SPRING 2007 Volume 8, Issue 1

# Tracker News

## Microwave Telemetry, Inc.

# Cruising the Oceans: Above and Below

Dear Customers and Friends,

I have always dreamed of taking the 'Southwest Chief' from Chicago to Los Angeles; this would be an amazing train ride crossing the prairies of Kansas, the mountains of Colorado and the desert and stark red rock country of Arizona. I also wonder how I would occupy my time: perhaps admiring the scenery or reading a book. I recall our last newsletter where we looked at amazingly long journeys taken by relatively small birds. Do they admire the scenery? Do they rest or take a break? Why do birds undertake these long treks, particularly over the oceans? So, please join me in this newsletter as we cruise above and below the oceans.

The wandering albatross has rightly earned the reputation of being the ultimate cruiser of oceans, covering staggering distances. We thank Susanne Åkesson and Henri Weimerskirch for taking us on their albatross' journey of 52,346 km covered in 7 months, an average distance of 610 km a day!

From the southern oceans we travel to the Pacific Ocean where we follow the foraging trips of the Hawaiian Petrel with individual trips exceeding 10,000 km. We thank Josh Adams for introducing us to this rare and endangered bird. Also battling the wind and waves of the Pacific Ocean is the Pomarine Jaeger whose migration from Barrow, Alaska to Australia constitutes a trek of sorts. Our heartfelt thanks to Declan Troy for sharing his jaeger's wanderings with us.

As we hop across the United States and into the Atlantic Ocean, we encounter the ocean sunfish or *Mola mola*, whose shape and size belie its ability to cruise the oceans. We are grateful to Inga Potter for a most fascinating article on this mysterious creature of the deep.

It is rather astounding that all of the above bird studies were carried out using standard solar PTTs. I can only imagine how much more we could have learned using GPS PTTs, though at this point these are not light enough for the jaeger and the petrel. However, we continue to develop this technology and are pleased to bring you our latest parser with its capability of importing data directly into Google Earth™. Also, we present here a short introduction to GPS in an attempt to help newcomers to this technology.

We thank you for the opportunity to serve you. Have a productive field season and a good summer.

Sincerely,
Paul and the staff at MTI

Photo by Ghislain Doremus

Above:
A young male wandering albatross fitted with a GPS PTT at the Crozet Islands.



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# From the Top of the World to Down Under – Migration of a Pomarine Jaeger

*Declan Troy, Troy Ecological Research Associates, Anchorage, Alaska*

The Pomarine Jaeger (*Stercorarius pomarinus*) is a specialized predator while on its arctic breeding grounds. Nesting occurs only in areas experiencing peaks in lemming (*Lemmus*) abundance, the primary prey. This leads to large fluctuations in nest densities to the extent that 3-4 years can elapse between significant breeding events at a given location. The species is thought to be nomadic, moving to new nesting locations searching for lemming peaks. Outside the breeding season Pomarine Jaegers are pelagic. Their nomadism during breeding and marine distribution movements make tracking using conventional methods challenging, thus limiting any detailed understanding of Pomarine Jaeger migration.

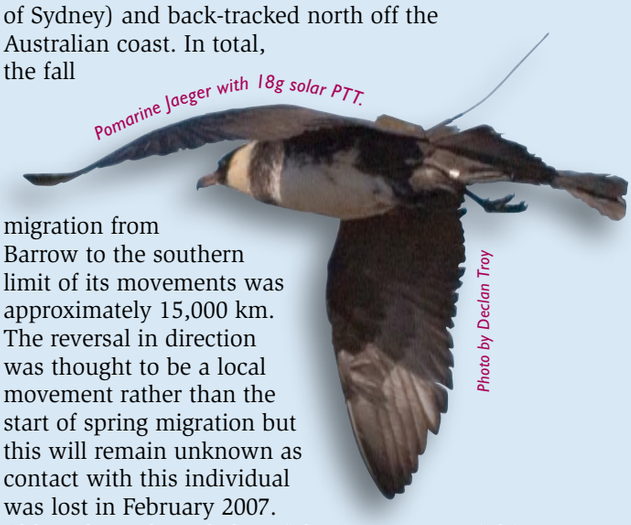
Photo by Declan Troy

*Pomarine Jaeger flying over the tundra near its nest. This is the individual, photographed prior to trapping, whose migration is shown in the map.*

The nature of the wanderings of Pomarine Jaegers is of interest in itself but an added feature of note is the association between the jaegers and Stellers' Eider (*Polysticta stelleri*). The eider, listed as a Threatened Species under the Endangered Species Act, breed in Alaska intermittently. Nesting occurs primarily during years when Pomarine Jaegers also nest. Although some eider nests are lost due to jaeger predation it appears that there is a net benefit to the eiders because the aggressive behavior of the jaegers deters most other potential predators.

The summer of 2004 was a breeding year for Pomarine Jaegers in northern Alaska providing the opportunity to investigate the feasibility of tracking this species using satellite telemetry. Four birds were trapped at their nests near Barrow, Alaska (71°N). Their 18g solar PTTs were attached with strips of Teflon ribbon forming "fanny-pack" harnesses.

