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Results of a community-based acoustic survey of ruru (moreporks) in Hamilton city

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Abstract Ruru or moreporks (*Ninox novaeseelandiae*) are an iconic native species that are relatively widespread in New Zealand, yet little is known about populations that reside within urban areas. Here we present results from a ruru survey conducted by volunteers within the city of Hamilton, New Zealand to: 1) collect baseline data for future comparative ruru surveys, and 2) to introduce and promote ornithology to a wider audience. In addition, these data may be used to quantify the success of urban restoration projects and pest control operations, as many of the desired outcomes of those projects (*e.g.*, increased native vegetation and reduced mammalian predators) would have a positive impact on ruru numbers. Twenty sites were surveyed in areas such as amenity parks and gullys with established vegetation. Teams of observers recorded the time and approximate bearing of all ruru vocalisations at sites for 1 h each night for 5 consecutive nights between 2000-2230 hours in late October 2011. Ruru were detected at 80% (16/20) of sites at least once over the survey period; at 13 of these sites ruru were detected on >2 nights, while birds were detected every night at 5 sites. Multiple birds were detected at 11 sites, which suggested that some may have been resident pairs and breeding. We recommend that including members of the public in similar surveys is highly desirable as it raises awareness around conservation issues and introduces ornithology to a wider audience.

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INTRODUCTION

Urban landscapes are often viewed as areas of low conservation value because they are highly modified ecosystems that accommodate a concentrated human population (Miller & Hobbs 2002; Chace & Walsh 2006). However, urban areas consist of a mosaic of different habitat types, many of which are capable of supporting functioning native floral and faunal populations (Clarkson *et al.* 2007). In New Zealand, where 78% of people now live in cities (Statistics New Zealand 2008), a growing body of urban research on birds (Innes *et al.* 2005; van Heezik *et al.* 2008a), mammalian pests (Gillies & Clout 2003; van Heezik *et al.* 2008b; Morgan *et al.* 2009; van Heezik *et al.* 2010; Morgan *et al.* 2011), and vegetation (Clarkson *et al.* 2007) is accumulating. Furthermore, public enthusiasm for promoting or protecting urban areas with populations of native species is also increasing, and there are numerous community groups throughout New Zealand where this is their main objective (*e.g.*, Scott 2007; Collier *et al.* 2009).

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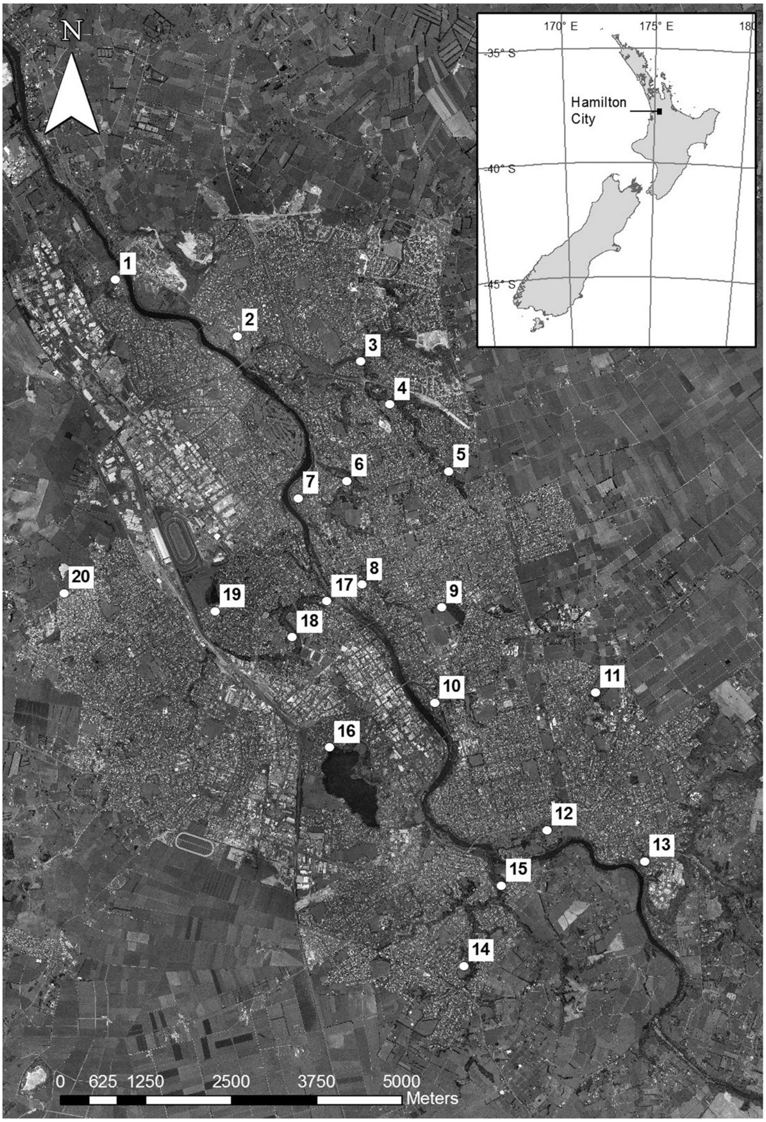

