How should we Manage and What should we Plant?

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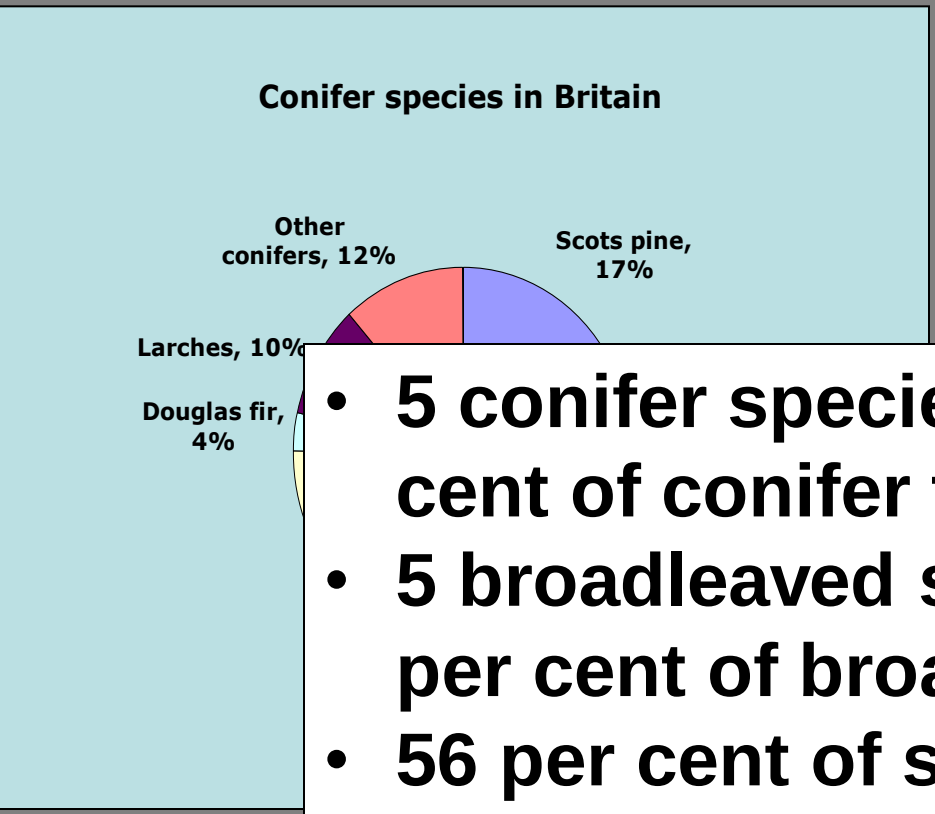
Forest Research, CCFG, and Morton Estate

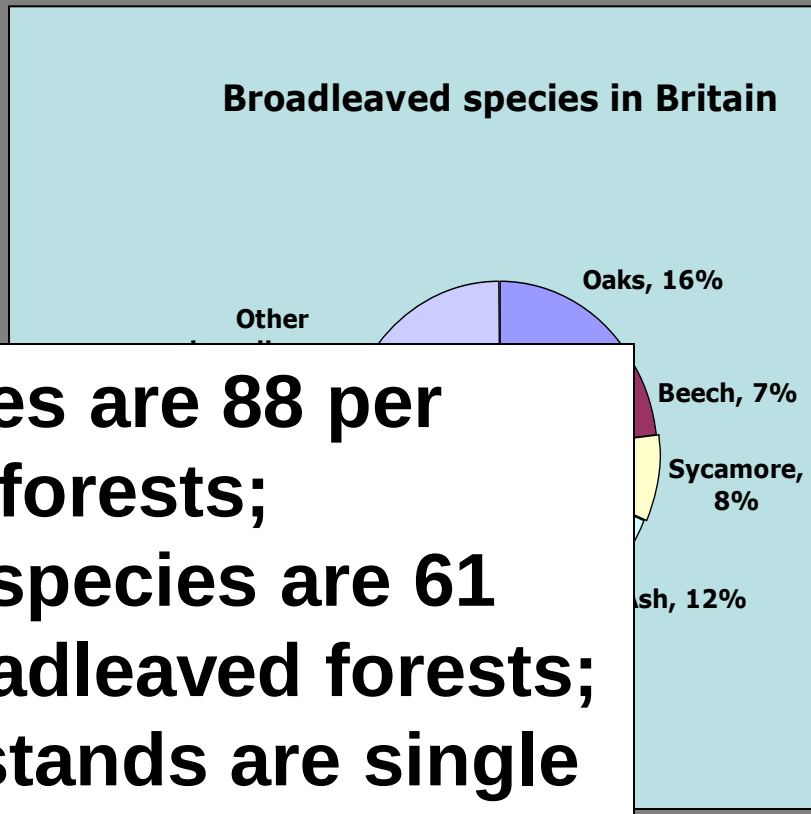
1. Setting the scene

British forests in 2014

[Source: FC Statistics 2014]

