



Biodiversity indicators of ground-dwelling spiders in plantation forests and native woodlands

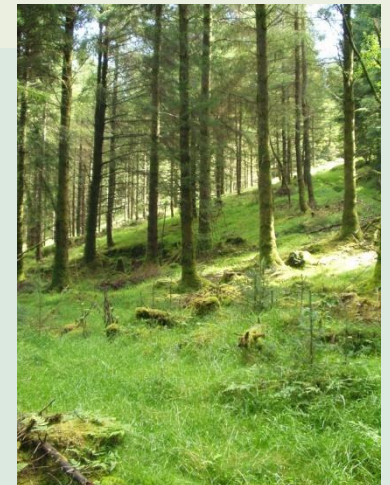
Anne Oxbrough, Sandra Irwin, Tom Kelly, John O'Halloran



Irish forests



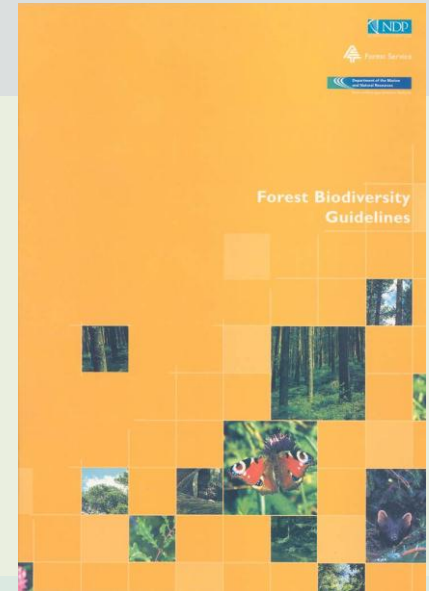
- Forest cover reduced to <math><1\%</math> by 1900s
- Increased to 10% today
- 1% of land area native woodland
 - Oak, Ash dominated
- Remaining area is plantation forest
 - Non-native conifers (Sitka spruce)
 - 55% state owned, now being reforested
 - 45% privately owned, afforestation of agricultural land
- Target of 17% cover by 2030



Irish Forest policy



- Developed to incorporate sustainable forest management in recent years
- Forest biodiversity guidelines (2000)
 - Planting of species mixtures
 - Broadleaf species
 - Areas for biodiversity enhancement
 - Retained habitats
 - Open space
- Recent planting trends
 - Increase in mixes
 - Increase in broadleaves



Research questions

- What lives in Irish native woodlands?
 - Are there any specialist species?
- What species are supported in plantations?
 - Monocultures and mixes
 - Second rotation
- What management practices can enhance plantation forest biodiversity?