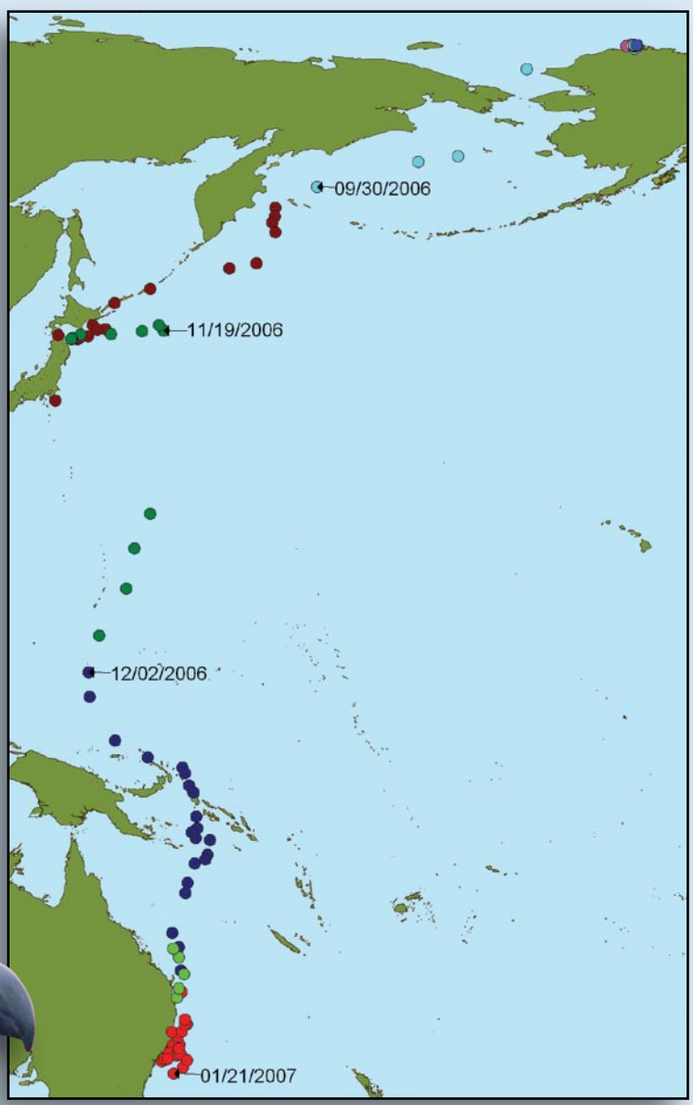
All the birds remained near their nest sites into September then exploded away from Barrow. The birds dispersed widely to the extent that during much of the fall there was an individual in each quartisphere of the globe (all in the Pacific Ocean). The migration of one individual is illustrated. This bird quickly crossed into the eastern hemisphere and remained in Russian waters until reaching Japan. It loitered around eastern Japan until mid-November then proceeded rather directly south though the Solomon Islands to Australia. This individual made a U-turn around 35°S (south of Sydney) and back-tracked north off the Australian coast. In total, the fall migration from Barrow to the southern limit of its movements was approximately 15,000 km. The reversal in direction was thought to be a local movement rather than the start of spring migration but this will remain unknown as contact with this individual was lost in February 2007. Although our knowledge of the movements of this bird were terminated prematurely it transmitted long enough to allow us to add Pomarine Jaeger to the short list of birds known to migrate between North America and Australia.



Pomarine Jaeger with 18g solar PTT.

Photo by Declan Troy

*declan.troy@acsalaska.net*




*Map: fall migration route of Pomarine Jaeger from Barrow to Australia. Fixes are color coded by month to give a rough idea of periods of peak movement.*

Pomarine Jaeger (*Stercorarius pomarinus*)

Photo by D. Troy

# Long Solo Migrations Across the Southern Ocean by Juvenile Wandering Albatrosses

*Susanne Åkesson, Department of Animal Ecology, Lund University, Sweden and Henri Weimerskirch, Centre d'Etudes Biologiques de Chizé, Centre National de la Recherche Scientifique, France*

Albatrosses are seabirds with a natural history shaped by an extreme oceanic lifestyle. They are known for their impressive navigational abilities, enabling them to successfully locate isolated breeding islands and to cover thousands of kilometres during migrations across open seas, but very little is known about their migratory movements. They were the first birds to be studied by the Argos system since 1989 and now the foraging behaviour of breeding birds is very well known. However what juvenile and immature birds do when at sea remained a mystery. From the time young albatrosses leave the colony on their first flight until they first breed, they spend 6 to 10 years at sea. In 2001, Susanne Åkesson at Lund University and Henri Weimerskirch, CNRS, Chizé started a collaboration to study by satellite telemetry, the first time migration by young wandering albatrosses born at the French Sub-Antarctic Crozet and Kergulen Islands, south-western Indian Ocean. To start with we used six solar panel powered 35–50g satellite transmitters (Microwave PTT 100) with a duty cycle of 10 hours on and 24 hours off, and seven 35-45g battery powered satellite transmitters with a duty cycle of 10-18 h on and 54 h off fitted with adhesive tape on the back feathers to fully feathered juvenile wandering albatrosses in 2001 and 2002.

On 23 November 2002 a young female wandering albatross, called "Boule de Plume", was fitted with a 35g solar PTT at Crozet Island, 46.357 latitude S and 51.716 longitude E. At capture she weighed 12.6 kg and when she left the nest and the Island 8 days later she had reduced her weight to 11.6 kg. She remained in the area of the Island for 9 more days and then started her migration journey to the northeast until she crossed the subtropical convergence 600 km to the north of the Crozet Islands. The flight north happened when southerly winds were blowing in the region of Crozet Islands, and thus, she could get some tailwind assistance during this rapid flight north. We received 792 positions from 23 November 2002 to 23 June 2003 from the female wandering albatross and she had by then covered a distance of 52,346 km with her last location at 166.925 longitude East. During this time she covered an average distance of 610 km/day.

