

# Utilizing UAS Ravens to Estimate Sandhill Crane Abundance

## Project Overview



The first DOI operation in the National Airspace System  
Photo taken during morning civil twilight mission

The Department of the Interior (DOI) conducted the first small unmanned aerial system (UAS) mission using the Raven RQ-11A UAS from March 19-24, 2011, at Monte Vista National Wildlife Refuge near Monte Vista, Colorado. The U.S. Geological Survey's (USGS) Unmanned Aircraft Systems Project Office and Fort Collins Science Center collaborated with the U.S. Fish and Wildlife Service (USFWS) to organize and conduct this project. The USGS utilized the Raven RQ-11A UAS in cooperation with the USFWS to determine the feasibility of using an UAS to capture videography of roosting Sandhill Cranes to derive methodology for estimating population abundance. This mission was the first UAS operation conducted by the DOI in National Airspace System (NAS) using the Federal Aviation Administration's (FAA) Certificate of Authorization (COA) process.

## Sandhill Cranes: The Refuge and Survey Background

Sandhill Cranes are migratory birds that travel from nesting areas as far away as northern Canada and western Siberia in Russia, to wintering areas in central and southern Mexico. The Monte Vista Wildlife Refuge is a primary migration stopover for the Rocky Mountain Population of Sandhill Cranes during both fall and spring migrations. Because the cranes congregate in relatively small areas on the Refuge during the night, there is a high likelihood of obtaining accurate counts of the population. Traditionally, Sandhill Crane population surveys have been conducted during the day using fixed-wing aircraft. However, because cranes spread out across the landscape during the day to feed, these traditional methods are costly, time-consuming, and involve some level of risk for pilots and their crew.



A Sandhill Crane dances in courtship



USGS RQ-11(A) Raven UAS

## Objectives and Operational Findings

The objective of this proof of concept operation was to determine if the Raven's sensor package was capable of detecting the cranes' thermal signatures. Investigators also wanted to determine the cranes' behavioral response to the Raven while flying above them. Eagles are a predator of cranes, and biologists were concerned the cranes would view the UAS as a threat and react by flushing into the air when approached by the aircraft. The reactions of the cranes to the UAS varied greatly by the time of day and the activity in which the birds were engaged (i.e., roosting, feeding, or loafing). Sandhill Cranes tended to flush at daytime feeding sites when the Raven approached, but observers noted no reactions during the morning civil twilight flights when the roosting cranes were settled. The results at loafing sites varied depending on the altitude of the UAS. Video data from the early morning flights indicated that the birds could be detected using the thermal camera sensor. However, because the birds began to fly at sunrise, the potential for a UAS/crane strike increased as morning progressed. Based on these results, and knowing that cranes typically do not fly at night, operators and scientists believe night flights over roosts would be the best procedure for capturing the videography. The birds are the most concentrated at that time, and the risk of a crane strike with a UAS would be very low. Further, flying the missions at night would also reduce impacts to Refuge operations and decrease the potential for incidents with the public.

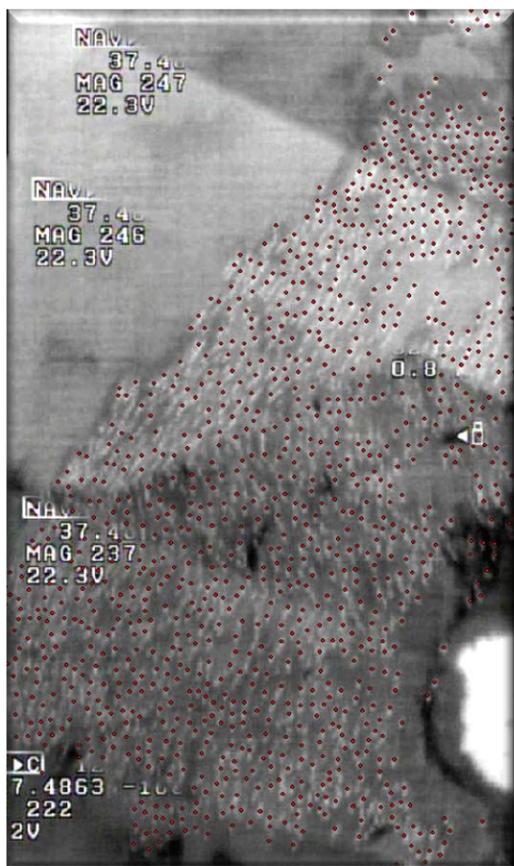


Raven infra-red thermal imagery of roost,  
(black is hot), taken 6:39 am 3/24/11

"This was a great demonstration of teamwork and capability that will ultimately save the taxpayers money and enable our wildlife stewards to better manage our valuable assets."  
Harry Kieling - Regional Director, Aviation Management Directorate

## Operations

After it was determined the UAS could identify the thermal signatures of the cranes, efforts were focused on collecting videography along several linear transects, which then could be used to estimate the number of birds within a sampled site. A total of eight transect passes were completed over a chosen roosting site at two hundred feet above ground level (AGL) as well as three collects at three hundred feet AGL. Accomplishing these collects under the current COA proved to be a challenge. The UAS operators had only a twenty-five minute window to fly the transects, because the cranes typically leave roosting areas at sunrise to feed in nearby fields. Once the cranes begin to fly, the risk of a mid-air collision increases and the ability to capture them on the imagery disappears. Due to the FAA restrictions in the COA, no flights could be conducted before morning civil twilight. Case studies for night flight approvals are currently being explored for future surveys. The USFWS land managers and biologists and USGS UAS operators believe night flight operations could be conducted safely while expanding the survey time of the collects.



Raven infra-red (black is hot) imagery and extracted population counts

"I would like the team back to my refuge next year. I would definitely recommend the UAS crew to other refuge managers and biologists."  
Floyd Truetken - U.S. FWS Refuge Manager



View of cranes roosting at sunrise

## Post Processing

With the videography collected, USGS analysts then converted the analog data into a digital format. The videos were reviewed and exported into still images. Analysts used the mosaics of these images to estimate crane abundance using a combination of methods including manual extraction, automated segmentation, and feature extraction. The estimate obtained using videography from the Raven UAS were compared to ground counts conducted by biologists from the USFWS Division of Migratory Bird Management. The count extracted from the Raven UAS videography (2,567) was very close to that of the USFWS crew (2,692), a difference of only 4.6%.



Estimated distribution of cranes of roost site #14

## Project Milestones

Many milestones were reached during this project, notably, the first approved UAS flight in the NAS for the Department of the Interior, and demonstration of the importance of adapting the RQ-11 (A) UAS platform. Although designed for military operations, this project demonstrated the key role Raven UAS can play in collecting scientific data for improved wildlife management, a direct benefit to our nation.

## Key Project Partners

U.S. Army, DOI Aviation Management Directorate, USFWS Region 6, and USFWS Division of Migratory Bird Management.

## For More Information

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