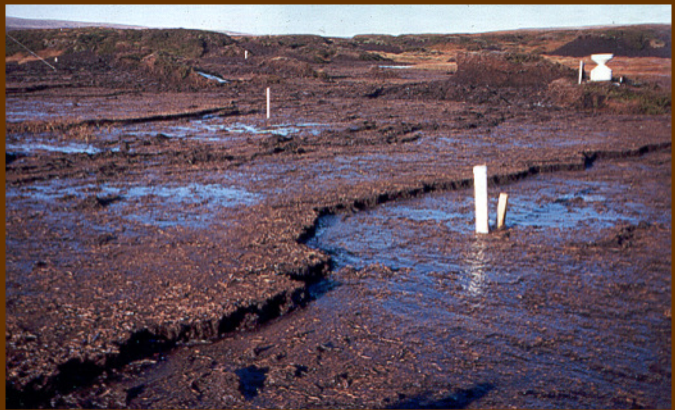
Macro – region / catchment scale

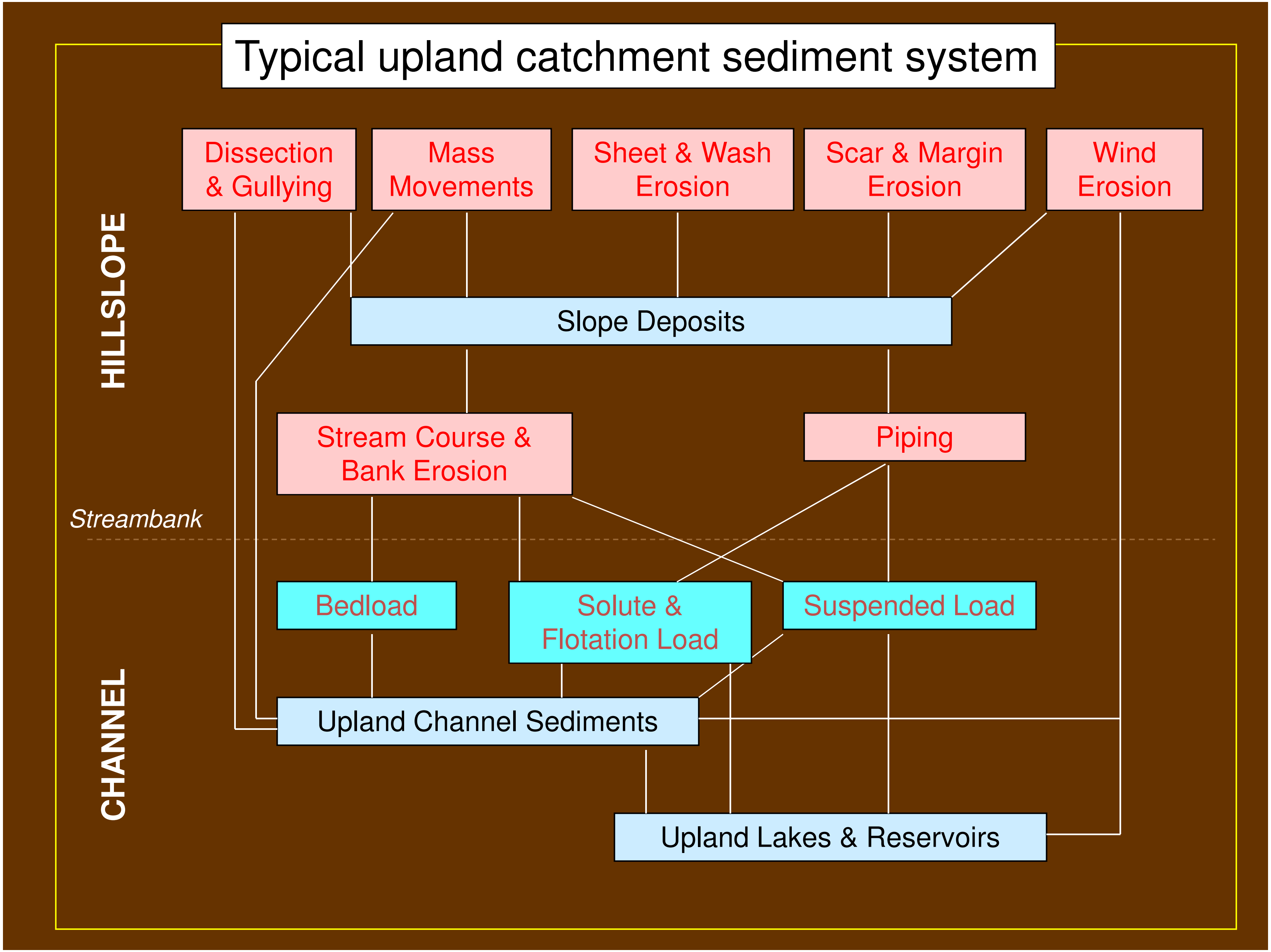


Meso – slope / channel scale



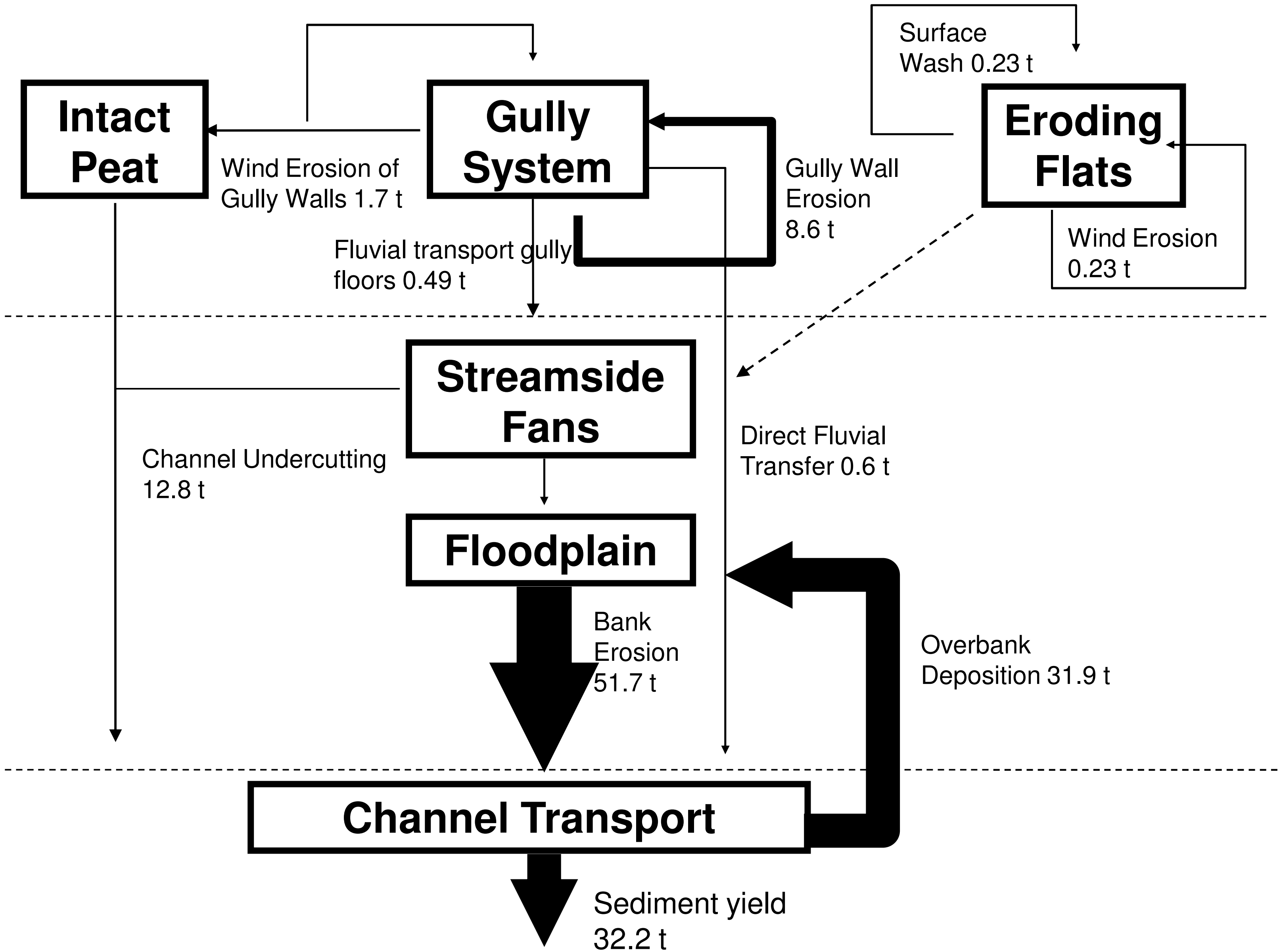
Micro – material / structure scale





Typical upland catchment sediment system
HILLSLOPE
Dissection & Gullying
Mass Movements
Sheet & Wash Erosion
Scar & Margin Erosion
Wind Erosion
Slope Deposits
Stream Course & Bank Erosion
Piping
Streambank
CHANNEL
Bedload
Solute & Flotation Load
Suspended Load
Upland Channel Sediments
Upland Lakes & Reservoirs

