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BIRD AVOIDANCE MODELING AT DARE COUNTY BOMBING RANGE, NC AND MOODY AIR FORCE BASE/GRAND BAY WEAPONS RANGE, GA

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Summary

This paper contains a brief summary of the recently completed project at Dare County Bombing Range, North Carolina and the current project at Moody Air Force Base/Grand Bay Weapons Range complex, Georgia. The objectives at Dare Range were to quantify the effects of military aircraft on endangered species and the risk of bird strikes to military aircraft. Radar, radio telemetry, satellite telemetry and acoustics were used to remotely monitor all bird movements across the bombing range. The objective at Moody Air Force Base/Grand Bay Weapons Range is to quantify the risk of bird strikes to military aircraft. A thermal imaging camera has been added to these technologies to provide better species identification. The data generated is used to quantify the bird strike risk and to monitor the effects of low-level flying on wild bird populations. This risk analysis is distributed to aircrews and mission schedulers through the Bird Avoidance Model software: a multi-media computer model used to schedule flights around high-risk areas, altitudes and times. An outline is given of the radar and telemetry equipment used.

Keywords: Radar, Avoidance, Electronic, Local Movements

The United States Air Force (USAF) Bird Aircraft Strike Hazard Team (BASH Team) contracted Geo-Marine, Inc. (Plano, TX) to construct and operate a mobile radar installation at Dare County Bombing Range (DCBR), North Carolina. The objectives of this study were to:

a) Investigate the effects of low-level bombing missions on migratory birds.
b) Quantify the risk of a bird strike to aircraft operating at the range.

The United States Fish and Wildlife Service (USFWS) questioned the effects of low-level military aircraft on migration of endangered species through the Alligator River National Wildlife Refuge (ARNWR) in 1988. The ARNWR entirely surrounds DCBR. The endangered species found utilizing and/or migrating through the area are the Peregrine Falcon (*Falco peregrinus anatum*) and Bald Eagle (*Haliaeetus leucocephalus*). The Air Force, in reply to the USFWS, raised the question that acquisition of land surrounding the range in the past decade to create the ARNWR may increase the risk of a bird strike to USAF and US Navy aircraft operating at the range. As a result, radar was recommended by the BASH Team as the best means to identify migrants whose passage was affected by aircraft operations and to quantify the risk of a bird strike at the range. In this way, even if migratory birds were not adversely affected by flying operations, military training could be reduced or stopped during periods of increased or high bird activity.

With the completion of the study at DCBR, the radar project was continued at Moody Air Force Base (AFB) and Grand Bay Weapons Range (GBWR) in south-central Georgia. Significant bird strike hazard exists with migratory and resident birds. The installation is currently changing to a composite wing flying C-130s, A/OA-10s and F-16s. A large number of turkey vultures and black vultures in the area year-round present an especially high risk to the single-engined F-16.

The GBWR and most of the surrounding area is managed as wildlife refuges by Georgia Department of Natural Resources and USFWS. Migrations of waterfowl, sandhill cranes (*Grus canadensis*) and wood storks (*Mycteria americana*) will be monitored as possible bird strike risks. The USFWS has voiced concern about disturbance to wood stork rookeries, bald eagle nest sites and bat caves. Data collected will assist in achieving both flight safety and conservation objectives. This new project provides an opportunity to test the use of the Bird Avoidance Model (BAM) concept in an airfield environment for scheduling departures and arrivals of military aircraft.

Methods

<u>Radar Systems - DCBR</u>

An S Band surveillance radar (FR-8300DS, 30 kw) was semi-permanently installed on a 6 m tower at Range Operations to detect large birds at long range. It has the advantage over X band radar of not being as susceptible to the adverse effects of ground clutter and weather which can mask bird targets. The disadvantage of this system is the inability to detect single small birds at any distance. However, multiple small birds were detected. The data derived from this radar were the track of bird movements in the x and y axis over the study area.

An X Band surveillance radar (FR-8250D, 25 kw) was mounted on a slide-in camper unit that could be relocated to any area accessible to a four-wheel drive truck. The radar was used to detect single small birds at short range with great precision. As with all X band systems, this radar was adversely affected by ground clutter and weather. The radar was designed to collect detailed information on bird movements in areas previously identified by the S band radar or by observation. This provided a closer look at specific areas of interest. The track of bird movements in the x and y axis over a portion of the study area was collected.

An X Band vertical beam radar (FR-8100D, 10 kw) was co-located with the X band surveillance radar. It had a vertical pencil beam pattern of radiation which served as a precision range finder. It detected individual small birds passing through the beam at heights from 180 m to 1200 m and gulls to 2400 m. This design had a low slant range error. The disadvantage of the system was that it observed a very small volume of airspace. When bird density and activity was low, it generated very little data on the altitudes of bird flight. To some extent this limitation was mitigated by using the surveillance radar to find areas of bird activity under which to place the vertical beam antenna. Ground clutter was minimized by shielding the antenna. The data collected indicated the number of birds passing through a known volume of space at a given altitude.

