ECOLOGICAL ENHANCEMENTS – THE EVIDENCE BASE FOR SUCCESS OF ENHANCEMENT TECHNIQUES

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Contents

- Definition
- Examples
- Evidence for Success
- Conclusions

Ecological Enhancements - Definition

- Measures proposed to improve the ecological assets of a given site.
- Independent of the impact assessment, i.e. not mitigation or compensation.
- Ecological enhancements may be included in proposed developments, even those without anticipated significant ecological impacts, because:
  - The National Planning Policy Framework (NPPF) 2012 places a responsibility on Local Planning Authorities to aim to conserve and enhance biodiversity and to encourage biodiversity in and around developments.
  - There is a general biodiversity duty in the Natural Environment and Rural Communities (NERC) Act 2006 (Section 40) which requires every public body in the exercising of its functions to 'have regard, so far as is consistent with the proper exercise of those functions, to the purpose of conserving biodiversity'. Biodiversity, as covered by the Section 40 duty, includes all biodiversity and not just Habitats and Species of Principal Importance.

Examples

- **Mammals** – bat boxes, new/restored hedgerows, new woodland plantings
- **Birds** – nest boxes, wild bird seed mixes
- **Reptiles** – new hibernacula creation
- **Amphibians** – new ponds, pond management/restoration, new hibernacula creation
- **Invertebrates** – beetle banks, field margins, nectar seed mixes

Evidence for Success

Bat boxes:

- Berthinussen,A., Richardson O. C. and Altringham J.D. (2014). Bat Conservation: Global evidence for the effects of interventions. Pelagic Publishing

  Key conclusions: bat box efficacy highly variable; efficacy can be influenced by controllable factors such as location/position, design of box and number of boxes.

- Meddings A., et al. (2011). Managing competition between birds and bats for roost boxes in small woodlands, north-east England. *Conservation Evidence* 8: 74-80

  Key conclusions: high numbers of bat boxes can be used by birds (>40%); providing bird boxes can significantly reduce bird use of bat boxes; based on observed occupancy limits, the optimal number of boxes to install in small woodland areas is 9-12 (installing three boxes per tree).

- Aughney, T. (2008). An investigation of the impact of development projects on bat populations: Comparing pre- and post-development bat faunas. Irish Bat Monitoring Programme. Bat Conservation Ireland, www.batconservationireland.org

  Key conclusions: woodcrete boxes more successful than timber boxes; 1FS woodcrete bat boxes tended to be occupied by birds; monitoring and management is important to counter insects, bird nesting and vandalism.

- Dodds M. and Bilston H. (2013). A comparison of different bat box types by bat occupancy in deciduous woodland, Buckinghamshire, UK. *Conservation Evidence* 10: 24-28

- Bilston H. (2014). Maximising occupation of bat boxes in an ancient woodland in Buckinghamshire: a summary of recent research. BSG Ecology

  Key conclusions: seasonal bird competition influences which boxes are most successful; Schwegler 1FS and 2FN boxes most effective in attracting use by BLE and Natterer's bats (2F also decent); timber boxes poor results; boxes 20m apart at varying heights (3-6m); shaded boxes can be successful.

Schwegler 1FS vs. the new 3FS

(with anti-bird modifications)

Mystery Cornwall bat boxes

(self-cleaning and no bird nesting potential)

Evidence for Success (cont.)

Nest boxes

- Johnson P.N. (1994). Selection and use of nest sites by barn owls in Norfolk, England. *Journal of Raptor Research*, 28, 149-153

- Petty S.J., Shaw G. & Anderson D.I.K. (1994). Value of nest boxes for population studies and conservation of owls in coniferous forests in Britain. *Journal of Raptor Research*, 28, 134-142

  Key conclusions: nest box provision can be effective in attracting species and even increasing populations.

  *Kingfishers, swallows, swifts, house martins, sand martins – couldn't find nest box success rate information.

