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SHORT NOTE

Bird abundance in grey shrubland in the Wakatipu Basin, Otago, New Zealand

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Primary succession or semi climax vegetation on outwash fans and terraces subject to severe frosts are a significant component of the vegetation of the dry inland basins of the eastern South Island. The leaves of many of the shrub species are small, mostly obscured by divaricating branches, giving a dark appearance meriting the epithet 'grey shrubland' or 'grey scrub'(Wardle 1991). They are distributed from the rainy districts west of the Southern Alps to the eastern dry inland basins where they are found on recent alluvial soils (see Rogers *et al*. 2005 for an overview). In the inland basins they can ascend to *c.* 1000 m asl.

Grey shrublands are generally short in stature (usually 1-3 m tall) and have surprising floristic uniformity considering that rainfall varies from 400 to 10000 mm across their range. *Coprosma propinqua* is invariably present and usually dominant, but with decreasing rainfall and humidity, matagouri (*Discaria toumatou*) enters the community and dominates on the extreme dry flats. The shrubs of most species occur either as clumps or as scattered bushes among herbaceous vegetation, which can consist of wetland, grassland pioneering or ruderal plants. This is partly because soil drainage and texture varies over short distances, and partly because of the pattern of human disturbances (*e.g.*, fire or land clearance; Wardle 1991).

The birds of grey shrublands have not been described in detail. Bishop (1992) noted that fantail (*Rhipidura fuliginosa*), pipit (*Anthus novaeseelandiae*) and swamp harrier (*Circus approximans*) were common in scrub habitats. In another review, yellowhammer (*Emberiza citrinella*) and dunnock (*Prunella modularis*) are noted as common on high country tussocklands, with brown creeper (*Mohoua novaeseelandiae*) occurring in second growth scrub (Darby *et al*. 2003). More recently, a study in the Otago drylands identified the avifauna of this dry region as distinctive, but that many of the indigenous birds that formerly occurred are now either extinct, extirpated or uncommon, and instead exotic species predominate (Wilson *et al*. 2014). At 3 sites in central Otago, variation in the abundance of dryland birds was studied by estimating population densities of 7

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Table 1. Results of mist netting at 2 study sites in the Wakatipu Basin during the spring of 2010. * Native species.

Species	Loch Linnhe			Moke Lake		
	Number caught	Birds per ha	SD[1]	Number caught	Birds per ha	SD[1]
Bellbird*	2	0.59	0.58	2	1.25	0.55
Blackbird	11	3.24	1.89	5	3.13	0
Chaffinch	4	1.18	0.00	12	7.50	0.55
Dunnock	12	3.53	4.08	8	5.00	1.34
Greenfinch	2	0.59	0.58	0	0.00	-
Grey warbler*	3	0.88	0.96	12	7.50	2.07
California quail	1	0.29	0.50	0	0.00	-
Redpoll	2	0.59	1.00	2	1.25	0.89
House sparrow	1	0.29	0.50	0	0.00	-
Song thrush	8	2.35	2.45	7	4.38	1.52
Tomtit*	0	0.00	-	2	1.25	0.55
Silvereye*	12	3.53	0.82	9	5.63	2.17
Yellowhammer	5	1.47	0.96	3	1.88	0.89
Total native	17	5	1.38	25	16	1.68
Total introduced	46	14	1.87	37	23	1.14
Grand total	63	19	1.75	62	39	1.36

[1]There were 4 days mist netting at Loch Linnihe and 5 days at Moke Lake. The SD is calculated as the daily variation in the mist netting for each species.

exotic species (yellowhammer, goldfinch [*Carduelis carduelis*], blackbird [*Turdus merula*], dunnock, chaffinch [*Fringilla coelebs*], greenfinch [*C. chloris*], common redpoll [*C.flammea*]) and 2 indigenous species (silvereye [*Zosterops lateralis*], grey warbler [*Gerygone igata*]) across grassland, mixed grassland–shrubland and shrubland habitats. Wilson *et al*. (2014) reported that generally, succession from grassland to forest leads to decreased numbers of granivorous birds and feeding generalists, and increased numbers of insectivores. They concluded that continued succession to shrubland in central Otago will have little effect on densities of many exotic passerine birds, but may lead to local declines in yellowhammer, goldfinch and redpoll.