Deadwood in native forest

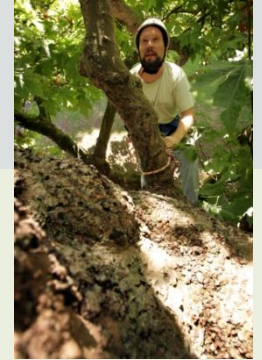


Deadwood in second rotation plantations

PLANFORBIO Research Programme



1. Forestbio



2. Hen Harrier



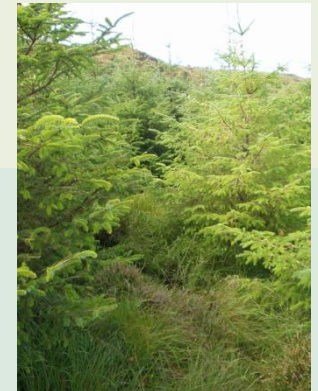
3. Rhododendron control

4. BIOPLAN Integrating research and management



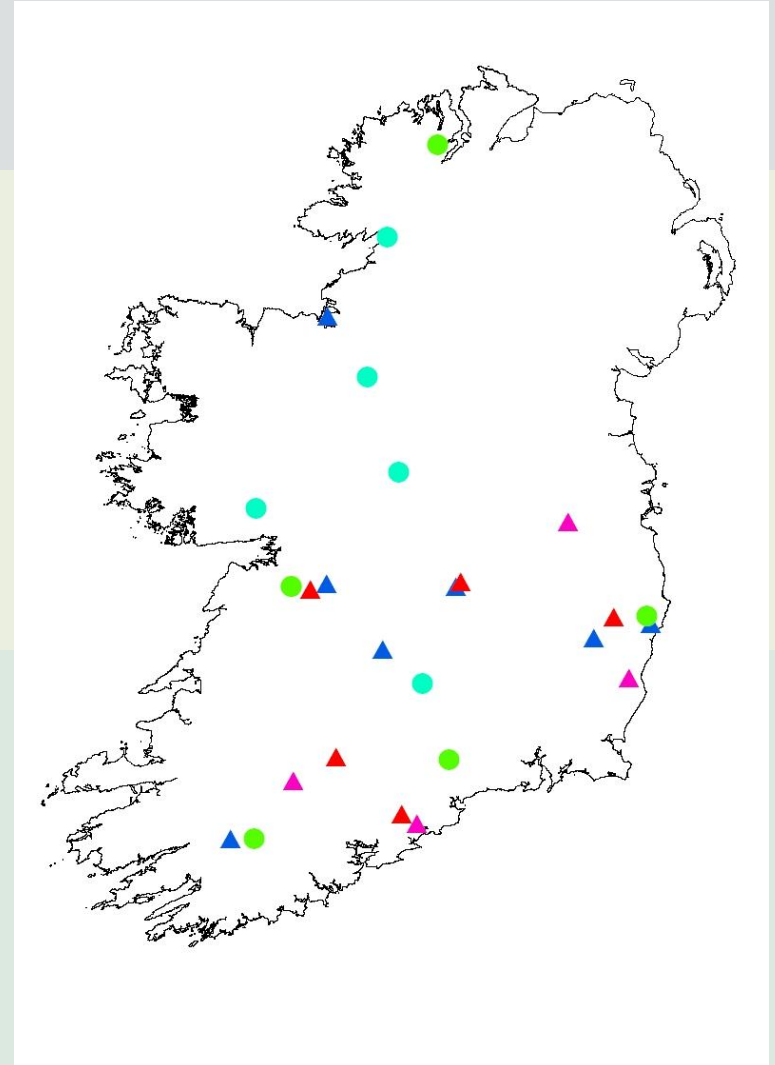
Using spiders to detect habitat change

- Influenced by vegetation structure
 - Prey availability
 - Web attachment
 - Hiding places for active hunters
 - Stable microclimate
 - Protection from predators
- Abundant
- Taxonomically well known
- Found in all vegetation layers
- Occupy a strategic position in food webs



Experimental design

- 2001 and 2007
- Plantations
 - ▲ 1st rotation Ash (4)
 - ▲ 1st rotation Sitka spruce (7 sites)
 - ▲ 2nd rotation Sitka spruce (5)
- Commercially mature plantations
- Range of soil types, altitudes
- Min 6ha size, 100m wide
- Native woodlands
 - Native ash dominated (5)
 - Native oak dominated (5)
- Appeared on 1920s maps



Spider sampling

- Pitfall traps
 - 6 pitfalls per plot
 - 2m apart
 - Between 3-5 plots per site
 - May-August

- Habitat variables
 - Stand structure
 - Vegetation structure
 - Deadwood cover
 - Litter cover and depth



