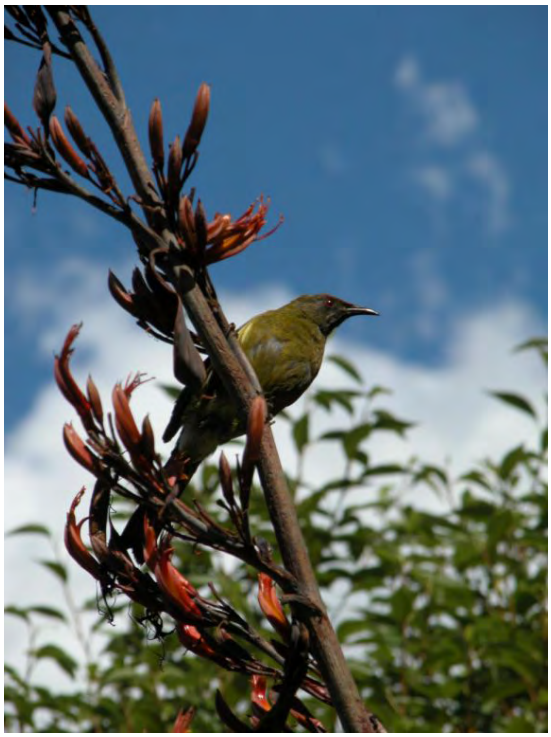
MONITORING BIRDS AT THE KATE VALLEY CONSERVATION MANAGEMENT AREA, CANTERBURY



CONTRACT REPORT
PREPARED FOR
TRANSWASTE CANTERBURY

BY

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WILDLIFE SURVEYS UNLIMITED

FEBRUARY 2006

1. BACKGROUND

Transwaste Canterbury Ltd have committed to a comprehensive ecological restoration project as part of the mitigation for the establishment of the Canterbury regional landfill at Kate Valley for which a 35-year resource consent has been granted. This project will be carried out in a designated Kate Valley Conservation Management Area (CMA) also known as Tiromoana Bush, which is located in the Motunau Ecological District in coastal North Canterbury. The proposed conservation, protection and restoration over a 35-year period will result in a substantial increase in the overall biodiversity values in this area (Norton 2004). In particular, the restoration of Tiromoana Bush will result in the protection and enhancement of a substantial area of lowland forest which is a nationally rare and poorly represented vegetation type. Conservation management will involve removal of domestic stock, animal and plant pest control, and the establishment of restoration plantings (Norton 2004).

It is proposed that population trends of common indigenous forest birds (particularly bellbirds[1] and grey warblers) are monitored from the outset of conservation management for the duration of this management. Methods to measure these population trends involve a standard five-minute bird count technique (after Dawson & Bull 1975) modified to include distance sampling of common indigenous forest birds (after Moffat & Minot 1994). Specialised methods to monitor kereru (after Mander *et al*. 1998; Handford 2002) will be trialled during seasons when kereru are present in the area.

This report provides details of methods and results of a field monitoring survey carried out by the author 19-26 October 2005. A discussion of these methods and results, and recommendations for further monitoring etc are also provided. Power analysis will be completed prior to further monitoring to ensure that sufficient sampling is carried out to detect population trends of birds.

[1] Scientific names of birds are given in Appendix 1

2. METHODOLOGY

2.1 Birds

The monitoring method used during the current survey involved a standard New Zealand method of measuring the relative abundance of forest birds (Dawson & Bull 1975), modified to include a simplified distance sampling technique (Barraclough 2000; Moffat & Minot 1994). In addition, five-minute bird-call audio atmospheres were recorded once at each count during mornings (between 0800 hrs and 1200 hrs, New Zealand Daylight Saving Time (NZDT)). Counts were carried out between 0800 hrs and 1530 hrs NZDT during appropriate weather conditions (Dawson & Bull 1975).

Transects comprising three count stations 50m apart were established at 12 forest patches and one scrub patch (Map 1; Appendix 2). Each count station was permanently marked with blue cattle ear-tags nailed on trees, and routes linking counts and transects were temporarily marked using orange cruising tape. Each station was visited three times providing a grand total of 117 counts (108 forest counts and 9 scrub counts).