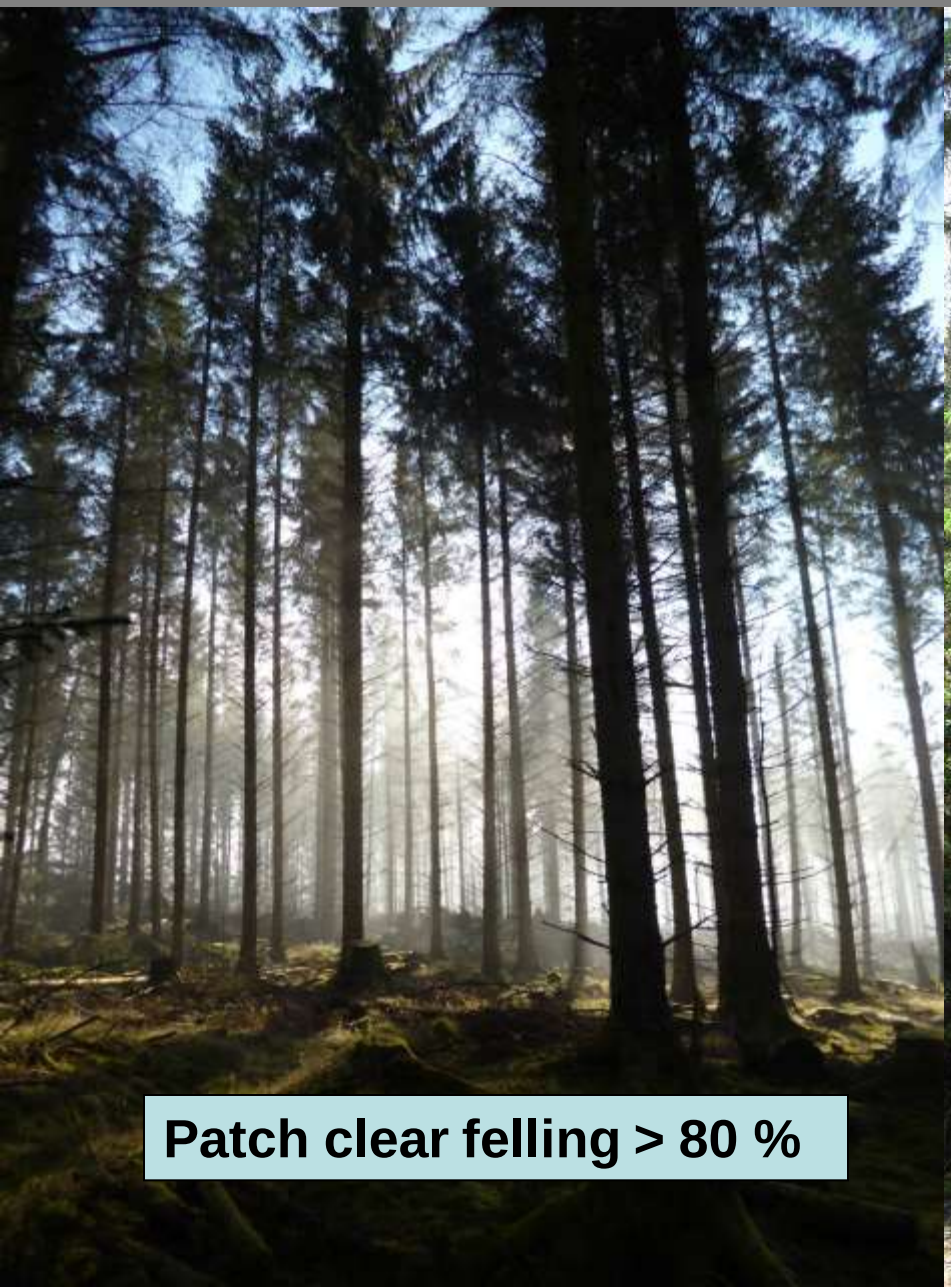
[adapted from Kerr, 2014]





- **5 conifer species are 88 per cent of conifer forests;**
- **5 broadleaved species are 61 per cent of broadleaved forests;**
- **56 per cent of stands are single species.**