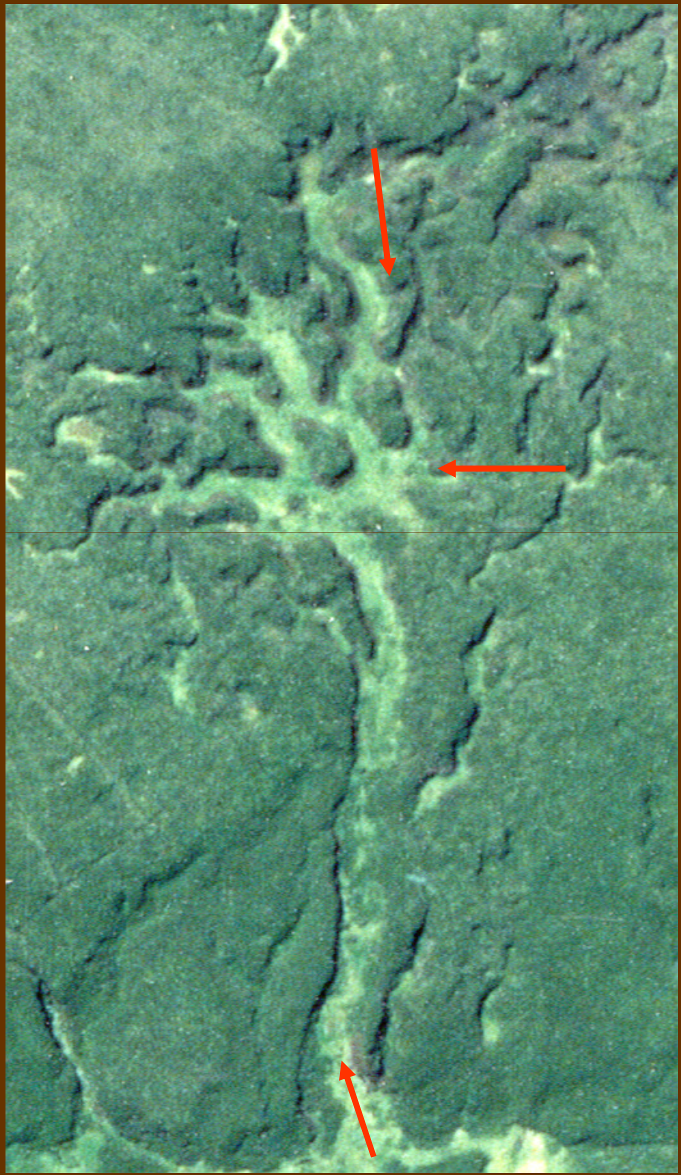
Sediment Budget – Rough Sike



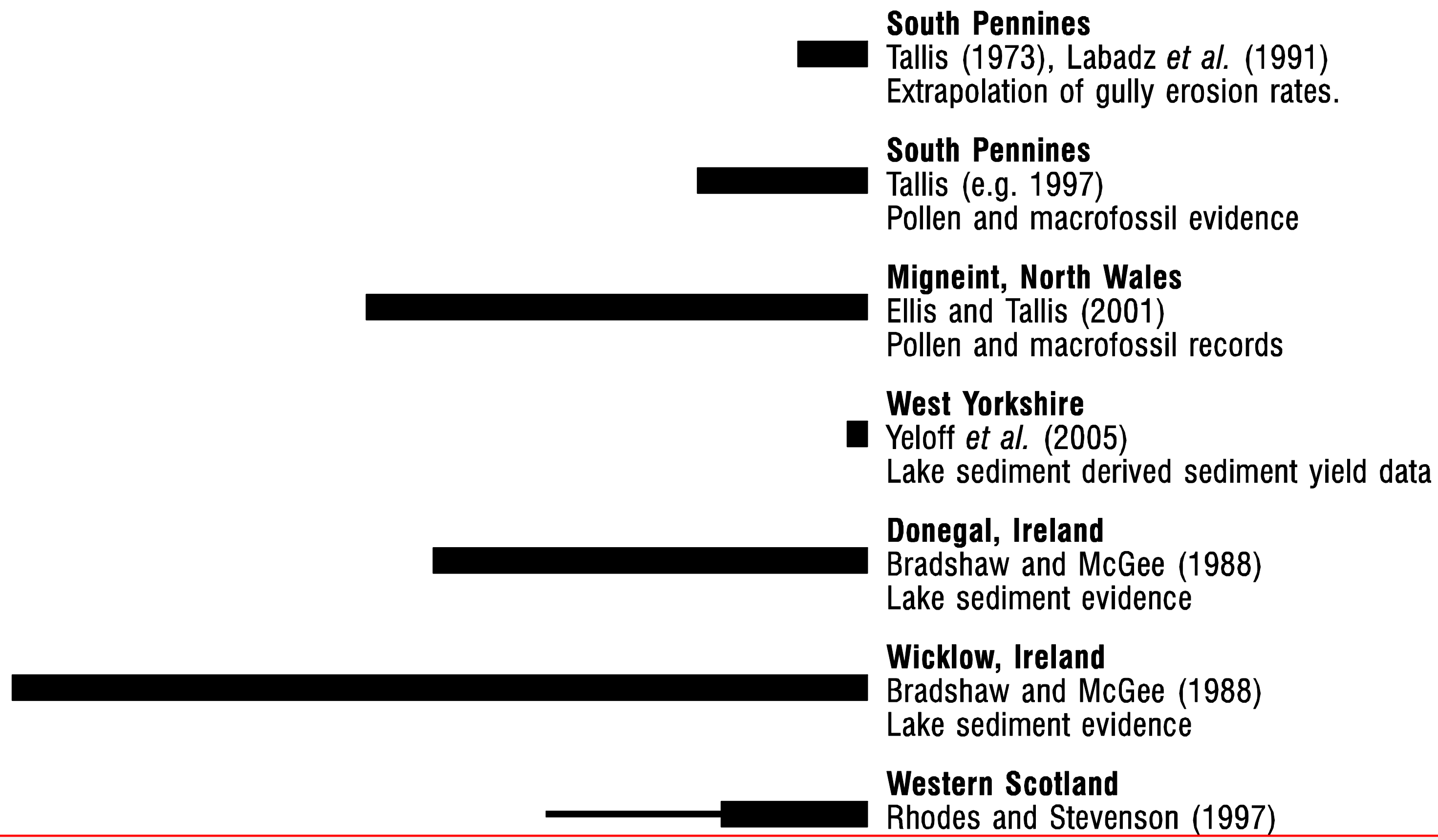
Estimate of Rough Sike Sediment Yield

Crisp (1960)	93 t a^{-1}
(2000)	32 t a^{-1}