Due to the patchy nature of the forest/scrub remnants and generally small size of patches (Figs. 1 & 2), counts could rarely be established ≥200m from the patch edge, a distance recommended in standard five-minute bird count protocol (Dawson & Bull 1975). The first count station of each transect was randomly chosen but the direction of the transect was usually determined from the shape of the patch.

Figure 1 Central Kate valley showing typical rural landscape with forest patches

For statistical purposes, each count within a transect is treated as dependent whereas average counts of each transect (i.e. patches) are treated independently. A power analysis will be carried out on data, and results of this given in a separate report.

During each five-minute bird count all individuals of all species were counted within a radius of 200m from the observer (note that species such as welcome swallow, scaup or spur-winged plover that are not associated with forest or scrub habitat were excluded from counts). Birds were recorded as first heard or first seen to provide a simple measure of conspicuousness.

Lateral distances of each bird from the observer (station point) were estimated and stratified into the following radial delimiters: 0-5m; >5-20m; >20-50m; and >50-200m. Given the very low number of registrations within the 0-5m delimiter these registrations will be combined with the >5-20m data, thus providing three lateral distance estimates for each count ("near", "moderately close" and "far"). A rangefinder and tape measure were used when the lateral distance to a particular bird was uncertain, or close to the delimiter boundary.

Distance analysis will be carried out for bellbird and grey warbler only, though the full data-set may be required to evaluate long-term (>20 year changes) in the ratio of indigenous and exotic bird individuals and species.

Figure 2 Lower Kate valley and coastal forest areas

Audio samples were taken once at each count station during fine, calm mornings when birds tended to be most vocal. For this purpose, a portable Minidisc™ recorder (Sony MZ-R909) and Vizivox "hammerhead"™ stereo omnidirectional microphone was set up to record bird calls within an approximate 100m radius during the five-minute count. This system has been found to produce professional-standard recordings though external noise (e.g. wind, aeroplanes, land vehicles and machinery) can affect the recording quality.

2.2 Bats

Surveys for bats using electronic bat detectors were carried out on settled, mild-warm nights (minimum temperature ≥5°c) during the survey. Surveillance for bats involved setting up two Batbox III™ bat detectors at night to automatically record bat signals through voice-activated tape recorders (O'Donnell & Sedgeley 1994). Bat detector units were placed at various sites considered to be ideal foraging areas for long-tailed bats, *Chalinolobus tuberculatus* (e.g. forest, lake or stream edge). A maximum/minimum thermometer was used to record dusk and minimum temperatures.

Although detectors were usually set up for recording long-tailed bats (40 kHz) the most likely species to be present, one detector was set up for recording short-tailed bats, *Mystacina tuberculata* (28 kHz) in the forested gully containing beech (Transect 8, CMA area 1) on the night of 25/26 October 2005 (Appendix 3). A bat detector was also used manually during a walking transect at night in this area (25 October 2005). The bat detector was held by hand and orientated in different directions while moving (O'Donnell & Sedgeley 2001). This focussed effort was made after questionable signals were recorded at the Transect 8 area on the night of 23/24 October 2005.

3. RESULTS

3.1 Birds: distribution and relative abundance

Forest and scrub remnants within the CMA contain relatively few species of indigenous birds and proportionally higher numbers of introduced birds and species (Table 1; Appendix 4). The overall averages of counts for indigenous and introduced species were 2.62/count and 4.67/count respectively, and for indigenous and introduced individuals 6.20 and 8.40 respectively (n=117). The maximum number of indigenous species recorded on a count was six (one occasion only) whereas the maximum number of introduced species was eight (also one occasion only).

Overall bird densities at patches were high with an average of 14.60 individuals recorded per five-minute count. Higher densities were recorded in forest patches than at the scrub patch (14.73/count *cf*. 13.0/count). These figures are high compared to most five-minute count data records in larger blocks of forest such as on the West Coast (e.g. Best & Harrison 1976; Morse 1981). However, a much higher density and diversity of introduced birds are found in the forest remnant patches at Kate valley than in extensive forest blocks on the West Coast.

