

ARGOS FORUM

85 11/18

SPECIAL EDITION

**EUROPEAN USER
CONFERENCE
ON ARGOS WILDLIFE**

Innovations
in Argos wildlife

**SHARE, EXCHANGE,
DISCOVER**



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Publication director:

Christophe Vassal

Editorial directors:

Marie-Claire Demmou
mdemmou@groupcls.com
Yann Bernard
ybernard@groupcls.com

Editor-in-Chief

Marianna Childress
mchildress@groupcls.com

Contributed to this issue:

Alexa Burgunder
aburgunder@groupcls.com
Anne-Marie Bréonce
abreonce@groupcls.com
Sophe Baudel
sbaudel@groupcls.com
Aline Duplaa
aduplaa@groupcls.com
Anna Salsac-Jimenez
asalsacjimenez@groupcls.com

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www.argos-system.org



FOR 40 YEARS,

Argos has been the key tool of Earth scientists and Life scientists to study our physical environment and reveal the mysteries of the animal world.

With over 100,000 animals tracked since its inception, Argos is the only satellite system that caters to biologists, with miniaturized platforms, low power transmitters, and the ability to send data in extremely difficult conditions. Argos manufacturers are largely responsible for the innovations that have pushed the limits of Argos satellite telemetry ever further, to track more than 1,000 species today.

Our mission is to build on this successful past, continuing to work hand in hand with scientists and manufacturers, while introducing more satellites, a wider frequency bandwidth dedicated to low power transmitters, and greater transmission capabilities so scientists can send more positions and more sensor data, via ever smaller, light-weight tags. To do so, Argos joins the New Space movement while maintaining close ties to the international space agencies that govern the system (CNES, ISRO, EUMETSAT, NOAA).

Faced with unprecedented loss of biodiversity, we are inspired by the work of the scientific community that uses Argos to preserve our planet's biodiversity, understand the impact of climate change and to provide data necessary to establish protective measures for natural habitats. Their innovative projects combine science and technology with today's key societal issues.

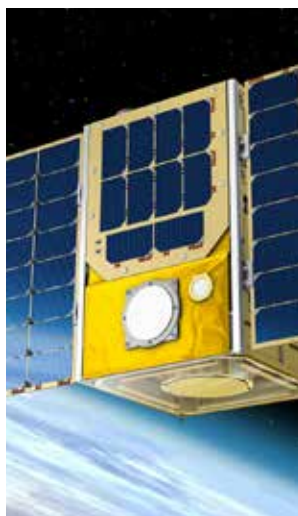
In this ArgosForum, we are pleased to feature the noteworthy projects of the scientists attending the European User Conference on Argos Wildlife. We salute the work of these determined and brilliant teams and the organizations they represent. We are very proud to host this group of scientists and manufacturers, hailing from Australia, New Zealand, Russia, Germany, France, Turkey, Denmark, United States, United Kingdom and Spain, illustrating the great spirit of international collaboration that the Argos system embodies.

Christophe Vassal

President of the Executive Board of CLS

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CONTENTS



P. 06 SESSION 1

Updates on Argos system & services

*Chairman: Michel Sarthou
French Space Agency (CNES)*

P. 08 SESSION 2

Using Argos in the the polar regions

*Chairman: Mads Peter Heide-
Jørgensen Greenland Institute
of Natural Resources*

P. 12 SESSION 3

Tags & hardware

CLS

P. 13 SESSION 4

Innovative techniques in bird tracking

*Chairman: Nigel Butcher
Royal Society for the Protection
of Birds*



P. 16
SESSION 5

**Using Argos to track
the movements
of large pelagics**

*Chairman: Doug Beare
International Commission for the
Conservation of Atlantic Tuna*

P. 21
SESSION 6

**Long time-series
of Argos data for
historic bird studies**

*Chairman: Bernd Meyburg
BirdLife Germany*

P. 23
SESSION 7

**Using Argos for
research and
conservation**

*Chairman: Brendan Godley
University of Exeter*

P. 26
SESSION 8

**Future of Argos
satellite telemetry**

*Chairman: Alexandre Tisserant
Kinéis*



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UPDATES ON ARGOS SYSTEM & SERVICES



ARGOS-4 IS COMING SOON:
A NEW MOMENTUM
FOR THE ARGOS SYSTEM

ARGOS IS A COLLABORATIVE,

international satellite system
dedicated to environmental
monitoring that has been
flying for 40 years.

Today, thanks to 7 operational
satellites, it provides global
coverage via its polar orbits, a unique

robustness thanks to a communication
protocol fitted for harsh conditions, -
one of its main advantages compared
to other systems - and offers the
capability to work with a very low
output power transmission at terminal
level (around 500 mWatt and
even less).

In the future, the Argos4NG
constellation (Kinéis), based on
20 small satellites, will enhance

significantly the system revisit
performance and will provide a close
to real-time service, strongly requested
by the users.

To ensure the transition between the
current Argos-2/3 system and the
Argos4NG constellation (Kinéis),
CNES has developed a new
generation of instruments, called
Argos-4, able to:

- ensure the continuity of service and

then the population of the three Argos reference orbital plans thanks to the historical Argos partners : NOAA, EUMETSAT and ISRO and their hosting satellites, (CDARS, Metop-SG and Oceansat-3). The three reference orbits will be then perfectly covered until 2025/2030, affording a stable and performing service for many years.

- provide an in-orbit validation of the future Argos4NG system by offering the same extended frequency bandwidth (640 kHz instead of 80 kHz on the current system) and an enhanced on-board processing capacity, and also proposing new optimized terminal signals (mainly for very low power transmitters).
- deploy proof-of-concept programs by using specific part of Argos-4 bandwidth dedicated for instance to very low power transmitters.

In conclusion, Argos4 is the first step of a very promising future, with a first launch coming soon (2019) and the strong and ongoing involvement of the four international agencies managing the Argos system : CNES, NOAA, ISRO, EUMETSAT. //



Argos4 is the first step of a very promising future, with a first launch coming soon and the strong and ongoing involvement of the four international agencies managing the Argos system: CNES, NOAA, ISRO, EUMETSAT.