Burnt Hill gully - historical change 1958 to 1998



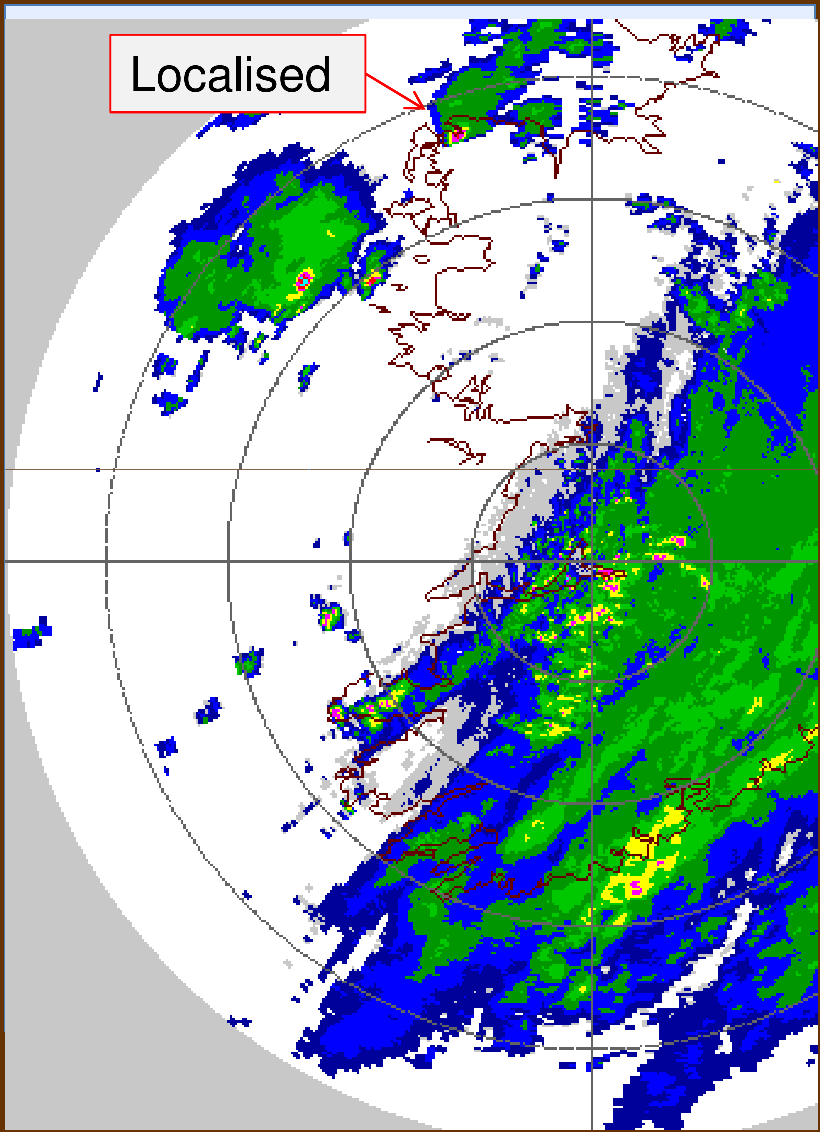
Onset of peat erosion

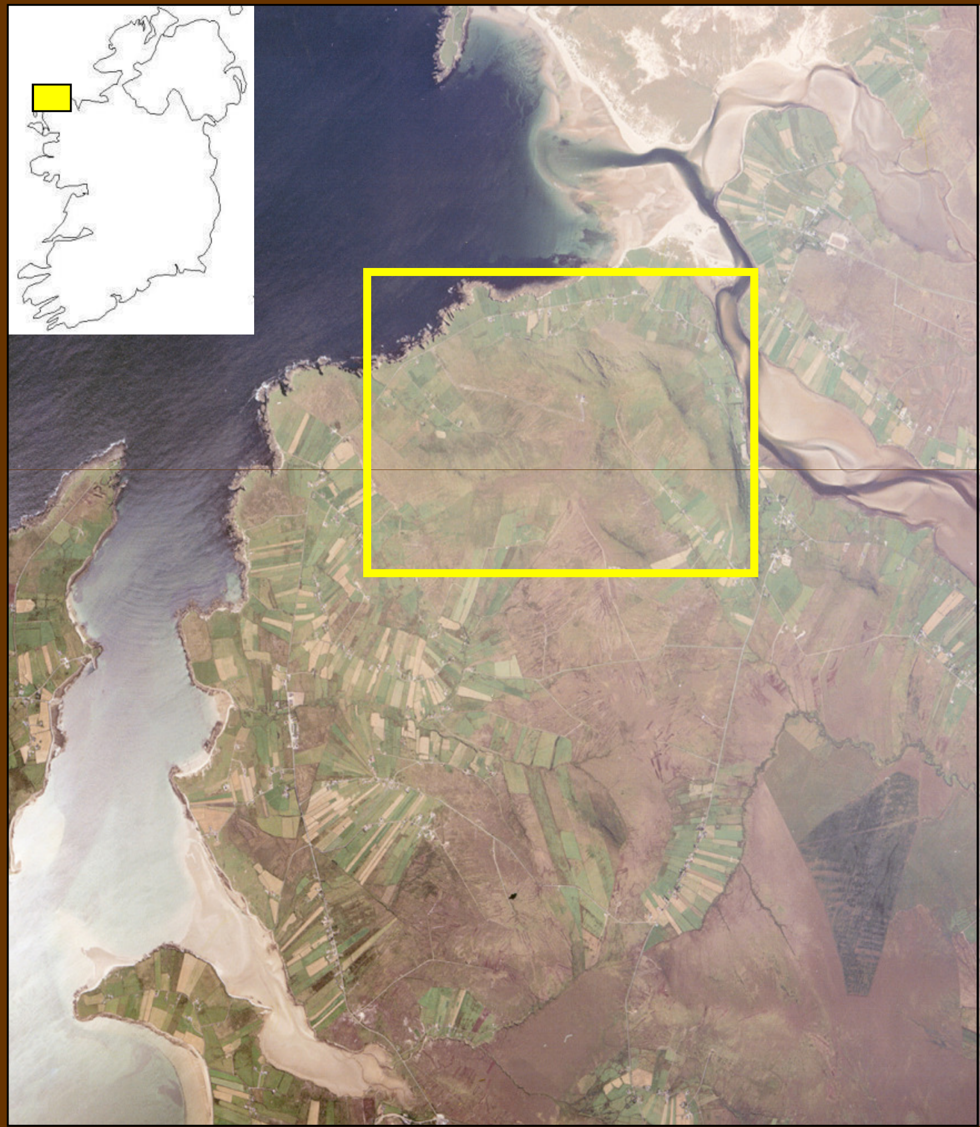


Evidence for the onset of erosion varies between peatlands