As may be expected, there were proportionally more introduced species and individuals recorded in the scrub habitat (Transect 5, mid Kate valley) than at forest patches (2.11 *cf*. 2.67 indigenous species; 5.33 *cf*. 4.61 introduced species; 3.33 *cf*. 6.44 indigenous individuals; 9.67 *cf*. 8.30 introduced individuals, respectively) (Table 1; Appendix 4). Coastal patches (lower Kate valley and vicinity) had higher overall averages of indigenous individuals than inland patches (mid-upper Kate valley and vicinity) being 7.11 *cf*. 6.10, and lower averages of introduced individuals (7.28 *cf*. 8.81). Count averages for species were similar in coastal and inland areas (2.61 *cf*. 2.69 for indigenous species and 4.44 *cf*. 4.69 for introduced species, respectively).

The only commonly recorded indigenous species were bellbirds (highest average counts of all species), grey warblers, silvereyes and fantails (Table 2). Occasional kingfishers, shining cuckoos, and harriers (the latter flying over forest remnants) were also recorded. Welcome swallows were commonly recorded outside forest/scrub patches in pastoral country, or flying over lakes and tarns. Similarly, paradise shelducks were commonly seen or heard outside forest patches, and were recorded with ducklings at most lakes or tarns in the area (Fig. 3).

Figure 3 Paradise shelduck and ducklings were common on the lagoons

No kereru, parrots, falcons, tomtits, robins, brown creepers, or riflemen were recorded. Kereru are known to visit the area seasonally. A possible tui was heard on two different occasions in the beech patch (Transect 8), though bellbirds in the area were noted to have a wide range of calls including unusual call dialects associated with specific areas.

Of the introduced species, chaffinches were overall the most conspicuous (average 2.09/count) though greenfinches (1.34), blackbirds (1.26), redpolls (1.25) and goldfinches (0.97) were also very common (Appendix 4). Song thrushes (0.72/count) and dunnocks (0.52) were also conspicuous, the latter particularly in scrubby areas or where there was dense forest understorey. Magpies, starlings, California quails and yellowhammers were less often recorded in forest/scrub patches, though yellowhammers were common in pastoral areas, and magpies and quails were often heard. Skylarks were heard occasionally in pastoral areas.

Birds associated with lakes and tarns in the CMA area included paradise shelduck (family groups), New Zealand scaup, pied stilts and the introduced Canadian goose and mallard duck. Spur-winged plovers and southern black-backed gulls were also occasionally recorded in coastal areas and valleys.

Table 1 Five-minute bird count averages for total indigenous and introduced bird species and individuals in different habitats and areas within the CMA

	All patches	**Forest patches**	**Scrub patch (5)**	**Coastal patches (1-4 incl.)**	**Inland patches (6-13 incl.)**	**Beech patch (8)**
No. counts	117	108	9	36	72	9
Indigenous species	2.62	2.67	2.11	2.61	2.69	1.78
Introduced species	4.67	4.61	5.33	4.44	4.69	3.89
Indigenous individuals	6.20	6.44	3.33	7.11	6.10	6.67
Introduced individuals	8.40	8.30	9.67	7.28	8.81	6.33

3.2 Bellbirds, grey warblers and other common indigenous birds: distribution and abundance

Bellbirds were relatively common throughout forest patches but were not recorded in the scrub patch (Transect 5) (Table 2; Appendix 4). Highest counts of bellbirds were recorded in Transect 8, within the only patch where beech was recorded (5.89/count; n=9), and overall count averages for bellbirds were higher in coastal forest patches than inland ones (4.86/count *cf.* 3.56/count; n=36 and 72 respectively). Bellbirds were sufficiently common to use distance sampling techniques to more precisely measure population trends (see Discussion).

Grey warblers were also common and widespread throughout forest patches and unlike bellbirds were recorded in the scrub patch area (Transect 5) where their average count (1.33) was highest overall (Table 2; Appendix 4). Also in contrast to bellbirds, grey warblers were recorded as more conspicuous in inland forest patches

than coastal patches, and lowest counts were recorded in the beech patch (Transect 8). Grey warblers were also considered an appropriate species to evaluate population trends by distance sampling (see Discussion).

