A burning issue:

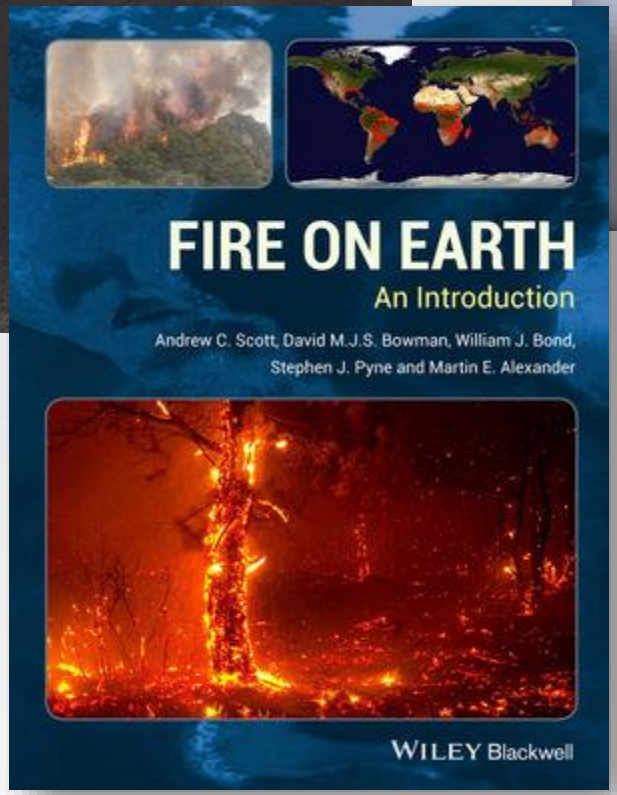
Ecological and evolutionary imprints of climate and land-use in coastal heathlands

Vigdis Vandvik

Tessa Bargmann, Sigird S. Bruvoll, Matt I. Daws, Hanna Lee, Inger Elisabeth Måren, Pål Thorvaldsen, Joachim Töpper, Liv Guri Velle

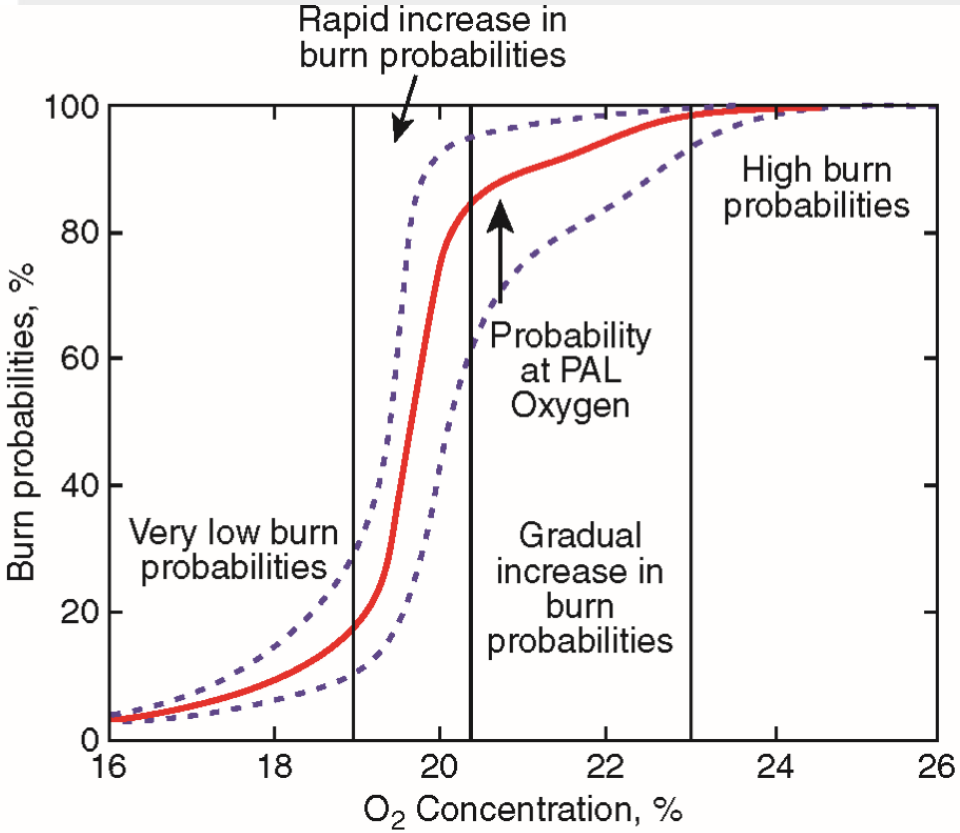
UNIVERSITY OF BERGEN

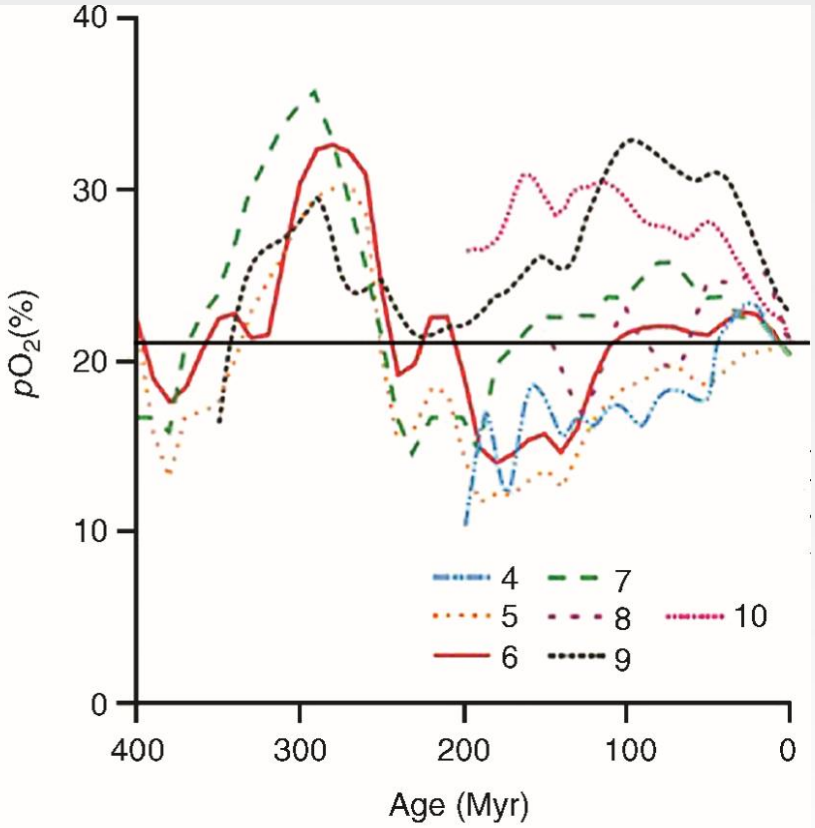
An inspireing read….



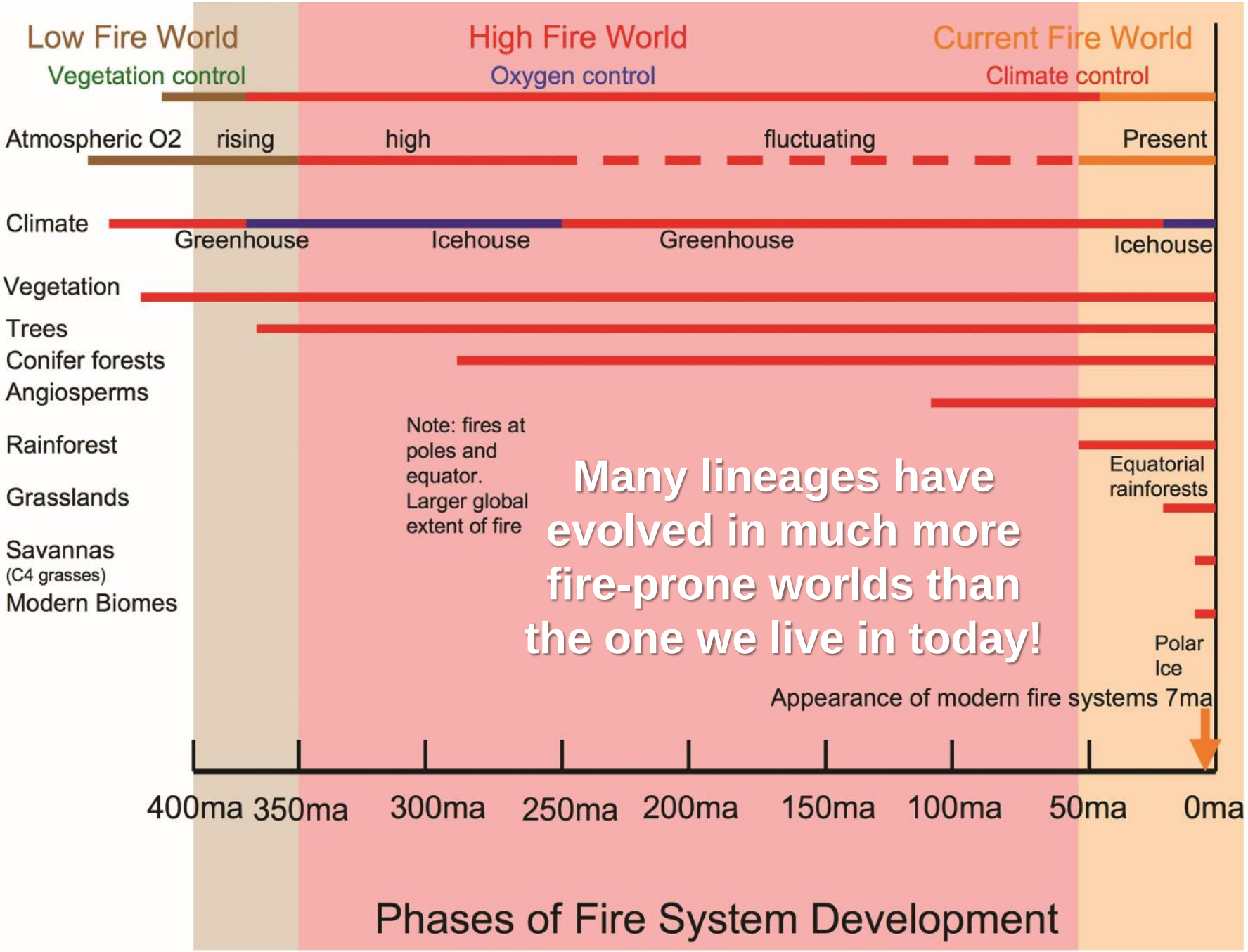

oxygen
fire-friendly
weather conditions
biomass
in a flammable state
enough fuel
ignition
(© Liv Guri Velle)

