#### WORLD METEOROLOGICAL ORGANIZATION

INTERGOVERNMENTAL OCEANOGRAPHIC COMMISSION (OF UNESCO)

ARGOS JOINT TARIFF AGREEMENT

ARGOS-JTA-XXXI/Doc. 6 REV. 8 (5-oct-11)

THIRTY-FIRST SESSION

GENEVA, SWITZERLAND 3-5 OCTOBER 2011 ENGLISH ONLY

**ITEM: 10** 

#### NATIONAL REPORTS

(Submitted by Representatives of Country (ROCs))

#### Summary and purpose of the document

This documents provides for the reports on Argos related national activities during the last intersessional period.

#### **ACTION PROPOSED**

The Meeting will be invited to comment, and particularly make decisions or recommendatio ns, as appropriate, on the following topics:

(a) Note and comment on the information contained in this document; and

(b) Take into account the contents of the report when discussing relevant agenda items.

**Appendices**: National reports form Canada, China, Germany, India, Netherlands, New Zealand, Russia, South Africa, Spain, Sweden, Switzerland, United Arab Emirates.

# APPENDIX

# NATIONAL REPORTS TO THE JTA (JTA National Report on Current and Planned Argos Use)

Year	2011
Country	CANADA

# Section 1. Overall Summaries of Programs

As in previous years, animal tracking has dominated Argos activity in Canada this year with meteorological and oceanographic applications being significant Argos participants. The effects of Arctic climate change on migration and dispersion of species such as caribou, polar bears, arctic fox, snowy owl and seals are being studied intensely and Argos technology is contributing strongly to wildlife management efforts.

Only 23 operational programmes operated by 85 managers replied to the questionnaire, some overlapping and some reporting no activity. Among these, animal trackers dominate with strong representation from large ungulate and seabird research. Ocean moored and drifting buoys operated by Environment Canada are also significant programs along with the Argo programme of drifting, profiling floats operated through the Department of Fisheries and Oceans.

Below are the responding programmes' summaries in order of their usage to date, from highest to lowest. All responders were very well satisfied with their service with some suggesting improvements which will be covered in the appropriate sections below.

1. Canadian Argo Profiling Floats Argos Programme Number 2442 Agency: Department of Fisheries and Oceans http://www.meds-sdmm.dfo-mpo.gc.ca/isdm-gdsi/argo/index-eng.html

Canada is deploying profiling floats in the north Atlantic and north Pacific in support of Argo, which is a component of the Global Ocean Observing System. Data from around the world is freely available to all and can be accessed through two Argo data centres.



NEUTRAL Summer Ocean Temperature (°C) at 0010 m depth

# 2. Ecology and Conservation of Northern Carnivores Argos Programme Number 2846 Agency: University of Alberta

Large carnivore ecology, conservation, and management are the focus of projects in my lab. My interests are to conduct research to improve our understanding the ecology of large carnivores with specific reference to how they are affected by human activities. My research over the past 20 years has focussed on polar bears but I have a broad interest in all carnivores and plans are to expand the number of species as opportunities arise. My main focus will be north of 60° N working in cooperation with territorial and federal government agencies.

Current species under study are polar bears in the Beaufort Sea and Hudson Bay, grizzly bears in the Mackenzie Delta, and wolves in the Central Rockies Ecosystem.



Placing a GPS –ARGOS satellite linked telemetry collar on an adult female grizzly bear near Inuvik, NT. The objective of this study is to examine the habitat use and movements of grizzly bears in the oil and gas development in the Mackenzie Delta to develop mitigative measures.

## 3. Arctic Fox Tracking Argos Programme Number 3297 Agency: Université du Québec à Rimouski

The main objective of our program is to better understand habitat use and large scale movements of arctic foxes throughout the seasons in the Canadian Arctic. Our program also include red foxes, which are gradually expanding their range to higher latitudes. In addition to characterizing both species movements, our objective is to better understand interactions between these two species, factors influencing their movements such as food resources availability, sea ice composition, and juvenile dispersal in the current climate change context. This program will continue again for 2012 with 20 to 30 collars active.



# 4. Caribou and Wood Bison Tracking in Northwest Territories Argos Programme Number 2814 Agency: Government of Northwest Territories, Department of Environment & Natural Resources, Fort Simpson

- a. Two programs both with similar goals but with different species of northern large ungulates; boreal woodland caribou and wood bison.
- b. Location information to address movements, range use, seasonality, calving timing/location, critical habitats at landscape level as well as finer detail.
- c. Caribou, satellite and majority GPS collars, currently 25. Should be maintaining 25-30 for at least another 3 years.
- d. Bison, satellite and GPS collars, currently 7. These will be monitored throughout remaining 14-20 month lifespan. After this future undecided on more collaring.
- e. All animals range in SW NWT Dehcho Region and into NE BC and NW AB.



# 5. Bird Tracking at Environment Canada (EC) Argos Programme Number 22375 Agency: Environment Canada, PYR Region

We plan to continue to mark birds with implant transmitters for the foreseeable future. I have at least another 2 years of marking to do for Barrows goldeneye and then will move on to other species.

Also, I have just arranged for a multi-year, national, standing offer between EC and CLS America so that requisitions for contracts can be set up easily by any EC researcher.



# 6. Arctic Marine Bird Tracking Argos Programme Number 2443 Agency: Environment Canada

My study has been ongoing since 2003, tracking various types of Arctic marine birds to determine the timing of their movements, key habitats that they use when away from the breeding colony, and their use of international waters.

#### 7. Government of Quebec Has Three Caribou Tracking Programs Argos Programme Numbers 959, 22857, 4229 Agency: Ministère des Ressources naturelles et de la Faune du Quebec

The Argos service is used to locate caribou. The data is used for scientific research and management purposes.



### 8. Canadian Ice Service, Ice Fragment Tracking Argos Programme Number 633 Agency: Canadian Ice Service (CIS)

Through partnership with NRC-Canadian Hydraulics Centre, the Canadian Coast Guard (CCG), and the University of Ottawa, the CIS beacon program consists of the following:

Previous year deployments still transmitting (3 CALIBs)

One CALIB from 2009, (PTT 16795) on an Ice Shelf fragment in the central Arctic; not expected to transmit much longer.

Two CALIBs from 2010, (PTT 12993 & 12994) both on Ice Shelf fragments; one in the high Arctic the other in the central Arctic.

2011 deployments and attempted deployments to date

In March 2011, 4 CALIBs (PTT 11254, 12995, 12997 and 16797) were deployed along the Labrador Coast and transmitted for a period of less than one week (wind storm crushed the ice).

Also in March 2011, one CALIB (PTT 93694) was successfully launched in the central Arctic to replace PTT 16795 but failed to transmit after deployment (approximately two weeks of transmitting occurred during the testing period).

Anticipated further 2011 deployments

Two CALIBs (PTT 16791 & 16792) are expected to be deployed in late August / September 2011 on multi-year ice floes or Ice Island fragments in the Western Arctic as part of the MetArea program.

One CALIB (PTT 16793) to be deployed in Baffin Bay in August 2011

One CALIB (PTT 11247) was expected to be deployed in July 2011, but its deployment is now uncertain.

