

Multidrone aerial surveys of penguin colonies in Antarctica

Grant Ballard and Annie Schmidt

gballard@pointblue.org, aschmidt@pointblue.org

Seabird colony count data is often gathered by expensive and disruptive helicopter or airplane surveys. Unoccupied aerial vehicle (UAV) surveys can cause far less disturbance but can be hard to implement efficiently with existing survey planning software.

Utilizing multiple UAVs in an autonomous system should enable higher frequency, faster surveys compared to traditional survey methods, to capitalize on brief windows of favorable weather and to ensure the most accurate count possible.

We developed flight planning software, Path Optimization for Population Counting with Overhead Robotic Networks (POPCORN), which plans paths for a team of UAVs to survey large areas. We tested this by conducting multiple photographic aerial wildlife surveys of Cape Crozier, one of the largest Adélie penguin colonies in the world containing more than 300,000 nesting pairs.

We surveyed more than 2 square kilometers in about 3 hours using a team of 3-4 UAV's simultaneously. In contrast, previous human-piloted single-drone surveys of the same colony required over 2 days to complete. POPCORN achieved a 13.7% improvement in efficiency over conventional sweep planning method. We also surveyed a much smaller penguin colony at Cape Royds, requiring only 7 minutes. The 2 colonies are on opposite ends of Ross Island, in the Southern Ross Sea, Antarctica.

Data collected from the surveys will be used to estimate breeding success as well as nest density for the two colonies. Due to climate change, new areas in and near penguin colonies are being exposed by retreating glaciers and snowfields. Fine-scale elevation differences, perhaps as little as a few inches, can affect the risk of a nest flooding and subsequently failing.

Combining the colony-wide estimates of breeding success from the UAV surveys with the

high-resolution digital elevation models generated from the UAV imagery will allow us to test the influence of fine-scale variability in nesting habitat and nest density on the likelihood of a nest successfully raising chicks.

Main Points

Our method reduces seabird colony survey time by limiting redundant travel while also allowing for safe recall of the UAV's at any time during the survey.

Data gathered from the surveys will be used to better understand the effects of climate change on penguin habitat quality.

The approach can be applied to other domains, such as wildfire surveys in high-risk weather conditions or disaster response.

Shah, K., G. Ballard, A. Schmidt, M. Schwager. 2020. [Multidrone aerial surveys of penguin colonies in Antarctica](#). *Science Robotics* 5(47). DOI: [10.1126/scirobotics.abc3000](https://doi.org/10.1126/scirobotics.abc3000) (published October 28, 2020). Point Blue contribution # 2332.