Fire needs oxygen, which has varied hugely through evolutionary time



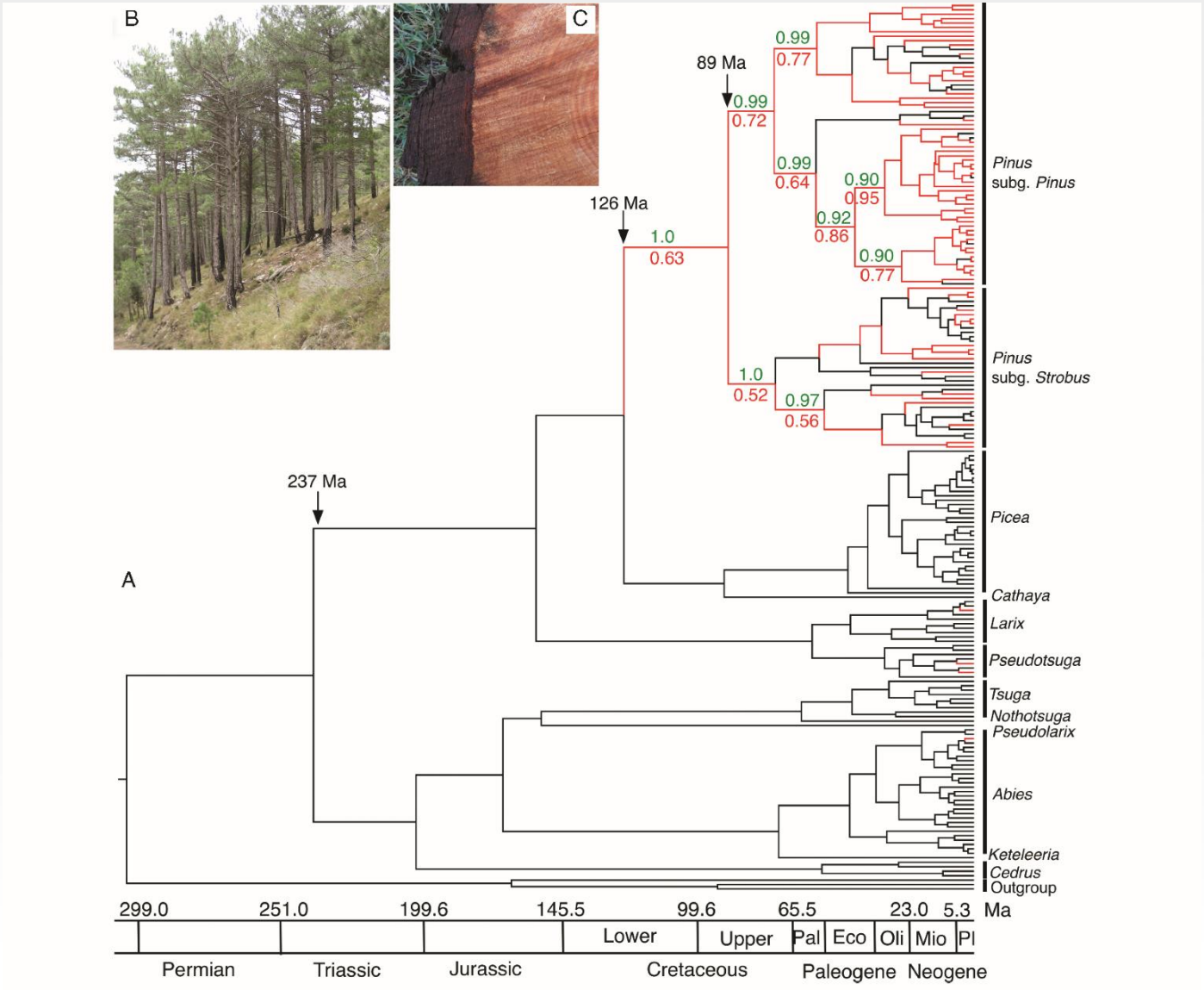


(Scott et al. 2014)

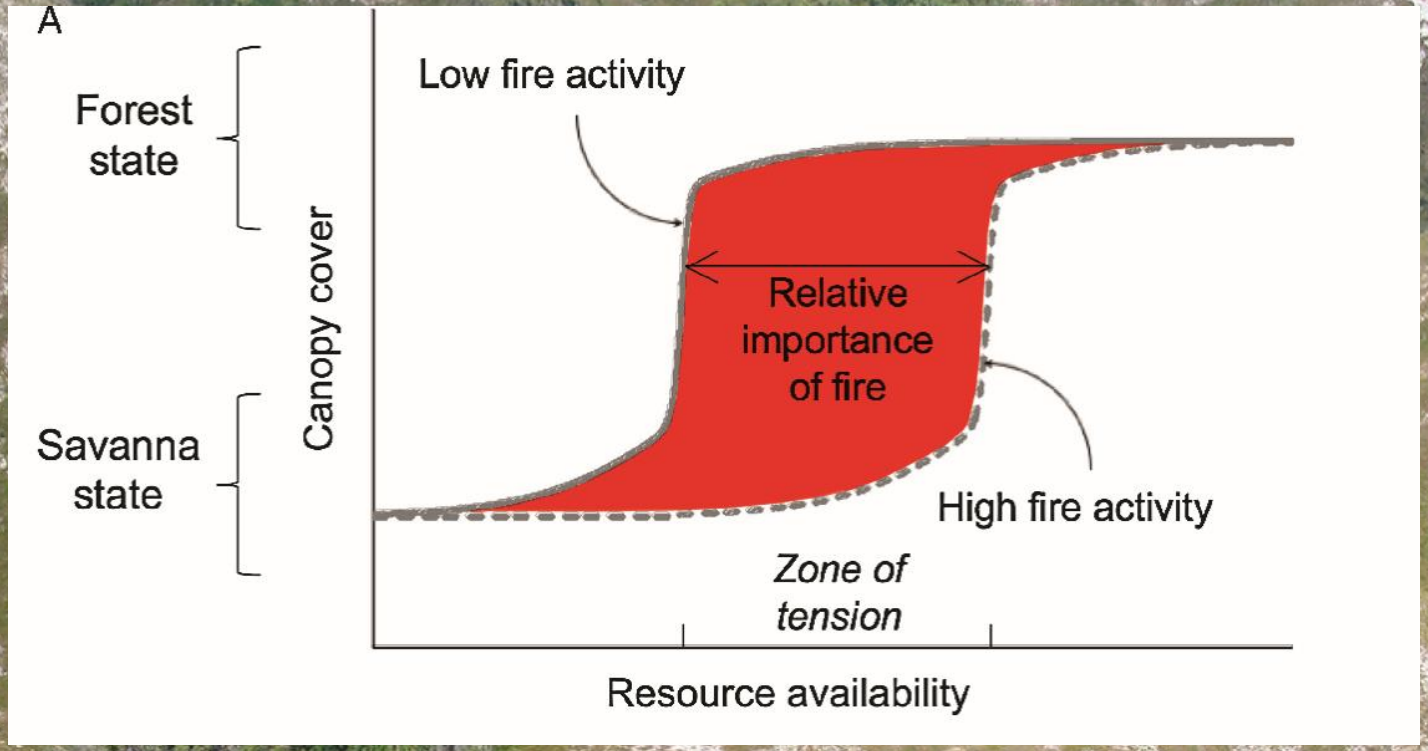


(Scott et al. 2014)

Thick bark in pines – a fire adaptation

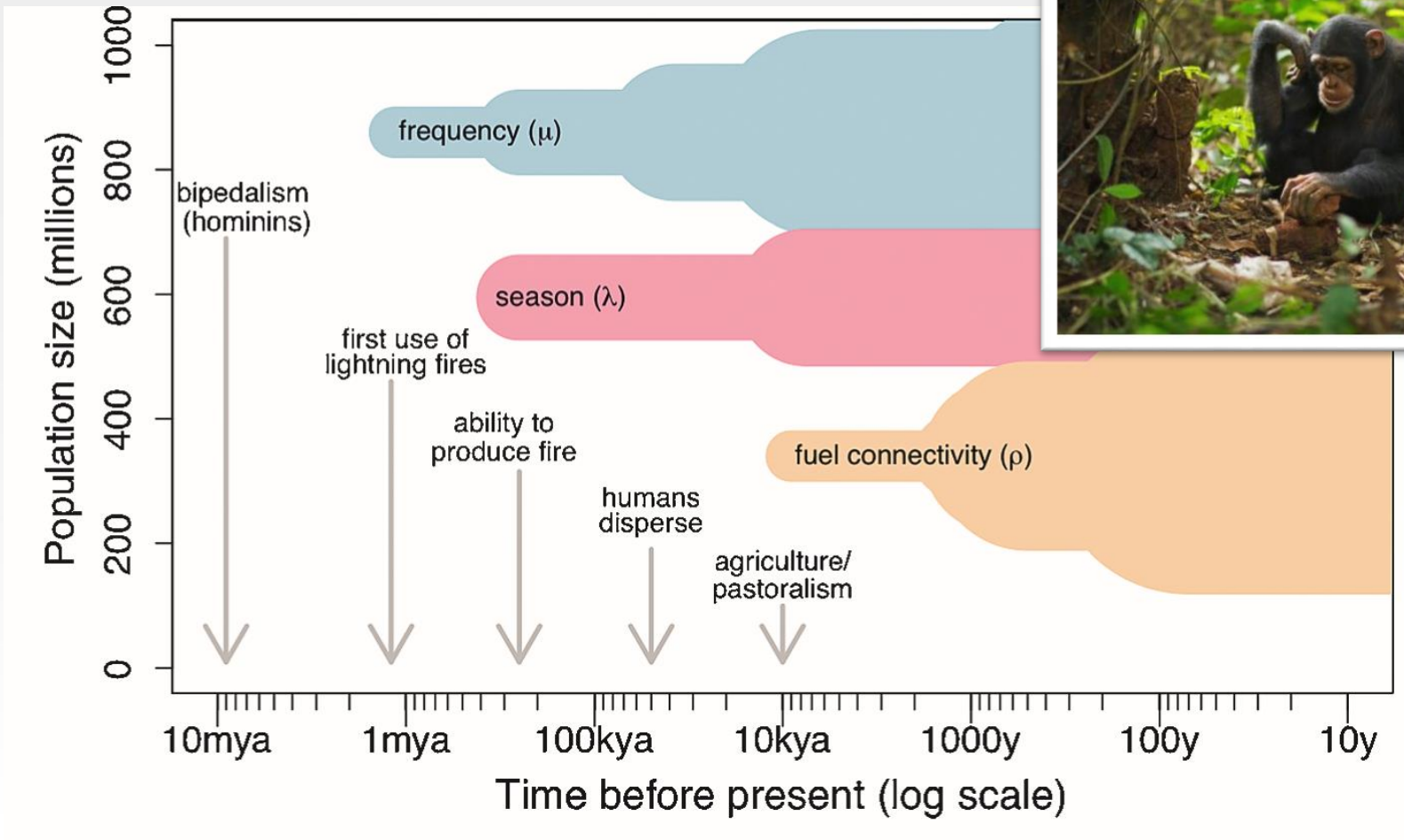


Fire can control vegetation structure



(Scott et al. 2014)

