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Effectiveness of Gas Cannons on the Bird Community at Sydney Airport

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ABSTRACT

Bird control takes many forms and can include the use of gas cannons to scare birds away from non-compatible land uses such as airports. Birds Australia designed and implemented this study to assess the effectiveness of the Gas Cannon as a bird deterrent at Sydney Airport.

The cannons were used in two ways: statically (set up at one location) and opportunistically (transported to a particular location in response to bird events, such as birds congregating on runways).

Effectiveness was measured quantitatively during the static trial by comparing the number of birds in the vicinity of the cannons, during pre-treatment and post-treatment periods, with the number of birds during the treatment period (when the gas cannons were detonated).

The study revealed characteristics about the local bird community including; species composition, abundance, behaviour, number and direction of the bird movements at dawn. The results indicate that the cannons were effective in reducing the number of bird movements in the study area and modifying the behaviour of birds in flight, particularly influencing the direction of bird movements.

1.0 BACKGROUND & METHODS

1.1 Background

To reduce the number of bird-strikes at Sydney Airport, a combination of bird control techniques are used. These include; habitat manipulation, exclusion devices and active bird control. Active bird control is designed to scare or remove birds from the airport and gas cannons are one of many different bird-scaring devices. Birds Australia designed and implemented this study to assess the effectiveness of the Gas Cannon as a bird deterrent.

1.1.1 Gas Cannon Description

The Gas Cannon used in this trial is a multi-directional unit, with four, fixed, cannon chambers, facing in four opposite directions. An acetylene gas cylinder is attached to each unit. The unit contains a control box, which houses the gas lines, sparkplugs and the solar-powered battery. A radio transmitter is used to detonate the cannons, initiating a gas release, causing the spark plugs to ignite the gas, emitting a loud noise out each chamber. A single detonation using the transmitter, results in four consecutive explosions (as each chamber ignites).

1.2 AIM OF THE TRIAL

The aim of the study was to assess the effectiveness of the Gas Cannon in dispersing birds from the Sydney Airport environment and make recommendations about the best way to use such a device, if it were effective. Effectiveness was determined by comparing the number of birds in the vicinity of the cannons, during a Pre-treatment and Post-treatment period, with the number of birds during the Treatment period. Habituation to the device was also assessed, by comparing the number of birds in the area before and after firing and the time taken for birds to respond.

1.3 IMPLEMENTATION

A Standard Operating Procedure (SOP) was developed in conjunction with airport staff and the manufacturer's distributor. The SOP detailed the aim and design of the study, how to operate the gas cannons, safety considerations and monitoring guidelines. These notes were used by staff during the study.

1.4 PROJECT DESCRIPTION

The cannons were used in two ways: statically (set up at one location for three weeks) and opportunistically (transported to other locations in response to bird activity, such as birds congregating around puddled water on runways).

1.4.1 Static Trial

For the static trial, 3 cannons were placed 100m apart, adjacent to the seawall of runway 16L/34R and north of the evacuation facility. Two observers using binoculars were positioned in a vehicle on the Foreshore Road beach, opposite the airport. Observers were stationed for a one hour period between 06:45 and 07:45 hours on each day of the static trial. The trial was run over three weeks, with five days of monitoring per week. Week 1 was used as the Pre-treatment period, Week 2 was the Treatment period and Week 3 was the Post-treatment period. During the Treatment period the Gas Cannons were detonated in sequence, every ten minutes, between 06:45 and 07:45 hours. The gas cannons were not detonated during the Pre- or Post-treatment periods. Observations of bird abundance and behaviour for each species were recorded on the data sheets. During the observation period, time, number of species, number of individuals, location, activity and direction of flying birds was recorded. Direction was recorded as north, south, east or west.

1.4.2 Opportunistic Trial

For the opportunistic trial, bird control staff transported a single gas cannon unit, secured in a car trailer, to four sites of problem bird activity. The cannon detonation was varied in response to bird behaviour and observations were recorded on the Gas Cannon Report Form.

