

Microwave Telemetry, Inc.



Around the world in 100 minutes—Part II

Dear Customers and Friends,

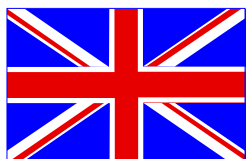
Our journey continues as the Argos receiver aboard a NOAA satellite completes its 100 minute journey around the world, sweeping over the many countries on the other side of the globe. In twelve hours (about seven orbits) it sees every point on earth and could potentially receive data from PTTs in every one of them. Here we present fifteen fascinating articles from dedicated scientists around the world. We thank each and every one of them for their contribution.

As I read these articles I think back to 1982 during a visit to the university of Aberdeen, when I saw a first generation satellite transmitter, destined to track Basking Sharks. These early transmitters and battery packs weighed more than any of the bird species in these articles (including Tommy King's Pelican!). One can only marvel at the rapid advances in this technology over the last twenty-two years. We at Microwave Telemetry continue to push the boundaries of this technology; as a result we now have complete units weighing less than 20 grams and shrinking. (Watch this space!) Early models have given way to very complex devices with GPS receivers, some with four internal microcomputers with thousands of lines of code and hundreds of components.

The success of a tracking project depends on more than just the flawless internal workings of a PTT. For this marvelous technology to succeed in bringing you your data, all parts of the system must work: the harness that holds the PTT on your animal, the PTT itself, the satellite, the various data links and computers used in processing the data before it is sent to your desktop. We are humbled and extremely gratified to be part of this revolution in wildlife research and conservation.

Sincerely,

Paul and the staff at MTI



United Kingdom

Satellite tracking of gannets in the North Atlantic Ocean

Recent concern over the roles of seabirds in marine ecosystems has highlighted the need for detailed information on the foraging locations and behavior of different species. Northern gannets, *Morus bassanus*, are the largest pelagic seabird breeding in the North Atlantic and have an important potential impact on marine food chains but until recently, very little was known about their foraging ranges or feeding locations.

We used satellite telemetry (lithium battery powered PTT-100s) to study the foraging trips of gannets that were rearing chicks at two colonies: Bass Rock, east of Edinburgh in the North Sea, and Great Saltee, south of Dublin in the Celtic Sea. We found that adults travelled up to 540 km from the colony (a round-trip of almost 1100 km) on a single trip. In the North Sea, adults focused their foraging activity around particular sites with high abundance and predictability of prey, and individual birds returned repeatedly to the same sites. In contrast, in the Celtic Sea, where prey appeared to have a more uniform and less predictable distribution, adults showed no such foraging area fidelity.

We are currently using satellite telemetry in conjunction with other devices including movement, depth and temperature recorders and GPS to describe the foraging behavior of birds in greater detail and to link this behavior more closely to the characteristics of the marine environment around their breeding colonies.



Keith Hamer



Northern gannets

Photos courtesy of Keith Hamer and Robert Lindner, respectively

Northern gannets are the largest pelagic seabird breeding in the North Atlantic and have an important potential impact on marine food chains but until recently, very little was known about their foraging ranges or feeding locations.

Keith Hamer, University of Leeds, UK



Burkina Faso

Winter ecology of the black stork in Burkina Faso (West Africa)

The black stork, *Ciconia nigra*, is a Palearctic migrant that breeds in Europe and winters in West Africa. This rare species (world population estimate: 8000 pairs) breeds in forests and, because it feeds on fish, is a good indicator of water quality. Its ecology is relatively well known in Europe but the behavior and habits in the black stork's wintering grounds are still poorly known and no long-term study has ever been made in tropical Africa. This project includes a three-year monitoring of its ecology in the game ranch of Nazinga, Southern Burkina Faso— in the Sudanian savannah belt—near the border of northern Ghana. The program involves four major parts: a). Etho-ecological study of the black stork on the 93,000 ha game ranch of Nazinga and its eleven dams. b). Study of human activities (hunting, fishing, gathering) on the same area to assess how natural resources and space are shared between the black stork and the local human population. c). Marking and satellite radio tracking of three individuals (juvenile and adult) to describe movement patterns of the species on its wintering grounds, the migration routes to the northern breeding grounds, and to identify their breeding area. d). With local people, define micro-projects of rural development (e.g., educational, medical) with the black stork as a symbolic keystone and guide for cooperation projects between Europe and Burkina Faso. This last part is aimed at securing optimal and lasting conditions for the protection of the black stork in Burkina Faso.