Over view of results

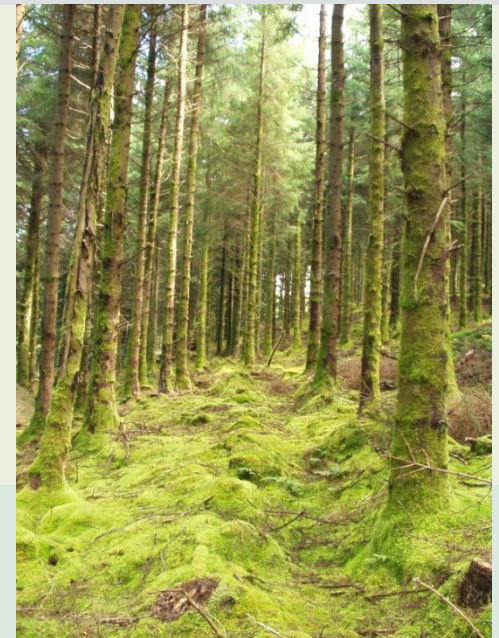
- 6871 adult individuals identified in 97 species

Sitka spruce plantation

- 19 forest assoc. species
- 2 assoc. with ancient, B/L
- 24 open assoc. species

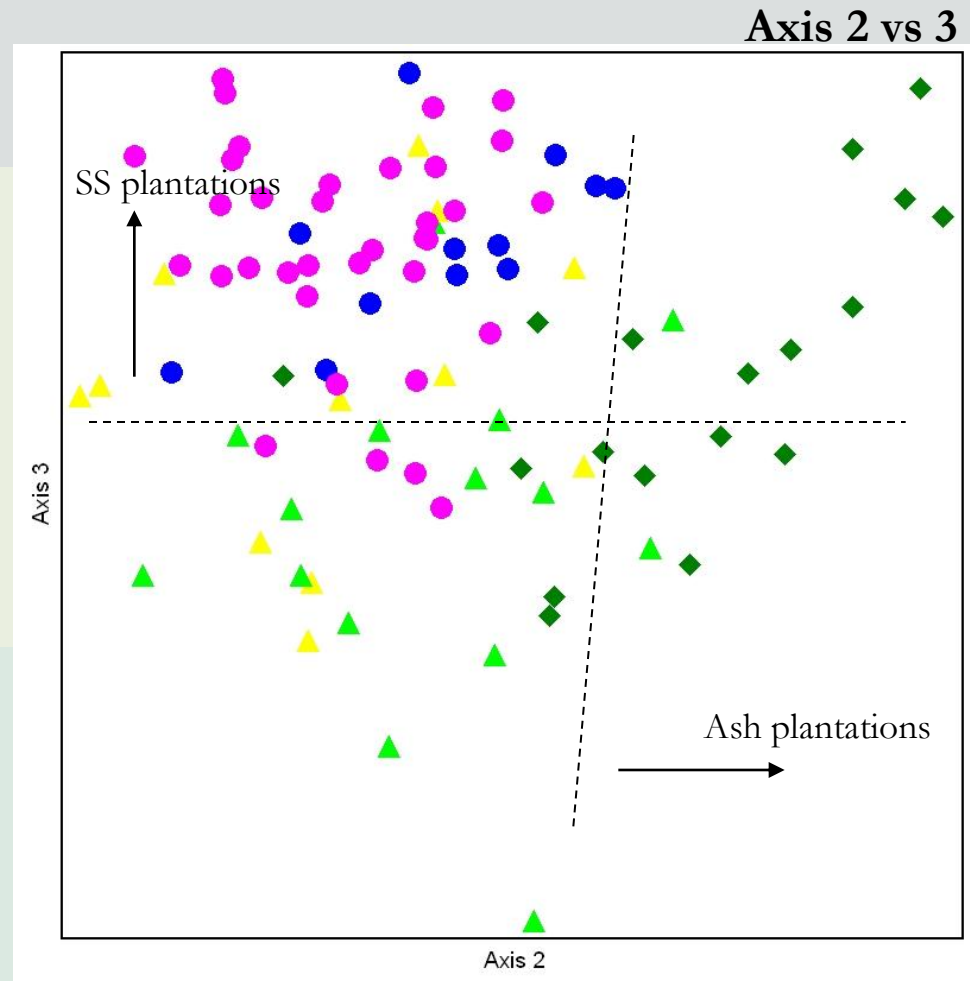
– Analyses

- Link diversity measures to habitat parameters



Spider assemblages among forest types

- SS 1st rotation plantation
- SS 2nd rotation plantation
- ◆ Ash plantation
- ▲ Oak Native woodland
- ▲ Ash native woodland