1.5 SITE LOCATION

The static trial was located at the site most suitable in relation to airport regulations and also within an area of high bird activity. This allowed for compliance with airport regulations relating to obstacles (>150 metres from runway and >45 metres from taxiway centrelines), was far enough from residential areas (>200 metres), and is a regular thoroughfare for cormorants, gulls and pelicans, which move between the airport, Botany Bay and the Mill Stream. The Mill Stream is used as a flyway between Botany Bay and the Botany Wetlands so the impact of the gas cannons on a variety of species and on local bird movements could be assessed.

2.0 RESULTS OF BIRD MONITORING

2.1 INTRODUCTION

Discussion of the results follows, describing the effectiveness of the gas cannons in reducing bird numbers, bird movements, influencing the direction of movements, species specific effects and effects on bird behaviour. An analysis of variance was performed to assess the numerical data statistically. Comments about bird behaviour have been drawn from the Gas Cannon Trial Datasheets. The opportunistic study was limited, as only four Gas Cannon Report Forms were completed by airport bird control staff, during the trial period, July-August 2000. This also compromised the ability of the study to detect habituation effects. To increase the power of the analysis, the behavioural data for both the static and opportunistic trials was combined.

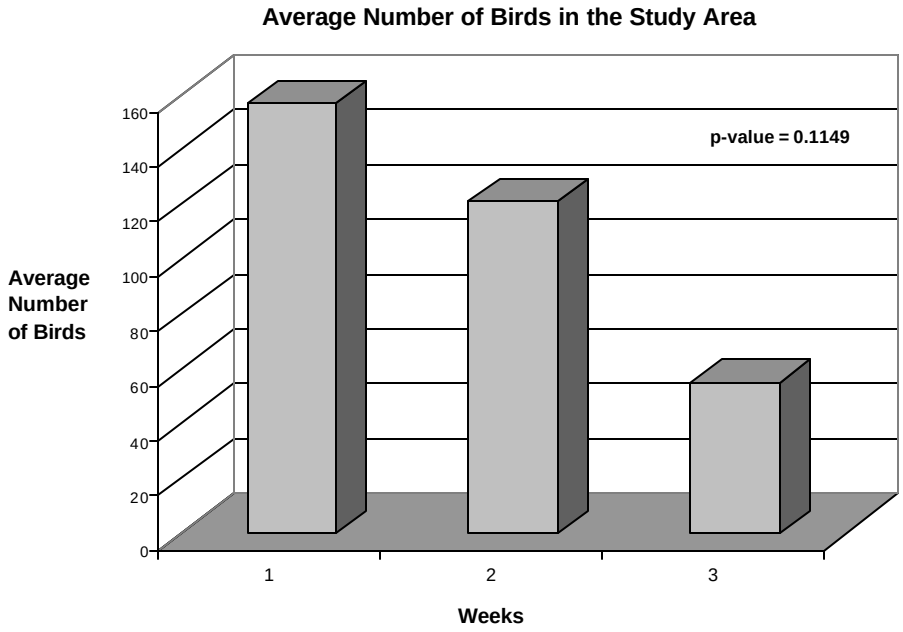
2.2 BIRD NUMBERS DURING THE STATIC TRIAL

There was a reduction in the in the average number of birds between the Pre- treatment and Treatment periods (table 1 & Figure 2). A further reduction in the average number of birds occurred between the Treatment and Post-treatment period.

Table 1: Bird Numbers **p-value = 0.1149**

Period	Pre-treatment	Treatment	Post-treatment
Mean	157	121	55
Standard Deviation	49.5	88.9	24.7

Figure 2:



This result suggests that the Gas Cannons were effective in reducing bird numbers and that this effect continued after the Treatment period. However, the statistical analysis indicates there was a large variation in the number of birds on each day of the trial, indicating that the reduction may not be a direct result of the Gas Cannons. Further monitoring would have provided a larger sample size for the study, giving greater statistical power to the analysis. The reduction in the total number of birds in the area could reflect larger scale seasonal movements of Silver Gulls from the Sydney Region during the time of year the trial was conducted. Silver Gulls depart the Sydney region in the winter months to breed on Five Islands off the coast of Wollongong during spring, returning to Sydney in late summer (Smith & Dorfman, 1992).

