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Author

Brown, Lex

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The Response of Sea Birds to Simulated Acoustic and Visual Aircraft Stimuli

Professor Lex Brown
School of Environmental Planning
Griffith University, Brisbane 4111
Australia

This paper describes an experiment conducted in the field to assess the response of seabirds to helicopter overflights. It also attempts to assess the importance of a visual cue to aircraft overflights as compared to the acoustic cue. The work reported here is for a species of sea bird nesting on the Great Barrier Reef in Australia – and it is not so much the results from this particular species that is important in the Canadian context – but more the approach to experimental technique, and the emphasis on good measurement of both disturbance stimulus and disturbance reaction. The finding in this study that visual stimulus appears to be much more important than the acoustic stimulus, if replicable in other species, allows the use of experiments where aircraft overflights are simulated – avoiding some of the ethical dilemmas associated with real life experiments on wild populations.

The author (Brown, 1990) has previously reported the response of Crested Tern (Sterna bergii), to acoustic stimuli simulating overflights of fixed-wing aircraft (a DHC-2 Beaver float plane). The experiments involved presentation of pre-recorded aircraft noise, with peak over-flight levels of 65 dB(A) to 95 dB(A), to sea bird colonies nesting on the Great Barrier Reef. Sea bird responses in the exposed colony were videotaped and these tapes were subsequently analysed by assessing the behavioural response of each bird in the colony. Results of the trial indicated that the maximal responses of preparing for flight, or escape, were restricted to exposures greater than 85 dB(A). A scanning behaviour was observed in nearly all birds at all levels of exposure. An intermediate level of response, an alert behaviour, demonstrated a strong positive relationship with increasing noise level. This earlier work has been extended by examining sea bird responses to helicopter and responses to visual stimuli simulating the approach of low-flying aircraft. The significance of the contribution of the visual component to bird disturbance needed to be resolved in this work that relies on simulated aircraft noise to assess the effect of aircraft flights on wildlife.

The Study

The study site was Eagle Cay in the Cairns-Cormorant Pass section of the Great Barrier Reef Marine Park. Colonies on this cay had had no prior chronic exposure to aircraft overflights or to other forms of human disturbance. The species of sea bird examined was again the Crested Tern. It is a colonial nester, found mainly in open habitat among low grasses and herbaceous vegetation, and breeds in large numbers, up to several thousands, in the summer months. The eggs are laid on the bare ground in hollow scrapes (Langham and Hulsman, 1985). Because it nests in open areas, this species could be videotaped relatively easily, allowing detailed measurement of the behaviour of individual birds in the colony.

The experiment was conducted on a colonies of which only portions on the periphery, about 20 to 35 individual birds present at any one time, were observed in the experiment. When the experiments started the birds were in the late stage of the incubation period. A hide was established at 15 – 20 m distance from the edge of the colony and was the location from which the stimuli were controlled and bird behaviour filmed.

The acoustic stimuli consisted of instrumentation quality, mono tape recordings of Kiowa helicopter operations recorded at various distances from an alighting point. The aircraft operation consisted of approach and descent to the alighting point, a brief pause on the ground with motor and rotor idling, then lift off and departure. This operation simulates a tourist activity ferrying passengers to locations on the Great Barrier Reef. The Kiowa is a military equivalent of a Bell Jetranger helicopter, commonly used for tourist activities on the Reef. The recordings were conditioned to represent six "alighting" treatments where the peak level in the helicopter alighting operation ranged from 70 dB(A) to 95 dB(A) in five 5 dB(A) increments. In the field these recordings were amplified and replayed through a column loud speaker. No birds were located between the speaker and the part of the colony under observation. A microphone located in the column monitored the level of every simulated alighting operation to confirm that the correct treatment level had been delivered. These aircraft signals were superimposed on an acoustic background of bird calls from within the colony and the sound of wave action on the shores of the cay. The simulated alighting recordings were of some 80 to 90 seconds duration. A colony was exposed to five replications of each of the six helicopter alighting treatments and a control (no acoustic stimulus) over a period of four days. Treatments were applied in random order within each of the replications. Replications were separated by a minimum of four hours, most by 24 hours. Individual treatments were separated by at least 10 minutes.

