CONSERVATION IN FRAGMENTED LANDSCAPES UNDER CLIMATE CHANGE

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SPECIES NEED TO MOVE BECAUSE OF CLIMATE CHANGE

Huntley et al. (2007) A climatic atlas of European breeding birds
SPECIES IN BRITAIN ARE ON AVERAGE SHIFTING NORTHWARDS

Each individual landscape will have species moving in and out

LACK OF HABITAT IS PRIME CULPRIT IN SPECIES FAILURE TO SHIFT

NEW FOCUS ON HABITAT RESTORATION – MORE, BIGGER, BETTER, JOINED

- Why traditional conservation (habitat quality in special sites) still works
- What is the role for agri-environment schemes?
- Where is best to restore?
WHY COULD TRADITIONAL APPROACHES STILL WORK?

• Invasion theory
  • Speed ~ reproduction x dispersal
  • reproduction ~ habitat quantity x quality
• Mini review of empirical evidence (to 2010)
  • Habitat area effects often stronger than isolation effects
  • Habitat quality effects sometimes even greater than area effects
  • Current range expansions being limited by habitat amount

EXISTING PROTECTED AREAS ARE BEING USED TO ACHIEVE RANGE EXPANSIONS

Colonization of PAs relative to PA availability

Same after the exclusion of urban, suburban, and arable land

ACTIVE CONSERVATION MANAGEMENT IMPROVES COLONISATION PROSPECTS

- Voluntary management (Agri-environment schemes) had no sig. effect

CONCLUSIONS:
• PROTECT EXISTING HABITAT
• ESPECIALLY WHERE IT ALREADY COVERS CLIMATE GRADIENT
• IMPROVE HABITAT QUALITY TO INCREASE SOURCE POPULATION SIZES

NOW TO THE WIDER, FARMED LANDSCAPE
WHAT ROLE FOR WILDLIFE-FRIENDLY (ORGANIC) FARMING?

BUTTERFLY ABUNDANCE MODEST INCREASE

- Organic average 1.4 times conventional
- Reserves average 5 times organic
BUTTERFLY DENSITY IN ENTIRE LANDSCAPE DEPENDS ON LAND-USE TRADE-OFFS

- Threshold of organic:conventional yield 87%

![Graph showing the relationship between percent organic and percent reserves, with average butterfly abundance indicated by color, and an asterisk marking the point of 87% organic yield.]
AES MARGINS ONLY BENEFIT SPECIALIST MOTHS AT HIGH CONNECTIVITY TO SEMI-NATURAL HABITAT

Photos: C van Noordwijk; J Hodgson; J Alison

CONCLUSIONS:
• GENERAL-PURPOSE AES BENEFITS DEBATABLE
• MAY BE AREA-INEFFICIENT
• MAY ONLY RECEIVE “SPILLOVER” FROM SEMI-NATURAL HABITAT

NOW TO PLANNING RESTORATION
WITH GIVEN AREA OF HABITAT, WHAT’S THE OPTIMAL SPATIAL ARRANGEMENT?

• “Classical” principles of reserve arrangement
  • Aim to prevent population decline and extinction
  • Theory recommends clustering/ aggregation
    • Rescue after chance extinctions
    • Less dispersal mortality
BUT WITH CLIMATE CHANGE

- Bigger aggregated clumps mean bigger gaps
- “increase connectivity” is ambiguous
LOCAL VIABILITY DOES NOT PREDICT RANGE SHIFT SPEED

NEW METRIC OF CONDUCTANCE PREDICTS SPEED OF RANGE EXPANSION

‘FLOW’ THROUGH EACH CELL SHOWS IMPORTANT ROUTES

• Leads to ‘dropping’ routine

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FROM THEORY TO SOFTWARE: CONDATIS
APPLICATIONS, E.G. BUGLIFE B-LINES

TARGET

SOURCES

Ranking for restoration (brown high)
CONCLUSIONS FOR CONSERVATION PLANNING

• Protect existing habitat
  • Especially where it already covers climate gradient
• Improve habitat quality to increase source population sizes
• General-purpose AES benefits debatable
  • May be area-inefficient
  • May only receive “spillover” from semi-natural habitat

• Restoration is potentially high-risk, high reward
  • Don’t try to connect everything!
  • Find key bottlenecks e.g. using Condatis
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