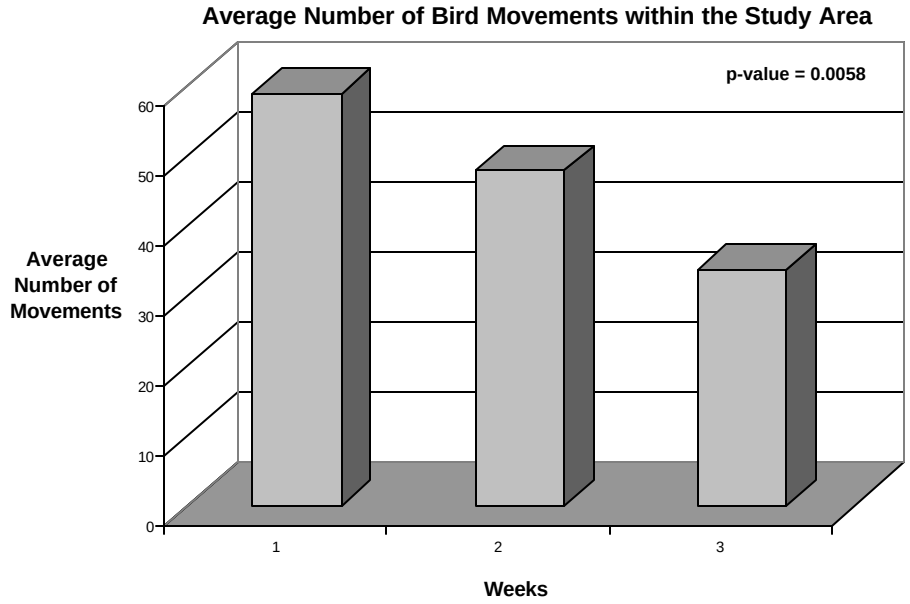
2.3 BIRD MOVEMENTS DURING THE STATIC TRIAL

There was a reduction in the number of bird movements (number of birds flying past) between the Pre-treatment and Treatment periods, with further reductions between the Treatment and Post-treatment period (Table 2, Figure 3).

Table 2: Bird Movements **p-value = 0.0058**

Period	Pre-treatment	Treatment	Post-treatment
Mean	59	48	34
Standard Deviation	10.8	6.6	9.3

Figure 3:



This effect could reflect the lower total number of birds in the area during the progress of the trial, however the statistical analysis showed that the result has a p value of 0.0058, indicating the reduction in bird movements could have been a direct result of the gas cannons. For more certainty (>95% certain) more study days would be required. Further analysis of the effect of the Gas Cannons on bird movements is discussed in Sections 2.4 and 2.5.

2.4 DIRECTIONS OF BIRD MOVEMENTS

A summary of the direction of each bird movement (north, south, east or west) during each week of the trial was performed. It appears that during the Treatment period westerly bird movements (birds crossing the airport runways) decreased from 10% of movements during control periods, to 6% when gas cannons were active. There was also a slight increase in northerly movements from 26% during control periods to 30% of movements when gas cannons were active.

It could be interpreted that this wall of three gas cannons, detonated periodically, could be acting as a harassment barrier, encouraging birds to move north up Mill Stream, rather than moving west across the airport runways.