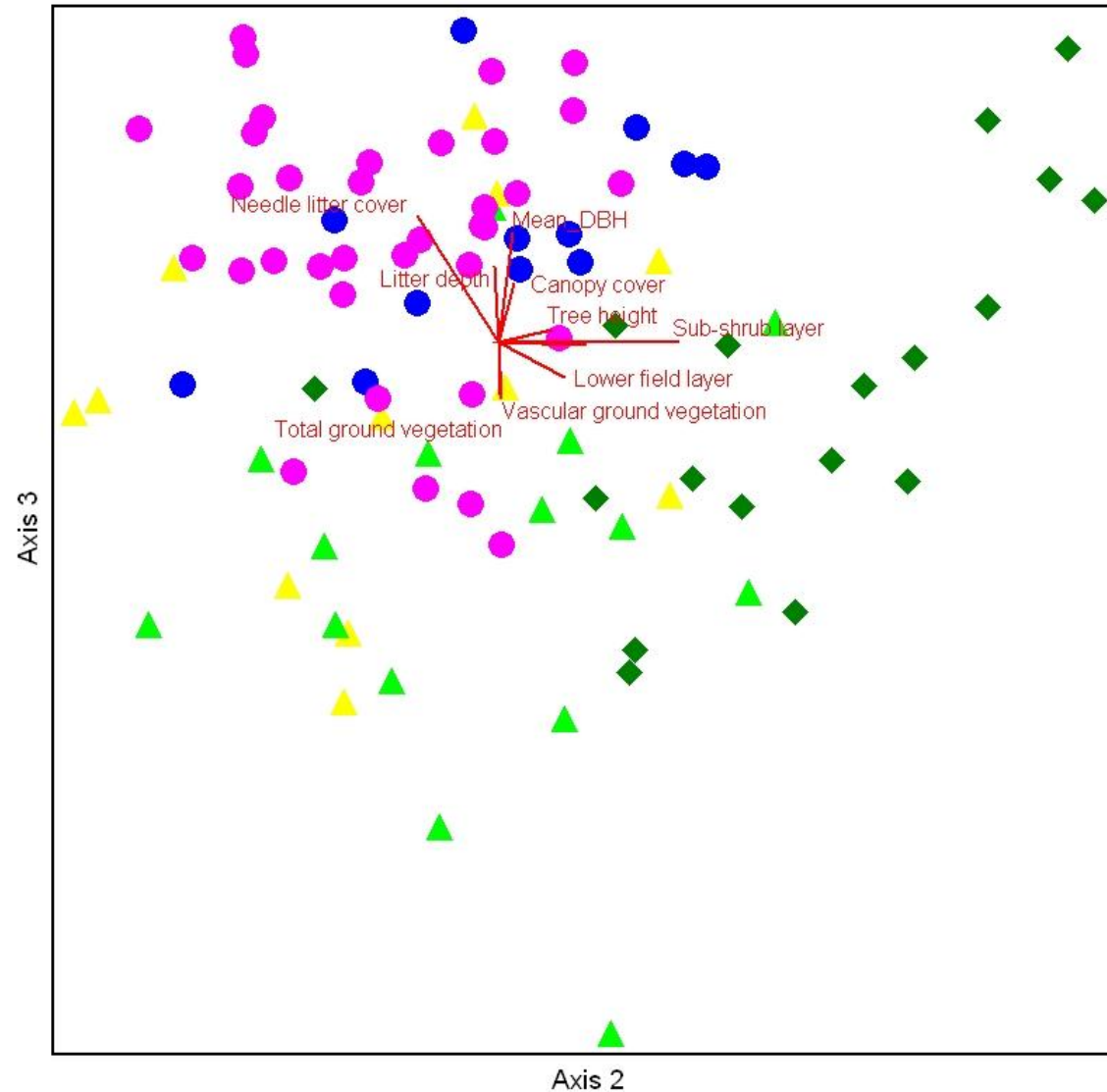




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