#### 9. Ring-Billed Gull Tracking Argos Programme Number 4203 Agency: Université du Québec à Montréal

We have 22 22-g solar GPS PTTs to track Ring-billed gulls marked in a breeding colony near Montreal, Quebec. Our main objective is to study the post-breeding dispersal of these birds and to identify their migration routes and wintering areas. This is part of a larger study on the ecology of this species (http://gull.uqam.ca).Ten birds were marked in 2010 and 14 in 2011 including 2 PTTs that were recovered from last year. A proportion of birds dispersed rapidly in late summer in all directions before they undertook they fall migration to their wintering areas. Some birds, however, remain in the Montreal area before leaving for the winter. We will continue our tracking until the PTT will last. Tracking the same birds over a year is particularly interesting to determine fidelity in the dispersal pattern.



# 10. Canadian Arctic Marine Mammels Tracking Argos Programme Number 1142 Agency: Fisheries and Oceans Canada

Canadian Arctic marine mammals are instrumented with satellite-linked position only or time-depth recorders and tracked for 6 months to a year depending on the success of the attachment and provided there is no damage to the equipment. At present, this program targets bowhead whales, beluga, narwhals, killer whales and ringed seals. The objectives are to understand the seasonal spatial distribution of the animals, the habitat use and their dive activity. This information is important to assess their numbers and trends and to understand their habitat requirements.

## 11. Raptor Tracking Argos Programme Number 2900 Agency: Environment Canada

I will continue to track three species of raptors; peregrine falcons, short-eared owls and burrowing owls. Funding limits the sample size to 10 transmitters currently.

# 12. Department of National Defence Search and Rescue Argos Programme Number 2019 Agency: Department of National Defence (Canada)

DND utilizes Argos to track and report location on the Self Locating Datum Marker Buoy (SLDMB) that is used to refine search area parameters for Search and Rescue. The SLDMB is programmable to one of 99 discrete channels to permit flexibility for multiple searches. Annual usage is highly variable since it depends on the number and types of searches. Usage tends to be highest in late Summer and early Fall.

# 13. Greater Snow Geese Tracking Argos Programme Number 3082 Agency: Service canadien de la faune, Environnement Canada

The main objective of the program is a large monitoring program on Greater Snow Geese. The Greater Snow Goose is an overabundant population and conditions that led to this situation are still present of even increasing (development of agriculture and climate changes) and the impacts on their staging and reproductive habitat are not well known. The Canadian Wildlife Service from Environment Canada had published a management plan. The conclusions of this project will help us for a good follow-up of the population and habitat, one of the objectives of the plan. The data from the Argos system will be used on two different projects. The first one is to validate the survey methodology used to evaluate population size from the annual spring survey. The proportion of radio marked geese detected during the spring survey will be used to estimate the proportion of the population not photographed by the survey. This will allow us to develop an index enabling us to evaluate the real population size, the management plan basis. The second project is the monitoring of bird migration from the East Coast of the United States where they overwinter, to the High Arctic (Bylot Island) where they reproduce. We want to learn more about the landscape structure of the habitat use by the geese and their related reproductive output. The Argos system is the only way to follow them over such a large range. Environment Canada (Canadian Wildlife Service) has three main partners in these projects, Université de Sherbrooke, Université du Québec à Rimouski et Université du Québec à Montréal. We are at the end of the project.

#### 14. Snowy Owl Tracking Argos Programme Number 3471 Agency: Department of Biology and Centre d'études nordiques, Université Laval

The objective of my program is to study annual movements, habitat use and breeding dispersal of arctic-nesting birds. The main species of interest is the snowy owl. During the first phase of the project, we deployed 12 PTTs on Bylot Island (NU) in summer 2007 and 4 additional ones on Herschel Island (YK) in 2008. We successfully tracked these animals across the Canadian Arctic for up to 3 years, until summer 2010. This program has revealed new and expected information on migratory movements, habitat use and breeding dispersal of this nomadic species. Winter use of sea-ice by snowy owls in the eastern Canadian Arctic was documented, a behaviour that was previously unknown. We intend to continue this project as we have 17 new PTTs ready to deploy. However, we were unsuccessful in catching snowy owls on Bylot Island in summer 2011. We will try again in summer 2012.

# 15. Canada Lynx Argos Programme Number 3816 Agency: University of Alberta

The Canada lynx is listed as a threatened species in the US under the US Endangered Species Act and lynx numbers are low in the southern portions of Alberta and BC. The agencies responsible for management of Canadian lynx and lynx habitat in both Canada and the US need information on which to make sound management decisions. The overall objectives of the Lynx Cycles and Barriers (Lynx CAB) project are to determine the distribution, habitat requirements, population dynamics, and dispersal potential of lynx in Canada and their connection with US populations.

Little is known about the habitat needs and selection of dispersing lynx. Even with "adequate" gene flow to maintain a genetically connected population, the cycles of lynx in the southern range may depend on substantial immigration from the northern core of the population. Tracking live lynx is the only way to add to the knowledge of habitat selection, which is vital to maintain lynx in the southern range and to maintain immigration corridors. Lynx are the most widely dispersing land

mammals on earth, with recorded movements up to 1500km. Although in winter it is possible to snow track animals through some habitats, this only provides a restricted picture of habitat use compared to typical lynx movement. This is a unique opportunity to gather movement data on dispersing lynx, with a high likelihood of gathering data even when the subjects leave the immediate study area.



Photo by Keith Williams

# 16. Tracking Problem Bears Argos Programme Number 1015 Agency: Parks Canada

Radio telemetry collars with Argos satellite & GPS technology have been used successfully for monitoring bears in scientific research projects in Kluane National Park for many years. We hope to continue to use this technology to monitor bears that have been involved in negative human bear interactions and have been deemed problem bears. These bears are difficult to monitor and in many cases end up being destroyed. By being able to capture and radio collar these bears and monitor their activities in real time it may provide additional opportunities for alternative management response (i.e. aversive conditioning) rather than simply destroying the bear. Continuing to utilize a limited number of GPS collars with Argos uplink capability on bears that we handle as part of our management activities may result in fewer control kills as well as an opportunity to augment existing data.

As bears become increasingly pressured by human development and activity it is crucial that we develop new methods to deal with human wildlife problems if we ultimately want to preserve grizzly bears and their habitat.



Photo by Harvey Barrison

# 17. Drifters in the Great Lakes Argos Programme Number 3041 Agency: Environment Canada

The purpose of this program is to track four Clearwater, surface layer drifters which will be deployed during periodic times throughout the summer months (April-October). The units will be deployed during selected periods (while other experiments are being conducted at the same location) throughout the summer season, mainly in the Great Lakes (and elsewhere in Canada) to assist in measuring the water velocity at the surface for these water bodies.

# 18. Wild Turkey Habitat Study Argos Programme Number 4196 Agency: Ministère des ressources naturelles et de la faune

We will use GPS/ARGOS transmitters to identify precisely habitat used by wild turkey. We have put PTT on 11 wild turkeys in January 2011 and followed them all year long. However, worst climatic conditions (heavy snow) during winter 2011 have resulted to a high mortality on wild turkey populations, as a result that actually only 2 animals are still alive. We expected to capture others wild turkey in January 2012 to increase the number of animals with PTT in our study site.



# Section 2. User types by family in Canada (projected to year-end)

Overall, animal tracking accounts for 77% of usage in Canada and the total usage is not expected to exceed 210 PTT-Years.

	Average active PTTs per month	Total PPT Years
Buoys and others		41.7
Profiling floats		8.3
Animals		165.7
Fixed stations		0
TOTAL		215.7

# Section 3. Technological Changes that Effect User Requirements

CLS's Iridium services have benefitted the Argo program:

"Canadian Argo has just one float operating on the CLS/Rudics system. This float has so far returned 110 perfect high-resolution profiles since launch in 2008. We conclude that this is a very successful process and we should be looking to increase the number of floats using Iridium."