Simple forests + Simple silvicultural systems

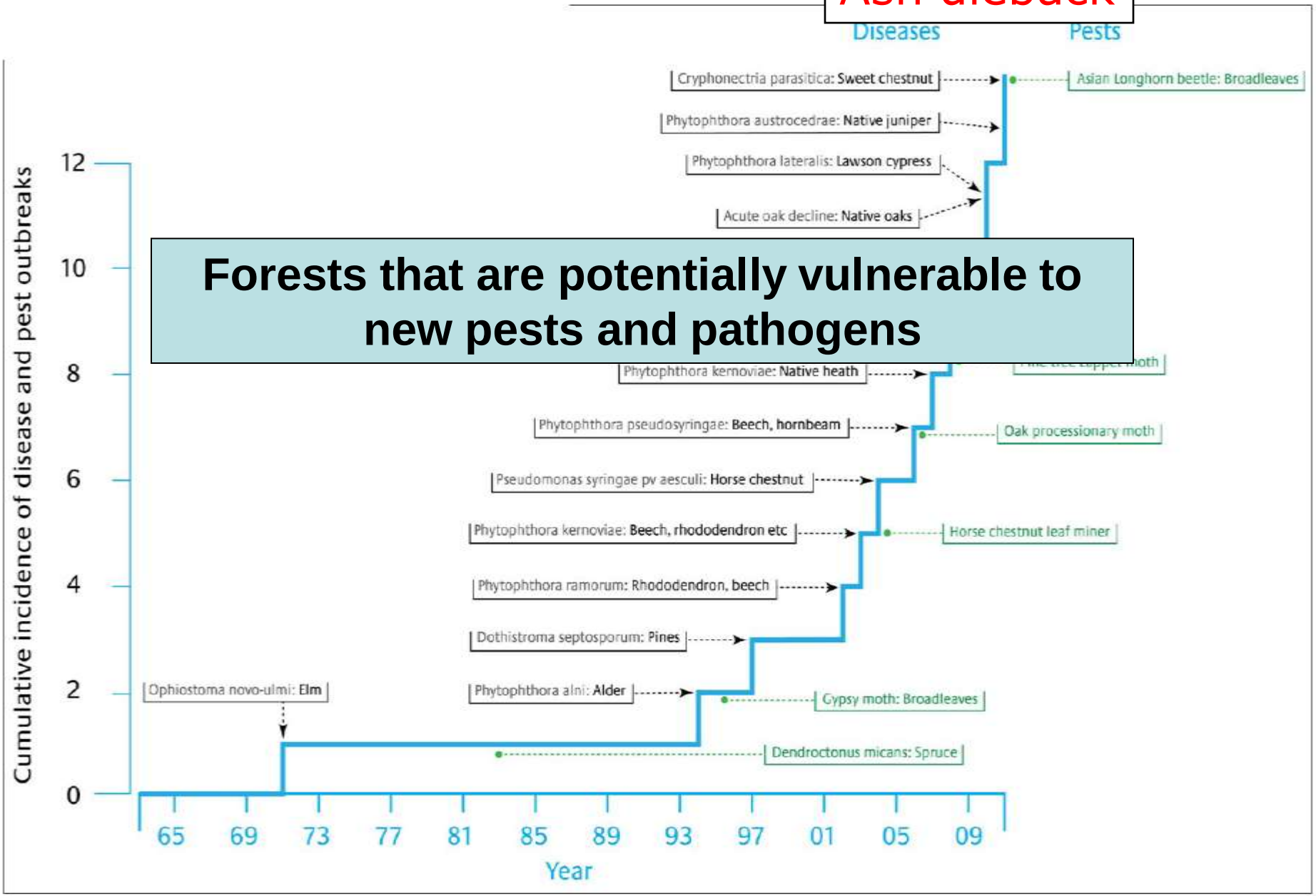


Forests that are vulnerable to abiotic disturbances

We have experienced major wind damage in 1953, 1968, 1976, 1987, 1990, 1998, and 2012.

Figure 9: New tree disease and pest outbreaks UK

Ash dieback



Based on data supplied by the Forestry Commission.

Diversification and adaptation

- “Uncertainties over future growth and potential threats to particular species […] has led to favouring the use of mixtures of species […] at

2. THE PROBLEM:
WHEN to diversify, WHERE to diversify and HOW to create resilience?

- accelerate the diversification of woodlands, which we believe is the best way of reducing risk [from climate change]”. (Welsh Woodlands Strategy, 2009, p 16).

CONCEPT

The structure and composition of forest stands and landscapes can be used to estimate both resistance and resilience to biotic and abiotic disturbances

Resilience can be considered as the potential influence of disturbances on forest structure and composition in relation to desired future conditions.

[after DeRose and Long, 2014, Forest Science, 1205-1212.

Can we learn from case studies?

Case study 1 – Morton estate – c. 70 ha

SITE FEATURES:

- ***Rainfall*** **– 600 mm;**
- ***Elevation*** **– 40-50 m asl;**
- ***DAMS*** **– 13 (i.e. low wind risk);**
- ***Soils*** **– Sandy brown earths to sands;**
- ***Soil Moisture Regime*** **(SMR) – Fresh – moderately dry;**
- ***Soil Nutrient Regime*** **(SNR) – Medium to poor;**
- ***Main hazards*** **– drought (e.g. 1976), DNB (on pines);**
- ***Woods*** **– originate from C19 and C20 plantings on poor agricultural soils – about 26 species present;**
- ***Silvicultural systems*** **– Group/patch felling (70%); group selection (30%).**


Mixed broadleaves


Pines

Future proofing the Morton woods

Number of 'very suitable' or 'suitable' species in ESC under '2080 high' climate change scenario:

Soil Moisture Regime	All conifers	Pines	B/Ls
Fresh/slightly dry	13	7	21
Moderately dry	8	6	8
Very dry	3	3	0

Morton in 2080?

Forest type	Per cent area	Main SMR	Main silvicultural measures
Mixed broadleaves	50	Fresh-slightly dry	CCF via group selection, promote SOK and SCH, reduce use of beech
Mixed conifer and broadleaves	25	Moderately dry	CCF via irregular shelterwood, underplanting Douglas fir, *Abies* spp., accept B/L regeneration.
Pine dominated	25	Moderate-very dry	Patch clearfell and heavy thinning (vs DNB).