The pattern of migration for this individual female wandering albatross was very similar to what we observed for other young albatrosses from Crozet Island. At first she departed offshore from the island, probably sitting on the water drifting with ocean currents and practicing flying, and then when suitable southerly winds appeared she departed north with some wind assistance. These flights often lasted until the albatross had reached the area of the subtropical convergence zone and suitable foraging waters with somewhat lower wind speeds. The migration routes taken by individual young wandering albatrosses contained similar features, like sections of straight flights and then return movements and circuitous flights influenced strongly by the winds, during which the albatross often returned to an ocean area previously visited. Based on the 13 satellite trackings, the juvenile Crozet Island wandering albatrosses on average fly distances corresponding to 4.6 times around the Earth during the first year of life! This is an amazing achievement for a bird which is making this journey alone without assistance from its parents, and for the first time in their life. We found that the migration distance covered per day increased during the tracking period, while the individual birds improved their skills to manage their peculiar and energy-minimizing flying technique (dynamic soaring).

Our results will be important for conservation issues, as we have found that the juvenile wandering albatrosses from Crozet Island fly to ocean regions to the north of those used by adult wandering albatrosses, and thus frequent areas which are intensely used for long-line fishing. In this region these inexperienced young albatrosses face the risk of being captured on the long-lines while being attracted by the easy-captured prey items exposed during fishing. Our satellite tracking data will also be extremely important for us to understand how a young oceanic avian migrant navigates during its first migration, and how this navigation system is shaped by experience into the one used by adult birds.

Photo by Ghislain Doremus

*Helène Maheo, field worker at the Crozet Islands for the program on the ecology of seabirds holding the young male before its release.*

We are currently using GPS PTTs to study the phase of the life cycle of albatrosses that is still unknown, the period of immaturity. Indeed after their first years at sea, young birds start to visit briefly their birth colonies from the age of 4-5 years. During the past two years we have been tracking these young birds to understand how the behaviour of these birds evolves from a purely oceanic life during their first year of life and to the first breeding. This period of learning is probably very important since albatrosses appear to start breeding only when they have acquired foraging skills similar to those of adult birds.

*Satellite tracking of the first migration of a young female wandering albatross born at the Crozet Islands. The PTT was deployed on 23 November 2002.*

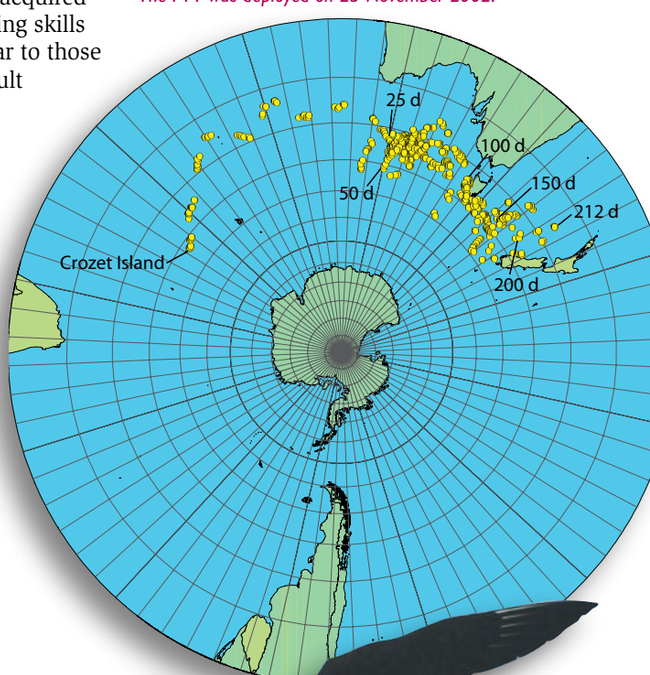



Photo by Ghislain Doremus

*A young female fitted with a GPS PTT displaying with a young male at the Crozet Islands. These birds have been tracked for the last 2 months and have now left the Crozet sector to forage in the Tasman Sea.*

# Petrels in the Pacific: Tracking the Far-ranging Movements of Endangered ´Ua´u (Hawaiian Petrel)

*Josh Adams, US Geological Survey, Western Ecological Research Center*

Known to the Hawai´ians as ´Ua´u for their haunting, nocturnal flight call, the Hawai´ian Petrel (*Pterodroma sandwichensis*) retains mystery. A member of the procellariid family of seabirds commonly referred to as tubenoses for their pronounced tubular nares, *Pterodroma* petrels are among the ocean's most wide-ranging and pelagic vertebrates. These birds truly exist in an environment of wind and waves, only returning to the Hawai´ian Islands to nest during the subtropical spring and summer. Established breeding pairs will first attempt nesting at approximately 6 years of age, and will return to the same nest site year after year for upwards of 40 years in an annual effort to produce a single chick (typically, procellariids lay only one egg per year; replacement eggs are very rare). Such a life history strategy can facilitate rapid population decline (if adult or subadult mortality rates increase) and ensures slow population recovery because of naturally low fecundity.