Homidinds have impacted fire regimes on *long* time-scales



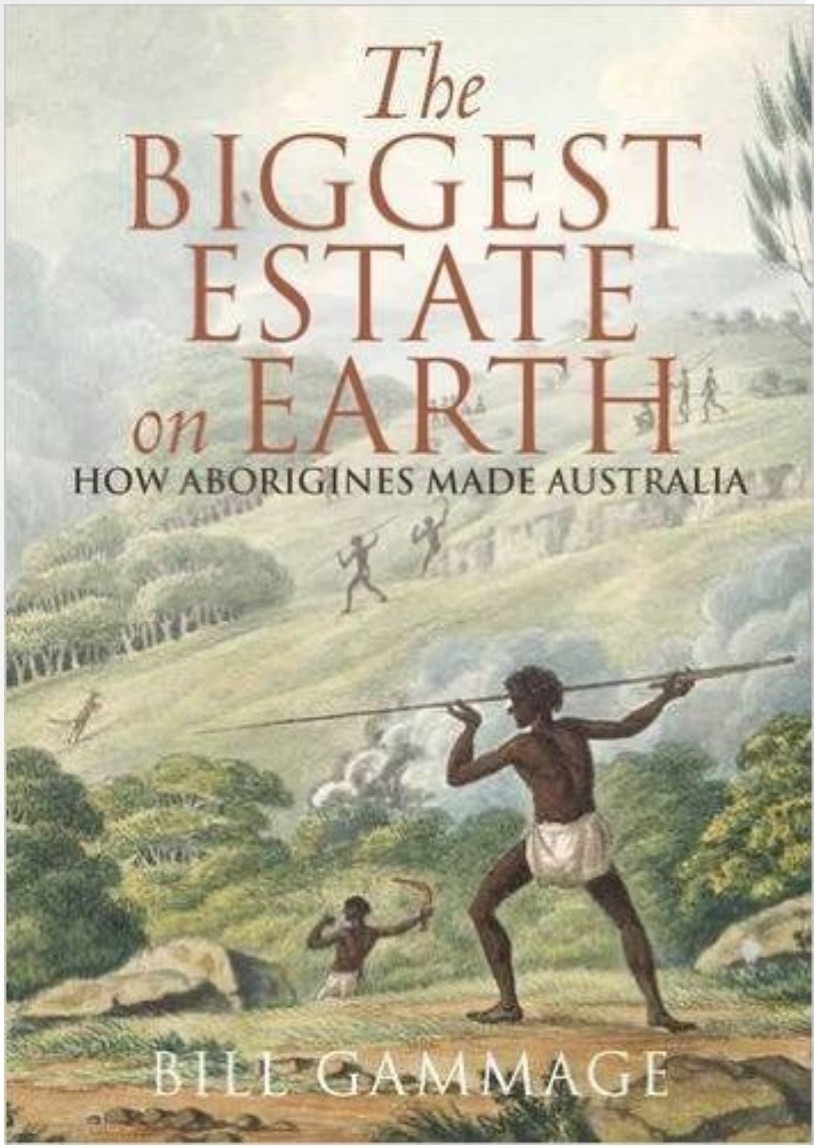
(Scott et al. 2014)

What have we used fire for?

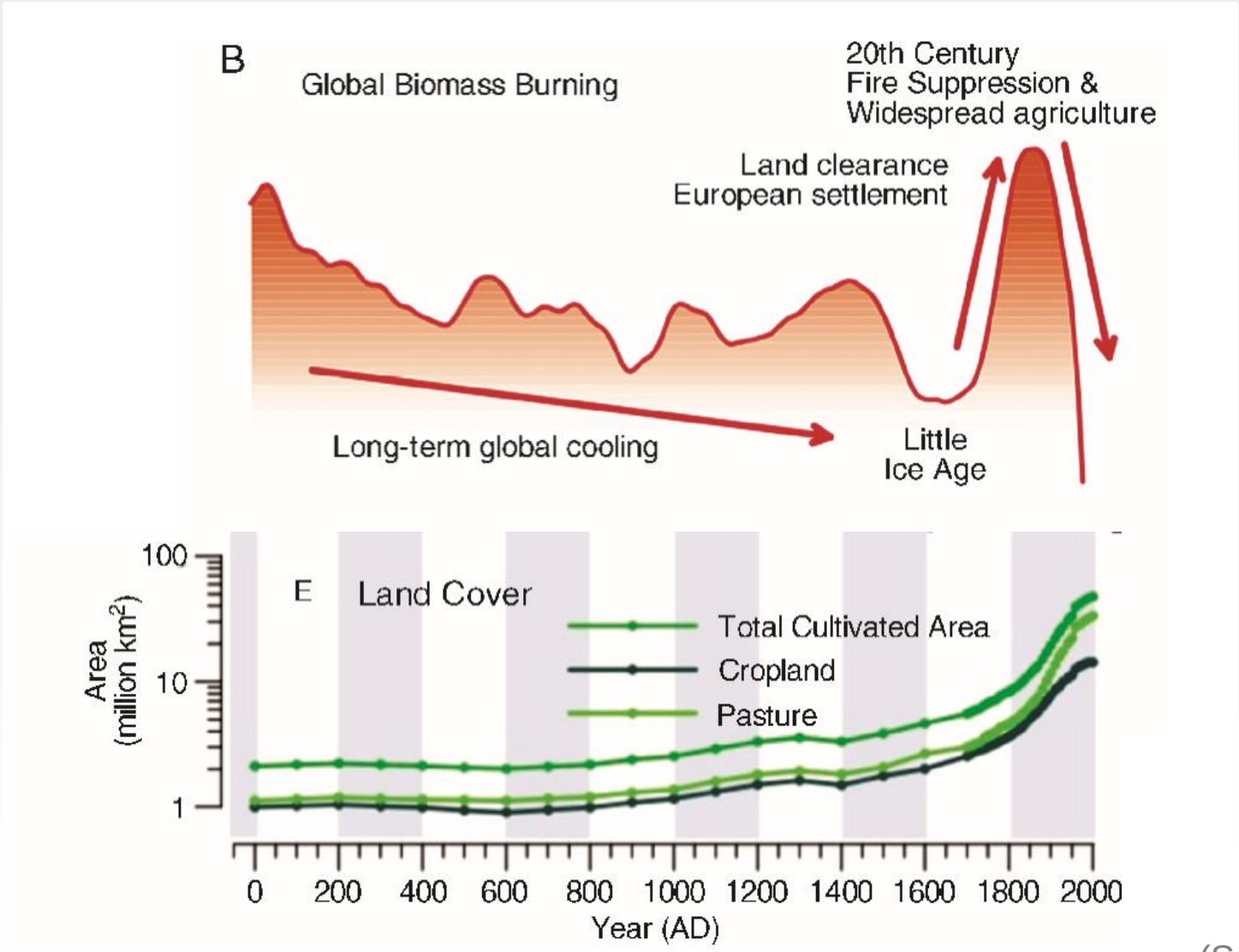
- Cooking
- Hunting, chasing animals

- Deforestation
- Manipulating animal movement
- Creating, maintaining alternative habitats
- ‘Tidying up’ the landscape
- Manipulating soil fertility

- [running engines]

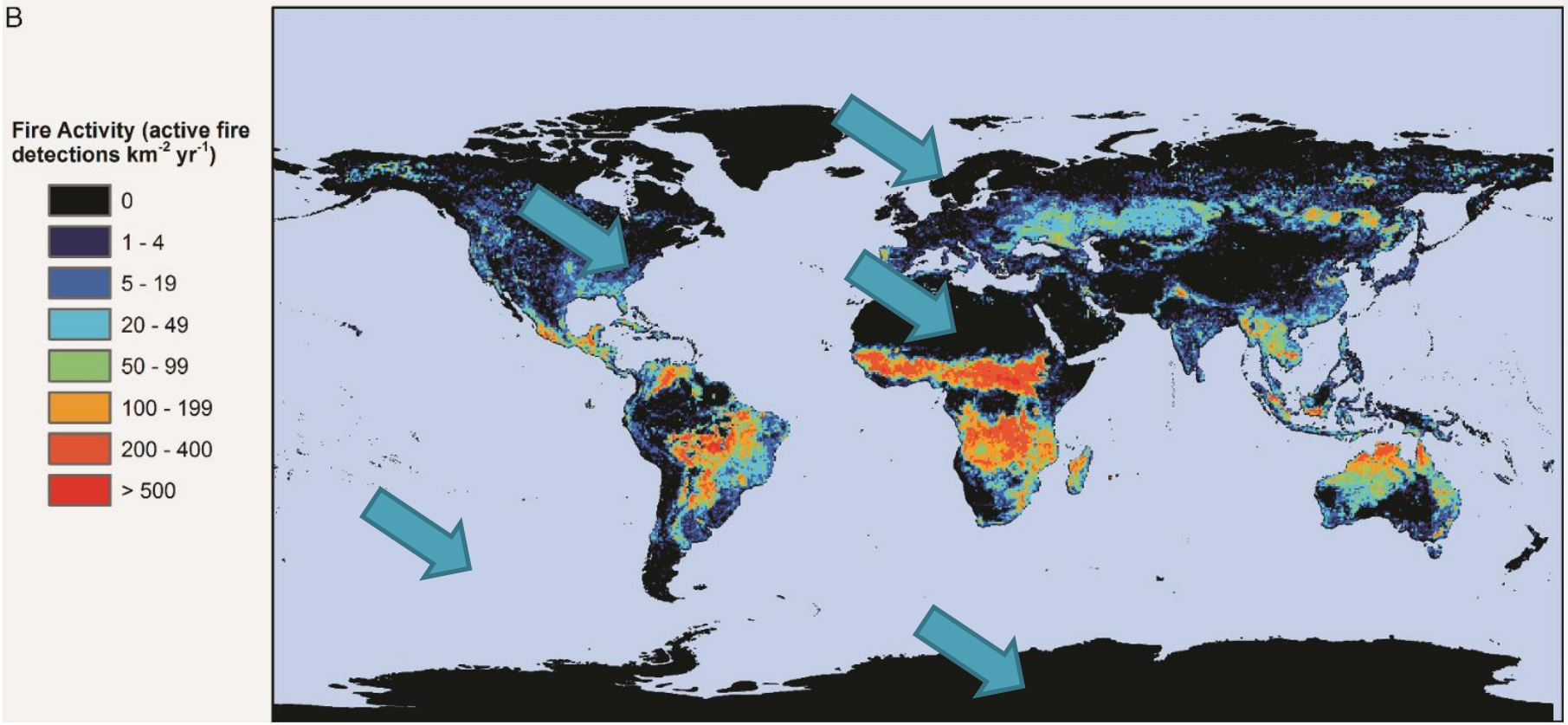


Fire in the Anthropocene – ups & downs



(Scott et al. 2014)

