

Supplementary Material

Aspatially explicit model framework to predict the spread of the noisy miner (*Manorina melanocephala*)

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Table 1. Bird species recorded in the major reserves (each reserve surveyed once) in the study landscape between 2017 and 2020 (combined data set). Asterisks indicate sensitive bird species considered most likely to occupy a home range year-round based on descriptions from a variety of resources (e.g. Handbook of Australian, New Zealand and Antarctic Birds) and examination of publicly available bird sighting data sets.

Species	Common Name	Sensitive sp. (Y/N)	Total grid cells	Total with NM	% with NM
<i>Alectura lathami</i>	Australian Brush-turkey	N	26	9	34.62
<i>Coturnix ypsilophora</i>	Brown Quail	N	2	1	50
<i>Anas superciliosa</i>	Pacific Black Duck	N	2	1	50
<i>Chenonetta jubata</i>	Australian Wood Duck	N	2	1	50
* <i>Geopelia humeralis</i>	Bar-shouldered Dove	Y	14	3	21.43
<i>Ochyphaps lophotes</i>	Crested Pigeon	N	8	1	12.5
<i>Spilopelia chinensis</i>	Spotted Dove	N	3	0	0
<i>Podargus strigoides</i>	Tawny Frogmouth	N	4	3	75
<i>Aegotheles cristatus</i>	Australian Owlet-nightjar	N	4	0	0
<i>Butorides striata</i>	Striated Heron	N	1	1	100
<i>Ixobrychus flavicollis</i>	Black Bittern	N	1	1	100
<i>Ardea intermedia</i>	Intermediate Egret	N	2	0	0
<i>Egretta garzetta</i>	Little Egret	N	1	0	0
<i>Platalea regia</i>	Royal Spoonbill	N	1	0	0
<i>Threskiornis molucca</i>	Australian White Ibis	N	2	0	0
<i>Aviceda subcristata</i>	Pacific Baza	N	1	1	100
<i>Accipiter novaehollandiae</i>	Brown Goshawk	N	1	0	0
<i>Haliastur indus</i>	Brahminy Kite	N	1	0	0
<i>Amaurornis moluccana</i>	Pale-vented Bush-hen	N	2	2	100
<i>Gallirallus philippensis</i>	Buff-banded Rail	N	3	1	33.33
<i>Gallinula tenebrosa</i>	Dusky Moorhen	N	3	0	0
<i>Porphyrio porphyrio</i>	Purple Swamphen	N	4	0	0
<i>Himantopus himantopus</i>	Black-winged Stilt	N	1	0	0
<i>Vanellus miles</i>	Masked Lapwing	N	5	2	40
<i>Calyptorhynchus funereus</i>	Yellow-tailed Black Cockatoo	N	1	0	0
<i>Eolophus roseicapilla</i>	Galah	N	3	0	0

