Forest Research

Adapting the management of forests to Scotland's future climate

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Presentation overview

- Why adapt forests?
- Recorded climate change but which future climate?
- Scotland's forests and climate change policy
- Some key actions to reduce impacts
- How does climate change impact biodiversity?
- Some key actions to maintain biodiversity
- Adaptation summary

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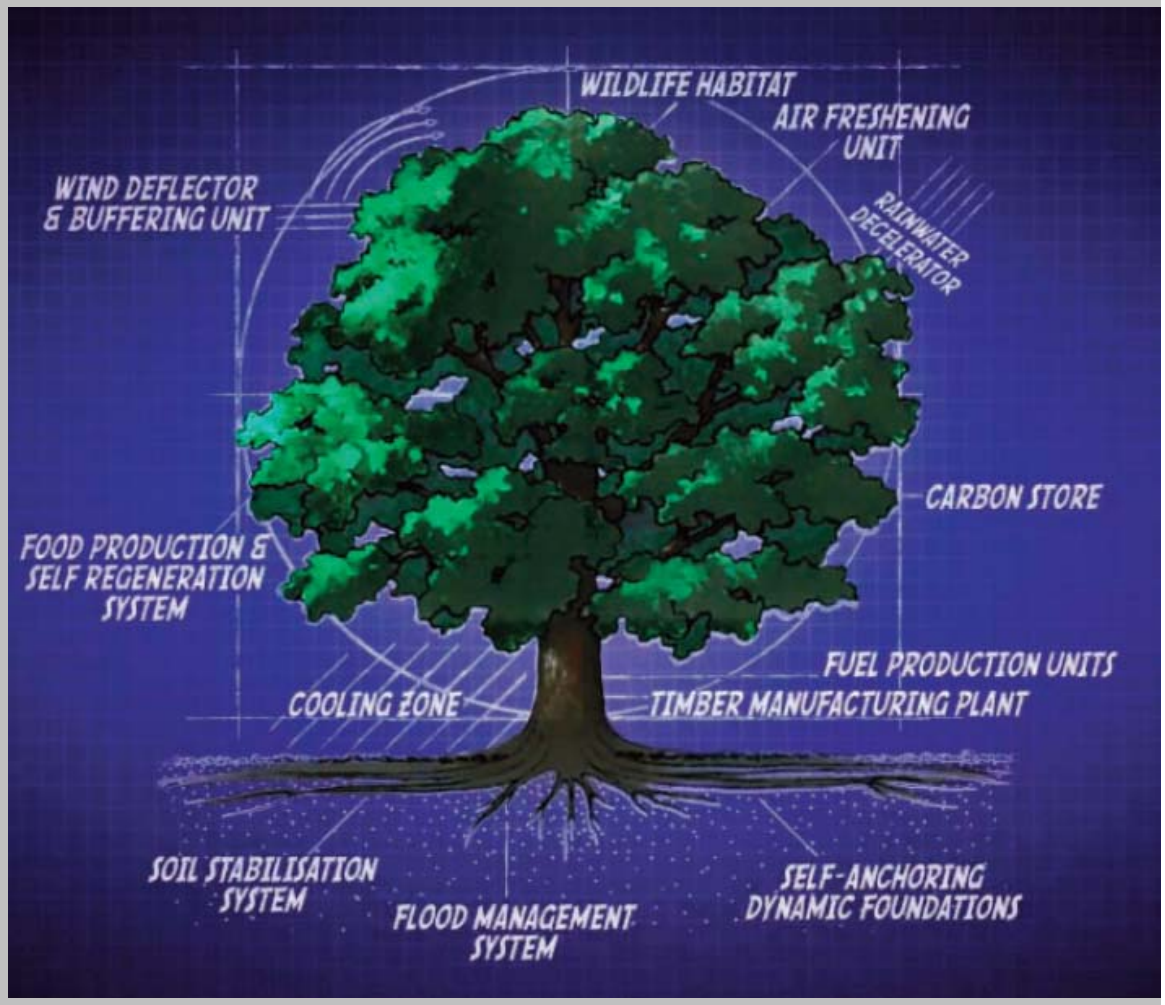
Why adapt forests to climate change?

