Spring 2017 Volume 18 Issue 1

Tracker News

Microwave Telemetry, Inc.

Downsizing in a Super-Sized World

Dear Customers and Friends,

Though not yet halfway over, 2017 has already included a lot of progressive changes here at MTI. Progress, however, doesn't always indicate expansion or growth, a sentiment particularly relevant as we introduced our (and the industry's) smallest solar Argos-linked PTT ever. Now, many 2g PTTs have been deployed on birds that all weigh less than 100 grams (roughly the weight of our original PTT-100). As with any new product, its introduction has required adjustments and absolute focus from our entire team. Though our team consists of only 25 people, we average almost 9 years of experience per person at MTI. Each person plays a vital role in MTI's and your projects' successes. We are often asked why we do not outsource portions of the manufacturing process. The answer is simple. MTI was founded under a "quality-first" principle, which we apply to our business structure as well as our production output. As environmental movements encourage a societal shift towards consuming "local," we can proudly say we have consistently done so for the last 26 years. Virtually every step of the manufacturing process, from populating circuit boards to troubleshooting data, is completed within our facility. And many of the parts we use are produced by fellow Maryland businesses. So as we work to continually downsize our footprint (even this issue of our newsletter has taken on an abbreviated form) and the physical size of our transmitters, we appreciate your patience as we work to fit you into our tightly packed production schedule. But, be assured, it is a direct result of the collective effort to ensure every MTI transmitter is of the highest quality, designed and manufactured by a dedicated group highly invested in your exciting projects!

As always, we are grateful to this issue's contributors for sharing their work within these pages: Kasper Thorup; David Wiley and Linda Welch; Tony Flaherty, Clive Minton and Maureen Christie; and Rob Bierregaard. Your discoveries and dedication inspire us.

Sincerely,

Lucy and the Team at MTI

Photo by Rob MacDonald

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Above: Great shearwater skimming the water.

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Time to Fledge: Tracking First Migration in Cuckoos

Kasper Thorup is Associate Professor and head of Copenhagen Bird Ringing Centre at CMEC, Natural History Museum of Denmark, University of Copenhagen. His research focuses on understanding migration in smaller land birds using all available kinds of tracking methods.

Co-authored by Mikkel Willemoes, Marta Lomas Vega, Katherine Rachel Scotchburn Snell, and Victor Bulyuk

The long-distance, solitary migration, crossing oceans and deserts, of many songbirds remains equally fascinating and mysterious. Travelling alone without guidance from experienced conspecifics: how do the young manage to locate their wintering grounds, how do they know their direction and when to stop, are they able to compensate for wind displacement, and from a research perspective not least – do many fail and why? As migrants are showing widespread declines, understanding their biology and how their lifestyle fits into the seasonally changing environment has become even more urgent.

Photo by Kasper Thorup

Cuckoo tagged with 5g Solar PTT.

The migration routes of most migrants are roughly known based on ring recoveries, and the use of geolocators has recently revolutionised our ability to map annual spatiotemporal schedules of even the smallest migrants. However, tracking the first migration remains extremely difficult: mortality is high and most disperse, making the later recovery of, for example, geolocators a chance event. Additionally, understanding their migration programme in detail requires knowing the fate of all individuals (also those that fail) and, in most cases, some experimental manipulations. This means that because most migrants are so small, the study of their orientation and navigation has mainly taken place in the laboratory simply because it has been impossible to extend it to free-flying birds.