Case study 2 – Clocaenog Forest – 5600 ha

SITE FEATURES:

***Rainfall* – 1100 mm;**

***Elevation* – 300-500 m asl;**

***DAMS* – 16 + (i.e. higher wind risk);**

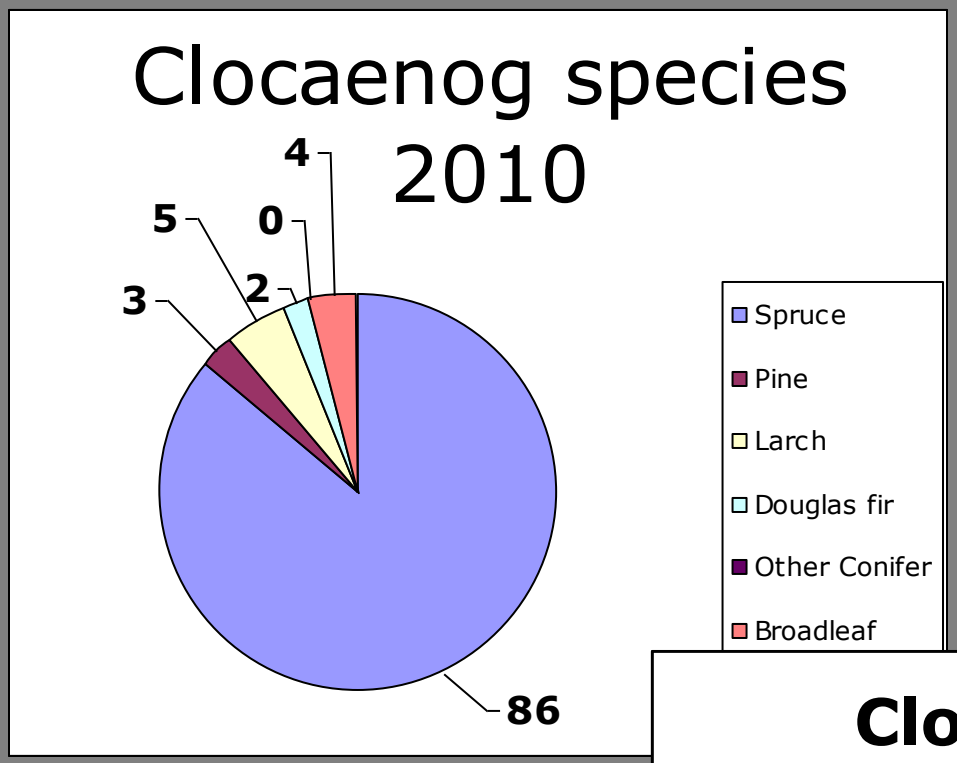
***Soils* – brown earths-iron pans-gleys;**

***Soil Moisture Regime (SMR)* – Moist;**

***Soil Nutrient Regime (SNR)* – Poor;**

***Main hazards* – windblow, drought (especially for spruce in a warming climate).**

Main reference: Ray et al., 2014, *Reg. Environ. Change*, DOI 10.1007/s10113-014-0644-6