- Trees are combined climate attenuation and carbon sequestration systems
- Woodland provides multiple ES delivery to society
- But …
- Rapid climate range shifts are happening
- Forest ecosystems are slow to adapt
- Need new species and provenances on some sites!
- Must also reduce the fragmentation of forest habitat



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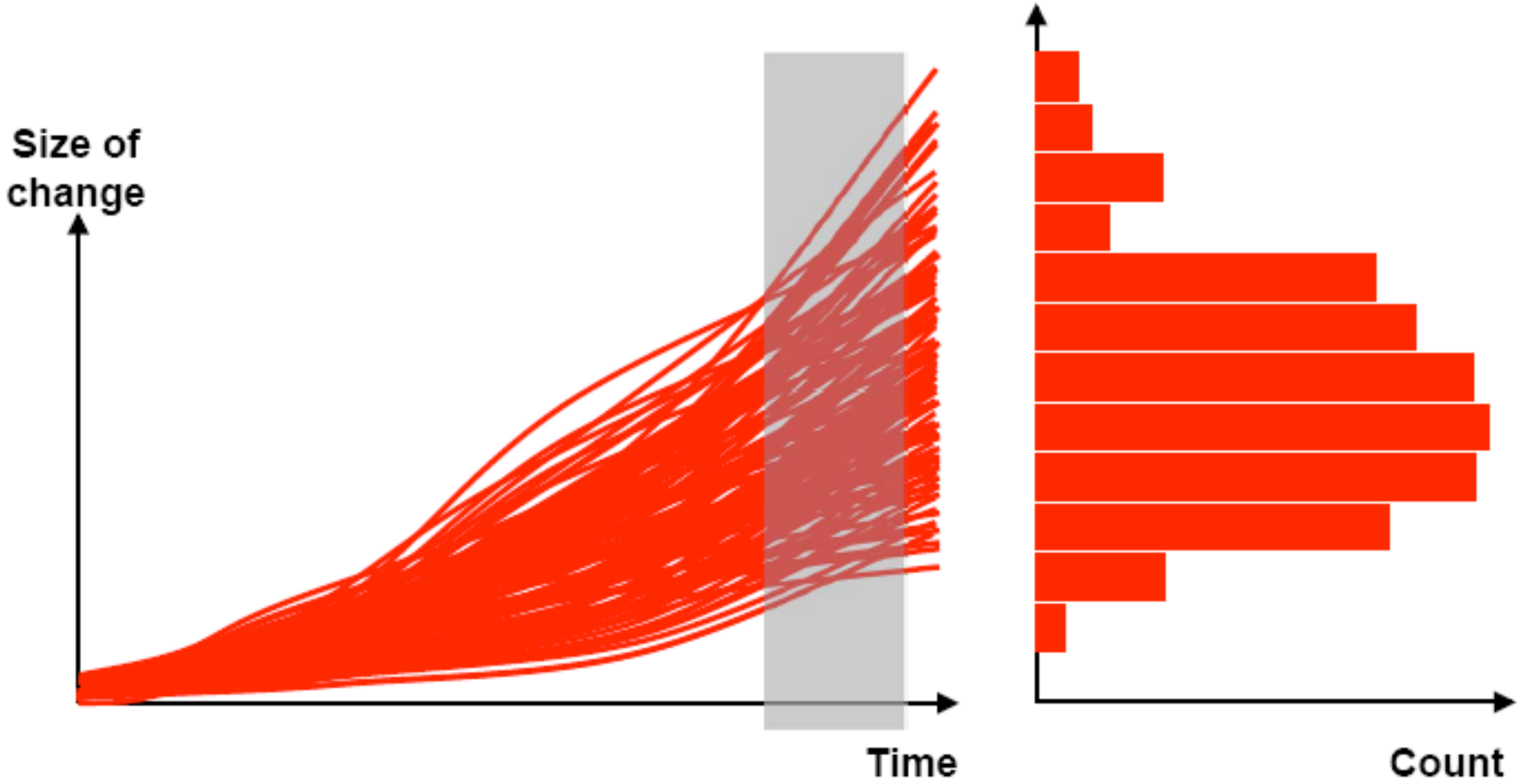
Uncertain future climate?



