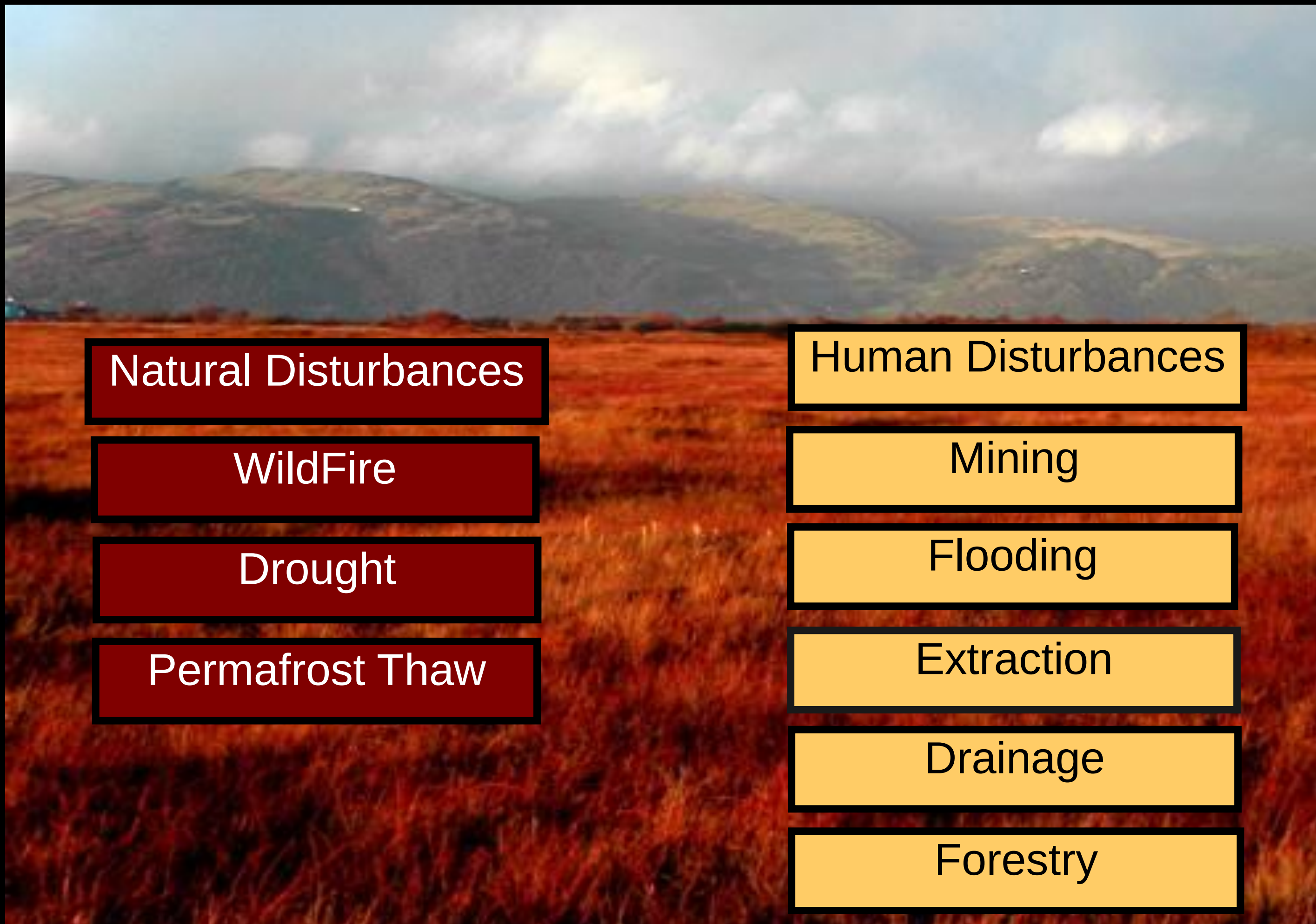
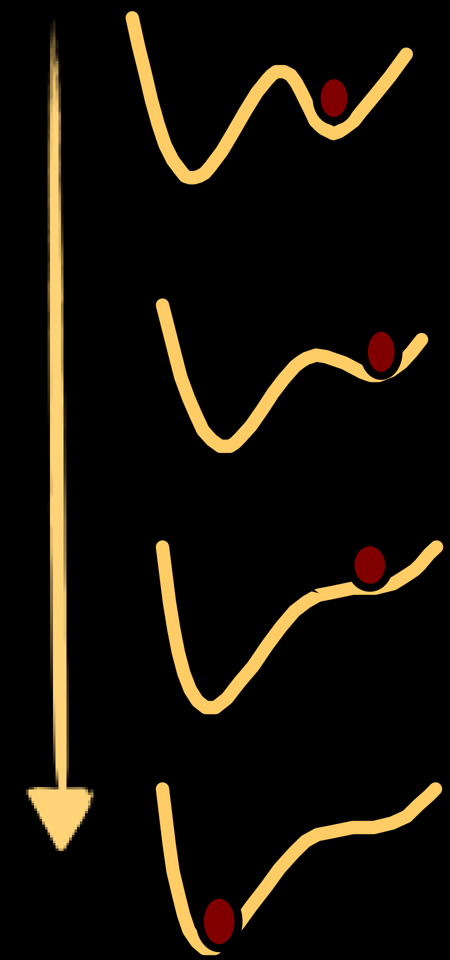
EXCEEDING PEATLAND ECOHYDROLOGICAL RESILIENCE THROUGH COMPOUND DISTURBANCE:
THE EFFECT OF WILDFIRE AND DRAINAGE

Nick Kettridge (University of Birmingham)
Mike Waddington (McMaster University)
James Sherwood (McMaster University)
Dan Thompson (Canadian Forest Service)
Paul Morris (University of Reading)
Uldis Silins (University of Alberta)