Suggests different drivers

Significance of the *big event*

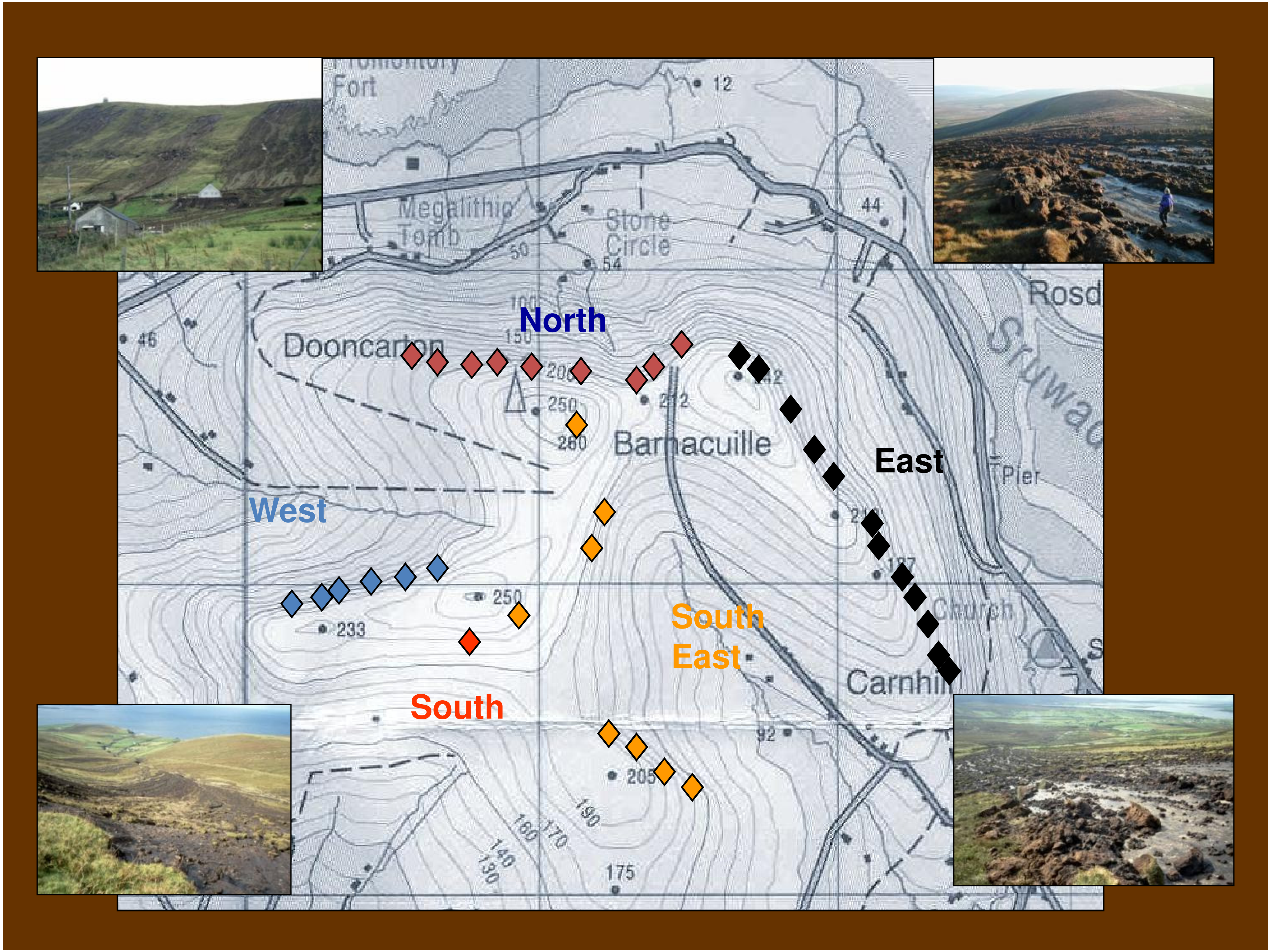




HOUSE TALKS: Taoiseach meets Mayo victims of landslide

The Taoiseach, Mr Ahern, holds an impromptu press conference beside a house which was damaged by a landslide in Glengad, Co Mayo, yesterday. Photograph: Keith Heneghan/Phocus; ***reports page 2***

