BIRD SPECIES, POPULATIONS, AND ACTIVITIES AT CHRISTCHURCH INTERNATIONAL AIRPORT, NEW ZEALAND, BETWEEN 1986 AND 1988: IMPLICATIONS FOR A PREVENTATIVE BIRD STRIKE PROGRAMME

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ABSTRACT

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Bird populations at Christchurch International Airport, New Zealand, were monitored between 1986 and 1988 to aid in the development of a preventative bird strike programme. The study documented patterns of distribution, abundance, and activities of five bird species groups throughout a day, among seasons, between years, and in relation to weather. A total of 30 bird species were seen: starlings, goldfinches, southern black-backed gulls, skylarks, white-backed magpies, spur-winged plovers and harriers were the most frequently sighted species. Comparisons between years showed an increase in gulls and finches in 1987, while starling, magpie and plover numbers remained consistent in both years. Seasonal trends were evident in gulls, starlings, magpies and finches, with highest numbers seen in autumn and winter. Gulls were mainly observed during the mornings and evenings, with the majority in flight. Starlings and finches were most common during the middle of the day; plover and magpie numbers were consistent at all times of the day. No relationship was found between weather conditions and bird abundance. Recommendations for the development of a bird strike prevention programme are given.

KEYWORDS: bird strike preventative programme - Christchurch International Airport - finch - gull - magpie - plover - starling.

INTRODUCTION

The hazards posed by birds to aircraft have long been known, however the number and severity of bird strikes on aircraft continue to increase world-wide. Christchurch International Airport (43° 29′ S, 172° 32′ E; Fig. 1), New Zealand's busiest airport in terms of aircraft movement (Tilley 1984), has a significant bird hazard problem.

Records of bird strikes and near misses at Christchurch since 1980 show a total of 173 strikes and 691 near misses on aircraft (Ministry of Transport, unpubl. data). Between 1980 and 1983, a bird strike rate of 3.45 / 1000 passenger-carrying-movements was reported (Tilley 1984). Gulls were reported to be responsible for the majority of strikes and near misses reported by airline personnel, but the accuracy with which birds were identified is uncertain.

The majority of incidents occurred during aircraft take-off and landing (89 %), with almost half (42 %) occurring at altitudes of less than 50 feet (Ministry of Transport, unpubl. data). Thus, birds within and near the boundaries of airports are a major hazard. Consequently, control of bird numbers and movements in and around airports has the potential to significantly reduce the risks posed to aircraft and passengers.

Several studies have examined the hazards which birds pose to aircraft at New Zealand's airports (Caithness 1965, 1966, Caithness *et al.* 1967, Saul 1967, Caithness 1968), including some at Christchurch International Airport (Stonehouse 1964, 1966, Moeed 1970, 1976). However, because these studies were short-term,

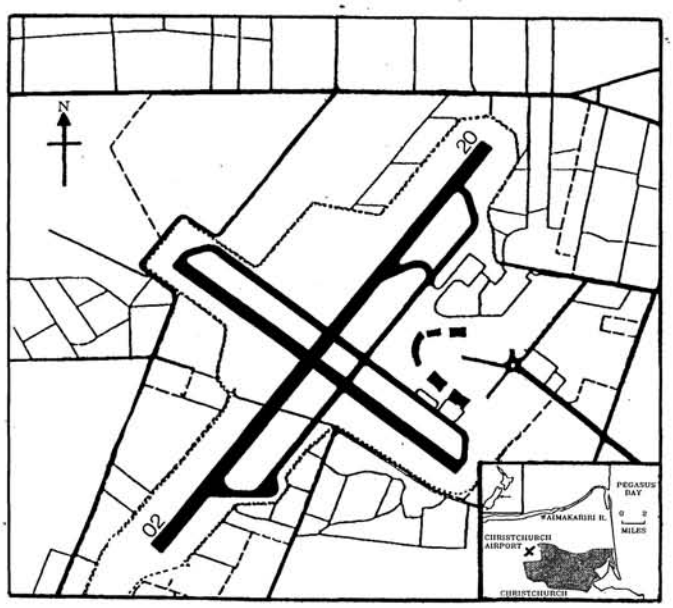

Figure 1. Christchurch International Airport and its environs (after Moeed 1970).

little information exists regarding current bird populations, activities and distribution, and trends within and between days, seasons and years.