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<i>Glossopsitta pusilla</i>	Little Lorikeet	Y	1	1	100
<i>Trichoglossus chlorolepidotus</i>	Scaly-breasted Lorikeet	N	2	1	50
<i>Trichoglossus haematodus</i>	Rainbow Lorikeet	N	70	29	41.43
<i>Alisterus scapularis</i>	Australian King-parrot	N	2	1	50
<i>Platycercus adscitus</i>	Pale-headed Rosella	N	15	7	46.67
<i>Cacomantis variolosus</i>	Brush Cuckoo	Y	7	1	14.29
<i>Cacomantis flabelliformis</i>	Fan-tailed Cuckoo	Y	8	0	0
<i>Centropus phasianinus</i>	Pheasant Coucal	N	2	0	0
<i>Dacelo novaeguineae</i>	Laughing Kookaburra	N	17	4	23.53
<i>Todiramphus sordidus</i>	Torresian Kingfisher	Y	4	1	25
<i>Todiramphus sanctus</i>	Sacred Kingfisher	Y	21	1	4.76
<i>Todiramphus macleayii</i>	Forest Kingfisher	Y	1	0	0
<i>Merops ornatus</i>	Rainbow Bee-eater	Y	57	3	5.26
<i>Eurystomus orientalis</i>	Dollarbird	N	3	0	0
* <i>Cormobates leucophaeus</i>	White-throated Treecreeper	Y	2	0	0
* <i>Malurus melanocephalus</i>	Red-backed Fairy-wren	Y	82	6	7.32
* <i>Malurus lamberti</i>	Variiegated Fairy-wren	Y	62	3	4.84
* <i>Malurus cyaneus</i>	Superb Fairy-wren	Y	8	0	0
* <i>Sericornis frontalis</i>	White-browed Scrubwren	Y	23	4	17.39
* <i>Gerygone levigaster</i>	Mangrove Gerygone	Y	47	1	2.13
<i>Gerygone olivacea</i>	White-throated Gerygone	Y	2	0	0
<i>Pardalotus punctatus</i>	Spotted Pardalote	Y	23	2	8.70
<i>Pardalotus striatus</i>	Striated Pardalote	Y	255	18	7.06
<i>Acanthorhynchus tenuirostris</i>	Eastern Spinebill	Y	8	0	0
* <i>Meliphaga lewinii</i>	Lewin's Honeyeater	Y	43	4	9.30
<i>Lichenostomus chrysops</i>	Yellow-faced Honeyeater	Y	43	1	2.33
* <i>Lichenostomus fasciocularis</i>	Mangrove Honeyeater	Y	1	0	0
<i>Myzomela sanguinolenta</i>	Scarlet Honeyeater	Y	198	6	3.03
<i>Lichmera indistincta</i>	Brown Honeyeater	Y	193	5	2.59

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Species	Common Name	Sensitive sp. (Y/N)	Total grid cells	Total with NM	% with NM
<i>*Melithreptus albogularis</i>	White-throated Honeyeater	Y	63	4	6.35
<i>Plectorhyncha lanceolata</i>	Striped Honeyeater	Y	1	0	0
<i>Entomyzon cyanotis</i>	Blue-faced Honeyeater	N	8	5	62.5
<i>Philemon citreogularis</i>	Little Friarbird	Y	11	0	0
<i>Philemon corniculatus</i>	Noisy Friarbird	N	7	1	14.29
<i>Manorina melanocephala</i>	Noisy Miner		698		
<i>*Psophodes olivaceus</i>	Eastern Whipbird	Y	9	4	44.44
<i>Coracina novaehollandiae</i>	Black-faced Cuckoo-shrike	Y	21	1	4.76
<i>Coracina tenuirostris</i>	Cicadabird	Y	17	0	0
<i>Lalage leucomela</i>	Varied Triller	Y	1	0	0
<i>Lalage suerii</i>	White-winged Triller	Y	1	0	0
<i>Pachycephala pectoralis</i>	Golden Whistler	Y	26	1	3.85
<i>Pachycephala rufiventris</i>	Rufous Whistler	Y	49	1	2.04
<i>*Colluricincla harmonica</i>	Grey Shrike-thrush	Y	63	0	0
<i>*Colluricincla megarhyncha</i>	Little Shrike-thrush	Y	4	0	0
<i>Oriolus sagittatus</i>	Olive-backed Oriole	Y	7	0	0
<i>Sphecothebes vieilloti</i>	Australasian Figbird	N	18	7	38.89
<i>Artamus leucorhynchus</i>	White-breasted Woodswallow	Y	16	1	6.25
<i>Cracticus torquatus</i>	Grey Butcherbird	N	109	67	61.47
<i>Cracticus nigrogularis</i>	Pied Butcherbird	N	51	24	47.06
<i>Cracticus tibicen</i>	Australian Magpie	N	42	12	28.57
<i>Strepera graculina</i>	Pied Currawong	N	7	2	28.57
<i>Corvus orru</i>	Torresian Crow	N	37	8	21.62
<i>Rhipidura rufifrons</i>	Rufous Fantail	Y	33	1	3.03
<i>Rhipidura leucophrys</i>	Willie Wagtail	Y	18	0	0
<i>Rhipidura albiscapa</i>	Grey Fantail	Y	173	10	5.78
<i>Myiagra alecto</i>	Shining Flycatcher	Y	1	0	0
<i>Myiagra rubecula</i>	Leaden Flycatcher	Y	14	0	0
<i>Symphysarchus trivirgatus</i>	Spectacled Monarch	Y	1	0	0