An X Band conical scan radar (FR-8100D, 10 kw) was co-located with the S band surveillance radar and mounted on a 3 m tower. It had a 25 x 1.8 degree-wide beam around the vertical axis. It detected individual small birds passing through the beam at heights from 180 m to 1200 m and gulls to 4000 m. Bird targets were recorded from the screen as either small, medium, large, or multiples of a target size. The design scanned a large volume of air space and had a higher probability of detecting a bird than the vertical beam radar. This was extremely beneficial when low-density bird movements occurred and a smaller sample size was insufficient. However, this system had high slant range errors and birds passing through the beam could only be allocated to height band (i.e. 180-360 m) and not actual altitudes. The number of birds passing through a known volume of space at a given altitude band was recorded.

The radars were linked to video recorders, and tapes were analyzed after each six hour radar session. Video tapes were used to record bird activity on the range impact area unmanned. This was to prevent loss of life in the event of a stray bomb, rocket or ammunition round.

Telemetry

The slide-in radar unit and the trailer unit had 9 m telescopic masts for tracking telemetry equipped birds. Computerized data loggers and scanning telemetry receivers were used to automatically record the presence or absence of birds in the vicinity of the bombing range along with activity, time and date. VHF radio telemetry transmitters were installed on 16 turkey vultures (*Cathartes aura*) in 1994 to monitor daily activity patterns and movement. In the fall of 1994, in collaboration with USFWS biologists at Lake Mattamuskeet NWR (Hyde County, NC), 16 tundra swans (*Olar columbianus*) and 6 pintail ducks (*Anas acuta*) were equipped with telemetry transmitters to track local movements during the winter months. An additional 12 tundra swans were radio-tagged at ARNWR in the fall of 1995 to track local movements during the winter months. Many of the feeding sites used by the swans at the lake were unknown.

Nocturnal Acoustic Monitoring

An automated, nocturnal, flight call, monitoring system was tested at DCBR to assess the equipment for detecting night bird migratory activity. The technique was successfully used to identify species of neo-tropical migrants passing overhead.

Data Collection - Moody AFB/GBWR

All of the equipment used at DCBR is being used at Moody AFB/GBWR. Some improvements were made, and some additional equipment was purchased to enhance remote sensing capabilities on this project. The X band surveillance radar was semi-permanently mounted on a 3 m tower on GBWR to track very local movements over the range. We replaced the X band radar on the slide-in unit with an S band radar to improve the mobile unit capabilities. The S band is less affected by ground clutter, increases the range of bird detection, and increases our ability to locate high-risk bird activity areas. Acoustic monitoring will be expanded to help identify other avian species hazardous to aircraft and complement thermal imagery (see below) for species identification of radar targets.

Thermal Imagery Camera

The various radar units used at DCBR provided high quality, high resolution data on the number, altitude, distribution, direction and relative size of all birds crossing the area. One very important piece of data that was lacking was species identification. To identify species of birds picked up on radar, a thermal imaging camera has been co-located with the vertical beam radar on the slide-in unit. Any bird picked up on the radar can now be identified to family, genus or species by its silhouette shape and wing-beat pattern. Species data from the thermal imagery camera increases the accuracy of calculated bird strike risk. Species specific radar data will permit a better understanding of bird behavior and its effect on aircraft safety.

Radio Telemetry and Satellite Telemetry

Radio telemetry will be used to collect data on the activity of sandhill cranes, wood storks, red-tailed hawks, black vultures and turkey vultures. Additionally, satellite telemetry will be used on selected migratory species to determine the migration routes into and out of the study area.

Summary

A computer-based BAM has been completed and will be available to pilots using DCBR to plan missions to lower the risk of bird strikes. The study revealed a very dense migration of waterfowl (notably tundra swans) through the area in November. Lake Phelps lies under the holding pattern for the range. Bird altitude data collected with the mobile radar unit at this location in the migratory seasons were used to identify safe heights for aircraft to fly before entering the range. Flight safety for the Air Force and mitigation for disturbance to these wild populations may be achieved by reducing flight operations during this period of high migratory activity.

A breeding pair of bald eagles was located in the flight path between DCBR and Oceana Naval Station, Virginia. This was the first pair to attempt breeding in the vicinity of the range since the 1960s. The pair was monitored during the breeding season and no obvious effects of military flights on the pair were noted. The pair successfully reared one chick in the first breeding season (1995).

The work at Moody AFB/GBWR will produce a similar model and enhance our knowledge of bird activity and implications for aircraft safety. These studies help identify how conservation issues are closely linked to bird hazard issues. These studies also indicate that, through cooperation, the USAF and conservation agencies will be able to achieve their mission requirements.

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Use of commercial projects in the course of this research does not provide or imply an endorsement by the USAF BASH Team, USAF, or Department of Defense.