Extreme events in arctic ecosystems:
Diverse causes and challenges to observation

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Extreme events

Picture: Frost-drought mortality of heathland, Norway

- Large ecological impact disproportionate to their short duration
- Take organisms “past lethal thresholds
- Browning events: extreme events that cause die back and/or loss of biomass/productivity

Challenge: Diverse “Browning” events

Climatic events:

Extreme winter warming

Frost-drought

Icing

Drought / heatwave

Biotic events:

Caterpillar outbreaks

Caterpillar outbreaks

Snow mould

Lemming peaks

Physical disturbance events:

Fire

Fire after frost-drought

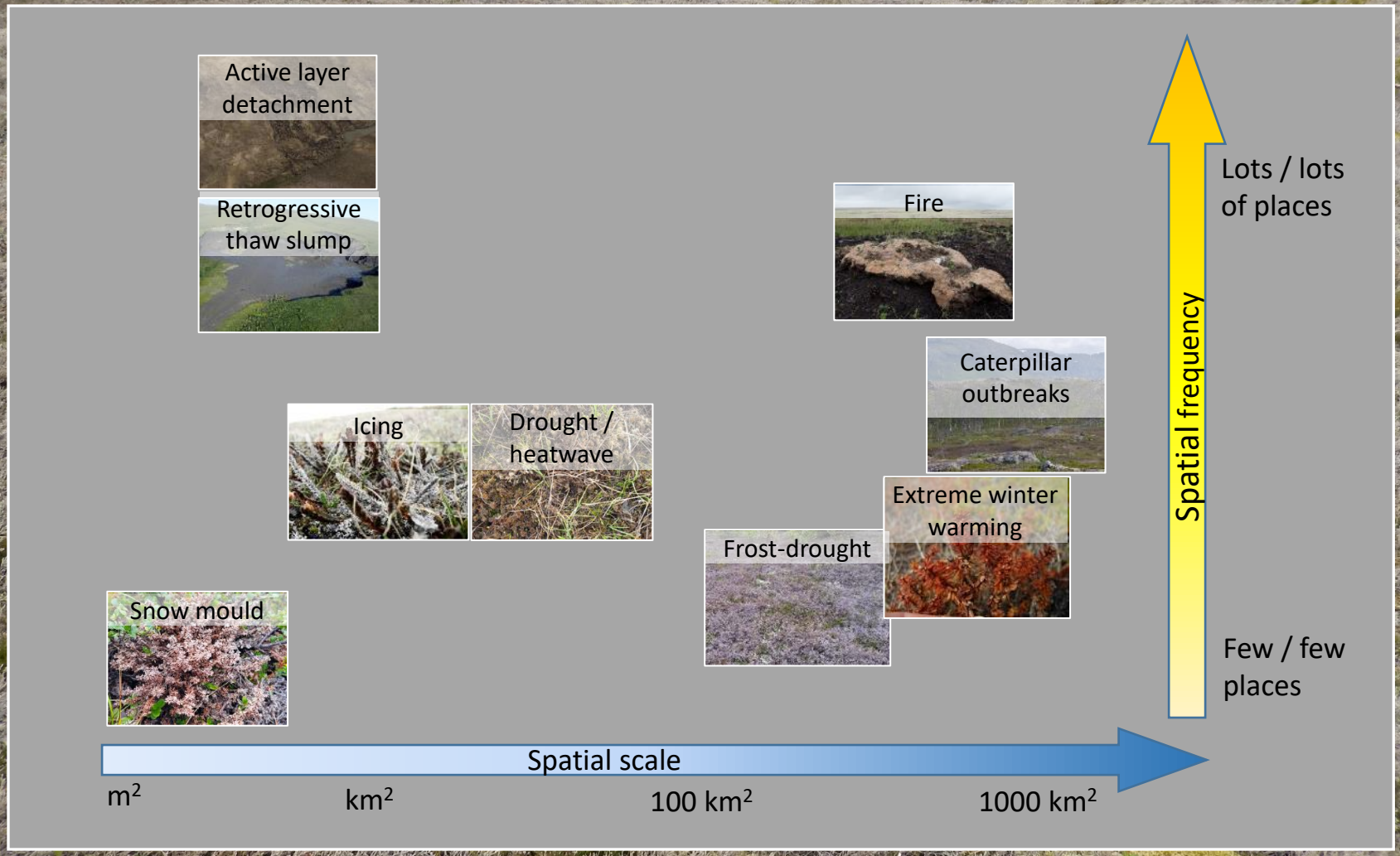
Retrogressive thaw slump

Active layer detachment

[Photos: R Treharne, G Phoenix, D Zona; T Parker, J Olofsson, K-B Strann, C Linder, J Murton, A Lewkowicz]