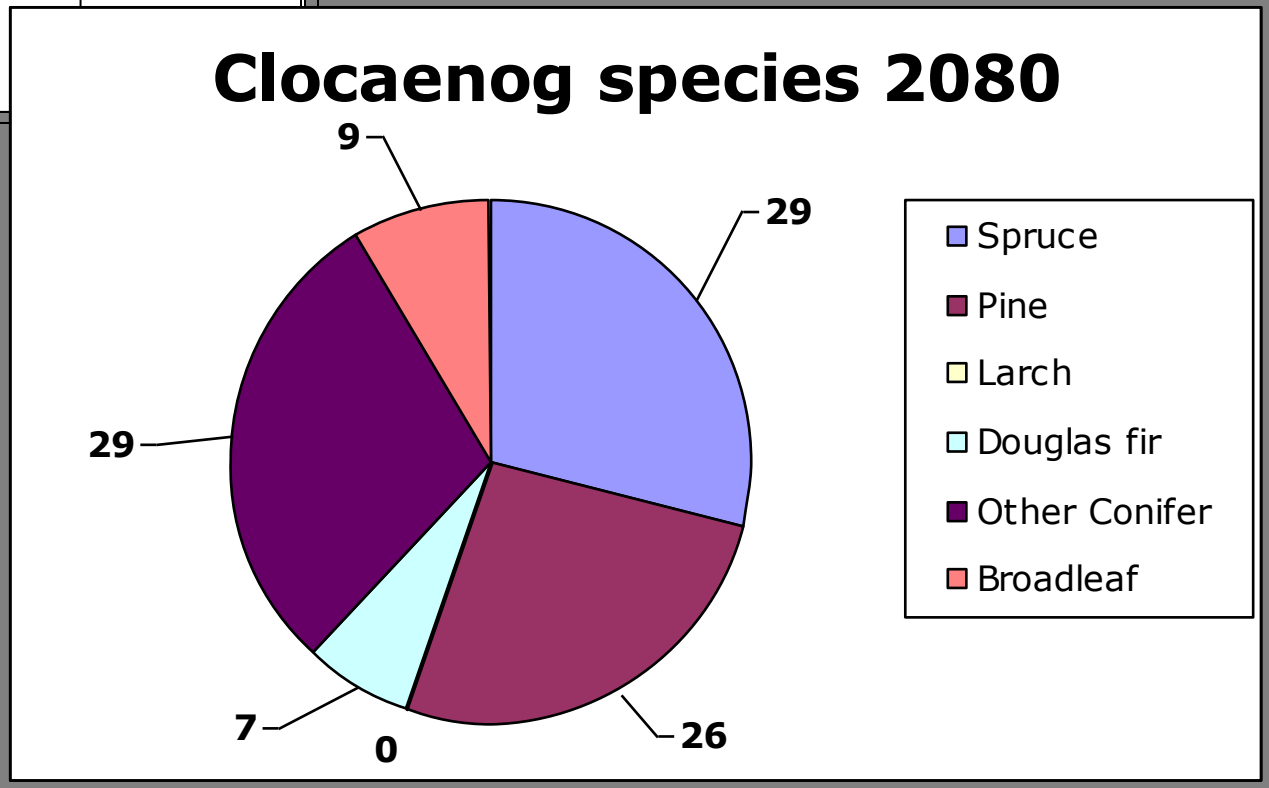


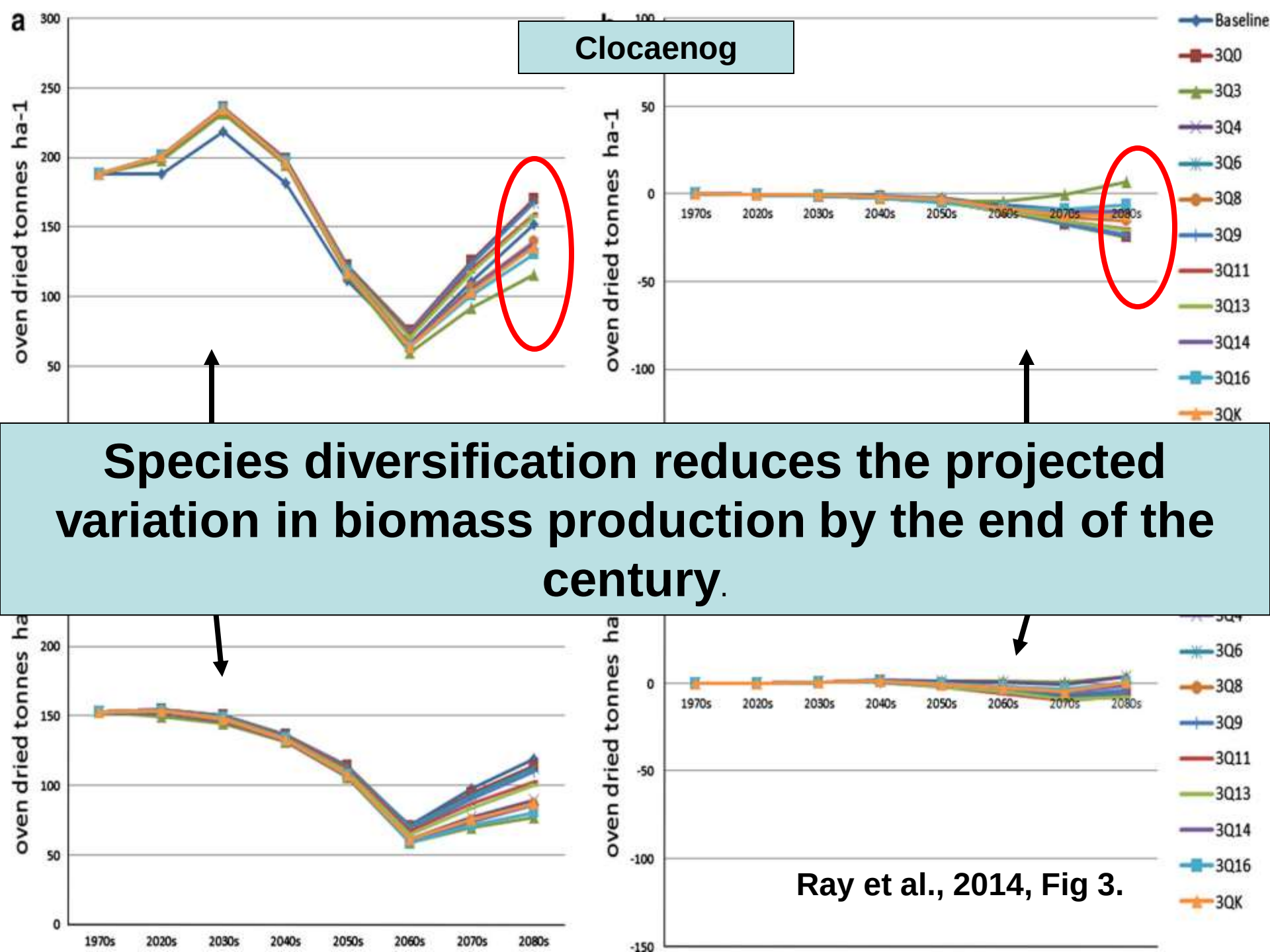
2080 – Substantial reduction in spruce;

Increase in pines and other conifers (coast redwood, red cedar)

2010 –

Tested species suitability under a range of climate scenarios over the rest of the century using ESC




a
Clocaenog
oven dried tonnes ha-1
300
250
200
150
100
50
50
0
-50
-100
1970s
2020s
2030s
2040s
2050s
2060s
2070s
2080s
Baseline
3Q0
3Q3
3Q4
3Q6
3Q8
3Q9
3Q11
3Q13
3Q14
3Q16
3QK
Species diversification reduces the projected variation in biomass production by the end of the century.
0
-150
Ray et al., 2014, Fig 3.

Case study 2 – Clocaenog Forest – 5600 ha

Can we help species/stands adapt to potential disturbances without replacement?