PEATLANDS, ECOHYDROLOGY & DISTURBANCE

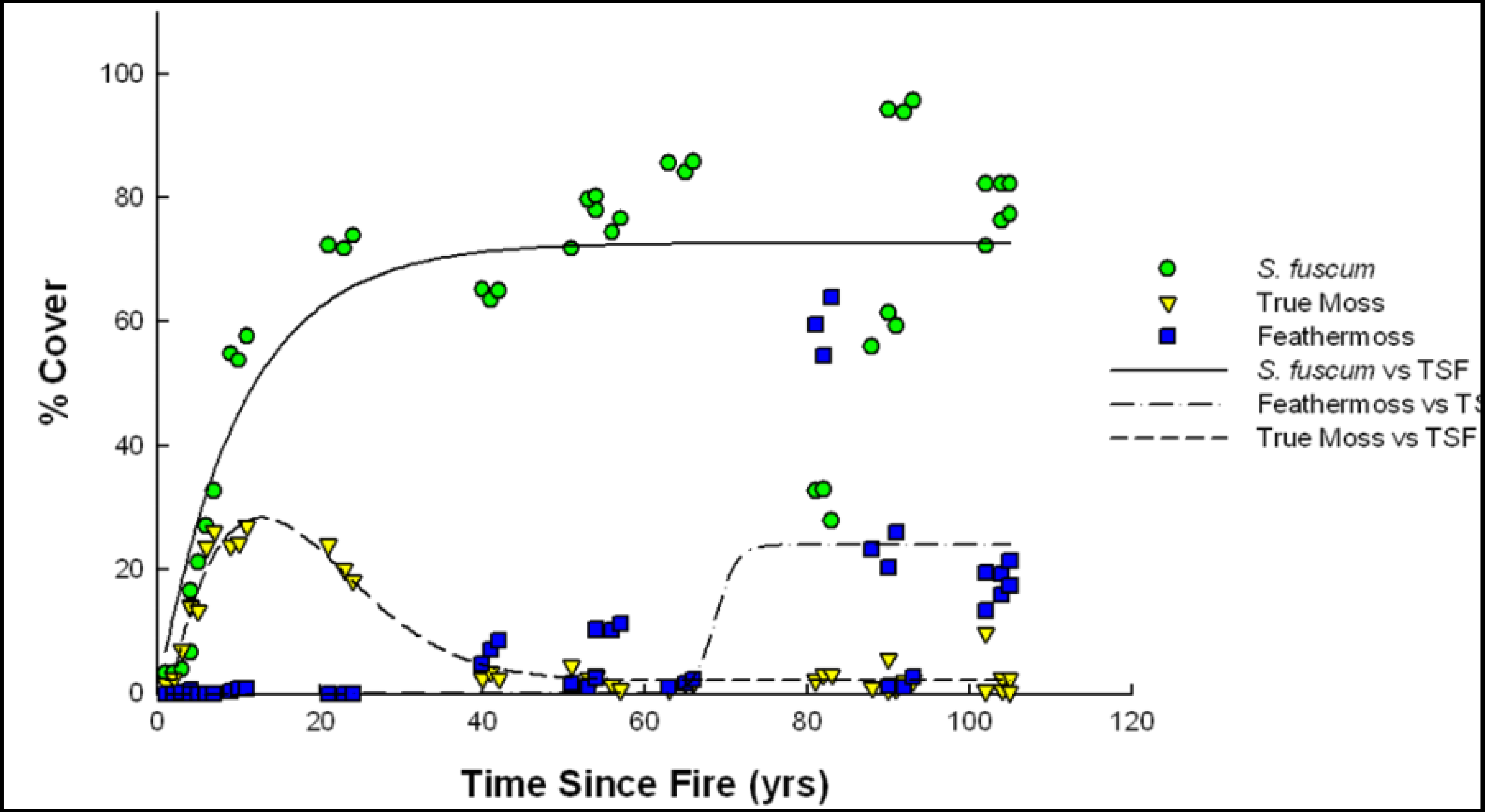




Valuable ecosystem services
Peatlands:10% of global fresh water, 33% of global soil carbon

Effective peatland management (mitigation and/or adaption) requires a <u>quantification</u> of ecohydrological resilience to disturbance

PEATLANDS, ECOHYDROLOGY & DISTURBANCE



Benscoter et al.

PEATLANDS, ECOHYDROLOGY & DISTURBANCE

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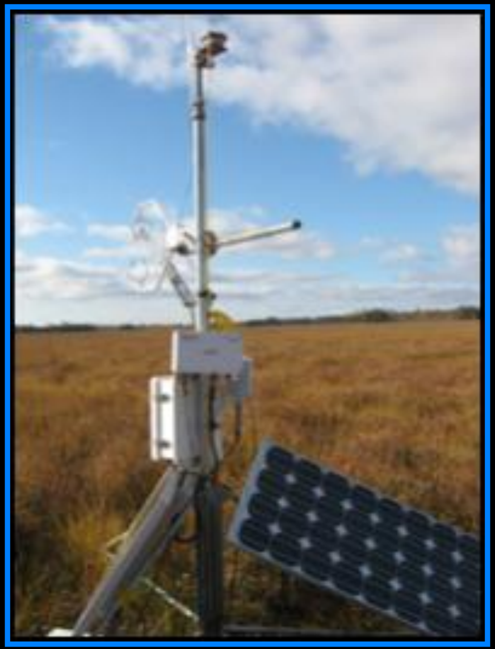

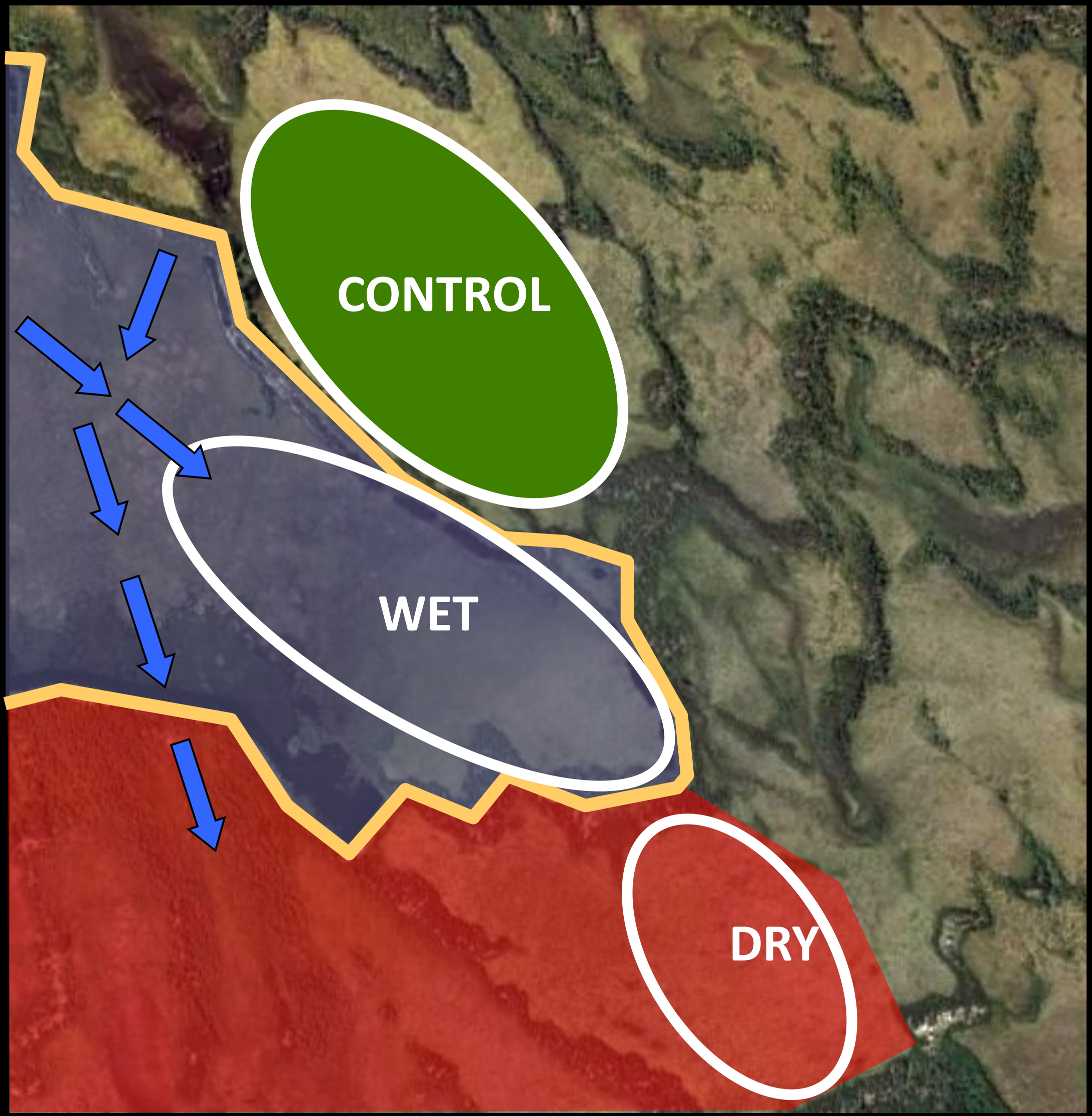

Moore et al. (submitted)