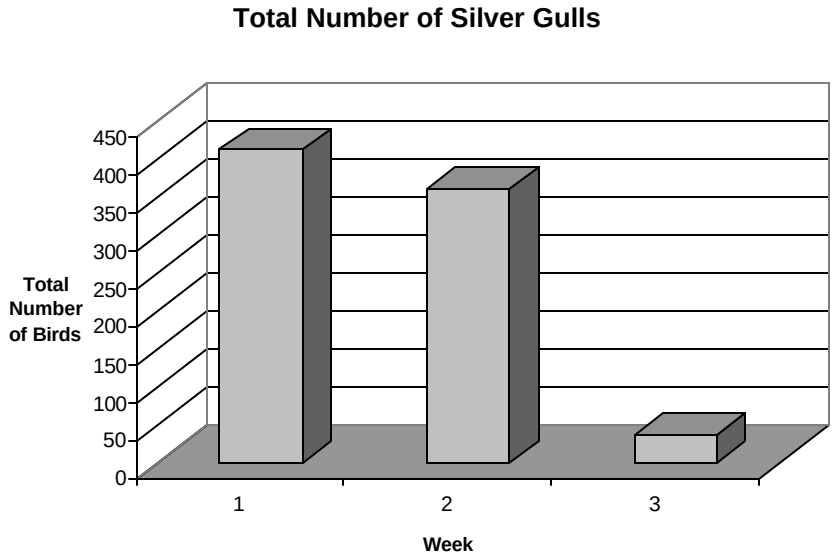
2.5 SPECIES SPECIFIC RESULTS

2.5.1 Silver Gulls (*Larus novaehollandiae*)

2.5.1.2 Bird Numbers

There was a reduction in the number of Silver Gulls in the study area, from 412 birds to 34 birds, between the Pre-treatment and the Post-treatment period (Figure 5). The tendency of Silver Gulls to move in large flocks would contribute to the reduction in the total number of birds in the latter week of the trial.

Figure 5:



Silver Gulls appear to have been scared away from the area as a result of the gas cannons. The reduction could also be attributed to Silver Gulls departing from the Sydney region as part of larger scale seasonal movements.

2.5.1.2 Movement Direction in Relation to the Airport

In general, it appears that this study supports Smith & Dorfmans (1992) study, that local dawn movements of Silver Gulls are primarily in a northerly direction from their overnight roost sites, south-east of the airport (Table 3). They appear to approach the airport from the south-east along Foreshore beach, following the coast until it reaches Mill Stream, and continue northward, parallel to runway 16L/34R. Airport-wide observations would be required to gauge the full extent of Silver Gull movements in relation to the airport.

Table 3: Silver Gull (*Larus Novaehollandiae*)

Trial Period	R	L	U	D
Pre Treatment	62%	21%	17%	
Treatment	58%	28%	10%	5%
Post Treatment	91%	9%		

2.5.1.3 Flock Characteristics

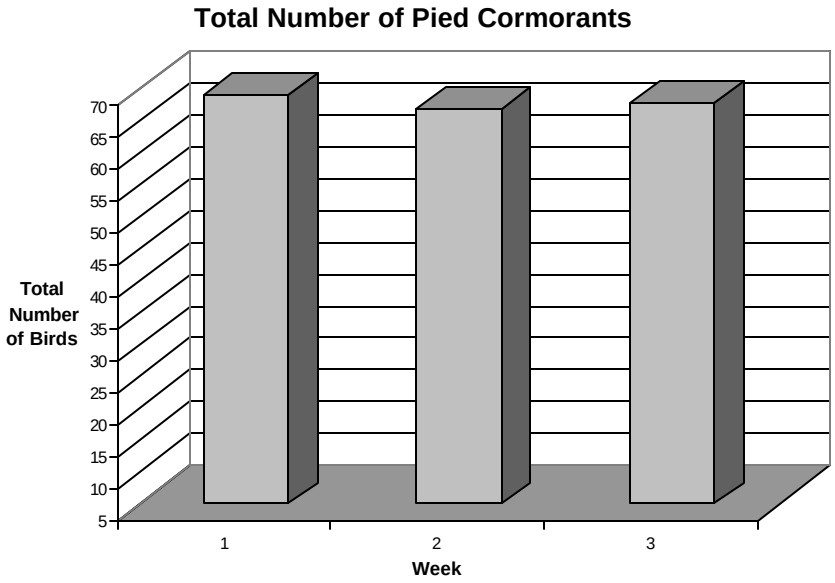
Overall there was a reduction in the maximum flock size and the proportion of birds in flocks of more than 2 birds for each week of the trial (Appendix 4). These figures could support the possibility that Silver Gulls are moving out of the Sydney region and therefore the study area during the period of the trial.