I don't know if this is possible but it would be great if Argos could set up a program that automatically checks the PTT temperature sensor to determine if the bird has died (eg, temperature < 37 deg C) and then to warn the user. The problem is that if we don't check our data on a daily basis and if a bird dies and continues to transmit then it costs \$ for data that are pretty well useless.

One issue has to do with the optimal duty cycle to use at different latitudes. In the sea duck world we want to lengthen the DC as much as possible to achieve PTT longevity to understand site fidelity across years while at the same time recording enough high quality data for each season, and not wasting data (and \$). Some ON periods (eg 4-5h ON) generate lots of high quality data that we can't use due to pseudoreplication. We are experimenting with 2h ON periods and having some success... my point here is that Argos should be working with researchers directly (and supplying free data) to determine the optimum DCs, rather than the researchers having to experiment on their own and at their own expense.

#### Section 4. User Issues, Problems and Level of Satisfaction with Argos

The level of satisfaction was almost universally high in spite of some issues noted below.

"We have cancelled our ArgosDirect service because it proved to be very expensive (ranging between 10 to 50% of Argos monthly cost). We are now only requesting monthly Databank CD. The issue with that service is that the CD arrives 3 weeks into the following month. A faster delivery service would prove a better value."

"We continue to have issue with the rigidity of breaking a transmission day down into four 6-hour periods 0000-0559, 0600-1159, 1200-1759, and 1800-2359 UTC. This creates unnecessary restrictiveness when setting transmission schedules that are of 4-6 hours in length. Can't we be billed for actual usage given some minimum?" (To some extent, the 12 days per month capping addresses this issue.)

"Service Argos is a straight-forward system to use and the company, CLS, is easy to work with. I always find CLS employees to be highly responsive to my needs."

Development is encouraged toward smaller transmitter with reduced power consumption and more accurate locations.

Keeping the data available a bit longer would help one user: Request: "access to more than the last 10 days of data ".

Lynx Tracking: "Level of satisfaction was high. Battery pack was bulky. Would have preferred to have a different VHF signal when battery was running low."

#### Section 5. Successful Programme Use of Argos

All users felt that their Argos-based programs were successful.

"The best news about Argos is that it has been around for a long time, worked well 20 years ago and continues to work well today. Well done."

"The data provided through Argos has been instrumental in the successful completion of many Search and Rescue incidents since 1999 and has also contributed significantly to DND's knowledge and understanding of ocean currents and conditions."

"The extra services provided by CLS to upload beacon/buoy messages onto GTS is always a great help. It allowed the program to run relatively smoothly with minimal involvements from Operational Staff."

"Arctic Marine mammals travel great distances and live in remote location where access is very expensive and limited in time. The use of Argos satellite tracking devices has proved to be the most cost effective way of studying those species. Over the past 20+ years, the Argos system has allowed us to gather significant information on the movements, diving behaviour and habitat use. The work continues as the tag technology is improving and more environmental data are becoming available. Now the challenge is to analyse the large amount of data into valuable species specific habitat use, migration pattern and movement range."

"Argos satellite data are essential to meet our needs of tracking remote breeding birds, and has been very effective for us since 2003."

"In the past year I have successfully tracked peregrine falcons, short-eared owls and burrowing owls."

Argos allowed us to track a male lynx as he completed a 200 km dispersal outside of the study area. The 2-hour GPS fix data was the first of its kind to be recorded on this type of journey.

We are still in the process of getting the data but we already shoed some fidelity in dispersal patterns of ring-billed gulls.

Telemetric data is central to study animal behaviour. The remoteness of our study area requires satellite transmissions to obtain geographic information on a regular basis. This data is a key aspect in the management of caribou.

For boreal caribou work has been essential in our providing information at the national level for critical habitat and ultimately the production of a recovery strategy. The quality of has been critical in describing how boreal caribou use the landscape in the southwestern Northwest Territories. First Nation's people have begun to embrace the importance of the information provided by collared animals and have been using this scientific knowledge along with local traditional knowledge based studies to better understand boreal caribou location data collected over the past 5-8 years in the NT. Now we have managed to keep the collars on the wood bison the information has been key in expanding the known distribution of occupancy of animals and highlighting their constant

use of linear features on the landscape.

# Section 6. Analysis of Local Operational Issues

"We have discovered a result that is not unexpected but has to be accounted for in our study of boreal caribou. In some localized parts of the boreal forest in this region there are relatively expansive stands of high density tall timber. Some of the individually collared caribou whose annual home ranges include these stands tend to spend more time in them than other caribou. The collars on these caribou that frequent these stands have had shorter life spans than anticipated and shorter than the other caribou in the study. We have attributed this to the increased length of time it will take to get a satellite fix from within these more heavily timbered stands." Note: The Russians have similar problems and have developed a new antenna. It might be worth adopting their approach.

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#### NATIONAL REPORTS TO THE JTA (JTA National Report on Current and Planned Argos Use)

Year	2011
Country	CHINA

### Section1. Overall Summery

In 2011, there are 16 institutes or organizations operating 21 programs using Argos to transmit data in China. The total of average active PTTS per month is 105.28 and profiling floats take up larger proportion which is over 50%.

# Section2. User Types by family (Table of PTT use by the country)

Family	Average active PTTS per month	Total PTT. Years
Buoys and others	27.14	10.68
Profiling floats	55.71	2.89
Animals	21.85	1.38
Fixed stations	0.57	0.265
Total	105.28	15.22

# Section3. Technological changes that affect user requirements

# Section4. User issues, problems, and level of satisfaction with ARGOS

There is one thing we need propose. An institute may miss its data on some occasions. The charge for historical data is very high. Actually, the data had been paid. So, could it be free or cheaper for historical data requiring?

Section5.Successful program use of ARGOS

# Section6. Analysis of Local Operational Issues

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# NATIONAL REPORTS TO THE JTA (JTA National Report on Current and Planned Argos Use)

Year	2011
Country	GERMANY

Year: 2011 Country: Germany

(please delete text in italic and replace with actual information)

# Section 1. Overall Summary

# 1. Water masses in the Nordic Seas

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53, 20146 Hamburg, Germany

ARGOS Programme Number 592

The aim of the program is to monitor the water masses in the different basins of the Nordic Seas with the data from profiling floats (Greenland Sea, Norwegian Sea, Iceland Sea, Lofoten Basin). Since 2001 floats were deployed in the Greenland Sea, since 2004 also in the Norwegian Sea and Lofoten Basin and since 2005 in the Iceland Sea. Changes in the water mass transformation processes and therefore also in the water mass characteristics in the context of climate change are examined. The floats are part of the international ARGO programme. No more floats have been period. More information available deployed in the report is at http://www.ifm.zmaw.de/forschung/regionale/projekte/mersea/





Data profiles collected from Argo Floats in the period 2001-2011.