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Species	Common Name	Sensitive sp. (Y/N)	Total grid cells	Total with NM	% with NM
<i>Dicrurus bracteatus</i>	Spangled Drongo	Y	40	2	5
<i>Grallina cyanoleuca</i>	Magpie Lark	N	6	0	0
<i>Petroica rosea</i>	Rose Robin	Y	5	0	0
* <i>Eopsaltria australis</i>	Eastern Yellow Robin	Y	5	1	20
<i>Anthus novaeseelandiae</i>	Australasian Pipit	N	5	0	0
<i>Cisticola exilis</i>	Golden-headed Cisticola	N	29	0	0
<i>Acrocephalus australis</i>	Australian Reed-warbler	N	11	0	0
* <i>Megalurus timoriensis</i>	Tawny Grassbird	Y	104	0	0
<i>Zosterops lateralis</i>	Silvereye	Y	131	5	3.82
<i>Hirundo neoxena</i>	Welcome Swallow	N	2	1	50
<i>Dicaeum hirundinaceum</i>	Mistletoebird	Y	36	5	13.89
<i>Taeniopygia bichenovii</i>	Double-barred Finch	Y	18	0	0
<i>Neochmia temporalis</i>	Red-browed Finch	Y	10	0	0
<i>Lonchura castaneothorax</i>	Chestnut-breasted Mannikin	Y	27	0	0

Table 2. Survey dates and number of grid cells surveyed for areas in the selected landscape within which bird surveys were conducted.

*Map ref.	Reserve	Date surveyed	Number of grid cells surveyed
1	Boondall Wetlands Reserve	March 2018	1,836
2	Tinchi Tamba Wetlands Reserve	January 2018	1,034
3	Brighton Wetlands Reserve	April 2020	199
4	Deagon Wetlands Reserve	May 2020	251
5	Fitzgibbon Bushland Reserve	May 2019	224
6	Telegraph Road Reserve	April 2020	83
7	Musgrave Avenue Reserve	March 2017	70
8	Cabbage Tree Creek Corridor	May 2018	244
9	Chermside Hills Reserve	May 2018	342
10	Raven Street Reserve	May 2019	159
11	Milne Hill Reserve	March 2020	89
12	Albany Creek Road Reserve	May 2018	64
13	Woodcroft Street Park	May 2019	36
14	Mensforth Bushland Reserve	June 2019	35
15	Aspley Reservoir	May 2019	46
16	7 th Brigade Park	May 2018	29

*Correspond to numbers in Figure 1 (following page).

Figure 1. Estimated distribution of broad habitat types within the study landscape (excluding the 1 km buffer). Numbers correspond to the first column of Table 2. Thin grey lines represent main roads and major creeks.