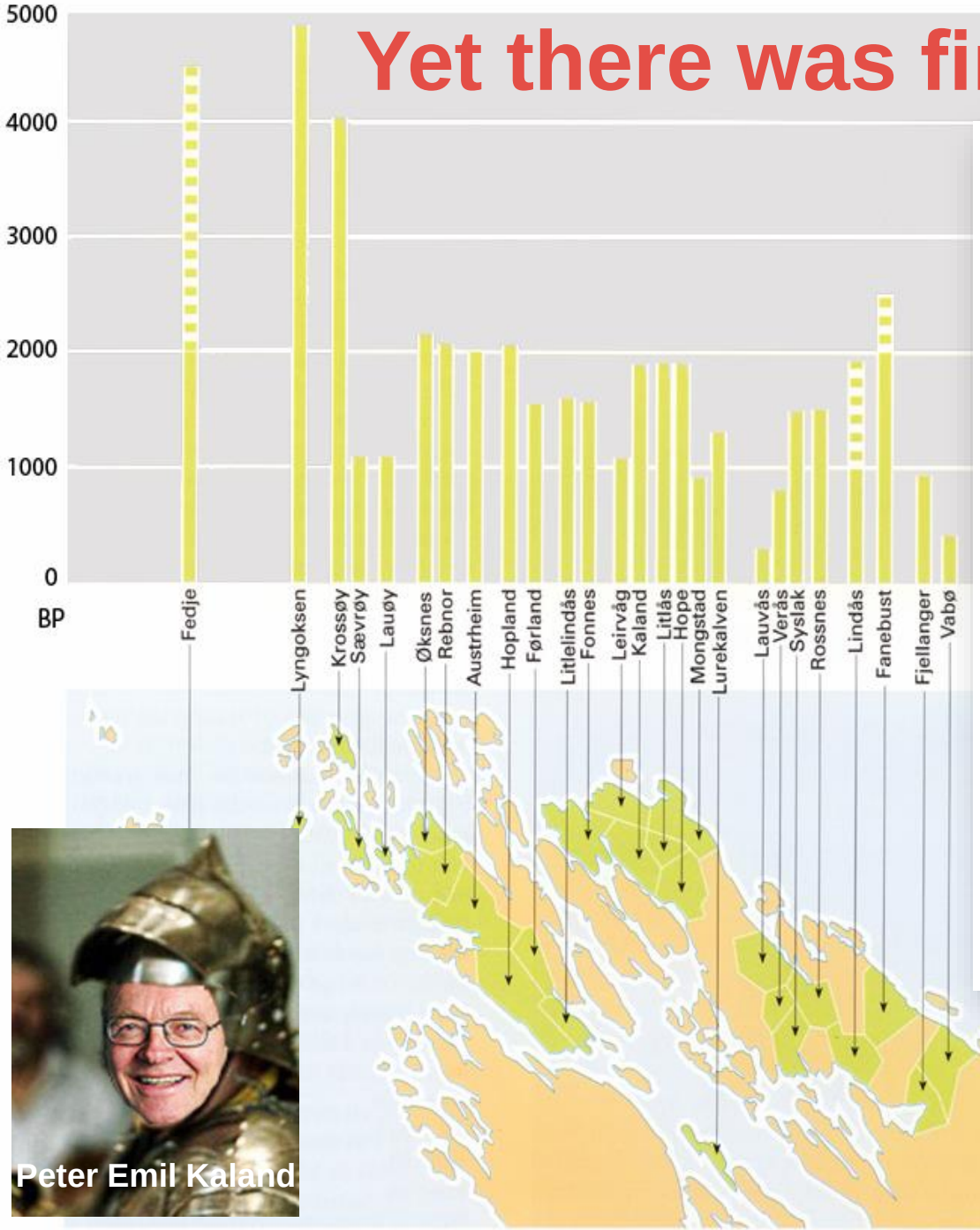
The biogeography of fire…

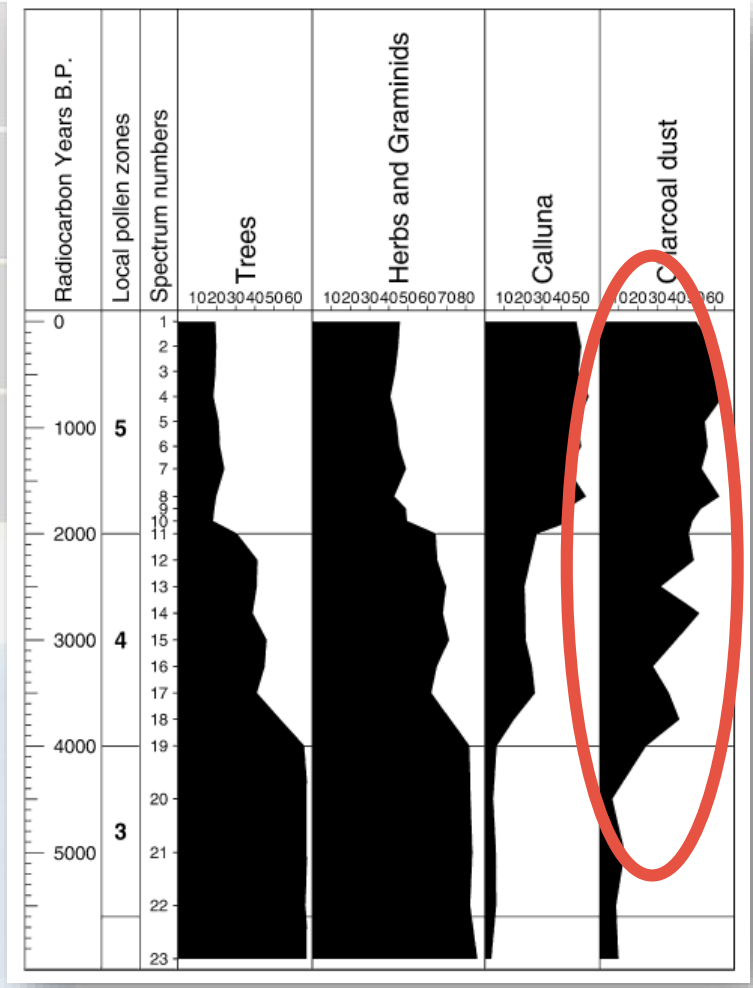


Without oxygen, biomass, fuel in burnable state, fire weather, and ignition, no fire…

(Bowman et al. 2009)

Yet there was fire….





Peter Emil Kaland

(Kaland 1986)

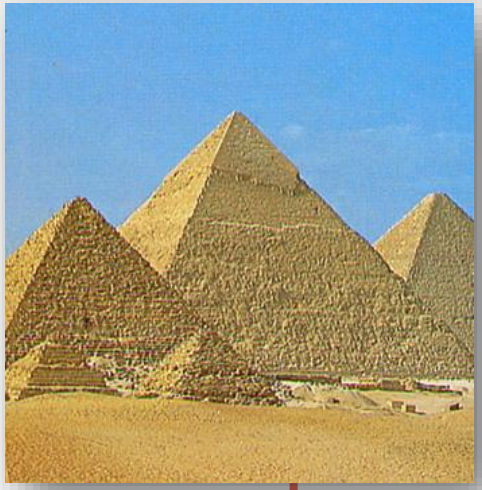

(© Håland)

(©Nationalmuseet i København)

(© Peter E. Kaland)

(Diemont & Kaland 2002)

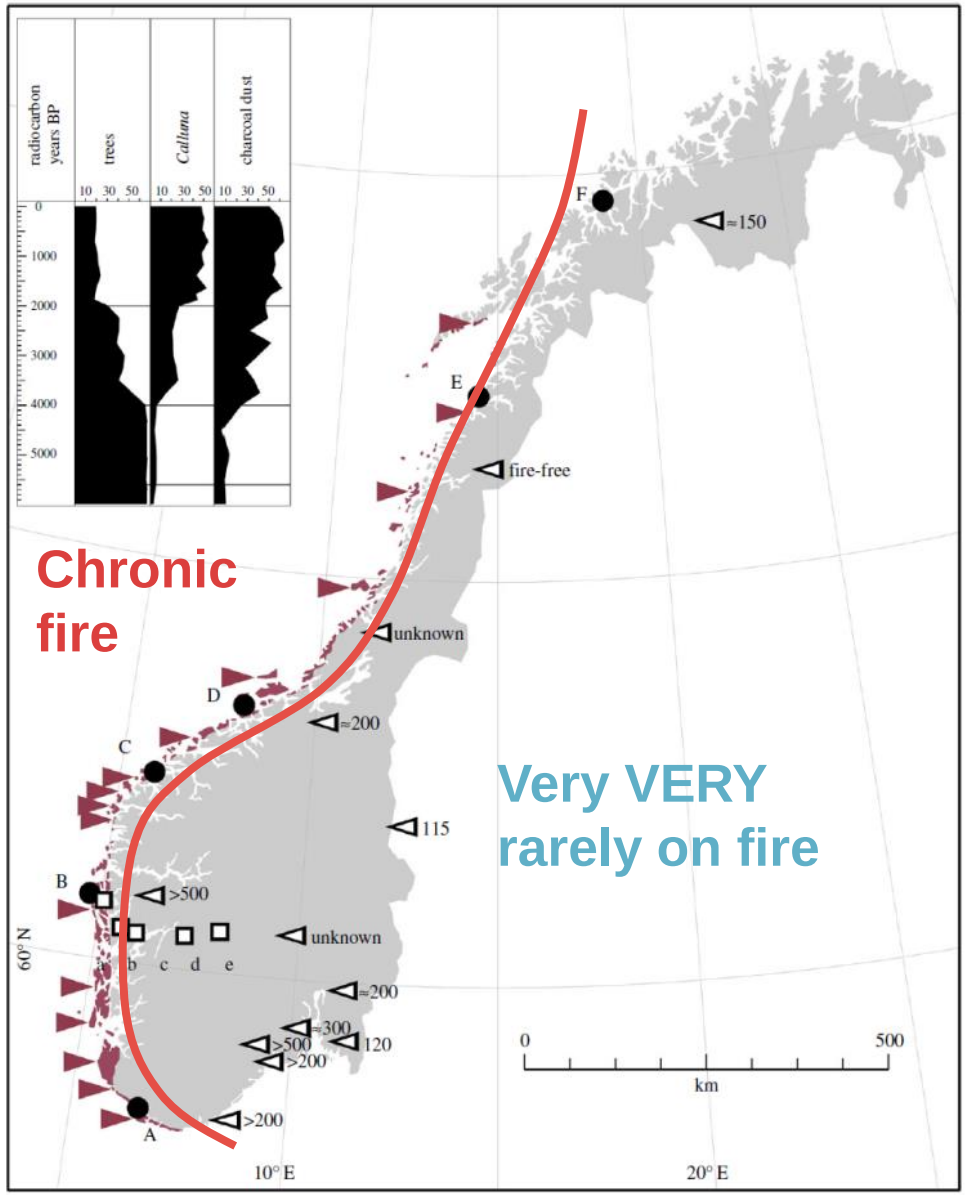
Coatal heathlands – old cultural heritage!



7000 6000 5000 4000 3000 2000 1000 nå

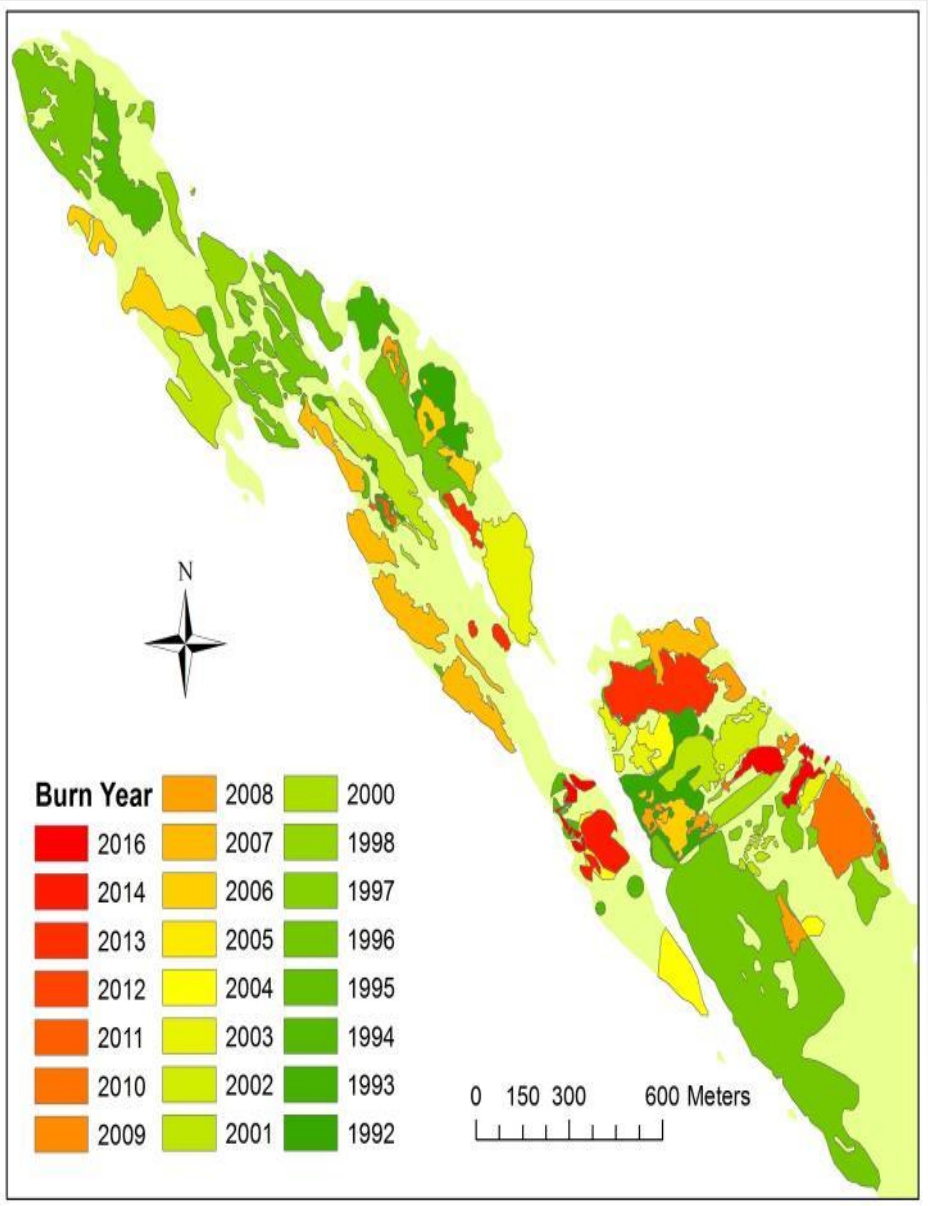
Norway: a great fire experiment!