# 2. Hamburg Ice Buoy Programme

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Meteorological Institute, ZMAW, University of Hamburg, Bundesstr. 55, 20146 Hamburg, Germany ARGOS Programme Number 636

The project studies processes in key regions of the climate system using air crafts and data buoys. Examples are atmospheric cold air outbreaks and their influence on deep water production in the North Atlantic and the influence of cyclones on the advection of Atlantic waters into the Arctic. More information is available at <u>http://www.mi.uni-hamburg.de/8.0.html</u>

# 3. IFM-GEOMAR: Mooring ARGOS beacon

Jürgen Fischer, <u>JFISCHER@IFM-GEOMAR.DE</u> Leibniz-Institut für Meereswissenschaften, IFM-GEOMAR, Düsternbrooker Weg 20, 24105 Kiel, Germany ARGOS Programme Number 783

The aim of the project is to monitor subsurface moorings that get accidentally are at drift by using ARGOS beacons. The beacons are equipped with a pressure or conductivity sensitive switch which activate them when at the sea surface. More information is available at <u>http://www.ifm-geomar.de/index.php?id=physoz&no\_cache=1</u>

# 4. Sea ice processes in polar regions

Gerd Rohardt, Gerd.Rohardt@awi.de

Alfred Wegener Institute, P.O.Box 120161, 27515 Bremerhaven, Germany ARGOS Programme Number 919

The aim of the project is to monitor moorings with Argos watchdogs. More information is available at

http://www.awi.de/de/forschung/fachbereiche/klimawissenschaften/messende\_ozeanographie/instr umente/verankerungen/

# 5. Norwave

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Germany

ARGOS Programme Number 948

The Norwave measurements take place at fixed monitoring stations in the North Sea and Baltic Sea (see Marnet programme). Waverider buoys are measuring sea state conditions, one of these is transmitting data through the ARGOS satellite system. Watchdog services are used for the other buoys. More information is available at <a href="http://www.bsh.de/de/Meeresdaten/Beobachtungen/Seegang/index.jsp">http://www.bsh.de/de/Meeresdaten/Beobachtungen/Seegang/index.jsp</a>



Permanent measurement stations in the North Sea and Baltic equipped with wave instruments.

# 6. Bird migration in Africa and Eurasia - a pilot study

Max Planck Research Centre for ornithology, Migration and Immuno-ecology (Vogelwarte Radolfzell), Schloß Möggingen, Schloßallee 2, 78315 Radolfzell, Germany Martin Wikelski, <u>martin@ORN.MPG:DE</u> ARGOS Programme Number 983

The International Cooperation for Animal Research Using Space (ICARUS) mission is working towards establishing a remote sensing platform for scientists world-wide that can track small organisms globally, enabling observations and experiments over large spatial scales. A white paper is available at <a href="http://www.icarusinitiative.org">http://www.icarusinitiative.org</a>





Global satellite tracking of small animals by ICARUS - International Cooperation for Animal Research Using Space

#### ARGOS-JTA-XXXI/Doc. 6 REV. 8, Appendix, p. 16

# 7. Migration of raptors

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World working group on birds of prey and owls (Berlin), Wangenheimstr. 32, D-14193 BERLIN, Germany.

ARGOS Programme Number 1126

The W.W.G.B.P. has been active for thirty years now and today plays an important role in the promotion of raptor conservation and research on an international level. Its membership list today comprises over 3,000 raptor specialists and enthusiasts in all parts of the world, and anybody with an interest in raptors is welcome to become a member. The W.W:G.B.O tracks birds of prey world-wide since 1992. Theses raptors are belonging to 14 species. Resulting publications are available as PDF files: www.raptor-research.de".

More information is available at http://www.raptors-international.de/index.htm



# 8. Migratory behaviour of Antarctic seals

Joachim Plötz, <u>JPLOETZ@AWI-BREMERHAVEN.DE</u> Alfred Wegener Institute, P.O.Box 120161, 27515 Bremerhaven, Germany ARGOS Programme Number 1535 The Marine Mammal Tracking (MMT) project of AWI and its Partner Institutions concentrates on the Southern Ocean. Variations in the foraging ranges and movements of marine mammals are an important source of information about environmental variability integrated over a wide range of spatial and temporal scales. The complex synthesis of data on marine mammal positioning and feeding locations with oceanography and bathymetry aims to identify those parameters which are characteristic for feeding areas of top predators in the respective regions, and will provide clues as to why some areas of the Antarctic Ocean are important to these animals while others are not. This will further our understanding of the distribution patterns of marine mammals in Antarctic and Subantarctic marine ecosystems of the Southern Ocean. More information is availabe at <a href="http://www.wdc-mare.org/projects/mmt.html">http://www.wdc-mare.org/projects/mmt.html</a>



Tagged southern elephant seal.

# 9. IfM-Geomar: gliders

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ARGOS Programme Number 1783

The gliders are equipped with Argos beacons to be located in case other navigational and communication devices fail. More information is available at <u>http://www.ifm-geomar.de/index.php?id=glider</u>



Testing a glider at sea.

# 10. Bigset

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ARGOS Programme Number 1806

The project BIGSET (in situ experiments using benthic chamber landers ) studies processes at the benthic boundary layer. The autonomous instrument carrier systems are equipped with ARGOS beacons for retrival. The landers are usually deployed on the seafloor at depths of several hundred to 6,000 metres beyond the reach of remote sensing and conventional systems. More information is available at <a href="http://www.ifm-geomar.de/index.php?id=mg\_observatorien">http://www.ifm-geomar.de/index.php?id=mg\_observatorien</a>

# 11. Tracking of penguins at sea

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Antarctic Research Trust, Am Oste-Hamme-Kanal 10, 27432 Bremervörde, Germany

ARGOS Programme Number 1857

In this project the foraging behavior of penguins in the Southern Ocean is investigated on a seasonal and inter-annual scale. The project is momentarily suspended but is expected to continue in 2012. More information is available at <a href="http://www.antarctic-research.de/">http://www.antarctic-research.de/</a>



Equipment of Black-browed Albatross fledglings from South Georgia with satellite transmitters to study their postnatal dispersal

# 12. German-Argo/BSH

Birgit Klein, <u>BIRGIT.KLEIN@BSH.DE</u> Bundesamt für Seeschifffahrt und Hydrographie, Bernhard-Nocht-Str. 78, 20359 Hamburg, Germany ARGOS Programme Number 1895





The aim of the program is to contribute to the international Argo programme with about 50 floats per year. Presently all 116 BSH floats are transmitting their data through the ARGOS system. The BSH is using Argo data to monitor water mass changes in the North Atlantic since they are changing inflow conditions for waters entering the North Sea. Main deployment areas will be the Atlantic and source regions in which deep water formation occurs in the polar areas. More information is available at <a href="http://www.german-argo.de">http://www.german-argo.de</a>

# Positions and tracks of active floats in the BSH Argo-programme in the Atlantic

# 13. Marnet, BSH

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Germany

ARGOS Programme Number 2120

The Marnet program consists of fixed monitoring stations in the North Sea and Baltic Sea which measure oceanic parameters as temperature, salinity, oxygen and currents in the water column. Waverider buoys are measuring sea state conditions, one of these is transmitting data through the ARGOS satellite system. Watchdog services are used for the other buoys. More information is available at <a href="http://www.bsh.de/de/Meeresdaten/Beobachtungen/MARNET-Messnetz/index.jsp">http://www.bsh.de/de/Meeresdaten/Beobachtungen/MARNET-Messnetz/index.jsp</a>



Positions of fixed measurement stations in the North Sea and Baltic (MARNET).

# 14. IfM-Geomar: moored data buoys

Johannes Karstensen, jkarstensen@ifm-geomar.de

Leibniz-Institut für Meereswissenschaften, IFM-GEOMAR, Düsternbrooker Weg 20, 24105 Kiel, Germany

ARGOS Programme Number 2736

The project uses Argos telemetry to transmit mooring data in near-real time to land. A surface module collects data from subsurface instrumentation which are inductively coupled to the mooring wire. Subsequently the surface module transmits the data via ARGOS telemetry to a land station. More information is available at <u>http://www.ifm-geomar.de/index.php?id=telemetrie</u> and <a href="http://www.eurosites.info/cis/data.php">http://www.eurosites.info/cis/data.php</a>

Number of active beacon PPTs: 1



Figure: Temperature data from 12 instruments between 10 and 1000m depth from the Central Irminger Sea. This data has been transmitted between June 2009 and April 2010 via an ARGOS based surface telemetry buoy.

