

Turning Gardeners into Conservationists

Citizen scientists demonstrate the biodiversity and human wellbeing benefits of wildlife-friendly gardening



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Introduction

The *Turning Gardeners into Conservationists: Using Gardens to Conserve Wildlife* Project was a three-year (2021-2024) citizen science project that explored vertebrate (birds, frogs, mammals and reptiles) use of gardens and seven wildlife-friendly structures (bat boxes, bird baths, bird boxes, frog hotels, ponds, possum shelters and reptile shelters) in residential gardens of southwestern Australia (Figure 1).

This project aimed to (1) provide skills and build capacity of the general community to contribute to biodiversity conservation, (2) directly contribute to wildlife conservation through the provision of shelter and water resources in gardens, and (3) research the biodiversity and human-wellbeing benefits of wildlife-friendly gardening.

More specifically, the research aims of the project were to determine:

1. **Biodiversity benefits of wildlife-friendly gardening**, including the vertebrate species that occur within gardens in southwestern Australia, and the frequency that vertebrate wildlife use installed water and shelter structures in gardens, and
2. **Human wellbeing benefits of wildlife-friendly gardening**, including the influence of habitat structure installation and wildlife monitoring on participant's physical health, emotional wellbeing and connection to nature.

This report summarises the outcomes from this project, including key findings from the ecological and sociological research components of this project.

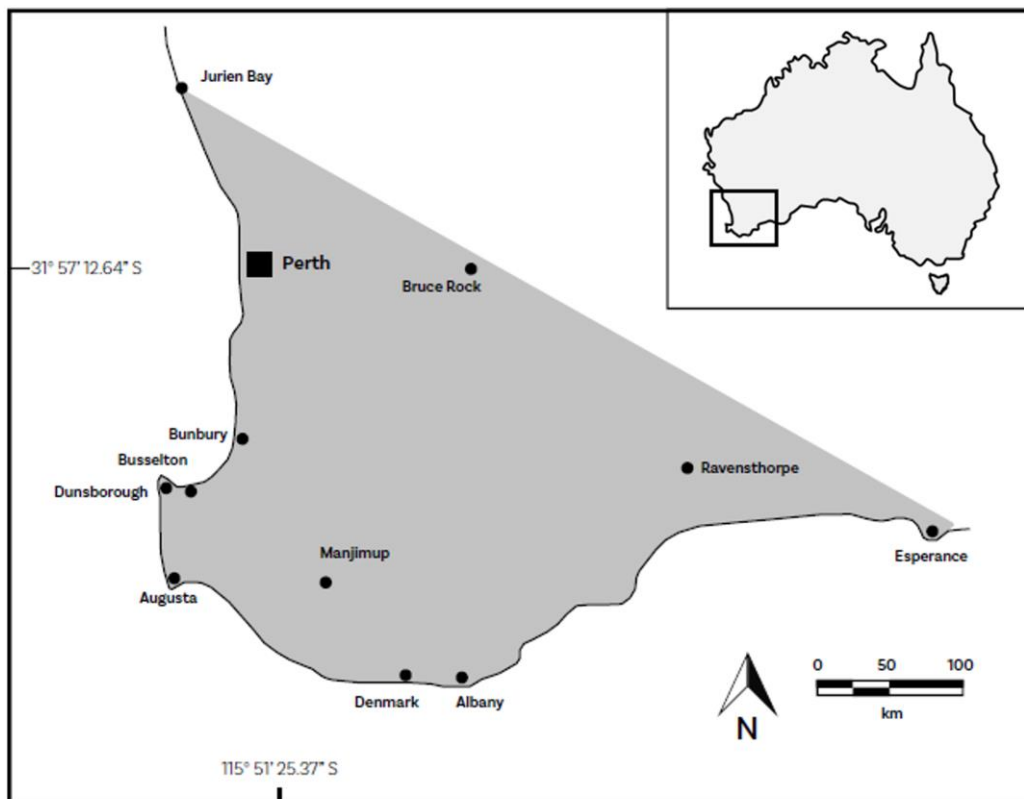


Figure 1. Map defining the study area of southwestern Australia, from Jurien Bay to Esperance.



Methods

Ecological methods

To investigate how wildlife-friendly gardening benefits biodiversity, citizen scientists monitored the vertebrate wildlife that used their gardens and wildlife-friendly structures. They monitored both existing structures already present in their garden and structures they installed as part of this project.

Wildlife monitoring in residential gardens

To investigate the vertebrate species that used gardens and wildlife-friendly garden structures, 243 citizen scientists completed wildlife monitoring surveys in their garden over an 18-month period (August 2022 – January 2024). Collectively, they used five ‘general garden monitoring’ methods, seven ‘wildlife-friendly structure monitoring’ methods and ‘opportunistic surveys’ (refer to Guide 2, Van Helden et al. 2022 for details) to document the wildlife using gardens and wildlife-friendly structures. For most methods, citizen scientists were encouraged to complete these surveys on a weekly basis for the duration of the study. Prior to beginning monitoring, citizen scientists were asked to provide contextual site information about their gardens including where their gardens sit in the landscape.

To standardise the monitoring methods and increase accuracy of species identification, all citizen scientists were given comprehensive training in (1) species identification, (2) the monitoring methods, (3) general scientific principles, and (4) animal ethics protocols and procedures. Training was delivered through a combination of face-to-face workshops, online training videos and written guides (Figure 2) that provided step-by-step instructions of the monitoring methods (Guide 2, Van Helden et al. 2022) and images of species likely to be encountered in gardens (Guide 1, Gulliver et al. 2022). Citizen scientists were also able to ask experienced ecologists questions at any point during the study to help them with their monitoring and species identification.



Figure 2. Front covers of the *Turning Gardeners into Conservationists* project guides, including Species Identification Guide, Wildlife Monitoring Manual, and Garden Structure Installation Manual. All guides are freely available at www.perthnrm.com/project/gardening-for-wildlife/



Installation of new wildlife-friendly garden structures

Between March and May 2023, citizen scientists installed new wildlife-friendly structures within their garden and commenced monitoring of these new structures alongside their ongoing monitoring of existing structures and garden wildlife. The structures included nest boxes for possums, birds or bats, frog hotels, reptile shelters, bird baths, and ponds (Figure 3). The installation of these new wildlife-friendly gardening structures was guided by a Garden Structure Installation Manual (Guide 3, Greenop et al. 2023) developed as part of this project (Figure 2).

Data analysis

In January 2024, the data collected by citizen scientists using all methods except camera trapping were analysed to determine the total species diversity observed within residential gardens of southwestern Australia, the total diversity and frequency of species using the seven types of wildlife-friendly structures and how frequently newly installed structures were used compared to existing structures.



Figure 3. Examples of the wildlife-friendly structures installed and monitored as part of the project. Top (left to right): nest boxes for bats, pardalotes, parrots, possums (photos by Simon Cherriman). Bottom (left to right): reptile shelter, frog hotel, bird bath, pond (photos by Thomas Baskerville and BEVH).

Sociological methods

To investigate how wildlife-friendly gardening influences human wellbeing, citizen scientists were invited to participate in online surveys and in-person semi-structured interviews. The online surveys provided an opportunity to measure changes in metrics of human health, wellbeing and nature-relatedness over the course of the project. The semi-structured interviews provided opportunities to gain a deeper and richer understanding of the impacts of wildlife monitoring and



wildlife-friendly gardening, as well as some of the potential underlying reasons for changes in wellbeing measured through the online surveys.

Online surveys

Online sociological surveys were distributed to citizen scientists at the beginning of the wildlife monitoring in June 2022 (baseline), approximately midway through the project in February 2023 (interim), and at the end of the project in December 2023 (final). The surveys included questions about participant's physical health, mental wellbeing and connection to nature, using three internationally recognised metrics:

- 1) the RAND 36-Item Short Form Health Survey (SF-36; Ware & Sherbourne 1992), which includes eight measures of human health on a scale from 0-100 (physical functioning, role limitations due to physical health, role limitations due to emotional problems, energy/fatigue, emotional wellbeing, social functioning, pain, and general health),
- 2) the Warwick-Edinburgh Mental Well-being Scale (WEMWBS; Tennant et al. 2007), a measure of mental well-being focusing entirely on positive aspects of mental health, on a scale from 14-70, and
- 3) the Short Version, 6-Item Nature-Relatedness Scale (NR-6; Nisbet & Zelenski, 2013), a measure of connectedness with the natural environment, on a scale from 1-5.

For each metric, higher scores indicate a greater condition of health, wellbeing, and connection to nature, respectively.

The surveys also included questions about the participant's demographic information and their gardening activities as part of the project to provide contextual information about the cohort of respondents. A control group who had not participated in the wildlife monitoring activities also completed the surveys. See Appendix 1 for a summary of survey questions.

Semi-structured interviews

During July 2023, twenty citizen scientists shared their experiences of wildlife-friendly gardening and wildlife monitoring through semi-structured interviews. Interviews were conducted within participant's gardens, with the majority occurring in and around Perth, Bunbury and Albany. Interviewees were randomly selected from a subset of citizen scientists who had engaged in regular wildlife monitoring activities and installed at least one new wildlife-friendly structure during the project. See Appendix 2 for a summary of interview questions.

Data analysis

The sociological survey data was analysed to determine changes in the three metrics (SF-36, WEMWBS, NR-6, defined above) over the three survey periods (baseline, interim, final). Participants who took part in wildlife monitoring activities were compared with the control group who did not participate in these activities. The semi-structured interviews were transcribed, and then analysed to uncover themes related to eight dimensions of human wellness (Stoewen 2017): physical, emotional, intellectual, environmental, social, spiritual, financial, and vocational.



Results snapshot

TURNING GARDENERS INTO CONSERVATIONISTS RESULTS SNAPSHOT

PROJECT STATS

243 citizen scientists across

30 towns & cities

15,795 wildlife surveys

216 species seen in gardens

77 species used habitat structures & all structure types were used

232 new habitat structures

installed in gardens

Positive trends in human health & wellbeing metrics



Mammal Diversity

19

Bird Diversity



144



Reptile Diversity

43

Frog Diversity



10

SURVEYS COMPLETED

Bird Counts: 4933

Camera Traps: 281

Reptile Searches: 1321

Frog Searches: 927

Spotlight Surveys: 901

Bird Bath Surveys: 2941

Pond Surveys: 442

Bat Box Inspections: 415

Bird Box Inspections: 496

Possum Box Inspections: 253

Frog Hotel Inspections: 675

Reptile Shelter Inspections: 681

Opportunistic Surveys: 1529

...it takes away the anxieties of the world and I think, you know, I tend to feel anxious about the impact of what we've done to our world. So I felt that if I could do something to make a difference, even if it's gardening and increasing the wildlife population of some butterflies or frogs...'

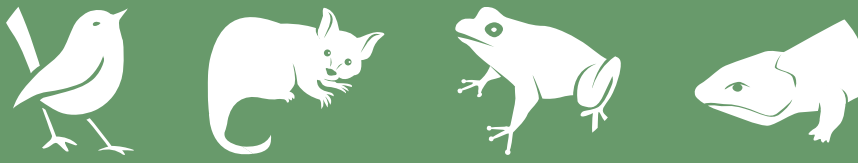
'it's the excitement of watching the [nest] box and seeing if something is actually going to inhabit it and also recognising perhaps what works and what doesn't work from a learning point of view'

'it was a way for me ... to connect to other people who share the same interest.'

'I think you feel every sense comes alive from hearing the birds, smelling the blossom or whatever's out in flower. Seeing, touching, every sense'



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Biodiversity benefits of wildlife-friendly gardening

Types of gardens monitored

Wildlife monitoring occurred within citizen scientist’s own residential gardens, spread across more than 30 towns and cities in southwestern Australia, with Perth and Albany cities having the highest proportion of participant gardens. Based on the cohort of residents that submitted garden site data ($n = 121$, 91%), 63.3% of gardens were located in medium-density urban areas (~8–15 dwellings per hectare), 28.5 % were located in low-density urban areas (~1–7 dwellings per hectare) and 8.1% of gardens were located in rural areas of southwestern Australia (~ < 1 dwelling per hectare). The degree of tree cover, shrub cover, open space and plant nativeness within gardens, and their proximity to natural vegetation remnants and water bodies varied (Figure 4).