Four months after a potentially serious strike on a Boeing 747 aircraft in October 1985, the Christchurch International Airport Authority, in co-operation with the University of Canterbury, initiated a study of bird populations at the airport. This study is part of an integrated programme which also examines vegetation and entomological problems at the airport. The goal of these studies is to enable the development of a programme of bird strike prevention which will minimise the bird-hazard level at the airport.

A planned five-year ornithological study has now been in progress for two years (January 1986-January 1988). This paper outlines our preliminary results. Five major bird species groups highlighted by Civil Aviation personnel as the main threat to aircraft (termed finch, gull, magpie, plover and starling, Table 1) were examined.

The objectives of the study were: (a) to document the abundance and spatial distribution of birds at Christchurch International Airport; and (b) to document patterns of variation in bird abundance within a day, seasonally, and be-

SPECIES GROUP	MEMBER SPECIES
finch	chaffinch, goldfinch, greenfinch, redpoll, housesparrow, hedgesparrow.
gull	southern black-backed gull, red-billed gull, black-billed gull.
magpie	white-backed magpie.
plover	spur-winged plover, banded dotterel, black fronted tern, South Island pied oystercatcher.
starling	starling, blackbird, thrush.

Table 1. Bird species groups used in this study.

tween years, and to examine the effects of weather conditions on bird numbers. Preliminary recommendations for reducing bird numbers are presented.

MATERIALS AND METHODS

SAMPLING PROCEDURES

Bird observations were made between 9 January 1986 and 31 January 1988 at 22 alternating red and green markers, located at 500 m intervals along the perimeter road surrounding the runway (Fig. 2). Both red and green markers were consecutively numbered from 1 to 11 and marked with a "due north" indicator. Observations were made at 3-day intervals, and recordings were taken at red or green markers on alternative sampling days. At each marker, all birds identified during a 10-minute period (within a 360° field) were counted. The behaviour (feeding/loafing, flying, roosting), and direction of flying of each bird sighted were recorded. For each sampling day the weather was noted (sunny, cloudy, raining). Two observers on foot completed the eleven counts in two hours. Observations on successive sampling days began at the time of day the previous sampling was completed. All observations were made between 0500 and 2100 hours. From January 1986 - January 1987, surveys were conducted each month, but during 1987-88, observations were made for a full month at 3 month intervals (April, July and October 1987, and January 1988).

STATISTICAL PROCEDURES

Although all birds were identified to species level, only five species groups were analysed (Table 1). Average values are expressed as numbers of birds, per marker, per single 10-minute count. Only months for which two years' data were available (January, April, July and October) were included in the analysis, and these were termed Summer, Autumn, Winter and Spring respectively.

To examine the effects of year (1986-87 and 1987-88), season and time of day, bird numbers were analysed using a 3-way ANOVA (Sokal and Rohlf 1981). Effects of weather was analysed using a 1-way ANOVA. Bird numbers were transformed ($\ln (x + 1)$) to compensate for the skewed distribution caused by the presence of large flocks.

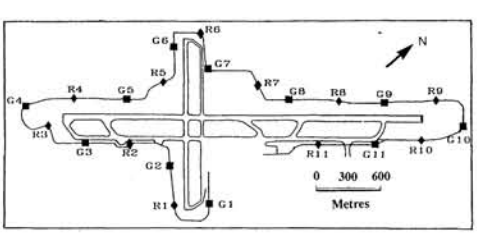

Figure 2. Location of observation sites (markers).

RESULTS

A total of 30 bird species were recorded at Christchurch International Airport between January 1986 and 1988 (Table 2). The most frequently sighted birds were (in order of abundance) starlings, goldfinches, southern black-backed gulls, skylarks, white-backed magpies, spur-winged plovers, and harriers.

COMPARISON OF BIRD POPULATIONS DURING 1986-87 AND 1987-88

Two species groups, finches and gulls, were significantly more abundant during the second year of the study than the first (Table 3). Average abundances (per marker, per day) for magpies, plovers and starlings were not significantly different between years.

SEASONAL TRENDS

Finch, gull, magpie and starling numbers were significantly higher in autumn and winter than in spring and summer (Fig. 3). The number of plovers were consistent in all seasons. Seasonal trends were similar in 1986-87 and 1987-88 for gulls, plovers, magpies and starlings, whereas seasonal trends between years varied significantly for finches ($F = 8.91$, $df = 2, \infty$, $P < 0.001$).