USGS photo J. Adams

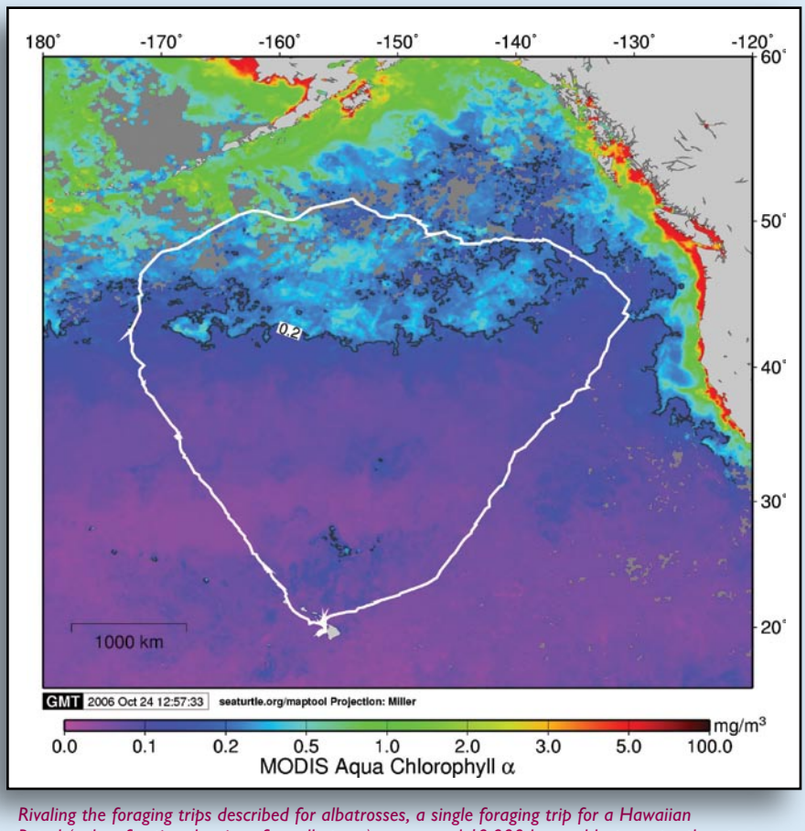
*The Hawaiian Petrel is an endangered, endemic seabird. Before MTI developed miniature solar-powered satellite transmitters, the high-resolution movements of these relatively small petrels (~470g) could not be measured.*

Coincident with the early colonization of the Hawai´ian Islands, first by Polynesians and subsequently by American, European and Asian settlers, rapid proliferation of introduced mammalian predators and ungulates, diseases, industrialized agriculture and fishing, and urbanization have imposed substantial pressure on the Hawai´ian Petrel population. As a result, ´Ua´u were listed as Endangered by the Secretary of the Interior in 1967 only one year after the passage of the Endangered Species Preservation Act. Remnant colonies of once abundant ´Ua´u now are confined to the summit areas of Mauna Kea and Mauna Loa, Hawai´i, Haleakala, Maui, and remote forested areas on Hawai´i, Kaua´i, and Lana´i. ´Ua´u continue to be impacted by loss of habitat, predation, and threats both on land and at sea.

USGS photo J. Adams

*Hawaiian Petrels nest in remote, isolated areas in Hawaii. Although easily detected flying over their colonies at night, finding a petrel burrow amidst dense, head-high uluhe fern stands on Lana'i Hale, can be extremely difficult.*

Effective conservation of ´Ua´u requires a better understanding of its biology and ecology. In 2006, the US Geological Survey partnered with the US Fish & Wildlife Service and initiated a broadly collaborative research effort to use satellite telemetry to better understand ´Ua´u. The overarching goal of any research involving ´Ua´u is to provide information that will contribute toward efforts that will enable recovery of the species and eventual "down-listing" from the Endangered Species list.




USGS unpublished image J. Adams

*Rivaling the foraging trips described for albatrosses, a single foraging trip for a Hawaiian Petrel (only a fraction the size of an albatross) can exceed 10,000 km and last greater than two weeks. This individual tracked from Haleakala, Maui performed a clockwise loop throughout the greater North Pacific and into the Transition Chlorophyll Zone (color-shading indicates satellite-sensed chlorophyll concentration) before returning to feed its chick.*

Whereas predation and habitat degradation by non-native species are principal threats to endangered Hawaiian Petrel, we are using satellite telemetry to address several prerequisites for conservation. Our studies aim to establish methods that will help generate precise locations of remote, montane nesting areas, enable more refined techniques for population assessment, and to identify at-sea habitat. In summer 2006, we made an initial attempt to track the fine-scale movements of four ´Ua´u using 12g solar PTTs. We discovered that breeding birds make dramatic, clockwise looping foraging trips throughout a broad area of the north Pacific (individual trips can exceed 10,000 km). Tests on Haleakala, indicate the feasibility of using satellite telemetry techniques in the near future to track the inland movements of both petrels, and potentially smaller Newell's Shearwaters, to help locate previously undescribed colonies. We are looking forward to examining interannual variations in the movements of individual ´Ua´u as our telemetry studies continue throughout the next several years.