# 15. Iffezheimer Störche auf Reisen

Herbert König, <u>KINGSCASTLE@T-ONLINE.DE</u> Initiativgruppe Naturschutz, Severin-Schäfer-Str. 3, 76473 Iffezheim ARGOS Programme Number 3100

The conservation initiative Iffezheim has ringed a storch in 2006 which hatched in Iffezheim. The Argos transmitter is used to study the migrationary behaviour of this bird. More information is available at <a href="http://www.iniffezheim.de/">http://www.iniffezheim.de/</a>



# 16. European Whitefronted Geese ResearchProject, European whitefronted goose

# (Blessgans)

Helmut Kruckenberg, HELMUT.KRUCKENBERG@BLESSGANS.de

Europäisches Blessgans Forschungsprogramm, Am Steigbügel 3, D-27283 Verden (Aller),

Germany

ARGOS Programme Number 3189

The project studies the European White-fronted Goose (Anser albifrons)- its migration, behavior, and ecology. The White-fronted Goose is the most numerous goose species wintering in Western Europe. By satellite tracking important new facts about migration behavior and routes were found. The project used microwave GPS transmitters for 36 birds and relays data via ARGOS, a special internet tool (live tracking) based on GoogleEarth was developed in 2006. With support of Vogelschutz-Komitee e.V. and Alterra Institute Wageningen. More information is available at <a href="http://www.blessgans.de">http://www.blessgans.de</a>

# Reports / Publications:

Kruckenberg, H., A. Kondratyev, J.H. Mooij, C. Zöckler & E. Zaynagutdinova (2008): White-fronted Goose Flyway Population Status. – Angewandte Feldbiologie 2: 1-63. ISSN 1861-227X Kruckenberg, H., G.M.M.J. Müskens & B.S. Ebbinge (2007): Satellitentelemetrie von Blässgänsen Anser albifrons aubifrons auf dem Frühjahrszug 2006 und 2007. – Vogelwarte 45: 330-331 Kruckenberg, H., G.M.M.J. Müskens & B.S. Ebbinge (2008): Satellite tracking of Greater White-fronted Geese Anser albifrons during spring migration 2006 - preliminary results. – Vogelwelt 129: 338-342.

Kruckenberg, H., J. Bellebaum, G. Müskens, B.S.Ebbinge & A.Kondratyev (eingereicht): Tracking European Greater Whitefronts Anser albifrons by satellite transmitters during spring migration in 2006, 2007 and 2008. Ornis Svecica spec. issue.

van Wijk, R. E., A. Kölzsch, H. Kruckenberg, B. S. Ebbinge, G.J.D.M. Müskens & B.A.Nolet (eingereicht): Individually tracked geese follow the green wave during spring migration. OIKOS



Transmittered bird (Geert) with its mate (c) K. Veldkamp

# 17. Montagu's Harrier

Klaus-Michael Exo, MICHAEL.EXO@IFV-VOGELWARTE.DE

Institut für Vogelforschung, "Vogelwarte Helgoland", An der Vogelwarte 21, 26386 Wilhelmshaven,

Germany

ARGOS Programme Number 3338

The project studies the migration routes as well as the location of stopover sites and wintering areas of Circus pygargus (Montagu's Harrier, Wiesenweihe) breeding in NW- and NE- Europe, respectively. Circus pygargus is an endangered long distance migrant, breeding in northern Germany and wintering in W-Africa. A report can be downloaded at http://www.fh-oow.de/ifv//downloads/96/wiesenweihe dbu abschlussbericht ifv jan 2009.pdf.



Montagu's harrier Rudi on its migration

# 18. Biota Maroc, Hamburg University

Manfred Finckh, MFINCKH@BOTANIK.UNI-HAMBURG.DE

Biozentrum Klein Flottbek, Systematik der Pflanzen, Ohnhorststr. 18, D-22609 Hamburg,

Germany

ARGOS Programme Number 3455

Biota Maroc is part of the BIOTA AFRICA project invented by African and German researchers aiming at the establishment of research supporting sustainable use and conservation of biodiversity in Africa. The project tracked movements of 3 nomadic herds in the Atlas mountain range using ARGOS and GPS transmitters. More information is available at <a href="http://www.biota-africa.org/">http://www.biota-africa.org/</a>



Photos from Biota MAROC testsides

# 19. ESA precursor, Tracking of individual birds

Klaus-Michael Exo, MICHAEL.EXO@IFV-VOGELWARTE.DE

Institut für Vogelforschung, "Vogelwarte Helgoland", An der Vogelwarte 21, 26386 Wilhelmshaven,

Germany

ARGOS Programme Number3490

The project is carried out in the context of the ESA FlySafe activities. It analyses the technical prospects and limits in using satellite based bird tracking and monitors small scale and large scale movements. The work includes analyses of medium- and long-range bird migration behavior as well as smale scale feeding flights (study species: Herring Gull Larus argentatus, Lesser black-backed Gull Larus fuscus, Barnacle Geese Branta leucopsis). A report is available at http://www.fh-oow.de/ifv//downloads/96/esa\_report\_sovon\_cover\_2008-10.pdf



Figure 5.1. from esa\_report\_sovon\_cover\_2009-10.pdf. Herring Gull marked M.AFH carrying GPS PTT 41750 on the beach of Texel, Netherlands, on 24-10-2007. Photograph by Pieter Veeling.

20. Transdrift-TR

Guenther Heinemann, HEINEMANN@UNI-TRIER.DE

Umweltmeteorologie, Uiniverstität Trier, Behringstraße 21 (Campus II), 54286 Trier, Germany ARGOS Programme Number 3635

The project uses data buoys to study the effects of polynjas in the Laptev sea for the system atmosphere-ocean-sea ice. More information is available at <a href="http://www.uni-trier.de/index.php?id=15138&L=2#c21459">http://www.uni-trier.de/index.php?id=15138&L=2#c21459</a>

# 21. Hobby falcon

Bernd Meyburg, BUMeyburg@aol.com

World working group on birds of prey and owls, Wangenheimstr. 32, D-14193 BERLIN, Germany. ARGOS Programme Number 4126 (sub-PGM of PGM 1126)

The W.W.G.B.P. has been active for thirty years now and today plays an important role in the promotion of raptor conservation and research on an international level. Its membership list today comprises over 3,000 raptor specialists and enthusiasts in all parts of the world, and anybody with an interest in raptors is welcome to become a member. The W.W.G.B.O tracks birds of prey world-wide since 1992. Theses raptors are belonging to 14 species. Resulting publications are available as PDF files: www.raptor-research.de".