2.5.2 Little Pied Cormorant (*Phalacrocorax melanoleucos*)

2.5.2.1 Bird Numbers

The total number of Little Pied Cormorants remained relatively constant during each week of the trial, between 67 and 69 birds (Figure 6).

Figure 6:

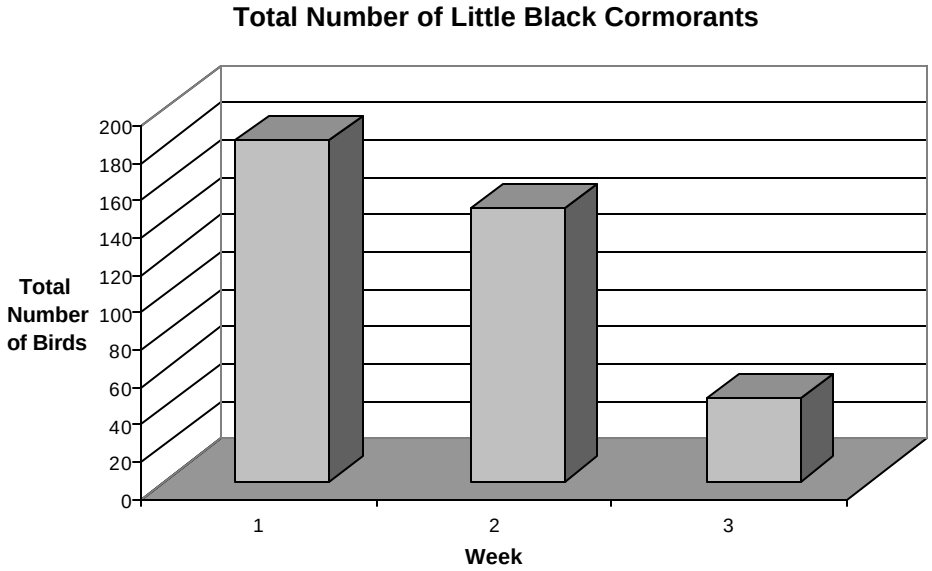


2.5.3 Little Black Cormorant (*Phalacrocorax sulcirostris*)

2.5.3.1 Bird Numbers

Little Black Cormorant numbers declined by, approximately 30%, during the Post-treatment period (from 140+ birds to 44 birds) (Figure 7).

Figure 7:



2.5.3.2 Movements of Cormorants in Relation to the Airport

The majority of dawn movements for both Little Pied and Little Black Cormorants are dominated by southerly movements, suggesting birds are roosting overnight in the direction of and possibly within the Botany Wetlands themselves (Tables 4 & 5). These birds are probably using the Mill Stream as a flyway entrance to Botany Bay, where they disperse to feed during the day.

Table 4: Little Pied Cormorant (*Phalacrocorax melanoleucos*)

Trial Period	R	L	U	D
Pre Treatment	4%	86%	11%	
Treatment	3%	97%		
Post Treatment	6%	91%		3%