Fig. 1. Aerial photograph of Hamilton showing locations of counting sites (see Table 1 for location names).

Ruru or moreporks (*Ninox novaeseelandiae*) are small (29 cm, 175 g) owls native to New Zealand (Heather & Robertson 1996), although other subspecies are found across the Australasian region (Gill 2010). Their diet mainly consists of macroinvertebrates supplemented by small vertebrates (Haw & Clout 1999), and they are commonly found in areas with large trees, which they require for roosting and nesting (see Higgins 1999 and references therein). Accordingly, ruru are widely distributed across much of New Zealand (Robertson *et al.* 2007).

Up to 10 different types of vocalisations have been described for ruru (Higgins 1999); however, there is debate over whether there is overlap between these classifications as other researchers have suggested that this species may only have up to 5 call types (*e.g.,* Olsen & Trost 1997; Olsen *et al.* 2002). Previous studies have reported difficultly sexing ruru from vocalisations, even with known-sex birds being radio-tagged (*e.g.*, Olsen *et al.* 2002); however, other studies have suggested that females generally have 'deeper' calls than males (*e.g.,* Debus 1996; Olsen 1997). Most research on ruru in New Zealand has been conducted on birds that inhabit forested areas (*e.g.*, Imboden 1975; Brown & Mudge 1999; Stephenson & Minot 2006; Denny 2009), and comparatively little research has been conducted on urban populations, except noting their presence (*e.g.*, Beauchamp 2009; but see O'Donnell 1980).

Table 1. Results from a 5-night ruru survey (24-28/10/11) at 20 count sites in Hamilton (see Fig. 1 for count site locations); 'nd'= not detected.

Site	Minimum number of ruru detected/night					Time ruru 1st heard[#]
	1	2	3	4	5	
1. Pukete Mountain Bike Track*	0	1	1	0	1	2035
2. Flagstaff River Walkway	0	0	0	0	0	nd
3. Kirikiriroa Gully East	0	1	0	0	1	2035
4. Kirikiriroa Gully West	1	2	0	0	3	2035
5. Porrit Stadium	0	0	1	2	2	2025
6. Donny Park	0	0	0	0	1	2045
7. Days Park	2	1	0	0	0	2032
8. Casey Avenue Gully	0	1	1	0	2	2025
9. Claudelands Bush	0	0	0	0	0	nd
10. Memorial Park	0	0	0	0	0	nd
11. Waikato University	2	2	1	1	1	2030
12. Hamilton Gardens	2	1	2	1	2	2025
13. Hammond Bush	3	2	2	1	3	2010
14. Te Anau Park	2	2	2	2	2	2024
15. Sanford Park	0	0	0	0	1	2115
16. Lake Domain Reserve	1	0	0	1	1	2115
17. Edgecumbe Park	0	0	0	2	1	2025
18. Willoughby Park	2	1	1	2	1	2040
19. Minogue Park	0	0	0	0	0	nd
20. Horseshoe Lake	0	2	0	0	0	2145

* The count at this site was abandoned on night 4 due to persistent rain and repeated on 29/10/11. Therefore, night 4 and 5 at this site was 28/10/12 and 29/10/11, respectively.
[#]Time of first detection determined by noting: 1) the end time of the recording interval (see Methods) that a ruru was 1st detected in at a given site over the survey period; or 2) the actual time, if recorded by observers.