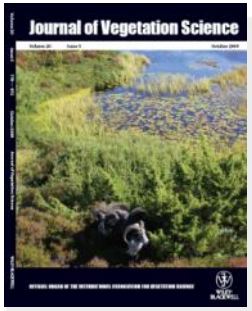
- Natural fires *very* rare & frequency descreasing westwards
- Anthropogenic fire regime along the coast since 6000 BP
- …perpendicular to a climate gradient



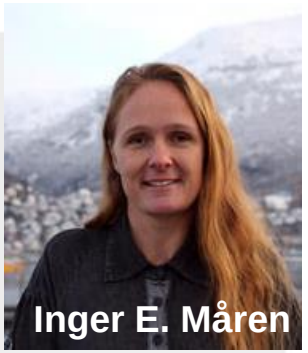
(Ohlson et al. 2006, 2009, 2011, Prøsch-Danielsen Simonsen 2000; Hjelle et al. 2010)

Heathlands burning creates a mosaic



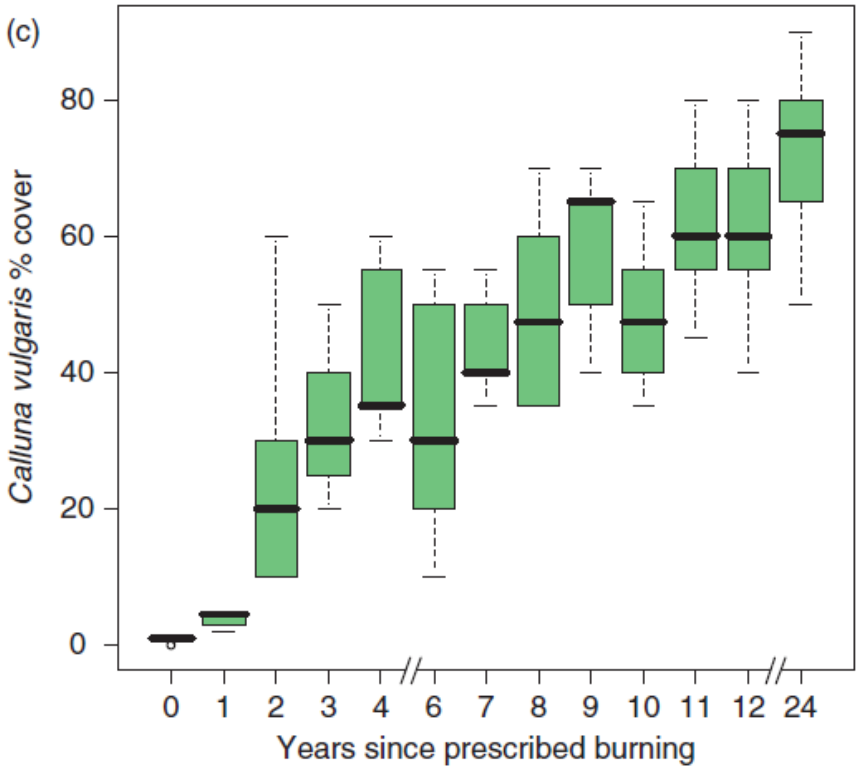


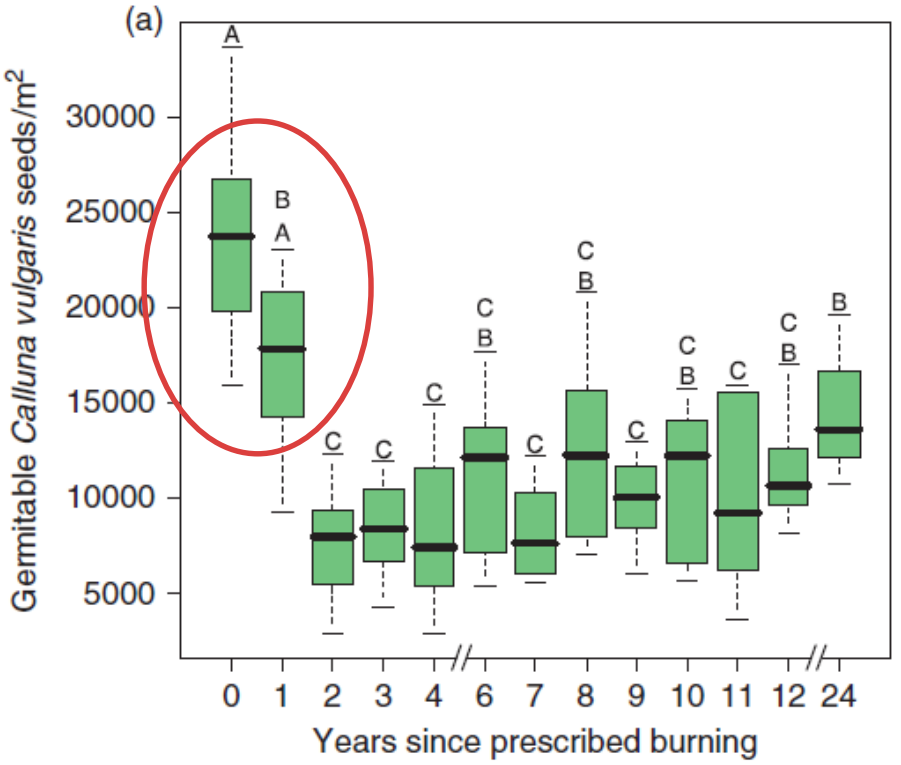
After fire: *Calluna* germinates from seed bank. Lots….



vegetation

soil seed banks





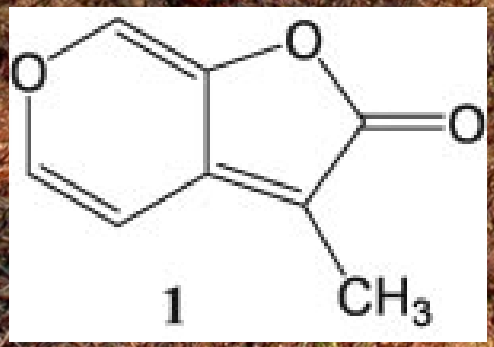
But … where do the ‘extra seeds’ come from?

Smoke as a germination cue

- Smoke from burnt plant material induces germination in many Mediterranean, South African and Australian species – including many Ericaceae

- In 2004 Flematti et. al. isolated the ”active” compound for smoke-induced germination:

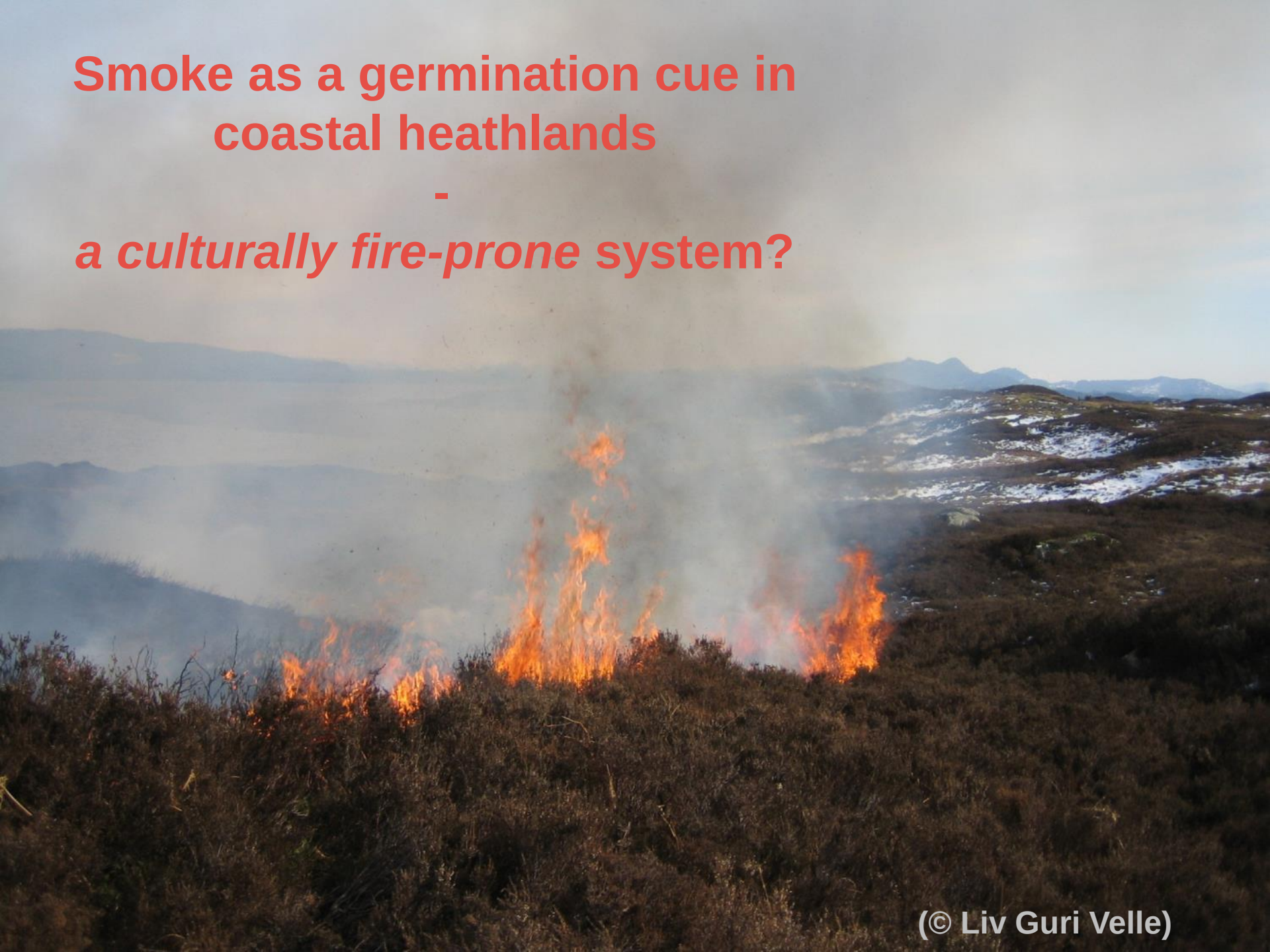
3-methyl-2*H*-furo[2,3-*c*]pyran-2-one



Smoke as a germination cue in coastal heathlands

-

a culturally fire-prone system?