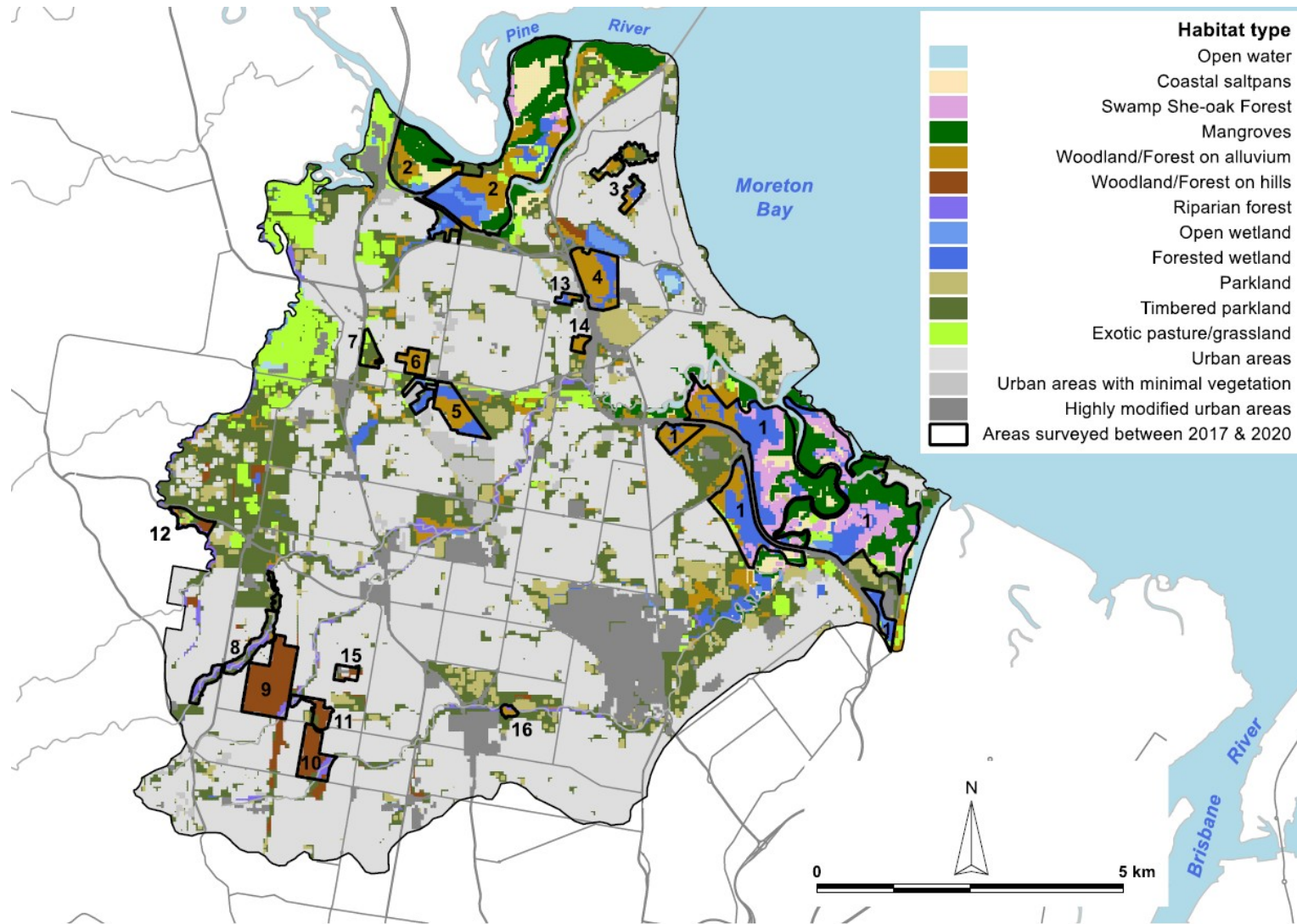
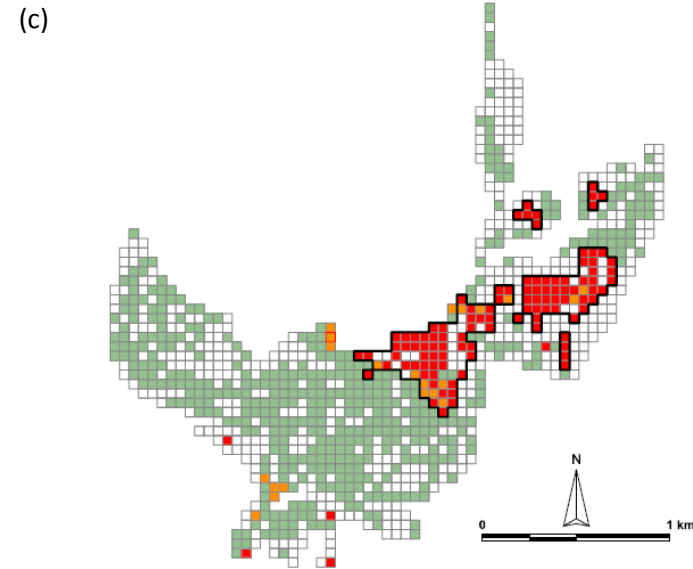
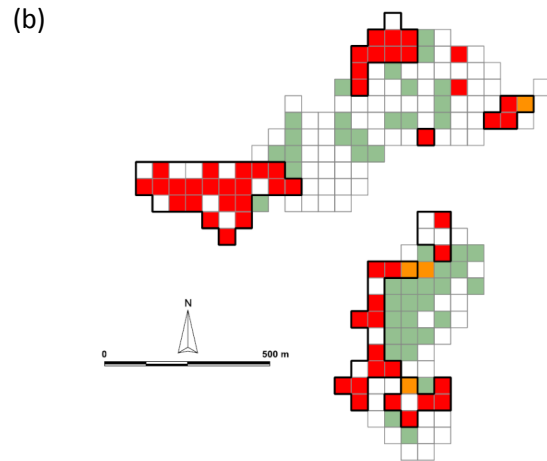
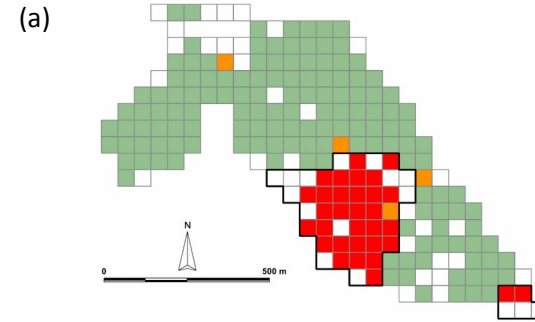
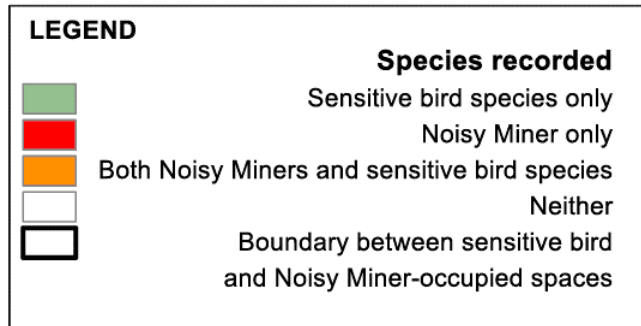