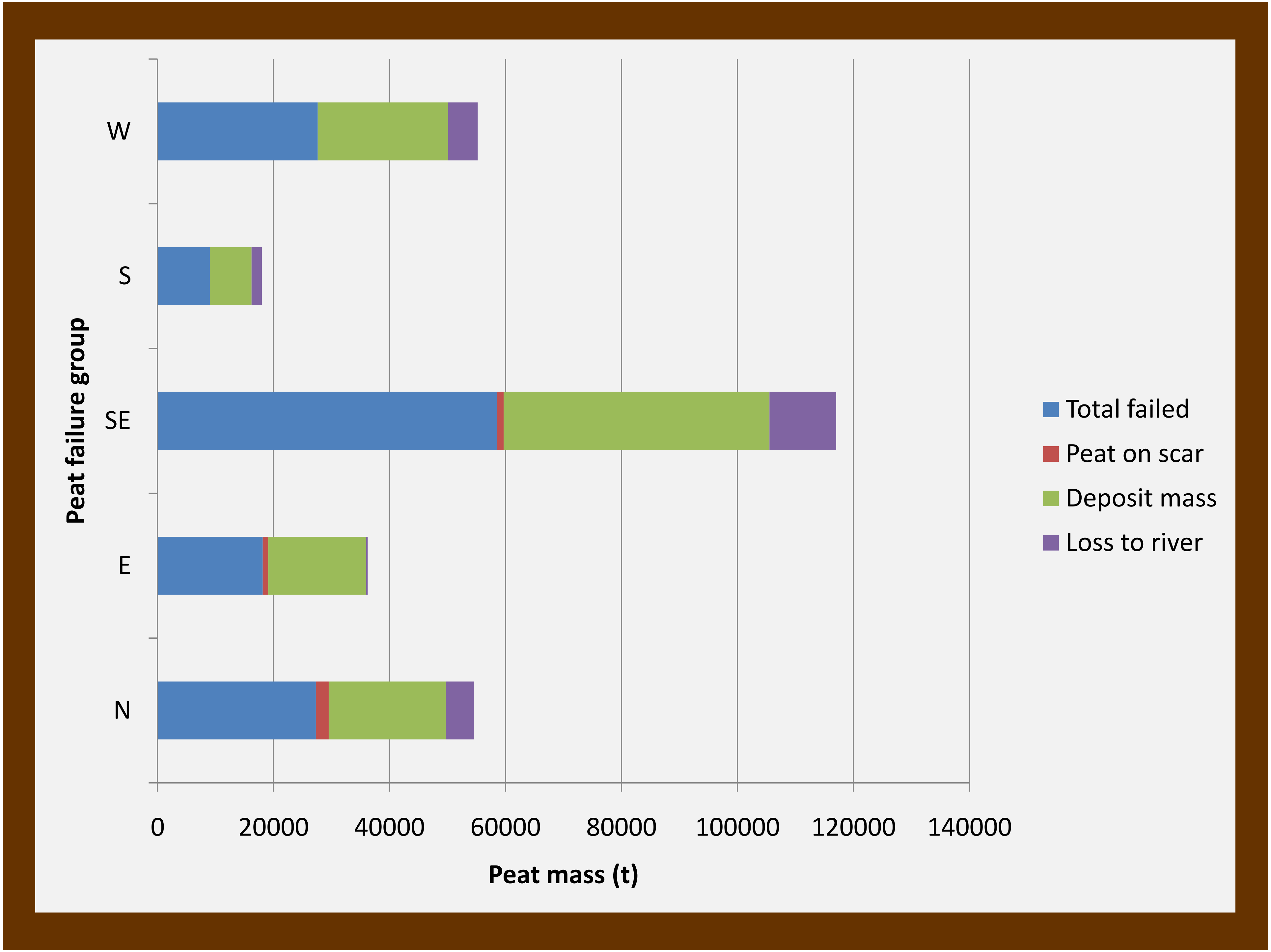
Irish Times
24.10.2003


North
West
East
South East
South
Dooncarton
Megalithic Tomb
Stone Circle
Fort
Pier