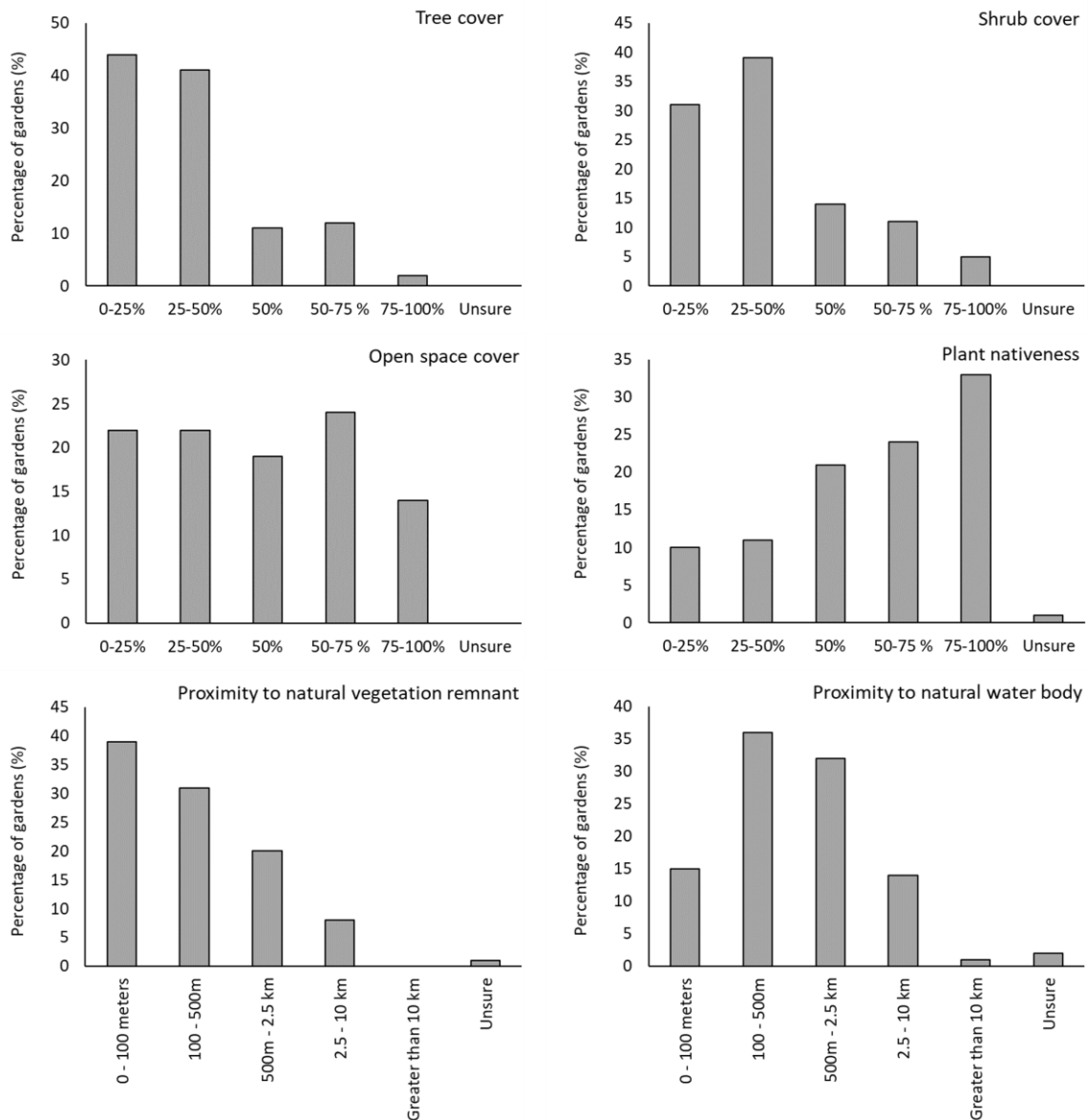


Figure 4. The percentage of garden study sites with different garden characteristics including percentage of tree cover, shrub cover, open space, native Australian plants and proximity to natural vegetation remnants and water bodies.



Total effort by citizen scientists

In total, 243 citizen scientists completed 15,795 wildlife surveys and installed 232 wildlife-friendly structures over the 18-month monitoring period (Table 1). Bird monitoring methods were the most popular, with bird counts and bird bath surveys being the most frequently completed general garden monitoring method and structure monitoring method, respectively. Similarly, bird baths and pardalote boxes were the most installed wildlife-friendly gardening structures, however bat boxes and reptile shelters were also commonly installed. Overall, high numbers of surveys were completed for all wildlife monitoring activities, and more than 10 individual structures were installed for all structure types.

Table 1. Number of wildlife monitoring surveys completed and wildlife-friendly garden structures installed by citizen scientists between August 2022 - January 2024.

Activity		Number completed/ installed	
Wildlife monitoring	General garden monitoring	Bird counts	4933
		Camera trapping	281
		Frog searches	927
		Reptile searches	1321
		Spotlight surveys	901
	Structure monitoring	Bat box inspections	415
		Bird bath surveys	2941
		Bird box inspections	496
		Frog hotel inspections	675
		Pond surveys	442
		Possum shelter inspections	253
		Reptile shelter inspections	681
	Opportunistic surveys	Opportunistic submissions	1529
Structures installed	Shelter sites	Bat boxes	34
		Frog hotels	28
		Pardalote boxes	40
		Parrot boxes	14
		Possum boxes	14
		Reptile shelters	39
	Water sources	Bird baths	43
		Ponds	20

Wildlife occurring within residential gardens

Based on all wildlife monitoring methods (except camera trapping) and opportunistic observations, a total of 216 species were detected within residential gardens of southwestern Australia, including four threatened species (Table 2). Of the total number of species, 144 were birds, 10 were frogs, 19 were mammals and 43 were reptiles. Of the 216 species, 14 were not native to southwestern Australia and included 6 bird, 7 mammal and 1 reptile species.

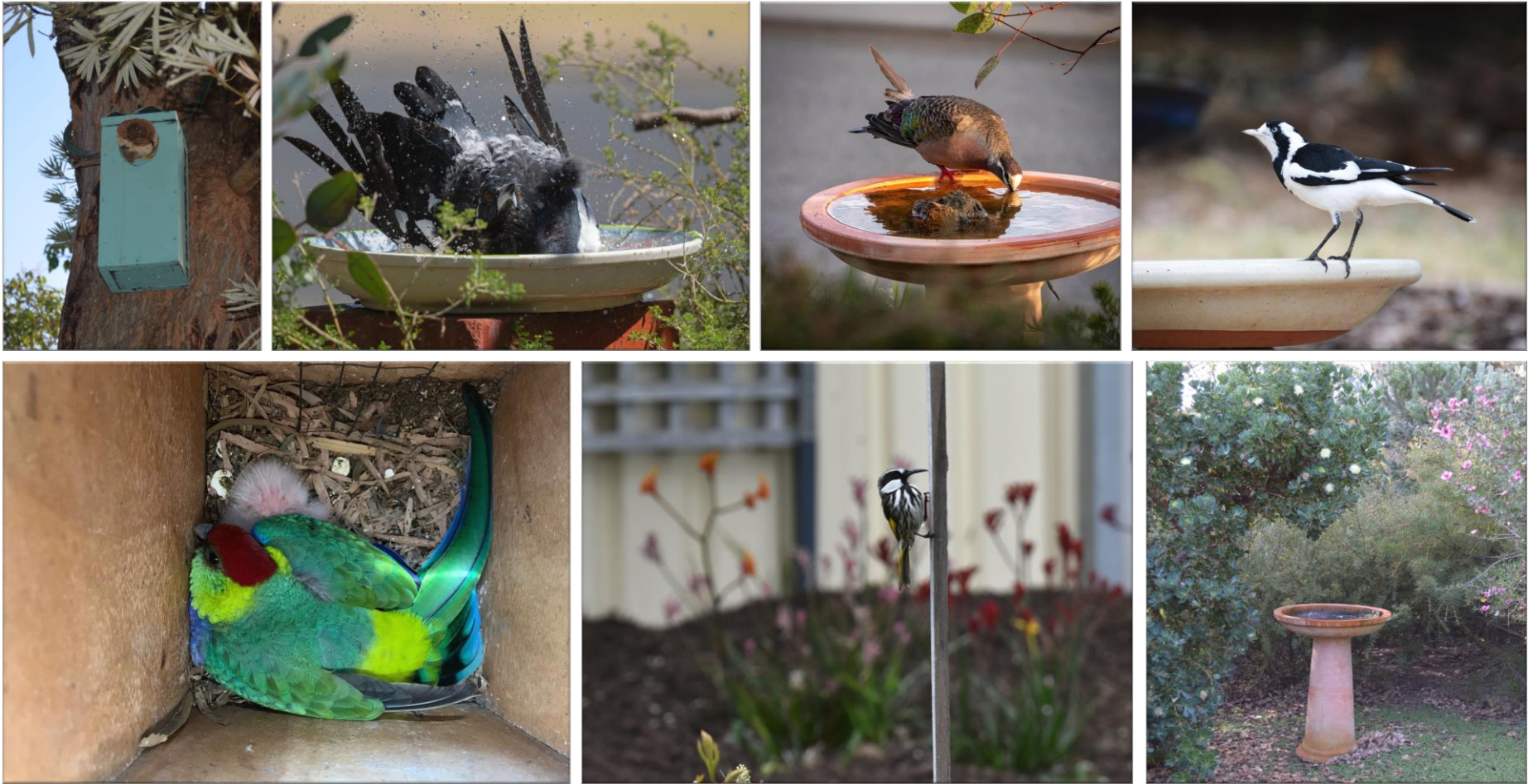


Image 1. Top (left to right): bird box by BEVH; magpie by Jane Putland; bronzewing pigeon by Dennis Friend; mudlark by Isabelle Wavre. Bottom (left to right): red-capped parrot and chick by Sally Malone; white-cheeked honeyeater by Jacqui McGhie; bird bath by BEVH.

Table 2. List of vertebrate species detected by citizen scientists in southwestern Australian gardens between August 2022 - January 2024. Species have been categorised by animal group and whether they are native to southwestern Australia. ‘*’ identifies species listed as threatened under Australia’s Environment Protection and Biodiversity Conservation Act 1999. List excludes invertebrates and fish.

Animal group	Common name	Scientific name
Bird (native)	Australasian pipit	<i>Anthus novaeseelandiae</i>
	Australasian shoveler	<i>Anas rhynchos</i>
	Australian hobby	<i>Falco longipennis</i>
	Australian magpie	<i>Gymnorhina tibicen</i>
	Australian pelican	<i>Pelecanus conspicillatus</i>
	Australian pied oystercatcher	<i>Haematopus longirostris</i>
	Australian raven	<i>Corvus coronoides</i>
	Australian reed warbler	<i>Acrocephalus australis</i>
	Australian ringneck	<i>Barnardius zonarius</i>
	Australian shelduck	<i>Tadorna tadornoides</i>
	Australian white ibis	<i>Threskiornis moluccus</i>
	Australian wood duck	<i>Chenonetta jubata</i>
	Barn owl	<i>Tyto alba</i>
	Baudin's black cockatoo*	<i>Zanda baudinii</i>
	Black kite	<i>Milvus migrans</i>
	Black swan	<i>Cygnus atratus</i>
	Black-eared cuckoo	<i>Chalcites osculans</i>
	Black-faced cuckoo-shrike	<i>Coracina novaehollandiae</i>
	Black-fronted dotterel	<i>Elseya melanops</i>
	Black-shouldered kite	<i>Elanus axillaris</i>
	Blue-breasted fairywren	<i>Malurus pulcherrimus</i>
	Brown falcon	<i>Falco berigora</i>
	Brown goshawk	<i>Accipiter fasciatus</i>
	Brown honeyeater	<i>Lichmera indistincta</i>
	Brown quail	<i>Coturnix ypsilophora</i>
	Brown-headed honeyeater	<i>Meliphaga brevirostris</i>
	Brush bronzewing	<i>Phaps elegans</i>
	Budgerigar	<i>Melopsittacus undulatus</i>
	Buff-banded rail	<i>Gallirallus philippensis</i>
	Carnaby's black cockatoo*	<i>Zanda latirostris</i>
	Cattle egret	<i>Ardea ibis</i>
	Chestnut teal	<i>Anas castanea</i>