*josh_adams@usgs.gov*

# Movement and Behavior of Ocean Sunfish, *Mola mola*, in the Northwest Atlantic

*Inga Potter, Department of Zoology, University of New Hampshire, Durham, New Hampshire*

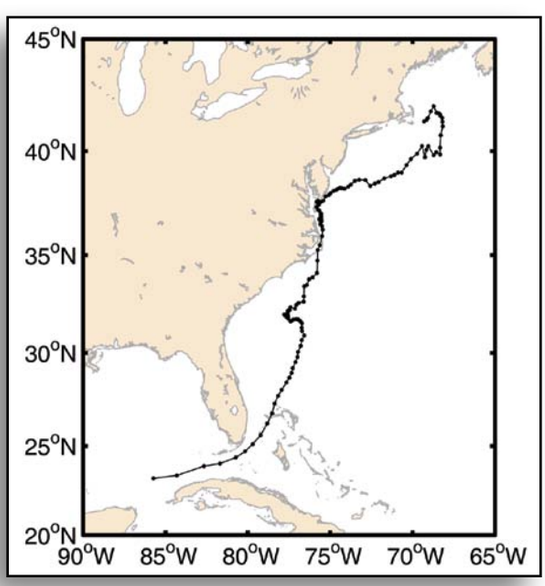
The ocean sunfish, *Mola mola*, is found in every ocean in the world. Known for its unusual body shape resembling a large "head" with no tail and long fins, and its large size (up to 5,000 lbs), the biology of this species is poorly understood. Most of

Photo by Inga Potter

*Tagging of an ocean sunfish off of Nantucket Island, Massachusetts.*

the basic biological questions about ocean sunfish remain a mystery. These include areas of growth and development, reproduction, feeding ecology, population size and distribution, movement, and behavior. Recent studies have shown that ocean sunfish make up a large portion of the bycatch in commercial fisheries in the Pacific and Mediterranean, and they are increasing in popularity as a food fish in Asia. Because there is little information on its basic biology, scientists have no idea how the global population of ocean sunfish is faring.

The current project at the University of New Hampshire's Large Pelagics Research Center is the first to study ocean sunfish in the North Atlantic Ocean, where they are a common resident. The project seeks to gain an understanding of the biology of ocean sunfish in the region including information on their movement, behavior, temperature and depth preferences. To date, 19 fish have been tagged with pop up satellite archival tags (PTT-100's) during the summer and fall of 2005 and 2006. Tags were deployed from Nantucket Island, MA, Harwichport, MA, and York, ME.




*Track does not include uncertainty. Methods of F. Royer UNH Large Pelagics Research Center*

*Most probable track of tag ID 14538. Tag was deployed on 9/3/2005 and popped off on 1/15/2006.*

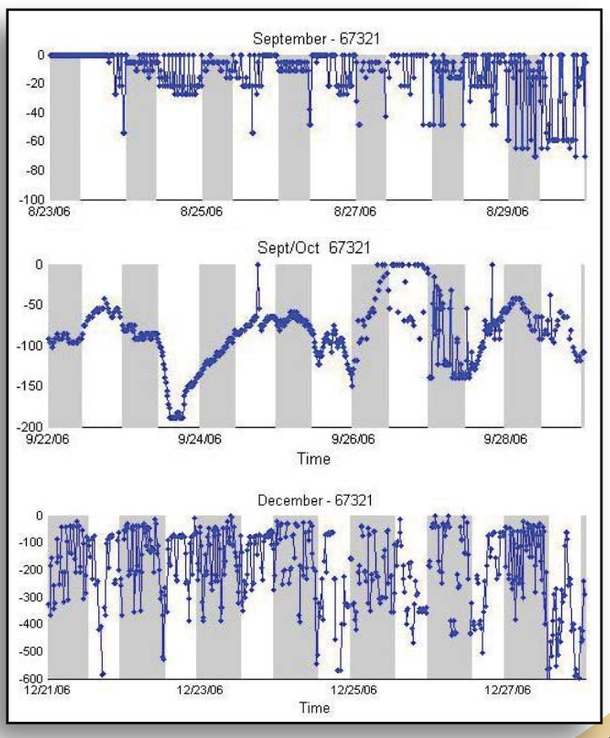
Preliminary analysis from the tags reveal that ocean sunfish are capable of making large scale movements (as far as 3000 km in 130 days) and diving to depths of over 800 meters. *M. mola* found off of New England in the summer months appear to migrate southward along the continental shelf or shelf edge and to move as far south as the Caribbean or Gulf of Mexico before moving north again in the spring. During this migration the fish are spending considerable time at depth, rather than exhibiting the primarily surface oriented behavior thought to be typical of the species. Significant changes in vertical behavior in both dive depth and dive frequency have been observed as the fish move southward. As the tags continue to pop-off and relay data, more information about the movement and behavior of *M. mola* in the northwest Atlantic will become available, leading to a better understanding of the biology of this unique and mysterious creature.

Photo by Josh Eldridge

*Mola mola with Pop-Up Archival tag attached.*

Results of the project will establish a baseline of information for the species in the region, and will improve the understanding of the habitat, migration routes, behavior and environmental associations of *M. mola*. In addition, data on distribution of *M. mola* may serve as a useful indicator of nutrient rich areas with high productivity, where other important marine organisms may be found.