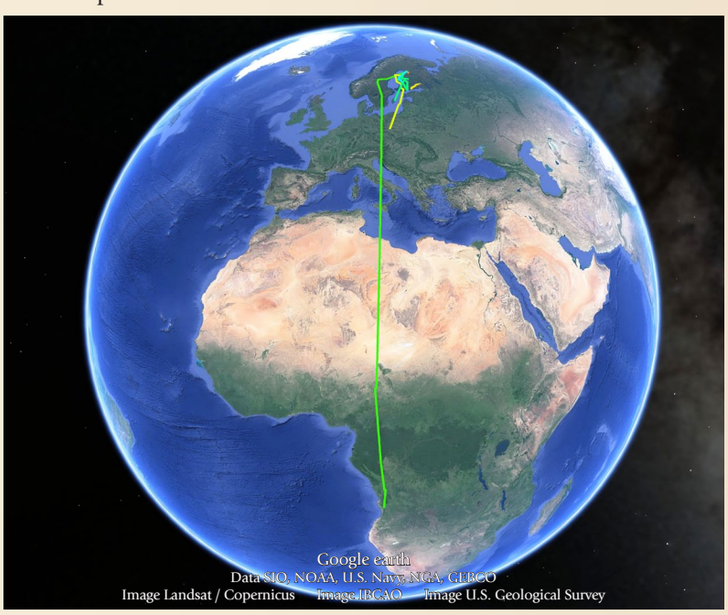
Most solitary migrants are still too small to be satellite tracked. However, the common cuckoo is just large enough and, given its most special biology, it is well suited for studying the inborn migration programme that juveniles use. Being a nest parasite, the adults lay eggs in other species' nests, and the young cuckoo never sees its parents. They are long gone when the young cuckoo fledges after being raised by its foster parents. The young cuckoo is presumably left to travel to Africa all on its own.

Several aspects of migration in adult cuckoos have already been studied, documenting surprisingly similar routes in South Scandinavian cuckoos, flexible navigational response after displacement, and differences in mortality along different routes. While we tracked the migration patterns in adult cuckoos, we also initiated an effort to track the migrations of the young on their first migration through the MATCH project. Would they really travel on their own, and would they follow the same routes as those that we knew adults were using?

Tagged cuckoo in flight. Photo by Palle Sørensen

For the first pilot study, we aimed at tagging young cuckoos raised by reed warblers, but it soon became apparent that the young left the nests at a too young age for carrying the transmitters. This was solved by tagging cuckoos raised by redstarts in nest boxes. In this case, fledging can be controlled, ensuring that tagged birds would be of sufficient size and weight for carrying the transmitters. This was only possible because of collaboration with ongoing intensive nest-box studies involving the effects of cuckoo parasitism.

With tagged young cuckoos raised by redstarts in nest boxes in Finland, we were finally able to track one young all the way to the wintering grounds in Angola, where also many adults spend the winter! Interestingly, the young were travelling on a different route from the breeding grounds, first travelling southwest from Finland, involving extensive sea-crossings, to a prolonged stopover, and then changing route to travel straight south to the wintering site. It seemed clear that the young were not following experienced conspecifics.



Migration route of young cuckoo travelling from Finland to wintering grounds in Angola.

The main challenge continues to be the high tag loss. Simply from natural causes, we expect a high proportion of cuckoo chicks to get lost. The cuckoo lays a comparatively large number of eggs presumably to compensate for the difficulties in reaching independence when raised by foster parents. And migration is, for all species, a dangerous undertaking. To extend the study of the migration orientation programme in young cuckoos, we are trying to circumvent the initial high loss associated with the transition to independence. Thus, we are now working in collaboration with the Biological Station Rybachy at the Courish Spit on the Baltic Coast. Here, cuckoos, including both young and adult, are caught on migration during routine ringing operations. The young caught here are already independent. Of course, we have to trade off this with the lack of knowledge of the exact breeding grounds and host species, but this allows us to track young cuckoo migration in more detail and ideally, in addition to longer-time tracks revealing the ontogeny of migration, we shall be able to displace birds to study their inborn orientation system.

Tracking Great Shearwaters Leads Down Many Paths

David Wiley is the research coordinator for NOAA's Stellwagen Bank National Marine Sanctuary where his work focuses on whales, seabirds, and forage fish. Linda Welch is the seabird biologist at the Maine Coastal Islands National Wildlife Refuge Complex and specializes in the foraging behavior and movements of coastal seabirds.