UK CLIMATE PROJECTIONS

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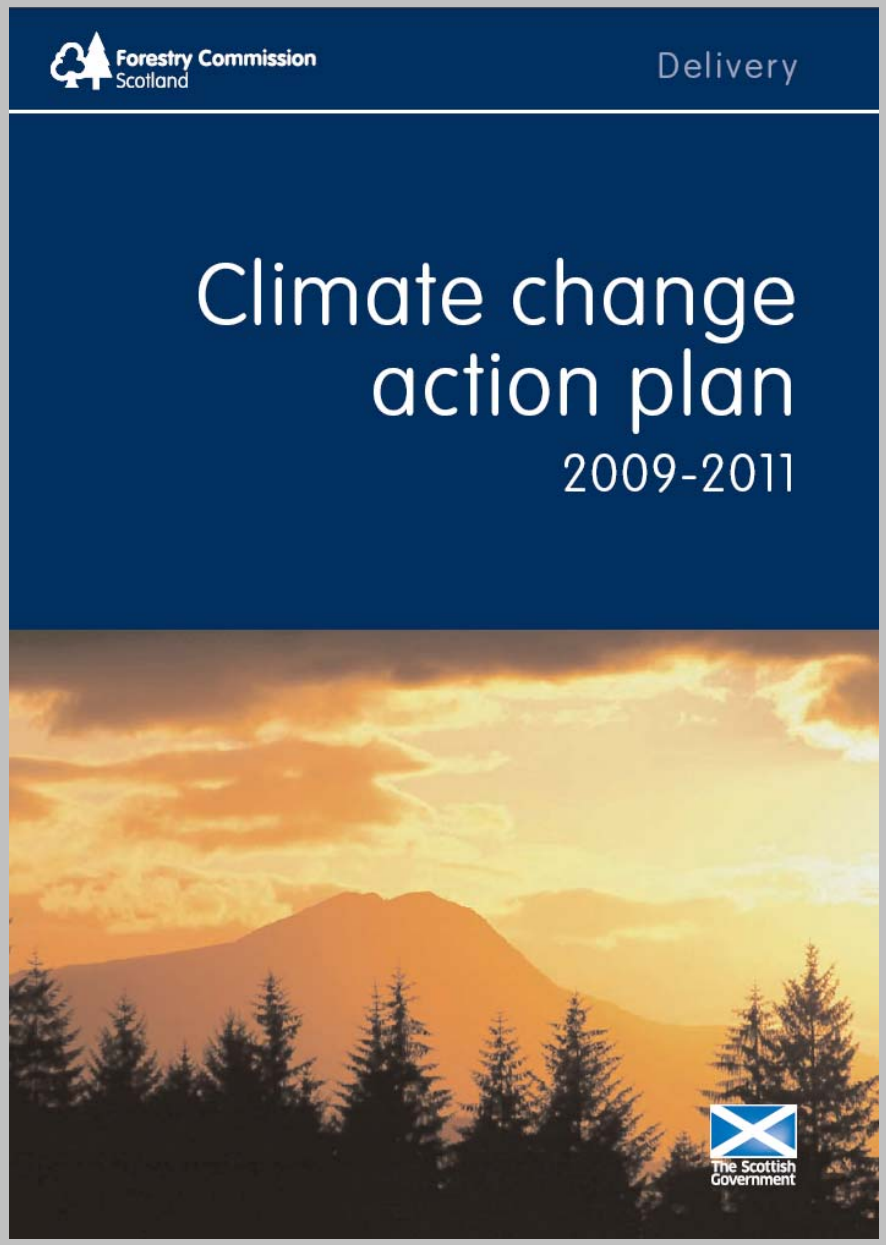
Scotland's Forestry and Climate Change Policy

- FCS and SG have CC Action Plan in place (2009)
- Sustainable Forest Management
- Minimise woodland removal
- Conserving forest carbon stocks
- Woodland creation in towns
- Carbon monitoring framework
- Habitat connectivity
- Woodland expansion
- Pests and Pathogens
- Adapting silviculture and species choice
- Identifying risk of slope instability
- Flood risk management
- Urban cooling
- Renewable energy
- Wood substitution
- Sector emissions
- Awareness raising



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Abiotic impacts (examples)

Winter

- Shallow rooting
- Wind disturbance
- Soil damage

Summer

- Summer drought stress and damage
- Drought restricted growth
- Increased risk of fire

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Key adaptation actions to reduce impacts

Windthrow

- Better site selection – avoid planting shallow rooted trees on very wet sites
- Thin early or not at all on exposed sites
- Shorter rotations – wood fuel

Drought

- Better site selection – avoid planting drought sensitive species on shallow freely draining soils in east
- Thin early to reduce competition for water

Pests and pathogens

- Better site selection
- Vigilance
- Mix species where possible
- Clear damaged forest quickly

Planning

- Spread the risk of damage across sites and topography
- Contingency plan
- Use current recommended guidance
- 'new' species – monitor and review