Animal group	Common name	Scientific name
	Collared sparrowhawk	<i>Accipiter cirrocephalus</i>
	Common bronzewing	<i>Phaps chalcoptera</i>
	Crested pigeon	<i>Ocyphaps lophotes</i>
	Crested shrike-tit	<i>Falcunculus frontatus</i>
	Crimson chat	<i>Epthianura tricolor</i>
	Dusky woodswallow	<i>Artamus cyanopterus</i>
	Eastern great egret	<i>Ardea modesta</i>
	Eastern osprey	<i>Pandion cristatus</i>
	Elegant parrot	<i>Neophema elegans</i>
	Eurasian coot	<i>Fulica atra</i>
	Fan-tailed cuckoo	<i>Cacomantis flabelliformis</i>
	Forest red-tailed black cockatoo*	<i>Calyptorhynchus banksii naso</i>
	Galah	<i>Eolophus roseicapilla</i>
	Gilbert's honeyeater	<i>Melithreptus chloropsis</i>
	Grey butcherbird	<i>Cracticus torquatus</i>
	Grey currawong	<i>Strepera versicolor</i>
	Grey fantail	<i>Rhipidura albiscapa</i>
	Grey shrike-thrush	<i>Colluricincla harmonica</i>
	Hoary-headed grebe	<i>Poliiocephalus poliocephalus</i>
	Hooded robin	<i>Melanodryas cucullata</i>
	Horsefield's bronze cuckoo	<i>Chalcites basalis</i>
	Inland thornbill	<i>Acanthiza apicalis</i>
	Jacky winter	<i>Microeca fascinans</i>
	Little corella	<i>Cacatua sanguinea</i>
	Little eagle	<i>Hieraaetus morphnoides</i>
	Little egret	<i>Egretta garzetta</i>
	Little grassbird	<i>Poodytes gramineus</i>
	Little pied cormorant	<i>Microcarbo melanoleucos</i>
	Little wattlebird	<i>Anthochaera chrysoptera</i>
	Long-billed corella	<i>Cacatua tenuirostris</i>
	Magpie-lark	<i>Grallina cyanoleuca</i>
	Masked woodswallow	<i>Artamus personatus</i>
	Mistletoebird	<i>Dicaeum hirundinaceum</i>
	Mulga parrot	<i>Psephotellus varius</i>
	Nankeen kestrel	<i>Falco cenchroides</i>

Animal group	Common name	Scientific name
	New Holland honeyeater	<i>Phylidonyris novaehollandiae</i>
	Northern mallard	<i>Anas platyrhynchos</i>
	Pacific black duck	<i>Anas superciliosa</i>
	Pallid cuckoo	<i>Cacomantis pallidus</i>
	Peregrine falcon	<i>Falco peregrinus</i>
	Pied butcherbird	<i>Cracticus nigrogularis</i>
	Pied honeyeater	<i>Certhionyx variegatus</i>
	Purple swamphen	<i>Porphyrio porphyrio</i>
	Purple-crowned lorikeet	<i>Glossopsitta porphyrocephala</i>
	Purple-gaped honeyeater	<i>Lichenostomus cratitius</i>
	Rainbow bee-eater	<i>Merops ornatus</i>
	Red wattlebird	<i>Anthochaera carunculata</i>
	Red-capped parrot	<i>Purpureicephalus spurius</i>
	Red-collared lorikeet	<i>Trichoglossus rubritorquis</i>
	Red-eared firetail	<i>Stagonopleura oculata</i>
	Red-winged fairywren	<i>Malurus elegans</i>
	Regent parrot	<i>Polytelis anthopeplus</i>
	Restless flycatcher	<i>Myiagra inquieta</i>
	Rufous fieldwren	<i>Calamanthus campestris</i>
	Rufous songlark	<i>Cincloramphus mathewsi</i>
	Rufous treecreeper	<i>Climacteris rufus</i>
	Rufous whistler	<i>Pachycephala rufiventris</i>
	Sacred kingfisher	<i>Todiramphus sanctus</i>
	Scarlet robin	<i>Petroica multicolor</i>
	Shining bronze cuckoo	<i>Chalcites lucidus</i>
	Shy heathwren	<i>Hylacola cauta</i>
	Silver gull	<i>Chroicocephalus novaehollandiae</i>
	Silvereye	<i>Zosterops lateralis</i>
	Singing honeyeater	<i>Gavicalis virescens</i>
	Southern boobook	<i>Ninox boobook</i>
	Spiny-cheeked honeyeater	<i>Acanthagenys rufogularis</i>
	Splendid fairywren	<i>Malurus splendens</i>
	Spotted nightjar	<i>Eurostopodus argus</i>
	Spotted pardalote	<i>Pardalotus punctatus</i>
	Square-tailed kite	<i>Lophoictinia isura</i>

Animal group	Common name	Scientific name
	Straw-necked ibis	<i>Threskiornis spinicollis</i>
	Striated pardalote	<i>Pardalotus striatus</i>
	Stubble quail	<i>Coturnix pectoralis</i>
	Sulphur-crested cockatoo	<i>Cacatua galerita</i>
	Swamp harrier	<i>Circus approximans</i>
	Tawny crowned honeyeater	<i>Glyciphila melanops</i>
	Tawny frogmouth	<i>Podargus strigoides</i>
	Tree martin	<i>Petrochelidon nigricans</i>
	Varied sittella	<i>Daphoenositta chrysoptera</i>
	Variiegated fairywren	<i>Malurus lamberti</i>
	Wedge-tailed eagle	<i>Aquila audax</i>
	Weebill	<i>Smicronis brevirostris</i>
	Welcome swallow	<i>Hirundo neoxena</i>
	Western corella	<i>Cacatua pastinator</i>
	Western gerygone	<i>Gerygone fusca</i>
	Western rosella	<i>Platycercus icterotis</i>
	Western spinebill	<i>Acanthorhynchus superciliosus</i>
	Western thornbill	<i>Acanthiza inornata</i>
	Western wattlebird	<i>Anthochaera lunulata</i>
	Western whistler	<i>Pachycephala occidentalis</i>
	Western yellow robin	<i>Eopsaltria griseogularis</i>
	Whistling kite	<i>Haliastur sphenurus</i>
	White-bellied sea-eagle	<i>Haliaeetus leucogaster</i>
	White-breasted robin	<i>Quoyornis georgianus</i>
	White-browed babbler	<i>Pomatostomus superciliosus</i>
	White-browed scrubwren	<i>Sericornis frontalis</i>
	White-cheeked honeyeater	<i>Phylidonyris niger</i>
	White-eared honeyeater	<i>Lichenostomus leucotis</i>
	White-faced heron	<i>Egretta novaehollandiae</i>
	White-fronted chat	<i>Epthianura albifrons</i>
	White-fronted honeyeater	<i>Purnella albifrons</i>
	White-necked heron	<i>Ardea pacifica</i>
	White-winged triller	<i>Lalage sueurii</i>
	Willy wagtail	<i>Rhipidura leucophrys</i>
	Yellow-rumped thornbill	<i>Acanthiza chrysorrhoa</i>

Animal group	Common name	Scientific name
	Yellow-throated miner	<i>Manorina flavigula</i>
Bird (exotic)	Chicken	<i>Gallus gallus domesticus</i>
	Laughing dove	<i>Streptopelia senegalensis</i>
	Laughing kookaburra	<i>Dacelo novaeguineae</i>
	Rainbow lorikeet	<i>Trichoglossus moluccanus</i>
	Rock dove	<i>Columba livia</i>
	Spotted dove	<i>Streptopelia chinensis</i>
Frog (native)	Moaning frog	<i>Heleioporus eyrei</i>
	Motorbike frog	<i>Litoria moorei</i>
	Quacking frog	<i>Crinia georgiana</i>
	Rattling froglet	<i>Crinia glauerti</i>
	Slender tree frog	<i>Litoria adelaidensis</i>
	South coast froglet	<i>Crinia subinsignifera</i>
	Spotted-thighed frog	<i>Litoria cyclorhyncha</i>
	Ticking frog	<i>Geocrinia leai</i>
	Western banjo frog	<i>Limnodynastes dorsalis</i>
	Western spotted frog	<i>Heleioporus albopupnctatus</i>
Mammal (native)	Ash-grey mouse	<i>Pseudomys albocinereus</i>
	Brush-tailed phascogale	<i>Phascogale tapoatafa</i>
	Bush rat	<i>Rattus fuscipes</i>
	Common brushtail possum	<i>Trichosurus vulpecula</i>
	Dunnart	<i>Sminthopsis sp.</i>
	Southern brown bandicoot	<i>Isodon fusciventer</i>
	Southern forest bat	<i>Vespadelus regulus</i>
	Western grey kangaroo	<i>Macropus fuliginosus</i>
	Western mouse	<i>Pseudomys occidentalis</i>
	Western pygmy possum	<i>Cercartetus concinnus</i>
	Western ringtail possum*	<i>Pseudocheirus occidentalis</i>
	Yellow-footed antechinus	<i>Antechinus flavipes</i>
Mammal (exotic)	Black rat	<i>Rattus rattus</i>
	Brown rat	<i>Rattus norvegicus</i>

Animal group	Common name	Scientific name
	Cat	<i>Felis catus</i>
	Dog	<i>Canis lupus familiaris</i>
	European rabbit	<i>Oryctolagus cuniculus</i>
	House mouse	<i>Mus musculus</i>
	Red fox	<i>Vulpes vulpes</i>
Reptile (native)	Bardick	<i>Echiopsis curta</i>
	Black-headed monitor	<i>Varanus tristis</i>
	Bobtail	<i>Tiliqua rugosa</i>
	Buchanan's snake-eyed skink	<i>Cryptoblepharus buchananii</i>
	Burton's legless lizard	<i>Lialis burtonis</i>
	Children's python	<i>Antaresia childreni</i>
	Coastal plains skink	<i>Ctenotus ora</i>
	Common dwarf skink	<i>Menetia greyii</i>
	Common garden skink	<i>Lampropholis guichenoti</i>
	Common scaly-foot	<i>Pygopus lepidopodus</i>
	Common south-west skink	<i>Ctenotus labillardieri</i>
	Darling range south-west ctenotus	<i>Ctenotus delli</i>
	Dugite	<i>Pseudonaja affinis</i>
	Elegant slider	<i>Lerista elegans</i>
	Gould's hooded snake	<i>Suta gouldii</i>
	King's skink	<i>Egernia kingii</i>
	Lowlands earless skink	<i>Hemiernis peronii</i>
	Marbled gecko	<i>Christinus marmoratus</i>
	Sand goanna	<i>Varanus gouldii</i>
	Sedgeland's worm-lizard	<i>Aprasia repens</i>
	Shrubland morethia skink	<i>Morethia obscura</i>
	South coast gecko	<i>Diplodactylus calcicolus</i>
	Southern blind snake	<i>Anilius australis</i>
	South-western crevice skink	<i>Egernia napoleonis</i>
	Southwestern earless skink	<i>Hemiernis initialis</i>
	South-western orange-tailed slider	<i>Lerista distinguenda</i>
	South-western rock-skink	<i>Liopholis pulchra</i>
	South-western slider	<i>Lerista microtis</i>
	Southwestern snake-necked turtle	<i>Chelodina colliei</i>

Animal group	Common name	Scientific name
	South-western spiny-tailed gecko	<i>Strophurus spinigerus</i>
	Speckled stone gecko	<i>Diplodactylus lateroides</i>
	Thick-tailed barking gecko	<i>Underwoodisaurus milii</i>
	Tiger snake	<i>Notechis scutatus</i>
	Two-toed earless skink	<i>Hemiergis quadrilineata</i>
	Variiegated tree dtella	<i>Gehyra variegata</i>
	West coast laterite ctenotus	<i>Ctenotus fallens</i>
	West coast morethia skink	<i>Morethia lineocellata</i>
	Western bearded dragon	<i>Pogona minor</i>
	Western blue tongue	<i>Tiliqua occipitalis</i>
	Western limestone ctenotus	<i>Ctenotus australis</i>
	Western three-lined skink	<i>Acritoscincus trilineatus</i>
	Western worm lerista	<i>Lerista praepedita</i>
Reptile (exotic)	Asian house gecko	<i>Hemidactylus frenatus</i>



Wildlife using existing wildlife-friendly gardening structures

Based on data collected between August 2022 and February 2023, a total of 77 species were observed using existing wildlife-friendly structures including three threatened species and four species not native to southwestern Australia (Table 3). Collectively, structures were used by 55 bird species, 4 frog species, 5 mammal species and 13 reptile species. Frog hotels were used by 3 species, bird boxes were used by 6 species, possum shelters were used by 2 species, reptile shelters were used by 17 species, ponds were used by 14 species and bird baths were used by 57 species. The frequency that different species used each structure type is provided in Appendix 3.