The great shearwater (GS) is a numerous, long-lived species of seabird that breeds in the South Atlantic's remote Tristan da Cunha Island group and spends the austral winter foraging throughout the western North Atlantic, including the Gulf of Maine (see figure). While the general annual migration pattern of the birds is well known, little fine-scale information exists relative to habitat use and interaction with human activities. This is a management concern for the U.S. Fish & Wildlife Service and U.S. National Marine Fisheries Service, since GS are subject to high levels of bycatch in commercial fisheries, at least in the northern parts of its range.

Great shearwater. Photo by Rob MacDonald

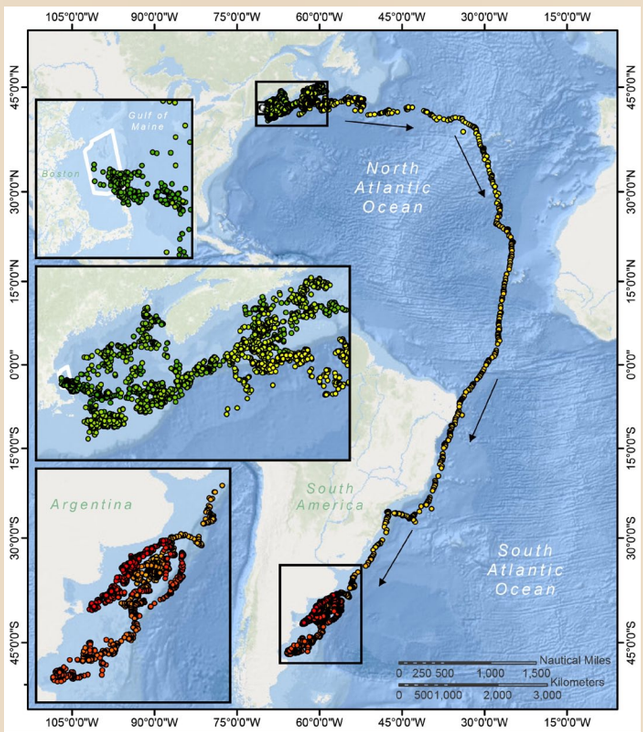
The U.S. National Oceanic and Atmospheric Administration's Stellwagen Bank National Marine Sanctuary is a 2181 km^2 marine protected area located in the southern Gulf of Maine (see figure; top insert, white polygon). Ecosystem-based management of the sanctuary requires extensive knowledge about species using the sanctuary, how those species fit into the Gulf of Maine ecosystem, and potential interactions with human uses such as commercial fishing. Complete ecosystem-based management also requires an understanding of habitat use and threats occurring away from the sanctuary, such as GS activity throughout the Northern and Southern Hemispheres.

While GS are seasonally abundant in the sanctuary, little information exists relative to habitat use and threats. Since 2012, each July we have been attaching 12g solar-powered PTT tags to 10 GS (n=50 tags) and tracking their movements in the sanctuary, Gulf of Maine, and beyond (see figure; top, middle, and bottom inserts). Because our goal is identifying fine-scale habitat use rather than migratory paths, we chose not to duty cycle our tags, but allow them to constantly transmit locations. As a result, we have been receiving ~18 locations per day and applying those data to understand GS habitat use (Powers et al., Marine Ecology Progress Series, In Press). However, as location data began flowing, so did ideas as to their interpretation and how we could combine the locations with other data to truly understand GS. What are they doing in the Stellwagen Sanctuary? Combining GS location data with our ongoing research into the abundance and distribution of sand lance (a key forage fish) suggests that GS only use the sanctuary when and where sand lance are abundant, such as the southern part of the sanctuary in 2016 (see figure; top insert). To further investigate food habits, we are collaborating with Les Kaufman (Boston University) and Kent Hatch (Long Island University Post) for stable isotope analysis of exhaled gas, blood, and feather samples from captured birds. Understanding the importance of sand lance to GS and other seabirds is significant since there is no management or protection for these forage fish in the Gulf of Maine.

