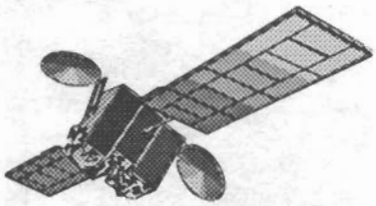
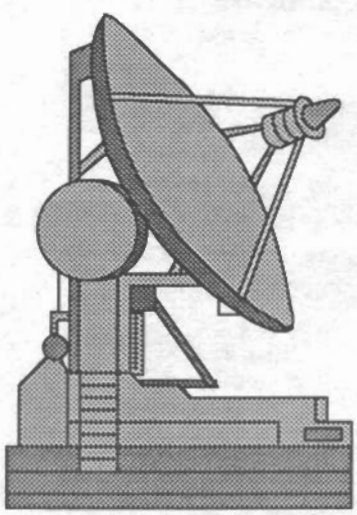
Conservation From Outer Space:
Boldly tracking migration patterns

Chris Eberly



Biotelemetry has been used for years to command a better understanding of daily movement patterns and home range size of animals. Conventional biotelemetry involves securing a radio transmitter to an animal and using directional receiving antennas to locate the transmitter. This technique, which requires maintaining radio frequency contact with the animal/transmitter, is troublesome for wide-ranging bird species, and nearly useless for migrating birds. On the other hand, transmitters tracked by satellite can follow animals over thousands of miles, over land or in water, day or night. The first experimental satellite platform transmitter terminal (PTT) was fitted on a Mute Swan in 1983 on Maryland's Chesapeake Bay. A year later, a Bald Eagle was tracked for 270 days between Maryland and Florida. In 1989, satellite PTTs were fitted on six male Wandering Albatrosses and tracked throughout the Indian Ocean. Albatrosses thought to travel up to 1,800 km from their nest site on foraging trips were revealed to travel between 3,600 and 15,000 km in a single foraging trip lasting two to 33 days! The floodgates of research on wide-ranging bird species were now opened. And best of all, once a PTT was fitted on the bird, researchers could literally sit back and watch the locations beam back from space.



Like many advances in science and technology, tracking birds with satellites was likely born from boredom and serendipity. Bill Seegar and Paul Howey met in the mid-1970s as research fellows at Oxford University. They were using an electronic egg Paul had invented to measure the nest microclimate of brooding Peregrine Falcons. During prolonged periods of nest monitoring (i.e., sitting and waiting), their discussions turned to falcon migration. What resulted was, at that time, a far-fetched plan to use satellites and transmitters to follow falcons to their wintering grounds, which were poorly understood. By 1983, the successful Mute Swan test flight confirmed they had a viable product. Paul Howey started his own company, Microwave Telemetry, in 1990, working to miniaturize the PTT to a size that would fit a Peregrine Falcon. Biologically, the PTT should be no more than 3% of the falcon's body weight (up to 5% for eagles and swans). By 1993, their far-fetched plan came to fruition when a 27 gram transmitter was strapped onto a female falcon. Within a few short years, more has been learned about Peregrine Falcon migration than in 25 years of conventional field studies and leg band returns.

Wildlife tracking now constitutes about 25% of the operations of Service Argos, the company whose satellite system tracks PTTs. Argos instruments are flown on board the National Oceanic and Atmospheric Administration (NOAA) Polar Orbiting Environmental Satellites (POES). Power consumption is low due to the satellites' relatively low orbit altitude (833 km) and sensitive receiver equipment. Extended operation of a year or more is possible on battery power alone, depending on the number of transmissions. For example, a 27 gram PTT will allow about 600 hours of transmissions. A typical scenario might be to transmit once every 10 days during nesting, when birds are stationary, but increase to once every other day during migration. Location estimates often are ±3 km for these PTTs, but depend on the number of satellites and environmental conditions (terrain, background "noise"). Integrating global positioning system (GPS) technology, with its constellation of 24 satellites, into PTTs may soon provide reliable estimates to ± 150 meters.

Satellite transmitters already have reaped significant dividends for bird conservation. Brian Woodbridge of the U.S. Forest Service has been banding Swainson's Hawks for years. While populations in California were considered "healthy" by many accounts, color bands revealed a somewhat different story. In some years, mortality was low and most banded birds returned. Other years, however, showed the average age of the population was dropping, with up to 50% mortality of the adult population. Little was know about Swainson's Hawks once they migrated south, such as where large gatherings of hawks may occur and why. When satellite PTTs dropped in weight to where they could be fitted onto a bird

the size of the Swainson's Hawk, Brian fitted several hawks with transmitters in California. Around that same time Bill Seegar, now a biologist with the Army, and Mark Fuller, of Boise State University, were outfitting hawks in other states throughout the West. Brian visited the area where his hawks ended up, and was astonished to find a field full of dead hawks (*Bird Conservation*, Fall Migration 1996). Birds banded in the other states also were tracked to the same location in the pampas region of Argentina. This discovery led to the removal of monocrotophos pesticides from the market in Argentina. The future stability of Swainson's Hawks now appears less remote, thanks to satellites.