Average counts of the other common indigenous species (silvereyes and fantails) found in forest and scrub patches are given in Table 2 and Appendix 4. Population trends of these species are perhaps not appropriately evaluated using distance sampling analysis (see Discussion).

Table 2 Five-minute bird count averages for common indigenous birds in different habitats and areas within the CMA

SPECIES	All patches	Forest patches	Scrub patch (5)	Coastal patches (1-4 incl.)	Inland patches (5-13 incl.)	Beech patch (8)
Bellbird	3.68	3.99	0	4.86	3.56	5.89
Warbler	1.03	1.01	1.33	0.81	1.11	0.11
Silvereye	0.85	0.81	1.33	0.92	0.76	0.22
Fantail	0.45	0.44	0.67	0.44	0.43	0.11

3.3 Bats

No bats were detected in a total of eight bat-surveillance-nights from 22 October to 26 October 2005 (seven bat-nights using detectors set on 40 kHz to best detect long-tailed bats, and one bat-night using a detector set on 28 kHz to best detect short-tailed bats). Automatic bat surveillance involved two bat detectors each night placed at different sites (see Appendix 3).

One of the detectors recorded bat-like calls though these were later interpreted as probably originating from crickets. On the night of 25 October 2005, a hand-held bat detector was used to check the area where these recordings were made, and two automatic detecting units were set up close to this area (the gully containing beech trees in central Kate valley). No bats were detected.

Temperatures were generally around 10°c at dusk and ≥5°c minimum. Flying insects were common thus overall conditions during the survey were considered ideal for foraging bats.

4. DISCUSSION

Bird count methodology was designed specifically to evaluate trends in bird populations before and after restoration management within the CMA. Although the sampling design is somewhat weakened by not providing counts in an appropriate paired non-treatment area, it is considered that the five-minute bird count sampling will provide adequate assessment of population trends of at least the common indigenous birds, i.e. bellbirds and grey warblers. It will also be possible to measure

changes in bird species richness and diversity, and measure any change over time in the ratio of indigenous/introduced birds and species.

Modifications to the standard five-minute bird count method involving distance sampling (Barraclough 2000; Buckland *et al*. 1993) allows a greater degree of precision in measuring bird populations and trends as distance sampling provides an estimate of density rather than an index of density given by standard five-minute counts (Barraclough 2000). Also, distance sampling provides a probability of detection, thus reducing the problem of confusing relative abundance for conspicuousness (Moffat & Minot 1994). The first seen/first heard data collection method also helps to reduce this problem (Gibb 1996).

The author prefers using the delimiter method (adapted from Järvinen & Väisänen 1975 and Moffat & Minot 1994) than individual distance estimates for measuring bird registrations in New Zealand forests, because the delimiter method requires less concentration and can be used for all bird species registered in a count, whereas individual measurement estimates can be practicably used only for a few species. There are acknowledged problems in estimating distances of birds in forest due to acoustic variables, observer experience etc (Scott *et al*. 1981), with inaccuracies of measurement especially pertaining to calling birds that are not seen. However, considerable effort was made to record all birds near (i.e. ≤20m) to the count station so as not to breach one of the main assumptions of the distance sampling technique (Barraclough 2000; Buckland *et al*. 1993).

Monitoring the population trends of silvereyes and fantails using distance sampling techniques may not be appropriate because the number of registrations of these species may be too low or there may be behavioural constraints (e.g. the tendency for fantails to be attracted toward the observer making the original encounter distance difficult to measure and the difficulty of estimating numbers of individuals in flocking silvereye populations) (Barraclough 2000; Buckland *et al*. 1993). However, the method should perform well for bellbirds and grey warblers which tend to be less inquisitive than fantails (or robins if they were present) and were found in relatively high numbers in forest patches.

Because counts could rarely be carried out ≥200m from the forest (or scrub) edge due to the small size of patches, there was a likelihood of counting some species that did not belong to the forest (or scrub) habitat. This did not appear to present much problem in terms of the key species (bellbirds and grey warblers) as these species were not recorded outside these habitats. Species such as welcome swallows and skylarks did not appear to occupy forest or scrub habitat so were not counted, whereas yellowhammers and harriers (that favour pastoral areas) were counted only if they were thought to be calling within forest or scrub margins. Similarly, California quail which prefer scrubby areas were counted in forest areas only if they were thought to be within the forest patch.