Table 3. Breakdown of grid cells into broad habitat types and sensitive bird species and Noisy Miner-occupied within the selected landscape, including the 1 km buffer.

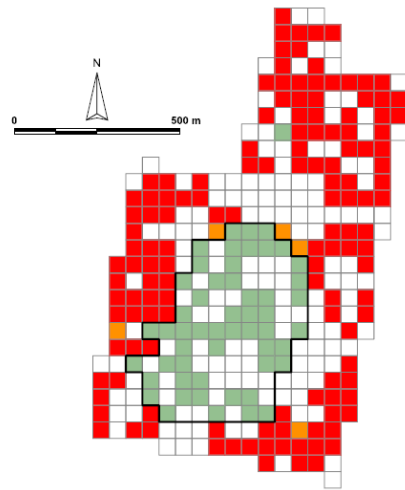
Habitat	Total grid cells	Area (ha)	Number of sensitive bird-occupied grid cells*	Number of Noisy Miner-occupied grid cells
Woodland/open forest on alluvial soils	2295	573.75	789	1506
Riparian forest	965	241.25	160	805
Woodland/open forest on hills	1416	354	463	953
Open wetland	284	71	109	0
Timbered wetland	1653	413.25	1031	622
<i>Casuarina glauca</i> -dominated woodland/open forest	915	228.75	481	434
Mangroves	3060	765	3060	0
Saltmarsh/saline clay pan	1246	311.5	0	1246
Parkland – trees rare	2189	547.25	0	2189
Parkland – trees scattered to moderately dense	9855	2463.75	198	9657
Grazed/unmown grasslands	2331	582.75	0	2331
Urban areas with scattered tall trees	27235	6808.75	0	27235
Urban areas with trees mostly absent	730	182.5	0	730
Urban areas - highly modified (roads/shopping centres/industrial areas)	4332	1083	0	4332
Water	6717	1679.25	0	0
Total	65,223	16,305.75	6,291 (9.6%)	52,040 (79.8%)