Shelter sites

Bat boxes had evidence of bat guano (bat poo) on 1% of inspections (N = 100) with no other records of non-target wildlife recorded (Figure 5; Table 3; Appendix 3). Bird boxes were used by birds on 19.7% of inspections and chicks or eggs were recorded on 15.5% of inspections (N = 142). Non-target wildlife such as possums were recorded in bird boxes on 2.1% of inspections. Possum shelters were only used by possums and were occupied on 19.9% of inspections (N = 136). Frog hotels were used by frogs on 5.9% of inspections (N = 269) and by non-target animals such as reptiles on 0.4% of inspections. Reptile shelters were used by reptiles on 14.5% of inspections and by non-target wildlife such as frogs and mammals on 1.0% of inspections (N = 502).

Water sources

Bird baths were used by birds on 53.3% of surveys and by non-target wildlife such as frogs and mammals on 0.1% of surveys (N = 1513, Figure 5, Table 3, Appendix 3). The average visitation to bird baths was 12.8 visits per hour (N = 1513) and the average number of species that used the baths was 1.3 species per survey (N = 1513, 504.3 h of observation). Ponds were used by target wildlife on 45.3% of pond surveys (N = 179, Figure 5, Table 3). Tadpoles were recorded on 21.8% of survey occasions (N = 179). The average visitation to ponds was 5.6 visits per hour (N = 179) and the average number of species using ponds was 0.52 species per survey (N = 179, 42.3 h of observation).



Image 2. Top left: western ringtail possum by Christine Taylor; bottom left: brushtail phascogale by Robert Tait; right: Brushtail possum by Stella Johnson.

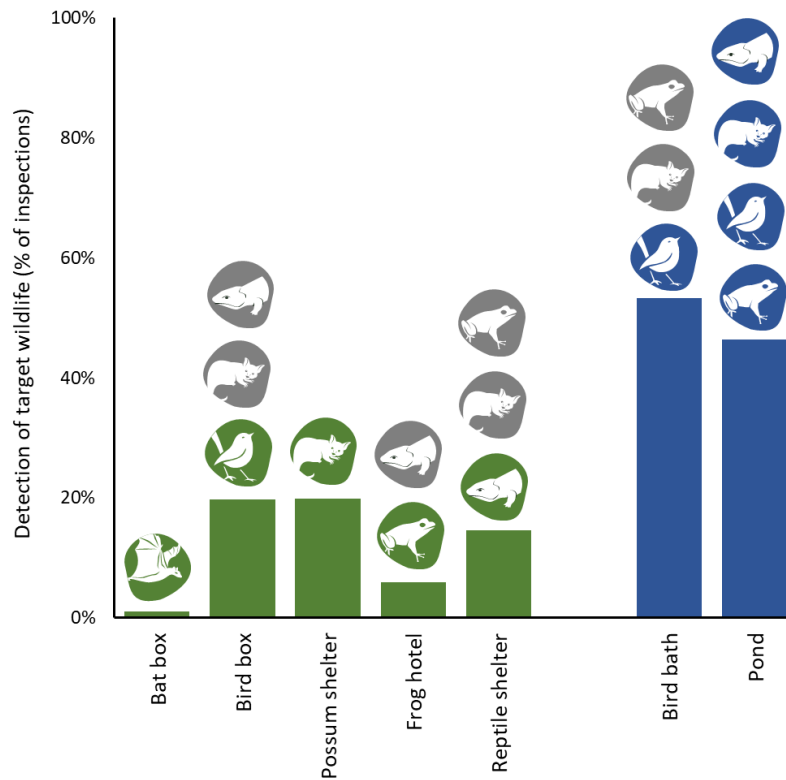


Figure 5. Bars represent the percentage of shelter inspections (green) or water source surveys (blue) during which target animals were detected. Icons (bats, birds, frogs, reptiles, and mammals) represent the animal groups that were recorded using each wildlife-friendly structure type. Coloured icons represent the target animal groups and grey icons represent the non-target animal groups observed using each structure type. Figure modified from Van Helden et al. (2024). Graph is based on data collected by citizen scientists between August 2022 and February 2023.



Image 3. Top left: motorbike frog by BEVH; bottom left: slender tree frog by Isabelle Wavre; middle: pond by BEVH; top right: motorbike frog by Margaret Doust; bottom right: motorbike frog by Jason Pitman.

Table 3. Species recorded using wildlife-friendly structures by citizen scientists in southwestern Australia between August 2022 and February 2023. List excludes invertebrates, fish and taxa that were not identified to species level. ‘*’ identifies species listed as threatened under Australia’s Environment Protection and Biodiversity Conservation Act 1999 and ‘+’ identifies species not native to Western Australia. List excludes invertebrates and fish.

Structure Type	Target species recorded	Non-target species recorded		
Bird bath	Australian magpie	<i>Gymnorhina tibicen</i>	Motorbike frog	<i>Litoria moorei</i>
	Australian raven	<i>Corvus coronoides</i>	Western grey kangaroo	<i>Macropus fuliginosus</i>
	Australian ringneck	<i>Barnadius zonarius</i>		
	Australian white ibis	<i>Threskiornis moluccus</i>		
	Baudin's black cockatoo*	<i>Zanda baudinii</i>		
	Black-faced cuckoo-shrike	<i>Coracina novaehollandiae</i>		
	Brown honeyeater	<i>Lichmera indistincta</i>		
	Brown-headed honeyeater	<i>Melithreptus brevirostris</i>		
	Budgerigar	<i>Melopsittacus undulatus</i>		
	Carnaby's black cockatoo*	<i>Zanda latirostris</i>		
	Common bronzewing	<i>Phaps chalcoptera</i>		
	Crested pigeon	<i>Ocyphaps laphotes</i>		
	Dusky wood swallow	<i>Artamus cyanopterus</i>		
	Elegant parrot	<i>Neophema elegans</i>		
	Galah	<i>Eolophus roseicapilla</i>		
	Gilbert's honeyeater	<i>Melithreptus chloropsis</i>		
	Grey butcherbird	<i>Cracticus torquatus</i>		
	Grey fantail	<i>Rhipidura albiscapa</i>		
	Grey shrike-thrush	<i>Colluricincla harmonica</i>		
	Hooded robin	<i>Melanodryas cucullata</i>		
	Inland thornbill	<i>Acanthiza apicalis</i>		
	Laughing dove+	<i>Streptopelia senegalensis</i>		
	Laughing kookaburra+	<i>Dacelo novaeguineae</i>		
	Magpie lark	<i>Grallina cyanoleuca</i>		
	Mistletoe bird	<i>Dicaeum hirundinaceum</i>		
	Mulga parrot	<i>Psephotellus varius</i>		
	New Holland honeyeater	<i>Phylidonyris novaehollandiae</i>		
	Pied honeyeater	<i>Certhionyx variegatus</i>		
	Rainbow bee-eater	<i>Merops ornatus</i>		

Structure Type	Target species recorded	Non-target species recorded		
	Rainbow lorikeet ⁺	<i>Trichoglossus moluccanus</i>		
	Red wattlebird	<i>Anthochaera carunculata</i>		
	Red-capped parrot	<i>Purpureicephalus spurius</i>		
	Red-eared firetail	<i>Stagonopleura oculata</i>		
	Red-winged fairy-wren	<i>Malurus elegans</i>		
	Scarlet robin	<i>Petroica multicolor</i>		
	Silvereye	<i>Zosterops lateralis</i>		
	Singing honeyeater	<i>Gavicalis virescens</i>		
	Splendid fairy-wren	<i>Malurus splendens</i>		
	Spotted dove ⁺	<i>Streptopelia chinensis</i>		
	Spotted pardalote	<i>Pardalotus punctatus</i>		
	Striated pardalote	<i>Pardalotus striatus</i>		
	Weebill	<i>Smicrornis brevirostris</i>		
	Western rosella	<i>Platycercus icterotis</i>		
	Western spinebill	<i>Acanthorhynchus</i>		
	Western thornbill	<i>superciliosus</i>		
	Western wattlebird	<i>Acanthiza inornata</i>		
	Western whistler	<i>Anthochaera lunulata</i>		
	White-breasted robin	<i>Pachycephala occidentalis</i>		
	White-browed babbler	<i>Quoyornis georgianus</i>		
	White-browed scrubwren	<i>Pomatostomus superciliosus</i>		
	White-cheeked honeyeater	<i>Sericornis frontalis</i>		
	White-eared honeyeater	<i>Phylidonyris niger</i>		
	Willie wagtail	<i>Lichenostomus leucotis</i>		
	Yellow-rumped thornbill	<i>Rhipidura leucophrys</i>		
	Yellow-throated miner	<i>Acanthiza chrysorrhoa</i>		
		<i>Manorina flavigula</i>		
Bird box	Carnaby's black cockatoo*	<i>Zanda latirostris</i>	Marbled gecko	<i>Christinus marmoratus</i>
	Red-capped parrot	<i>Purpureicephalus spurius</i>	Western pygmy possum	<i>Cercartetus concinnus</i>
	Striated pardalote	<i>Pardalotus striatus</i>	Western ringtail possum*	<i>Pseudocheirus occidentalis</i>
Frog hotel	Motorbike frog	<i>Litoria moorei</i>	Western three-lined skink	<i>Acritoscincus trilineatus</i>
	Western banjo frog	<i>Limnodynastes dorsalis</i>		

Structure Type	Target species recorded	Non-target species recorded		
Possum shelter	Common brushtail possum	<i>Trichosurus vulpecula</i>		
	Western ringtail possum*	<i>Pseudocheirus occidentalis</i>		
Pond	Australian magpie	<i>Gymnorhina tibicen</i>		
	Common bronzewing	<i>Phaps chalcoptera</i>		
	Buchanan's snake-eyed skink	<i>Cryptoblepharus buchananii</i>		
	King's skink	<i>Egernia kingii</i>		
	Laughing dove+	<i>Streptopelia senegalensis</i>		
	Motorbike frog	<i>Litoria moorei</i>		
	New Holland honeyeater	<i>Phylidonyris novaehollandiae</i>		
	Red wattlebird	<i>Anthochaera carunculata</i>		
	Silvereye	<i>Zosterops lateralis</i>		
	Singing honeyeater	<i>Gavicalis virescens</i>		
	Spotted dove+	<i>Streptopelia chinensis</i>		
	Spotted-thighed frog	<i>Litoria cyclorhyncha</i>		
	Western banjo frog	<i>Limnodynastes dorsalis</i>		
Western grey kangaroo	<i>Macropus fuliginosus</i>			
Reptile shelter	Bobtail	<i>Tiliqua rugosa</i>	Motorbike frog	<i>Litoria moorei</i>
	Common dwarf skink	<i>Menetia greyii</i>	Quacking frog	<i>Crinia georgiana</i>
	Buchanan's snake-eyed skink	<i>Cryptoblepharus buchananii</i>	Southern brown bandicoot	<i>Isodon fusciventer</i>
	King's skink	<i>Egernia kingii</i>	Spotted-thighed frog	<i>Litoria cyclorhyncha</i>
	Lowlands earless skink	<i>Hemiernis peronii</i>		
	Marbled gecko	<i>Christinus marmoratus</i>		
	Sedgeland's worm-lizard	<i>Aprasia repens</i>		
	Shrubland morethia skink	<i>Morethia obscura</i>		
	Southwestern earless skink	<i>Hemiernis initialis</i>		
	South-western orange-tailed slider	<i>Lerista distinguenda</i>		
	Two-toed earless skink	<i>Hemiernis quadrilineata</i>		
	Western three-lined skink	<i>Acritoscincus trilineatus</i>		
	Western worm lerista	<i>Lerista praepedita</i>		



Wildlife using new wildlife-friendly gardening structures

All structure types installed between March and May 2023 were used by wildlife based on inspections between March 2023 and January 2024 (Figure 6). Reptile shelters were used by reptiles on 36.5% of survey occasions (N = 115) and were the most used new wildlife-friendly structure type, closely followed by bird baths which were used by birds on 32.1 % of surveys (N = 287). All other structure types that were newly installed were used by wildlife on less than 8% of survey occasions (N range: 42 - 337). Except for reptile shelters, newly installed structures were used less frequently than structures already present in gardens before the project commenced.