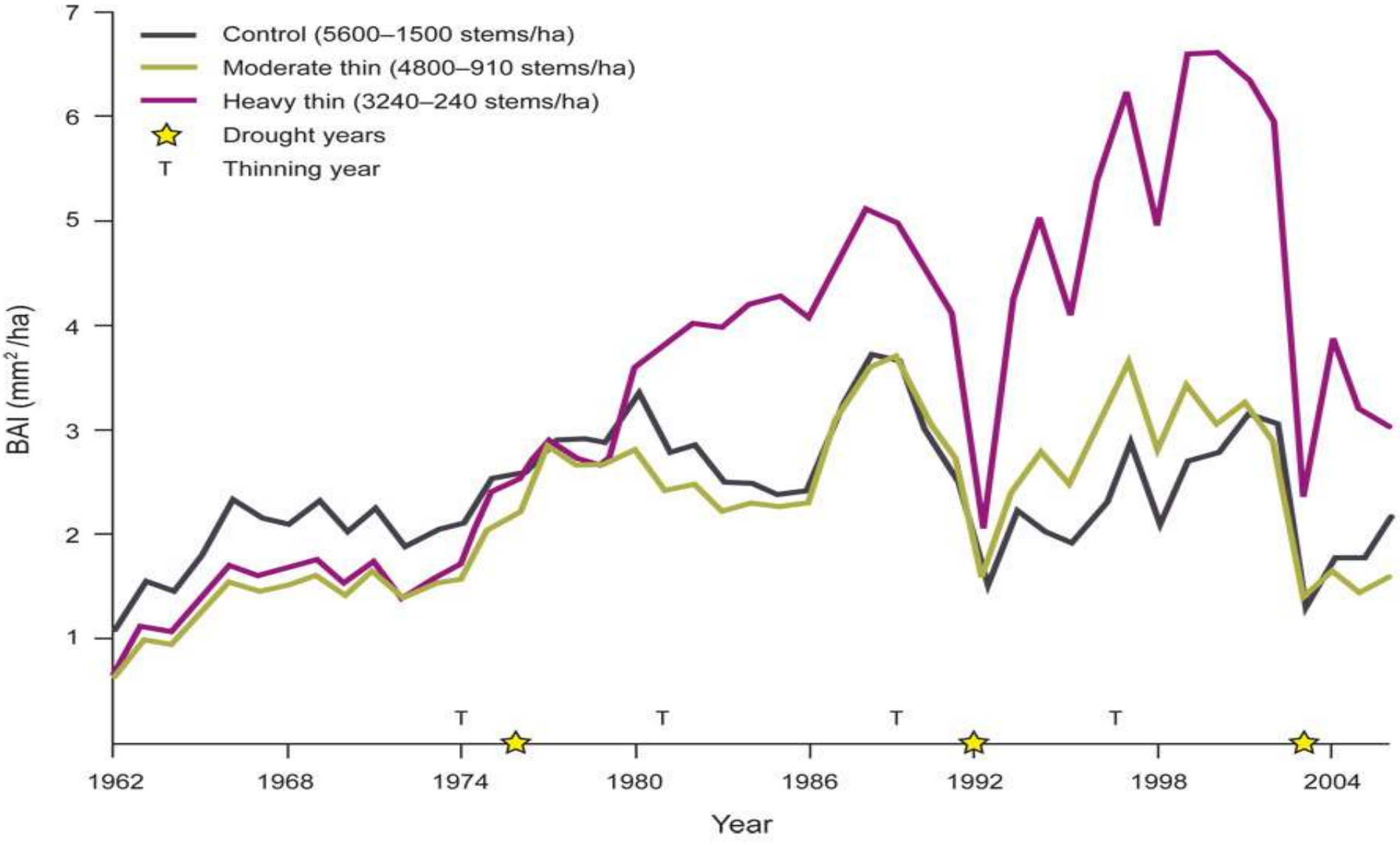
Options include:

1. Thinning;

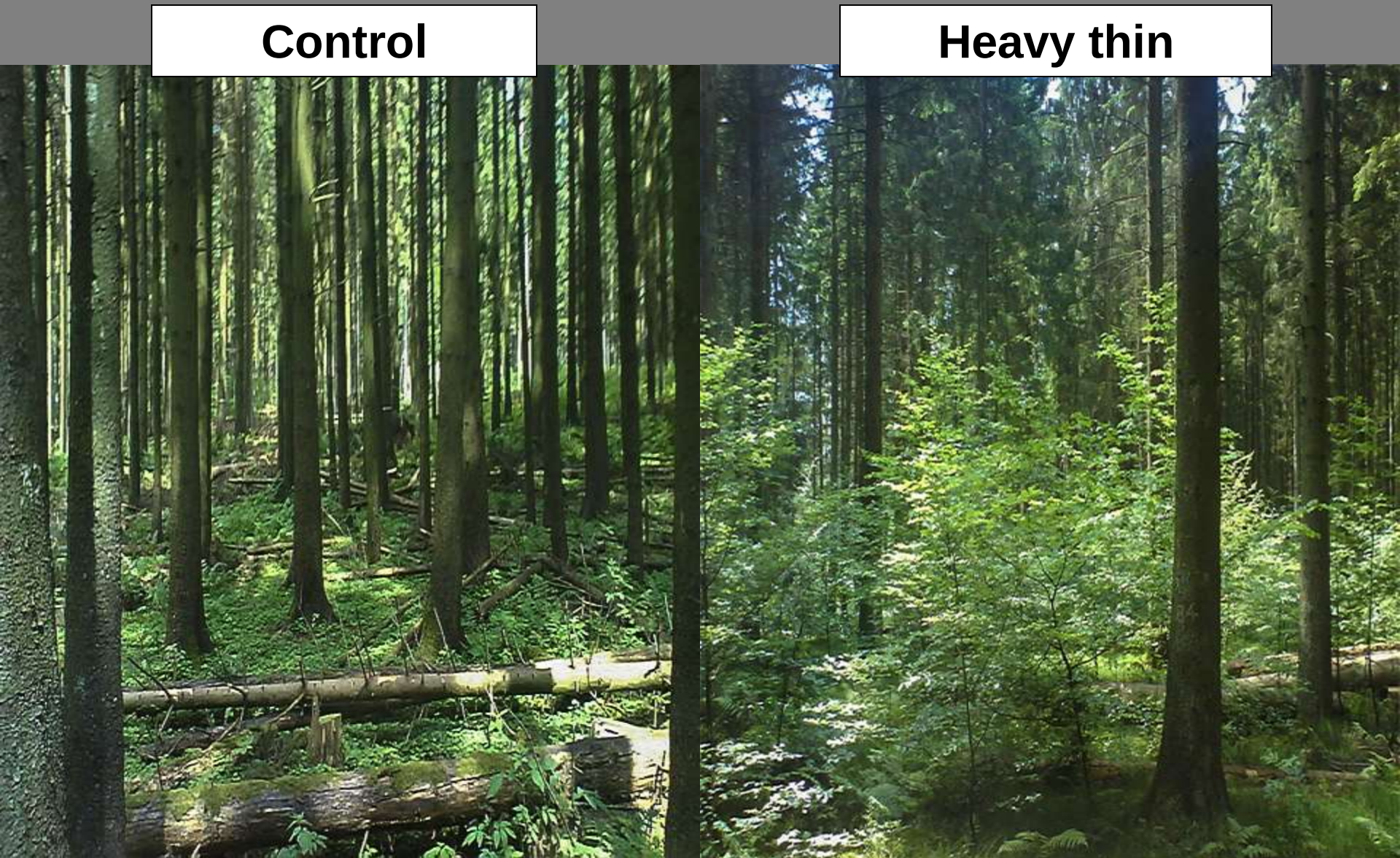
2. Greater use of mixtures
(see Wilson & Cameron, 2014 & 2015)

Mitigation of drought stress in Norway spruce by thinning

[adapted from Sohn et al., 2013, *Forest Ecology & Management*, 188-197]



Impact of thinning upon 65 years old Norway spruce in southern Germany [Sohn, 2014]



Thinning is also relevant to Sitka spruce forests: The CCF areas at Clocaenog

“The rain forests of the North American Pacific margin have simple species composition, but complex forest age and tree size structure”.

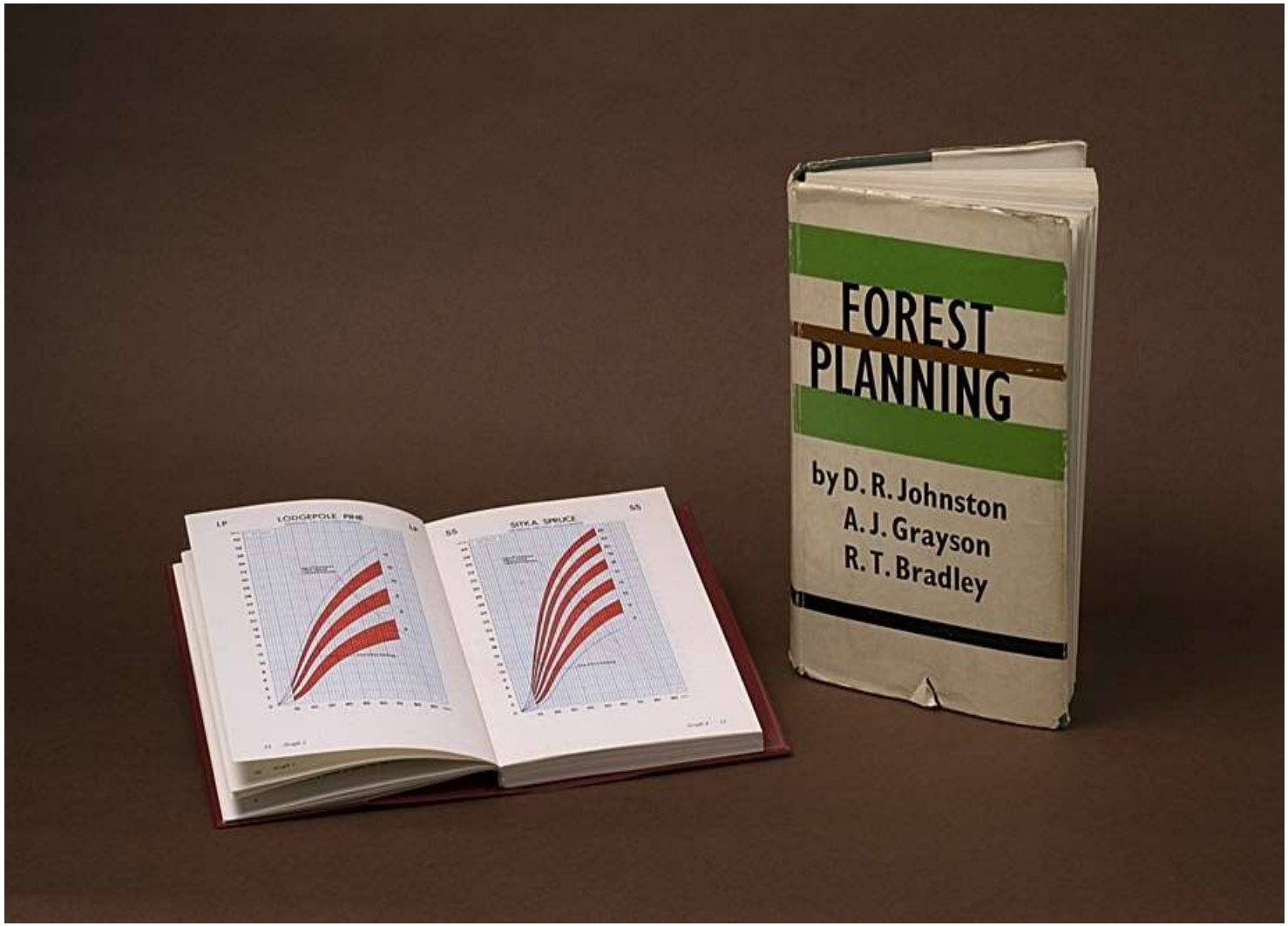
Deal et al, 2014, Forestry, 193-208.