OPTIMIZING ARGOS TRANSMISSION STRATEGY

by **Stéphan Lauriol**

Understanding polar-orbiting low earth orbit satellite systems and how they work is key to optimizing Argos transmission strategy. This presentation includes a crash course in how Argos works and includes key pointers on how to program transmitters before deployment in order to get the most reliable data collection.

DEMYSTIFYING ARGOS LOCATIONS: TIPS & METHODS

by **Adrien Mezerette**

This presentation will describe the different Argos-Doppler positioning algorithms to better understand location results. A special attention will be given to the multi-model smoothing algorithm (only available with the offline reprocessing service) which improve the positioning accuracy, especially when few messages are received.

OUR ARGOS WILDLIFE COMMUNITY

by **Sophie Baudel and Aline Duplaa**

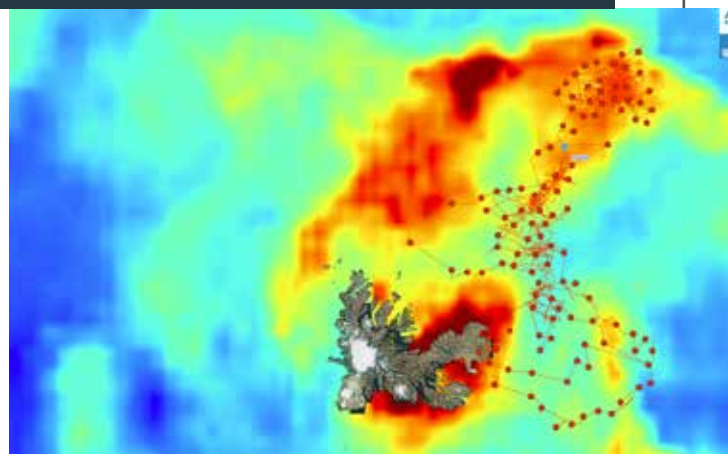
Argos is the main satellite telemetry system used by the wildlife monitoring and research community to monitor animals. Biologists, scientists and researchers have been using Argos services since its creation, to analyze and understand animal migrations and behavior. In this presentation, we will give maps and statistics of Argos for wildlife uses and users (animal family, number of IDs, programs, users type, etc.), as an overview of Argos long-term activity for the benefit of animal's studies for preservation.

NEW ARGOS SERVICES

by **Philippe de Saint Léger and Anna Salsac-Jimenez**

CLS is pleased to present a number of new services to our user community.

Our new services include an improved ArgosWeb mapping interface with environmental data, as well as a number of items that make your fieldwork easier. For example, the Argos gonimeter will help you find lost Argos platforms in the field and our Iridium tablet will provide connection while you're in the field so you can view up-to-date Argos positions and communicate with family and coworkers. Finally, benefit from CLS's 20 years of experience in satellite oceanographic data processing and enrich your Argos tracks with ocean and weather data. Make a link with your animal's behavior and its physical & biochemical environment by linking environmental parameters from CLS-DATASTORE to your Argos tracks.



Example of metocean data (primary production) from CLS to enhance elephant seal tracks. Courtesy of Clive Mc Mahon, IMOS Animal Tagging at the Sydney Institute of Marine Science and Christophe Guinet, CEBC, MUR 7372 CNRS-ULR and SNO-MEMO.

USING ARGOS IN POLAR REGIONS





UNVEILING THE LIFE OF ARCTIC MARINE MAMMALS THROUGH THE USE OF SATELLITE TELEMETRY

Some of the most intriguing questions about migrations and natural behavior of marine mammals are focused around Arctic seals and whales.

Animals that are widely dispersed in inaccessible areas and that only in brief seasons can be observed in their natural surroundings. Naturally these species have also been targeted by some of the largest efforts for data acquisition through satellite telemetry using Argos satellite telemetry. Most of the 1990's was spent on developing instruments that could meet the requirements for use on marine mammals, with the development of a very fast salt-water switch being a turning point for tracking animals that only briefly appear at the surface of the oceans. Major insight into critical biological questions were emerging after 2000 with successful instrumentations of large numbers of marine mammals with tags that provided data for months and sometimes years. Critical habitats and migratory corridors have been delineated, exposure to anthropogenic activities revealed and sensitivity to climate perturbations has been assessed. New possibilities for using instrumented animals for environmental sampling are emerging where data can be used for long-term monitoring of oceanic conditions. //



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A narwhal in the Arctic ocean.

1000

ARGOS TAGS
DEPLOYED
SINCE 1988

30

 YEARS

USING THE
ARGOS SYSTEM

250

BOWHEAD WHALES
TRACKED WITH ARGOS
(AMONG THE LARGEST
ANIMALS THAT HAS EVER
LIVED ON THE PLANET)

”

We had one episode with bowhead whales a couple of years ago where we could not understand why the whale was transmitting from the same location on the east coast of Baffin Island for many months. We then had a film team that went out to the locality in spring and they were met with 32 polar bears that were hanging out around a dead bowhead whale that was washed ashore! Clearly our work would not have been possible without the Argos system.

”



Mads Peter Heide-Jørgensen
- Greenland Institute of
Natural Resources

WHEN DEEP DIVING SEALS HELP US TO OBSERVE RAPIDLY CHANGING POLAR OCEANS

Polar seals are used to collect in-situ measurements of temperature, salinity, fluorescence and light along their paths during their dives and which complement and extend to deep depth satellite surface observations. Information on sea states, direction and wind strength are also sampled.

Simultaneously, biological data on nekton and prey density are also collected using a combination of methods such as assessing prey catch attempts from acceleration and passive acoustic measurements, measuring bioluminescence distribution and active echo-sounding.