More information is available at http://www.raptors-international.de/index.htm

# 22. Argo Floats

Jürgen Fischer, <u>JFISCHER@IFM-GEOMAR.DE</u> Leibniz-Institut für Meereswissenschaften, IFM-GEOMAR, Düsternbrooker Weg 20, 24105 Kiel, Germany ARGOS Programme Number 8165

The project studies the circulation and water mass anomalies in the tropics using autonomous profilers. The floats are part of the international ARGO programme. More information is available at <a href="http://www.ifm-geomar.de/index.php?id=argo">http://www.ifm-geomar.de/index.php?id=argo</a>

# 23. Subsurface mooring monitoring

Gerd Rohardt, <u>Gerd.Rohardt@awi.de</u> Alfred Wegener Institute, P.O.Box 120161, 27515 Bremerhaven, Germany ARGOS Programme Number 8919 (sub-program 919)

The aim of the project is to monitor moorings with Argos watchdogs. More information is availabe at

http://www.awi.de/de/forschung/fachbereiche/klimawissenschaften/messende\_ozeanographie/instr umente/verankerungen/

# 24. Norwave

Dieter Schrader, Dieter.Schrader@BSH.de

Bundesamt für Seeschifffahrt und Hydrographie, Bernhard-Nocht-Str. 78, 20359 Hamburg,

Germany

ARGOS Programme Number 9948 (see 948)

The Norwave measurements take place at fixed monitoring stations in the North Sea and Baltic Sea (see Marnet programme). Waverider buoys are measuring sea state conditions, one of these is transmitting data through the ARGOS satellite system. Watchdog services are used for the other buoys. <u>http://www.bsh.de/de/Meeresdaten/Beobachtungen/Seegang/index.jsp</u>

# 25. Bulgaria

# Bernd Meyburg, <u>BUMeyburg@aol.com</u>

World working group on birds of prey and owls, Wangenheimstr. 32, D-14193 BERLIN, Germany. ARGOS Programme Number 10126 (SS PGM 1126)

The W.W.G.B.P. has been active for thirty years now and today plays an important role in the promotion of raptor conservation and research on an international level. Its membership list today comprises over 3,000 raptor specialists and enthusiasts in all parts of the world, and anybody with an interest in raptors is welcome to become a member. The W.W:G.B.O tracks birds of prey world-wide since 1992. Theses raptors are belonging to 14 species. Resulting publications are available as PDF files: www.raptor-research.de".

More information is available at http://www.raptors-international.de/index.htm

# 26. Argo sub-surface

Olaf Boebel, <u>OBOEBEL@AWI-BREMERHAVEN.DE</u> Alfred Wegener Institute, P.O.Box 120161, 27515 Bremerhaven, Germany ARGOS Programme Number 10919 (Sub-program of program 919)

The project studies variability and long-term changes in warm deep water in the Weddell Gyre. It also monitors convection events. The floats are equipped with special ice sensing technology to withstand the ice season during winter. The floats are part of the international ARGO programme. Due to winterly surface ice coverage the transmission of the floats are switching to Iridium, due to shorter surface transmission times. More information is available at <a href="http://www.awi.de/en/research/research\_divisions/climate\_science/observational\_oceanography/projects/weccon/">http://www.awi.de/en/research/research\_divisions/climate\_science/observational\_oceanography/projects/weccon/</a>



Nemo float deployed in the polar ocean.

# 27. Red Kite

# Bernd Meyburg, <u>BUMeyburg@aol.com</u>

World working group on birds of prey and owls, Wangenheimstr. 32, D-14193 BERLIN, Germany. ARGOS Programme Number 11126 (Sub-program of PGM 1126)

The W.W.G.B.P. has been active for thirty years now and today plays an important role in the promotion of raptor conservation and research on an international level. Its membership list today comprises over 3,000 raptor specialists and enthusiasts in all parts of the world, and anybody with an interest in raptors is welcome to become a member. The W.W:G.B.O tracks birds of prey world-wide since 1992. Theses raptors are belonging to 14 species. Resulting publications are available as PDF files: www.raptor-research.de".

More information is available at http://www.raptors-international.de/index.htm

# 28. Seismic ice flow drifter

Gerd Rohard, <u>Gerd.Rohardt@awi.de</u> Alfred Wegener Institute, P.O.Box 120161, 27515 Bremerhaven, Germany ARGOS Programme Number 12919 (sub-program of 919)

The project uses Argos beacons to locate seismometers on ice floats during expeditions. The use

of the beacons is suspended at the moment and will be used again in 2013. More information is available at

http://www.awi.de/en/research/research\_divisions/geosciences/geophysics/projects/seismology/sei smology\_ridges\_move/agave2007/?0= A lonely seismic station on an ice floe

#### 29. Imperial eagle

Bernd Meyburg, BUMeyburg@aol.com

World working group on birds of prey and owls, Wangenheimstr. 32, D-14193 BERLIN, Germany. ARGOS Programme Number 21126 (sub-PGM OF PGM 1126)

The W.W.G.B.P. has been active for thirty years now and today plays an important role in the promotion of raptor conservation and research on an international level. Its membership list today comprises over 3,000 raptor specialists and enthusiasts in all parts of the world, and anybody with an interest in raptors is welcome to become a member. The W.W:G.B.O tracks birds of prey world-wide since 1992. Theses raptors are belonging to 14 species. Resulting publications are available as PDF files: www.raptor-research.de".

More information is available at http://www.raptors-international.de/index.htm

#### 30. Eagles

Bernd Meyburg, <u>BUMeyburg@aol.com</u>

World working group on birds of prey and owls, Wangenheimstr. 32, D-14193 BERLIN, Germany ARGOS Programme Number 31136 (sub-PROGRAM OF PGM 1126)

The W.W.G.B.P. has been active for thirty years now and today plays an important role in the promotion of raptor conservation and research on an international level. Its membership list today comprises over 3,000 raptor specialists and enthusiasts in all parts of the world, and anybody with an interest in raptors is welcome to become a member. The W.W:G.B.O tracks birds of prey world-wide since 1992. Theses raptors are belonging to 14 species. Resulting publications are available as PDF files: www.raptor-research.de".

More information is available at http://www.raptors-international.de/index.htm

# 31. Studies to understand the decline in migratory waterbirds using the German Wadden Sea

Klaus-Michael Exo, MICHAEL.EXO@IFV-VOGELWARTE.DE

Institut für Vogelforschung, "Vogelwarte Helgoland", An der Vogelwarte 21, 26386 Wilhelmshaven,

Germany

ARGOS Programme Number 4852

About 40% of the birds using the Lower Saxony Wadden Sea during migration declined during the last decades. The main aim of the project is to analyze (ecological) factors that may cause the decline, therefore migration routes and connectivity between the Wadden Sea and Arctic breeding grounds as well as African wintering areas will be analyzed for a few selected species, the Grey Plover Pluvialis squatarola and the Bar-tailed Godwit Limosa Iapponica, using satellite transmitters as well as geolocators.

## Section 2. User Types by family (Table of PTT use by the country)

	Average active PTTs per month	Total PTT.Years
Buoys and others	34	
Profiling floats	~200	
Animals	hundreds	
Fixed stations	37	
TOTAL		

# Section 3. Technological Changes that Affect User Requirements

#### Section 4. User issues, problems, and level of satisfaction with ARGOS

Programme 6 is in contact with ARGOS to establish a link to MOVEBANK <a href="http://www.movebank.org/#page=search\_map">http://www.movebank.org/#page=search\_map</a> .

Programme 2 mentioned precision problems using ARGOS location in ice drift measurements. Temperature data were spiky. Is there a problem with interference from other transmitters?

Programme 16 mentioned the need for individual bills for each transmitter. The project costs are sponsered by private associations which would prefer to pay only for the transmitter for their respective animal.

Programme18 mentioned precision problems using ARGOS locations. Mountain effects resulted in few and imprecise locations. The allocation of a single time slot for transmission was also problematic and the costs of transmission were high compared to the project budget.