Since GS are a species of high bycatch concern, we collaborated with Josh Hatch and Kimberly Murray (U.S. National Marine Fisheries Service) to search for areas of interaction. Combining GS locations with gillnet activity and fishery observer data, we were able to identify a small area constituting only 1% of the Gulf of Maine that accounted for 50% of observed GS bycatch (Hatch et al., 2015; Conservation Letters), along with identifying the ports of interacting fishing vessels. What about bycatch in other areas? Our birds, which are primarily juveniles and subadults, spend the November–March period on the Patagonia Shelf (see figure; bottom insert). Global Fishing Watch (*http://globalfishingwatch.org*) indicates high levels of fishing activity co-occurs with GS in that area, which could expose them to substantial bycatch risk.

Can highly mobile, satellite-tracked seabirds provide indications of bycatch in other species? Dynamic ocean management is an emerging paradigm that uses near real-time data for management decisions. We are collaborating with Jooke Robbins (Center for Coastal Studies; humpback whales) and Moria Brown (New England Aquarium; right whales) to investigate the ability of GS locations to predict the presence/absence of these species, each of which suffers from entanglement in commercial fisheries. If a correlation exists, tagged GS could remotely and inexpensively identify offshore whale aggregations in need of short-term management.

Our decision not to duty cycle our tags has also led to other emerging research opportunities. Whereas duty-cycled satellite-tagged birds provide only a few locations per day, our higher-resolution data provide an unusual opportunity to investigate bird navigation relative to large-scale influences (e.g., magnetism) and short-term occurrences (e.g., shifting wind and storms). Incredibly, some of our birds wearing continuously transmitting tags have traveled the entire migration route, the longest remaining active for over 300 days (see figure).



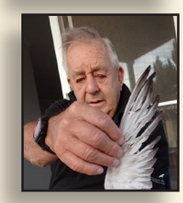
A 267-day satellite track of GS "Everglades" from 2016 showing use of southern portion of the Stellwagen Bank National Marine Sanctuary (white polygon), top insert; use of the Gulf of Maine and Scotian Shelf, middle insert; and use of the Patagonia Shelf, bottom insert. Map by Mike Thompson, SBNMS

Long-term data sets such as ours (five years and hopefully continuing) will become increasingly important as we attempt to understand the impacts of climate change at local and global scales. Our focal study area in the Gulf of Maine is experiencing one of the marine world's most rapid increases in temperature. Our data set that includes movement, food habits, and bird condition (e.g., body weight and measurements) will allow us to use GS as a barometer for the entire system. Additionally, since GS travel between hemispheres and are highly dependent on winds for travel, our birds can be used as a large-scale indicator of environmental change and how species react.

Anyone interested in following our birds can find them at *http://stellwagen.noaa.gov/seabirds.html*. Starting in 2017, our birds will have their own Twitter account: @Trackseabirds

Grey Plover Migration in the East Asian-Australasian Flyway

Tony Flaherty is Manager, Coast and Marine, Natural Resources Adelaide and Mount Lofty Ranges, Department of Environment, Water and Natural Resources. Tony works with a small team to undertake coastal conservation works in the Adelaide region, including shorebird conservation and monitoring. Clive Minton has a long global history in shorebird research and the development of cannon-netting as a means of catching waders for banding and demographic studies. Both Clive and Maureen Christie have had a long involvement in the Victorian Wader Study Group's research program. Maureen is also a key member of Friends of Shorebirds SE, dedicated to studying and conserving shorebirds with a focus on the southeast of South Australia.