By combining these data we aim at assessing how oceanographic conditions influence the vertical and horizontal distribution of biological fields on a fine spatial scale. Today, southern seals represent a major component of the Southern Ocean observing system and help us to evaluate how quickly that system is changing. Within that observatory system, relying on animal samplers, real time transmission via the Argos System of in-board processed data



© J.-B. Pons

is the main challenge to be achieved. This requires the development of fast, low energy consumption algorithms to process the data on small, energy-constrained Argos satellite tags. These developments are crucial for us to be able to investigate the foraging ecology and the environmental conditions for species we are unable to recapture (such as seals) in a rapidly changing, Arctic marine environment. //

In January 2015, we were in the Kerguelen Islands when we received news that a female elephant seal that we had tagged just three months before had returned to land. Hoping to retrieve her Argos tag and behavior tracker (including an acoustic recorder) we set off on foot to find her. The first two days, we had no luck. On the third day, we received a new position. She was only 4 kilometers away! We set off and managed to collect the Argos beacon and the acoustic logger from her back. Then something on the ground attracted our attention. It was another Argos tag: one that was lost by a male elephant seal when he moulted three years before. As the tag had stopped transmitting before the seal returned to land, our chances of finding it were close to zero. But what a stroke of luck, three years later, the precious data recorded on the tag was still intact!

350

TAGS DEPLOYED ON
ELEPHANT SEALS IN THE
KERGUELEN SINCE 2003

1996

FIRST STUDIES WITH
ARGOS SATELLITE TAGS ON
AMSTERDAM FUR SEALS

22

YEARS
USING THE
ARGOS SYSTEM

16

MONTHS
THE LONGEST ARGOS TRACK
OF A YOUNG HOODED SEAL
TAGGED OFF THE COAST OF
NEWFOUNDLAND



Christophe Guinet,
CEBC-CNRS

REPORTING ON THE WORK OF RUSSIAN SCIENTISTS IN THE ARCTIC USING SPECIALIZED ARGOS TAGS

Russian scientists use the Argos satellite system almost exclusively in Arctic zones, where satellite passes are frequent since Argos is a polar-orbiting system.

In these regions, they can transmit a higher volume of data with Argos for intensive animal tracking to study migration of marine and terrestrial wildlife in Northern regions. For administrative, customs and financial reasons, Russian users prefer to use Russian-made tags developed and manufactured by the Russian company ES-PAS. ES-PAS provides Argos tags for tracking marine animals as well as Argos and Argos/GPS/GLONASS collars for land animals. This equipment makes it possible to track animals

intensively over long time periods in extreme weather. For example, within the framework of reindeer-tracking projects in Siberia, scientists have obtained up to 300 animal positions per day by studying the annual migration cycle. For 10 years, Russian scientists have used this equipment to lead successful tracking projects for killer whales, belugas, walruses, gray seals, bearded seals, Greenland seals, Harbor seals, polar bears, brown bears, bison, muskoxen, moose, snow sheep, Arctic blue foxes... //

© Institut des Problèmes Biologiques de Cryolithozone de l'Académie des Sciences de la Russie



© CLS

“
Today, we are adapting the Argos/GPS/GLONASS collars for livestock monitoring. The first tracking projects for reindeer and domestic horses have been successful in Siberia.
”



THE MISSING LINK: PELAGIC PREY FIELD PREDICTION FOR SOUTHERN OCEAN MARINE PREDATORS

David Green, University of Tasmania

Southern Ocean predators tend to lead cryptic lives, which in many cases are spent mostly at sea. This makes their foraging behaviour inherently difficult to study. Species distribution models generally incorporate physical (oceanographic and static) drivers, and intrinsic constraints as predictors of predator occurrence, but seldom include estimates of prey distribution. In his study, David March investigates the efficacy of modelled prey biomass (from the prey sub-model of the Spatial Ecosystem and Population Dynamics Model (SEAPODYM)) as a foraging predictor for a well tracked and ubiquitous Southern Ocean predator, the southern elephant seal (SES).

To do this, he models multiple years of SES movements, determined using the Argos satellite tracking system, against concurrent estimates of potential prey biomass within the upper-mesopelagic layer (their predominant foraging depth), as well as against known oceanographic and intrinsic predictors of foraging, and evaluates the additional explanatory power provided by the addition of the prey model. The implications of this are discussed in the context of marine top predator conservation and global change.

TAGS & HARDWARE



LOTEK OFFERS THE BROADEST RANGE OF ARGOS ENABLED TAGS

Lotek Argos enabled products use Argos Doppler positioning or they use Argos to relay GPS location data and other behavioural or environmental data. Argos enabled tags are available for a vast range of species covering avian, marine, freshwater and terrestrial applications.



ARGOS TAGS: SMALL IN SIZE BUT NOT IN DATA

Improvements in technology have led to smaller and smaller Argos transmitters. This along with the wealth of data you can get from Argos tags has allowed researchers to study new species and learn even more about the ones they are currently studying. Wildlife Computers continues creating tools to work with what is already offered by CLS to give you more information. The tools along with onboard data processing allow you to program your tags to efficiently use their battery capacity. Wildlife Computers has also developed the Wildlife Computers Mote; a ground based receiving station which will receive up to 100% of the transmissions made by an Argos tag while in range of the Mote.



A NEW & INNOVATIVE COST-EFFECTIVE BEACON IDEAL FOR LARGER BIRD TAGGING CAMPAIGNS

Syrlinks is a leading manufacturer of Space and Ground radio equipment, and has been involved with Argos technologies for many years, developing Argos transceivers and miniature Argos beacons. Today, Syrlinks is introducing its new 25 gram, all-in-one and cost-effective Argos beacon that will allow scientists to triple their tagging animal campaigns for the same budget.



XERIUS' SOLUTIONS TO MEASURE THE CONSEQUENCES OF CLIMATE CHANGE ON WILDLIFE

Interested in climate change and its consequences on wildlife, Xerius' team decides to provide 19 years of technological expertise to increase scientist's knowledge. Data collected through miniaturized tags, and 100% manufactured by Xerius, give species behavioural responses. Whether in the Middle East with hawks, in Mexico with flamingos, in France the wood pigeon, more than 100 individuals are already being followed around the world and some great solutions are yet to come.