- Raivo Mänd R., Tilgar V., Lõhmus A. and Leivits A. (2005). Providing nest boxes for hole-nesting birds – Does habitat matter? *Biodiversity & Conservation* 14(8): 1823-1840

  Key conclusions: 'Ecological trap' concept; nest boxes caused a supra-optimal breeding density resulting in lower fledging rates and body weights; be careful in providing large numbers of artificial nest sites in preferred habitats as opposed to improving less favourable habitats by removing critical constraints. Nest boxes unlikely to increase the population unless nest site availability is the factor limiting population growth. If that is not the case then introducing more nest sites might even have a negative effect on the target species or other species.

- Björklund H., Valkama J., Saurola P. and Laaksonen T. (2013). Evaluation of artificial nests as a conservation tool for three forest-dwelling raptors. *Animal Conservati*on 16: 546–555

  Key conclusions: the probability of successful nesting of goshawk and common buzzard was lower in artificial nests as compared to natural nest sites; breeding at artificial nests can still add to the population, if otherwise non-breeding individuals settle to nest.

- Klein A., Nagy T., Csörgő T. and Mátics R. (2007). Exterior nest-boxes may negatively affect Barn Owl Tyto alba survival: an ecological trap. *Bird Conservation International* 17: 273-281

  Key conclusions: owlets developing in nest-boxes had significantly lower survival than those hatched in Hungarian church towers (the 'natural' nest location).

Evidence for Success (cont.)

New hedgerows

- MacArthur and EO Wilson's theory of island biogeography fundamental to conservation ecology – spawned corridor concept. Corridor concept is supported by evidence but how significant are hedgerows as corridors?

- Davies Z.G. and Pullin A. S. (2007) Are hedgerows effective corridors between fragments of woodland habitat? An evidence-based approach. *Landscape Ecology* 22(3): 333-351

  Key conclusions: the utility of hedgerows as corridors between woodland habitat patches examined via a review of 26 studies; the studies provided anecdotal evidence of positive local population effects and indicated that some species use hedgerows as movement conduits (no effects confirmed statistically).

- Öckinger E. and Smith H.G. (2008) Do corridors promote dispersal in grassland butterflies and other insects? *Landscape Ecology* 23(1): 27-40

  Key conclusions: "corridors do not always have positive effects on insect dispersal and that the effect seems to depend on the quality of the surrounding matrix, on the spatial scale in which the study is performed and on whether true dispersal or routine movements are considered." [Also the quality of the connected habitats and the corridor.]

  I.e., semi-improved grassland would be a better matrix than arable or scrub; more species would find their way across a short hedge than a long one; a hedge between two ancient woodlands would convey more species than a hedge between two conifer plantations; a 2.5m wide hedge with a ditch and 4m buffer would convey more species than a 1.5m wide hedge only.

Evidence for Success (cont.)

- Boughey K.L., Lake I.R., Haysomb K.A. and Dolman P.M. (2011) Improving the biodiversity benefits of hedgerows: How physical characteristics and the proximity of foraging habitat affect the use of linear features by bats. *Biological Conservation Vol. 144(6): 1790–1798*

- Brandt G., Blows L., Linton D., Paling N. and Prescott C. (2007) Habitat associations of British bat species on lowland farmland within the Upper Thames catchment area. *Centre for Wildlife Assessment & Conservation E-Journal 1: 10-19*

  Key conclusions: generally speaking, bats favour hedgerows for commuting and foraging (hedge height and standard trees are important characteristics for soprano pipistrelle).

- Kotzageorgis G. C. and Mason C. F. (1997), Small mammal populations in relation to hedgerow structure in an arable landscape. *Journal of Zoology 242: 425–434.*

  Key conclusions: hedgerows also serve as habitat in their own right, not just as movement corridors; wood mouse, yellow-necked mouse, bank vole, field vole, common shrew, pygmy shrew, water shrew and harvest mouse all captured from hedgerows in arable farmland in eastern England; habitat value influenced by hedgerow condition, age, plant species composition, proximity of water/woodland and margin characteristics.