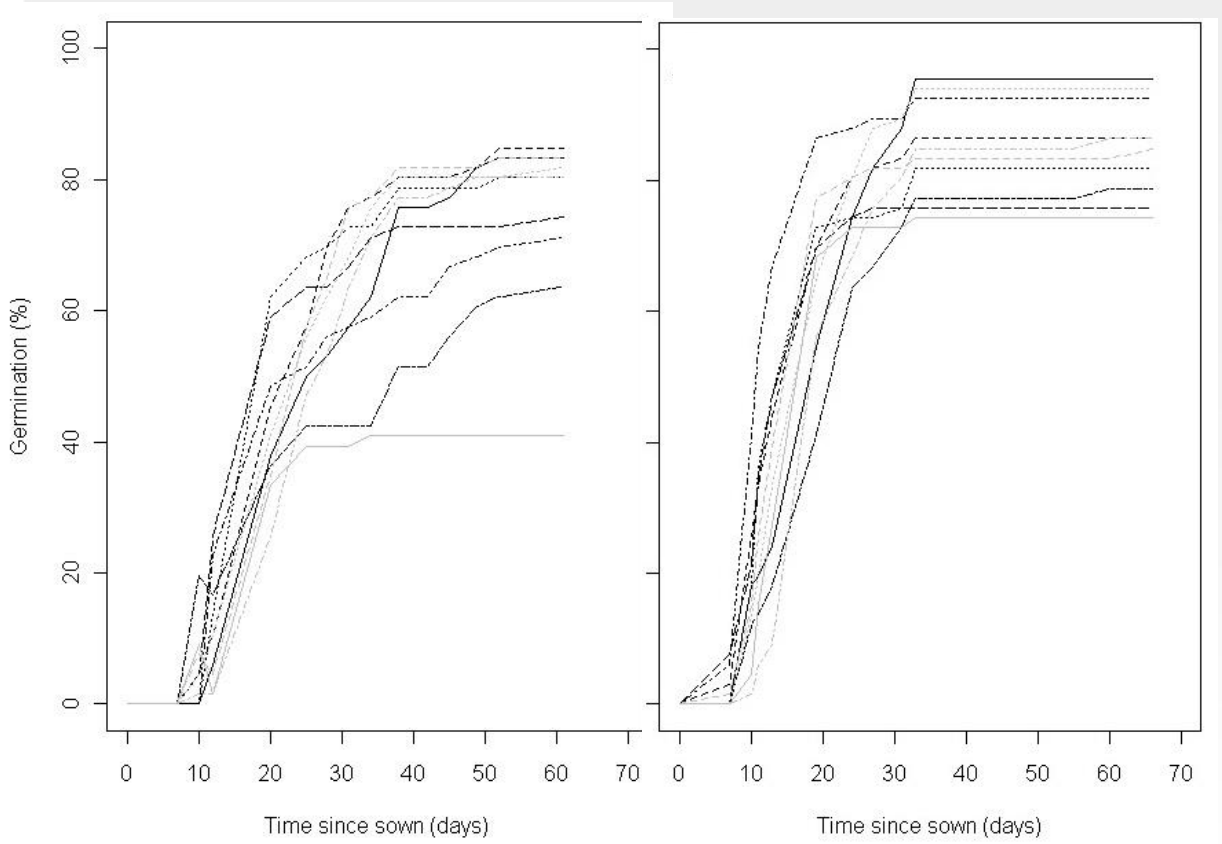


(© Liv Guri Velle)

Smoke induces germination in fresh *Calluna* seeds

control

smoke

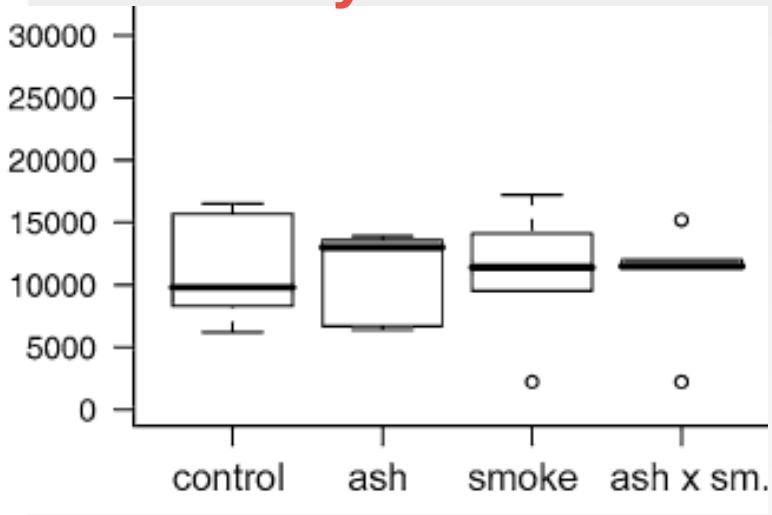


MILLENNIUM SEED BANK PROJECT Kew

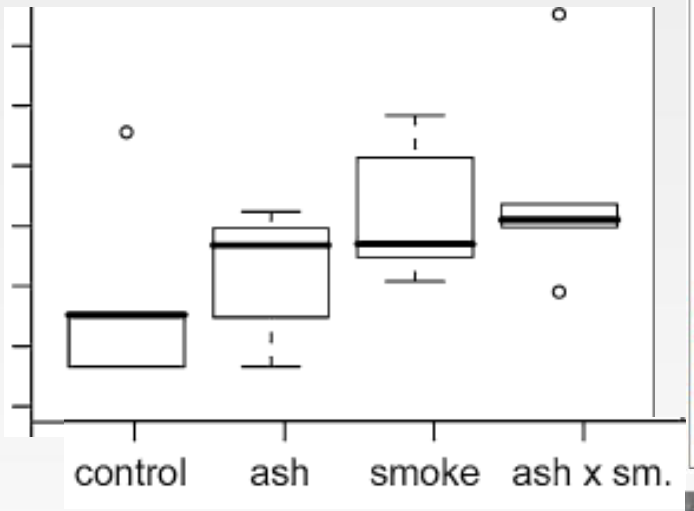
(Måren et al. 2009)

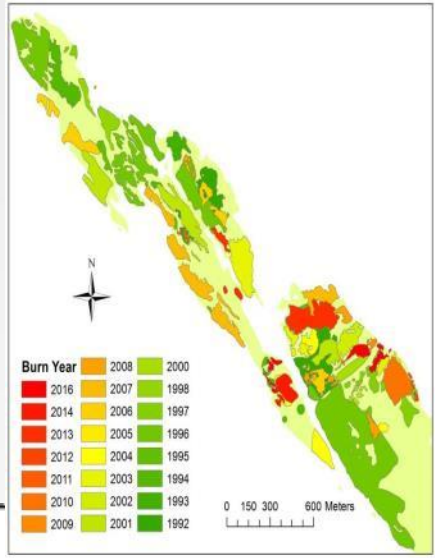
Smoke induces germination from “old”, but not from newly-burnt heath seedbanks

Newly-burnt heath



Old heath

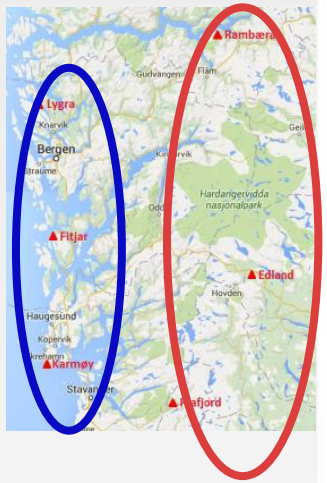


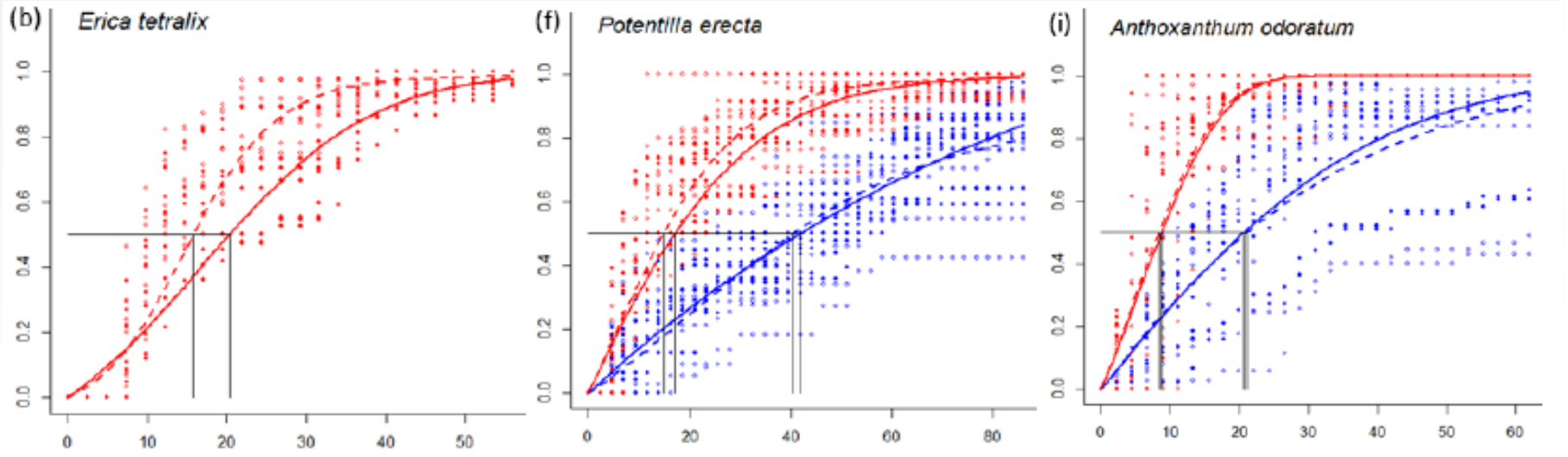


(Måren et al. 2009, Bargmann et al. 2014)

Smoke-induced germination across heathland flora

Species tested (2 dwarf-shrubs, 5 forbs, 11 grams)	18
Smoke responses	14
Coast > inland (heath 1; forbs 4; grams 6)	11





(Bruvoll 2016)

Smoke response in coastal heathland *Calluna* ‘natural’ or human-induced?