The bird trackers in general mentioned higher accuracy needs in locations and needs for smaller and lighter transmitters.

The collection of data for table 2 is difficult. Argos itself probably would be able to provide much more accurate numbers.

#### Section 5. Successful program use of ARGO (good news)

#### Section 6. Analysis of Local Operational Issues

The compilation of a list of users for each individual country helped a lot in compiling the national report.

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#### NATIONAL REPORTS TO THE JTA (JTA National Report on Current and Planned Argos Use)

Year	2011
Country	INDIA

# JTA National Report of India

(Report submitted by M. Ravichandran, INCOIS, India)

Year: 2011 Country: INDIA

Section 1. Overall Summary

India is using ARGOS services for Ocean Observation platforms such as Argo floats, drifting buoys and moored buoys. From next year, India will also use ARGOS services for fish tagging

Section 2. User Types by family (Table of PTT use by the country)

	Average active PTTs per month	Total PTT.Years
Buoys and others	20	18.77
Profiling floats	80	6.32
Animals	20	5.51
Fixed stations	10	7.18
TOTAL	130	37.78

#### Section 3. Technological Changes that Affect User Requirements

Since the bandwidth is low, we could not acquire higher vertical resolution of temperature and salinity. Also, the floats need to be longer time on the surface for transmission, it quickly drifting to the shore or beached. Further, we could not communicate to the float/buoy, once deployed. Hence, we started using some of the floats with Iridium communication. ARGOS can think about higher bandwidth and also two way communication.

Section 4. User issues, problems, and level of satisfaction with ARGOS

Though ARGOS could cater many useful services with low cost, bandwidth need to be increased. Also, more number satellites are required for the low latitude regions for better repeatability,

#### Section 5. Successful program use of ARGOS

Low cost, low power one way communication is very much suitable for some platforms, but it will not cater all platforms.

Section 6. Analysis of Local Operational Issues Nil

#### NATIONAL REPORTS TO THE JTA (JTA National Report on Current and Planned Argos Use)

Year	2011
Country	THE NETHERLANDS

#### Section 1. Overall Summary

# **Royal Netherlands Meteorological Institute**

Dutch Argo (2936)

#### Bureau Waardenburg for three different customers

Dutch Purple Herons Ardea purpurea, Eurasian Bittern Botaurus stellaris and Greylag Geese Anser anser with Satellite Transmitters (3447)

Herons and geese are equipped with transmitters. These include standard solar PTT transmitters as well as GPS-PTT transmitters. The aim is to track down migration routes and habitat use of birds in order top get information about protection of habitats. The project started in 2007 and is continued in 2010-2011. Prolongation depends on results in the first years and available budgets.

#### Institute for Marine and Atmospheric Research (IMAU)

Land ice change and sea level change monitoring (1238)

As a contribution to the European Project on Ice Coring in Antarctica (EPICA) IMAU has installed at one time a maximum of eight Automatic Weather Stations (AWS) in Dronning Maud Land, Antarctica. Four are currently operational. These AWSs were installed on a transect ranging from the coast to the plateau Amundsenisen, along the Swedish research stations Wasa and Svea.. The goal of this project is to extend the knowledge of the climatological conditions of this particular part of Antarctica and to obtain a better understanding of the surface energy and mass balance of the Antarctic ice sheet. Therefore surface and subsurface (bore holes up to 600 meters) temperatures, relative humidity, wind speed and direction, snow height, air pressure, short and long wave incoming and outgoing radiation is measured. Together with GPS positioning the data are transmitted as two hour averaged values through the ARGOS system. See for more information: http://www.phys.uu.nl/~wwwimau/research/ice\_climate/aws/aws\_ antarctica.html.

Beside the AWS we have also a combine ARGOS / GPS system, Automatic Velocity Monitoring System (AVMS) in Svalbard and Antarctic. At the end of this year/beginning next year our total number of ;

AVMS (GPS Svalbard 13 (2012). AVMS (GPS) Antarctica 6 (2012). AWS Antarctica 9 (2012).

#### Free University of Amsterdam, Centre for World Food Studies

FOLLOWING THE AFAR The program is in its initial phase and will start its activities by the end of 2011 or early 2012.

#### Natuurmomumenten

Protection of spoonbills along the west-palearctic (3685)

All PTT's are mounted on spoonbirds and make contact with an ARGOS satellite every three days to send PGS data

# Section 2. User Types by family (Table of PTT use by the country)

	Average active PTTs per month	Total PTT.Years
Buoys and others		
Profiling floats	36	2
Animals	5-10 plus 9	2007-2011 In 2011 a maximum of 11 platforms was active
Fixed stations	28 (2011)	17 (2011)
TOTAL	78-83	30

# Section 3. Technological Changes that Affect User Requirements

**Royal Netherlands Meteorological Institute** *n/a* 

Bureau Waardenburg for three different customers No comment

Institute for Marine and Atmospheric Research (IMAU) No comment

Free University of Amsterdam, Centre for World Food Studies No comment

#### Natuurmomumenten

No changes

#### Section 4. User issues, problems, and level of satisfaction with ARGOS

#### **Royal Netherlands Meteorological Institute** Highly satisfied – no problems

Bureau Waardenburg for three different customers

No comment

Institute for Marine and Atmospheric Research (IMAU) No comment

Free University of Amsterdam, Centre for World Food Studies No comment

Natuurmomumenten No comment

#### Section 5. Successful program use of ARGO (good news)

# Royal Netherlands Meteorological Institute n/a

#### Bureau Waardenburg for three different customers

The data handling and speed of data provision is satisfactory. Additional overviews of costs per transmitter ID provided by CLS, make it very easy to split costs for our subsequent customers.

#### Institute for Marine and Atmospheric Research (IMAU) No comment

Free University of Amsterdam, Centre for World Food Studies No comment

# Natuurmomumenten

No comment

# Section 6. Analysis of Local Operational Issues

**Royal Netherlands Meteorological Institute** *n/a* 

**Bureau Waardenburg for three different customers** *No issues to address* 

Institute for Marine and Atmospheric Research (IMAU) No comment

# Free University of Amsterdam, Centre for World Food Studies No comment

# Natuurmomumenten

No issues

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## NATIONAL REPORTS TO THE JTA (JTA National Report on Current and Planned Argos Use)

Year	2011
Country	NEW ZEALAND

### Section 1. Overall Summary

The NZ JTA Argos usage in 2011, consists of one large programme (MetService Buoy programme), and 8 smaller programmes covering a range of animal tracking applications and land conservation projects. The animal applications track birds, fish and mammals. An application monitoring crater lake levels and lake temperatures on an active volcano has been ongoing since 2009.

# Section 2. User Types by family (Table of PTT use by the country)

The Table below shows the major 2011 NZ usage, but is incomplete because only 5 Users (out of 9) provided input to this report.

	Average active PTTs per month	Total PTT.Years
Buoys and others	7	7
Profiling floats		
Animals	Number unknown	2+
Fixed stations	1	1
TOTAL	?	Approx. 10

#### Section 3. Technological Changes that Affect User Requirements

During 2011, MetService NZ has participated in the Iridium and the Argos3 Pilot Programmes by deploying buoys of each type to trial the systems. The hourly data from the Iridium buoys is available on GTS by H + 12 which is very timely. If MetService was to move to using Iridium for all buoys this would significantly impact on NZ Argos usage. Under this section, a NZ seal tracker commented that 'a change in algorithm was good'.