François Baillon

Preliminary data suggest that there are no traditional routes. The birds' location is shifting according to that of the current food sources, probably to minimize energy expenses. Our first data also suggest that the juvenile birds just move through southern Burkina Faso, but do not actually winter there, or do not do so completely. Most birds regularly seen in the Nazinga Game Ranch between December and February are adults, and are more faithful to the area.

François Baillon, Institut de Recherche pour le Développement

Francois.baillon@ird.fr



Black stork

Photos courtesy of Damien Chevallier and François Baillon

The ecology of the black stork is relatively well known in Europe but the behavior and habits in the its wintering grounds are still poorly known and no long-term study has ever been made in tropical Africa



Madeira

Following Cory's shearwaters with PTTs

The majority of the population of the Atlantic subspecies of Cory's Shearwater live in the Azores and Madeira Archipelagos. They are excellent bio-indicators of the state of the surrounding waters and also of the oceans through which they travel during migration. Fishermen in both archipelagos use them to indicate the shoals of tuna and bonito.

Previous work in conjunction with the Parque Natural da Madeira and the Museum of Natural History, Paris, showed that Cory's shearwaters migrate to the coast of Africa to feed during the incubation period. Current work, headed by Dr. Francis Zino and involving also Dr. Manuel Biscoito, Director of the Marine Biology Station of Funchal and Dr. Uli Querner of the Max Planck Institute (who greatly finance the project), aims at tracking Cory's adults during their annual migration.

It is known through previous ringing work that Cory's move to South America during migration, but it is of prime importance to know how they get there and back and where they stop to feed. This work should be repeated at regular intervals in order to ascertain the influence of currents and weather changes on migration patterns and food availability. The team also hopes to be able to better understand the way that Cory's "navigate" and their dependence on wind and currents.

With this knowledge it may be possible to identify ecologically important areas in the ocean—areas where birds are known to feed—and then influence Governments to create marine protected areas (MPAs). MPAs will not only benefit the birds, but they will also help restock the depleted Atlantic fish stocks.



Frank Zino holding a juvenile Zino's petrel



Cory's shearwater

Photos courtesy of Elizabeth Zino and Henrique Costa Neves, respectively

Cory's shearwaters are excellent bio-indicators of the state of the surrounding waters and also of the oceans through which they travel during migration.

Francis J. Zino, Marine Biology Station of Funchal



Brazil

Protection of swallow-tailed kite wintering destinations

It was terrifically exciting when we began using Microwave Telemetry's smallest PTT in 1996 to discover the migration route and destination of the small population of swallow-tailed kites that nests in the United States. In a matter of weeks, we went from knowing almost nothing about this behavior to describing a well defined, 8,000 km journey certain to present many challenges and risks for this lightly built, social raptor.

Since then, Avian Research and Conservation Institute (ARCI) has used battery- and solar-powered PTTs to identify stopover areas and other critical passage points, rates and patterns of movement, the influences of weather, and the locations and timing of mortality. It is the winter range, however, that demands the most attention from those who wish to shape a conservation strategy for this species. By combining the satellite data with the locations of our study birds carrying VHF transmitters, ARCI has uncovered the details of how wintering swallow-tailed kites consistently gather in large communal roosts (sometimes containing 2,000 to 3,000 birds) on fewer than 20 privately owned ranches in southwestern Brazil.



Ken Meyer

One goal is to work with the Brazilian government to protect these sites under binding cooperative agreements with the land-owners (who would retain ownership). We also are interested in learning whether we can influence survival in other ways, and we hope to collaborate with Brazilian colleagues in a satellite-tracking study of swallow-tailed kites from the Brazilian breeding population—which nests sympatrically with the wintering population from North and Central America—to determine their migration corridor and wintering destination.