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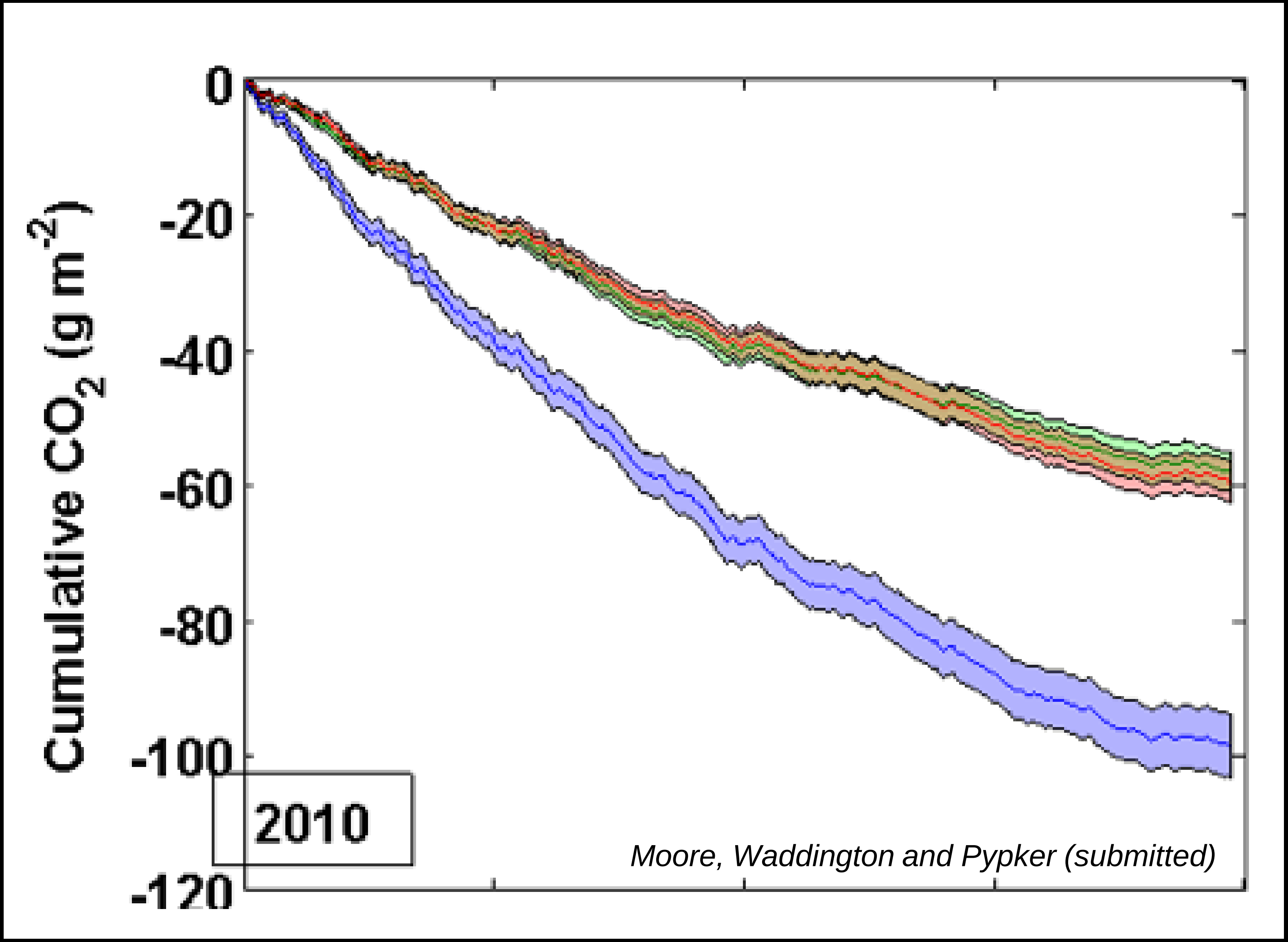
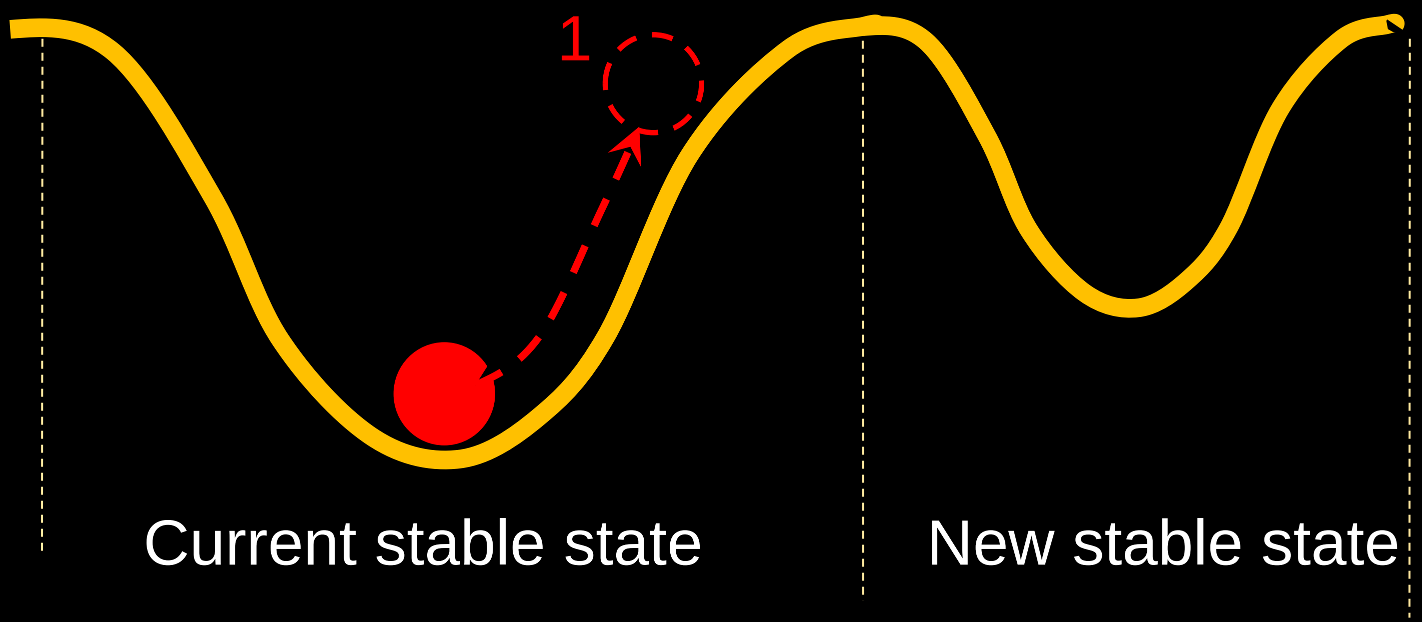