TIME OF DAY

Two patterns of distribution were evident (Fig. 3). The frequency distribution for finches and starlings was unimodal. Birds were more

abundant during the middle of the day (i.e. between 1000 and 1600 hours). The distribution of gull numbers throughout the day was bimodal, with morning (i.e. 0700-0900) and evening (i.e. 1700-1900 hours) peaks. No significant differences in abundance at different times of the day were detected for magpies and plovers.

Significant interaction effects between season and time of day were detected for finches, gulls and starlings (Table 4). This suggests that for these species peaks in bird abundance occur at different times of the day in winter, and summer. No such interaction was evident for magpies or plovers.

WEATHER

The weather had no significant effect on bird abundance for the 5 species groups examined in both years (Table 5).

BIRD DISTRIBUTION

Although the 5 species groups were recorded

COMMON NAME	SPECIFIC NAME	1986-87	1987-88
black shag	*Phalacrocorax carbo*	*	
white-faced heron	*Ardea novaehollandiae*	*	*
canada goose	*Branta canadensis*	*	
paradise shelduck	*Tadorna variegata*	*	*
mallard	*Anas platyrhynchos*	*	*
harrier hawk	*Circus approximans*	*	*
South Island pied oystercatcher	*Haematopus finschi*	*	*
spur-winged plover	*Lobibyx novaehollandiae*	*	*
banded dotterel	*Charadrius bicinctus*	*	
southern black-backed gull	*Larus dominicanus*	*	*
red-billed gull	*Larus scolpulinus*	*	*
black-billed gull	*Larus bulleri*	*	
black-fronted tern	*Chlidonias albostriatus*	*	
feral pigeon	*Columba livia*	*	*
kea	*Nestor notabilis*	*	
skylark	*Alauda arvensis*	*	*
welcome swallow	*Hirundo neoxena*	*	*
fantail	*Rhipidura fuliginosa*	*	*
song thrush	*Turdus philomelos*	*	
blackbird	*Turdus merula*	*	*
hedgesparrow	*Prunella modularis*	*	*
silvereye	*Zosterops lateralis*	*	*
starling	*Sturnus vulgaris*	*	*
greenfinch	*Chloris chloris*	*	*
goldfinch	*Carduelis carduelis*	*	*
redpoll	*Carduelis flammea*	*	*
chaffinch	*Fringilla coelebs*	*	*
yellowhammer	*Emberiza citrinella*	*	*
housesparrow	*Passer domesticus*	*	*
white-backed magpie	*Gymnorhina hypoleuca*	*	*

Table 2. Bird species recorded between January 1986 and January 1988. Asterisks indicate years in which species were sighted.

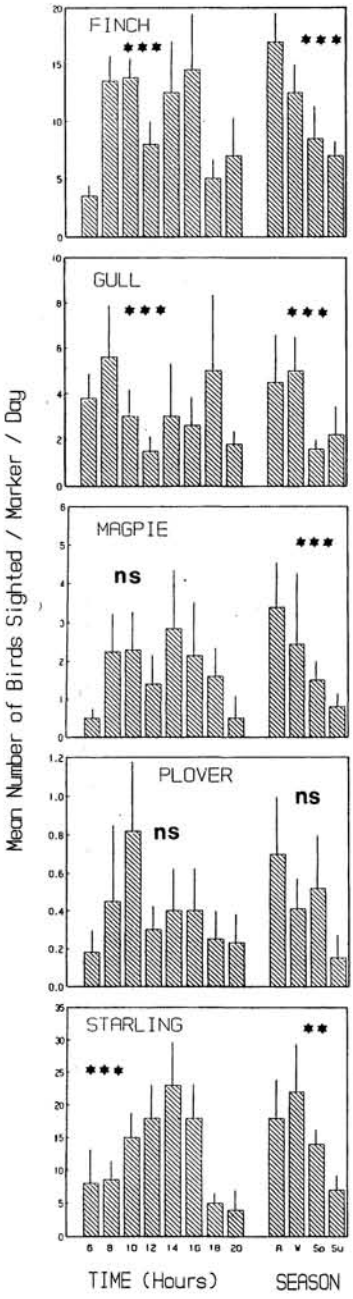

Figure 3. Mean number of birds observed per marker per day (for time of day and season) between 1986 and 1988. Standard error bars, and significance of 'between time of day' and 'between season' comparisons are shown. *ns*, not significant; **, $P < 0.01$; ***, $P < 0.001$.