INNOVATIVE TECHNIQUES FOR BIRD TRACKING

THE RSPB AND ARGOS: AN OVERVIEW OF USING SATELLITE TELEMETRY IN OUR SCIENTIFIC RESEARCH



*By Nigel Butcher, Technical
Officer, Royal Society
for the Protection of Birds*

THE ARGOS TRACKING SYSTEM

**has been used in avian ecology
for many years now and the
RSPB has benefited from it on
a number of different projects.**

As Senior Technical Officer within the Centre for Conservation Science since 2000, I will discuss 3 of the many tracking projects that the RSPB have undertaken and highlight some of the success we have achieved. Mortality among bird species is high. Retrieving the bird's carcass is very important so that the cause of death can be established. This can be easily determined with the larger Argos PTT's which incorporate GPS,



© N. Butcher

but it is considerably more difficult with standard Doppler tags like those used in the Hen harrier LIFE project. To locate dead birds, we monitor a combination of sensor parameters and check transmissions regularly. The addition of a goniometer in 2016 has been invaluable, coinciding with enhancements to the Argos website.

More than 30 bird carcasses have been retrieved to date. Independent post mortems reveal the causes of death are largely natural. There are still a large number of Hen harriers where tag transmissions stop suddenly and no carcass is located despite a thorough search of the area of last known location, which indicates that illegal killing of birds is highly suspected. These projects contribute to our understanding of the plight of bird species in the UK, and help us to instigate measures to better protect them. //



© Ellie Owen (RSPB)

Nigel Butcher, RSPB.

333

TAGS DEPLOYED ON BIRDS
SINCE 2000

20

BIRD SPECIES TRACKED
WITH ARGOS (THE
ATLANTIC YELLOW-NOSED
ALBATROSS, NORTHERN
BALD IBIS, SOCIABLE
LAPWING, OSPREY, RED
KITE, GOLDEN EAGLE,
WHITE-TAILED SEA EAGLE,
TURTLE DOVE, GOSHAWK,
TRISTAN ALBATROSS,
SOOTY ALBATROSS, BENGAL
FLORICAN, HEN-HARRIER,
6 SPECIES OF VULTURE
AND THE SPOON-BILLED
SANDPIPER)

THE UTILITY OF ARGOS SATELLITE TAGGING IN MONITORING A LONG-LIVED RAPTOR: WHITE-TAILED SEA EAGLE REINTRODUCTION TO IRELAND

By Allan Mee , co-author Torgeir Nygard
Organization: Golden Eagle Trust,
Norwegian Institute for Nature Research

White-tailed Sea Eagle (WTSE) *Haliaeetus albicilla*
became extinct in Ireland in the early 20th century.
Reintroduction began in Ireland in 2007-2011 with the
release of 100 chicks taken from nests in the wild in
Norway under a joint project with Irish and Norwegian
counterparts.

Prior to release birds were fitted with Argos solar GPS PTTs
(n=11) or VHF radio transmitters (n=89) for post-release
monitoring. The dispersal distances of the birds will be
presented during this presentation as well as post-fledging
movements and roost and nest site location.

Argos satellite tags have also allowed the rapid recovery
of dead birds and determination of the cause of mortality.
Major sources of mortality to date have been illegal
poisoning and, to a lesser extent, wind turbine collisions
and most recently Avian Influenza. Although cost is a
serious issue for small scale conservation projects, satellite
tags have proved invaluable in both applied and research
elements of the Irish WTSE reintroduction project



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USING ARGOS FOR TURTLE DOVE MANAGEMENT

By Hervé Lormée,
Office nationale de la chasse
et de la faune sauvage

The European Turtle Dove *Streptopelia turtur* shows one of the most dramatic population decline among all farmland bird species breeding in Western Europe, abundance having been reduced by 78% over the 1980-2013 period (PECBMS 2014). Accordingly, the species was recently listed as vulnerable (VU) on the IUCN Red list (BirdLife 2015).

Changes in agricultural practices and the consecutive degradation of breeding conditions most likely play a role in population decline, through

a reduction in breeding productivity (Browne & Aebischer 2004). However, this trans-Saharan migrant species spends two thirds of its annual cycle either along migration routes or in its sub-sahelian wintering quarters. Consequently, the species may also face additional environmental threats, with significant consequences on population dynamics (Newton 2004). In this context, the identification of migration routes, major stopover sites and wintering habitats is a crucial issue to predict the consequences of changes in land use, as well as the impact of hunting pressure, on population dynamics, and for developing appropriate conservation measures (Kirby et al. 2008).

Taking advantage of the miniaturised Argos solar powered satellite transmitter (PTT), we report here tracking data obtained in the course of a pioneering study conducted from 2013 to 2016 on Turtle Doves tagged in France. //



SATELLITE-TRACKING TO CREATE THE DEMOGRAPHIC EVIDENCE-BASE FOR THE SUSTAINABLE MANAGEMENT OF HUNTED ASIAN HOUBARA

By Robert J. Burnside, University of East Anglia

The migratory Asian Houbara *Chlamydotis macqueenii* is threatened (IUCN Vulnerable) and declining primarily due to over-exploitation by Arab falconers.

We have taken an evidence-based approach to sustainable hunting to understand how captive breeding and release can contribute to population stabilisation under scenarios of regulated hunting. Using a powerful combination of fieldwork and tracking with Argos satellite tags we quantify the demography (productivity and survival rates) and migration strategies of both wild and captive-bred birds to develop a stochastic population model. Results suggest that wintering rates of hunting and poaching of wild birds are currently unsustainable. To avoid the genetic erosion of the current wild stock requires hunters to accept scientifically determined quotas, and also requires coordinated transboundary conservation efforts across flyway states, that would limit the winter mortalities to a sustainable level.