Challenge: spatially discrete

Spatially discrete, with contrasting scales and contrasting



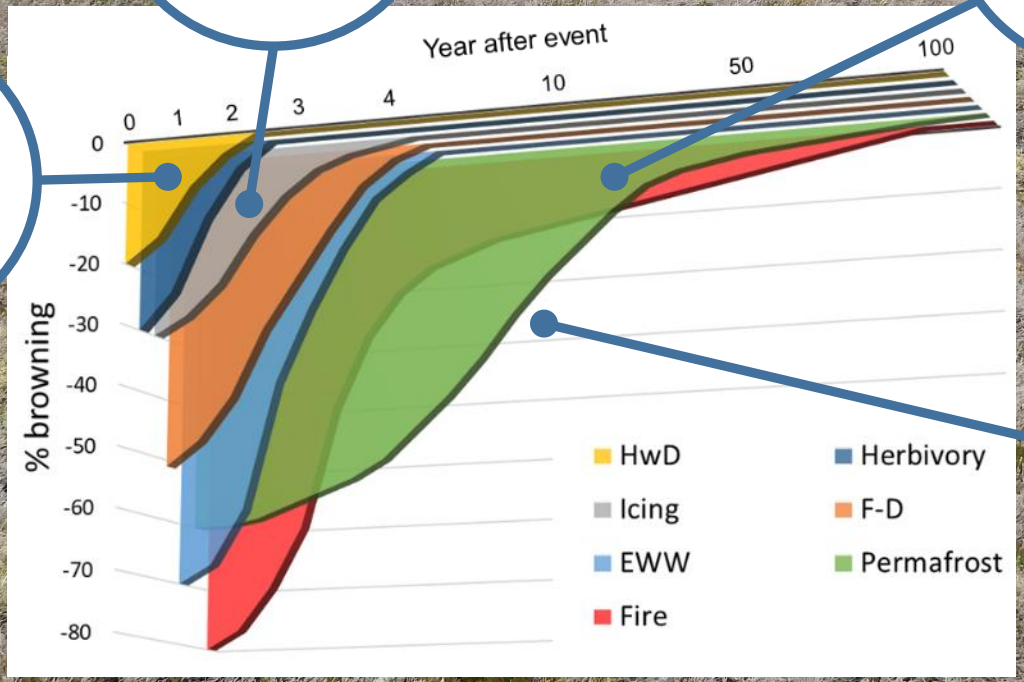
Challenge: temporally discrete:

Temporally discrete, but length of impact differs

Shorter events: less time to observe

Physical disturbance events take longer to recover

Climatic and biotic events can recover "quickly"



Recovery in biomass, not always community

Challenge: hard to predict

But ground observation generally “reactive”

Widespread monitoring: more chance of collecting data prior to the event

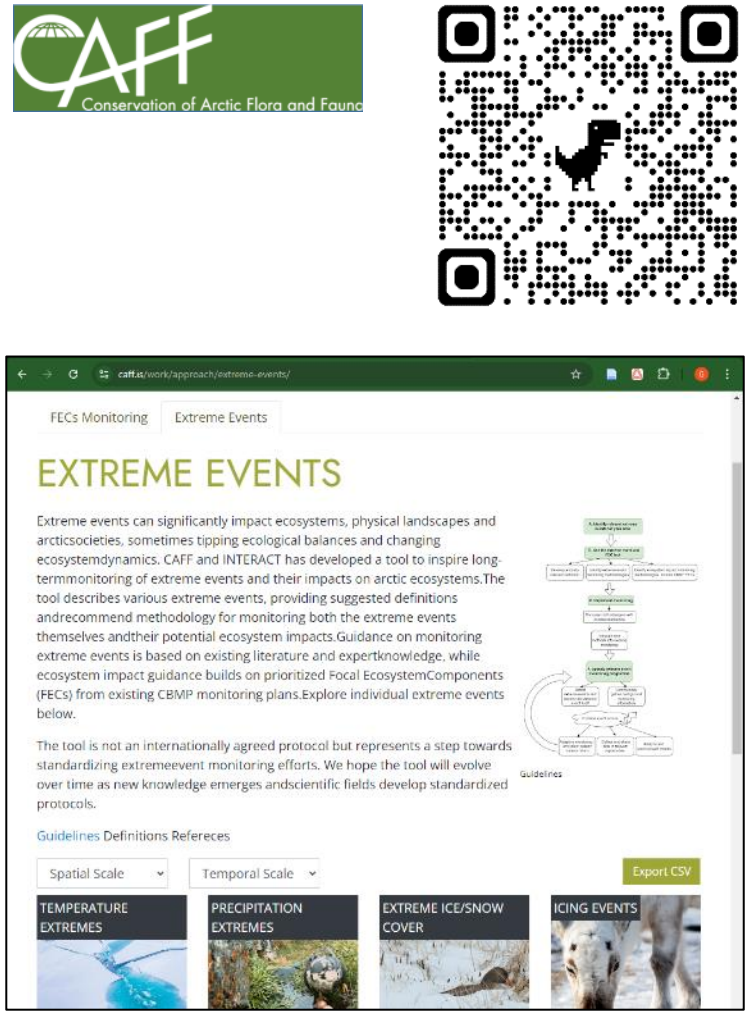
Field simulation experiments: create predictable events for proactive research