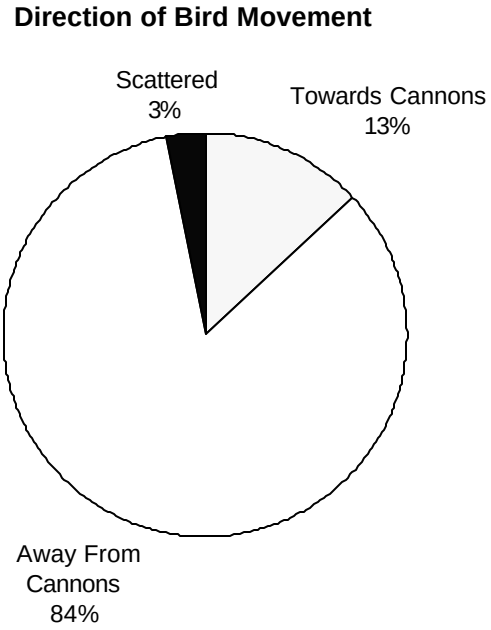
Table 5: Little Black Cormorant (*Phalacrocorax sulcirostris*)

Trial Period	R	L	U	D
Pre Treatment	19%	78%	4%	
Treatment	19%	76%	5%	
Post Treatment	15%	82%	4%	

2.6 OPPORTUNISTIC TRIAL RESULTS

The majority of birds (84%) moved in a direction away of the cannons (Figure 8). In most cases all or most birds left the area (77% of cases) (Figure 9). In both the static and opportunistic trials, the time taken for birds to respond ranged from immediately to approximately thirty seconds, if they were going to move away at all.

Figure 8:



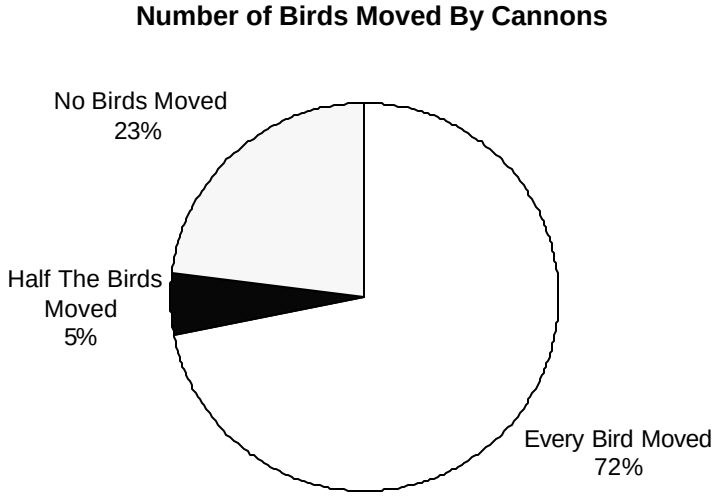


Figure 9:

This timeframe should be used by staff when assessing the effectiveness of implementing bird control. If birds do not respond within approximately thirty seconds, an alternative device or modification of the harassment regime should occur e.g. combined with other harassment techniques or altering the number of detonations and distance from the target species.

2.6.1 Species Effects

Gas cannons were used on five different species during the opportunistic trial, and was most effective on Feral Pigeons (*Columba livia*) and Common Starlings (*Sturnus vulgaris*) and least effective on Masked Lapwings (*Vanellus miles*). It was noted that distance from the cannons could have been responsible for the reduced effectiveness on the Masked Lapwings (extrapolated from the Gas Cannon Report Forms).

2.6.2 Combined With Other Harassment Measures

The Gas Cannons were used in combination with another scaring device, Bird Frite, on one occasion, and appeared effective. More data is required before recommendations on the use of gas cannons combined with other harassment strategies can be made.

2.7 BIRD BEHAVIOUR

2.7.1 Avoidance Behaviour

The most significant observation of bird behaviour was the immediate response of flying birds to cannon detonation. Birds flying past at the time of detonation appeared to tilt at a 45 degree angle, left and right, preceding a drop in elevation. This behaviour suggests that the bird is trying to determine the direction of the sound as either coming from the left or right, before descending and flying low over the water or at ground level, which may be safer than flying exposed in mid-air. Australian Ravens (*Corvus coronoides*), Silver Gulls, Willie Wagtails (*Rhipidura leucophrys*) and cormorants were all observed exhibiting this behaviour.