Because of the small size of forest and scrub patches and the relatively low number of sample areas, counts within patches were spaced 50m apart and treated as dependent units. Thus for statistical analysis, counts for each patch represent an average of the three transect counts. This method has been used elsewhere to monitor bird population trends (Turitea Reserve, Palmerston North; Rowallan Forest, Southland (unpublished

data)) as a means of increasing sampling intensity in study areas that have restricted sampling areas.

It is well known and documented that smaller patches (remnants) of forest support lower numbers of indigenous bird species than larger, expansive areas of forest (e.g. Dawson & Hackwell 1978; Diamond 1975; MacArthur 1964; MacArthur & Wilson 1967; Pickett & Thompson 1978; Simberloff & Abele 1976). McLay (1974) found that although the total number of indigenous bird species declined from virgin forest through altered forest to highly modified forest (e.g. suburban parks and gardens) in New Zealand, overall bird densities increased. Although the number and diversity of indigenous bird species declines as the habitat is more extensively modified or fragmented, the total density of indigenous birds tends to remain constant. While the diversity of indigenous species declines the numbers and diversity of introduced species increases as forest habitat is modified or reduced. These patterns were observed during the current survey at Kate valley CMA, where numbers of indigenous forest species in the modified forest patches were very low, yet overall bird densities there were comparatively high.

The higher counts of indigenous bird individuals in coastal forests than in inland forest may be due to the overall larger-sized patches in coastal areas. However, it was noted that forest understorey was often far more diverse and dense in coastal areas than inland areas, a factor which may also influence bird abundance.

The author is not aware of any New Zealand study that has specifically examined population and diversity trends of birds in areas comprising isolated forest patches that are undergoing conservation management to (1) reduce the patchiness of forest through extensive plantings and (2) reduce threats of predators and pests on indigenous birds. Thus the proposed project at the Kate valley CMA will provide an important pioneering study in this field.

Although kereru were not observed during the current survey they have been noted to be present the Kate valley area during winter (M Pinkham, pers. comm.). A few kereru may return in summer to breed in forest areas. Various methods may be used to monitor kereru outside the breeding season including roadside transect counts or helicopter flushing (Mander *et al*. 1998). Another method would involve marking favoured trees (such as kowhai, native broom or introduced legumes) where kereru are known to return each year, and counting kereru annually at these sites. However, probably the most appropriate method of monitoring kereru in this area is to establish "canopy overview" stations, and count the numbers of kereru seen within 30-minute periods (Handford 2002; Peter Handford, pers. comm.).

The main constraint using methods to monitor kereru outside the breeding season is that the visiting populations of kereru attracted to seasonally available foods are monitored rather than source breeding populations. These visiting populations may be highly variable in numbers from year to year depending on seasonal food availability.

The failure to detect bats at the CMA does not necessarily mean bats are absent from the area. Both long-tailed bats and short-tailed bats can be very cryptic, and easily be missed during surveys (O'Donnell 1997). Also, it is possible that bats may visit the area seasonally. Habitat restoration and pest control may favour bats which may move

into the area or expand in numbers in future years. The fragmented habitat in this area is likely to favour long-tailed bats more than short-tailed bats.

5. RECOMMENDATIONS

The current monitoring survey has set a baseline on which further monitoring will be required on an annual basis (each October) for the first 3-5 years. After this, monitoring should be carried out at five year intervals, with each monitoring period involving 3-5 consecutive years (a pulsed monitoring regime). Note that this monitoring is designed to evaluated trends of common indigenous birds (especially bellbird and grey warbler) and that additional and specialised monitoring will need to be carried out for other species such as kereru.

General recommendations are listed below.