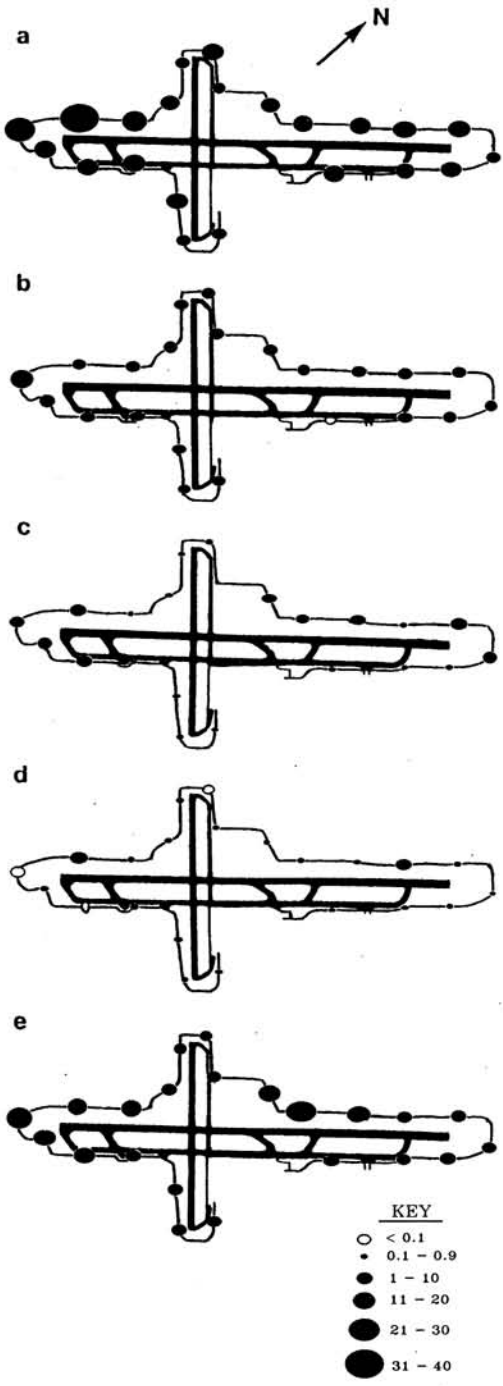

Figure 4. Mean number of birds observed per marker per day between 1986 and 1988 broken down by species group: finch (a); gull (b); magpie (c); plover (d) and starling (e).

SPECIES GROUP	1986-87 Mean	SE	*n*	Max	1987-88 Mean	SE	*n*	Max	*F*	*df*	*P*	
finch	9.11	0.89	509	200	12.34	0.95	646	230	22.6	1, ∞	0.000	***
gull	2.50	0.37	429	110	3.79	0.60	450	170	10.6	1, ∞	0.001	**
magpie	2.38	0.33	372	60	1.70	0.25	480	88	3.58	1, ∞	0.060	*ns*
plover	0.44	0.06	429	12	0.44	0.10	446	29	0.47	1, ∞	0.500	*ns*
starling	16.07	1.69	542	383	13.36	1.16	581	265	0.22	1, ∞	0.638	*ns*

Table 3. Comparison of total mean number of birds observed per marker per day between 1986-87 and 1987-88. SE, standard error of the mean; *F*, *F* statistic; *ns*, not significant; **, $P < 0.01$; ***, $P < 0.001$.

SPECIES GROUP	*F*	*df*	*P*	
finch	2.25	15, ∞	0.004	*
gull	1.87	16, ∞	0.020	*
magpie	0.54	14, ∞	0.909	ns
plover	0.82	17, ∞	0.675	ns
starling	2.31	15, ∞	0.003	**

Table 4. Season x time of day interaction effects, calculated from mean numbers of birds observed per marker per day. *F*, *F* statistic; *ns*, not significant; *, $P < 0.05$; **, $P < 0.01$.

at all markers around the runway's perimeters throughout the study, the relative frequency of sightings for each bird group suggests distinct distribution patterns.

Highest finch and starling numbers occurred at the south-west region of 02-20 Runway (Fig. 4). Gulls were similar in abundance at all markers (Fig. 4b). Magpies and plovers showed a localised distribution suggesting resident populations (Fig. 4c & 4d).

