***Conservation Biology***

**Evaluating complementary networks of restoration plantings for landscape-scale occurrence of temporally dynamic species**

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**Supporting Information**

Appendix S1: Summary of planting attributes considered in the analyses, and example of previous studies that have found the attribute to be important in explaining bird diversity in restoration plantings.

| Planting attributes | Definition | Mean (Range) | Example studies |
| --- | --- | --- | --- |
| Cost | Establishment cost | $16, 052 ($4, 948 – $75,869) | Polyakov et al. 2015 |
| Age | Number of years since the establishment of the planting (since 2006). | 11 (0 – 44) | Lindenmayer et al. 2010Munro et al. 2011 |
| Area | Size of planting (ha). | 4.24 (0.3 – 60.3) | Kavanagh et al. 2007 Lindenmayer et al. 2010Munro et al. 2011 |
| Width | Width of planting (m). | 65.16 (10 – 300) | Kinross 2004Lindenmayer et al. 2007Lindenmayer et al. 2010Munro et al. 2011 |
| Habitat complexity score (HCS) | Vegetation structural complexity was based on vegetation data collected in 2007/08 and 2013: (i) the percent cover of overstorey, midstorey and understorey vegetation, the number of logs per ha, and the presence of large trees (> 50 cm diameter at breast height) were recorded within three 20 x 20 m plots located at the 0 m, 100 m and 200 m transect points; and (ii) the percent cover of native grass, exotic grass, exotic perennials, broadleaf weeds, forbs, leaf litter, and moss and lichen were recorded within twelve 1 m x 1 m quadrats located at the corners of the plots. A combined site-level habitat complexity score was calculated from these data, following Munro et al. (2011) (Table S2). | 18 (9 – 29) | Lindenmayer et al. 2010Munro et al. 2011 |
| Woody vegetation (WoodyVeg) | Percentage of vegetation cover within a 1 km buffer from the 100 m transect point. Derived from Landsat satellite imagery (Danaher 2011). | 5.45% (0.00% – 23.00%) | Kavanagh et al. 2007Lindenmayer et al. 2010Munro et al. 2011Radford et al. 2005 |
| Topographic wetness index (TWI) | Position in landscape, ranging from ridge tops to valley floors. Derived from a 20 m resolution Digital Elevation Model (DEM) (Montague-Drake et al. 2011), and calculated at the 100 m transect point | 0.61 (-2.68 – 10.23) | Lindenmayer et al. 2010Montague-Drake et al. 2011 |

**Literature cited**

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Munro, N., J. Fischer, G. Barrett, J. Wood, A. Leavesley, and D. B. Lindenmayer. 2011. Bird's response to revegetation of different structure and floristics - are "restoration plantings" restoring bird communities. *Restor Ecol* 19:223-235.

Polyakov, M., D. J. Pannell, M. Chalak, G. Park, A. Roberts, and A. D. Rowles. 2015. Restoring native vegetation in an agricultural landscape: spatial optimization for woodland birds. *Land Economics* 91:252-271.

Radford, J. Q., A. F. Bennett, and G. J. Cheers. 2005. Landscape-level thresholds of habitat cover for woodland-dependent birds*. Biol Conserv* 124:317-337.

Appendix S2: Habitat complexity score (HCS). Planting HCS was the sum of the scores for each element.

|  |  |  |  |
| --- | --- | --- | --- |
| Score | Strata % cover\* | Logs/ha | Trees > 50 cm/ha |
| 0 | < 1% | < 1 | < 1 |
| 1 | 1-5% | 1-10 |  |
| 2 | 6-30% | 11-50 |  |
| 3 | 31-70% | 51-100 |  |
| 4 | > 70% | > 100 | ≥ 1 |

\*Strata includes overstorey, midstorey, understorey and ground layer (native tussock, exotic tussock, exotic grass, broadleaf weeds, forbs, and leaf litter).

Appendix S3: Costs of materials and labour for fencing and direct-seeding of restoration sites, based on 2015 pricing rates used by Greening Australia

|  |  |  |
| --- | --- | --- |
| Item | Description | Rate ($AU) |
| Fencing | Fencing materials and labour | $10,000/km |
| Direct-seeding - materials | Seed, machinery | < 2 ha = $750/ha2-4 ha = $625/ha>4 ha = $550/ha |
| Direct-seeding - labour | Labour, site preparation | $77.68/ha  |

Appendix S4: Woodland bird species of conservation concern, justification for inclusion and number of observations between 2006 and 2013. ‘Legislation’: listed as threatened in NSW under the *Threatened Species Conservation Act 1995* (this also captures relevant nationally-listed threatened species) or ‘Atlas’: identified as having a >20% decrease in South West Slopes bioregion reporting rate between the first and second Atlas of Australian Birds.