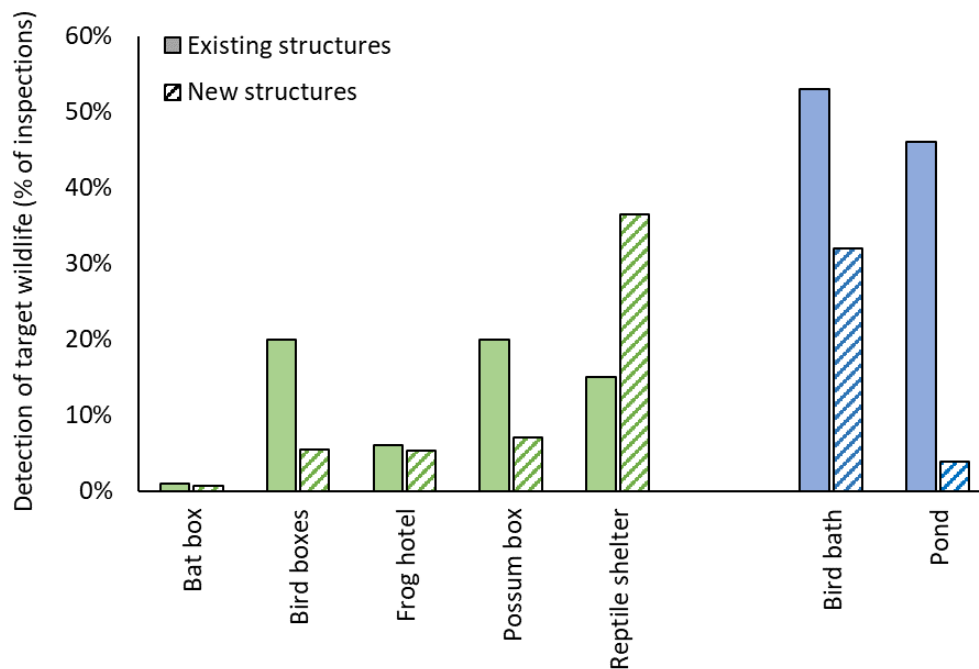


Figure 6. Bars represent the percentage of shelter inspections (green) or water source surveys (blue) during which target animals were detected for structures already present in gardens before the project commenced (before July 2021, solid bars) and for structures installed between March and May 2023 as part of the project (lined bars).

Implications and future research priorities

This research has demonstrated that a remarkably high diversity of wildlife use gardens in southwestern Australia, with approximately one-third of these species benefiting from wildlife-friendly garden features. This provides empirical support for the role residential gardens can play in biodiversity conservation and highlights the ability and willingness of householders to contribute to conservation through the implementation of wildlife-friendly gardening practices.

The study indicates that wildlife-friendly structure types support wildlife to varying extents, with none singularly supporting all 77 recorded species. This emphasises the importance of incorporating numerous structure types in gardens to maximise biodiversity benefits, both for common and threatened species. Water sources appeared particularly beneficial as they were used more frequently and supported a greater diversity of wildlife compared to shelters. This



suggests that in regions with similar hot and dry climates, prioritising water provision may be most beneficial for supporting a broad array of wildlife in gardens. Alternatively, if the goal is to support threatened species specifically, our findings suggest that possum shelters (nest boxes and man-made dreys) may be the best option for supporting the critically endangered western ringtail possum, cockatubes may be best to support breeding Carnaby's black cockatoo, and that water sources will support both threatened white-tailed black cockatoo species.

With the exception of reptile shelters, our research indicates that newly introduced wildlife-friendly structures were used less compared to those already present in gardens before July 2021. While the reason for this remains unclear, it is likely that wildlife require an extended period of time to familiarise themselves with and use the new structures in their environment. We anticipate that with time, these newer additions will be used as frequently as the established ones. Encouragingly, despite being installed for less than a year, all types of structures were used by wildlife, suggesting that the provision of resources within gardens is readily utilised by biodiversity. This provides optimism that additional initiatives to expand the number of people engaging in wildlife-friendly gardening, as well as the intensity of their engagement, could yield significant biodiversity benefits within residential settings.

In addition to the findings outlined in this report, the data gathered by citizen scientists in this project presents a wealth of opportunities for further research exploration and application. These additional avenues will be investigated in the coming months and include:

- Investigating the optimal design and placement of wildlife-friendly features within gardens to determine which configurations attract the highest diversity and abundance of wildlife,
- Exploring whether installing these wildlife-friendly features increases the overall diversity and abundance of wildlife within gardens, and
- Understanding how seasonal variations, geographic locations and garden characteristics influence species diversity and their use of wildlife-friendly structures.

Other key future research priorities that will increase the value of urban areas for biodiversity include:

- Exploring methods to mitigate wildlife-related risks in gardens. This includes developing strategies to:
 - Minimise conflicts between wildlife and humans by addressing potential safety concerns or preventing damage to property while promoting wildlife-friendly practices, and
 - Reduce native wildlife predation, injury or poor reproductive output to increase the value of cities for biodiversity conservation. This could include advocating for stricter enforcement of domestic cat regulations to reduce the threat of predation and injury to wildlife, investigating the risk of urban areas acting as 'ecological traps', and trialling different wildlife-friendly placements and design to reduce predation risk.
- Exploring strategies to increase public engagement in wildlife-friendly gardening initiatives both in terms of the number of people involved and increasing the efforts of those already engaged. This includes:



- Understanding the barriers to participation and developing outreach and educational programs that can help expand the reach of wildlife-friendly gardening practices,
- Trialling ways to incentivise and increase uptake of wildlife-friendly gardening activities, and
- Considering wildlife-friendly gardening opportunities in public greenspaces such as verges, parks, golf courses, and cemeteries.



Image 4. Top left: python by Sarah McNamara; bottom left: reptile shelter by BEVH; top right: bobtail by Sue Youngman; middle right: king's skinks by Brenda Diepeveen; bottom right: Gould's hooded snake by Ben De Haan.



Human wellbeing benefits of wildlife-friendly gardening

Online surveys

A total of 66 citizen scientists completed all three surveys. Of these, 12 were in the control group (18%) and 54 were in the wildlife monitoring group (82%). The majority of survey participants identified as female (77%), between 55-74 years of age (62%), and were born in Australia (65%). In addition, the majority live as a couple (58%) and own their home (70%), are retired (35%) or employed part-time/casual (32%), and hold a Bachelors (35%) or postgraduate degree (30%).

Across all metrics (SF-36, WEMWBS, NR-6), the wildlife monitoring group tended to exhibit a greater average score than the control group, indicating greater condition of health, wellbeing, and connection to nature. This difference was most pronounced at the final survey after the full 18-month period of wildlife monitoring (Figure 7, Figure 8).

For the WEMWBS Mental Well-being scale (Figure 7) and several of the SF-36 scales (Figure 8, e.g. emotional wellbeing, social functioning, role limitations due to emotional problems, general health), an increasing trend over the course of the project was revealed for the wildlife monitoring group. In comparison, the control group's scores tended to either stay the same or have a slight decrease over the course of the project. For other scales (e.g. SF-36 pain scale), the change trend did not appear to differ between the control and wildlife monitoring group (Figure 8). This suggests that participating in the wildlife monitoring activities may have supported improvements in aspects of participant's health and wellbeing, particularly their mental and emotional wellbeing, social functioning, role limitations due to emotional problems, and general health.

For the NR-6 Nature Relatedness scale (Figure 7), both the control group and the wildlife monitoring group were revealed to have high nature-relatedness scores to begin with, and these scores remained high throughout the project. This suggests that all participants, whether they engaged in wildlife monitoring activities or not, were already highly connected to nature at the beginning of the project and this level of connection remained relatively steady over the project.

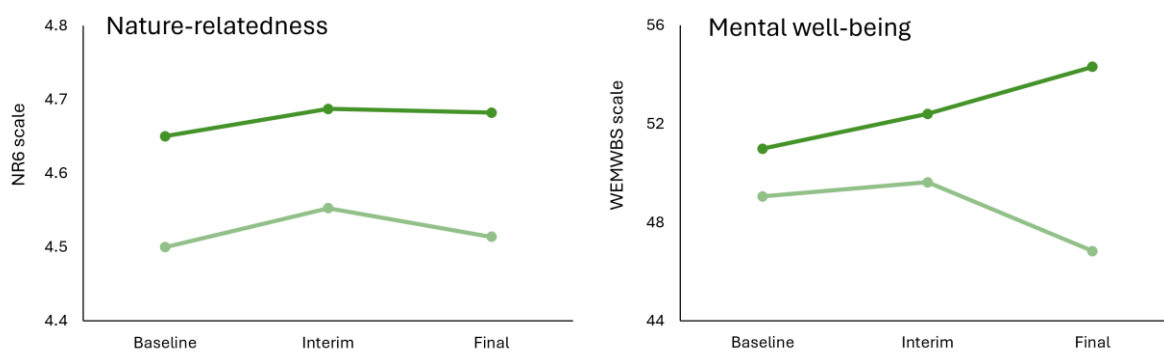


Figure 7. Changes in the average NR-6 (Nature-relatedness) and WEMWBS (Mental well-being) scales over the course of the project (baseline to interim to final) for the wildlife monitoring group (dark green) and control group (light green).

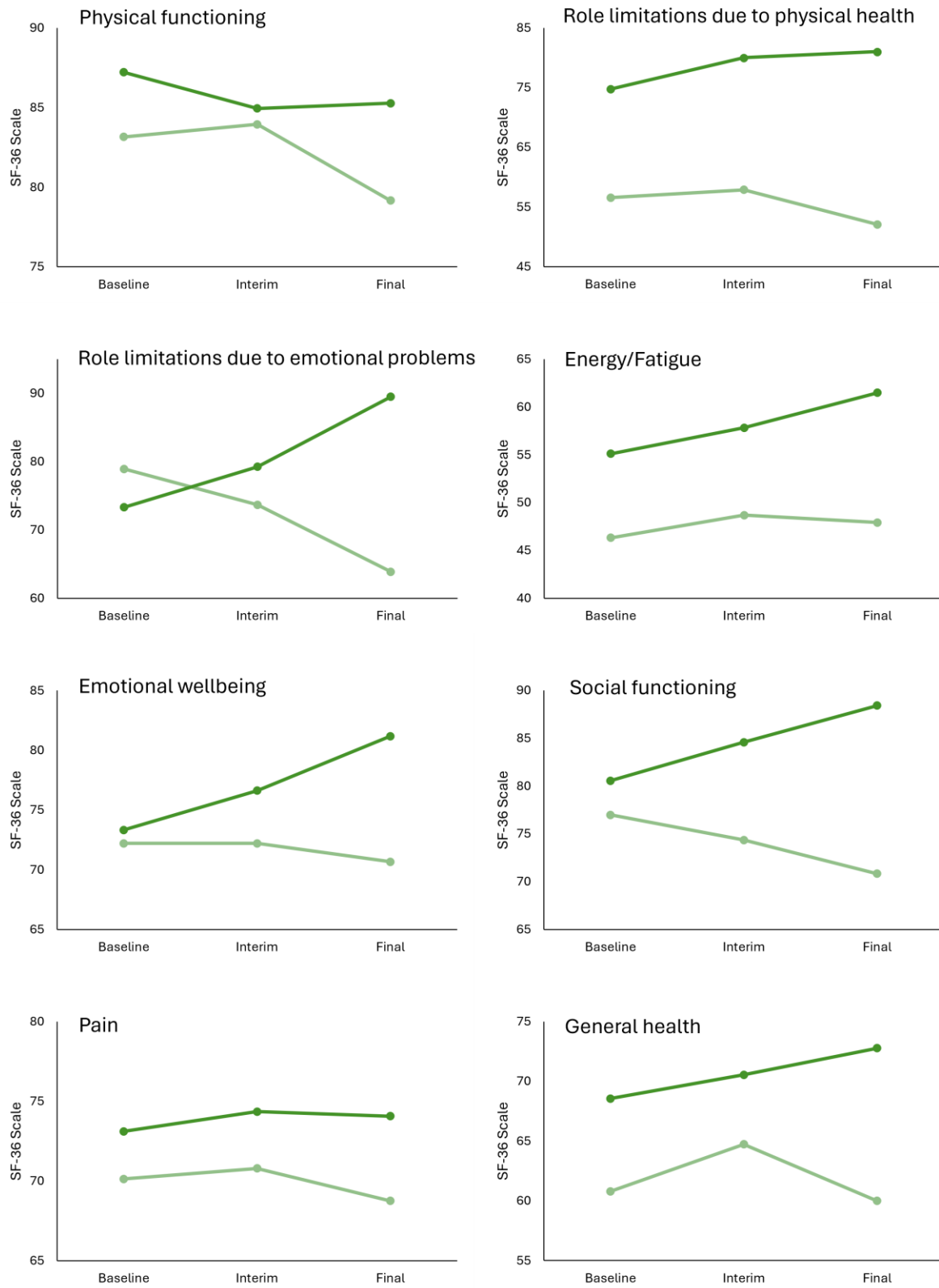


Figure 8. Changes in the average SF-36 Scales over the course of the project (baseline to interim to final) for the wildlife monitoring group (dark green) and control group (light green).