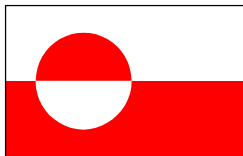
Ken Meyer, director of the Avian Research and Conservation Institute, Gainesville, Florida, USA.



Swallow-tailed kite

Photos courtesy of Gina Zimmerman and Ken Meyer, respectively

It is the winter range that demands the most attention from those who wish to shape a conservation strategy for this species.



Greenland

Satellite tracking gyrfalcons in Greenland

Gyrfalcons are the largest of the falcons and breed circumpolar to the arctic. Beginning in the summer of 2000, The Peregrine Fund began a long term project using PTTs to track the seasonal movements of gyrfalcons in Greenland. Due to the dark and long-lasting subzero winters in Greenland there is little to no information known on the gyrfalcons' seasonal movements, for example, whether or not they migrate at all or stay on their breeding territories year round.



Kurt Burnham holding two gyrfalcons

Using two study areas on the west coast, Kangerlussuaq at 67°N and Thule at almost 77°N, we placed PTTs on both male and female adult and juvenile gyrfalcons. The information we have gained has provided us with the first ever detailed look at the seasonal movements of gyrfalcons in Greenland and will aid us in better focusing our conservation and research efforts in the future. Already we have identified what is most likely the main wintering area for gyrfalcons on the West Coast of Greenland and learned a tremendous amount about the migration routes that are used.

Beginning in the late summer of 2004 we will expand our research to the East Coast of Greenland and begin working in the Scoresbysund area.

Kurt Burnham, The Peregrine Fund



Gyrfalcon

Photos courtesy of Jack Stephens and Jack Cafferty, respectively

The information we have gained has provided us with the first ever detailed look at the seasonal movements of gyrfalcons in Greenland and will aid us in better focusing our conservation and research efforts in the future.



Eastern Canada

The St. Lawrence River estuary and Barrow's goldeneye

The Barrow's goldeneye, *Bucephala islandica*, is a duck species distributed mainly in northwestern North America. A small population is found in northeastern North America, on which little research had been done until recently—after it was designated as of Special Concern by the Committee on the Status of Endangered Wildlife in Canada.

During the past few years, species-at-risk biologists from the Canadian Wildlife Service have implemented studies on this population using aerial and ground surveys, nesting boxes, and satellite telemetry. They established that the St. Lawrence River estuary, Québec, is the major wintering area for the eastern North American population of Barrow's goldeneyes, supporting over 50 percent of the entire population, estimated at no more than 4,500 birds. In 1998-1999, they notably implanted 21 Barrow's goldeneyes (18 males and 3 females) wintering along the St. Lawrence with PTT-100s to document their breeding and molting distribution and phenology, and to describe the timing and routes of their spring, molt, and fall migrations. They found that the north shore of the St. Lawrence River estuary and gulf is the core breeding area for Barrow's goldeneyes in eastern North America, refuting the idea that these birds breed in northern Québec and Labrador. They also established that males undertake a genuine molt migration and highlighted the importance of northern molting areas because birds stayed there four months each year.

In the near future, they plan to implant more Barrow's goldeneyes, specifically adult females, with PTT-100s (20 g implantable) in order to locate their molting areas and get additional information on their migration routes and breeding distribution.

Michel Robert, Canadian Wildlife Service



Michel Robert holding a male Barrow's goldeneye implanted along the St. Lawrence River



A pair of Barrow's goldeneye

Photos courtesy of Alain Hogue and Denis Faucher respectively

The St. Lawrence River estuary, Québec, is the major wintering area for the Eastern North American population of Barrow's goldeneyes, supporting over 50 percent of the entire population, estimated at no more than 4,500 birds.



Venezuela

Post-release survival and habitat utilization of white marlin

We are studying post-release survival and habitat utilization of white marlin, *Tetrapturus albidus*, released from commercial and recreational fisheries throughout the western North Atlantic Ocean. White marlin are highly prized by recreational fishermen, and the species is also taken as incidental bycatch by commercial pelagic longline fishing operations targeting tunas and swordfish. Recent assessments indicate that white marlin are seriously overfished, and in 2002 the species was petitioned for listing as Threatened or Endangered under the U.S. Endangered Species Act.

