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Birds and Roads: A Longitudinal Study of a Major Road Project in SEQ

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1.0 Rationale

Roads allow for the transport of people and the safe distribution of services and products but can cause significant negative impacts for wildlife. Impacts include disruption of migration pathways, increased mortality through exposure to vehicle collisions, and reduced physiological condition, particularly where these intersect natural reserves (Jones *et al.*, 2010; Jones & Bond, 2010; Pell & Jones, 2015). The aim of this presentation is to explore the innovative research methods developed for a novel study monitoring the influence of road construction on the presence and dispersal of the wildlife community, specifically birds. The presentation covers the background issues concerning birds and the influence of roads and traffic, the site where the research will be conducted and a summary of the key methodologies that will be used.

Impacts on smaller animals are poorly understood due to the disproportionate bias towards larger animals within the published research (Wilson *et al.*, 2007). Birds are one such taxa and can be attributed to a widely held assumption that flight grants bird's immunity from such terrestrial processes (Jones & Pickvance, 2013; Kociolek *et al.*, 2015). However, previous research (Johnson *et al.*, 2017) demonstrated that birds are highly susceptible to the impacts of roads when moving across fragmented landscapes in southern Brisbane. This is likely to result from several factors that comprise the 'road effect zone': the area of which the ecological effects of roads, traffic and other associated activities extend into the adjacent landscape (Forman & Deblinger, 2000). For example, frequent compaction and chemical treatment of the roadside environment typically results in a vegetation community that is composed of exotic species that are drought- and disturbance-tolerant (Johnson *et al.*, 2017). These communities do not provide the same benefits as native species, and thus are unable to support the levels of diversity observed at less disturbed interior sites (Forman & Deblinger, 2000; Johnson *et al.*, 2017). In addition, vehicle-generated noise from the road network may permeate out across considerable areas of the landscape (Madadi *et al.*, 2017) and adverse impacts have been reported for many species globally (Brumm *et al.*, 2017). For example, studies in the US observed shifts in the range and occurrence of migratory birds when a forest reserve was exposed to audio playback of traffic noise (McClure *et al.*, 2013; Ware *et al.*, 2015; McClure *et al.*, 2017). Elevated stress responses have also been observed in many birds exposed to traffic noise (Dorado-Correa *et al.*, 2018; Injaian *et al.*, 2019; Zollinger *et al.*, 2019; Grunst *et al.*, 2020). Most of these studies examined areas and/or communities' post-disturbance, however, and very few studies have used before-after-control-impact (BACI) (Benítez-López *et al.*, 2010). Indeed, the most recent BACI reported no impact of highway construction and traffic noise on breeding activity of an endangered bird (Long, Colon, Bosman, McFarland, *et al.*, 2017; Long, Colon, Bosman, Robinson, *et al.*, 2017).

The Coomera Connector is a new road arterial corridor proposed for the Northern Gold Coast in Southeast Queensland, east of the existing M1 Pacific Motorway. The new road was included in *Shaping SEQ* (DILGP 2017, pg. 143) and the Queensland Transport and Roads' *Roads Investment Program 2018-19 to 2021-22*, the latter committing funding to undertake transport project planning from Loganholme to Nerang. Funding for construction of Stage 1 (Coomera to Nerang) was recently granted, and construction is expected to commence shortly. The proposed road will intersect the Southern Moreton Bay to Clagiraba regional biodiversity corridor at Coombabah Creek, Helensvale. This has been identified as a key regional biodiversity corridor within the City of Gold Coast, and the RAMSAR listed Lake Coombabah is important to the conservation of several migratory and resident birds, such as the Australian Temperate and Subtropical Bird Community (Fraser *et al.*, 2019) recently referred to the Commonwealth for 'Critically Endangered' status. As such, the management of roadside ecology, including high profile species such as koalas but also important taxa is a major issue for the project.

This research proposed here will use improved methods for the monitoring of nearby wildlife, specifically birds, both before and after construction of the Coomera Connector in Helensvale, Gold Coast. The objectives are to: A) obtain baseline data on bird populations and movement pathways within the reserve along and nearby the anticipated motorway route; and B) monitor changes in populations and movement pathways during and after construction. This will be achieved using bio-acoustic monitoring devices to monitor abundance/presence and movement patterns of birds within Coombabah Lake Nature Reserve. Monitoring efforts will be focussed towards areas along the proposed route of the Coomera Connector (along the Gold Coast heavy and light rail lines), in particular the Coombabah Lakes Conservation Park-Nerang State Forest link (-27.939218, 153.342035), Careel Reserve-Reservoir Park link (-27.916911, 153.342228), and northeast Coombabah Lake (-27.897293, 153.334220). This will provide an essential assessment of bird populations and movement patterns within the vicinity of existing transport infrastructure and wetlands, as well as monitor population-level changes in these in response to the construction of the Coomera Connector. Point-count surveys will also be used to ensure accuracy and precision of bio-acoustic monitoring.