The bird community of the extensive grey shrublands within the Wakatipu Basin, central Otago, has not been described in detail. However, observations indicate that this habitat supports a diverse range of both native and exotic passerines. This short note describes the results of a mist netting study to estimate the relative densities of birds in the grey shrublands in the Wakatipu Basin. We also discuss the importance of this vegetation type as a habitat for prey of the 'at risk' New Zealand eastern falcon (*Falco novaeseelandiae* "eastern").

Birds were captured at 2 study areas within the Wakatipu Basin, South Island, New Zealand. The first was Moke Lake, situated 8 km WNW of Queenstown. It comprised 2 grey shrubland patches, each 0.8 ha, on 2 adjacent fans at 450 m asl (E aspect: 168° 33′ 54.9″ E, 45° 0′ 1.4″ S). The vegetation was dominated by matagouri; *Coprosma propinqua, C. rugosa, Aristotelia fruticosa* and *Olearia odorata* were present and common. The area surrounding the grey shrubland included short tussock and exotic grasses with *Gaultheria depressa* and *Dracophyllum uniflorum* present.

The second study area was on Loch Linnhe, located 8 km north of Kingston, on the eastern face of Lake Wakatipu at 380 m asl (WNW aspect: 168° 45′ 50.7″ E, 45° 16′ 30.3″ S). The site in which netting was conducted consisted of 3.4 ha of a larger area of *Coprosma propinqua* dominated grey shrubland. Matagouri, *Olearia odorata,* and *Muehlenbeckia complexa* were common, and some *Fuchsia excorticate* was present. The study site was immediately adjacent to cultivated pasture, with cattle and sheep grazing in and around the shrubs.

Mist netting was carried out using 12 m x 5.2 m mesh nets (35 mm gauge) from late September to late October 2010. We undertook 4-5 days of mist

netting at each site over a 2-week period. Each site had 8 mist nets running simultaneously between approximately 1000 h and 1600 h, which were checked every 20 minutes. Netting sessions were only run in fine weather and calm to light breeze conditions. All trapped birds were given a unique colour band combination. The area of coverage by the mist nets at each study site was estimated by GIS from GPS waypoints for each mist net location. On 2 occasions at each site, birds were observed to determine the numbers that were unbanded. In addition, observations were taken of the use of adjacent pasture by birds nesting in the shrubs. To estimate the density of birds per hectare for each species, the total number of individuals caught over the 4 to 5 day period was divided by the study site area (1.6 or 3.4 ha, respectively). We did not estimate the variation in density of birds as there was only one sampling period.

A total of 62 passerine birds were caught at Moke Lake (40% native) and 63 passerines at Loch Linnhe (27% native). Ten species were caught at Moke Lake and 12 species at Loch Linnhe (Table 1). The only non-passerine captured was California quail (*Callipepla californica*).

Capture rates varied between species with high standard deviation of capture rate, indicating species that were captured on fewer days overall but in which the captures were clumped in time (Table 1). At Moke Lake, the estimated bird density was 39 birds per hectare, with an average of 16 native birds and 23 introduced birds, per hectare. At Loch Linnhe, the estimated bird density was 19 birds per hectare, which included 5 native birds and 14 introduced birds, per hectare (Table 1). The minimum bird density for each species captured at each study site is provided in Table 1. The ratio of banded to unbanded birds at Moke Lake was 1:6 and at Loch Linnhe 1:13.

