THE NAVY'S ENVIRONMENTAL MAGAZINE

Currents

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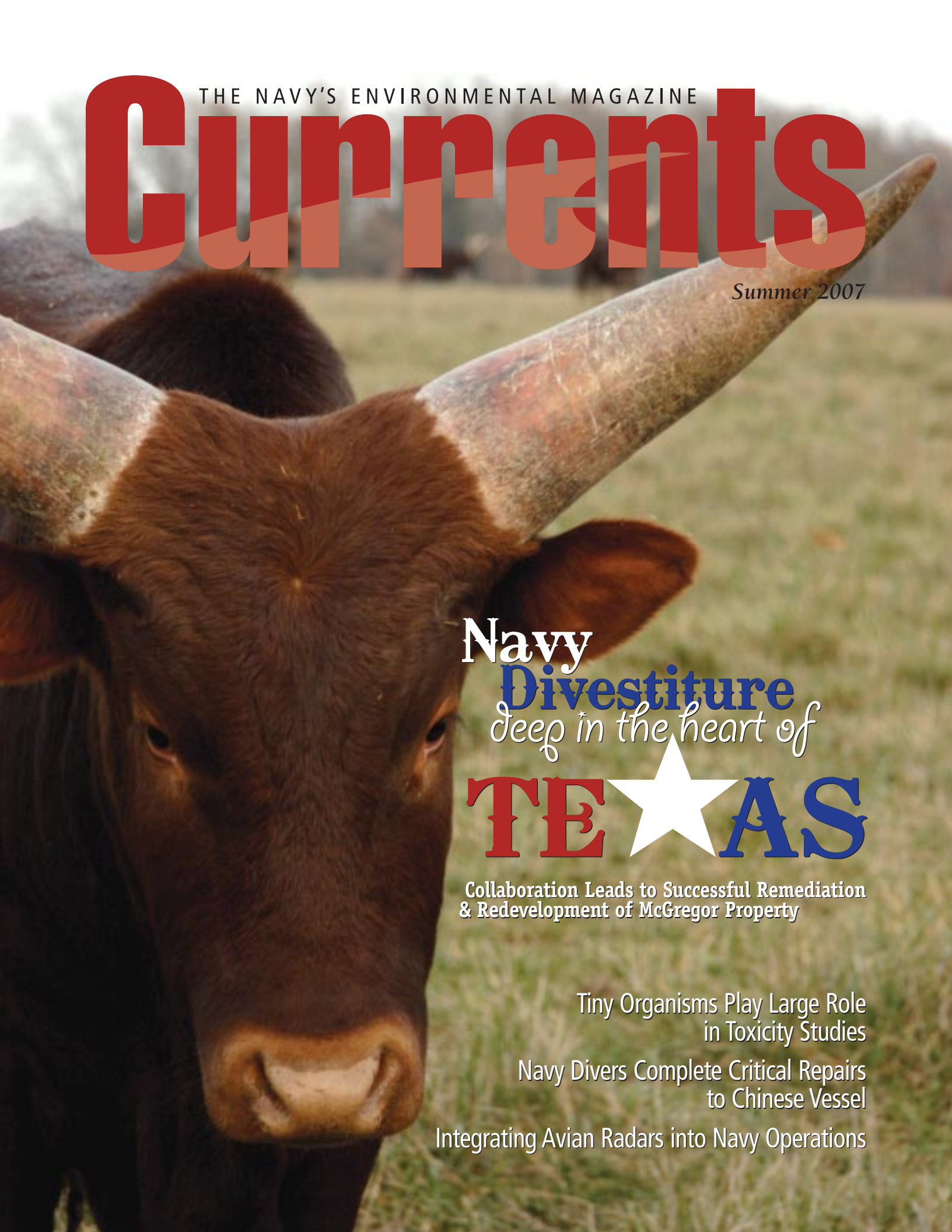

Navy Divestiture deep in the heart of TEXAS

Collaboration Leads to Successful Remediation & Redevelopment of McGregor Property