Semi-structured interviews

Twenty citizen scientists participated in the semi-structured interviews, the majority of these identified as female (75%), between 65-74 years of age (45%), and born in Australia (70%). Most live as a couple (50%) or a couple with dependents (30%), own their home (90%), are retired (55%) or employed part-time/casual (30%), and hold a postgraduate (50%) or Bachelor’s degree (25%).

The interviews revealed a range of experiences with wildlife-friendly gardening and wildlife monitoring, and provided evidence for a variety of benefits to participant’s health, wellbeing, and connection to nature. Several wellbeing dimensions emerged through the interviews (Table 4), with the environmental and emotional dimensions of wellbeing the most apparent. Interview responses revealed positive feelings of environmental stewardship and responsibility for wildlife visiting their gardens, with wildlife-friendly garden practices providing an opportunity for taking positive action and relieving negative feelings of eco-grief or eco-anxiety. For some participants, the impacts of wildlife-friendly gardening on their emotional and environmental wellbeing were quite pronounced, e.g. “it takes away the anxieties of the world” (Table 4).

Table 4. Example responses from the in-person garden interviews, illustrating different dimensions of human wellbeing benefit from wildlife-friendly gardening and wildlife monitoring.

Wellbeing dimension	Example responses from the interviews
Environmental	‘you don’t own them [wildlife], but it’s like you’re looking after them... it’s your responsibility to protect them to the best of your ability.’
Emotional	‘It gives you a nice, relaxed feeling ... watching animals who are free and doing what they want ... suddenly I’m not worried about traffic and problems of the world’
Environmental & Emotional	‘I suppose it feels ... joyful and relief when, you know, it makes you think you’re in nature... I think it makes you feel a bit wondrous. It makes you feel like a connection’
Environmental & Emotional	‘...it takes away the anxieties of the world and I think, you know, I tend to feel anxious about the impact of what we’ve done to our world. So I felt that if I could do something to make a difference, even if it’s gardening and increasing the wildlife population of some butterflies or frogs...’
Intellectual	‘recognising different species in the garden has been wonderful’
Intellectual	‘it’s the excitement of watching the [nest] box and seeing if something is actually going to inhabit it and also recognising perhaps what works and what doesn’t work... from a learning point of view’
Social	‘it was a way for me ... to connect to other people who share the same interest.’
Physical	‘It makes me feel good about being outdoors and do something a bit physical and, you know, not sitting inside’
Spiritual	‘it’s being far more present... sort of like meditation’
Physical & Spiritual	‘I think you feel every sense comes alive from hearing the birds, smelling the blossom or whatever’s out in flower. Seeing, touching, every sense’



In addition to the environmental and emotional dimensions of wellbeing, the intellectual, social, physical, and spiritual dimensions of wellbeing were also apparent in participant's responses (Table 4). In terms of intellectual wellbeing, participants enjoyed learning to identify the different species visiting their gardens, observing and understanding how wildlife responded to newly installed garden structures, and adapting or improving their wildlife-friendly gardening practices based on their own observations and learnings from the project. Wildlife-friendly gardening practices related to physical wellbeing through spending time outdoors, engaging physical senses (sight, smell, touch), active movement, and physical relaxation. Spiritual wellbeing benefits emerged from participant's experiencing awe and wonder when noticing different species within their gardens, and through meditative experiences particularly for wildlife monitoring activities that required participants to be relatively still and silent while observing, such as bird counts and bird bath surveys.

While social connections between participants was not a key component of this project (social connection between participants occurred minimally, mainly through participants attending the Wildlife Monitoring workshop and/or Habitat Structure Installation workshop, or monthly exchanges of camera traps for some participants who shared camera traps), several interview participants discussed how their wildlife-friendly gardening practices have connected them to (or provided new avenues of connection with) their neighbours, local conservation groups, relevant online communities, and friends and family.

Interview participants also shared some negative human wellbeing impacts of wildlife-friendly gardening and wildlife monitoring activities. For example, some interviews expressed feelings of distress or frustration when observing introduced species or animal predation within their gardens, dissatisfaction with garden habitat structures that were not yet being used by wildlife, and/or concern over the impacts of environmental or landscape changes on local wildlife.

Implications and future research priorities

In this study, wildlife-friendly gardening and wildlife monitoring activities were found to contribute positively to human health, wellbeing and connection to nature. The online surveys suggest positive impacts of wildlife monitoring activities on several metrics of human health and emotional wellbeing, while the garden interviews reveal a wide range of participant experiences and a deeper understanding of how wildlife monitoring and habitat structure installation influenced participant's health, wellbeing, and connection to nature. The qualitative outcomes from the interviews complement the quantitative data from the online surveys, further enriching our understanding of the human impacts of wildlife-friendly gardening activities.

This research adds to a growing body of literature on the human-wellbeing benefits of connecting with nature, whether that be through supporting biodiversity conservation, participating in citizen science, or gardening activities. This project provides a unique perspective, highlighting the influence of wildlife monitoring within residential gardens, and installing wildlife-friendly garden habitat structures, on human health, wellbeing, and connection to nature. As cities become more urbanised and natural areas diminish, the role of gardens becomes increasingly important not only for their benefit to wildlife conservation, but also for their benefits to human health, wellbeing, and connection with nature.



As with the ecological research, there are a wealth of opportunities to further investigate the connections between wildlife-friendly gardening activities and human health, wellbeing, and connection to nature. For example, future research could explore:

- The influence of wildlife monitoring and/or wildlife-friendly gardening for communities with relatively low levels of nature-relatedness, and/or low health and wellbeing scores. The cohort involved in this study all had relatively high scores for the nature-relatedness scale, and various health and wellbeing scales.
- The potential for human wellbeing benefits to act as a persuasive lever to promote wildlife-friendly gardening (and other pro-environmental behaviour changes) to new audiences who may be more motivated by human wellbeing benefits than by ecological benefits. For example, the role of physical and emotional health benefits as motivators for individuals to begin wildlife-friendly gardening practices, and/or the role of social connection as a means of further spreading wildlife-friendly gardening activities throughout neighbourhoods and across the urban landscape, could be further explored.
- The long-term benefits of wildlife-friendly gardening and wildlife monitoring activities, and strategies to combat any negative impacts associated with these activities. Future studies could follow up with the cohort of the present study, to understand whether participants continued with their wildlife-friendly gardening or wildlife monitoring activities, and any further changes in their health, wellbeing or connection to nature.
- The possibility for wildlife-friendly gardening and/or wildlife monitoring activities to support or enhance existing human wellbeing initiatives connected to nature, such as therapeutic horticulture or forest bathing. Future studies could explore the potential benefits of adapting the wildlife monitoring (Van Helden et al. 2022) and habitat structure installation methods (Greenop et al. 2023) to specifically support participant's health and wellbeing goals, e.g. by prompting relaxation or mindfulness techniques during wildlife monitoring surveys or wildlife-friendly gardening activities.

Conclusion

This project has revealed that wildlife-friendly gardening not only contributes to biodiversity conservation but that it also fosters human wellbeing. This research has shown that residential gardens and habitat structures support a wide diversity of vertebrate wildlife in southwestern Australia, and there is widespread interest amongst citizen scientists and the wider community to contribute to urban biodiversity conservation. By providing essential habitat resources and supporting reproductive opportunities for wildlife, wildlife-friendly gardening can actively benefit biodiversity. Simultaneously, it offers people opportunities to connect with and support nature in their own garden, deepening their understanding of local wildlife and providing a constructive outlet to alleviate eco-anxiety. It encourages increased outdoor activity, promoting physical health, while evoking emotions of joy, surprise, calm, respect, and wonder, which positively impact mental and emotional wellbeing. In essence, this project illuminates that gardening for wildlife is also gardening for wellbeing, and thus advocating and engaging community in wildlife-friendly gardening practices will benefit both people and nature.



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Appendix 1

Online survey questions provided to participants, including the SF-36, WEMWBS and NR-6 metrics, demographics, and questions related to garden activity and general thoughts on wildlife.

SECTION 1: DEMOGRAPHIC QUESTIONS

There are 'prefer not to answer' options for sensitive questions if you wish not to answer. However, where comfortable, answering these questions allow us to analyse potential variables that could affect our data, meaning that we can more credibly come to conclusions and answer our study questions.

What is your age?

- <18 (precludes from survey)
 - 18-24 years
 - 25-34 years
 - 35-44 years
 - 45-54 years
 - 55-64 years
 - 65-74 years
 - 75-84 years
 - 85+ years
-

Which gender do you most strongly identify as?

- Female
 - Male
 - Non-binary
 - Not sure
 - Other
 - Prefer not to say
-

What is your annual household income?

- <\$12,000
 - \$12,001-\$40,000
 - \$40,001-\$80,000
 - \$80,001-\$120,000
 - \$120,001-\$160,000
 - \$160,001-\$200,000
 - \$200,001+
 - Prefer not to say
-

How would you describe the home you currently reside in?

- Renting
 - Mortgaged
 - Fully owned
-

Who lives within your household?

- Single person household
 - Single person household with dependents
 - Couple household
 - Couple household with dependents
 - House share
 - Other household structure. Please specify: [Open comment]
-

What is your employment status?

- Employed full-time (37.5+ hours/week)
 - Employed part-time or casual (less than 37.5 hours/week)
 - Full-time parent/guardian
 - Retired
 - Student
 - Not currently working
-



-
- Other. Please specify: [Open comment]
-

What is your highest educational qualification?

- No formal education
- Completed primary school
- Some high school
- Completed high school (or equivalency)
- Certificate or Diploma (including trade or another certificate)
- Bachelor's degree (including Honours)
- Post graduate qualification (e.g Master's or PhD)
- Still at school
-

What was your country of birth?

[Drop down list of countries to choose from]

Do you identify as Aboriginal or Torres Strait Islander?

- No
- Aboriginal
- Torres Strait Islander
- Both
- Prefer not to say
-

How would you describe **your** cultural identity or identities? Some examples include Wadjuk, Menang, Noongar-Scottish, Australian-Chinese, Lebanese-Australian, Italian, Polynesian, etc.

- [Open comment]
- I do not identify with a specific cultural identity
-

What is your religious affiliation?

- Christian (Catholic protestant or any other Christian denominations)
- Buddhist
- Hindu
- Muslim
- Jewish
- Sikh
- No religion
- Prefer not to say
- Other. Please specify: [Open comment]
-

SECTION 2: GENERAL WELLBEING

Choose one option for each questionnaire item. Please respond as you really feel, rather than how you think "most people" feel. This section will help us to understand how gardening for wildlife can impact people's general wellbeing. This section includes questions from the 36-Item Short Form Health Survey (SF-36), developed at RAND as part of the Medical Outcomes Study.