Areas of highest bird abundance included markers G3, R3, G4, R4, R7, G8, R8, G9 and R9; lowest bird numbers were recorded in areas G1, G11 and R11.

FEEDING VERSUS FLYING

Between 1986 and 1988, gulls were predominantly recorded flying (80 % of all sightings; Table 6), primarily in an east-west direction (Fig. 5). Finches, plovers and starlings were seen feeding and flying in equal numbers, and magpies were most often observed feeding (76%). These trends were independent of time of day and season effects, although plovers and starlings showed a slight increase in the proportion of feeding birds during autumn. Markers R3 and G4 consistently had the greatest number of birds feeding.

DISCUSSION AND RECOMMENDATIONS

Christchurch International Airport provides suitable feeding habitats for a number of bird populations. Common pasture feeders and scavenging birds were the most frequently observed species. Magpies and spur-winged plovers (a new immigrant to the area in 1982) were generally resident populations using grazed/mown and crop fields, buildings, trees, hedges and shrubs for feeding, resting, roosting and nesting. Gulls (predominantly *Larus dominicanus*) were generally transient, flying over the vicinity of the airport, or using the fields temporarily for short periods of time to feed and rest. Finches and starlings fell into both categories, with resident populations maintained throughout the year, and large seasonal flocks.

Variation in bird numbers over the two year period is due to several factors. High fledgling survival rates - a result of the warm winter in 1987 - may explain the increase in finch and gull numbers during the second year of the study. For example, an increase of 84 % in the survival

SPECIES GROUP	CLEAR Mean	SE	*n*	CLOUDY Mean	SE	*n*	RAINING Mean	SE	*n*
finch	10.5	0.9	563	10.8	1.0	484	13.8	2.8	108
gull	2.5	0.3	455	3.2	0.8	342	2.7	0.7	82
magpie	2.4	0.4	417	1.7	0.2	362	1.0	0.2	73
plover	0.4	0.1	455	0.5	0.1	338	0.7	0.3	82
starling	15.0	1.6	536	14.2	1.4	418	15.0	3.5	106

Table 5. Number of birds observed per marker per day between 1986 and 1988, broken down by weather conditions. SE, standard error of the mean.

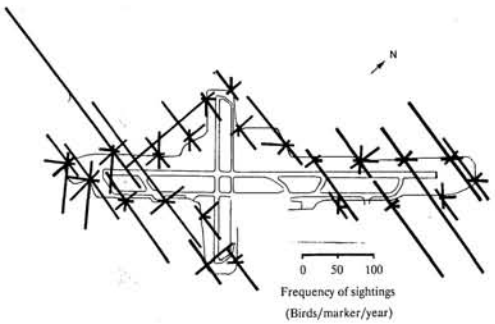

Figure 5. Frequency of gull sightings versus direction between 1986 and 1988, during daylight hours.

rate of fledgling gulls was observed between 1986 and 1987 around Christchurch beaches (P. Harper, unpubl. data). As a result, increased numbers of juvenile birds joined adult populations in the following spring. Although higher winter temperatures should lead to similar increases in magpie, plover and starling numbers in 1987, no significant differences were found in these species between the two years. The implementation of bird management programmes at the airport in 1987, which focused on these three species groups (including vegetation modification, destruction of nests, and an increase in shooting activity by airport personnel), may have offset the increase in their numbers.

Seasonal variation in bird numbers occurred throughout this study. High bird numbers

SPECIES GROUP	*n*	FEEDING Mean	SE	FLYING Mean	SE
finch	1156	5.4	0.5	5.6	0.5
gull	879	0.6	0.2	2.5	0.3
magpie	852	1.6	0.2	0.4	0.1
plover	875	0.2	0.0	0.2	0.0
starling	1123	7.5	0.8	7.2	0.7

Table 6. Comparison of numbers of birds feeding versus flying (mean per marker per day between 1986 and 1988). SE, standard error of the mean.

during autumn and winter presumably resulted from the addition of fledged young into the adult populations. Finches, magpies, and starlings, all formed large, conspicuous flocks during autumn and winter prior to spring breeding; these flocks ranged in size from 5 to 900 individuals. Gulls migrate from high country areas during summer and congregate in large numbers on the plains during autumn and winter (P. Harper, pers. comm.). As there are no major bird predators in the area (Moeed 1970), flocking of birds is probably associated with the onset of courtship and exploitation of food resources. The decline in bird numbers during spring and summer is associated with the break up of flocks and subsequent territorial behaviour. Our results are similar to those of Moeed (1970), who found that finch, magpie and starling numbers varied with season, with maximum numbers recorded during April to October.