*i.e. grid cells forming part of an area occupied by assemblages (five or more species) of sensitive bird species

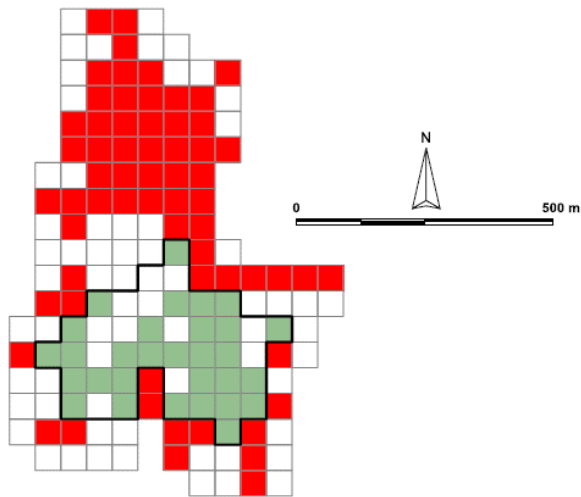
Figure 2. Distributions of grid cells in which sensitive bird species and/or Noisy Miners were recorded in (a) Fitzgibbon Bushland Reserve (surveyed May 2019); (b) Brighton Wetlands Reserve (April 2020); (c) Tinchi Tamba Wetlands Reserve (January 2018); (d) Chermside Hills Reserve (May 2018); (e) Raven Street Reserve (June 2019), and (f) Boondal Wetlands Reserve (March 2018). The boundaries indicated between the two grid cell states is the outcome of the extrapolation process used. Attribution to the Noisy Miner-occupied state of grid cells near Noisy Miner-occupied spaces in which neither Noisy Miners or sensitive bird species were recorded was favoured to create model input representing a 'worst-case' scenario at time t . Cells on the boundary of sensitive bird and Noisy Miner-occupied spaces in which both Noisy Miners and sensitive bird species were recorded were attributed as Noisy Miner-occupied if the number of Noisy Miners exceeded the number of sensitive birds observed.