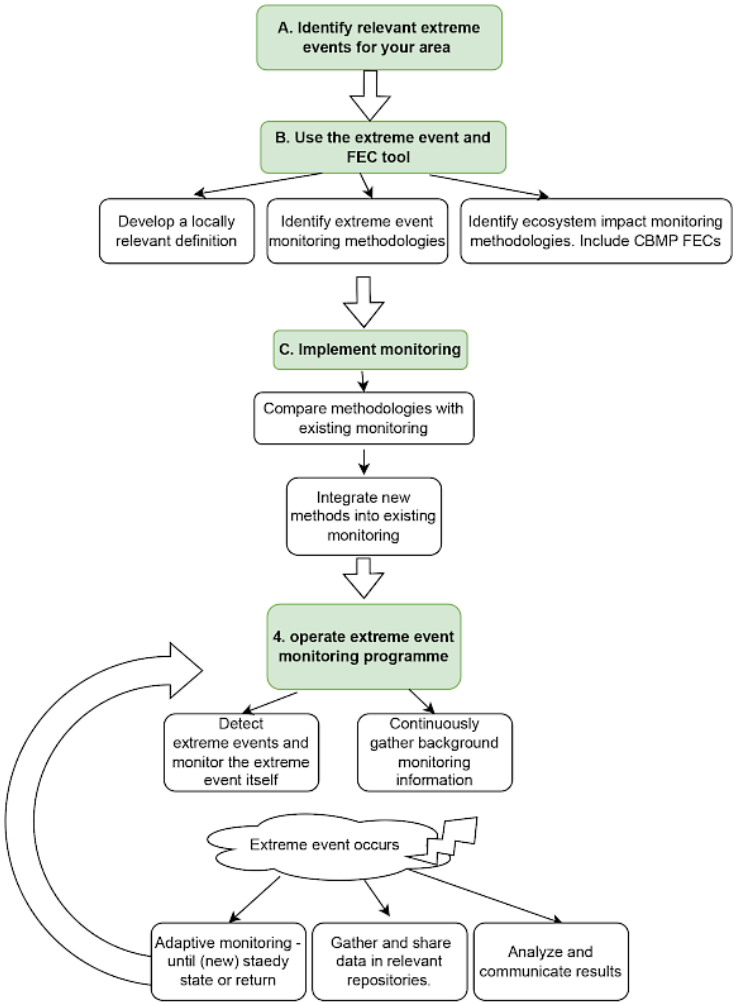
Extreme winter warming
e.g. Bokhorst et al. (2011)
Global Change Biology
doi: 10.1111/j.1365-2486.2011.02424.x

Icing
e.g. Preece et al. (2012)
Physiologia Plantarum
doi:10.1111/j.1399-3054.2012.01640.x

Extreme rainfall
e.g. Magnússon et al. (2022).
Nature Communications
doi.org/10.1038/s41467-022-29248-x

Monitoring “ready to go”: CAFF tool





Conclusions

Challenge of extreme events

- Extreme browning events are diverse, sporadic, spatially and temporally discrete, and hard to predict
- Ground observations are mostly reactive
- Monitoring can improve reactive science

Priorities for ground-based monitoring

- More monitoring, with greater pan-arctic coverage, on more plant community types.
- More focus on the least studied extreme events.
- Collaborate with Indigenous knowledge holders.
- Create some predictable events (field simulations).