|  |  |  |  |
| --- | --- | --- | --- |
| Common name | Scientific name | Source | Records |
| Black-chinned Honeyeater | Melithreptus gularis | Legislation | 6 |
| Brown Songlark | *Cincloramphus cruralis* | Atlas | 56 |
| Brown Treecreeper | *Climacteris picumnus* | Legislation | 8 |
| Cockatiel | *Nymphicus hollandicus* | Atlas | 15 |
| Crested Shrike-tit | *Falcunculus frontatus* | Atlas | 30 |
| Diamond Firetail | *Stagonopleura guttata* | Legislation | 21 |
| Dollarbird | *Eurystomus orientalis* | Atlas | 2 |
| Dusky Woodswallow | *Artamus cyanopterus* | Atlas | 10 |
| Fairy Martin | *Petrochelidon ariel* | Atlas | 5 |
| Grey-crowned Babbler | *Pomatostomus temporalis* | Legislation | 11 |
| Jacky Winter | *Microeca fascinans* | Atlas | 3 |
| Little Lorikeet | *Glossopsitta pusilla* | Legislation | 3 |
| Masked Woodswallow | *Artamus personatus* | Atlas | 7 |
| Pied Butcherbird | *Cracticus nigrogularis* | Atlas | 5 |
| Rainbow Bee-eater | *Merops ornatus* | Atlas | 13 |
| Restless Flycatcher | *Myiagra inquieta* | Atlas | 9 |
| Scarlet Robin | *Petroica boodang* | Legislation | 2 |
| Southern Whiteface | *Aphelocephala leucopsis* | Atlas | 10 |
| Speckled Warbler | *Chthonicola sagittata* | Legislation | 9 |
| Superb Parrot | *Polytelis swainsonii* | Legislation | 19 |
| Weebill | *Smicrornis brevirostris* | Atlas | 66 |
| White-browed Woodswallow | *Artamus superciliosus* | Atlas | 54 |
| White-fronted Chat | *Epthianura albifrons* | Legislation | 8 |
| White-winged Triller | *Lalage sueurii* | Atlas | 46 |
| Yellow-rumped Thornbill | *Acanthiza chrysorrhoa* | Atlas | 119 |
| Zebra Finch | *Taeniopygia guttata* | Atlas | 2 |

Appendix S5 Comparison of dynamic complementarity scenarios with cost included and excluded, for the representation targets of 30% and 60% species occurrence. The locations of plantings selected under the two scenarios were similar (Bray-Curtis dissimilarity 13% and 23% for the 30% target and 60% target, respectively).

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Scenario | Cost | Plantings | Area (ha) | % Occurrence | Target met |
| 30%: cost included | $535,125.80 | 32 | 185.00 | 60.63 | 100 |
| 30%: cost excluded | $591,778.60 | 30 | 203.80 | 60.28 | 100 |
| 60%: cost included | $725,628.00 | 43 | 222.20 | 80.19 | 100 |
| 60%: cost excluded | $754,132.20 | 42 | 227.50 | 80.53 | 100 |

Appendix S6. Mean (SD) selection frequencies of plantings selected the in the best solutions for each representation target under dynamic complementarity scenarios and those not selected.

|  |  |
| --- | --- |
|  | Best solution |
| Target | Selected | Not selected |
| 10% | 98.71 (6.42) | 1.06 (5.92) |
| 20% | 96.34 (13.32) | 3.22 (9.90) |
| 30% | 96.88 (10.93) | 3.55 (10.92) |
| 40% | 98.00 (7.91) | 3.07 (19.93) |
| 50% | 98.06 (7.80) | 3.19 (9.03) |
| 60% | 98.21 (7.56) | 4.28 (11.40) |
| 70% | 96.25 (12.42) | 13.92 (17.29) |
| 80% | 97.22 (11.57) | 24.00 (21.76) |
| 90% | 99.62 (2.89) | 19.67 (15.31) |
| 100% | 100.00 (0.00) | - |

Appendix S7. Candidate set of models including single and additive combinations of all planting attributes. See Appendix S1 for explanation of planting attributes.

|  |
| --- |
| Models |
| Area |
| Age |
| HCS |
| Woody Veg |
| TWI |
| Area + Age |
| Area + HCS |
| Area + Woody Veg |
| Area + TWI |
| Age + HCS |
| Age + Woody Veg |
| Age + TWI |
| HCS + Woody Veg |
| HCS + TWI |
| Woody Veg + TWI |
| Area + Age + HCS |
| Area + Age + Woody Veg |
| Area + Age + TWI |
| Area + Age + Woody Veg  |
| Area + HCS + Woody Veg |
| Area + HCS + TWI |
| Area + Woody Veg + TWI |
| Age + HCS + Woody Veg |
| Age + HCS + TWI |
| Age + Woody Veg + TWI |
| HCS + Woody Veg + TWI |
| Area + Age + HCS + Woody Veg |
| Area + Age + HCS + TWI |
| Area + Age + Woody Veg + TWI |
| Age + HCS + Woody Veg + TWI |
| Area + Age + HCS + Woody Veg + TWI |