The main aim of the current study was to conduct a survey within Hamilton city at vegetated sites likely to support ruru (*e.g.*, gully systems, amenity parks and other green spaces with suitable habitat). To our knowledge, this is the 1st survey of its kind to be conducted within a New Zealand city; therefore, the results may be used as baseline data for future surveys in this and other urban areas. Local government and community groups have been restoring gully systems in Hamilton for a number of years which appears to have increased tui (*Prosthemadera novaeseelandiae*) visits, and a resident population is probably now present (J. Innes, *pers. comm.*). The impact of these restoration efforts on most other native species, including ruru, is largely unknown; monitoring ruru at the same sites over several years may therefore act as an alternative way of quantifying the success of restoration projects as improving habitat should have positive impacts on ruru populations. A secondary aim was to conduct a survey that involved a broad sector of the community. There are few nocturnally active birds in Hamilton and ruru vocalisations are easily recognisable, meaning that a high degree of ornithological experience was not necessary in order for people to be involved in this survey. We further hoped that the survey would promote ornithology to a wider audience.

METHODS

Study sites

Hamilton (37.47°S, 175.19°S; Fig. 1) is New Zealand's largest inland city by population and covers an area of *c.*10,000 ha. Although Hamilton has a relatively low proportion of high quality indigenous vegetation cover (<20 ha; Clarkson & McQueen 2004), there are 135 amenity parks that represent *c.*10% of the land within the city (Morgan *et al.* 2009); many of these parks have a mixture of exotic and native vegetation cover. In addition, 4 main and several minor gully systems drain into the Waikato River, which bisect the city, and contributes a further 750 ha of 'open space' (Clarkson & McQueen 2004) that could provide appropriate habitat to ruru.

Ruru surveys were conducted at 20 sites within the Hamilton city boundary between 24 to 28 Oct 2011 (Fig. 1). These sites were randomly selected from 30 possible sites considered to provide potential ruru habitat using the random function in

Excel (© Microsoft Corporation 2010). The survey was conducted during this period as other studies have shown that call rates are greatest between Sep and Oct (*e.g.*, Olsen *et al.* 2002). 'New moon' occurred on 27 Oct 2011 (Royal Astronomical Society of New Zealand 2012), and the weather during the survey period was generally fine; although a single count (Site 1; Fig. 1) was abandoned on the 4th night (27 Oct 2011) due to poor weather. A survey of this site was repeated on 29 Oct 2011. Sites were well distributed across the city (Fig. 1) and located in areas with established trees and other vegetation that would be capable of supporting ruru populations (*e.g.*, amenity parks, gully systems, bush fragments), or are currently the focus of ecological restoration work, and could support ruru in the future (*e.g.*, Site 20; Fig. 1). At the start of the survey, however, we did not know if ruru were present at any of our count sites. A distance of at least 550 m (Fig. 1) was observed between sites to reduce the probability of double counting the same individuals on a given night. Ruru territory and home-range size can be highly variable; territory sizes between 0.2 – 19.6 ha have been reported (Olsen *et al.* 2011). Therefore, it is possible that an individual ruru may have occupied a territory that encompassed >1 counting sites; however, this was probably only a problem when count sites were close together (*e.g.*, sites 8 and 17; Fig. 1). A 'counting station' within each site was marked with flagging tape, or specific directions were given to observers if this was not possible, so that counts could be conducted from exactly the same place each night.

Survey protocol

Ruru were counted for 1 h at each site for 5 consecutive nights (therefore, 20 sites x 5 nights = 100 counts). Counts generally started shortly (<30 minutes) after sunset; however, on 2 occasions counts started at the later times of 2125-2130 h because observation teams had 2 sites to survey. All counts were completed between 2000-2230 hours. A 5 day survey period was chosen because we were unsure how common ruru were in Hamilton and wanted to maximise the probability of detecting a ruru at any given site if they were present. Furthermore, the survey period fitted within the working week, which suited most participants. A sampling duration of 1 h was chosen to capture the period after sunset when ruru become active (O'Donnell 1980). Count stations were staffed by teams of 2-5 observers; although, on 5/100 counts, only 1 observer was present. Where possible, OSNZ members were teamed with volunteers that had less ornithological experience. The observation period was divided into 6 intervals, each lasting 10 min and the approximate directional bearing of ruru vocalisations heard during each interval was recorded only once. Therefore, by noting the direction of vocalisations, we were often able to conservatively estimate the minimum number of ruru at a given site, while reducing the risk of double counting the same individual. It was possible, however, that vocalisations heard coming from 2 different directions during the same interval may have been made by the same bird, especially if those calls were heard at the beginning and end of the 10 min interval. A "notes" section was included on datasheets so that observers could include additional information in order to clarify these issues. If it was not possible to determine that vocalisations came from one or more ruru, then only one bird was included in the analysis. Observers were also asked to classify the level of background noise, wind strength, and the amount of precipitation; however, these variables were relatively constant across the entire survey period and these data are not presented here.