Over the past year and a half we have deployed more than fifty PTT-100 and PTT-100 High Rate Archival Pop-up Tags, most of which were programmed to release after ten days, on white marlin released from the recreational and commercial fisheries. In the recreational study, we tagged twenty-one white marlin caught off La Guaira Bank, Venezuela, and another twenty on white marlin caught off the Dominican Republic, Mexico, and the U.S. mid-Atlantic coast. Our results indicate a big difference in survival between white marlin caught on standard J-hooks (35 percent mortality) and circle hooks (0 percent mortality), suggesting that a simple change in hook type could reduce recreational fishing mortality for this overfished species. Data from returned tags from fish released from recreational and commercial gears demonstrate that white marlin make frequent dives below 100 meters, presumably in search of food, although they spend the majority of time in the warm, upper 10 meters of the water column. The data also indicate that the species is highly migratory—surviving fish have moved as much as 782 km over the ten-day tagging period.

John Graves, Virginia Institute of Marine Science



Andrij Horodysky, John Graves and David Kerstetter



Tagged white marlin ready for release

Photos courtesy of Guy Harvey and Nettan Carlisson respectively

Our results indicate a big difference in survival between white marlin caught on standard J-hooks and circle hooks, suggesting that a simple change in hook type could reduce recreational fishing mortality for this overfished species.



Argentina

The Andean Condor Conservation Project (ACCP)

In August 1991, the Andean Condor Conservation Project (ACCP) was inaugurated in Argentina. Since then, through the artificial incubation hatching program, breeding in human isolation, and with the existence of our rescue center for wild specimens, it has been possible to release 35 Andean condors, *Vultur gryphus*, in remote areas of the South American Andes, including Venezuelan Páramos and Argentinean Patagonia.

In 1997, the ACCP—thanks to an agreement with NASA—was the first to use satellite technology to monitor condor flights and to follow them on their daily long distance displacement, even in such a complex environment as the Andes.

Radio and satellite telemetry, along with hard fieldwork, allowed us to make a GIS (Geographic Information System) specific to this species. The use of Decosat—a program developed specifically to simulate the flight of the condors—helps us to better understand the displacement patterns. Thanks to modern technology, it is possible to discover, among other things, the condors' role in the environment, their sleeping places (called Condoreras), their flight capacity and habitat preferences. This information makes it possible to make informed decisions for the conservation of this wonderful bird and its majestic ecosystem.



Luis Jácome attaches a PTT to an Andean condor

The ACCP also leads an educational program that reaches thousands of pupils every year, carrying a strong message of conservation. Before each release, ancestral ceremonies are organized with the participation of original Andean communities—who have known how to honor and live together in harmony with this species for thousands of years. Native inhabitants are in charge of offering a prayer in their original language—a message of respect and veneration for all life—to return the Andean soul to its own place.

Luis Jácome, Andean Condor Conservation Project



Andean condors

Photos courtesy of Hernan Pepe and Andres Capdevielle respectively

In 1997, The Andean Condor Conservation Project, thanks to an agreement with NASA, was the first to use satellite technology to assist condor flights and follow them on their huge displacement every day.



Eastern Canada

Satellite tracking raptors at risk

The peregrine falcon, *Falco peregrinus*, is probably one of the most studied and researched birds around the globe over the past thirty years. Yet despite this, very little is actually known about the peregrine's activities in the first couple of years of its life.

The Canadian Peregrine Foundation has been actively involved in the monitoring and satellite tracking of the juvenile (first-year hatched peregrine) activities in an effort to investigate some of the unanswered questions regarding the juvenile's dispersal, mortality, migration times and routes, wintering grounds, and migration stopovers. The research has involved both pre- and post-fledged first-year hatched birds; 20 g, 30 g PTT-100 battery units, and 18 g solar units have been deployed with incredible success.