- It is recommended that power analysis is carried out on the 2005 data so that, if required, adjustments can be made to the sampling design for future monitoring (this power analysis is currently being carried out and the results will be presented in a separate report).
- A more detailed population trend analysis should be carried out after 3-5 years (end of first pulse of monitoring), thence after future monitoring periods.
- Audio recordings should be backed up and transferred from minidisc to mp3 files and/or analogue cassette tape.
- Methods of monitoring kereru should be examined. As kereru appear to be seasonal visitors rather than residents, it will be important to ascertain the times of year when kereru are present in the area and their favoured food sources. An appropriate method given the topography of the Kate valley area would involve “canopy overview” surveys (Handford 2002; Peter Handford, pers. comm.) where vantage points are chosen and permanently marked, and 30 minute counts of kereru and other larger birds are made from these points (see also Discussion).
- To save costs, it is recommended that a local ornithologist be used to monitor kereru activity and population dynamics, as the study would require several short trips into the area each year (especially the first year). This study would be appropriate for a student or member of the Ornithological Society of New Zealand who is based at Christchurch or closer to the study area.
- Monitoring birds would be advantaged if other components of the ecosystem are also monitored, as changes in these components over the years may provide clues to the trends in bird populations. Such additional monitoring may include plant phenology and seedfall monitoring, and monitoring densities of introduced mammals.

Acknowledgements

The author sincerely thanks Dr David Norton (School of Forestry, University of Canterbury) for advice, field guidance, comments on this draft, and providing the cover photograph. Martin Pinkham (Canterbury Waste Services Ltd) is thanked for information and permission to access the CMA area.

Gareth James (Canterbury Waste Services Ltd) kindly provided an aerial image from which Roger May (Silvics NZ Ltd) produced the map.

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APPENDICES

Appendix 1 Scientific names of birds referred to in document

Canada goose*	*Branta canadensis*
Paradise shelduck*	*Tadorna variegata*
Mallard*	*Anas platyrhynchos*
New Zealand scaup*	*Aythya novaeseelandiae*
Australasian harrier*	*Circus approximans*
New Zealand falcon	*Falco novaeseelandiae*
California quail*	*Callepepla californica*
Pied stilt*	*Himantopus himantopus*
Spur-winged plover*	*Vanellus miles novaehollandiae*
Southern black-backed gull*	*Larus dominicanus*
Kereru (NZ pigeon)	*Hemiphaga novaeseelandiae*
Shining cuckoo*	*Chrysococcyx lucidus*
New Zealand kingfisher*	*Halcyon sancta vagans*
South Island rifleman	*Acanthisitta chloris chloris*
Skylark*	*Alauda arvensis*
Welcome swallow*	*Hirundo tahitica*
Dunnock (hedge sparrow)*	*Prunella modularis*
Blackbird*	*Turdus merula*
Song thrush*	*Turdus philomelos*
Brown creeper	*Finschia novaeseelandiae*
Grey warbler*	*Gerygone igata*
South Island fantail*	*Rhipidura fuliginosa fuliginosa*
South Island tomtit	*Petroica macrocephala macrocephala*
South Island robin	*Petroica australis australis*
Silvereye*	*Zosterops lateralis*
Bellbird*	*Anthornis melanura*
Tui	*Prosthemadera novaeseelandiae*
Yellowhammer*	*Emberiza citrinella*
Chaffinch*	*Fringilla coelebs*

Greenfinch*	*Carduelis chloris*
Goldfinch*	*Carduelis carduelis*
Redpoll*	*Acantha flammea*
Starling*	*Sturnus vulgaris*
Australian magpie*	*Gymnorhina tibicen*

***** Recorded during the 2005 survey

Appendix 2 Locations of bird count stations

CMA area	Locality area	Habitat	Transect	Count	Easting	Northing
4	Coastal	Forest	1	1	2499293	5789800
4	Coastal	Forest	1	2	2499258	5789898
4	Coastal	Forest	1	3	2499261	5789925
4	Coastal	Forest	2	1	2499230	5790083
4	Coastal	Forest	2	2	2499211	5790129
4	Coastal	Forest	2	3	2499161	5790148
4	Coastal	Forest	3	1	2498929	5789600
4	Coastal	Forest	3	2	2498886	5789566
4	Coastal	Forest	3	3	2498840	5789550
4	Coastal	Forest	4	1	2498544	5789117
4	Coastal	Forest	4	2	2498588	5789076
4	Coastal	Forest	4	3	2498599	5789093
2	Mid Kate	Scrub	5	1	2498545	5790122
2	Mid Kate	Scrub	5	2	2498463	5790175
2	Mid Kate	Scrub	5	3	2498426	5790190
2	Mid Kate	Forest	6	1	2498033	5790214
2	Mid Kate	Forest	6	2	2497989	5790230
2	Mid Kate	Forest	6	3	2497945	5790261
2	Mid Kate	Forest	7	1	2497568	5790206
2	Mid Kate	Forest	7	2	2497574	5790160
2	Mid Kate	Forest	7	3	2497617	5790097
1	Mid Kate	Forest	8	1	2497532	5789815
1	Mid Kate	Forest	8	2	2497459	5789807
1	Mid Kate	Forest	8	3	2497435	5789857