Raptors are not the only avian recipients of satellite transmitters. Seegar and Fuller recently founded the Center for Conservation Research and Technology (CCRT), which seeks out innovative applications of satellite transmitter technology. Much of their work is carried out on military lands as part of the Department of Defense (DOD) Partners in Flight program, and is funded by the DOD's Legacy Resource Management Program and Strategic Environmental Research and Development Program. And while the applications may be novel, conservation of bird species is still the ultimate aim.

For example, years after DDT has been banned in the U.S., White-faced Ibis populations in western Nevada are still showing high levels of DDE, the principal metabolite of DDT. A decade of research has determined that the contaminants are not being acquired on the Nevada breeding grounds, which include Naval Air Station Fallon. Tracking these birds by satellite hopefully will lead researchers to the source of the problem. Implantable PTTs are being tested with Common Loons in the Great Basin to investigate breeding areas and migration routes as a means of providing data for regional water resource management efforts. Miniaturization of PTTs to fit smaller birds is another research priority of CCRT. It may be possible to track warblers via satellite and map their entire migration

FROM OUTER SPACE TO CYBERSPACE

Putting information in the hands of the public is perhaps one of the most exciting aspects of satellite technology. The driving force behind several satellite tracking programs has been environmental education and teaching the public, especially school children, about science by getting them involved. One such project tracks Wood Storks from their breeding grounds at Harris Neck Wildlife Refuge, Georgia, to wintering location in south Georgia and Florida. The cooperative effort, involving biologists and wildlife educators, was spearheaded by Lehr Brisbin and Larry Bryan of the Savannah River Ecology Laboratory and Beth Stevens of Walt Disney's Animal Kingdom. The team also includes John Robinette (U.S. Fish and Wildlife Service), Suzanne Safran (Zoo Atlanta), and Fred Koontz (Wildlife Conservation Society). Charles Koontz (Columbia Consultants) maintains the project's databases and web site.

One of the initial objectives was to test satellite telemetry technology with storks, which was an overwhelming success. The web site allows users to track the migration route of individual storks, as well as calculate the total distance traveled.

The Albatross Project, funded by the National Science Foundation, is targeted specifically at late elementary and middle school students. The project is administered through Wake Forest University, and teachers receive daily email messages containing albatross locations and other project information. Students learn real-world applications of science, such as hypothesis testing and using the Pythagorean Theorem to calculate flight distances with coordinate locations.

The Patuxent Wildlife Research Center (David Ellis, Principal Investigator) and the Applied Information Sciences Branch at NASA's Goddard Space Flight Center are working together on a project to monitor the migration routes of several endangered and/or migratory birds using satellite tracking. Their efforts focus on migratory birds, including the Siberian Crane, Eurasian Crane, Sandhill Crane, Walberg's Eagle, Cinereus Vulture, Andean Condor, and Lesser Spotted Eagle. Non-migratory species include the Harpy Eagle and Madagascar Fish Eagle. The project also includes satellite telemetry aspects to create additional migratory flocks of Whooping Cranes. With the help of other collaborators, the project expects to involve students in classrooms across America.

Wood Storks
http://www.clark.net/pub/wcsweb/stork/

The Albatross Project
http://www.wfu.edu/albatross/

Satellite Tracking
of Threatened Species
http://sdcd.gsfc.nasa.gov/ISTO/satellite_tracking/birds_home2.html

Wild Wings Heading North
http://north.audubon.org

route early in the 21st century.

Satellite tracking can complement other tracking techniques. Dan Anderson of the University of California, Davis, has banded Brown Pelicans for 28 years with color leg bands. The information gathered from leg band returns (re-sightings) provides significant demographic data about the pelicans. Use of conventional (radio) telemetry contributes to behavioral and survival information, and has proved invaluable in research on the effects of oil spills on marine birds. Satellite tracking has closed the loop by tracking long-distance movements and migration routes. Each method works at a different scale, and together they are filling in many gaps in the understanding of the life history of the pelican such as migration routes, dispersal patterns, and genetic exchange between groups and populations.

Independent findings are proving significant to the understanding of critical migration routes. Ken Meyer, of the Avian Research and Conservation Institute, tracked Swallow-tailed Kites from their breeding grounds in Florida to their wintering grounds in Brazil's Pantanal, one of the world's largest wetland systems. Besides the importance of identifying this significant roost location, the actual migration route was found to coincide with the major migration corridor for Tundra Peregrine Falcons. Both species leave the tip of Florida and follow a path to Cuba, across the Gulf of Mexico to the Yucatan Peninsula, then south through Central America. As satellite transmitter technology evolves, the status of bird conservation may very well be up in the sky. In fact, it may be in outer space!

Chris Eberly, Department of Defense Partners in Flight

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THANKS TO PAUL CARRIER!

A special thanks to our Artist, Paul Carrier for his contributions to the success of this (as well as previous) issues of Hawk Migration Studies. He provided the artwork used on several recent covers as well as numerous drawings that have been used throughout this edition. He also contributed to this edition's "Sightings and Observations."

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