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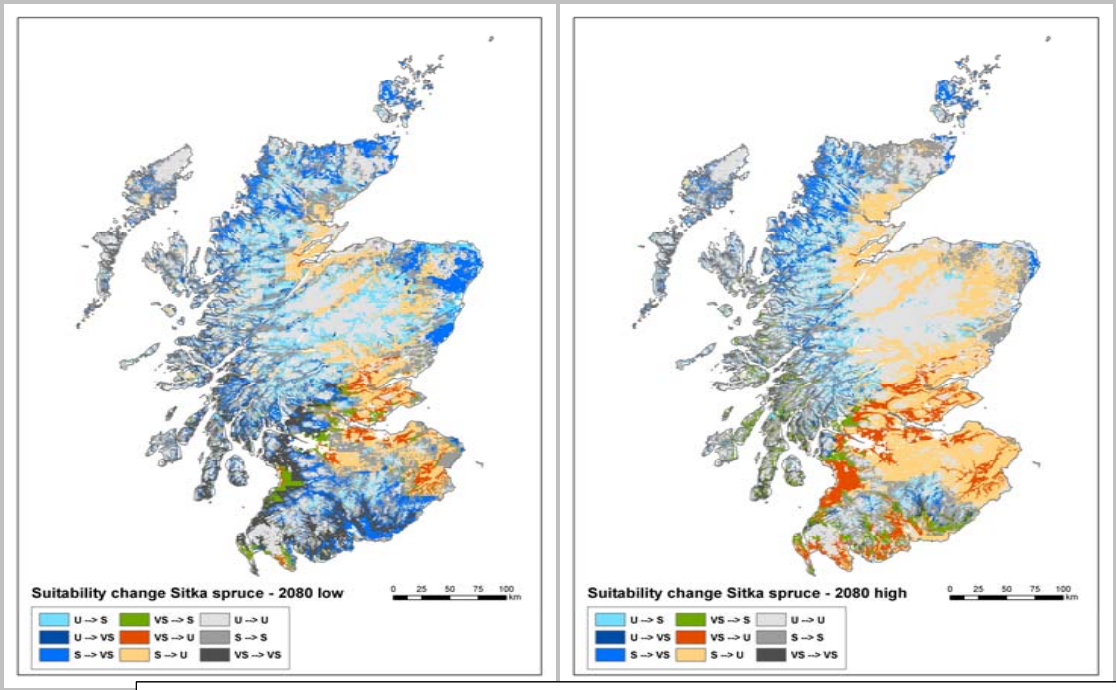
Tree species suitability

- Climate change proofing species choice using a forest site classification system

- Climatic risk assessments to efficiently time and target adaptation to climate change



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How does climate change impact biodiversity?

- Range shifts
- Competition between species
- Climate envelope modelling

Sekercioglu et al 2007. Conservation Biology, 22(1): 140-150.

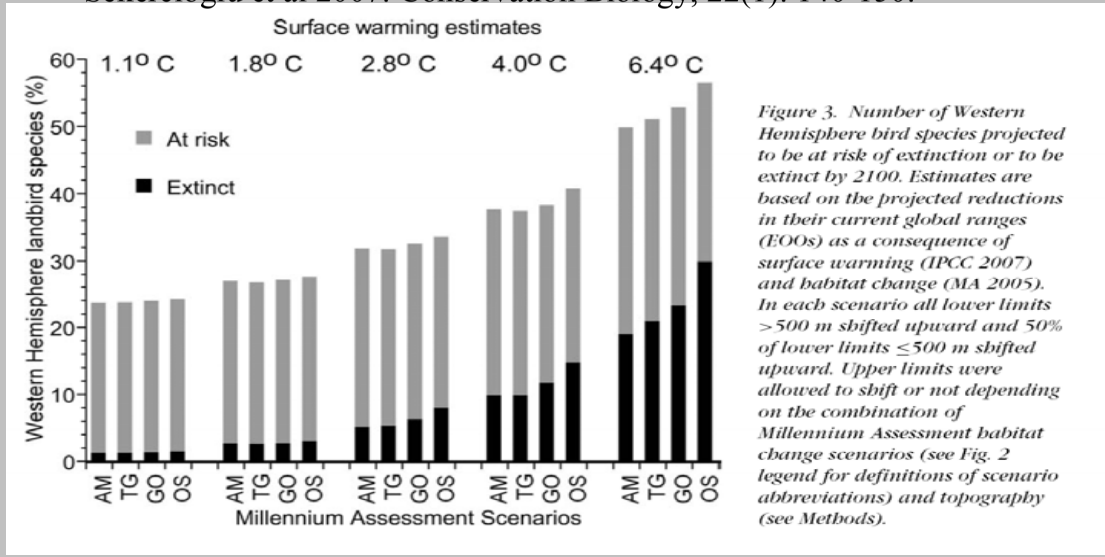
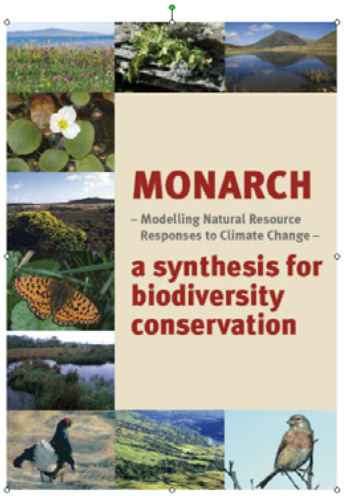
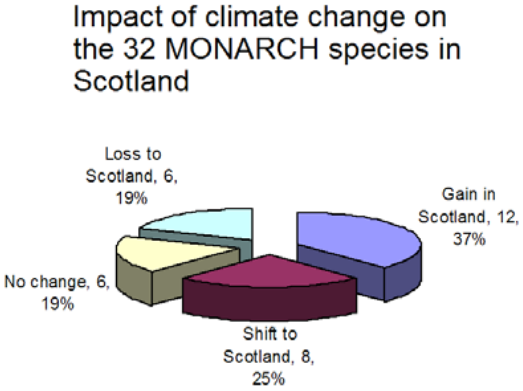


Figure 3. Number of Western Hemisphere bird species projected to be at risk of extinction or to be extinct by 2100. Estimates are based on the projected reductions in their current global ranges (EOOs) as a consequence of surface warming (IPCC 2007) and habitat change (MA 2005). In each scenario all lower limits >500 m shifted upward and 50% of lower limits ≤500 m shifted upward. Upper limits were allowed to shift or not depending on the combination of Millennium Assessment habitat change scenarios (see Fig. 2 legend for definitions of scenario abbreviations) and topography (see Methods).