*Ifredland@aol.com*




*Depth profiles for tag ID 67321 for 3 week-long periods during the tagging period. Gray bars indicate night. Fish was tagged on 8/23/2006 off of Nantucket Island, Massachusetts. Tag was attached for 143 days and surfaced off the coast of southern Florida.*

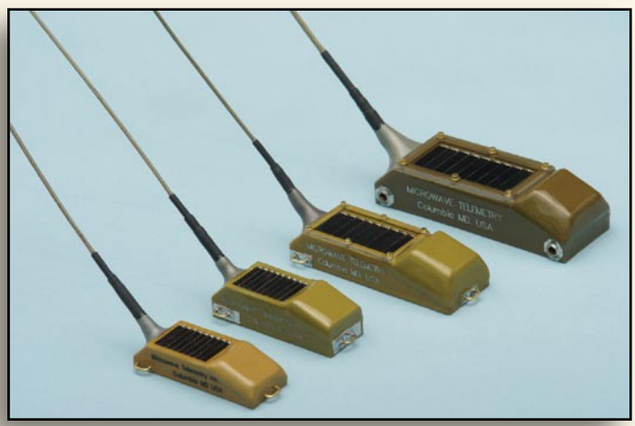
# GPS PTTs

Since 2001, when we first introduced our 70g GPS enhanced solar backpack PTT, we have worked our way through 5 generations of these PTTs, the latest weighing 22 grams. Since GPS provides accurate locations, our GPS enhanced PTTs have become the preferred tool for biologists worldwide.

These units have several other advantages over conventional PTTs in addition to more precise locations (typically within 15 m). In areas where radio interference negatively affects the Argos system, only the odd message may reach the user. A single message from a GPS PTT equipped with 2D software can contain five accurate GPS fixes whereas Argos cannot locate a PTT with a single message. The larger solar GPS PTTs can give positions in 3D also, i.e., an altitude position as well as latitude and longitude and even heading and speed when the bird is flying. Additionally, with these devices, home range studies, where high spacial resolution of small movements of a bird within a habitat need to be documented, can now be carried out.

As newcomers join other biologists in this field, and as we add other capabilities to our PTTs, it has become increasingly obvious to us that the technology presents a learning curve. We are repeatedly asked questions by researchers attempting to figure out how to best employ the technology for their project.

Though our website does contain relevant information on our GPS PTTs, we present here a summary to help clarify information on our GPS PTTs.



*Our GPS PTTs range in size from 22g to 70g.*

*MTI image archive*

## GPS

GPS enhanced PTTs make use of the Global Positioning System to record the precise location of a PTT rather than the Doppler location technique used by the Argos system to position conventional PTTs.

## How does a GPS PTT function?

Our GPS enhanced PTTs are much more complex than standard “Doppler positioned” PTTs. They consist of four major subsystems: a GPS receiver and antenna, a microcomputer/datalogger, an Argos uplink transmitter and a solar powered energy source or battery. The microcomputer continually runs through a complex program controlling all of these subsystems.

## Duty Cycles

Each unit is programmed with two independent duty cycles, defined by the customer’s specifications.

The first duty cycle defines times when the unit will attempt to obtain GPS positions. These times are always “on the hour” and defined in local time.

The second duty cycle independently defines when the transmissions of the stored GPS data to Argos are made, similar to a conventional PTT. Typically this is on every third day. The precise times of the transmissions are calculated by the microcomputer to be when there is likely to be a “Satellite in view” (SiV™) above the horizon. Transmissions are restricted to within two of the six hour GMT windows defined by CLS for billing purposes, on any particular day.

Both of these duty cycles are defined by the customer within a simple table on our online Production Form. Up to five separate duty cycles can be defined for different seasons within the calendar year.

## GPS Fixes

The GPS positions are stored onboard the unit until it is time to transmit them to Argos. At this point, they are assembled into messages and transmitted as “sensor data” in a series of Argos messages; a checksum is incorporated into each message that is later used to verify the integrity of the message. Dependent on whether the unit is programmed to collect 2D or 3D GPS fixes either five or three positions are contained in each Argos message. Experience has shown that about sixteen unique messages can typically be transmitted through the system on any given transmission day (e.g., every third day) which equates to 48 3D positions or 80 2D positions. In areas of heavy radio interference to the satellite the number of messages that get through the system are severely reduced.

## Data Analysis

In order to retrieve these positions from the system it is very important to receive this data in the correct format from Argos and to receive all of the messages. Although the positions are plainly visible in the Argos message it is a tedious job to manually extract them.

We supply a “parsing” program that will extract the GPS positions from the raw Argos data and present them to you in a tabular form. This program can extract the data from ‘DS’ and ‘DIAG’ data files for multiple GPS PTTs and separate them into data sets for individual PTTs after verifying the embedded checksums. The latest version of this parser program can also output data in a Google Earth™ compatible format, as described elsewhere in this newsletter.

As you can see, a very complex set of processes are involved that result in showing you in precisely which tree your bird was sitting at 4 PM local time yesterday on the other side of the world!

# X-Tag Update

In our winter newsletter we unveiled our new smaller next generation archival pop-up tag – the X-Tag, which we had been developing over the last two years. Over the last six months as we geared up to produce these new tags, we have been receiving data back from prototype X-Tags and those deployed in the first major project to use them. These first data sets have been impressive, proving the design under real field conditions.

Figures 1 and 2 show data from a standard rate X-Tag deployed on a Sailfish on December 7, 2006 off Stuart on the east coast of Florida. The tag was programmed to collect data for 3 months. It popped off on schedule on March 7, 2007 and subsequently transmitted to Argos for 23 days as it was carried by the Gulf Stream up the eastern seaboard of the USA. During this period 91% of its archived data set was successfully retrieved through the Argos system. Temperature and depth data were recorded at 15 minute intervals together with sunrise and sunset times for each day of the 3 month deployment.