© R. J. Burnside UEA-BirdLife-EBBCC



USING ARGOS TO TRACK LARGE PELAGICS



POP-UP TAGGING OF TROPICAL
TUNA IN THE ATLANTIC OCEAN:
THE EXPERIENCES OF THE ATLANTIC
OCEAN TROPICAL TUNA TAGGING
PROGRAMME BY DOUG BEARE, ICCAT

THE ATLANTIC OCEAN TROPICAL TUNA TAGGING PROGRAMME

**is a five year duration
project funded by the EU
(DG-DEVCO) and ICCAT
signatory countries (CPCs).**

Its aim is to improve the management of the three main tropical tuna stocks (bigeye, skipjack and yellowfin) in the Atlantic using up-to-date population parameters, such as growth and mortality, estimated from different types of tag-recapture information. AOTTP is using a range of different types of tags including spaghetti tags, electronic (pop-up and internal archival) tags and is chemically tagging fish to make ageing from otoliths easier. To date, AOTTP has deployed just over 100 pop-up tags. Two different suppliers have been used so far: Wildlife Computers and Desert Star (although the programme has recently purchased 30 tags from Microwave Telemetry). In this presentation, the results achieved with the pop-up tags on the programme will be summarized. So far, the results have been disappointing overall; and certainly in the context of the objective of the electronic tagging activity which sought improved understanding of long-distance migrations by tropical tuna. Many of the pop-up tags deployed by AOTTP had very short retention durations on the fish due to hardware issues, predation and also being caught by fishermen. Tuna behavior (very fast swimming, deep diving) itself also renders them a particularly challenging target species for this type of tag. Project planning was also hampered by two recalls to address technical problems identified. The idiosyncracies of the 2 types of tag will be discussed in the context of an ocean-wide tagging programme. Finally the results will be discussed in the context of the information available from the other types of tagging and standard fisheries landings and effort data. //



© P. Miller 2017



Photo courtesy of Doug Beare

23

**DESERT STAR
ARGOS TAGS DEPLOYED
(19 ON BIGEYE AND
4 ON YELLOWFIN).**

76

**WILDLIFE COMPUTERS
ARGOS TAGS DEPLOYED
(22 ON BIGEYE AND 54)
SO FAR.**

2

**YEARS WORKING
WITH ARGOS SYSTEM**

192

**DAYS :
LONGEST TRACK
TO DATE.**

Doug Baere
ICCAT and
the ICCAT tuna
tagging team
in Sao Tome.





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USE OF ARGOS DATA FOR FISHERIES MANAGEMENT & CONSERVATION: ICCAT PERSPECTIVE

The ICCAT Atlantic Wide Research Programme for Bluefin Tuna (ICCAT GBYP) started with electronic tag activities on Atlantic bluefin tuna *Thunnus thynnus* in 2011, when the first few Argos pop-up satellite tags were deployed.

The main objective of this tagging programme is to unveil Atlantic Bluefin spatial patterns in order to determine the mixing rates between the Western and Eastern stocks of this species, the

first spawning in the Gulf of Mexico and the latter in the Mediterranean, respectively, but overlapping in Atlantic Ocean foraging grounds, which is crucial for a proper evaluation and management of this emblematic species. Over the course of 7 years, up to 2017, within the framework of this Programme, or in joint actions with other institutions (WWF, IEO), more than 342 electronic pop-up tags have been deployed in different areas of the Mediterranean Sea and the Eastern Atlantic. For the purpose of estimating bluefin geolocations and movements from tag data, all available datasets were processed using best available CLS algorithms. In 2018 ICCAT GBYP plans to continue with tagging activities, by deploying 60 pop-up tags in several areas of NE Atlantic, from Portugal coasts to Norwegian. //

400

TAGS ON ATLANTIC
BLUEFIN DATA DEPLOYED
DIRECTLY BY THE GBYP
PROGRAMME
BETWEEN 2011-END 2018

1,219

E-TAGS

8

YEARS USING
ARGOS SYSTEM

360

DAYS LONGEST
TRACK RECORDED FROM
A TAG DEPLOYED ON
JUVENILE BLUEFIN TUNA IN
THE BAY OF BISCAY

364

KILOGRAMS: LARGEST
ATLANTIC
BLUEFIN TUNA TO WEAR
AN ARGOS TAG. TAG
DEPLOYED IN MAY 2012
OFF MO-ROCCO, BUT WAS
UNFORTUNATELY SHED OFF
AFTER ONLY 6 DAYS



*In general the e-tagging programme is crucial for determining the spatial patterns of bluefin tuna (*Thunnus thynnus*) across the Atlantic. Given that the Atlantic Bluefin tuna is composed by two different stocks, West and East, the first spawning in Gulf of Mexico and surrounding areas and the second in the Mediterranean, but which overlap in several feeding areas of the Atlantic Ocean, to implement a proper and reliable management system it is indispensable to get precise information about the proportion of fishes from each stock in every statistical area, and this is possible mainly thanks to the electronic tagging programme which makes use of Argos system.*

NEW INSIGHTS ON PORBEAGLE STOCK STRUCTURE IN THE NORTH EAST ATLANTIC FROM PSAT DEPLOYMENTS

By Gérard BIAIS, IFREMER

The porbeagle *Lamna nasus* is a large pelagic shark found throughout the North Atlantic.