The Victorian Wader Study Group and Friends of Shorebirds SE have been assisting the Adelaide and Mt. Lofty Ranges Natural Resources Management (NRM) Board with shorebird banding studies along the "Samphire Coast" area north of Adelaide in South Australia (SA) over the last five years. The work of these groups and other volunteer shorebirders over many years has formed the scientific basis for the recent establishment of the Adelaide International Bird Sanctuary (AIBS) and the recent successful nomination of the area and upper Gulf St. Vincent (GSV) as an East Asian-Australasian Flyway (EAAF) site (EAAF131). A key focus of work since 2012 has been to band and colour flag shorebirds. Whilst colour flagging has been undertaken at a range of sites across southern Australia, the gulf areas of SA have had limited work to date. Shorebirds banded in SA have leg flags of orange over yellow on their right leg. Engraved flags allow the identification of individuals. This flagging work seeks to better understand local movements of the birds within the extensive "terminal" southern summer feeding tidal flats and saltmarshes of the GSV, as well as migration through the EAAF. Flag resights of GSV Bar-tailed Godwit have been recorded in Bohai Bay and in Yalu Jiang in China, and Great Knot resights on Kamchatka Peninsula.

Photo by Tony Flaherty

Maureen Christie and Clive Minton attach a PTT to a Grey Plover.

With funding support provided through the Australian Government for the NRM Board's Samphire Coast Icon Project, 10 Microwave Telemetry 5g Solar PTTs have been deployed on Grey Plovers in GSV in SA since 2015. These units have been attached using "leg-loop harnesses" and programmed to a 10 hrs ON/48 hrs OFF duty cycle. Initial PTT deployments in 2015 and 2016 were made at Thompson Beach some 60 km north of Adelaide, though in December 2016, transmitters were deployed on a number of birds at Bald Hill.

Knowledge of Grey Plover migration in the EAAF is limited. Over 600 Grey Plovers have been banded in Australia since 1960, with few recoveries and no Australian-marked birds recorded in the breeding range.

Grey Plovers have demonstrated high site fidelity to locations in the non-breeding areas. Successful northward migration to Arctic Siberia was observed for two SA birds in 2016. Birds used stopover sites on the Chinese coast for over 50 days. From the Yellow Sea, birds were tracked to the Yakutia coast of eastern Siberia. From there, the SA flagged birds flew east to Wrangel Island in the Arctic Ocean. These are the first records of any Australian-marked bird on Wrangel Island.

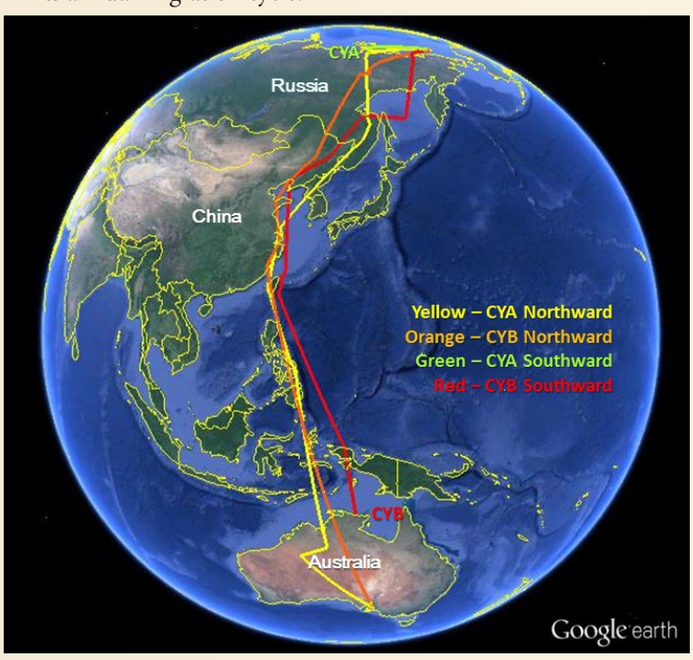
In a separate Australasian Wader Studies Group and BirdLife Australia project, two Grey Plovers with transmitters deployed at Roebuck Bay, northwestern Western Australia (WA) in 2016 were also tracked to nearby locations on mainland Siberia. The WA birds remained on the mainland.

What is remarkable is the validation that these WA and SA satellite-tracked birds have made of earlier biometric work. A 2001 analysis of biometric data suggested that northwestern Australian Grey Plovers probably utilised mainland Siberian breeding sites east of the Lena River, and that some southeastern Australian birds may breed on Wrangel Island, off the coast of northeast Siberia.