Figure 1 shows the estimated track of the fish in purple determined from the archived times of sunrise and sunset each day, the track having been refined with recorded sea surface temperatures using the techniques of Nielsen et al.* The yellow track shows the subsequent drift of the tag as determined by Argos; 85% of the Argos fixes were Class 1 or higher.

Figure 2 shows the vertical movements of the fish over the 3 month deployment at 15 minute intervals, together with the associated temperature readings.

Other deployments of X-tags have resulted in similar data sets.

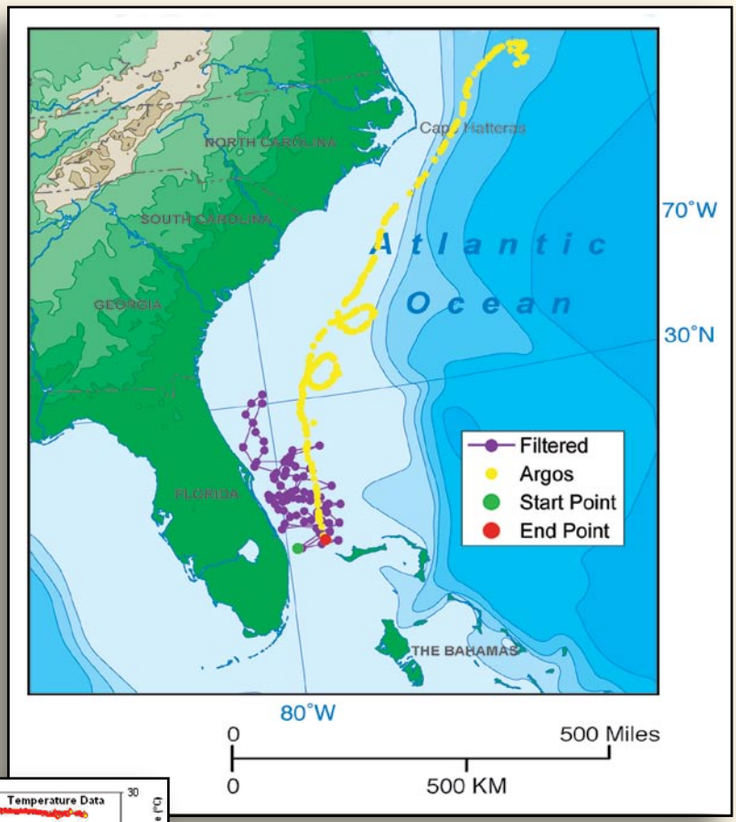



*Figure 1; The movements of a sailfish, tagged off Stuart, Florida, over the three month period between December 7, 2006 and March 7, 2007 as estimated from the sunrise and sunset times recorded by a prototype X-Tag. The subsequent drift of the popped up tag in the Gulf Stream is shown in yellow.*

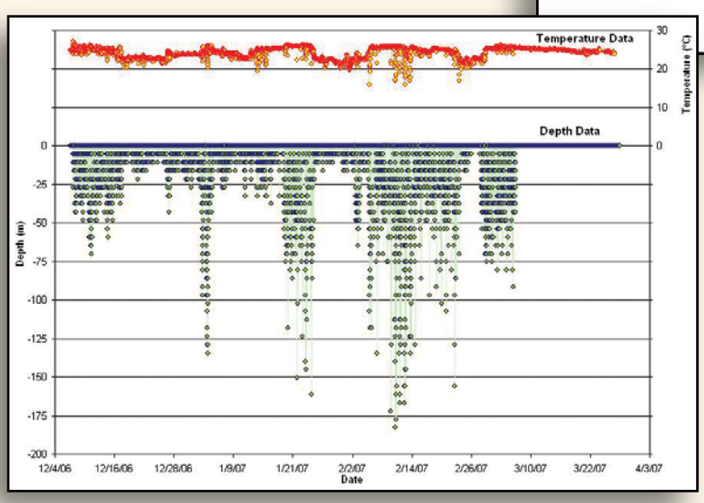
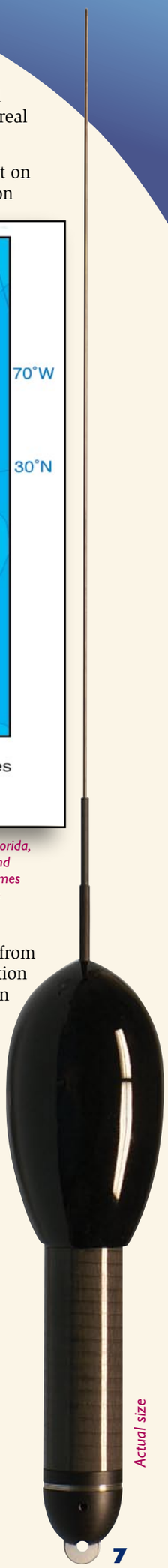



*Figure 2; Temperature and depth data transmitted back through Argos from the same prototype X-Tag and sailfish as Figure 1. Samples were recorded at 15 minute intervals for the whole 3 month deployment, 91% of these measurements were successfully transmitted back through Argos without error.*

We are very pleased with the initial results from these new tiny X-Tags; they verify its operation and give us confidence that this new tag can be used to gain valuable data from much smaller pelagic fish than has been possible before now.