Tiny Organisms Play Large Role in Toxicity Studies

Navy Divers Complete Critical Repairs to Chinese Vessel

Integrating Avian Radars into Navy Operations

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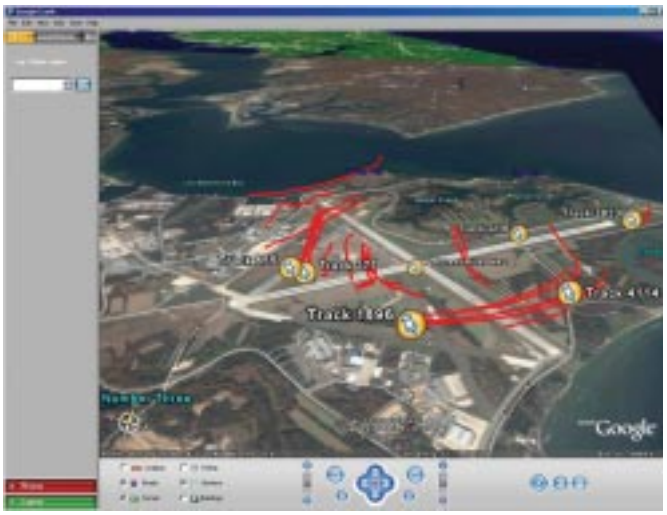
ESTCP to Support the Advancement of Monitoring Technology

A new project is underway to demonstrate that avian radar systems can provide natural resources managers and airport aviation safety personnel with improved tools for automatically monitoring the abundance and behavior of resident and migratory birds in and around military airfields and ranges.

Encroachment has made once-rural military facilities the only available habitat in town or as some say, "islands of habitat diversity surrounded by seas of urbanization". Many military bases and ranges have become refuges for wildlife that once ranged more widely. Consequently, the military's already significant role as stewards of natural resources on its properties is expanding.

As encroachment increases inside the fence line, impacts on the military mission are becoming more relevant and serious. These trends are straining the ability of natural resources managers to ensure that the installation commander can accomplish his or her mission while protecting the wildlife at these facilities. Encroachment issues are particularly germane to air stations, where birds and aircraft sometimes share the same airspace. When this occurs, there is a Bird Aircraft Strike Hazard (BASH) potential. BASH managers at airfields and ranges must study the behavior and ecology of resident and migratory birds to reduce bird strike events that cause more than $600 million a year in damage to U.S. military and civilian aircraft. These strikes also pose significant risks to aircrews and passengers.

To increase the margin of safety for naval aviators, Navy natural resources managers need tools that yield a clearer understanding of where and when birds and wildlife are present around the airfield, what attracts them to certain locations, and how changes in the natural or manmade environments affect their distribution. Current sampling methods (e.g. visual observations) are slow and expensive, particularly for larger facilities. These visual census methods, while more effective for sampling roosting birds during daylight, are impractical at nighttime when the activity of migratory species is greatest and when sampling at the elevations and ranges of most bird strikes.



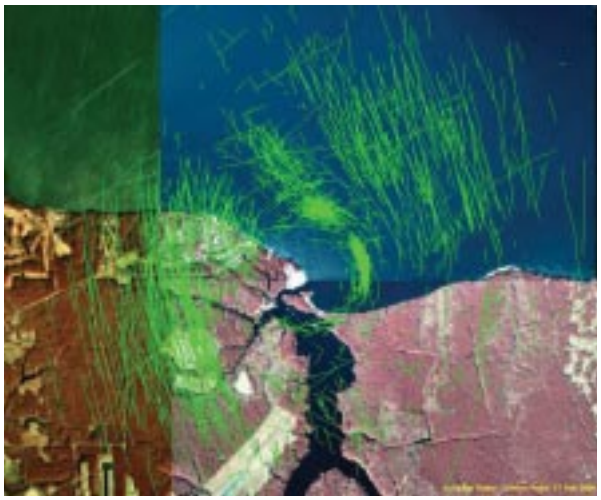
Representation of avian flight tracks from eBirdRad in GoogleEarth™ Geographical Information System. This image from NAS Patuxent River, MD shows several flight tracks have been designated with a unique flight track number. The eBirdRad system can track up to 1,000 individual avian flight tracks that contain information including estimates of altitude, bearing, and speed.

In fiscal year 2000, the Department of Defense (DoD) Legacy Program Office provided funds for the Clemson University Radar Ornithology Lab (CUROL), SC to develop an avian radar system capable of detecting birds on airfields in an effort to reduce the incidence of bird strikes. This original BirdRad system was designed to be an inexpensive, mobile avian radar. It included a low-cost commercially available marine radar outfitted with a 4 degree beam width parabolic dish antenna (for better altitude resolution) and a desktop personal computer for displaying and capturing the radar images in graphic files. Five BirdRad systems were built by CUROL and deployed at three Navy, one Marine Corps, and one Air Force sites. While highly effective at detecting birds in the desired zero to six nautical mile range, BirdRad had several limitations. Principally, radar returns from stationary objects ("ground clutter") obscured mobile targets; extracting target tracks from screen shots was too slow and labor intensive to track many types of birds; and, it was difficult to relate the targets on the screen to the surrounding landscape.