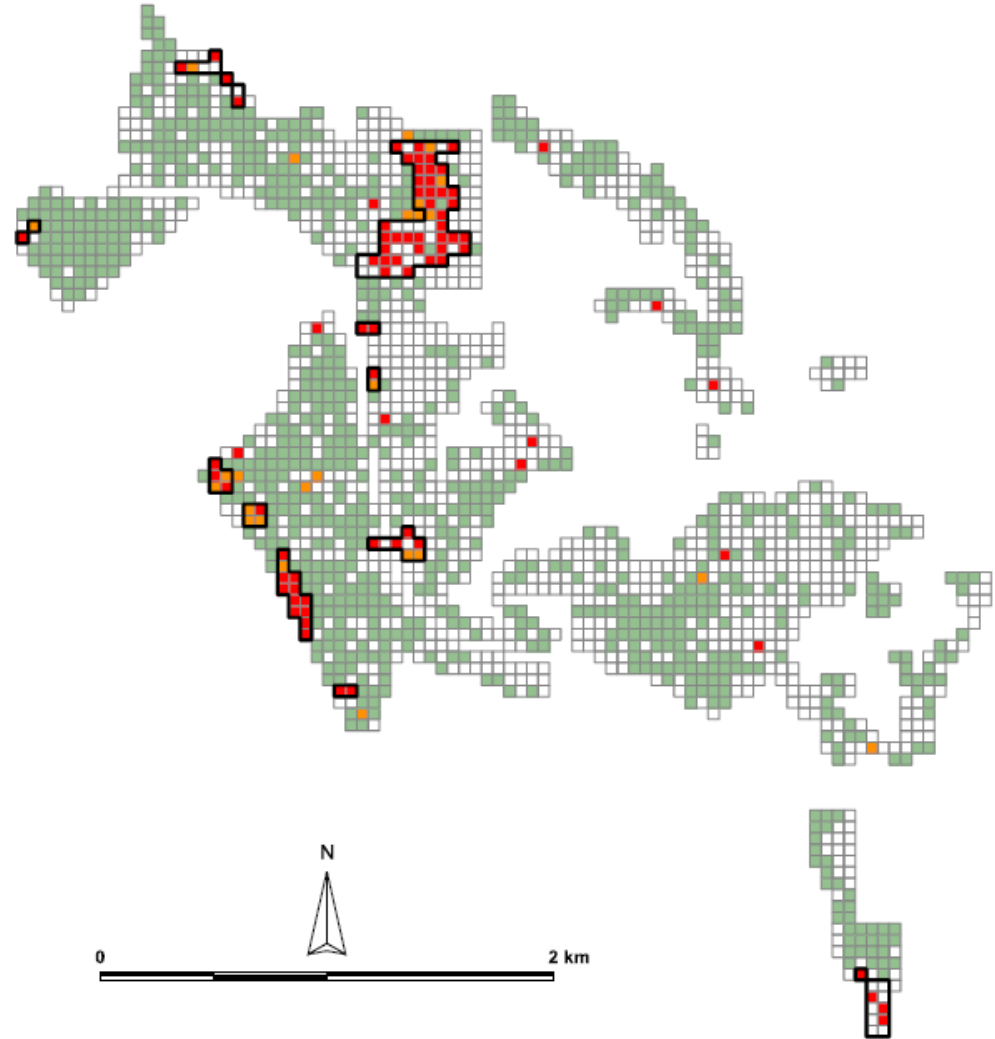
(d)



(e)



(f)



Simulation of Noisy Miner spread

The model framework was used to simulate the spread of Noisy Miners under a hypothetical scenario. The simulation was applied using a subset of grid cells in the southwestern portion of the landscape used for the case study presented in the paper. The subset included the grid cells representing sensitive bird-occupied spaces in Chermide Hills and Raven Street Reserves and the Cabbage Tree Creek Corridor. Under the hypothetical scenario, Noisy Miners were displaced when a linear corridor of remnant eucalypt woodland (Woodland/open forest on hills) was cleared. It was assumed that there was no mortality. For each grid cell in the sensitive bird species-occupied spaces the variable representing the number of Noisy Miners displaced (NM_D) was calculated by multiplying the number of ‘cleared’ grid cells within a 2 km radius of the cell by the estimated mean density of Noisy Miners in the Woodland/open forest on hills broad vegetation type. The social cohesion coefficient, ‘b’, was set at 1.1, which was considered a conservative value for this parameter (if it is assumed that social cohesion of Noisy Miners is maintained following the destruction of habitat comprising group territories).

The sequence of the simulation was as follows: The probabilities of transitions from SB to NM generated under the ‘static ecosystem’ assumption used to run the model across the entire study landscape (a) were recalculated to generate the revised probabilities across the subset of the landscape (b). A state transition threshold probability was set at 0.85. Grid cells with this or a greater transition probability were reclassified as Noisy Miner-occupied (c). Under this hypothetical scenario, the number of sensitive bird species-occupied grid cells decreased from 236 to 163. The number of grid cells with a ‘background’ vulnerability to displacement or replacement by Noisy Miners >0.7 increased from three to 22.