Flocking behaviour and increased bird activity shown in both studies clearly identifies autumn and winter as the peak hazard period for aircraft. The majority of bird strike incidents reported at Christchurch International Airport during 1987 occurred during autumn and winter (Airport Authority unpubl. data).

RECOMMENDATION 1:

As autumn and winter months are the time of peak bird abundance, measures aimed at reducing finch, magpie and starling numbers (i.e. destruction of roosting sites and nests, shooting, disruption of habitat) should be intensified between March and August.

Patterns of bird numbers over time clearly reflect their daily behaviour. Morning and evening peaks in gull numbers correlates well with their movements between the sea and the Canterbury Plains. Most gulls recorded were flying (80 % of all sightings), primarily in an east-west direction, particularly at each end of the 02-20 Runway. Between 0600-0900 hours, gulls were observed flying predominantly in an easterly direction, whereas between 1700-2000 hours, most were flying in a westerly direction. Moeed (1970) suggests that black-backed gulls have a set flight-path over the airfield. He observed gulls flying predominantly south in the morning, and north during the evening, to and from their roosting and breeding sites in the Waimakariri River bed. These daily movements were associated with feeding excursions to nearby cultivated fields, refuse dumps and the Islington Freezing Works. Since Mooed's (1970) study, however, a number of abattoirs (including Islington Freezing Works) and refuse dumps have been closed. This may explain the change in general flight-path over the airfield. Findings of both studies clearly indicate that gulls make little use of the airport directly, but rather, pass over the airport *en route* to feeding and roosting sites. Therefore, vegetation modifications within the airport boundary would have little or no effect on gull numbers and their activities.

RECOMMENDATION 2:

Measures aimed at deterring gulls should be applied outside the airport boundary. The removal of feeding, nesting and roosting sites is especially important.

Finches, magpies, plovers and starlings use the airport for both feeding and roosting. Finches and starlings were most common during the middle of the day, and were usually feeding and flying. As both are insectivorous species, it is most likely that peaks in numbers of these species correspond to times when insects and earthworms are plentiful. Magpies and plovers were common at all times of the day; this is probably due to permanent residence in the immediate area.

Although all 5 species groups were observed in all areas of the airport, a number of areas showed high and low bird densities. Highest bird densities were recorded in areas adjacent to farmland, where lucerne and wheat, and grazing sheep and cattle are maintained for most months of the year. Approximately 60-70 % of all birds observed at these sites were feeding, showing that farming practises in these areas are important bird attractants. Adjacent food resources include plant material, seeds, livestock carcasses, lambing remains and insects.

The highest number of birds were found in areas close to the south-west end of 02-20 Runway where farming practices are most intense; 84 % of all strikes and near misses occurred in this

region. Lowest bird numbers were recorded in sites close to buildings, where there are few food resources. Only a small number of birds (finches and starlings) use these buildings as resting and roosting sites.

RECOMMENDATION 3:

Reduce farming activity within and near the airport boundary by limiting ploughing and grazing, reduction of seed crop (e.g. wheat) area, and immediate removal of livestock carcasses.

Finches, magpies, plovers and starlings directly use the airport habitats, therefore modifications of the habitat and shooting of adult birds, particularly during autumn and winter, will have a significant effect on numbers and activities of these species. Long grasses and tall lucerne (> 20 cm) are relatively unattractive vegetation types to both passerine birds and skylarks (R. Harrison, pers. comm.). This is because plant height hinders detection of predators. The removal of breeding birds in the immediate vicinity of the airport would result in reduced breeding success, however, some replacement by immigrating birds from neighbouring areas may result.

RECOMMENDATION 4:

Reduce habitat attractiveness by habitat modification (i.e. planting of unattractive vegetation types such as long grasses and lucerne), removal of roosting and nesting sites in neighbouring trees and shrubs, and insecticide application.

This study has demonstrated that bird populations at Christchurch International Airport are influenced by many factors including year, season, time of day, and habitat locality. Monitoring of bird populations is required in order to formulate specific recommendations to successfully reduce the number of birds at the airport. Such reductions should lead to a decrease in the number of strikes and near misses of birds on aircraft.

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