Appendix S8. Summary of dynamic and static complementarity scenarios

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | Dynamic | 2006 | 2008 | 2009 | 2011 | 2013 |
| Target (%) | Cost ($AUD) | 5-yr. min occ. (%) | Target met (%) | Cost ($AUD) | 5-yr. min occ. (%) | Target met (%) | Cost ($AUD) | 5-yr. min occ. (%) | Target met (%) | Cost ($AUD) | 5-yr. min occ. (%) | Target met (%) | Cost ($AUD) | 5-yr. min occ. (%) | Target met (%) | Cost ($AUD) | 5-yr. min occ. (%) | Target met (%) |
| 10 | $503,891 | 54 | 100 | $114,068 | 5 | 15 | $209,546 | 11 | 31 | $156,488 | 4 | 19 | $281,986 | 11 | 35 | $166,364 | 4 | 12 |
| 20 | $509,593 | 55 | 100 | $123,890 | 5 | 12 | $247,124 | 17 | 42 | $166,002 | 5 | 4 | $297,123 | 11 | 31 | $177,061 | 6 | 19 |
| 30 | $535,126 | 61 | 100 | $163,907 | 7 | 12 | $283,631 | 19 | 38 | $216,123 | 8 | 8 | $332,201 | 17 | 27 | $212,421 | 11 | 15 |
| 40 | $573,122 | 66 | 100 | $195,243 | 8 | 4 | $330,638 | 33 | 50 | $266,335 | 9 | 4 | $370,808 | 19 | 27 | $257,570 | 12 | 4 |
| 50 | $575,591 | 66 | 100 | $229,085 | 13 | 12 | $381,571 | 34 | 42 | $305,878 | 10 | 4 | $395,025 | 20 | 23 | $300,573 | 22 | 15 |
| 60 | $725,628 | 80 | 100 | $332,518 | 13 | 8 | $549,920 | 41 | 31 | $448,961 | 21 | 4 | $480,195 | 35 | 23 | $395,403 | 28 | 8 |
| 70 | $814,979 | 87 | 100 | $397,461 | 25 | 8 | $620,428 | 48 | 27 | $534,510 | 26 | 4 | $525,713 | 36 | 15 | $459,828 | 36 | 12 |
| 80 | $889,818 | 96 | 100 | $503,252 | 31 | 8 | $690,304 | 57 | 27 | $606,834 | 28 | 4 | $661,279 | 54 | 27 | $572,794 | 45 | 15 |
| 90 | $951,035 | 99 | 100 | $574,287 | 38 | 8 | $789,620 | 76 | 35 | $704,481 | 37 | 8 | $746,849 | 59 | 23 | $751,666 | 57 | 12 |
| 100 | $979,198 | 100 | 100 | $633,418 | 51 | 19 | $890,734 | 89 | 62 | $816,398 | 64 | 31 | $788,795 | 61 | 23 | $870,880 | 71 | 27 |

Appendix S9. Summary of dynamic complementarity and ranked scenarios.

|  |  |  |  |
| --- | --- | --- | --- |
|  | Dynamic | Species-richness ranked | Species-richness / cost ranked |
| Target (%) | Cost ($AUD) | 5-yr. min occ. (%) | Target met (%) | Cost ($AUD) | 5-yr. min occ. (%) | Target met (%) | Cost ($AUD) | 5-yr. min occ. (%) | Target met (%) |
| 10 | $503,891 | 54 | 100 | $504,144 | 39 | 65 | $502,903 | 51 | 77 |
| 20 | $509,593 | 55 | 100 | $504,144 | 39 | 65 | $502,903 | 51 | 77 |
| 30 | $535,126 | 61 | 100 | $520,595 | 39 | 54 | $525,424 | 51 | 73 |
| 40 | $573,122 | 66 | 100 | $567,577 | 49 | 54 | $565,378 | 55 | 81 |
| 50 | $575,591 | 66 | 100 | $574,061 | 54 | 54 | $565,378 | 55 | 81 |
| 60 | $725,628 | 80 | 100 | $721,545 | 64 | 65 | $701,886 | 73 | 69 |
| 70 | $814,979 | 87 | 100 | $805,461 | 85 | 77 | $819,627 | 86 | 81 |
| 80 | $889,818 | 96 | 100 | $885,168 | 92 | 77 | $865,478 | 91 | 88 |
| 90 | $951,035 | 99 | 100 | $943,044 | 96 | 92 | $892,227 | 91 | 85 |
| 100 | $979,198 | 100 | 100 | $979,198 | 100 | 100 | $979,198 | 100 | 100 |



Appendix S10. Summary of model-averaged effect sizes (and 95% CIs) for terms in the top-ranked models (ΔAICc≤ 2) for 30% (closed circles) and 60% (open circles) representation targets. See Appendix S1 for a description of model terms.