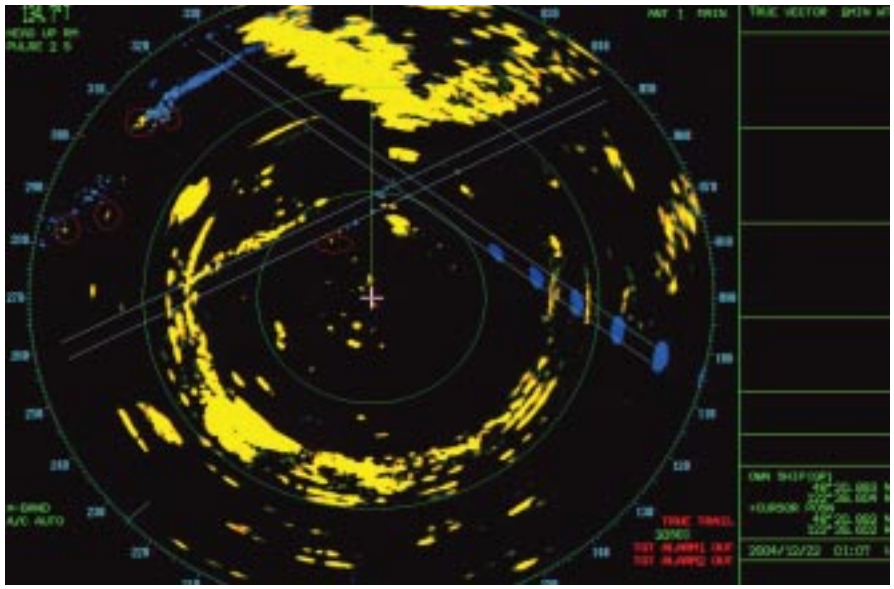
In 2002, the Navy's Pollution Abatement Ashore Program, sponsored by the Chief of Naval Operations Environmental Readiness Division and managed by the Naval Facilities Engineering Command (NAVFAC) tasked the Space and Warfare Systems Center, San Diego (SSC-SD) to find solutions to the technical limitations of BirdRad. SSC-SD and its contractor Computer Sciences Corporation further analyzed and defined these requirements and through a competitive procurement selected Sicom Systems, Ltd. to implement the requisite enhancements in the form of delivering and integrating its Accipiter®AR Digital Radar Processor (DRP). The first enhanced BirdRad unit now known as eBirdRad passed acceptance testing at Naval Air Station (NAS) Patuxent River, MD in September 2004.

In 2006, a group of biologists and radar specialists including: SSC-SD, Naval Facilities Engineering Service Center, NAVFAC Headquarters, CUROL, Sicom Systems Ltd., Computer Sciences Corporation, and the Federal Aviation Administration's Center of Excellence in Airport Technology (CEAT) at the University of Illinois submitted a research proposal to the Environmental Security and Technology Certification Program (ESTCP) to demonstrate that avian radar systems can provide natural resources managers and airport aviation safety personnel with improved tools for automatically monitoring the abundance and behavior of resident and migratory birds in and around military airfields and ranges.

The first step in this ESTCP project will be to validate that commercial X-band marine radars, coupled with advanced digital signal processing and tracking algorithms, can detect and track birds and other biological targets



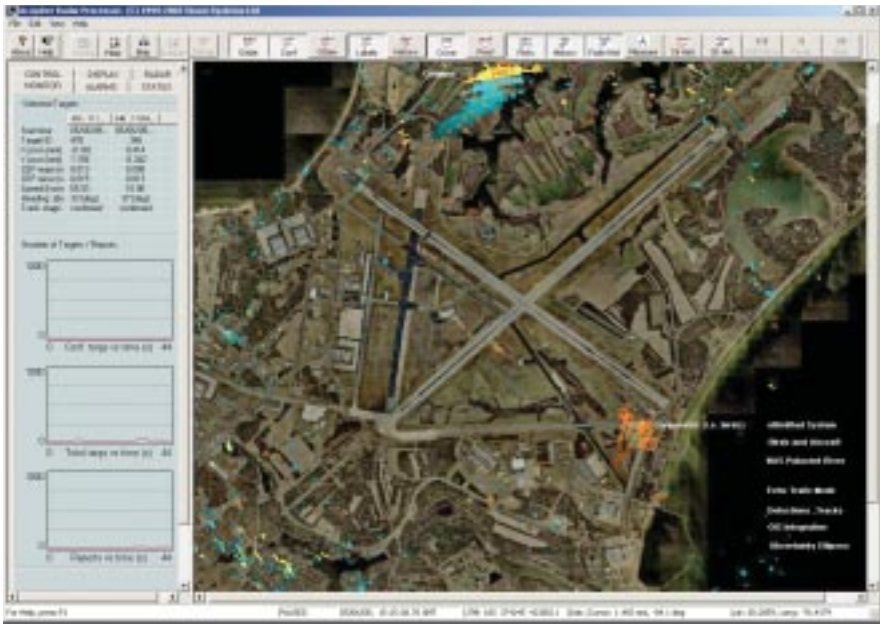
eBirdRad image from Marine Corps Air Station (MCAS) Cherry Point, NC showing accumulated flight track histories of birds during a nighttime survey period in February 2006 from 0100 to 0500.