Pål Thorvaldsen
(© Liv Guri Velle)

Calluna seed recruitment & evolutionary potential

Produces 150.000 seeds / individual & 1.000.000 seeds / m²

(Beijerinck 1940, Nordhagen 1938)

Seed banks 25.000 seeds / m²

(Måren et al. 2009a,b)

Recruitment up to 400 seedlings / m²

(Vandvik et al. 2005, Velle et al. 2012)

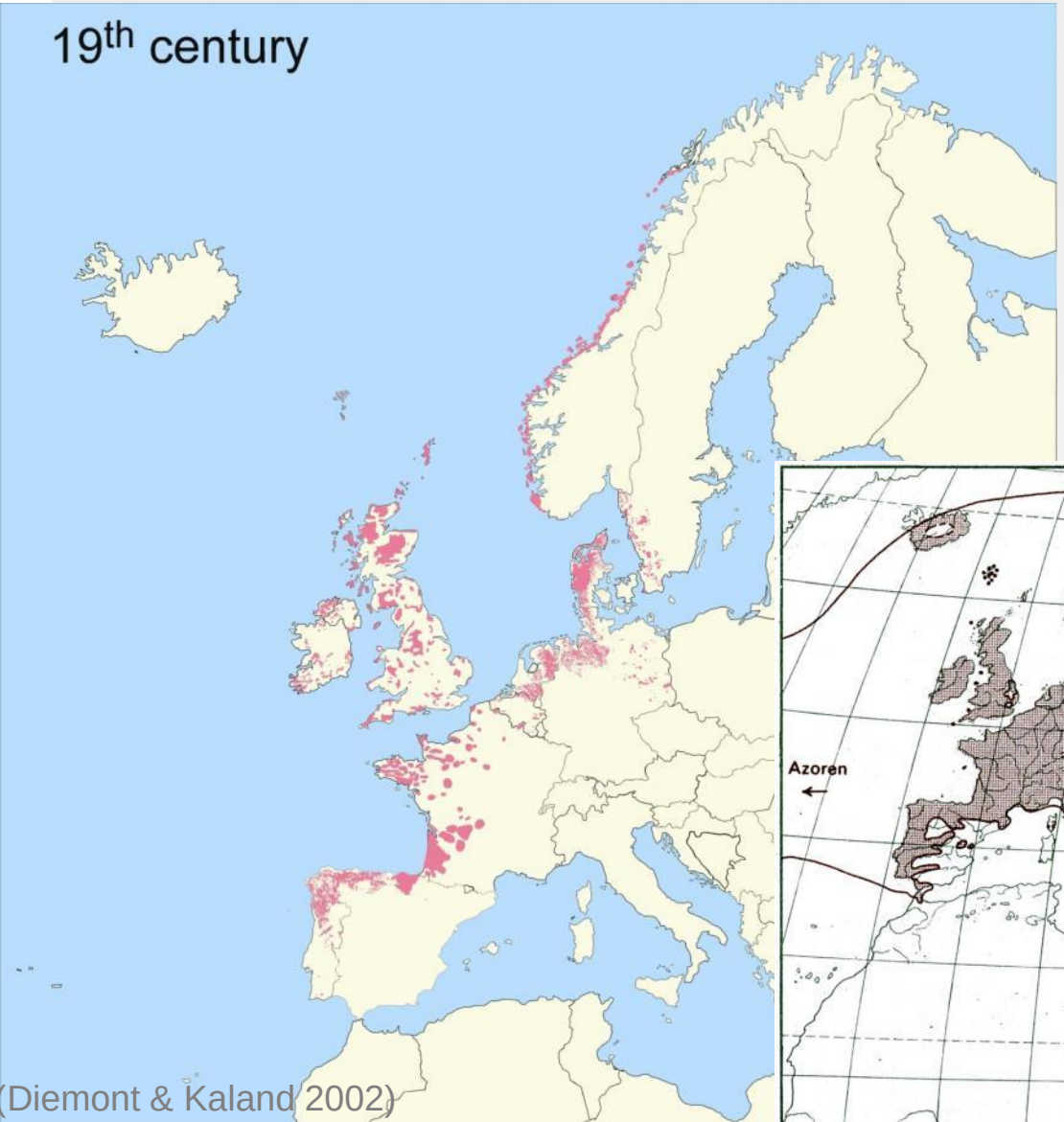
Fire frequency: every ~ 15 year for ~ 6000 years

(Prøsch-Danielsen & Simonsen 2000; Hjelle et al. 2010)

Generation time ~ 10 – 50 years

(depending on seeding or resprouting; Velle et al 2012)

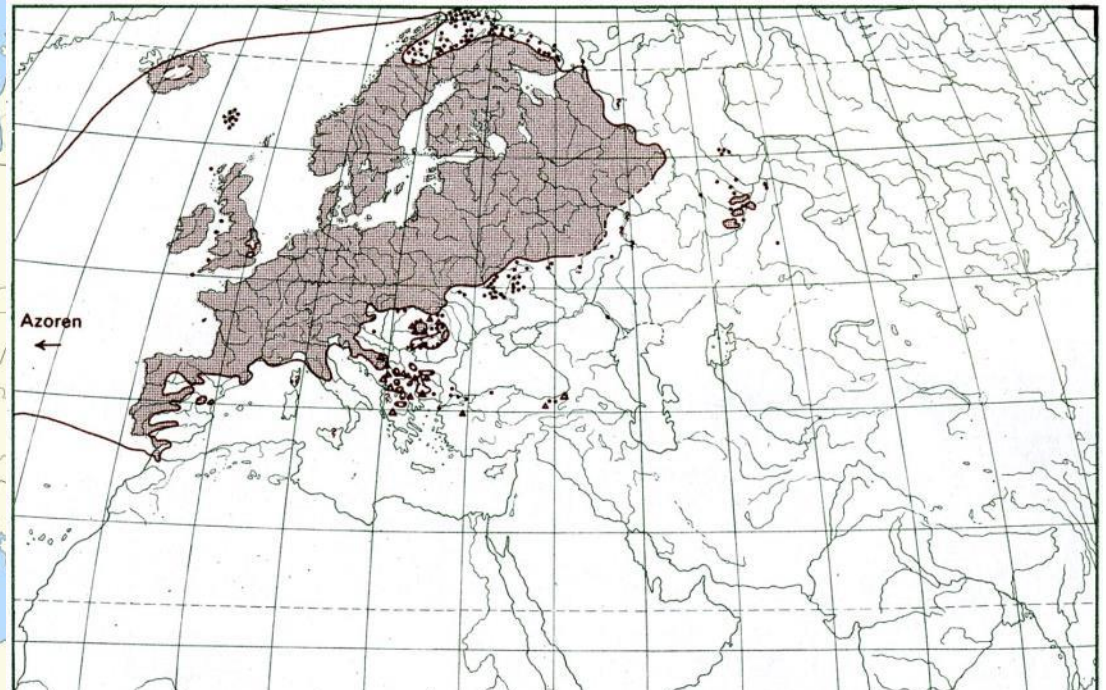
Smoke response should be higher in areas with a (long) history of fire



(Diemont & Kaland 2002)

"The ecology of *Calluna* is, to a large extent, the ecology of the European heathlands"

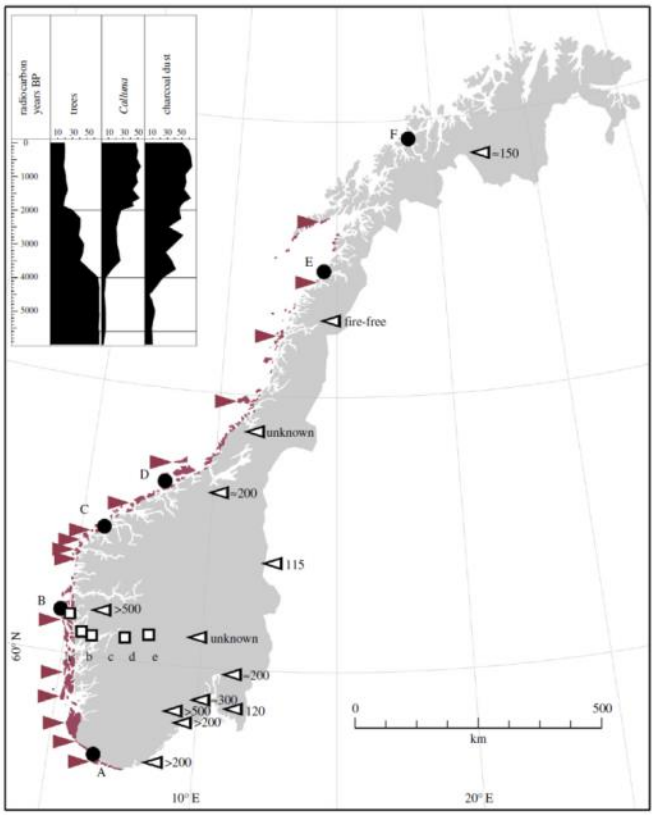
(Webb 1986)

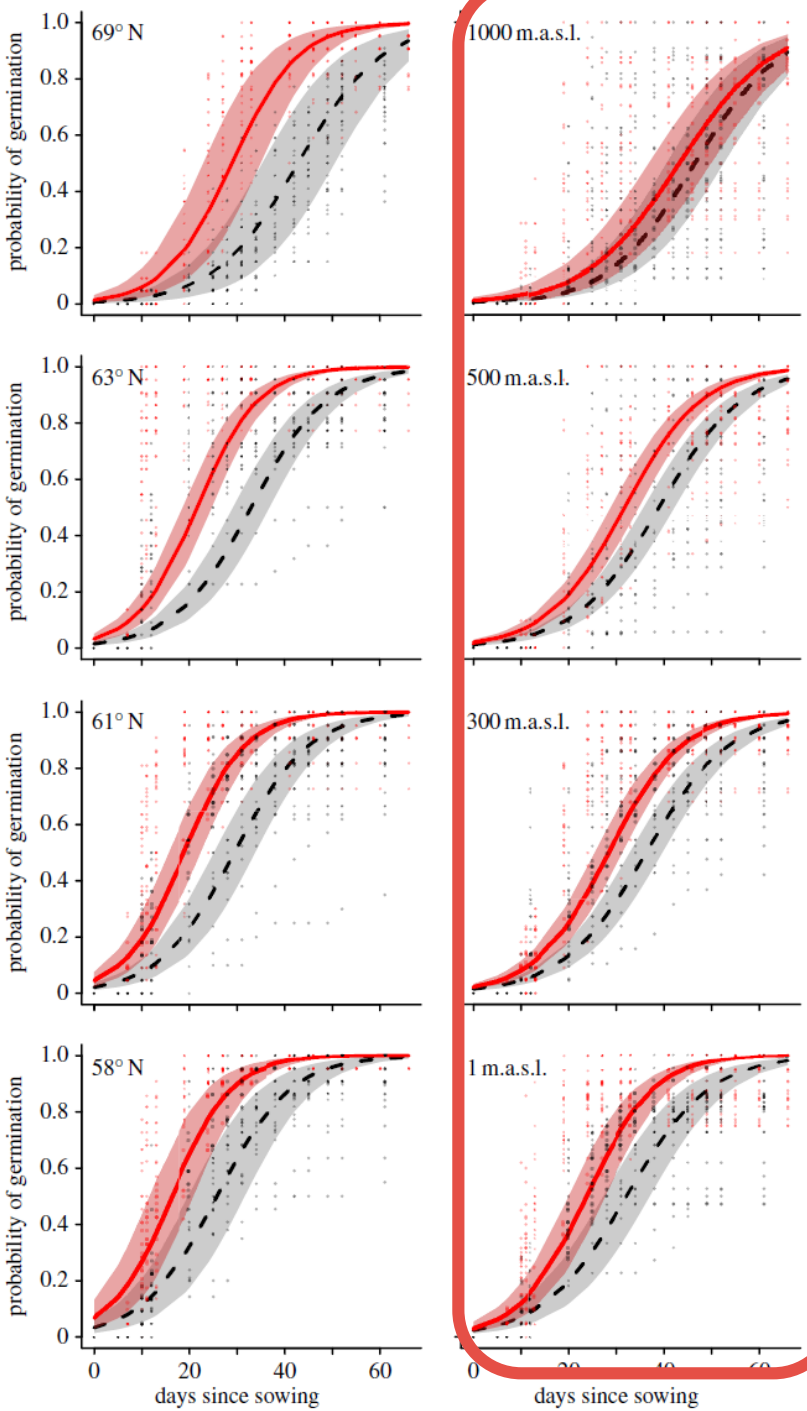


Conservation biology

Management-driven evolution in a domesticated ecosystem

Vigdis Vandvik[1], Joachim P. Töpper[1,6], Zoë Cook[3], Matthew I. Daws[3], Einar Heegaard[4], Inger E. Måren[2] and Liv Guri Velle[1,5]





The ‘seminatural paradox’...