In addition to juveniles from wild nest sites, birds from urban nest sites as well as captive bred and released birds from both urban and nonurban landscapes are also involved in the research. Over the past five years, the study area has expanded to include birds from Ontario, Quebec, and Edmonton here in Canada, and in New York and Pennsylvania in the USA.

Equally exciting, and one of our most ambitious projects to date will involve the satellite tracking of the eastern North American barn owl, *Tyto alba*. The first stage of the project will be to examine the dispersal and mortality of the first-year hatched birds; it will later expand to include adults. With an expanded mandate that includes "raptors at risk," the Canadian Peregrine Foundation can now broaden its horizons, and will be active in other avian satellite tracking.



Mark Nash holding a peregrine falcon

Mark Nash, The Canadian Peregrine Foundation

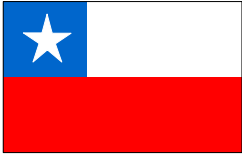
mark@peregrine-foundation.ca, <http://www.peregrine-foundation.ca>



Peregrine falcon equipped with an 18 g solar-powered PTT-100

Photos courtesy of Garnet Barker and Paul Marshman respectively

Very little is actually known about the peregrine falcon's activities in the first couple of years of its life.



Chile

Ecology and conservation of the threatened seabird community of the Juan Fernández Islands, Chile

As part of our research program on the ecology and conservation of the threatened seabird community of the Juan Fernández Islands, Chile, we are studying aspects of the foraging ecology of pink-footed shearwaters, *Puffinus creatopus*, a species of procellariiform seabird endemic to Chile. The species is globally listed by the IUCN as Threatened, in recognition of threats to populations on all three of their known breeding islands, two of which are in the Juan Fernández Islands. The Juan Fernández Islands, located 670 km off the central coast of Chile, have received national and international recognition for their biological uniqueness, having been designated both a Chilean national park and an UNESCO International Biosphere Reserve.

One of the factors potentially impacting shearwaters is interactions with commercial fisheries on their foraging grounds. We are using satellite tracking to determine foraging trip locations of breeding shearwaters in conjunction with diet studies in order to assess the possibility of overlap between shearwater foraging grounds and areas of commercial fisheries activities. This approach will enable us to better evaluate the likelihood of incidental bycatch of shearwaters in these fisheries. We will also combine the satellite tracking data with remote sensing data to investigate what oceanographic factors (i.e., sea surface temperature, chlorophyll *a* concentrations, bathymetry) shearwaters may be using as cues for finding productive foraging areas. In addition to the research component of our project, we are also actively developing community-based conservation and education programs for the resident community of the islands.

Peter Hodum (California State University, Long Beach) and Michelle Wainstein (University of Washington), co-directors of the Juan Fernández Islands Conservancy



Pink-footed shearwater

Photos courtesy of Peter Hodum and Nathalie Hamel respectively

One of the factors potentially impacting shearwaters is interactions with commercial fisheries on their foraging grounds.



Peter Hodum



Southeastern United States

Distribution and movements of American white pelicans

USDA Wildlife Services offices in the southeastern United States began receiving complaints of American white pelicans, *Pelecanus erythrorhynchos*, foraging in commercial channel catfish, *Ictalurus punctatus*, ponds in 1990.

Because of the relatively shallow pond depth and high fish stocking rates used by most catfish producers, commercial catfish ponds provide a near perfect foraging environment for pelicans. Although the impacts of pelican foraging can be significant, the potential for pelicans to transmit trematode infections and other diseases to aquaculture can be devastating.

In spring of 2001, a multi-year study was initiated to determine the corridors and timing of migration, daily movements, habitat use, and ranges of American white pelicans. Twenty-one pelicans were captured at loafing sites near aquaculture facilities in the southeastern U.S. and fitted with 70 g GPS/Satellite PTTs. Preliminary analyses of these data show that although the birds wintered in the southeastern U.S., they ranged widely. During the summer months, immature birds tended to remain in the southeastern U.S., whereas adult pelicans migrated to northern breeding areas.

This winter and spring another twenty GPS/Satellite PTTs will be deployed in the southeastern U.S. Data from this ongoing study will provide a better understanding of the regional and continental movements of pelicans, determine the extent of the role played by pelicans in the distribution of the *Bolbophorus* trematode, and help better evaluate current control methods and develop new control strategies to reduce pelican impacts to aquaculture.