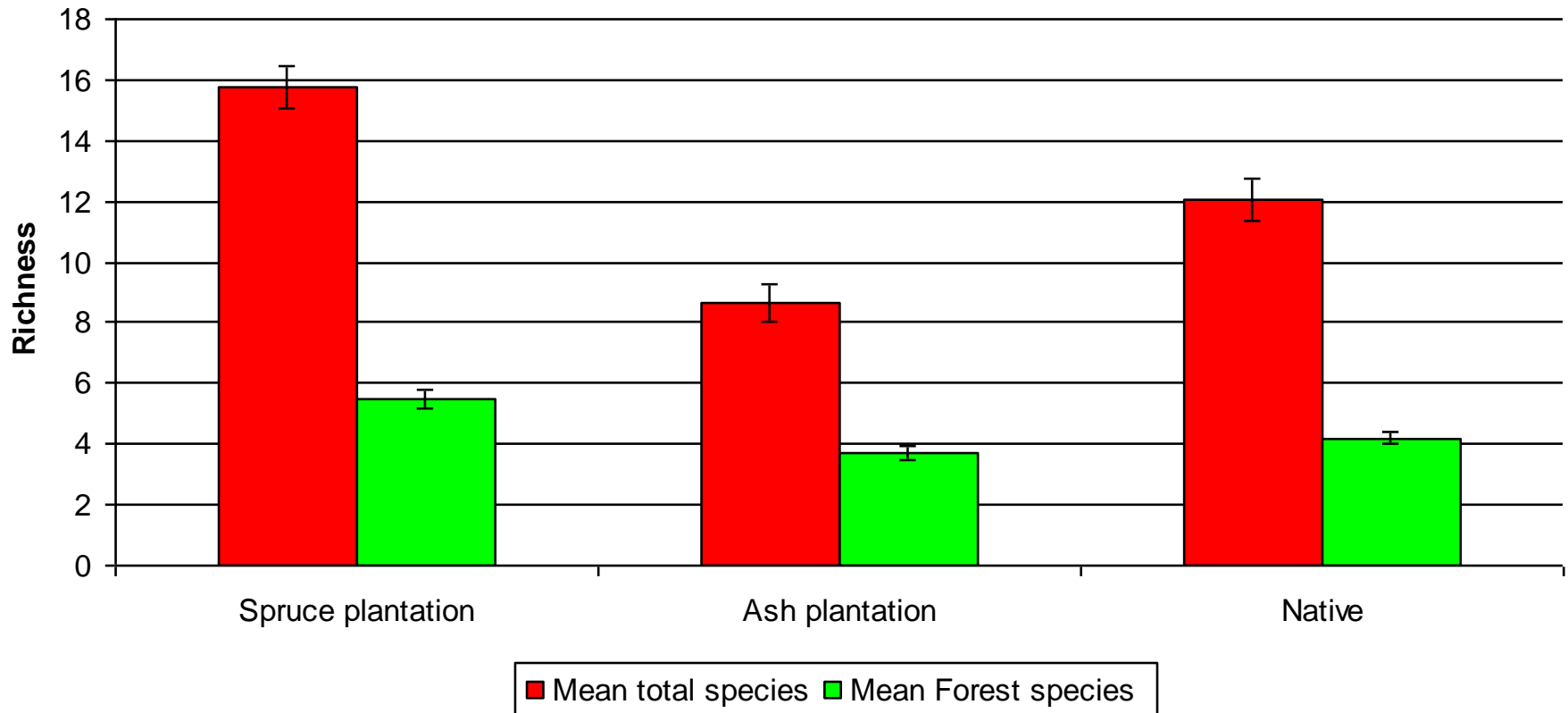
Assemblages and habitat variables