In general, would you say your health is:

- 1 – Excellent
- 2 - Very good
- 3 – Good
- 4 – Fair
- 5 - Poor
-

Compared to one year ago, how would you rate your health in general **now**?

- 1 - Much better now than one year ago
- 2 - Somewhat better now than one year ago
- 3 - About the same
- 4 - Somewhat worse now than one year ago
- 5 - Much worse now than one year ago
-

The following items are about activities you might do during a typical day. Does **your health now limit you** in these activities? If so, how much?



	Yes, limited a lot	Yes, limited a little	No, not limited at all
Vigorous activities , such as running, lifting heavy objects, participating in strenuous sports	1	2	3
Moderate activities , such as moving a table, pushing a vacuum cleaner, bowling, or playing golf	1	2	3
Lifting or carrying groceries	1	2	3
Climbing several flights of stairs	1	2	3
Climbing one flight of stairs	1	2	3
Bending, kneeling, or stooping	1	2	3
Walking more than a mile	1	2	3
Walking several blocks	1	2	3
Walking one block	1	2	3
Bathing or dressing yourself	1	2	3

During the **past 4 weeks**, have you had any of the following problems with your work or other regular daily activities **as a result of your physical health**?

	Yes	No
Cut down the amount of time you spent on work or other activities	1	2
Accomplished less than you would like	1	2
Were limited in the kind of work or other activities	1	2
Had difficulty performing the work or other activities (for example, it took extra effort)	1	2

During the **past 4 weeks**, have you had any of the following problems with your work or other regular daily activities **as a result of any emotional problems** (such as feeling depressed or anxious)?

	Yes	No
Cut down the amount of time you spent on work or other activities	1	2
Accomplished less than you would like	1	2
Didn't do work or other activities as carefully as usual	1	2

During the **past 4 weeks**, to what extent has your physical health or emotional problems interfered with your normal social activities with family, friends, neighbors, or groups?

- 1 - Not at all
- 2 - Slightly
- 3 - Moderately
- 4 - Quite a bit
- 5 - Extremely

How much **bodily** pain have you had during the **past 4 weeks**?

- 1 - None
- 2 - Very mild
- 3 - Mild
- 4 - Moderate
- 5 - Severe
- 6 - Very Severe

During the **past 4 weeks**, how much did **pain** interfere with your normal work (including both work outside the home and housework)?

- 1 - Not at all



- 2 – A little bit
- 3 – Moderately
- 4 - Quite a bit
- 5 - Extremely

These questions are about how you feel and how things have been with you **during the past 4 weeks**. For each question, please give the one answer that comes closest to the way you have been feeling. How much of the time during the **past 4 weeks**...

	All of the time	Most of the time	A good bit of the time	Some of the time	A little of the time	None of the time
Did you feel full of pep?	1	2	3	4	5	6
Have you been a very nervous person?	1	2	3	4	5	6
Have you felt so down in the dumps that nothing could cheer you up?	1	2	3	4	5	6
Have you felt calm and peaceful?	1	2	3	4	5	6
Did you have a lot of energy?	1	2	3	4	5	6
Have you felt downhearted and blue?	1	2	3	4	5	6
Did you feel worn out?	1	2	3	4	5	6
Have you been a happy person?	1	2	3	4	5	6
Did you feel tired?	1	2	3	4	5	6

During the **past 4 weeks**, how much of the time has **your physical health or emotional problems** interfered with your social activities (like visiting with friends, relatives, etc.)?

- 1 – All of the time
- 2 – Most of the time
- 3 – Some of the time
- 4 – A little of the time
- 5 – None of the time

How TRUE or FALSE is **each** of the following statements for you.

	Definitely true	Mostly true	Don't know	Mostly false	Definitely false
I seem to get sick a little easier than other people	1	2	3	4	5
I am as healthy as anybody I know	1	2	3	4	5
I expect my health to get worse	1	2	3	4	5
My health is excellent	1	2	3	4	5

SECTION 3: MENTAL WELLBEING

Please respond as you really feel, rather than how you think “most people” feel. This section will help us understand how gardening for wildlife can impact people's mental wellbeing. This section contains questions from the Warwick Edinburgh Mental Wellbeing Scale (WEMWBS) © NHS Health Scotland, University of Warwick and University of Edinburgh, 2008, all rights reserved.

Below are some statements about feelings and thoughts. Please tick the box (1 – 5) that best describes your experience of each over the last 2 weeks.



	None of the time	Rarely	Some of the time	Often	All of the time
I've been feeling optimistic about the future	1	2	3	4	5
I've been feeling useful	1	2	3	4	5
I've been feeling relaxed	1	2	3	4	5
I've been feeling interested in other people	1	2	3	4	5
I've had energy to spare	1	2	3	4	5
I've been dealing with problems well	1	2	3	4	5
I've been thinking clearly	1	2	3	4	5
I've been feeling good about myself	1	2	3	4	5
I've been feeling close to other people	1	2	3	4	5
I've been feeling confident	1	2	3	4	5
I've been able to make up my own mind about things	1	2	3	4	5
I've been feeling loved	1	2	3	4	5
I've been interested in new things	1	2	3	4	5
I've been feeling cheerful	1	2	3	4	5

SECTION 4: WILDLIFE/NATURE-RELATEDNESS

Please respond as you really feel, rather than how you think “most people” feel. This section will help us understand how gardening for wildlife can impact people's wildlife/nature-relatedness. This section contains questions from the Short Version, 6-Item Nature-Relatedness Scale (Nisbet E., Zelenski J., 2013. The NR-6: A new brief measure of nature relatedness. *Frontiers in Psychology*. Available at: <https://doi.org/10.3389/fpsyg.2013.00813>.)

Please tick the box (1 – 5) that best describes the extent to which you agree with each statement below.

	Disagree strongly	Disagree a little	Neither agree nor disagree	Agree a little	Agree strongly
My ideal vacation spot would be a remote, wilderness area.	1	2	3	4	5
I always think about how my actions affect the environment.	1	2	3	4	5
My connection to nature and the environment is a part of my spirituality.	1	2	3	4	5
I take notice of wildlife wherever I am.	1	2	3	4	5
My relationship to nature is an important part of who I am.	1	2	3	4	5
I feel very connected to all living things and the earth.	1	2	3	4	5

SECTION 5: GENERAL THOUGHTS ON WILDLIFE

These questions relate to your feelings about having wildlife in your garden.

Please rate how strongly you feel connected to animal wildlife in your garden in the following ways:



	Unconnected	Slightly connected	Moderately connected	Strongly connected	Extremely connected
How strongly do you feel connected with animal wildlife in your garden on an emotional level? For example, wildlife within your garden influences your emotions (e.g. calm or anxious).	1	2	3	4	5
How strongly do you feel connected with animal wildlife in your garden on a cultural level? For example, in terms of cultural identity, beliefs or practice.	1	2	3	4	5
How strongly do you feel connected with animal wildlife in your garden on a religious/spiritual level? For example, in terms of religious/spiritual identity, beliefs or practice.	1	2	3	4	5
How important do you consider the following in influencing your physical health?					
	Unimportant	Slightly important	Moderately important	Important	Very important
Your emotional connection with animal wildlife	1	2	3	4	5
Your cultural connection with animal wildlife	1	2	3	4	5
Your religious/spiritual connection with animal wildlife	1	2	3	4	5
How important do you consider the following in influencing your mental health?					
	Unimportant	Slightly important	Moderately important	Important	Very important
Your emotional connection with animal wildlife	1	2	3	4	5
Your cultural connection with animal wildlife	1	2	3	4	5



Your religious/spiritual connection with animal wildlife	1	2	3	4	5
---	---	---	---	---	---

How important do you consider the following in influencing your **happiness**?

	Unimportant	Slightly important	Moderately important	Important	Very important
Your emotional connection with animal wildlife	1	2	3	4	5

Your cultural connection with animal wildlife	1	2	3	4	5
--	---	---	---	---	---

Your religious/spiritual connection with animal wildlife	1	2	3	4	5
---	---	---	---	---	---

Overall, how would you describe your feelings about having animal wildlife in your garden?

- Very positive
- Positive
- Neutral
- Negative
- Very negative

SECTION 6: GARDEN ACTIVITY

These questions relate to garden use and your involvement in the project.

How often were you in your garden in the last 2 months?

- Very often (everyday)
- Often (several times a week)
- Occasionally (once per week)
- Rarely (once every couple of weeks)
- Very rarely (once)

Since joining this project, on average, how often do you see, smell or hear wildlife (birds, frogs, reptiles or mammals) in your garden?

- Very often (everyday)
- Often (several times a week)
- Occasionally (once a week)
- Rarely (once every couple of weeks)
- Very rarely (once every few months)
- Never

Have you monitored any wildlife as part of this project?

- Yes
- No



Appendix 2

Semi-structured interviews question guide.

SECTION 1: YOUR GARDEN

To start, I'm going to ask about your garden and gardening experiences:

- Can you describe your garden? e.g. what features does your garden have?
- How do you spend time in your garden, and how often?

How long have you been gardening for?

- Would you consider yourself an avid gardener?
- How did you first get into gardening?

How does being in your garden make you feel?

- Is your garden a special place for you?
- What connections do you have to your garden?

Can you tell me about any natural spaces nearby where you live? E.g. Are there any local bushlands, wetlands, beaches nearby?

- Do you spend much time in those places?
- How do you spend your time in those places?
- Do you tend to take notice of wildlife in those places?

Outside of this project, do you have much interest in wildlife conservation? E.g. Do you work, study, or volunteer in an environmental field?

SECTION 2: WILDLIFE-FRIENDLY GARDENING

Now thinking about wildlife-friendly gardening, can you tell me what “wildlife-friendly gardening” means to you? How would you define it?

For this project, we defined wildlife-friendly gardening as “the manipulation of gardens by residents with the goal of providing habitat for wildlife”. Habitat includes providing shelter, water, and food resources.

- What sort of actions or changes have you made in your garden to support wildlife?
- Was this project the first time you started gardening specifically for wildlife? If no: When did you first begin wildlife-friendly gardening? What kinds of actions have you taken for wildlife in your garden before this project?
- Why did you initially decide to get involved in this project? What part of the project in particular sparked your interest?
- Having now been involved in the project for several months, is that still the aspect you're most interested in?

You took part in the “wildlife-friendly gardening” phase of this project, installing new habitat structures. Can you tell me about the structures you chose to install in your garden as part of this project?

Why did you decide on these structures to install?

- Did you want to support any particular groups of wildlife with your structures? Were there any groups of wildlife that you weren't keen to support in your garden?
-



-
- When you first joined the project, were you planning to get involved in this wildlife-friendly gardening phase of installing structures? If no: What made you change your mind?
 - For each structure, we gave information about the type of animals they would support, their approximate cost, a difficulty rating for installing and monitoring, and a discount amount. Did any of those factors influence your decision about which structures to install?

What do you see as the main benefits from adding these structures to your garden?

- Have you enjoyed adding the new structures to your garden?
 - If yes: What have you enjoyed about it? Any favourite moments you can share? Is there anything you haven't enjoyed about having this wildlife-friendly structure?
 - If no: Were there any particular barriers that stopped you from enjoying the experience?
- Does having the new structures change the way you view or use your garden personally?

SECTION 3: WILDLIFE MONITORING

Now we're going to talk about the wildlife monitoring aspect of this project.

- What initially sparked your interest to monitor wildlife in your garden?

Can you tell me about each of the wildlife monitoring techniques you've tried?

- What made you choose each of those techniques?
- Were there any techniques you tried for a little while, then stopped? Why was that?
- Are there any particular reasons why you didn't choose to do the other techniques?

Overall, what has the experience of monitoring wildlife been like for you?

- Can you tell me about your favourite experience of seeing wildlife in your garden?
- Have there been any negative experiences you'd like to share?

In this project, we focused on vertebrate wildlife, particularly birds, reptiles, frogs and mammals.