Other migratory species on Wrangel, such as Red Knots and Lesser Snow Geese, utilise the American Pacific Flyway. Prior to a single 2014 sighting of a bird flagged on Wrangel Island, in Jiangsu Province, East China, there was no flyway information for Grey Plovers breeding on Wrangel Island. This tracking confirms Grey Plover use of the EAAF.

One WA-deployed unit and two SA-deployed units continued transmissions throughout the breeding season, and all three birds appear to have hatched eggs successfully. One SA bird was successfully tracked back to Australia. It utilised the same northern Bohai Bay location in China for a stopover and on departure, as well as a brief prior stop at Ul'banskiy Bay in eastern Russia. The bird successfully skirted super typhoon Meranti as it hit the Taiwanese coast. The bird did not return to GSV, but landed on the northern Australian coast near Maningrida, where it remained for some time before transmission was lost. Areas of the Northern Territory coast east of Darwin are important for Grey Plover, with particularly large roosts of them and other shorebird species being recorded in earlier aerial surveys.

The one bird which was tracked from southern Australia, Wrangel Island, and northern Australia flew over 25,000 km in its annual migration cycle.



Northward and southward tracks of Grey Plovers, "CYA" and "CYB," from South Australia to Wrangel Island.

How Do They Find Their Way?

Rob Bierregaard has been studying Ospreys since 1971. He began satellite-tagging Ospreys in 2000. Since then, he has followed the migration of 49 adults and 56 juveniles.

How young animals find their way to and from their wintering areas on their first migration cycle has long been a mystery. Some birds—cranes, waterfowl, and some gulls and terns for example—migrate in family groups or flocks, so the young learn the route by following migration veterans. In the Northern Hemisphere, young birds of prey migrate on their own—usually after both parents have headed south to their wintering ranges—so they cannot learn the route.

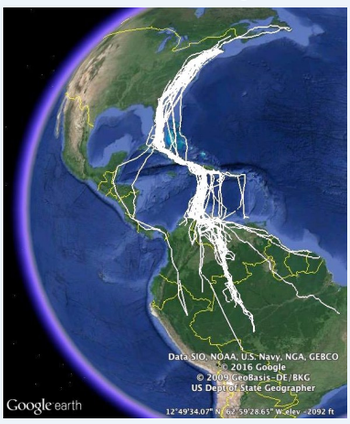


Figure 1. Southward migration routes of adult Ospreys.

From 2004 through 2016, my collaborators and I have outfitted 56 young Ospreys with Microwave Telemetry's 22g and 30g Solar Argos/GPS PTTs from South Carolina to the eastern edge of the North American continent in Newfoundland. Of these birds, 20 were tagged on Martha's Vineyard, an island in the Atlantic, just south of Cape Cod.

Studies of adult Ospreys have shown the route adults on the east coast follow to their winter ranges. Nearly all move south in a broad front to Florida. Ironically, Ospreys, whose diet consists entirely of fish, avoid water crossings if they can. (If they fly into foul weather, they can't stop and rest in the water as could a duck or gull). So by staying over land as long as possible, they're funneled to the southern tip of Florida, where they then push off and head to Cuba. They follow Cuba to its eastern tip, then cross over to Haiti and the Dominican Republic. With no land on the southern horizon, they then begin a 400-mile crossing of the Caribbean. Once in South America, they spread out over most of the continent as far south as Argentina (Figure 1).

Figure 2. Juvenile first migration routes from Martha's Vineyard.

Knowing this, we were surprised when one after another of the young tagged on Martha's Vineyard started their first migrations heading due south over the Atlantic, crossing as much as 1200 miles of open ocean before making landfall in the Bahamas (Figure 2). Some of the flights took more than 50 hours, and not all the young made the ocean crossing. Those that had wandered west prior to migrating followed the "adult route" down the coast to Florida.

Our first thoughts were that natural selection was eliminating young that made the risky flight across open water. What else would explain the lack of any adults migrating over the Atlantic? But then, as more and more young successfully completed this leg of their migration, we had to look for another explanation.