Peatlands as Resilient Ecosystems
(maintain or enhance carbon sink function despite disturbance)

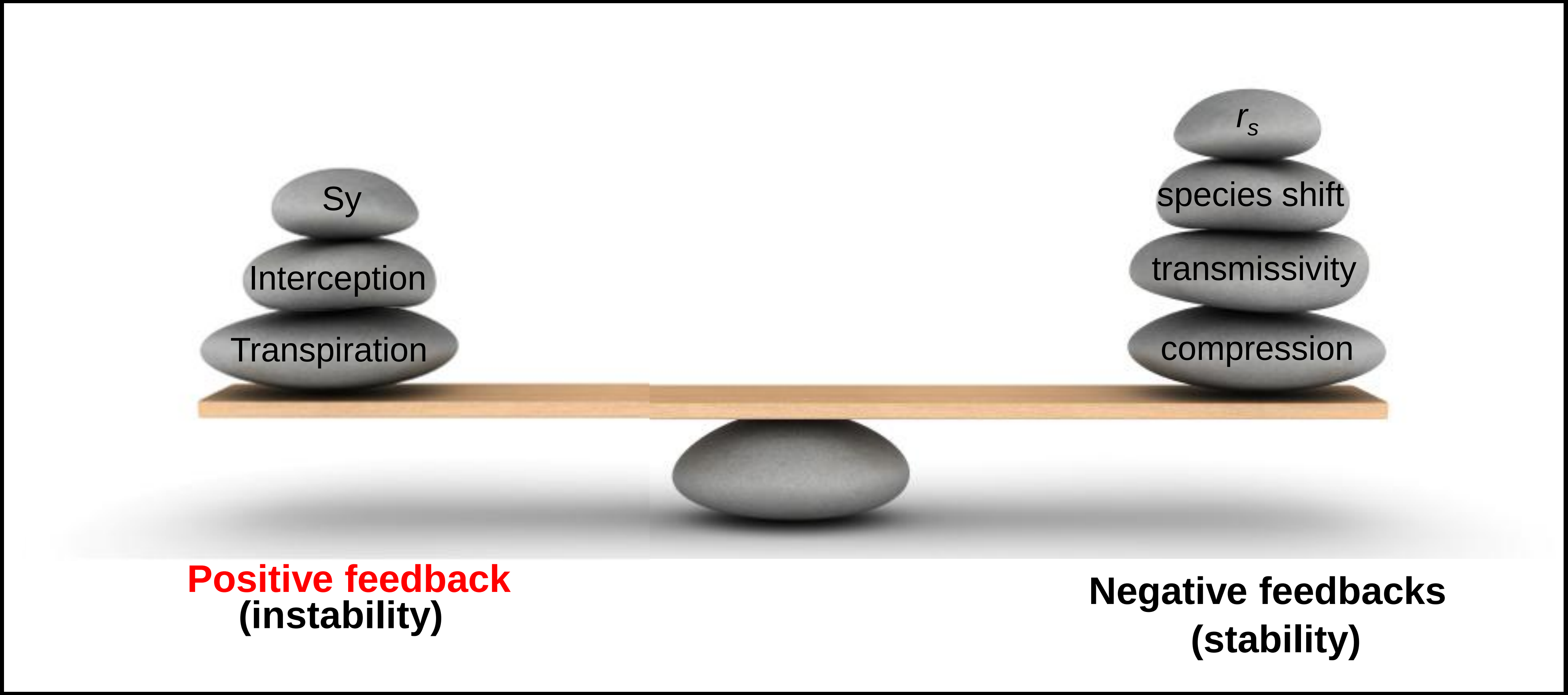
PEATLANDS, ECOHYDROLOGY & DISTURBANCE



Peatlands as Resilient Ecosystems
(maintain or enhance carbon sink function despite disturbance)

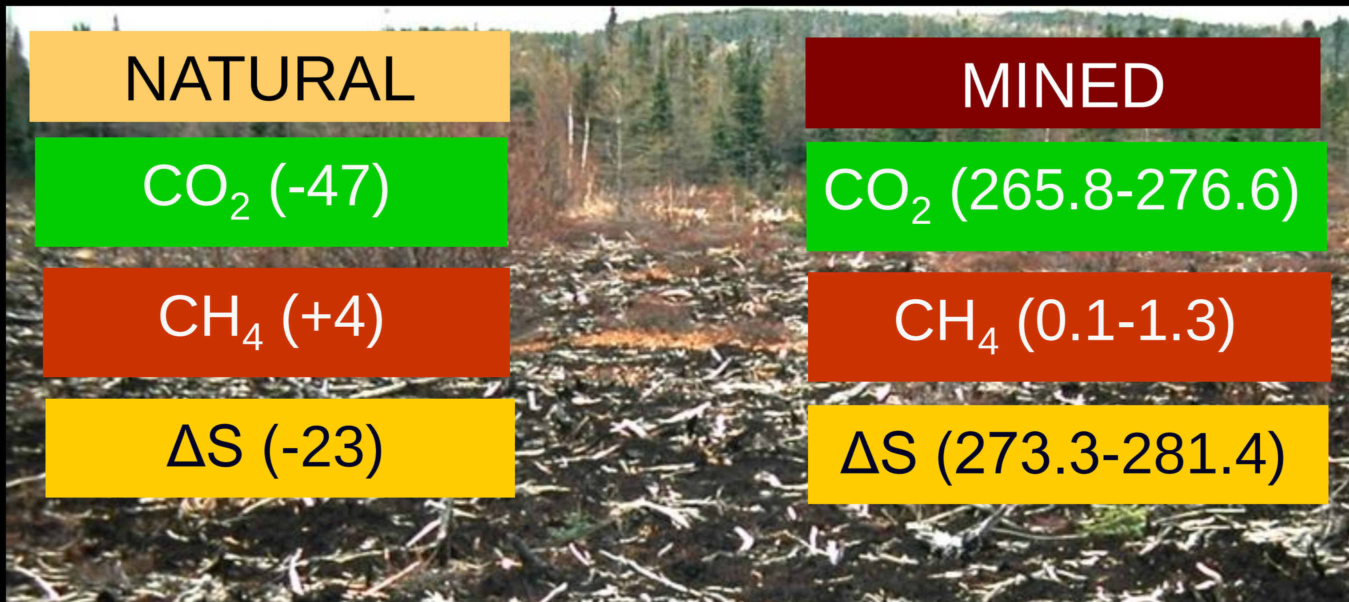
PEATLAND ECOHYDROLOGY & RESILIENCE

Peatland resiliency is controlled by strongly coupled feedbacks among vegetation type, litter production and quality, decomposition, hydraulic properties, and hydrodynamics.



