PARKER CONSERVATION

Bounty Island drone feasibility trials:

Proposed methodology

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Introduction

New Zealand fur seals are captured in the southern blue whiting trawl fishery around the Bounty Islands at one of the highest rates of any trawl fishery (Abraham & Thompson 2015), but information on their population level and trend at this site is poor.

Because many of the islands in the group are inaccessible, aerial photographs appear to be the best way to estimate population numbers across the whole group and assess trends over time. Fixed-wing aircraft provided the platform for aerial photographs used to count Salvin's albatross (Baker & Jensz 2019), and fur seals are also visible in those photographs. UAV (unmanned aerial vehicle or drone) also hold promise as a way to obtain aerial photographs suitable for estimating fur seal numbers.

Drone use for seal population assessment is becoming increasingly common worldwide, providing an effective monitoring tool (Nilssen *et al.* 2014; Arona *et al.* 2018; Gooday *et al.* 2018). In the NZ subantarctic, drones have been used successfully for a range of projects on the Antipodes and Auckland Islands (Dawson *et al.* 2017; Cox 2018; Cox *et al.* 2019; Muller *et al.* 2019; G. Elliott pers. comm.).

However, drones have yet to be used at the Bounty Islands, which are so densely populated with animals that the potential for disturbance must be assessed carefully. NZ fur seals have shown an awareness and

nervousness in response to drone activity on the Chatham Islands and elsewhere in the subantarctic (DOC UAV work in 2014, 2017 and 2018), and the response to a drone of nesting rockhoppers, Salvin's albatrosses, Bounty Island shags is unknown. Similarly, the response of seabirds in flight is also unknown.

We aim to test whether aerial surveys to quantify NZ fur seal population size can be conducted with a drone at the Bounty Islands without adversely affecting seals, penguins and albatrosses there. The trials have three parts:

- Flight characteristics (flight speed, height, time of day) will be trialled to find the combination that causes least disturbance.
- Using the flight characteristics that cause least disturbance, we will then fly programmed grids and conduct ground-truthing to test the accuracy of counts from aerial photographs.
- Images of suitable quality for fur seal detection will be stitched, counted, and counts checked for accuracy against ground-truthing data.

Methods

Logistics

This project involves a two-person team making a single trip to the Bounty Islands in October-November 2019, combined with other DOC CSP work (Salvin's albatross project). Transport from Dunedin to the Bounty Islands is contracted with Stephen Kafka of the sailing yacht *Evohe*.

Surveys will be weather dependent and occur within a planned eight-day window. Drone trials will be land-based to ensure the pilot and spotters have the best possible field of view to monitor animal responses.

Equipment

The drone will be a DJI Mavic 2 Pro with high-quality Hasselblad camera, with a DJI Phantom 4 Pro v2 as backup. Low-noise rotors will be available for the Mavic in case these are needed to reduce disturbance.

To minimise impact of potential software problems, we have multiple apps that provide suitable interface for manual and grid-flight: Pix4D capture, DJI Go4, UgCS and MapPilot. These apps are selected in part because they do not need to be online for map sourcing during grid/flight planning, but we will also take a set of pre-programmed saved flight grids, and load kml images for use offline.

Animal response trials

The first step is to assess whether there are adverse impacts on fur seals, penguins or seabirds. We will:

- Use two spotters during drone flights, one focusing on fur seal reactions and another to monitor seabird interactions in the air. The drone will always remain in the pilot and spotters' field of view. To ensure the best possible viewing of animal reactions to drone movements during this trial phase, we will fly the drone from land (rather than from ship's deck).
- We will assess animal responses to flight parameters (speed, height, time of day) while flying the drone manually, with spotters as described above, to identify the flight parameters that cause least

disturbance with best-quality imaging. For example, flight height will be tested in increments starting at 40 m (or just above the main albatross flight zone, whichever is lower) to find the flight altitude that causes least disturbance.

- During animal response trials we propose to film drone movements and animals' reactions. If problems are encountered, film would provide a secondary resource to refer to later. Filming will use a DLSR camera on tripod and a GoPro.
- Quantify disturbance: a full grid of the island will be flown with least-disturbance flight parameters, then repeated (see below). During counting, random quadrates will be checked for any sign of seal movement between the two flights that may indicate disturbance not detected by observers.

Aerial photography trials

To assess the feasibility of estimating fur seal numbers from aerial photographs from UAV, we will assess whether images are of suitable quality for detecting fur seals and whether counts from photographs are accurate enough for population size estimates.

- Using least-disturbance flight parameters, we will fly programmed grids of the island twice, taking high quality images suitable for image stitching and later counts. Programmed grids ensure high image overlap and can be saved for repeatability.
- Ground truthing for accuracy: we will mark the corners of three 25 m^2 quadrates with high-visibility non-toxic spray paint, ensuring these marks are visible in aerial photographs at the chosen flight altitude. Immediately after each flight, each quadrate will be visited on foot to count all fur seals. Ground counts enable a detection rate to be calculated later for aerial counts, providing a metric of the accuracy of seal counts in aerial photographs.
- Programmed grids covering other islands in the group will be flown as time and weather allows.

Animal response mitigation

During any part of this work (or during any stage of all flights), the following animal-response mitigation actions will be applied:

- If an animal on the ground exhibits a negative reaction to the presence of the drone (restless movements, fleeing etc by fur seals or seabirds) the drone will be removed from the vicinity of the animal by altering flight heights or flight path, or the drone will be grounded away from the animal.
- Mass movement of seals could damage themselves and breeding seabirds and would limit the accuracy of data collected from the images. If there is any indication of mass movement of seals, the flight will be aborted, and no further drone flights will occur that day. On next occasion when flights can be attempted, we will start at a higher flight altitude and slower flight speed.
- If there is an interaction of a bird with the drone (close miss with flying bird, collision), the current flight plan will be abandoned, and a new flight altitude tested.
- Trained drone operator will ensure fast, erratic movements will not be conducted, allowing flying seabirds to adjust their flightpath (perform an avoidance response) accordingly.

Thermal imaging

Thermal imaging cameras are sometimes used on drones to help detect animals (Gooday *et al.* 2018). A drone-mounted thermal camera is not available for this work, but a ground-based thermal camera could be a proxy to gauge the potential utility of this tool. If time allows, we will use a thermal-sensing camera on a tripod on a high point to take still images (paired thermal and standard images). Paired images will be compared to assess whether animals in the field of view are more likely to be detected with thermal imaging.

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