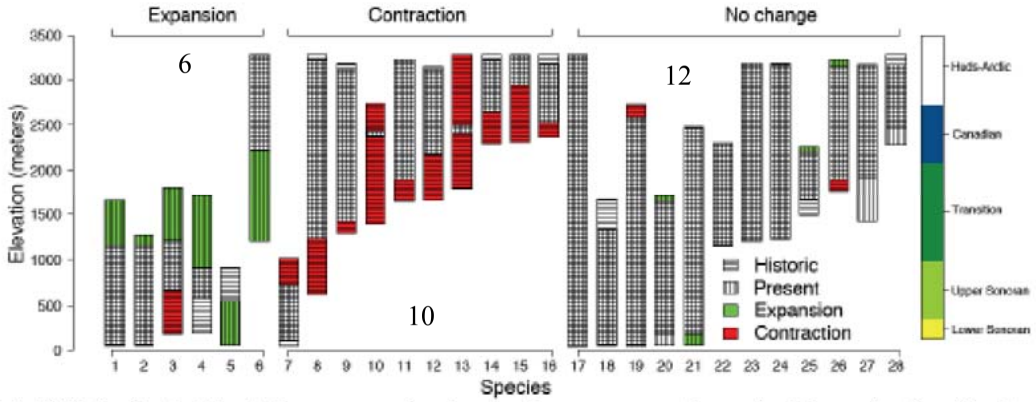




Walmsley et al 2007. Monarch Report, UKCIP

Running and Mills 2009. Terrestrial Ecosystem Adaptation

Figure 10. Elevational Range Changes for 28 Small-Mammal Species in Yosemite National Park over the Past Century



Note: Statistically significant changes are colored green for range expansion and red for contraction. Species were classified as "No change" if range shifts were <100m or <10% of previous elevation range.
Source: Moritz et al. 2008.

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How do landscapes interact with biodiversity and climate change?

- Habitat loss and fragmentation may exacerbate the impacts of climate change on biodiversity
- Land use change in a future climate?
- Forest Habitat Networks in Scotland

Vos *et al* 2008. Jnl Applied Ecology, 45, 1722-1731

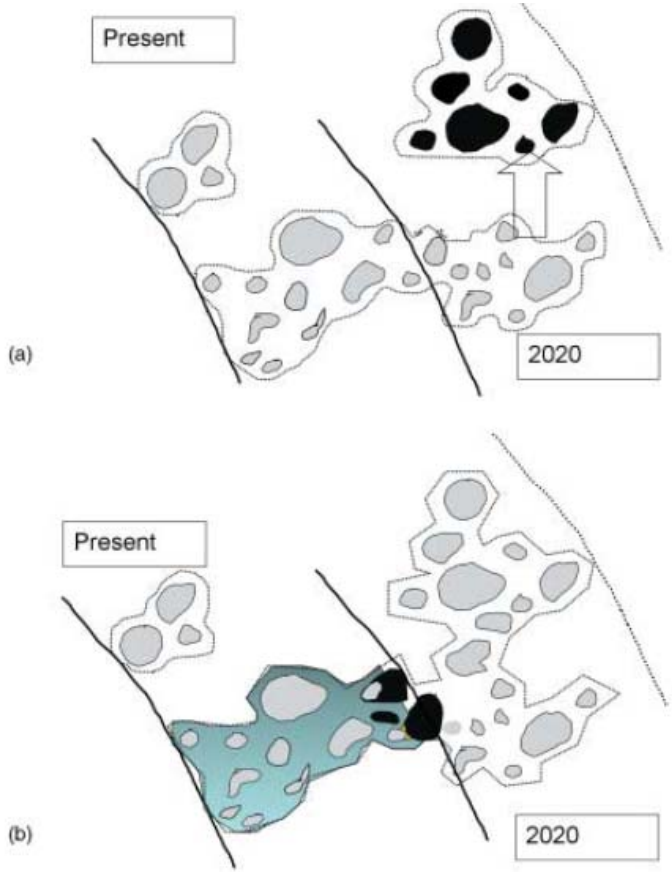

Fig. 2. (a) Link to climate-proof network. Although the dark network is situated in a climate space that becomes suitable in 2020, it is not climate proof as it is too isolated to become colonized. The arrow indicates the search area for adaptation measures. (b). Increase colonizing capacity. The shaded area indicates the overlap zone in the habitat network between two successive climatic time frames. The expanding capacity is improved by creating new habitat patches or enlarging existing habitat patches in the overlap zone (dark areas).