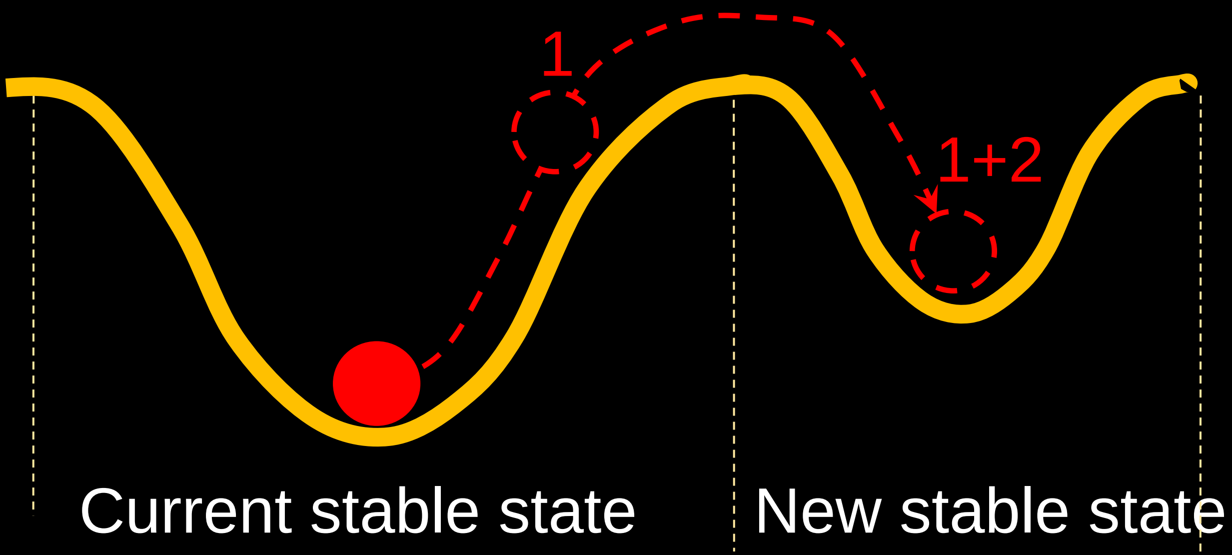
PEATLANDS, ECOHYDROLOGY & DISTURBANCE

Peatlands as Sensitive Ecosystems
(large and persistent source of atmospheric carbon)



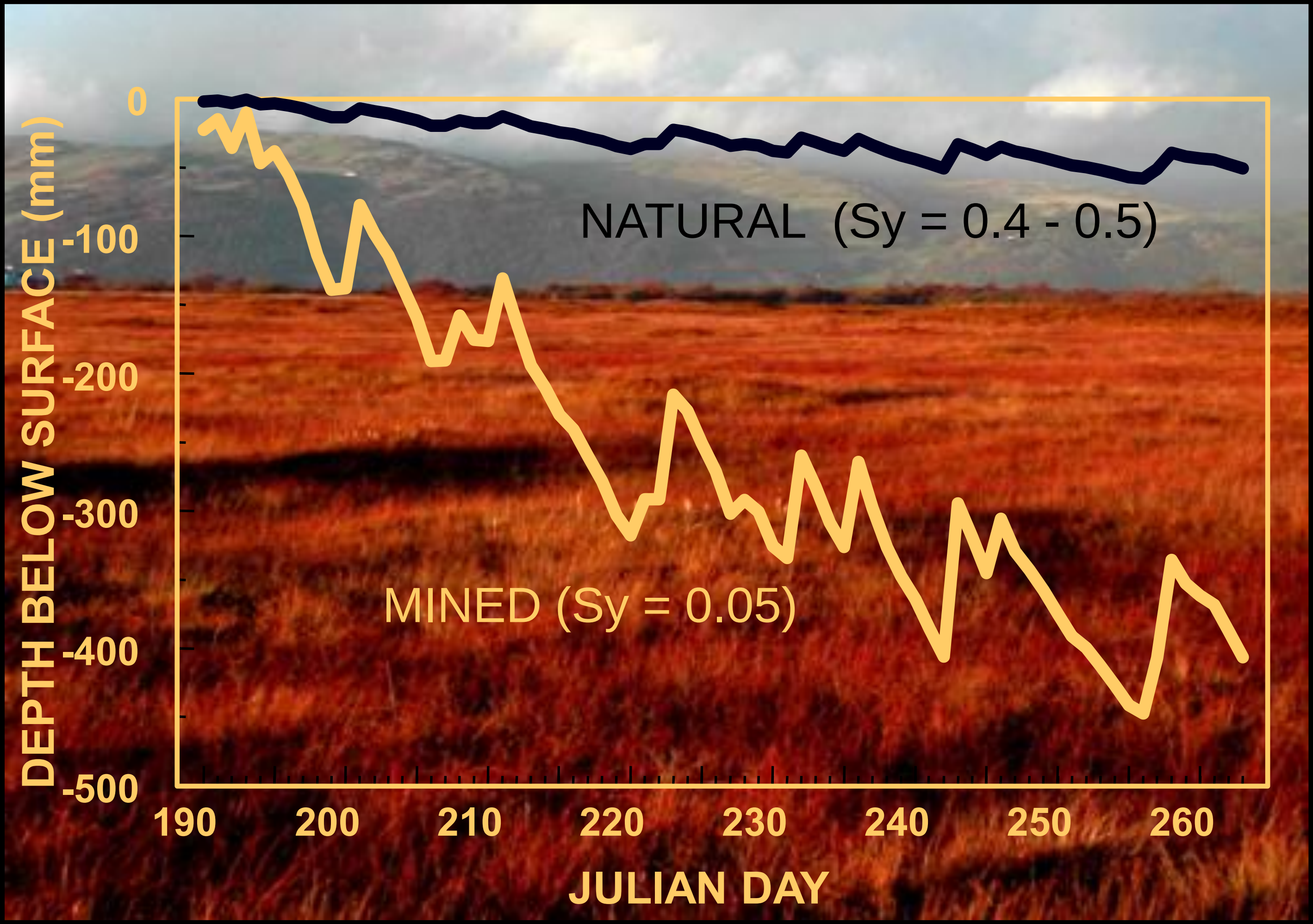
UNITS: g C m^{-2} yr^{-1}

Petrone et al. (2003)



PEATLAND ECOHYDROLOGY & RESILIENCE

Compound disturbance in mined peatlands (drainage and extraction) exceeds ecohydrological resilience?



Ecohydrological thresholds

1) WT > 40cm water table depth

2) Soil water tension > 100mb

PEATLAND ECOHYDROLOGY & RESILIENCE

Potential of large scale exceedance

Extraction = 1.1 $km^2\ yr^{-1}$
Wildfire = 1470 $km^2\ yr^{-1}$ (Turetsky et al., 2002)

Drying + wildfire
- Increased ET under future climates
- Increase frequency of fire