Land-use intensification threatens biodiversity

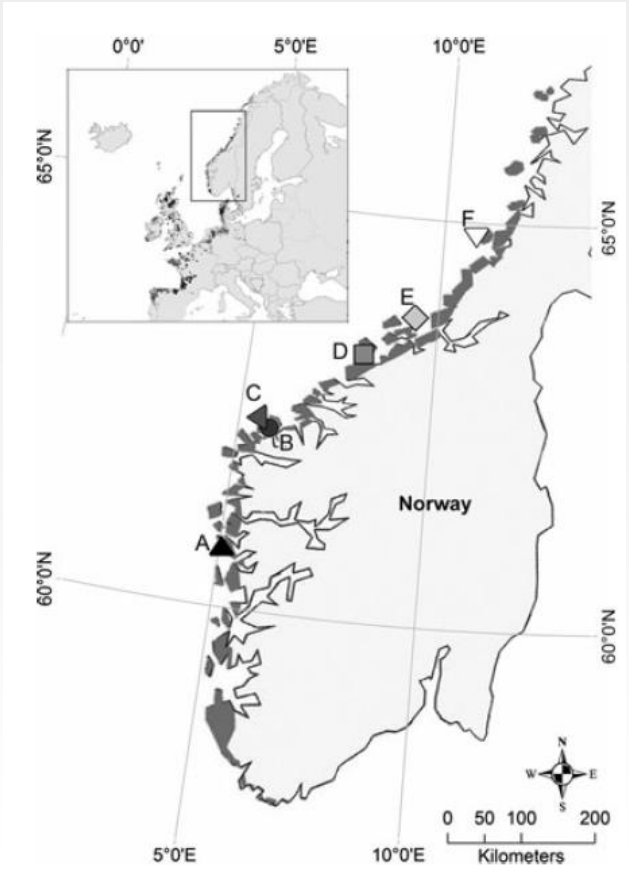
As does abandonment of traditional land-use

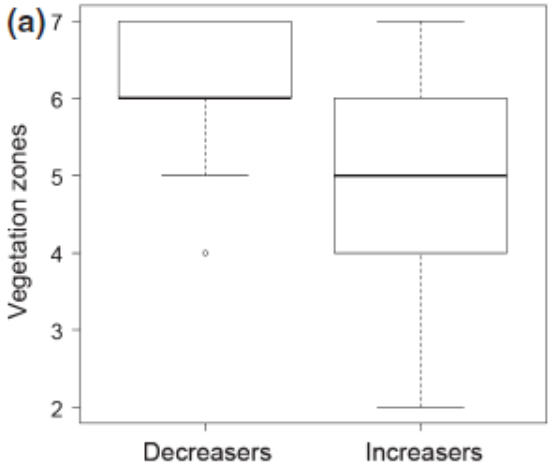
Global Change Biology

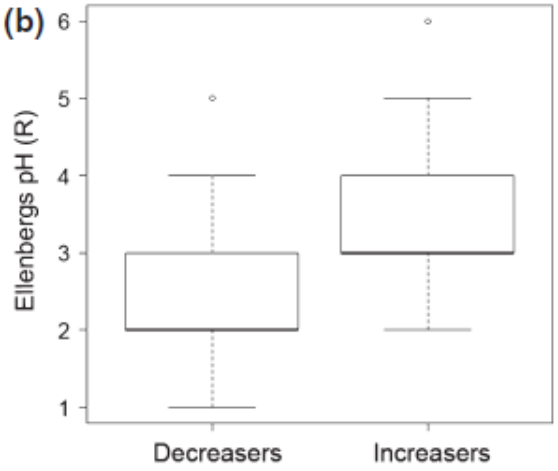
Global Change Biology (2014) 20, 1429–1440, doi: 10.1111/gcb.12448

Does prescribed burning result in biotic homogenization of coastal heathlands?

LIV GURI VELLE*†, LIV SIGRID NILSEN‡, ANN NORDERHAUG§ and VIGDIS VANDVIK†







Fire-promoted heathland species have

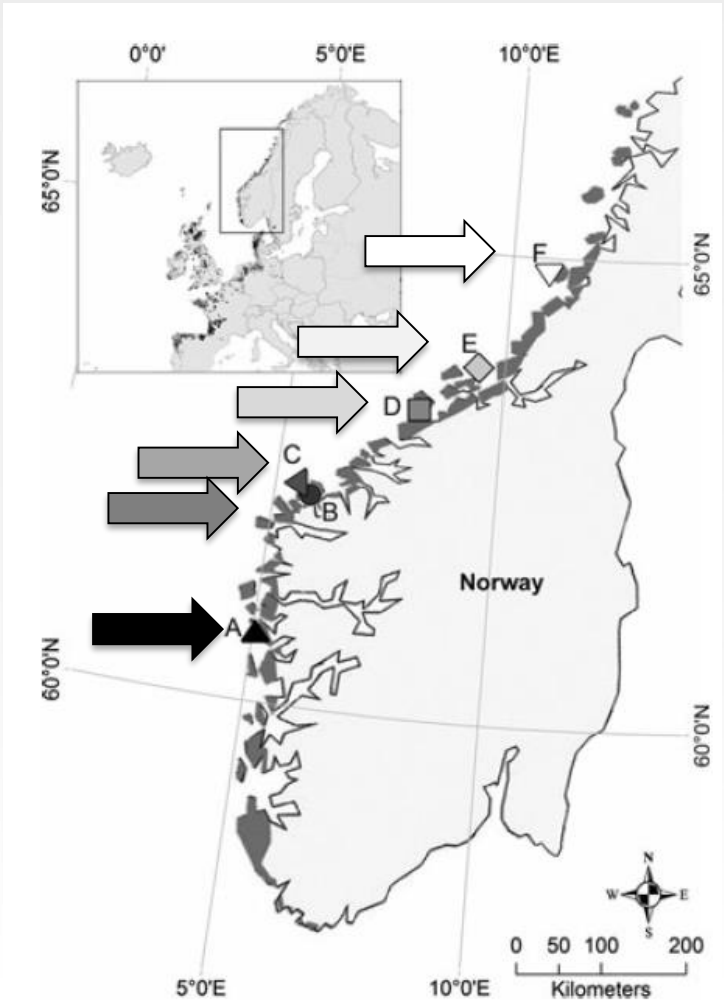
- narrow geographic ranges
- high pH demands

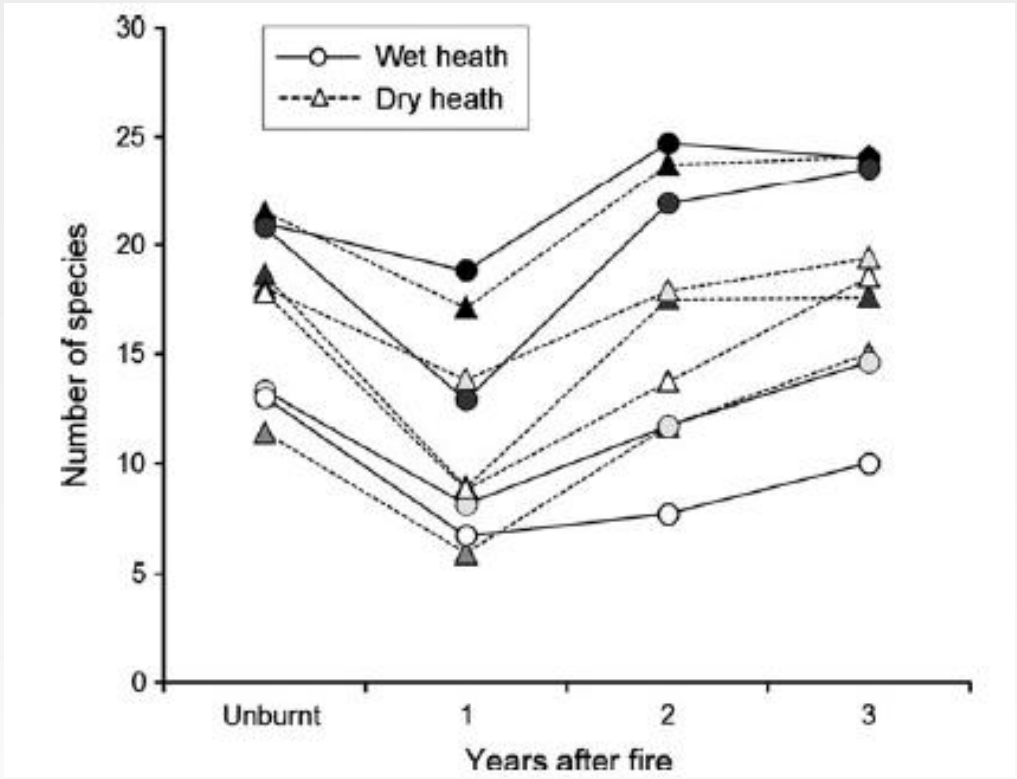
Specialised fire flora - NOT mere 'generalists'

Journal of Vegetation Science **25** (2014) 546–558

Succession after prescribed burning in coastal *Calluna* heathlands along a 340-km latitudinal gradient

Liv G. Velle & Vigdis Vandvik





The post-fire successional dynamics vary with climate

The future of coastal heathlands: Burning, wildfire, climate mitigation..

Flatanger, 28 January 2014 (Dagbladet)

Ecology and evolution of and in heathlands – who cares?

- Our research was important when coastal heath was deemed distinct from boreal heath in the new habitat classification scheme NiN
- We've also worked on Sitka spruce impacts – which was used in the Norwegian blacklist
- Outreach to heathland farmers – their heritage!
- It's been *great* for student research projects!


Siri Vatsø Haugum
Elisabeth Nesheim Hauge

Thank you!

..and the Norwegian Research Council, University of Bergen, Bioforsk, UNIResearch, Møreforskning, NIBIO, Heidi Saure, Jan Håkon Vikane, Ole Reidar Vetaas, Peter Emil Kaland, Ann Norderhaug, Samson L. Øpstad, LivS. Nilsen, Per Arild Aarrestad, Torhild Kvingedal, Mons Kvamme, Einar Heegaard, Zdenek Janovsky, land-owners, the European Heathland Network, Lyngheinettverket, Villsauprosjektet.

Heathlands: It's personal….

LINDBERGIA 22: 31–32. L[illegible]d 1997

Leptodontium flexifolium (Dicks.) Hampe new to Norway from a burnt *Calluna* heath

Per Arild Aarrestad and Vigdis Vandvik

P. A. Aarrestad

V. Vandvik

Aarrestad, P. A. and Vandvik, V. 1997. *Leptodontium flexifolium* (Dicks.) Hampe new to Norway from a burnt *Calluna* heath. – Lindbergia 22: 31–32.

Leptodontium flexifolium is reported as new to Norway from the western parts of Hordaland. It was found on sandy, newly burnt peat soil in heathland managed by fire and grazing. Details of its Norwegian habitat and associated species are given.

P. A. Aarrestad, Norwegian Inst. for Nature Research, Tungasletta 2, N–7005 Trondheim, Norway. (per.arild.aarrestad@nina.nina.no). – V. Vandvik, Botanical Inst., Univ. of Bergen, Allégaten 41, N–5007 Bergen, Norway.

Impact? Norwegian redlist, catergory EN
Coastal heathlands recognized as nature type,
(paper cited 7 times, mostly by me….)

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