How should we manage and what should we plant?

Lessons from the Case Studies

1. ESC and similar tools can be used to GUIDE choice of species and of silvicultural system;
2. A good knowledge of local soil types is necessary to identify potentially vulnerable sites/stands;
3. A wide range of alternative species can be used, depending on site;
4. Thinning and the use of mixtures have a critical role in helping to adapt stands/forests to future disturbances;
5. Need to quantify desired future condition in relation to impacts of known disturbances;
6. Formulating future forests in terms of forest types with major/minor species is more helpful than concentrating on individual species;
7. Structural diversity can be as important for resilience as species diversity;
8. There is an important role for CCF as a means of helping to develop resilient structures.

Adaptive silviculture is a different approach and involves a change of culture



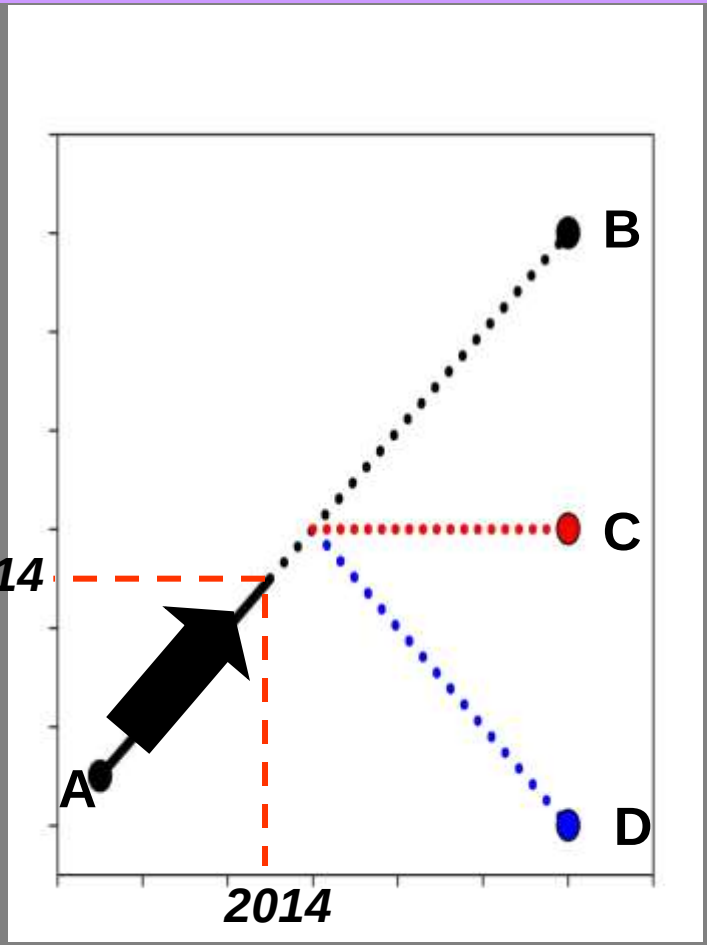
Principles of an adaptive silviculture

No longer a single path A-B;

Now Multiple paths: A-B,C,D

Anticipate change

- Know your forest
- Accept uncertainty
- Accept complexity
- Anticipate surprises
- Assess the risks and plan ahead
- Monitor and be flexible
- Manage your forest towards adaptation
- Use disturbance as an opportunity



Creating resilient forests requires good knowledge of silvics, of potential disturbances and imagination

“I am always astonished by a forest. It makes me realise that the fantasy of nature is much larger than my own fantasy.”

Gunter Grass, 2010

“Novels are made out of the writer's sense of what literature is or can be.”

Susan Sontag, 2001


Thank you for your attention
Dukes Wood, Glenbranter, near Kilmun, west Scotland