Data from all sites over the survey period were collated and analysed to determine: 1) the number of sites where ruru were detected; 2) the number of ruru detected at each site; 3) the number of nights before ruru detection; 4) the frequency of ruru detection at sites; and 5) the earliest time that ruru were 1st detected at sites over the survey period.

Observer recruitment and management

Observers largely consisted of members from the Waikato Branch of the OSNZ and Hamilton residents recruited by approaching local conservation groups (using email lists; see Acknowledgements). Using these recruitment methods, *c.*60 people volunteered to take part in the survey. Information was supplied to observers mainly through an email database that was managed by the authors. Internet links to recordings of ruru vocalisations were sent to all participants so that they were familiar with different call types. A meeting was held prior to the 1st night of the survey where observers were shown which count sites they were allocated and how to complete the datasheets. The mobile phone number of one of the authors was given to observers to answer urgent queries, and for security reasons we also asked one person from each count site to call or text when the count was completed. Finally, observers were issued with prepaid envelopes so that completed datasheets could be easily returned; although, some observers chose to deliver these to the OSNZ meeting venue (DOC Waikato Area Office, Hamilton), or scan and email to the authors instead.

Throughout the survey period, a daily email summarising the previous night's results was circulated to all observers. At the completion of the survey, a brief summary report was written and sent to all observers. This summary report was also sent to other interested organisations, such as Hamilton City Council, Waikato Regional Council and the Hamilton Environment Centre, some of whom posted modified versions on their websites (see Hamilton Environment Centre 2012; Waikato Regional Council 2012).

Observers were also asked why they took part in the survey in order to understand the motivating factors for participation in a volunteer project of this nature. We did not design a questionnaire for observers, instead they were simply asked their reasons for volunteering. Observers were able to give several reasons for taking part and a degree of interpretation was sometimes needed when classifying responses into categories.

RESULTS

Ruru were detected at 80% (16/20) of sites at least once over the 5 day survey block; of these 13 were verified as containing ruru on 2 or more nights, and birds were detected every night at 5 sites (Table 1). The mean (± se) number of birds detected at sites with calling ruru was 1.7 ± 0.16 (range = 1-3), with 9 of these sites containing 2 or 3 birds (Table 1). Furthermore, 75% (12/16) of sites with calling ruru detected birds by the end of the 2nd sampling night (Table 1). The mean number of ruru counted each night at all sites was 0.76 ± 0.15. Ruru were generally 1st detected soon after the survey started, but continuously heard throughout the counting period. On only 3 occasions was the 1st detection recorded after 2100 h (Table 1), which was largely due the count starting later than usual and ruru in those areas being relatively rare and not counted often over the survey period.

Although we did not attempt to quantify volunteer satisfaction, anecdotal evidence suggested that the project was enjoyed, and many people indicated that they would be willing to participate in future ruru surveys. Results on why volunteers took part in the survey are presented in Table 2. The most common reason given for taking part in the survey was that volunteers were fond of ruru and wanted to be involved in a project that specifically focused on this species; although, other important reasons why people took part included an interest in conservation and the desire to contribute towards a scientific project (Table 2).

Table 2. Reasons given on why volunteers participated in the ruru survey (n = 23 respondents); 'Other'= close to observer's home; an activity away from watching television.

Reason for doing survey	Number of times indicated
Interest in ruru	12
Interest in biodiversity/conservation	11
Desire to contribute to scientific project	9
Specific ornithological interest	6
Interest in urban ecology	3
Appropriate level of commitment	3
Something different or fun to do	3
Enjoy working with other people	2
Other	2

DISCUSSION

A growing number of studies have investigated the composition of bird communities within urban areas (*e.g.*, van Heezik *et al.* 2008a; Spurr 2010), including Hamilton (Day 1995; Innes 2005), although these studies have focused on diurnal bird species. While ruru have been recorded in urban areas (*e.g.*, O'Donnell 1980; Booth 1984; Howell 1986, Gaze 1987; Howell 1987), to our knowledge, this is the 1st study to attempt a co-ordinated survey of this species throughout a New Zealand city.