- SS 1st rotation plantation
- SS 2nd rotation plantation
- ◆ Ash plantation
- ▲ Oak Native woodland
- ▲ Ash native woodland



Correlations with axes: $r^2 > 0.2$

Richness analyses



Total species richness ($F = 21.7_{2,89} p < 0.001$)

Spruce plantation > Ash plantation and Native

Native > Ash plantation

Forest-associated species' richness

($F = 13.3_{2,89} p < 0.001$)

Spruce plantation > Ash plantation and Native

Native woodlands: relationship with habitat variables

Total species richness

(Model deviance = 35%, df_{3,33})

- **Non-vascular ground veg** (Z=-2.26, p<0.05)
- **Litter depth** (Z=-2.57, p<0.05)
- **Coarse woody debris** (Z=-2.18, p<0.05)



Forest associated species' richness

(Model deviance = 24%, df_{1,33})

- **Non-vascular ground veg** (Z=-2.11, p<0.05)



Microneta viaria (D = 53%, df_{2,33})

+ **Leaf litter cover** (Z= 2.44, p<0.05)

+ **Understorey cover** (Z= 2.25, p<0.05)

Agyneta ramosa (D = 41%, df_{2,33})

+ **Understorey cover** (Z= 3.01, p<0.01)

+ **Tree distance** (Z= 1.94, p<0.05)

Spruce plantations

Total species richness

(Model deviance = 43%, df_{3,40})

- **Canopy cover** (Z=-2.71, p<0.01)
- **Non-vascular ground veg** (Z=-1.95, p<0.05)
- + **Lower field layer veg** (Z=1.91, p<0.05)



Forest associated species' richness

(Model deviance = 29%, df_{1,40})

- **Canopy cover** (Z=-1.83, p<0.06)



Lepthyphantes flavipes (D = 14%, df_{2,40})

- **Canopy cover** (Z=-2.18, p<0.05)
- + **Needle litter cover** (Z=1.82, p<0.06)

Lepthyphantes alacris (D= 15%, df_{2,40})

- **Canopy cover** (Z=-1.83, p<0.06)
- **Non-vascular ground veg** (Z=-1.91, p<0.05)

Lepthyphantes tenebricola (D = 23%, df_{1,40})

- **Canopy cover** (Z=-2.76, p<0.01)



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Ash plantations (Pearson Correlations, n=17)

Total species richness

+ **Vascular ground veg** ($r = 0.61, p < 0.01$)

Forest-associated species' richness

+ **Vascular ground veg** ($r = 0.65, p < 0.01$)

+ **Canopy cover** ($r = 0.62, p = < 0.01$)

- **Non-vascular ground veg** ($r = -0.51, p = < 0.05$)





Potential biodiversity indicators

- Across all forest types
 - Neg with non-vascular ground veg
 - Predominately moss, less structurally diverse
- Native woodlands
 - Specialists positive with leaf litter cover, understory, tree distance
 - Assemblages: structural diversity of vegetation layers
- Sitka spruce plantations
 - Neg with canopy cover
 - LFL pos with total SR = generalists
- Ash plantations
 - Specialists: positive with vascular ground veg and canopy cover

Forest management for spiders?

- Emulate structural characteristics of native woodlands
- Promote vegetation layers, in particular understory and vascular ground veg
 - SS not ecological 'desert' BUT,
 - Generalists and open species
 - Not just through opening canopy
 - More open canopy = generalists?
- Greater structural diversity under the canopy
 - Increase mixed plantations (BL species)
 - Forest biodiversity guidelines

Oak/Norway spruce mix



Conclusions

- Management to promote forest specialists
 - Total SR not necessarily native woodland specialists
- How much of a forest associated fauna actually exists in Ireland?
 - Saproxylic species
- Reforestation
 - Felling etc
- Other taxonomic groups
 - Complimentarity
 - Testing indicators



Acknowledgements



- Colleagues on the PLANFORBIO Research Programme (<http://www.ucc.ie/planforbio/>)
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