When the Atlantic-crossing young that survived their first stay in South America made their maiden trips north, we realized what was going on.

Their drive to head north combined with the reluctance to head over open water directed them to the two peninsulas on either side of the Gulf of Venezuela, the northernmost points of South America. Arriving there, they were faced with the same dilemma that confronted them in their first fall trip when they got to the south shore of Martha's Vineyard and saw nothing but water. But the drive to go north trumps the drive to stay over land, so they pushed off across the Caribbean.

Once across the Caribbean, they could head northeast over the Atlantic, retracing their southern migration. But none did this. Instead, they see the Bahaman Islands stretched out like stepping stones, so they island-hop their way northwest to the Florida coast. From there, it's over land back to New England. They have discovered, rather than inherited, a safer route to and from their wintering grounds. It's longer than the trip across the Atlantic, but when the weather turns bad, the safety of solid ground beneath them makes it worth the extra miles flown.

On their next trip south, these now savvy Ospreys know they can get to South America without crossing the Atlantic. Staying over land as they work their way south gets them to the Florida Keys and into Cuba.

Belle is an Osprey that we tagged in 2010 not long after she had fledged from her nest on Martha's Vineyard. Six years later, she is the longest surviving Osprey tagged as a juvenile in the world, having just completed her fifth migration north from her winter range in Brazil's Amazonian rainforest.

Belle was not the first of our Ospreys to cross the Atlantic, but she went the furthest east of any of our adventurous youngsters. Her first four migration cycles beautifully demonstrate how this discovery process takes place (Figure 3).

On her first trip north, she used the Bahamas to get to Florida. On the second trip south, she started south down the coast but went over water from North Carolina to the Bahamas. On her second trip north, she found Cuba but turned north too soon. By her fourth migration cycle, she had the adult route fully wired into her internal navigation computer.

Our young Ospreys have shown us an elegantly simple explanation of how these birds know how to get to and from their winter ranges. It's not some complicated, genetic map wired into their DNA, but rather a very simple two-step algorithm that neatly explains the data we have collected. In the fall, head south and stay over land if possible. When there's no land to the south, just head over the water. In the spring, use the same program with north in the equation. After a few migration cycles, as Belle has shown us, a naïve Osprey will almost inevitably find the path that tens of thousands of adult Ospreys follow each fall and spring.

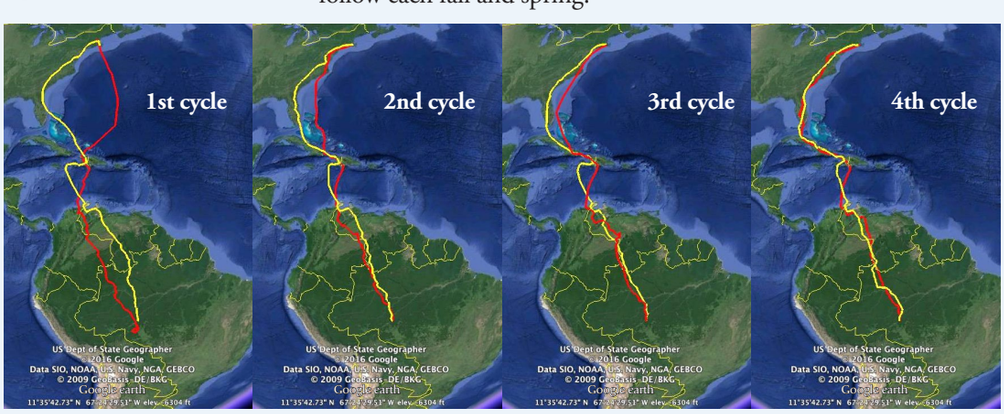


Figure 3. The first 4 migration cycles of the Osprey Belle. By her 4th migration cycle, she adopted the typical path taken by adult Ospreys. (Southern routes taken in the fall depicted in red, and northern routes taken in the spring depicted in yellow.)