Ruru are classified as 'widespread and moderately common' throughout New Zealand (Heather & Robertson 1996). This classification, however, is likely to refer to ruru that inhabit non-urban areas. Our results showed that ruru were detected at a high proportion (80%) of the count sites over the survey period; however, it is important to note that not detecting ruru at a site did not mean that they were absent from those areas. It is, perhaps, not surprising that such high detection rates were observed as our study sites were intentionally located in areas with established vegetation and trees, which are generally preferred ruru habitat (Higgins *et al.* 1999). Therefore, caution is advised as these results only reflect the detection rates at 'suitable' sites in Hamilton, and should not be interpreted as ruru being widespread across the entire city because Hamilton has a very low proportion of indigenous vegetation cover (Clarkson *et al.* 2007).

Nevertheless, it was encouraging that ruru presence was detected at so many of our sites over the survey period. Accordingly, we suggest that these data can be used as baseline information that future surveys can be compared to (assuming that the same protocols are employed). Many of the counting sites were located in areas within or close to gully sections (Fig. 1) and while these areas provide suitable habitat for many bird species, it is also where the largest populations of mammalian pests have been detected (Morgan *et al.* 2009). Predation of eggs and chicks is the main cause of nesting failure (Newton 1998), which can threaten species with localised extinction (O'Donnell 1996; Dilks *et al.* 2003). Therefore, we also suggest that these data may be used as an alternative way to measure the success of restoration projects and pest control operations as reducing pest populations and increasing vegetation cover would have a positive impact on ruru in Hamilton.

Our data could not establish the gender, social status, or any other demographic parameter of the birds that were detected. Accordingly, without further research, it is impossible to determine if multiple birds counted at the same site were indeed territorial pairs, or if single birds detected infrequently at sites were transients or simply that the count site only covered a proportion of these birds' home-range, meaning that they were less likely to be repeatedly detected over the survey period. Furthermore, it may have been possible that the same bird was counted at >1 site over the survey period, at sites that were closest together (Fig. 1), as territory sizes of up to 19.6 ha have been recorded for birds in Australia (Olsen *et al.* 2011). Catching and radio-tagging birds may help address some of these issues (*e.g.,* Imboden 1975; Olsen *et al.* 2002). However, because so many of the study sites detected birds over multiple nights during the survey, it was highly probable that some of these birds were indeed resident in those areas. Furthermore, it is also likely that some of the birds detected were breeding in Hamilton, as we conducted the survey during the peak egg laying period for ruru (Heather & Robertson 1996).

The use of volunteers to collect scientific data is often referred to as 'citizen science' (Cooper *et al.* 2007). Utilising volunteers to collect scientific data has several benefits as large quantities of data can be collected over a broad-scale and in a relatively short period of time for little cost. Furthermore, the participants can benefit from such projects as they can gain experience in collecting scientific data and develop a greater understanding and appreciation of the species they are surveying (Carr 2004). However, the use of volunteers is frequently criticised because the participants are often inexperienced in the collection of scientific data, and the potential for significant rates of observer variability can introduce unknown levels of bias (McCaffrey 2005). We attempted to minimise these problems by: 1) providing training; 2) generally having count sites staffed by different teams of 2-5 people to capture some of the variability between observers; 3) having experienced Waikato OSNZ members dispersed throughout the teams where possible; and 4) being in regular communication with the group before and throughout the survey period to resolve issues as soon as possible. We considered that these measures reduced the amount of bias that may be associated with scientific data collected by volunteers.

Approximately 60 people of all ages took part in this survey, and while many indicated an interest in biodiversity and conservation, the most common reason why participants took part in the survey was due to an interest in ruru and a desire to take part in a project that involved this species (Table 2). Therefore, we suggest that it is critical that researchers take into consideration the public's perception of the focal species when designing projects that require volunteer support. The ruru is an iconic New Zealand bird that appears to be highly valued by members of the public (Bird of the Year 2011). It is likely that the amount of support would not have been as great if the focal species in the current study was a species of lower perceived value, such as a cryptic exotic bird; although, this hypothesis needs testing.

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