Tommy King, USDA/WS National Wildlife Research Center,
Tommy.King@aphis.usda.gov



Flock of American white pelicans

Photos courtesy of Tommy King and Brent Harrel respectively

Because of the relatively shallow pond depth and high fish stocking rates used by most catfish producers, commercial catfish ponds provide a near perfect foraging environment for pelicans.



Tommy King holding an American white pelican



Western United States

Use of GPS PTTs to study California Condor mortality factors

Ventana Wilderness Society, a private nonprofit organization based in California, recently began using GPS PTTs on California condors, *Gymnogyps Californianus*, to augment efforts to manage free-flying flocks of birds. We are currently developing collaborations with universities, in addition to our program partners, to more fully utilize the benefits of this revolutionary technology in terms of scientific research as well. Although all location data are important and useful to our researchers, we are specifically interested in data relating to the greatest mortality factors currently inhibiting the recovery of this endangered species: lead toxicity and collisions and/or electrocutions with powerlines. We are coupling these data with field reports of feeding California condors in an effort to more fully document the exact pathways and type of lead contamination.



Photos courtesy of Ventana Wilderness Society

California condor

We are specifically interested in data relating to the greatest mortality factors currently inhibiting the recovery of this endangered species: lead toxicity and collisions and/or electrocutions with powerlines.



Kelly Sorenson

In terms of powerlines, we are focusing on commonly used flyways or other areas of high use concentration to determine high risk areas associated with this mortality factor.

Ventana Wilderness Society is the only nonprofit organization releasing condors to California. Our programs include the Big Sur Ornithology Laboratory, Natural Sciences Education, and Wildlife Restoration. We wish to especially thank William and Margaret Hearst, III for their initial support for this project. In addition, we wish to thank ChevronTexaco and Pacific Gas and Electric for their support as well. For more information, please visit our website, www.ventanaws.org.

Kelly Sorenson, executive director of Ventana Wilderness Society



United States—Alaska

Movement and habitat use of three species of scoters

All three species of scoters, surf scoters, *Melanitta perspicillata*, white-winged scoters, *M. fusca*, and black scoters, *M. nigra*, winter and breed in Alaska and western Canada. Collectively, breeding populations of all three species have declined by as much as 40 percent in the past 25 years although this varies by species and region. Until recently, scoters have been among the least studied of North American waterfowl and few specifics were known about their life history, ecology, or distribution. Without this basic information and more detailed information linking birds found on breeding areas with their wintering and molting areas it is difficult to identify the exact mechanisms causing this population decline.



Photos courtesy of John Ashley and Linda Bassett respectively

Male surf scoter

Until recently, scoters have been among the least studied of North American waterfowl and few specifics were known about their life history, ecology, or distribution.

Scoters are considered sea ducks because they spend most of the year on salt water where they dive in nearshore waters for benthic invertebrates. They migrate inland to nest and then return to the coast to molt, often at a different location than where they winter. They are an important subsistence resource to indigenous people of Alaska and western Canada.

In 1998 we began marking scoters with implantable PTTs to identify the timing and routes of migration, and their breeding, molting and wintering areas. We started with ten surf scoters wintering in southcentral Alaska and have since added wintering and breeding white-winged scoters. This winter we will implant black scoters with PTTs. Meanwhile other researchers have begun to mark scoters up and down the Pacific and Atlantic coasts giving us a better picture of the movements and habitat use of the continental population. This information will help us delineate populations, aid in survey efforts to determine population change, and hopefully help us understand the reasons for the decline in the number of scoters.