The state of the stock remains unknown in the North East Atlantic. However, presuming that this stock might be at risk, UE banned its fishing in 2010. This decision raised requests of improving the assessment of the state of this stock in France, because

the fishing ban severely affected several boats of Yeu Island. With a disrupted commercial catch series, it was a challenge because a scientific survey at sea was the only way to get abundance indices with a fishing ban, but the knowledge of porbeagle distribution must be improved to plan it at an acceptable cost. As a first step, 15 PSATs (Pop-up Satellite Archival Tag) were consequently deployed in 2011 and 2013. They showed evidence of porbeagle site fidelity to the Bay of Biscay shelf break in spring-summer, raising the hypothesis of several populations in the North East Atlantic. Although it must be demonstrated by further tagging, it seemed likely enough to support the launch an abundance survey limited to the Bay of Biscay shelf break in May-June 2018, given that it could be combined with PSAT deployments (31 achieved). //

52
WILDLIFE
COMPUTERS ARGOS
TAGS DEPLOYED
SINCE 2011

7 YEARS
USING THE
ARGOS SYSTEM

365 DAYS
LONGEST TRACK
RECORDED



Colshark Program



© COLSHARK-DRDH/Fundacion Malpelo

COLSHARK PROGRAM: FIRST SATELLITE TAGGING OF THRESHER SHARK IN EASTERN TROPICAL PACIFIC OCEAN

By Armelle Jung, Des requins et des hommes

The pelagic thresher shark *Alopias pelagicus* is one of the largest and most abundant open ocean predators in the Eastern Tropical Pacific (ETP), and one of the most exploited sharks in the sub-region. *A. pelagicus* has been classified as Vulnerable on the IUCN Red List since 2004.

Nonetheless, little is known about the biology and ecology of this species and the pelagic thresher shark is consequently recognized as the highest priority species for management in the Colombian Shark Action Plan (IPOA) which encourages research activities for the study of its biology and ecology. Short-term research activities include the study of the migrations and movement patterns along the Pacific Coast while population genetics are identified as long-term activities. *Des requins et des hommes* (DRDH) with the Foundation Malpelo and the Direction of Colombian Fisheries (AUNAP), created in 2012 the COLSHARK program to study this species. One of the objectives was to organize for the first time in the ETP, a scientific fishery expedition to tag pelagic thresher sharks off Pacific Colombian coasts. A ten days tagging expedition took place in March 2013 in Bahía Solano (Golfo de Tribugá): 11 satellite mini PAT tags and 20 visual tags were successfully deployed. After 6 months, 10 satellite tags have been released and first analysis of *Alopias pelagicus* movement patterns in ETP.

CO-AUTHORS : Sandra BESSUDO, Lina Maria QUINTERO, Cécile BRIGAUDEAU

SILVER EEL MIGRATION BEHAVIOUR IN THE MEDITERRANEAN SEA

By **Elsa Amilhat**,
University of Perpignan

Although Mediterranean ecosystems such as coastal lagoons are known to be productive habitats providing numerous silver eels in short generation time, migration routes used by silver eels in the Mediterranean Sea have been poorly studied. Using pop-up Argos satellite tags during escapement from coastal waters, we determined 3 migratory behaviours: on the continental shelf, on the deeper water (>200 m) and on the Gibraltar Strait. Tagged silver eels exhibited similar behaviour on the continental shelf, following continuously deeper water. Once in deeper water, they quickly

established diel vertical migration (DVM). A high percentage of tagged eels were taken by predators within the Mediterranean, but four eels reached the Atlantic Ocean and three at distances greater than 2000 km from release. These eels ceased their DVM while they negotiated the Gibraltar Strait, and remained in deep water until they reached the Atlantic Ocean, when they recommenced DVM. Our results are the first to show that eels from the Mediterranean can cross the Strait of Gibraltar and continue their migration into the Atlantic Ocean. This finding suggests that Mediterranean countries, as for other EU states, have an important role to play in the conservation and the recovery of the European eel stock. //

Co-authors: Kim Aarestrup, Elisabeth Faliex, Gaël Simon, Christophe Menniti, Thomas Scourzic, Håkan Westerberg, David Righton



© Simon

A silver eel equipped with an Argos pop-up tag. Photo courtesy of Elsa Amilhat.



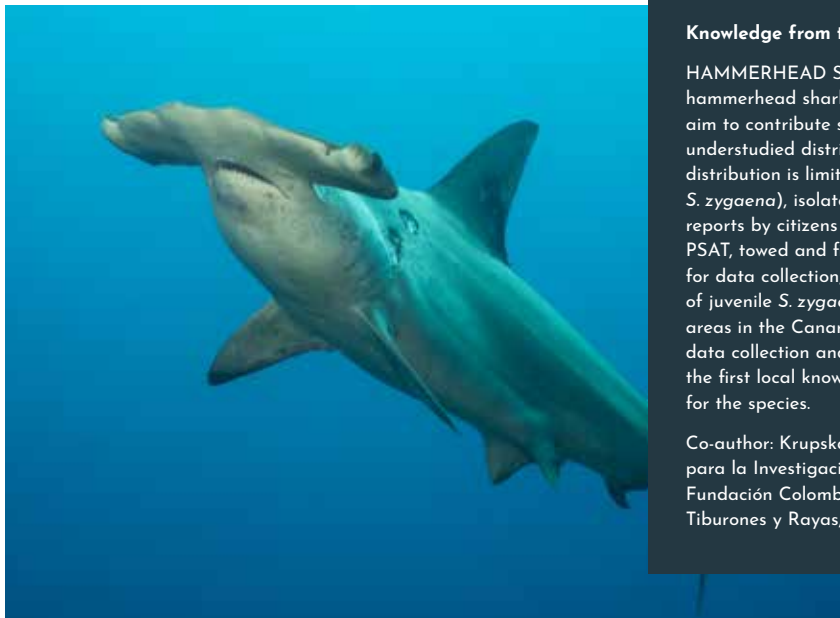
HAMMERHEAD SHARK RESEARCH

Filip Osaer, ELASMOCAN, Fundación Colombiana para la Investigación y Conservación de Tiburones y Rayas, SQUALUS

Knowledge from the populations in the Canary Islands

HAMMERHEAD SHARK RESEARCH is a project that studies hammerhead sharks *Sphyrna* spp in the Canary Islands with the aim to contribute scientific base knowledge of these species in an understudied distribution. Information of hammerheads in this distribution is limited to the presence of two species (*S. lewini* and *S. zygaena*), isolated records about behavior, and scant sighting reports by citizens in social media. Satellite telemetry (archival PSAT, towed and fin-mounted SPOT), using the Argos-network for data collection, is employed to get insights in the behavior of juvenile *S. zygaena*, and to understand the role of the coastal areas in the Canary Islands in the life cycle of these sharks. Future data collection and subsequent analysis is required to document the first local knowledge that can help in effective decision making for the species.