The simulation of the visual stimulus of an aircraft overflight was not as sophisticated as that of the acoustic stimuli. It was achieved by towing a target on a fixed wire towards and above the colony. The wire was fixed to a 12 m high mast that had been erected at the edge of the colony and to a point on the ground some 60 m distant from the colony, the latter hidden behind bushes. The target was towed rapidly to the top of the mast by winding the tow wire on a reel. The birds in the colony would have first observed the target when it emerged above bushes some 40 to 50 m from the colony and at an angle of approximately 5o above the horizon. Four target sizes were used and each had the wing and fuselage shape of a fixed wing aircraft. Wing spans were 280 mm (Target A), 409 mm (Target B), 602 mm (Target C) and 948 mm (Target D). At the point at which they could first be observed by the colony, these targets would have subtended angles of between 0.4o and 1.4o at a bird's eye.

A colony was exposed to nine replications of each the four visual targets and a control (winding the tow rope along the target wire, but with no target attached). Treatments were applied in random order within each of the replications. Replications were separated by a minimum of two hours; individual treatments by at least 10 minutes. The experimentation was completed over a period of seven days. All targets were towed at the same, uniform, velocity.

Observations

Bird behaviour during each noise and target treatment was filmed on videotape, and laboratory viewing of this videotape was used to score bird behaviour. Laboratory analysis was undertaken by repeated replay, with the behaviour of a single bird observed over each replay of the same segment. The maximum response behaviour of the observed bird was scored and the segment then replayed to observe the next bird. A summary of the categories of the hierarchy of responses is (Brown, 1990):

- Scanning behaviour: head turning, tilting, appearance of "looking" for disturbance.

- Alert behaviour: neck extension, carriage erect/tense; re-orientation or stepping on spot.
- Startle/avoidance behaviour: incomplete intention movement to fly up or escape. wing flapping, possibly leaving eggs or chicks exposed momentarily.
- Escape behaviour: flying up, nest exposed for a longer time.

It should be noted that these behaviours could also result, not just from the simulated stimuli, but from routine interactions with other birds in the colony and also from the presence of predators. Behaviours that could be attributed clearly to such interactions were discarded and only those behaviours that could not be attributed to such causes were used in this analysis. If responses that could be attributed to interaction were observed before another that could not be attributed to interaction or predators, a conservative approach was adopted by excluding the latter from the analysis.

The results of the five replications of the helicopter alighting experiment are shown in Figure 1. The figure shows the mean proportions of the birds that exhibited a particular (or greater) behavioural response. It is clear that bird response depends on the level of helicopter alighting noise. Over three-quarters of the colony exhibited a scanning (or greater) behaviour for all levels of the helicopter alighting stimulus. Escape, and startle (or greater), behaviours were also observed at all levels of the noise stimulus, with between 16% and 36% of the colony reacting in this way. These proportions increased slightly with increasing helicopter noise levels. The proportion of the colony exhibiting alert (or greater) behaviours increased more steeply with increasing maximum helicopter noise levels. There were some small, and unexplained, behavioural responses to the control stimulus, but response to the noise stimuli were always greater than for the control. These findings reinforce those of the previous fixed wing experiment, viz that there is an observable behavioural response to all levels of aircraft noise that can be heard above the background sound levels of the cay.

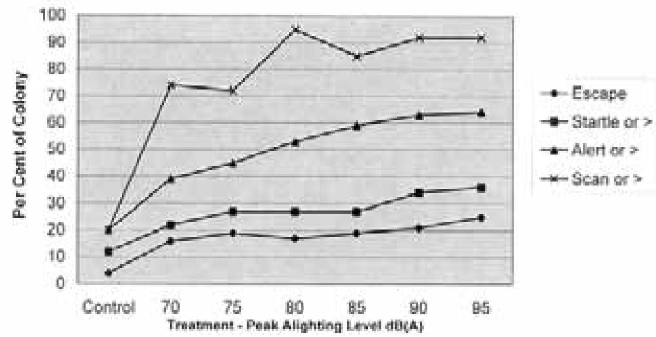

Figure 1. Mean Proportion of the Crested Tern colony exhibiting different behavioural responses to helicopter noise stimuli.