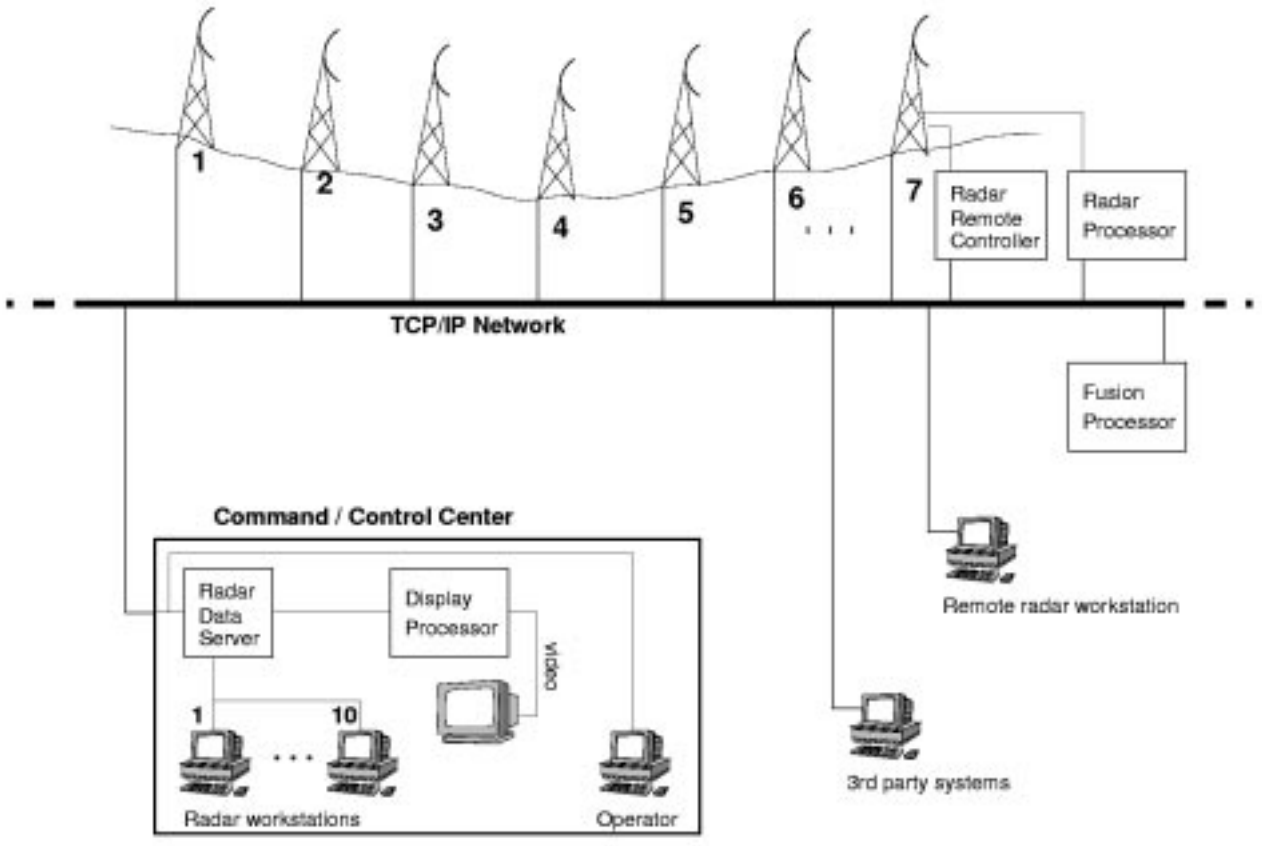
Winter 2004 BirdRad image showing the runway complex at NAS Whidbey Island, WA. Two flocks of birds in the northwest quadrant, yellow heads, circled in red with long fuzzy blue echo trails flying southwest, a single bird crossing the intersection of the runways flying southwest. Notice the EA-6B Prowler aircraft taking off on Runway 13 to the southeast.