Co-author: Krupskaya Narváez, ELASMOCAN, Asociación Canaria para la Investigación y Conservación de los Elasmobranchios, Fundación Colombiana para la Investigación y Conservación de Tiburones y Rayas, SQUALUS



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LONG-TIME SERIES OF ARGOS DATA FOR HISTORIC BIRD STUDIES



YEAR-ROUND SATELLITE
TRACKING OF AMUR
FALCON REVEALS THE
LONGEST MIGRATION
OF ANY RAPTOR SPECIES
ACROSS THE OPEN SEA

BY BERND MEYBURG, BIRDLIFE GERMANY (NABU)

THE TITLE FOR UNDERTAKING THE MOST ARDUOUS OF ALL RAPTOR MIGRATIONS, belongs certainly to the Amur Falcon *Falco amurensis*, which is a complete transcontinental, transequatorial, long-distance flocking migrant.

The principal breeding (mainly NE China) and wintering (mainly S. Africa) ranges are separated by both 70° of latitude and longitude. Details of the species' spring migration route have been almost completely unknown. Since 2010 we have tracked 10 adult falcons fitted with 5 gram solar-powered satellite transmitters.

The spring migration is a non-stop flight across the Indian Ocean from Somalia to India, covering 2,500 - 3,100 km of open water. The assumption of an ocean crossing in autumn is confirmed by our data. Eight ocean crossings by one female were recorded during 2010-2014, establishing that the migration of Amur Falcon regularly includes the longest (2,400 - 3,150 km) open-sea crossing of any bird of prey species. In total, both southbound and northbound migrations lasted about two months, and the distance as measured by the paths used by the birds between the breeding grounds and the wintering areas was about 14,600 kilometres. The annual cycle of Amur Falcon takes advantage of existing ecological and environmental conditions. Monsoons provide tailwinds for migrating falcons in both directions. //

Co-authors: PAUL HOWEY, Microwave Telemetry, RINA PRETORIUS, BirdLife, CHRISTIANE MEYBURG, World Working Group on Birds of Prey

THE ANNUAL CYCLE OF GERMAN ADULT OSPREYS

Studies in the breeding and wintering areas as well as during migration since 1995 by means of satellite telemetry

During 1995 - 2011 we marked 28 adult Ospreys *Pandion haliaetus* in NE-Germany with satellite tags working up to eight years. All except three males wintered in West Africa. The migratory paths followed while in Europe seemed much straighter and more directional compared to the migratory paths followed in Africa. This pattern was related to wind conditions, whereby individuals drifted with winds as they crossed the Sahara, then compensated as they approached their destination causing a more diffuse pattern in migratory paths. Consequently, individuals were fairly consistent in their use of routes between years in Europe, but not in Africa. Males started their autumn migration at the very end of the breeding season when the young have left, whereas females typically commenced migration much earlier, long before the young became independent. In contrast, the timing of the onset of spring migration showed little variation in either sex. However, while males showed little variation in arrival time on the breeding grounds, female arrival times were more variable. The difference between the sexes in the variance in arrival dates is perhaps due to the pressure on males to arrive at breeding places early in order to find and defend a high-quality breeding territory.

Co-authors: Dietrich Roepke, Christiane Meyburg, Andreas Bass, Rien E. van Wijk



© C. Meyburg



Bernd Meyburg, BirdLife Germany (NABU)



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USING ARGOS FOR RESEARCH & CONSERVATION



Loggerhead turtle equipped
with a satellite tag.

TRACKING TURTLES TO INFORM CONSERVATION

I have been tracking turtles using the Argos system for 20 years and have been involved in collaborative projects that have tagged over 500 hundred animals across the world.

This has led to fundamental and applied insights for the populations in question but also provided a number of lessons that are useful to the wider animal tracking community. At the European User Conference on Argos Wildlife (<http://www.argos-system.org/eucaw/>), I will elaborate on a number of case studies, in order to highlight the progress that has been made and how the true dividends of such work are still to be gained. //



“

I am a conservation scientist with wide ranging interests in biodiversity conservation. My research largely focuses on the study of marine vertebrates (turtles, mammals, birds and sharks). In the last few years, I have spent ever more efforts on interdisciplinary approaches to conservation research, including focussing on the issue of microplastics in our oceans. I now help co-ordinate the University of Exeter's marine strategy.

”

For more information:

<https://www.exeter.ac.uk/research/marine/>

20

YEARS USING
THE ARGOS SYSTEM

500

ANIMALS TAGGED
WORLDWIDE



© Photo courtesy of Brendan Godley.

A leatherback turtle
equipped with an
Argos tag by night.



© P. Chambault

COMBINING ARGOS AND GENETICS TO REVEAL CONNECTING PATHS BETWEEN JUVENILE AND ADULT HABITATS IN THE ATLANTIC GREEN TURTLE

Philippine Chambault, IFREMER/IPHC-CNRS

Although it is commonly assumed that female sea turtles always return to the beach where they hatched, the pathways they use during the years preceding their first reproduction and their natal origins are most often unknown, as it is the case for juvenile green turtles found in Martinique waters in the Caribbean.

We performed Mixed Stock Analysis (MSA) on 118 green turtles sampled in Martinique Island and satellite tracked 32 juvenile green turtles tagged in Martinique to: (1) assess their natal origin and (2) identify their destination. Our results from MSA confirm that these juveniles are descendant from females laying on several Caribbean and Atlantic beaches, mostly from Suriname and French Guiana, but also from more Southern Brazilian beaches. The extensive movements of the migrant turtles evidenced the crossing of international waters and more than 25 exclusive economic zones, reinforcing the need for an international cooperative network to ensure the conservation of future breeders in this endangered species. This raises the migration of juveniles from French Guiana and Suriname before arriving to Martinique, and the potential for either passive or active migration from nesting beaches to feeding grounds.