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Rounsevell *et al* 2006. Agriculture, Ecosystems and Environment 114 (2006) 57–68

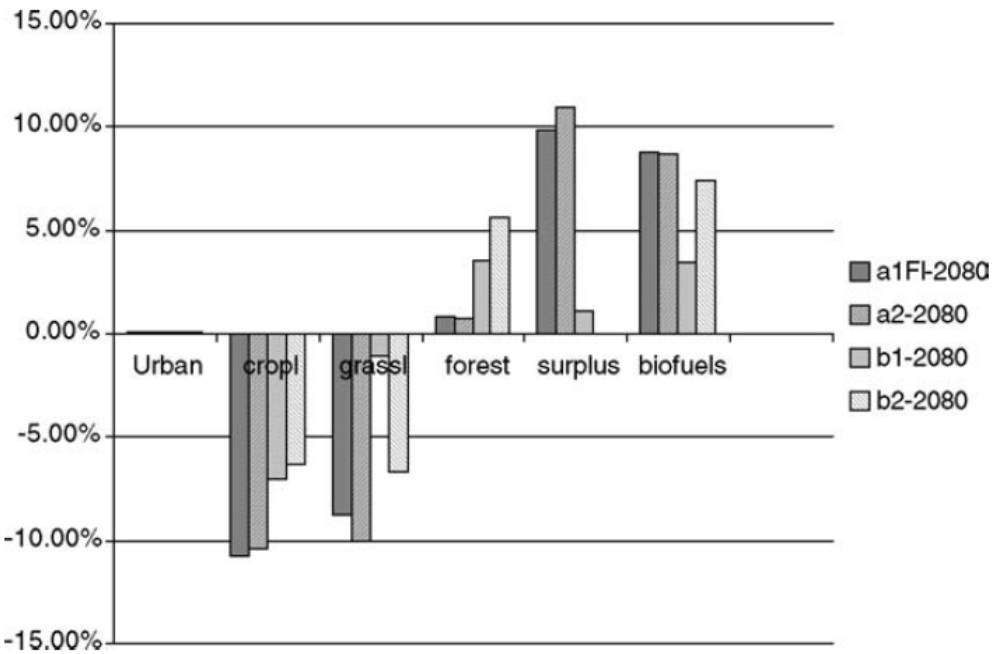

Fig. 2. Aggregated land use change trends in 2080 for Europe for the A1FI, A2, B1 and B2 (HadCM3) scenarios (the *y*-axis represents the absolute area as a percentage of the total European land area).

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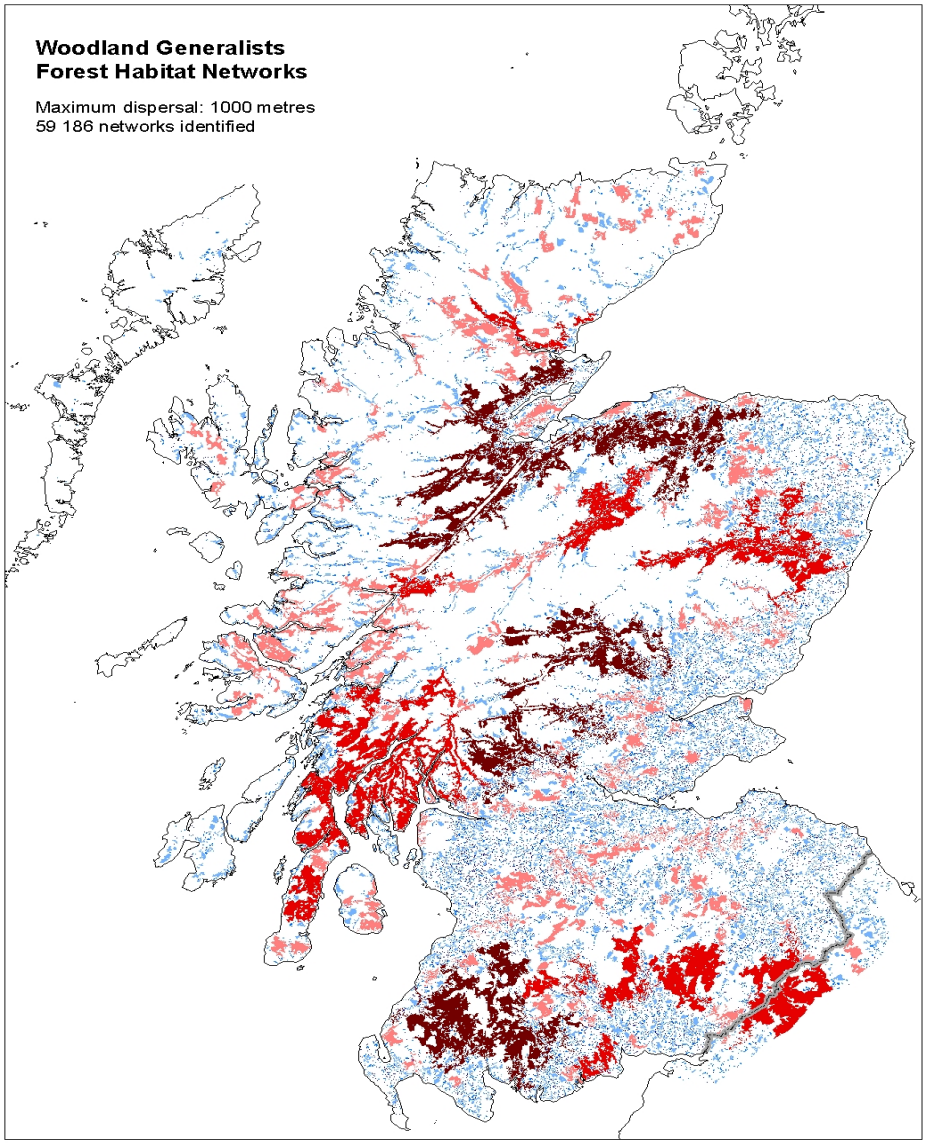