Long-term experiment

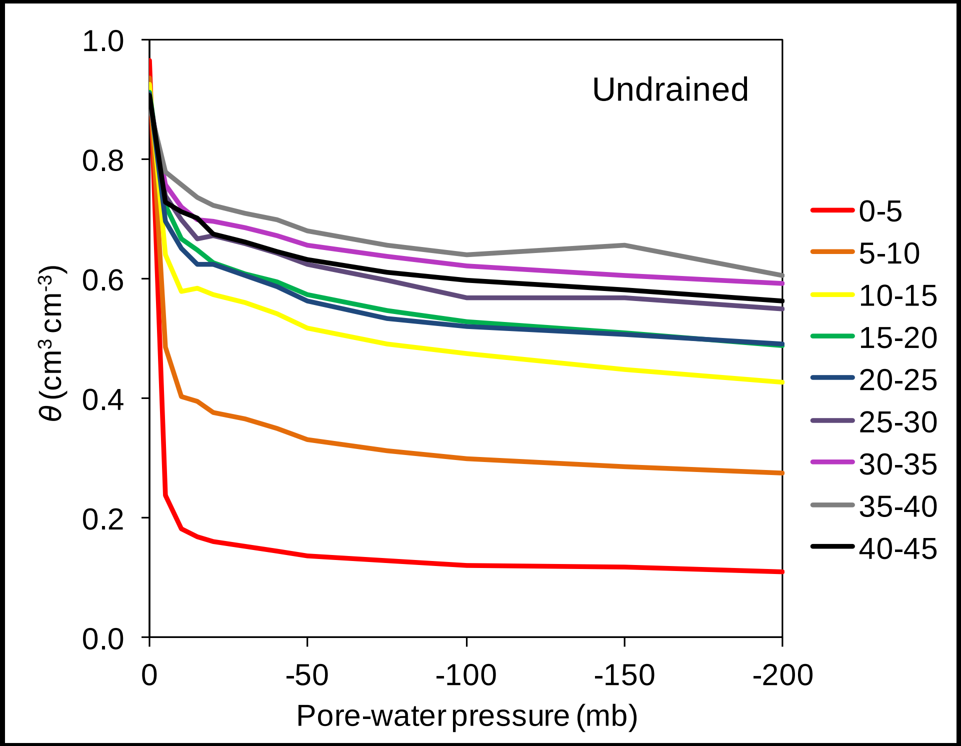
Salteaux peatland Alberta, Canada
- Drained in 1987
- Wildfire in 2001

Drainage as analogue for drying

PEAT HYDROPHYSICAL PROPERTIES

Hydrophysical properties characterized under each level of disturbance

- Water retention curves
  - Specific yield
  - VMC @ 100mb
- Bulk density

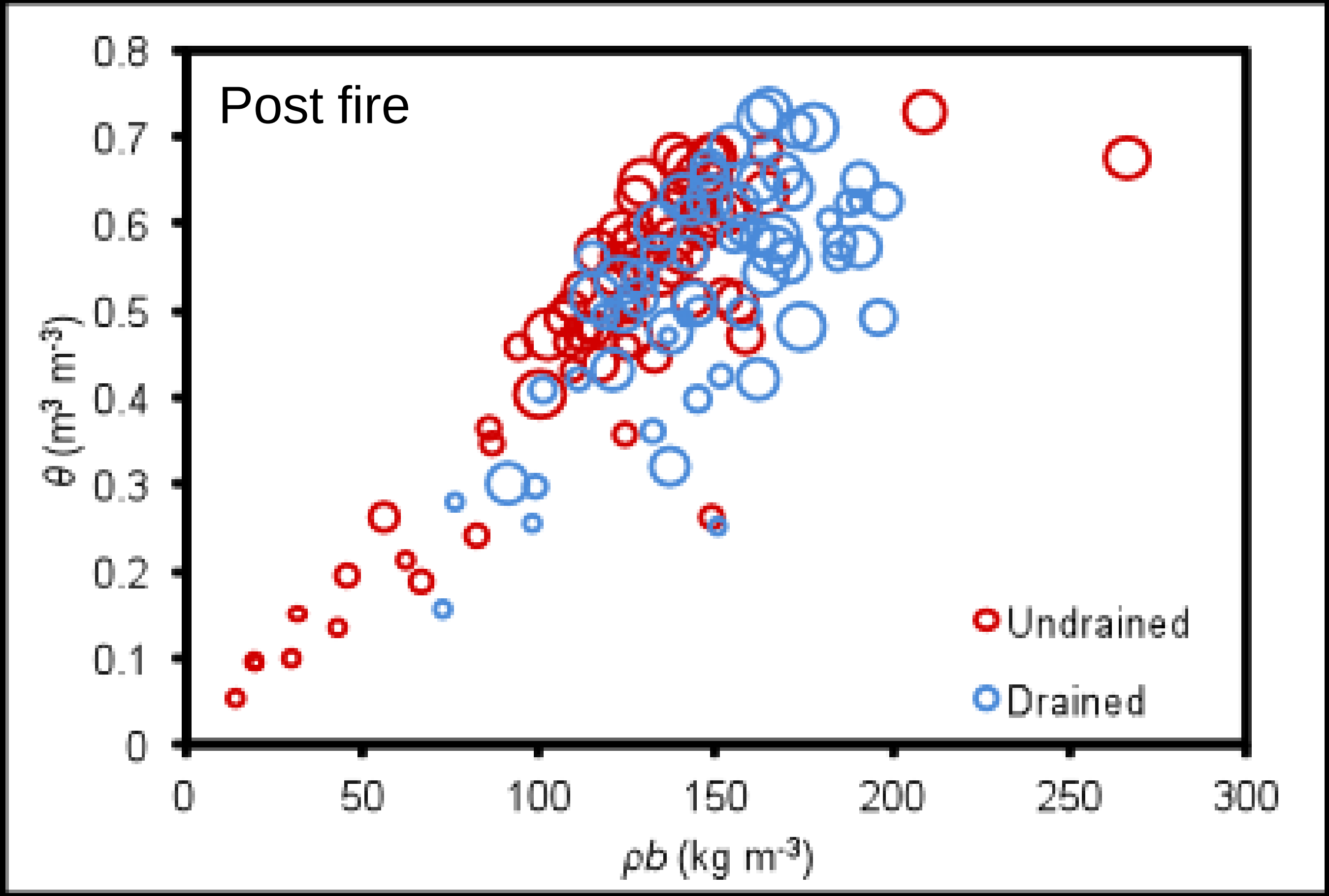


Undrained Pre-fire	Undrained Post-fire
Drained Pre-fire	Drained Post-fire

PEAT HYDROPHYSICAL PROPERTIES

Take home message:

> "Bulk density provides the primary descriptor of peat hydrophysical properties"