These novel methods are at the very forefront of the field. This is believed to be the first Southern Hemisphere study to use bio-acoustic monitoring to examine longitudinal effects of a new arterial road development on bird presence and dispersal in an important ecological site. Hopefully these methods will identify which of the interventions to be included in construction to support these species are beneficial, and, if not, can help identify areas for improvement.

2.0 Preliminary Methodology

2.1 Avian acoustic monitoring

In general, the methodology for avian acoustic surveys will be adapted from recent avian acoustic studies (Khanaposhtani *et al.*, 2019; Hao *et al.*, 2020; Stewart *et al.*, 2020). Acoustic recording devices will be installed across forested sites located along the proposed corridor for the duration of the recording period (2021-2026). Recording devices will be located at different distances from the road corridor (e.g., 0m, 100m, 200m, 300m, etc,) and will provide varied exposure to construction and traffic noise during the later stages of development. Recording sites will be separated by at least 100m to ensure spatial independence. The recorders will be set to capture 5mins of audio at the top of each hour from 0600 to 1000 (AEST +10) every day. This time frame will capture dawn choruses and is contemporaneous with in-person avian point count surveys (described below) performed in the same period. Recordings will be in stereo at a sampling rate of 44.1 kHz using an uncompressed .wav file format. Trained observers will listen to, and code each recording. Rainy and windy recordings, as well as recordings of other non-target species (i.e., non-birds), will be removed from sample pool and excluded from further analysis. Further refinements to this approach will be made through a field pilot study in consultation with an experienced acoustic professional.

2.2 Avian point count surveys

The methodology to be used is adapted from a previous successful study (Johnson *et al.*, 2017). Three passive point-count surveys (i.e., no call broadcasts) will be conducted at each site: one corridor (crossing) survey and two forest surveys.

Crossing surveys will be carried out by the same observer along the corridor edge at each site over a twenty-minute period. The edges of one count area per site, 30m wide, will be marked out using marking tape. The observer will then be stationed in the middle of each count area, leaving 15m on either side. The observer will then record any birds that successfully fly across the corridor. Only birds that make a complete crossing from one side of the corridor to the other will be recorded. Birds that do not cross to the other side, fly down the length of the corridor, or fly over the site above the canopy will not be recorded.

Two forest surveys will be conducted in tandem on opposite sides of the corridor, with the observer standing at different distances from the road corridor edge (e.g., 0m, 100m, 200m, 300m, etc,). Over a 20-minute period, all new observations and/or vocalisations will be recorded at each distance interval.

The first site survey will begin approximately 30 minutes after sunrise and run for twenty minutes. Surveys will be conducted between 0600 and 1000 (Brisbane time) and in the following order: forest survey, then corridor survey, then forest survey (opposite side). Each site will be visited numerous times throughout the duration of the experiment (2021-2026) to ensure adequate statistical power.

2.3 Species Selection

Species richness surveys for each study site are currently in development. Once completed, these will be combined into a master database for the project from which a selection of species will be considered for closer examination and analysis. This selection will be informed by the Australian Temperate and Subtropical Bird Community list provided in Fraser *et al.* (2019). In addition, species selection will also ensure appropriate representation of guild and body size classifications used in Johnson *et al.* (2017), as these were significantly associated with species response to the road.

2.4 Statistical Analyses

Overall, the species richness, species crossing, species types and crossing times will be recorded. Data obtained from acoustic monitoring and point count surveys at corridor and forest sites will be combined to create a site-specific master species list. Species observations will be categorised based on body size and life history guilds as per Johnson *et al.* (2017). Count gathered data will be used to calculate rates of crossing and probabilities at the species guild and body size levels (Johnson *et al.*, 2017). Emphasis will be placed on differences in species presence at forest and corridor sites, as well as numbers of crossing individuals of species of different guilds and body sizes. The outcomes of species guild and species size richness, crossing counts across the corridor will be analysed using negative binomial regression. The relationship between forest species richness and road crossing counts will be examined using bivariate correlation. The degrees of similarity between study sites during and between years will be assessed by lower triangular resemblance matrices, using Sorensen Index of Similarity (Dice Indices), and Multi-Dimensional Ordnance. All statistical analyses will be conducted using IBM Statistical Package for the Social Sciences (SPSS) Statistics software (Version 22.0.

Armonk, NY: IBM Corporation) and STATA (version 14.0, College Station, TX: StataCorp LP, USA). $P < 0.05$ will be considered statistically significant.

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