Watts et al (2010) *Landscape Ecology*, DOI 10.1007/s10980-010-9507-9.

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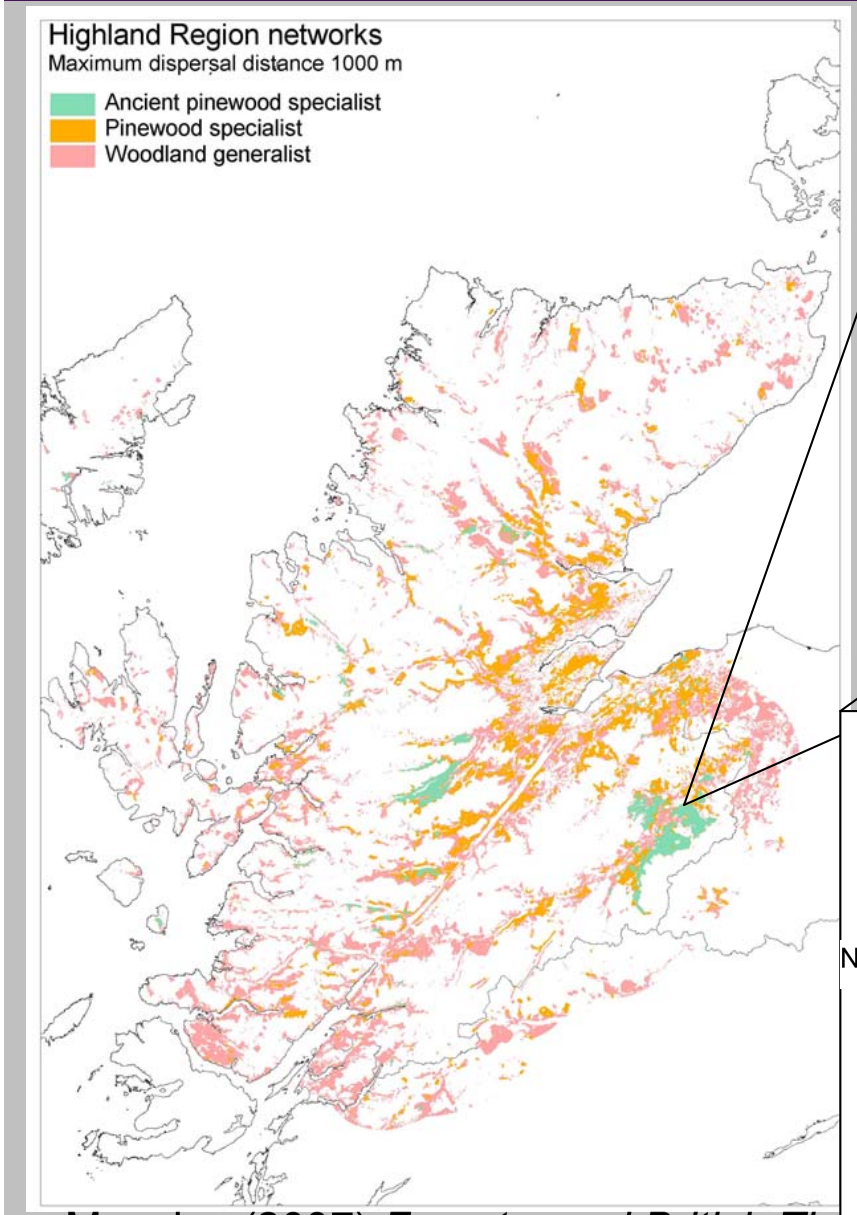
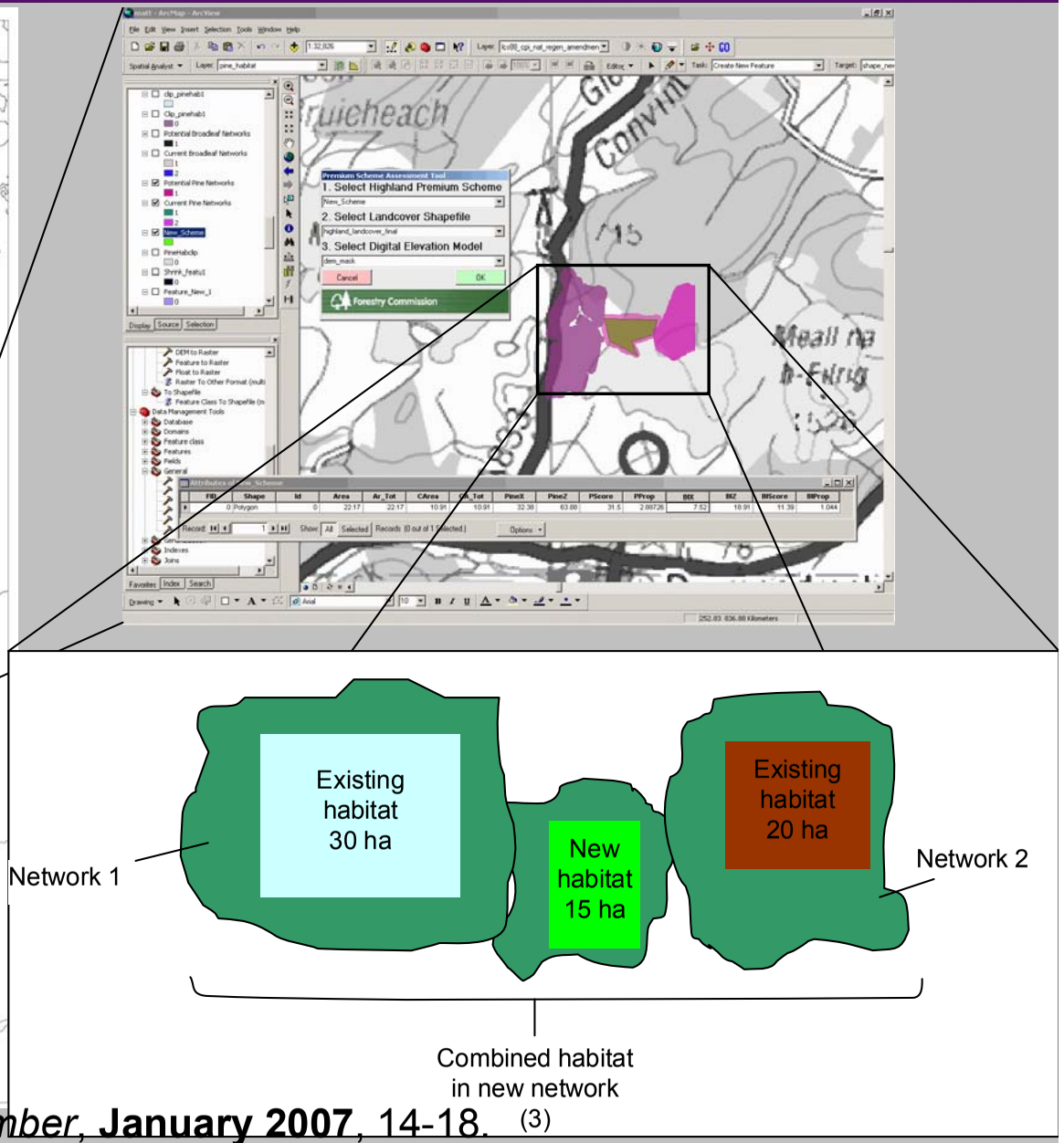
Highland Locational Premium Scheme





Moseley (2007) *Forestry and British Timber*, **January 2007**, 14-18. (3)

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Adapting woodlands and forests

Forest design, planning, structure and composition	Start to introduce more mixtures of species, silviculture, objectives and options to increase resilience.
Adaptive forest management	Management must remain flexible and anticipatory, using silviculture and operations that don't limit future options. But important to monitor and review.
Tree species selection	Tree species should be suited to sites, projected climate conditions and extreme events.
Woodland biodiversity	Maintain and improve habitat connectivity, improve landscape permeability to help dispersal and recolonisation.
Environmental protection and provision of Ecosystem Services	Forests and woodlands that are appropriately located, resilient and well managed can help alleviate some of the impacts of climate change on society.

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