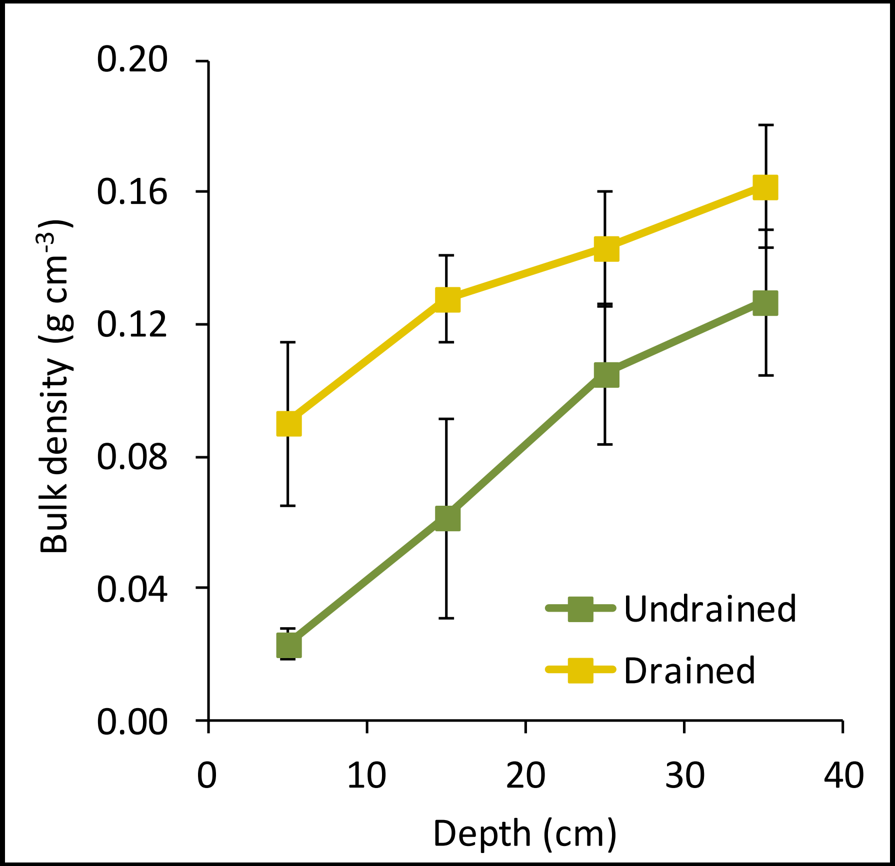
PEAT HYDROPHYSICAL PROPERTIES

Compaction

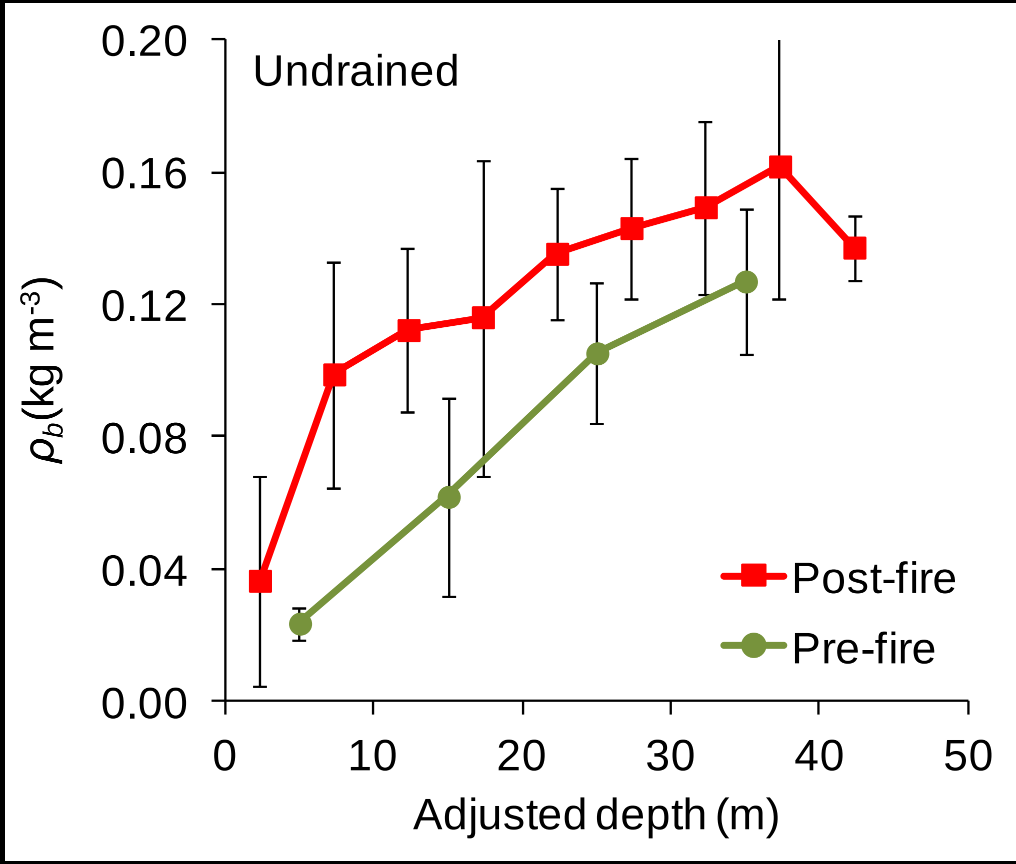
Combustion

PEAT HYDROPHYSICAL PROPERTIES

Compaction



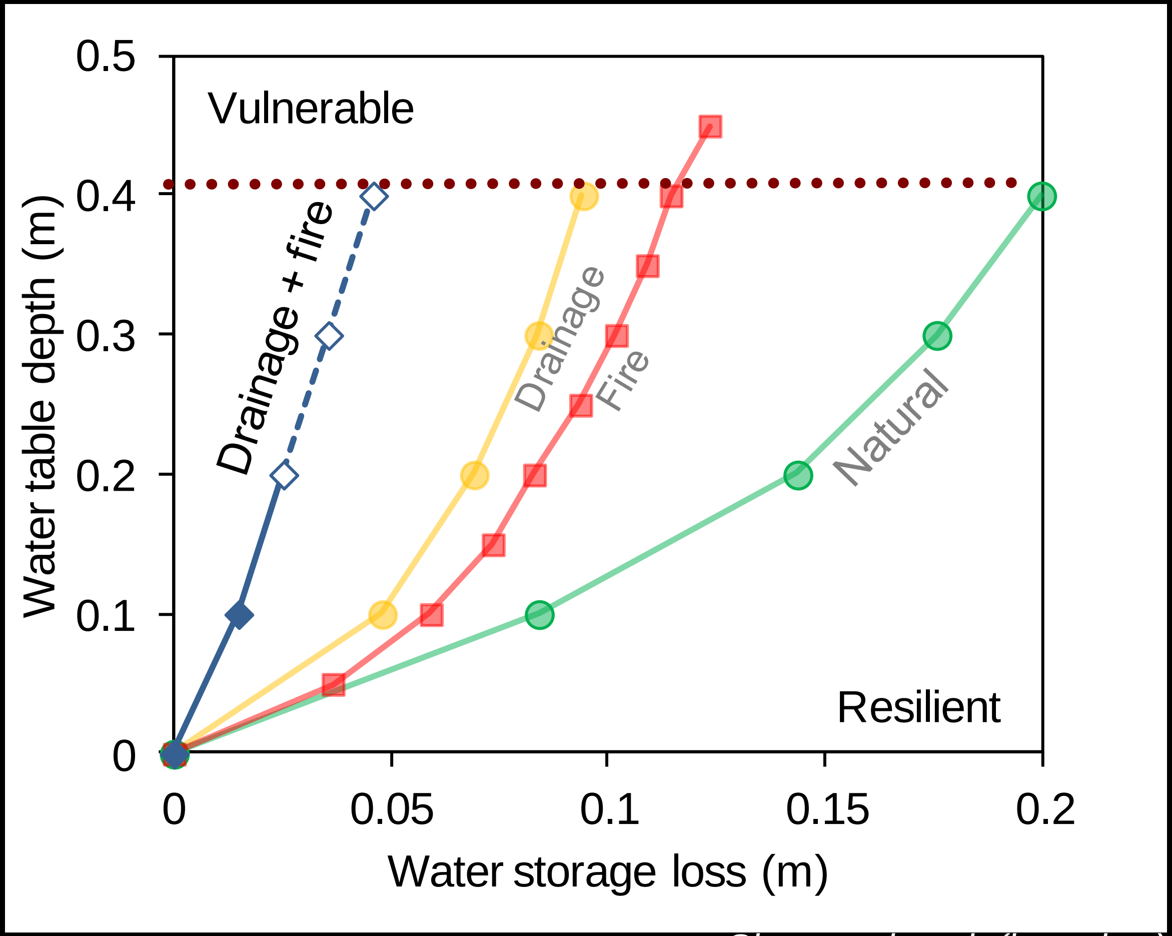
Combustion



EXCEEDING PEATLAND ECOHYDROLOGICAL RESILIENCE THROUGH COMPOUND DISTURBANCE

Water loss needed to decrease WT by 40cm:

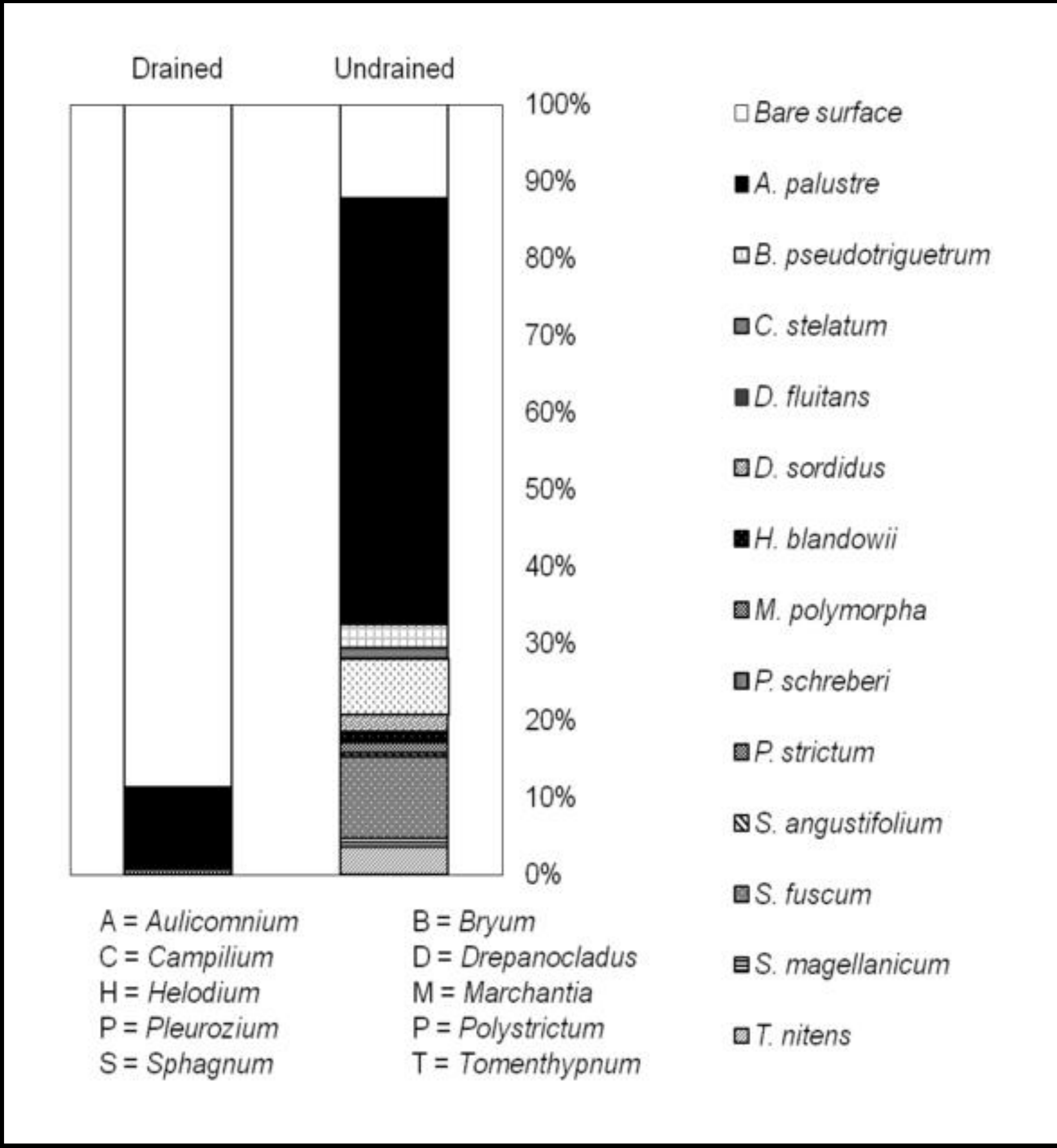
Natural (20cm), Fire (12cm), Drainage (10cm), Drainage & Fire (5cm)



Sherwood et al. (in review)

PEATLAND COMPOUND DISTURBANCE

1. Drainage and 2. Wildfire



RECOVERY POTENTIAL

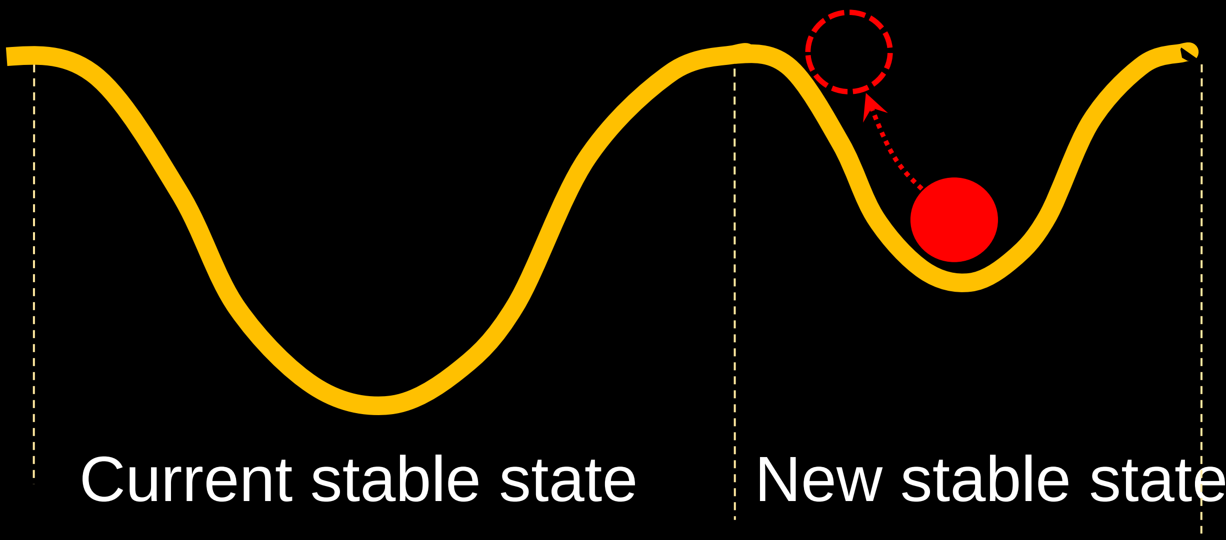
New negative feedbacks maintain ecosystem

Sphagnum require light

- Undrained = 87.3 ± 5.9%
- Drained = 20.7 ± 26.7%

Drained

Undrained



SUMMARY

Compound disturbances can dramatically impact peat hydrophysical properties - reducing *Sphagnum* recolonization

Drainage followed by wildfire can exceed the resilience of peatland ecosystems causing a shift towards a 'peat forest' ecosystem

Quantifying peatland ecohydrological resilience - necessary first step to develop effective adaptive peatland management strategies (in an era of rapid change).