Appendix 2 (continued)

CMA area	Locality area	Habitat	Transect	Count	Easting	Northing
7	Top Kate	Forest	9	1	2496775	5789546
7	Top Kate	Forest	9	2	2496743	5789575
7	Top Kate	Forest	9	3	2496693	5789520
7	Top Kate	Forest	10	1	2497233	5789185
7	Top Kate	Forest	10	2	2497216	5789140
7	Top Kate	Forest	10	3	2497186	5789115
7	Top Kate	Forest	11	1	2496890	5788765
7	Top Kate	Forest	11	2	2496860	5788825
7	Top Kate	Forest	11	3	2496856	5788858
7	Top Kate	Forest	12	1	2496740	5789044
7	Top Kate	Forest	12	2	2496742	5789079
7	Top Kate	Forest	12	3	2496750	5789122
6	Selby Rd	Forest	13	1	2495390	5789325
6	Selby Rd	Forest	13	2	2495355	5789358
6	Selby Rd	Forest	13	3	2495310	5789365

Appendix 3 Locations of bat monitoring sites

DATE	Locality area	Easting	Northing	Habitat	kHz setting	Min. temp.	Bat records
22/23 Oct. 05	Mid Kate valley	2498483	5790040	Close to small lake, patchy scrub, grass, rock	40	5°c	0
22/23 Oct. 05	Mid Kate valley	2497664	5789696	Small tarn (dam), forest edge	40	5°c	0
23/24 Oct. 05	Mid Kate valley	2497612	5789759	Near edge of forest, grassland	40	6°c	0
23/24 Oct. 05	Selby Road	2495738	5789256	Grassy area at forest edge, small tarn	40	6°c	0
24/25 Oct. 05	Coastal	2499876	5789349	Pastoral with isolated trees	40	10°c	0
24/25 Oct. 05	Coastal	2499646	5789420	Pastoral with forest remnants in valley	40	10°c	0
25/26 Oct. 05	Mid Kate valley	2497373	5789886	Edge of forest containing beech	40	8°c	0
25/26 Oct. 05	Mid Kate valley	2497503	5789872	Edge of forest containing beech	28	8°c	0

Appendix 4 Mean counts of common birds, and totals of individuals and species, in different locations and habitats

Species	All Transects	Forest transects				Scrub transect
		All	Coastal	Inland	Beech	
No. counts	117	108	36	72	9	9
Bellbird	3.68	3.99	4.86	3.56	5.89	0
Grey warbler	1.03	1.01	0.81	1.11	0.11	1.33
Silvereye	0.85	0.81	0.92	0.76	0.22	1.33
Fantail	0.45	0.44	0.44	0.43	0.11	0.67
Blackbird	1.26	1.27	0.97	1.42	0.89	1.22
Song thrush	0.72	0.69	0.86	0.60	1.11	1.11
Dunnock	0.52	0.43	0.67	0.31	0.11	1.67
Chaffinch	2.09	2.11	1.81	2.26	0.56	1.78
Redpoll	1.25	1.24	0.83	1.44	0.89	1.33
Greenfinch	1.34	1.36	1.03	1.53	1.33	1.11
Goldfinch	0.97	0.94	0.94	0.94	1.22	1.33
Total indigenous individuals	6.20	6.44	7.11	6.10	6.67	3.33
Total introduced individuals	8.40	8.30	7.28	8.81	6.33	9.67
Total indigenous species	2.62	2.67	2.61	2.69	1.78	2.11
Total introduced species	4.67	4.61	4.44	4.69	3.89	5.33