in real time. (Because of their short (three centimeters) wavelength, X-band radars can discriminate small targets like birds better that other types of radars.) This will be performed using avian radar systems at three geographical locations that have varying topographies, clutter environments, and bird species and densities. Validation will be performed using static and mobile artificial targets of known size and speed (i.e. reflectors and model airplanes) as well as targets of opportunity (birds, bats, and insects) that can be verified with visual, thermal, or other sensors.

Although most radar ornithologists are confident digital radar systems can automatically detect, track, and enumerate birds, and distinguish between some types of targets, the data have not been



The eBirdRad system showing flocks of cormorants at NAS Patuxent River, MD. This information can be used to warn pilots of potential bird strikes and in flight planning and assist natural resources managers in habitat management. Notice the helicopter at the top of the image veering away from the flight path of the cormorants.



A proposed network of fused radar signatures will be able to track birds across large areas in an effort to monitor local and regional migration routes.

rigorously and objectively validated. The results of any validation studies must be published in peer reviewed journals and scrutinized by the scientific community before decision makers will be confident enough to use data from avian radars for natural resources management and BASH avoidance purposes. Once validation is available and accepted, both military and civilian aviation will require that standards be established and that avian radars be certified to those standards before they can be widely deployed. This ESTCP project is the first step in that direction. It is also unique in that it brings together experts from different disciplines (biologists, ornithologists, radar ornithologists, radar signal processing detection/tracking, and system integrators) from government, industry and academia, with the objective of validating and automating digital radar systems for use by biologists, safety officers, air traffic controllers, and pilots.

There are four main objectives of this ESTCP project.

- Validation
  One of the main objectives for using the eBirdRad avian radar is to be able to use the system at multiple locations and validate through independent visual, thermal, and other observation that X-band radars, coupled with advanced digital signal processing and tracking algorithms, can detect and track birds and other biological targets. Conventionally, these tracks were counted directly from the radar display, from acetate overlays marked with a grease pencil, or from photographs of the display.

- Sampling Protocols
  Another objective of this effort is to develop and demonstrate the statistical validity of sampling protocols for measuring daily and seasonal bird activity and evaluate these protocols for use at multiple sites. While standardized sampling protocols are necessary to compare data among sites, the geography and habitats at a site, and the different bird's behaviors they engender, can vary markedly.

- Data Streaming
  This project will also demonstrate and validate protocols and algorithms for streaming bird track data in real-time across a network from multiple sites for immediate (e.g., alarms) and historical (e.g., activity patterns) management, analysis, visualization, and data sharing. Streaming data from one or more radars to a common repository for analysis and visualization is an instance of the broader requirement that modern avian radars be both networked-capable and compliant with emerging specifications for cyber infrastructures and metadata.

- Data Fusion and Integration
  This objective concerns the demonstration of improved bird tracking algorithms by integrating and fusing data from multiple radars. Data integration and fusion will produce a more robust analysis of bird movements across large areas for both conservation and BASH management. Fusion requires overlapping radar coverage to improve the quality of specific tracks and will allow an operator to evaluate activity at multiple sites simultaneously.

The eBirdRad unit at MCAS Cherry Point, NC. This unit was tested during a joint use project with the U.S. Department of Agriculture. (The eBirdRad image from Marine Corps Air Station, Cherry Point, NC was generated from this unit during the field test.)

Project results will be extremely valuable to the scientific community at large, and to the natural resources, conservation, and BASH communities in particular. One of the most important contributions of the project will be to publish in the open, peer-reviewed literature a record of the validation protocols used, the methods employed, and the scientific results obtained from these validation activities.

At the end of the day, all this research will help to justify more widespread use of these radars, which will result in safer flying conditions and reduced damage to Navy and Marine Corps aircraft. ⚓

CONTACTS

Matthew Klope
Naval Facilities Engineering Service Center
360-257-1468
DSN: 820-1468
matt.klope@navy.mil

Marissa Brand
Space and Naval Warfare Systems Command
619-553-5334
DSN: 553-5334
marissa.brand@navy.mil