We would like to thank Cookie Murray, Anthony Mendillo and their friends aboard the Cookie II, together with Lucy Howey of NSU for deploying prototype X-Tags for us.

*Fisheries Oceanography 15:4, 314-325





## for Your Strangest Story.

***Got a whopper of a story to tell?***

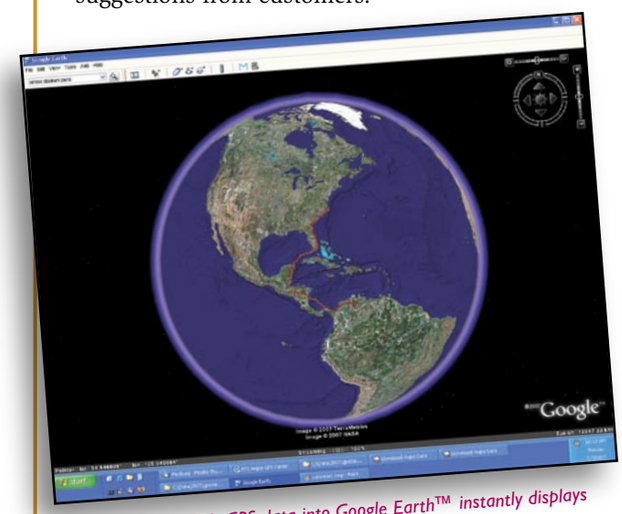
We would love to hear it. Submit a short email to Microwave Telemetry to tell us about a funny or strange bird or fish tracking experience you have had.

Entries that are published in Tracker News will receive a prize.

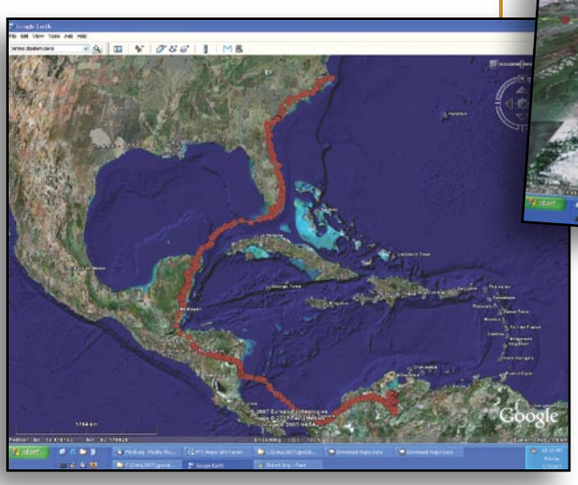
# Latest GPS Parser

As GPS enhanced PTTs become the predominant tool to accurately track bird species worldwide, biologists are now focusing on ways to sort through and present vast amounts of data.

The parsing software we provide with our GPS PTTs efficiently accomplishes the task of parsing data. However, over the last few months we have been asked if there was an easy way of importing the parsed data into Google Earth™ which would then plot the coordinates to display a track. As always, we give due consideration to all requests or suggestions from customers.




*Importing the PTT's GPS data into Google Earth™ instantly displays a track.*



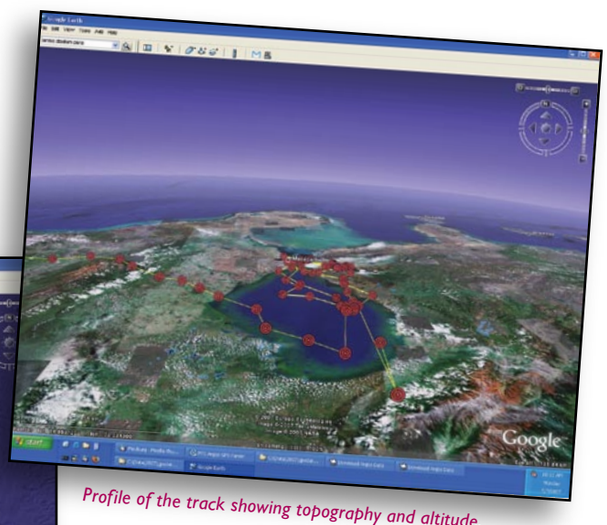

*Zooming in on the track on Google Earth™.*

Software development is an oncoming and integral part of our company's culture. After finding a free slot in our R & D slate, we worked on incorporating this new capability into our GPS parser.

Our new GPS parser now has the capability of importing the PTT's GPS data into Google Earth™ to instantly display tracks. By clicking this option when installing the new parser, a file is created which can then be imported into Google Earth™. The three screen captures shown are examples of how data is displayed.

We will start shipping our new and improved parser with all new GPS PTTs in early July. Bear with us as we modify and incorporate user friendly instructions into our manuals for the new parser.

If you are a current customer and would like a copy of the new parser, please email us at microwt@aol.com.




*Profile of the track showing topography and altitude.*

## Please Note...

we will be closed from Friday, July 20th to Wednesday, July 25th for our biennial retreat. We will begin returning phone and email messages when we reopen on Thursday, July 26th.

## *Congratulations!*

We congratulate our "MTI family" high school students on their graduations. From left to right:

Kirsten (our Production Manager's daughter) who will be attending the University of Maryland; Jennifer and Eric (our part time trainees) who will be attending Bryn Mawr College in Pennsylvania and the University of Maryland, respectively.