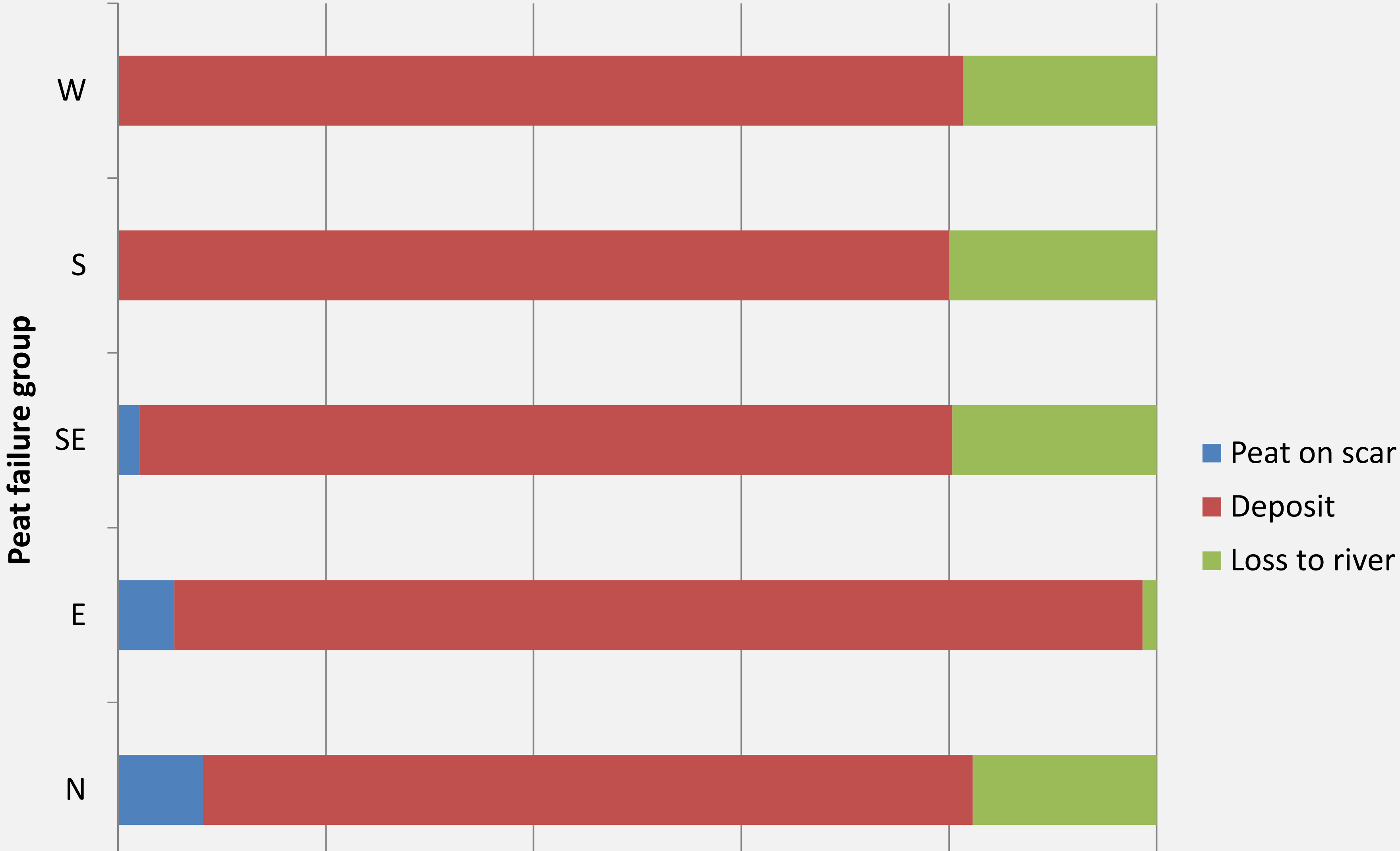
Dooncarton Mountain Sediment Budgets

Landslide group (n)	Volume of peat eroded (m^3)
North (8)	31,012
East (12)	27,386
South East (8)	69,610
South (1)	11,295
West (7)	38,370
TOTAL	177,674

Photograph: Peter Coxon



Peat failure group
W
S
SE
E
N
0
20000
40000
60000
80000
100000
120000
140000
Peat mass (t)
Total failed
Peat on scar
Deposit mass
Loss to river



Appreciation of the upland geomorphic systems allows us to link hillslope and river channel processes


Part 3 – Impact of peat loss

Environmental impacts of peat erosion

	Short-term impact	Long-term impact
At the site of the erosion		
Offsite effects		

Not a complete list

Example: Burnhope Burn August 2006

Significance of peat density

Estimates of the wet and dry bulk densities of peat and mineral soils

Peat type	Wet / Field bulk density ($Mg\ m^{-3}$)	Dry bulk density ($Mg\ m^{-3}$)	Source
Milled peat (von Post* 3-6)	0.19 – 0.24	0.04 – 0.08	Campbell et al., 2002
Loose peat (von Post 3-6)	0.23 – 0.40	0.1 – 0.23	Campbell et al., 2002
Crusted peat (von Post 3-6)	0.21 – 0.36	0.1 – 0.22	Campbell et al., 2002
Irish blanket peat	1.02	0.07	Galvin, 1976
Welsh bog peat	0.99 – 1.16	0.09 – 0.16	Nichol and Farmer, 1998
Peat soils (von Post 1-10)		0.05 – 0.2	Egglesmann et al., 1993
Mineral soil (A horizon)		1.0	Egglesmann et al., 1993

Peat is a low density geological material
Show considerable variability in this property
Key property determining impact

Significance of peat density

Entrainment by wind :

For loose (bare) peat thresholds greatly reduced

- *Mineral sediment requires 4x > shear velocity to entrain grains of equivalent diameter*

Novel transport mechanisms → *kite transport*

Transport by water:

Peat has a density similar to or less that water:

Hillslopes: peat easily washed from bare slopes

Channels: transport involves buoyancy / floatation

→ transport capacity almost unlimited

Peat is highly susceptible to erosion and when it occurs – peat loss is dramatic

Also - dry mass of peat is an order of magnitude less than soils

Erosion rates in peat landscapes (t km^2 yr^{-1}) translate into highly significant volumetric changes in the landscape.

HOWEVER – Vegetation plays a key role:

- Protecting bare peat
- Trapping eroded peat

Conclusions

1. Rates of peat erosion now well quantified - vary by an order of magnitude and are spatially and temporally very variable
2. Peatland sediment budgets clearly demonstrate:
   - The importance of fluvial erosion as the dominant geomorphic process
   - Can be used to characterise changes over time
   - Link hillslope and channel processes (on and offsite impacts)
3. Peatland sediment dynamics – strongly influenced by geomorphic connectivity and vegetation
4. Impact of peat loss both locally and offsite are conditioned by the specific properties of peat – particularly peat density