Dan Rosenberg

Dan Rosenberg, Mike Petrula, and Doug Hill, Alaska Department of Fish and Game

More information is available at: http://wildlife.alaska.gov/management/waterfowl/wtrfwl_home.cfm and <http://www.seaduckjv.org/ststoc.html>



United States— Hawaii

Convergent evolution of
diving behavior in species of
pelagic fishes and sharks



Swordfish immediately after harpooning

Photos courtesy of Phil White, NOAA

Researchers in Hawaii are using Archival Pop-up Tags to study important fisheries interaction and allocation issues related to the management of pelagic fishes, sharks and sea turtles in the Pacific Ocean (see Microwave Telemetry, Inc. Newsletter, Winter 2002). Quite serendipitously, Musyl and Brill discovered a commonality of diving behavior among numerous species of pelagic sharks and fishes with different morphological and physiological characteristics. They discovered that many pelagic species that evolved large eyes for enhanced visual capabilities (e.g. bigeye tuna, swordfish, bigeye thresher sharks) and other species with presumably overriding olfactory modalities (e.g. blue shark, short fin mako) have evolved amazingly similar dive strategies. These fishes and sharks display a pattern of deep (450-800 m) oscillatory diving patterns during the day and predominately shallow diving (surface to 80 m) at night.

Nighttime dive patterns of some species are highly correlated with moon phase. Certainly this oscillatory diel diving pattern fits in well with what is known of the thermoregulatory abilities and constraints of pelagic fishes and sharks. Interestingly, it also dovetails nicely into a forage utilization theory whereby pelagic predators have evolved convergent dive strategies to exploit and mirror the vertically migrating organisms which comprise the Sound Scattering Layer (SSL, i.e., various species of squids, mesopelagic fish, euphausiids) to the extent allowed by each species' physiological limitations.



Mike Musyl and Rich Brill prepare to attach an Archival Pop-up Tag to a blue shark

Musyl and Brill expect to continue this line of inquiry and will try to develop unique characters based on dive patterns in order to examine the evolution of ecological relationships and vertical niche partitioning in the ocean.

Michael Musyl, Joint Institute for Marine & Atmospheric Research, University of Hawaii (mmusyl@honlab.nmfs.hawaii.edu), Richard Brill, Virginia Institute of Marine Science, NMFS CMER (rbrill@vims.edu)

Many pelagic species that evolved large eyes for enhanced visual capabilities and other species with presumably overriding olfactory modalities have evolved amazingly similar dive strategies.

You need to know...

How to retrieve your data from Argos

Even if you receive your data via Argos ADS, it is useful to know how to log in and check it for yourself. Occasionally, ADS fails; should that happen, you may want to log in directly and retrieve your data.

The simplest way to download your data is to log into Argos via Telnet. We recommend using HyperTerminal which comes free with most Windows operating systems. (Of course, any other Telnet program which has text capturing capability is fine.) Open a connection to your local Argos data server (currently datadist.argosinc.com for North American users, netdis.cls.fr for all other users.)

Once you've logged in, begin capturing to a text file. Use the PRV/A command to get your DS data (**PRV/A,DS**, [enter day of the year—1...365, e.g., 46]). Use the DIAG command (**DIAG,.**, [enter day—1...365]) for Argos location data. For details see the Argos user manual chapter 4 (<http://www.cls.fr/manuel/html/chap4/chap4.htm>). Section 4.3 describes how to use Telnet; Section 4.4.9 describes how to use the PRV/A and DIAG commands.

An Argos user can log in and access the prior ten days of data; after ten days the data is archived, and is no longer easily accessible.

If you are concerned that your bird has died, or that your PTT is reaching the end of its operating life, the DS

format data is where to look for answers. DS data provides all the PTT's sensor data, whereas the DIAG format gives only a sampling.

The basic PTT's four sensors are for temperature, battery voltage, the transmission count and the activity count, respectively. Temperature and battery voltage data are integers representing the PTT's internal temperature and battery voltage; these can be converted using the calibration formulas listed in your PTT manual. The transmission counter increments every time the PTT transmits, and wraps back to zero when it reaches its maximum value.

The activity sensor indicates movement. During a PTT's ON time, it checks every minute for movement. If there is movement, the sensor increments up, then wraps back to zero when the maximum value has been reached. The activity sensor value in itself does not have meaning, it is the change (or lack thereof) that is significant. If the activity sensor value is constant (plus or minus 1) over two or more transmission cycles, it is indicative of bird mortality or PTT detachment.

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