- Can you tell me how you felt when you saw each of those groups in your garden?
 - How do you feel when you see [birds, reptiles, frogs, mammals]
- Are there any types of wildlife you don't enjoy seeing in your garden?
- Have you seen any invertebrate wildlife visiting your garden? E.g. insects, snails, spiders? How do you feel when you see those?
- Have there been any times when you were monitoring in your garden but didn't see any wildlife? How did that make you feel?
- Have there been any times when you were **not** monitoring, but you saw wildlife in your garden? How did that make you feel? Was it different to when you saw wildlife while monitoring?
- Have you seen wildlife using any of the wildlife-friendly structures that you have installed?
 - If yes: Can you tell me about how you felt seeing wildlife using your structure?
 - If no: Can you tell me about how that makes you feel?

During the project, did your experiences of monitoring wildlife in your garden have any influence on your choice of the structures you decided to install?

SECTION 4: OVERALL + FUTURE

Overall, what are some of the main benefits you have gotten out of wildlife friendly gardening and monitoring wildlife in your garden?



-
- Have there been any unexpected benefits?
 - Do you feel that you have benefitted personally?
 - Do you feel that you have gained new knowledge?
 - Has your wildlife-friendly gardening led to you spending more time outside?
 - Has it had any influence on your connection to nature?
 - Do you tend to notice wildlife more? Do you notice wildlife outside of your garden?
 - Have you spoken to other people (such as neighbours, family, friends, colleagues) about your wildlife-friendly gardening experiences?

Have you encouraged other people to do wildlife-friendly gardening?

- If yes: What do you say to encourage them?
- What aspects of wildlife friendly gardening do you think would get more people involved?
- Do you think personal enjoyment, or health and wellbeing benefits, are important factors for engaging people in wildlife-friendly gardening?

Do you feel that wildlife-friendly gardening has influenced your own health and wellbeing in any way? If yes: In what ways?

- Looking back, was your own health and wellbeing a motivator for you to engage in wildlife-friendly gardening? If yes: In what ways?

SECTION 5: FUTURE INTENTIONS

Looking to the future now, are there any other actions you plan to take *in your garden* that support wildlife?

- If yes: What do you plan to do next, and why?
- If no: Can you explain why?

Are there any other actions you plan to take (or are taking) *outside of your garden* to support wildlife? E.g. in your local natural areas (bushlands, wetlands, beaches).

- If yes: What sorts of actions do you do? What do you plan to do next, and why?
- If no: Are there any particular reasons why or barriers that you can share?

If you were to take part in a project like this in future, do you have any suggestions for how the project could be improved?

- Anything you would change or do differently?
- Any ideas for how we could get more people active and involved in wildlife-friendly gardening?

Is there anything else you would like to tell me about your personal experience with wildlife friendly gardening and wildlife monitoring?

Appendix 3

Percentage contribution of each species to the total number of vertebrate animals (N) recorded using artificial refuges (bird boxes, frog hotels, possum shelters, and reptile shelters) and water sources (bird baths and ponds) in southwestern Australian gardens between August 2022 and February 2023. List excludes invertebrates and fish. Species that are threatened under Australia’s Environment Protection and Biodiversity Conservation Act 1999 are indicated with ‘*’. Introduced species to Western Australia are indicated with ‘+’. Table modified from Van Helden et al. (2024).

Structure type (No. animal records)	Common name	Scientific name	Number of animal records	Percentage of animal records
Bird box (N = 39)	Striated pardalote	<i>Pardalotus striatus</i>	21	53.8%
	Carnaby's black cockatoo *	<i>Zanda latirostris</i>	9	23.1%
	Red-capped parrot	<i>Purpureicephalus spurius</i>	6	15.4%
	Western pygmy possum	<i>Cercartetus concinnus</i>	1	2.6%
	Marbled gecko	<i>Christinus marmoratus</i>	1	2.6%
	Western ringtail possum*	<i>Pseudocheirus occidentalis</i>	1	2.6%
Frog hotel (N = 21)	Motorbike frog	<i>Litoria moorei</i>	19	90.5%
	Western banjo frog	<i>Limnodynastes dorsalis</i>	1	4.8%
	Western three-lined skink	<i>Acritoscincus trilineatus</i>	1	4.8%
Possum shelter (N = 41)	Western ringtail possum*	<i>Pseudocheirus occidentalis</i>	37	90.2%
	Common brushtail possum	<i>Trichosurus vulpecula</i>	4	9.8%
Reptile shelter (N =183)	Two-toed earless skink	<i>Hemiergis quadrilineata</i>	77	42.1%
	Western worm lerista	<i>Lerista praepedita</i>	34	18.6%
	Common dwarf skink	<i>Menetia greyii</i>	13	7.1%
	Bobtail	<i>Tiliqua rugosa</i>	13	7.1%
	Lowlands earless skink	<i>Hemiergis peronii</i>	9	4.9%
	King’s skink	<i>Egernia kingii</i>	7	3.8%

Structure type (No. animal records)	Common name	Scientific name	Number of animal records	Percentage of animal records
	Unidentified lizard spp.	N/A	5	2.7%
	Southwestern earless skink	<i>Hemiergis initialis</i>	4	2.2%
	South-western orange-tailed slider	<i>Lerista distinguenda</i>	4	2.2%
	Marbled gecko	<i>Christinus marmoratus</i>	3	1.6%
	Gecko spp.	N/A	3	1.6%
	Shrubland morethia skink	<i>Morethia obscura</i>	2	1.1%
	Legless lizard spp.	N/A	2	1.1%
	Western three-lined skink	<i>Acritoscincus trilineatus</i>	1	0.5%
	Sedgeland's worm-lizard	<i>Aprasia repens</i>	1	0.5%
	Buchanan's snake-eyed skink	<i>Cryptoblepharus buchananii</i>	1	0.5%
	Quacking frog	<i>Crinia georgiana</i>	1	0.5%
	Southern brown bandicoot	<i>Isoodon fusciventer</i>	1	0.5%
	Spotted-thighed frog	<i>Litoria cyclorhyncha</i>	1	0.5%
	Motorbike frog	<i>Litoria moorei</i>	1	0.5%
Bird bath (N = 7018)	New Holland honeyeater	<i>Phylidonyris novaehollandiae</i>	2622	37.4%
	Silvereye	<i>Zosterops lateralis</i>	878	12.5%
	Brown honeyeater	<i>Lichmera indistincta</i>	604	8.6%
	Unidentified bird spp.	N/A	368	5.2%
	Red wattlebird	<i>Anthochaera carunculata</i>	276	3.9%
	Grey fantail	<i>Rhipidura albiscapa</i>	192	2.7%
	Gilbert's honeyeater	<i>Melithreptus chloropsis</i>	173	2.5%
	Australian magpie	<i>Gymnorhina tibicen</i>	164	2.3%
	Australian ringneck	<i>Barnadius zonarius</i>	160	2.3%
	Carnaby's black cockatoo*	<i>Zanda latirostris</i>	153	2.2%
	Willie wagtail	<i>Rhipidura leucophrys</i>	131	1.9%
	Common bronzewing	<i>Phaps chalcoptera</i>	113	1.6%

Structure type (No. animal records)	Common name	Scientific name	Number of animal records	Percentage of animal records
	Laughing dove+	<i>Streptopelia senegalensis</i>	101	1.4%
	Galah	<i>Eolophus roseicapilla</i>	96	1.4%
	Red-capped parrot	<i>Purpureicephalus spurius</i>	95	1.4%
	Australian raven	<i>Corvus coronoides</i>	93	1.3%
	White-browed scrubwren	<i>Sericornis frontalis</i>	67	1.0%
	Splendid fairy-wren	<i>Malurus splendens</i>	55	0.8%
	Red-eared firetail	<i>Stagonopleura oculata</i>	52	0.7%
	Singing honeyeater	<i>Gavicalis virescens</i>	52	0.7%
	Western wattlebird	<i>Anthochaera lunulata</i>	52	0.7%
	Spotted dove+	<i>Streptopelia chinensis</i>	44	0.6%
	Weebill	<i>Smicrornis brevirostris</i>	41	0.6%
	Baudin's black cockatoo*	<i>Zanda baudinii</i>	37	0.5%
	Inland thornbill	<i>Acanthiza apicalis</i>	32	0.5%
	Western spinebill	<i>Acanthorhynchus superciliosus</i>	32	0.5%
	Western rosella	<i>Platycercus icterotis</i>	31	0.4%
	Yellow-throated miner	<i>Manorina flavigula</i>	30	0.4%
	Red-winged fairy-wren	<i>Malurus elegans</i>	25	0.4%
	Yellow-rumped thornbill	<i>Acanthiza chrysorrhoa</i>	25	0.4%
	Brown-headed honeyeater	<i>Melithreptus brevirostris</i>	22	0.3%
	Rainbow lorikeet+	<i>Trichoglossus moluccanus</i>	22	0.3%
	White-breasted robin	<i>Quoyornis georgianus</i>	22	0.3%
	Magpie lark	<i>Grallina cyanoleuca</i>	21	0.3%
	Western thornbill	<i>Acanthiza inornata</i>	20	0.3%
	Crested pigeon	<i>Ocyphaps laphotes</i>	19	0.3%
	Scarlet robin	<i>Petroica multicolor</i>	19	0.3%
	Elegant parrot	<i>Neophema elegans</i>	12	0.2%
	Western whistler	<i>Pachycephala occidentalis</i>	11	0.2%
	White-cheeked honeyeater	<i>Phylidonyris niger</i>	9	0.1%

Structure type (No. animal records)	Common name	Scientific name	Number of animal records	Percentage of animal records
	White-browed babbler	<i>Pomatostomus superciliosus</i>	6	0.1%
	Striated pardalote	<i>Pardalotus striatus</i>	5	0.1%
	Black-faced cuckoo-shrike	<i>Coracina novaehollandiae</i>	4	0.1%
	Dusky wood swallow	<i>Artamus cyanopterus</i>	4	0.1%
	Mistletoe bird	<i>Dicaeum hirundinaceum</i>	4	0.1%
	Spotted pardalote	<i>Pardalotus punctatus</i>	4	0.1%
	Australian white ibis	<i>Threskiornis moluccus</i>	3	0.0%
	Laughing kookaburra+	<i>Dacelo novaeguineae</i>	3	0.0%
	Mulga parrot	<i>Psephotellus varius</i>	3	0.0%
	Grey butcherbird	<i>Cracticus torquatus</i>	2	0.0%
	Hooded robin	<i>Melanodryas cucullata</i>	2	0.0%
	Budgerigar	<i>Melopsittacus undulatus</i>	1	0.0%
	Grey shrike-thrush	<i>Colluricincla harmonica</i>	1	0.0%
	Motorbike Frog	<i>Litoria moorei</i>	1	0.0%
	Pied honeyeater	<i>Certhionyx variegatus</i>	1	0.0%
	Rainbow bee-eater	<i>Merops ornatus</i>	1	0.0%
	Western grey kangaroo	<i>Macropus fuliginosus</i>	1	0.0%
	White-eared honeyeater	<i>Lichenostomus leucotis</i>	1	0.0%
Pond (N = 267)	Motorbike frog	<i>Litoria moorei</i>	207	77.5%
	New Holland honeyeater	<i>Phylidonyris novaehollandiae</i>	16	6.0%
	Common bronzewing	<i>Phaps chalcoptera</i>	11	4.1%
	Unidentified bird spp.	N/A	8	3.0%
	Unidentified frog spp.	N/A	6	2.2%
	Spotted-thighed frog	<i>Litoria cyclorhyncha</i>	5	1.9%
	Laughing dove+	<i>Streptopelia senegalensis</i>	3	1.1%
	Silvereye	<i>Zosterops lateralis</i>	2	0.7%
	Spotted dove+	<i>Streptopelia chinensis</i>	1	0.4%

Structure type (No. animal records)	Common name	Scientific name	Number of animal records	Percentage of animal records
	Western grey kangaroo	<i>Macropus fuliginosus</i>	1	0.4%
	Western banjo frog	<i>Limnodynastes dorsalis</i>	1	0.4%
	Australian magpie	<i>Gymnorhina tibicen</i>	1	0.4%
	Singing honeyeater	<i>Gavicalis virescens</i>	1	0.4%
	King's skink	<i>Egernia kingii</i>	1	0.4%
	Buchanan's snake-eyed skink	<i>Cryptoblepharus buchananii</i>	1	0.4%
	Red wattlebird	<i>Anthochaera carunculata</i>	1	0.4%
	Unidentified lizard spp.	N/A	1	0.4%