Evidence for Success (cont.)

Hibernacula (reptiles and amphibians)

- Stebbings R. (2000). Reptile hibernacula - providing a winter refuge. *Enact* 4-7
- Showler D.A., Aldus N. and Parmenter J. (2005). Creating hibernacula for common lizards *Lacerta vivipara*, The Ham, Lowestoft, Suffolk, England. *Conservation Evidence* 2: 96-98
- Whiting C. and Booth H. (2012). Adder *Vipera berus* hibernacula construction as part of a mitigation scheme, Norfolk, England. *Conservation Evidence* 9: 9-16
- Latham D. and Knowles M. (2008). Assessing the use of artificial hibernacula by great crested newts Triturus cristatus and other amphibians for habitat enhancement, Northumberland, England. *Conservation Evidence 5*: 74-79

  Key conclusions: created reptile/amphibian hibernacula can be successful; design and surrounding habitat are important variables.

Pond creation/restoration

- Lesbarrères D., Fowler M. S., Pagano A. and Lodé T. (2010). Recovery of anuran community diversity following habitat replacement. *Journal of Applied Ecology* 47: 148–156
- Rannap R., Lõhmus A. and Briggs L. (2009). Restoring ponds for amphibians: a success story. *Hydrobiologia* 634: 87-95
- Baker J.M.R. and Halliday T.R. (1999). Amphibian colonisation of new ponds in an agricultural landscape. *Herpetological Journal* 9: 55-64

  Key conclusions: pond creation for amphibians can be successful; design and surrounding habitat are important variables.

Evidence for Success (cont.)

Habitat creation on intensively managed farmland

- Kleijn D., Baquero R.A., Clough Y., Día M., De Esteban J. and Fernández F. (2006). Mixed biodiversity benefits of agri-environment schemes in five European countries. *Ecology Letters* 9: 243-254

  Key conclusions: AES had marginal to moderately positive effects on biodiversity, but this was strongly biased towards common species.

- Fuentes-Montemayor E., Goulson D. and Park K.J. (2011). Pipistrelle bats and their prey do not benefit from four widely applied agri-environment management prescriptions. *Biological Conservation* 144: 2233–2246

  Key conclusions: "the implementation of the four common AES management prescriptions assessed in this study does not benefit Pipistrelle bats nor other bat species foraging on similar prey. Such species may respond more positively to a landscape-scale management approach focused mainly on the creation and management of woodland."

- Wilson A., Vickery J. and Pendlebury C. (2007) Agri-environment schemes as a tool for reversing declining populations of grassland waders: mixed benefits from environmentally sensitive areas. *Biological Conservation* 136: 128–135

  Key conclusions: "...AES can result in significant benefits, especially when monetary investment is high, [but] delivery of biodiversity targets are by no means guaranteed."

Evidence for Success (cont.)

- Pywell R.F., et al. (2012). Wildlife-friendly farming benefits rare birds, bees and plants. Biological Letters 8: 772-775

  Key conclusions:

  the most abundant "general" (generic) prescriptions (e.g. 4m buffer strips on cultivated land, ditch management, management of woodland edges, management of field corners) were "remarkably unsuccessful";

  the fewer "evidence-based" prescriptions (these being closely tailored to the ecological requirements of a target taxa – e.g. nectar flower mixture, skylark plots, beetle bank, uncropped cultivated areas for ground-nesting birds on arable land) did consistently increase the richness and abundance of both rare and common species;

  landscape factors can influence the outcome of AES prescriptions (i.e. prescriptions on farms set within species-poor landscapes have less likelihood of success than prescriptions on farms set within species-rich landscapes) depending on the mobility of the taxa considered.

Conclusions

The range of ecological enhancement schemes typically prescribed by WFE have a reasonable likelihood of achieving the desired effect if...

- all important variables are considered and stipulated in detail based on best practice advice and/or personal experience, and
- the potential influence of the site context is recognised.

Useful website for researching mitigation/compensation/enhancement:

http://www.conservationevidence.com/