The results of the nine replications of the visual experiment are shown in Figure 2. The figure shows the mean proportion of the observed birds that exhibited particular behavioural responses to each size of visual targets (Target A was the smallest target, Target D was the largest). There was no measurable response to the control. The largest target (near 1m wingspan) was the only stimulus to result in any of the higher orders of behavioural response in the colony. The scanning (or greater) response was observed for much lower proportions of the colony than observed for the noise stimuli.

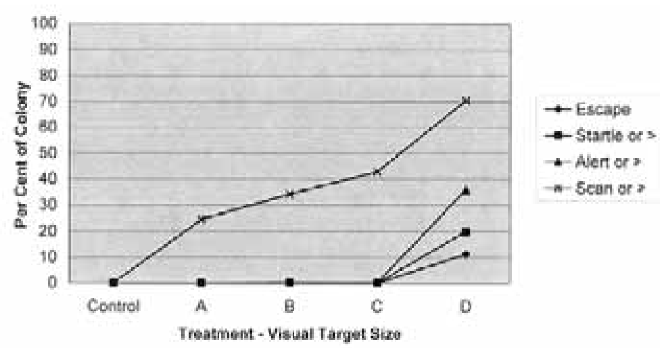

Figure 2. Mean Proportion of the Crested Tern Colony exhibiting different behavioural responses to visual stimuli. (Increasing target sizes A to D).

Discussion

The results of the helicopter alighting noise simulation experiments conform broadly to those found for the fixed wing DHC-2 Beaver float plane. For both helicopter and fixed wing sources, Crested Tern demonstrate an observable behavioural response to aircraft noise at all levels of noise exposure audible above the background sound levels. Escape or startle responses are exhibited by only a small proportion of the colony, whereas for the fixed wing noise source these behaviours were restricted to the higher noise level exposures of 90 and 95 dB(A). There was no similar threshold for the helicopter noise source. Overall, the noise of helicopter alighting generated greater levels of escape or startle behaviours than did the noise of fixed wing aircraft. For both noise sources, the most prominent relationship between level of noise and proportion exhibiting a particular response was for the alert (or greater) behaviour – though the gradient of the relationship was not as strong in the helicopter results as it was for the fixed wing results.

While the peak noise levels to which colonies were exposed were the same in the treatments for the fixed wing and the helicopter experiments, the difference in bird response to the same peak noise levels is notable. It may be possible to attribute the somewhat greater response to different frequency and temporal components in the noise sources. In particular, it may be the variability in the levels of sound produced by a helicopter as it hovers, alights, idles and takes off, relative to the somewhat more "predictable" signature of an overflying fixed wing aircraft, produces a greater response in the colony. These results suggest that a cautious approach should be taken in the control of helicopter movements when these are operating near wildlife.

The results of the visual stimulus experiments suggest, at least within any limitations of the current simulations, that the acoustic component of aircraft overflights near sea bird colonies may be far more important in generating behavioural responses than the visual components. There clearly is a response to visual stimuli, but of a much lower magnitude than to acoustic stimuli. This result means that simulating aircraft overflights by means of replay of recorded sound of aircraft movements is not overly confounded by the absence of a visual component of the stimulus. This finding is of considerable value. It means that it is possible to design experiments to determine operating limits for aircraft near wildlife which expose just small parts of a colony to disturbance using simulated noise operations, rather than exposing the whole of the colony, as would be the case if using real aircraft overflights. There is still a need, of course, to validate any findings obtained through simulation experimentation using actual aircraft.

References

Brown, A.L. (1990). Measuring the effect of aircraft noise on sea birds. Environment International, 16, 587-592.

Davies, S.J.J.F. (1962). The Response of the Magpie Goose to Aerial Predators. Emu, 62, 51-55.

Langham, N.P. and Hulsman, K. (1985) The breeding biology of the Crested Tern, Sterna bergii. Emu, 86, 23-39.