Co-authors : Benoît de Thoisy, Maïlis Huguin, Damien Chevallier



OCEANOGRAPHIC TURTLES: INTEGRATION OF SEA TURTLE TRACKING WITH OCEAN OBSERVING SYSTEMS

By David March, SOCIB

The project "Oceanographic Turtles" aims to provide the scientific basis to support the development of risk mitigation techniques based on new ocean observing and forecasting systems and contribute to the conservation of marine turtles.

In this work, I focus on the integration of Argos satellite tracking of sea turtles with ocean observing systems (OOS). More specifically, I will present the most significant advances that have been developed in the three key parts of the project:

- 1 / Analysis of satellite trajectories in relation to environmental factors and human impacts.
- 2 / Real-time multiplatform experiments that combine data from animal-borne sensors with different ocean observing platforms (submarine drones, drifting buoys, remote sensing) and numerical models of oceanographic conditions.
- 3 / Development of technical applications, like Tweeting Turtles, to automate the processing of Argos tags in real-time and delayed mode.

I will illustrate this approach using time-temperature-depth recorders (TTDR), Fastloc-GPS, and Argos platform terminal transmitters (PTT) on juvenile loggerhead turtles *Caretta caretta* in the Mediterranean Sea. //

David March.



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THE FUTURE OF ARGOS SATELLITE TELEMETRY

Kinéis is a team of men and women with a passion for space technologies who were the pioneering founders of the Argos location and data collection system. These men and women share the same dream: to make a system available for everyone that will enable us to understand animal migrations, to unravel the mysteries of the oceans and reach new frontiers in data collection and tracking. They have now created the next revolution: Kineis's network connectivity, a high-performance system that is both affordable and easy to use. The constellation of nanosatellites supporting Kineis connectivity is unprecedented. It is tailor-made for the Internet of Things in cooperation with strategic partners. By end 2021, this new, universal connectivity will make IoT connectivity available for everyone.

CLS, GLOBAL OPERATOR
OF THE ARGOS SYSTEM,
WISHES TO:

- ensure continuity of this historic service
- increase the level of service, and then
- remain a key partner of the international scientific community

To reach this goal, CLS decided to create a structure dedicated to the location and data collection system named Kinéis.

Its missions:

- Operate the Argos system,
- Find financial means, technological innovations to ensure both continuity of service and higher performance
- Increase the overall efficiency of the system

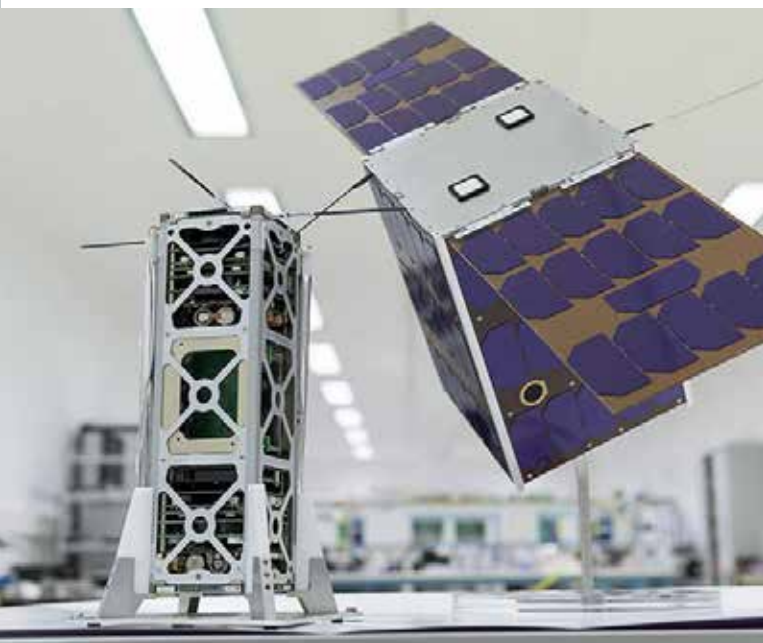


Learn more about Kinéis,
the future Argos-compatible constellation : www.kineis.com

THE ARGOS CHIPSET

CLS and its partners have developed revolutionary new technology, an Argos chipset for uplink and downlink communication.

Its small size and weight, just 7 mm x 7 mm and under 1 gram, are noteworthy. Low cost and easy to integrate, it gives Argos satellite connectivity to the smallest, most light-weight tags. Compatible with all existing Argos generations (2, 3 and 4), its flexible configuration allows it to benefit from several decades of technical improvements. Indeed, by regularly receiving the up-to-date satellite orbit parameters, the tag is able to transmit only when a satellite is in sight, thus saving precious battery lifetime. Besides, recognizing the generation of an in-sight satellite allows it to adapt its transmission strategy and parameters for better efficiency (satellite pass prediction, interactive protocol, high data rate capabilities, etc). The chip can also receive remote commands, for reconfiguration of either transmission or data collection settings. The increased efficiency has had knock-on benefits that have unveiled new opportunities for better, less invasive tracking. This makes it easier to monitor how wildlife is coping in our fast-changing environment. //



© CNES

View of the first Argos Nanosatellite ANGELS (on the right), precursor of the future Kinéis nanosat, with an Argos4NG payload. The constellation of 20 nanosats makes it possible to have a much faster revisit time (<20 minutes anywhere).

+200

THE NUMBER OF CHIPSETS
INTEGRATED INTO ANIMAL
TRACKING DEVICES AS OF
NOVEMBER 2018



© CLS

The Argos chipset developed by CLS and its partners measures just 7 mm x 7 mm and weighs under 1 gram.

We welcome your contributions!
We know your work is interesting.
Let us publish it!
mchildress@groupcls.com



The future of Argos is Kinéis :
A new constellation of 20 nanosats
coming in 2021