This response means gas cannons are favorable, as a method of bird dispersal for use at airports, as other methods may scare birds upward, into flying aircraft. Additional studies using colour-marked or tagged birds would indicate if the birds that react in this way, left the area for good, or returned after cannon fire ceased.

2.7.2 Activity Dependent

The response of flying birds could be separated to birds within 150m of the cannons and birds flying at a distance greater than 150m from the cannons. The former, veered in the manner described above, while the latter continued flying, which is in accordance with the Jaremovic (1990) study suggesting that a greater response is obtained from birds in the air, followed by birds loafing and leastly from birds occupied feeding.

2.7.3 Species Specific Responses

Silver Gulls feeding at a distance of 200m or more from the cannons, appeared to stop feeding, look up for the source of the sound and then either walk or run along the beach in the opposite direction to the cannons. They responded within 5 seconds of cannon detonation. Australian Pelicans (*Pelecanus conspicullatus*) feeding at this distance, also reacted by swimming in the opposite direction to the cannons, but were slower to respond (approximately 30 seconds after detonation).

2.9 LIMITATIONS

There were a number of limitations to this study which should also be considered.

Equipment Failure

The cannon did not always detonate on command. This occurred on 3 occasions and was possibly due to too rapid data entry of the operator.

Sample Size

The different conditions (weather conditions, different observers, disturbance i.e. from people walking dogs) of each test and the bird species composition limited the opportunity to test habituation during the static trial period. The number of surveys completed for the opportunistic trial also limited the opportunity to test habituation. For the static trial, the number of observations was limited to 4 days instead of 5 during the Post-treatment period due to illness of the principal observer.

Disturbance From Other Factors

The Foreshore Road beach is a public beach used by many people for recreation. Most days, fishermen or people walking dogs were present, however this did not appear to disturb the birds. The presence of the Operations vehicle may have influenced bird activity and bird response to the cannons, as resident birds may have recognized the vehicle and associated it with harassment procedures and avoided settling in the area.

Restrictions on Observations

Observations of bird behaviour, in response to cannon detonation, was compromised by difficulty separating birds arriving and birds leaving the area. This is due to the view of the beach where birds were landing and taking off, being partially obstructed by the sea-wall.

3.0 RECOMMENDATIONS

3.1 Recommendations Related to Gas Cannon Use

- Gas Cannons should be included as part of the bird control armoury used at Sydney Airport.
- Gas Cannons should be used within 150 metres of the target group of birds.
- If Gas Cannons are not effective within 30 seconds of detonation, alternative harassment strategies, such as combining gas cannons with other harassment techniques or altering the number of detonations and distance from the target species, should be tried.
- Gas Cannons should be detonated in advance of flying birds approaching the airport runways, as harassment is most effective on birds that have not yet settled to loaf or feed.
- The close proximity of the Botany Bay-Botany Wetlands-Mill Stream flyway to an active runway at Sydney Airport means vigilant bird control and close monitoring of the bird movements should occur on an on-going basis.
- Airport-wide studies recording observations of the number of birds, number of movements, direction of movements and flock size, of Silver Gulls and cormorants should be performed. Studies of birds during dawn and dusk should be performed annually.
- Colour-marking or tagged bird studies would be useful to determine if bird dispersal effectiveness extends beyond the initial exposure of birds to cannons.
- Ongoing assessment and observations of the effectiveness of this and other bird scaring devices should be performed as part of the overall Bird Hazard Management Program at Sydney Airport.

3.3 CONCLUSION

Outcomes of the study include discovery of the characteristics of the local bird community such as species composition, abundance, behaviour, number and direction of the bird movements at dawn. The results indicate that the cannons were effective in reducing the number of bird movements in the study area and modifying the behaviour of birds in flight, particularly influencing the direction of bird movements.

3.4 REFERENCES

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Jaremnovic 1990 Bioacoustical Scaring Trials in Flemings, Temby & Thompson, *National Bird Pest Workshop Proceedings*, 8-9 February, 1990 University of New England Armidale, Government Printer NSW