In two 15-minute periods, 25 movements were noted across the grey shrubland-pasture boundary at Loch Linnhe. Most were *Turdus* species (Eurasian blackbird and song thrush [*T. philomelos*]), but 1 chaffinch was observed moving across this boundary. The farthest distance travelled was 60 m into pasture from the grey shrubland edge. In comparison at Moke Lake, over 30 minutes, 29 movements between the grey shrubland and pasture were noted. The maximum distance travelled was by 2 song thrush, which flew 80 m into the pasture. A pair of yellowhammers used the pasture once in that period. A banded chaffinch was observed 20 m into the pasture on the last day outside the count period.

These are the first reported estimates of density via point mist netting for birds in the grey shrubland ecosystem of the Wakatipu Basin. We recorded a total of 13 species. The native species recorded in the grey shrubland included bellbird (*Anthornis melanura*), grey warbler, tomtit (*Petroica macrocephala*) and silvereye. Interestingly, rifleman (*Acanthisitta chloris*), brown creeper and fantail were not caught at either study area, but are known to utilise grey shrubland habitat at other sites (*pers. obs.*). Moke Lake had a higher estimated minimum density compared to that of Loch Linnhe (*i.e.,* 39 compared to 19 birds per hectare of mist net coverage). Given the complexity of ecosystems such variation is not unusual, however determining the causal factor would require further study. The density of bird species reported here indicates that the grey shrubland of the Wakatipu Basin can be an important habitat for native and exotic passerine species.

One goal of this study was to establish a baseline of bird densities in grey shrubland to better understand this restricted ecosystem and provide data for comparison across habitat types. However, due to differing methods of data collection across studies, comparisons of bird densities across habitats are difficult. For example, bird densities recorded in pasture often use line transects, which are particularly suitable for detecting birds in open uniform habitats (MacLeod *et al.* 2009). In more woody or scrubby habitat, given the difficulty in detecting birds, point transects are more appropriate (Wilson *et al*. 2014), but even here estimates would be confounded by birds moving through vegetation and unable to be observed by the counter. Consequently, mist netting and banding allowed identification of both the species and the number of individuals present without the risk of double counting. Nevertheless, the size of each study site was estimated by the area covered by the mist nets, and the densities we calculated are likely to be underestimates. This is because the number of birds caught was not the total in the catchment area, but the number of birds within the area surrounding the mist nets (*i.e.,* birds per hectare of mist net coverage). We presented minimum densities as it was not within the scope of this study to establish home ranges for the species studied and so the sampling area is a small proportion of the habitat used by individuals (our observations of movements indicate that home ranges are likely to be large). The high ratio of unbanded to banded birds caught in this study also shows that the above density estimates are conservative.

Grey shrubland is one of New Zealand's most threatened environments due to clearance for farming and housing developments (*pers. ob.*). However, anecdotal observations, this study, and work by Wilson *et al.* (2014) and Walker *et al.* (2014) indicate that grey shrublands can support a diverse range of both native and exotic passerines. In North America, it has been reported that the greater the

volume of vegetation the greater the abundance of passerine birds (Mills *et al.* 1991). We suggest a similar relationship is present in the diverse vegetation structure of the grey shrublands of the Wakatipu Basin, although this requires further investigation.

Grey shrubland is important for a range of passerine bird species. Although not studied directly, the species caught in this study are the primary prey items for New Zealand falcons (Seaton & Hyde, 2013). Consequently, grey shrublands are also potential habitat for the threatened eastern New Zealand falcon. Increased falcon abundance has been correlated to presence of woody cover in central Otago, with shrubland areas greater than 1 km^2 increasing the density of both bird and lizard species (Walker *et al*. 2014). It seems probable that such a relationship between shrubland habitat and population dynamics also occurs within grey shrubland of the Wakatipu.

There is now a need for more detailed studies on the causal relationships between bird prey and falcon abundance, and to promote greater protection of grey shrubland by local, regional and national regulatory bodies to protect not only the habitat of native passerines but also to support New Zealand falcon populations.

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