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Upcoming Conferences

This past holiday season, we decided to forgo a corporate gift and instead pledged to support student scholarships at your conferences throughout the year. We know from experience that meetings are a great way for students to increase exposure to ongoing science in their field, practice scientific presentation skills, and gain access to seasoned, and often incredibly busy, researchers in the community. The connections forged at conferences often provide collaboration opportunities and post-graduation prospects vital to early-career scientists. Thank you for reaching out to us with information about the meetings you are organizing; there are a lot of exciting gatherings on the calendar! We've committed to supporting these four conferences in 2017:

The 10th **Asian Raptor Research and Conservation Network Symposium** to be held October 18–22, 2017 at Ateneo de Davao University, Roxas Avenue, Davao City, Philippines

The 6th **International Bio-Logging Science Symposium** to be held September 25–29, 2017 in Lake Constance, Germany

The 33rd **Annual Meeting of the American Elasmobranch Society** to be held July 12–16, 2017 in Austin, Texas, USA

The 24th **Annual Conference of The Wildlife Society** to be held September 23–27, 2017 in Albuquerque, New Mexico, USA

MTI Employee Spotlight

Erik Mann – Electronics & Hardware Technician

Q: What is your role here at MTI?

A: My primary roles include installing electronics inside transmitters, performing quality control throughout the production process, and hermetically sealing completed units as the last line of defense. I am also responsible for each refurbishment that comes through the door.

Q: You started with MTI in 2010 after becoming our top choice in a recruiting class of roughly 30 individuals, but how did you gain your practical skills?

A: I worked as a radio repair specialist in the U.S. Army for seven years in California and Hawaii where I was trained to solder and properly handle electronic equipment. I've also managed a hobby shop where I was able to foster my love of making and fixing things and learn about different materials and tools.

Q: What is your favorite part about your job?

A: I really enjoy the challenge of working with refurbished transmitters. Each one comes back to us with a story about its bird and the places it has been. They are often very mangled when I get them, so it requires a little bit of detective work to troubleshoot the problem areas, and I find it very rewarding to upcycle a non-functional transmitter to one that can be redeployed to capture another bird's life story.

Q: What is your favorite memory from your time working at MTI?

A: My favorite memories are all from our annual office holiday party days. The camaraderie and energy after we've had our year-end reviews and received our personal bonuses is always exciting. Our gift exchange is always memorable as the gifts often seem to be extremely thoughtful or extremely absurd. I look forward to it every year.

Q: You grew up here in Maryland and in California; what are some other interesting facts about you?

A: My brother (who also works at MTI) and I have two deaf parents. So even though we can both hear, we learned sign language before learning to speak! I believe it's taught us patience and an attention to detail that we may not have learned otherwise. I also enjoy playing pinball and once played in a competitive league. But the most important thing about me is that I have an 18-year-old son who is starting college in Texas in the fall. I am excited (maybe as much as he is) to take him on a graduation trip to Jamaica this summer!

2018 Christiane Howey Rising Scholar Award

– CALL FOR ENTRIES –

In addition to granting many educational awards for transmitters over the years, Christiane Howey quietly found ways to help young researchers and start-up programs. To honor Chris, and to carry on in her spirit of generosity, we are proud to offer an annual award in her name: the Christiane Howey Rising Scholar Award.

Proposals for the 2018 Christiane Howey Rising Scholar Award will be accepted through October 31, 2017 and reviewed prior to the publication of the Winter 2017 issue of *Tracker News*. The award recipient will be notified in late December to schedule a production slot. Proposals will be judged by an internal committee. Applicants are encouraged to include an educational component in their research, but this is not required.

This award is intended to provide researchers who are starting out their careers with the means to get projects off the ground. It will provide the recipient with five transmitters of his/her choice. Proposals should include an outline of the project indicating the scope and expected outcome. We are looking for a maximum of 5 pages. Please include a timeline and let us know what model of transmitter you are interested in using. The recipient will be responsible for any Argos (or GSM) data distribution costs and any duties/taxes. For more information, please email **support@microwavetelemetry.com** or visit our website.