#### Section 4. User issues, problems, and level of satisfaction with ARGOS

In general, a high level of satisfaction with Argos was expressed by Users. MetService reported that User Office support was excellent and the processing and QC of buoy data for GTS is highly reliable. The Crater Lake Monitoring Programme said that the Argos system met their requirements, but that extra data capacity would be helpful. Other users had no issues.

#### Section 5. Successful program use of ARGOS (good news)

One user advised that many internationally peer reviewed papers on satellite tracking of NZ sea lions had been published. The MetService buoy programme is an operationally excellent programme for which data has been delivered 24/7 since the late1980s. The Shark tagging programme had successfully tracked white shark migrations to the tropics and back, had recorded a dive to 1200m, and had identified diel vertical migrations in porbeagle sharks. The Volcano Crater Lake monitoring is recording the temperature and level or the lake very hour, even when the PTT is buried in snow. This monitoring gives confidence that eruption precursory heating of the lake will be detected.

# Section 6. Analysis of Local Operational Issues

NZ Users have expressed satisfaction with the service provided by the Argos User Office in Melbourne. Users like the pay on consumption tariff, it is simpler for all and easier to understand and administer. MetService has some concerns about how the increased use of Iridium will impact on the future Argos JTA tariff price.

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# NATIONAL REPORTS TO THE JTA (JTA National Report on Current and Planned Argos Use)

Year	2011
Country	RUSSIA

#### Section 1. Overall Summary

The use of the Argos system for scientific research in Russia increased in 2011.

Russian scientific institutions continue to track Siberian cranes, gray whales, beluga whales, Greenland seals, tigers, wolves, reindeer, and brown, polar and Tibetan bears. At the same time, new monitoring programmes have begun for gray seals, leopards, snow leopards, musk oxen<sup>1</sup> and horses. Currently, teams of Russian scientists have started implementing tracking projects for walruses, snow sheep<sup>2</sup>, wild deer, elk, and wild boar.

The success scientists have had in tracking wild animals has prompted the organizations that control hunting in Russia to begin preparing the first project to monitor hunted animals. The aim is to collect data needed for the government to make decisions about authorized hunting seasons and zones. Projects for monitoring reindeer and elk are currently being prepared.

Finally, the latest project, which is very important for Russia, concerns the tracking of large herds of domestic animals. There is a clear need for satellite monitoring of horses in the Sakha Republic<sup>3</sup> (Yakutia), and of domestic reindeer in Chukotka<sup>4</sup>, in the Sakha Republic, and in the northern European part of Russia. For the first project of this kind, we began tracking domestic horses 200 km from Moscow.

Most of the projects mentioned above use equipment manufactured in Russia. Russian transmitter tags have been developed that take into account the very specific operating conditions namely the cold, the difficult terrain, the dense vegetation, and electromagnetic noise. Russian specialists continue to develop tags that are more and more reliable electronically and mechanically.

For maritime and Arctic studies, Russian organizations are continuing their research on ocean currents and ice movements in the Okhotsk Sea and projects for monitoring pack ice and icebergs in Northern Russia. A network of oceanographic buoys equipped with Argos transmitters was deployed in the Black Sea. The interesting results from these projects help in promoting Argos services for Russian scientific institutes specializing in maritime studies.

In addition, in 2011, the first Russian programme for transmitting environmental data using fixed<sup>5</sup> Argos stations was undertaken. This project aims to monitor the level and temperature of groundwater along the gas pipeline. Similar programmes are being prepared.

Most Russian maritime and environmental projects use Argos buoys<sup>6</sup> manufactured in Ukraine. The close relationship of the Russian and Ukrainian organizations has helped foster cooperation between Russian users and Ukrainian manufacturers. However, to facilitate the success of similar Russian projects, there are plans to develop the range of Russian Argos buoys using Ukrainian

<sup>1:</sup> http://en.wikipedia.org/wiki/Muskox

<sup>2:</sup> http://www.lhnet.org/snow-sheep/

<sup>3:</sup> http://en.wikipedia.org/wiki/Sakha\_Republic

<sup>4:</sup> http://en.wikipedia.org/wiki/Chukotka\_Autonomous\_Okrug

<sup>5:</sup> http://www.argos-system.org/html/services/tracking-monitoring\_en.html

<sup>6:</sup> http://www.argos-system.org/documents/publications/newsletter/anl\_57.pdf

equipment. The first joint project between Russia and Ukraine involves the development of an Argos buoy fitted with a parachute which can be dropped from an aircraft. Such a buoy could be conveniently deployed in the Arctic by an aircraft or helicopter and could help generate new applications of the Argos system.

	Average active PTTs per month	Total PTT. Years
Buoys and others	10	5
Profiling floats	0	0
Animals	34	8
Fixed stations	1	0.5
TOTAL	45	13

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Section 2.	User	i ypes by	y family	(Table of PTT	use b	y the country)

# Section 3. Technological Changes that Affect User Requirements

Russian scientific organizations conduct their animal monitoring programs under very unusual conditions of intense cold (down to -60°C), difficult terrain (mountains, hills), dense vegetation (especially in the Far East), and electromagnetic noise (particularly in the southern European part of Russia and in the Far East near the Chinese border). It is clear that these projects can only be successfully achieved by using equipment that is specially designed to withstand these conditions.

The Argos / GPS tags developed in Russia for monitoring wild land animals have the following features:

- Unlike collars made in other countries, which are composed of an electronic unit above and a battery unit below, the Russian Argos / GPS tag forms a single unit (electronics + antennas + batteries) attached to the collar just below the animal's head. Such a design eliminates the need for wires between the two units, which considerably enhances the mechanical reliability of the equipment;
- Despite this kind of design, and the less-than-optimal direction of the antenna, the tag is still able to define the GPS coordinates and to send Argos messages to satellites;
- to further enhance mechanical reliability, the Argos antenna is incorporated into the tag and protected by a layer of resin;
- the tag is capable of measuring the ambient temperature and then changing the operating modes depending on the season;
- Argos messages are encoded using a special code that can correct up to seven bit errors after the receipt of the message by the Argos system. Thus, nearly all of the messages received by the satellites can be read correctly in spite of the dense vegetation and electromagnetic noise;
- if problems occur in defining the GPS coordinates due to the specific behavior of an animal, the tag changes the operating mode and begins transmitting short messages to facilitate the location of the animal, by exploiting the Doppler effect ;

The operating periods for Argos transmitters are adapted to each specific project and even to each area in which wild animals are captured, taking into account when Argos satellites are scheduled

to pass overhead.

The development and implementation of this equipment has greatly improved animal monitoring in Russia. New products are being developed. The first Argos collar with a GPS / GLONASS receptor was recently commissioned. In addition, we have begun to study development opportunities for collars for the Argos-3 system.

# Section 4. User issues, problems, and level of satisfaction with ARGOS

The main problem in Russia is to ensure stable reception by satellites of messages from Argos tags subject to the unusual conditions of the Russian environment. Unfortunately, there is no way to solve this problem at the level of the satellite system or in the Argos data processing chain. Thus, the only way to solve the problem is to adapt Argos tags to these operating conditions. The development and adaptation of the tags is underway in Russia.

# Section 5. Successful programme use of ARGOS

In 2010 and 2011, Russian scientists achieved some very impressive results using the Argos system. Their main success concerns research on the Okhotsk-Korean population of gray whales. After decades of studying gray whales near Sakhalin Island without the use of space technology, an Argos transmitter was attached to a whale in 2010. Thanks to this tag, scientists were able to discover that the whale migrated to California instead of migrating to Korean waters as had been expected. Activity within the framework of this programme has increased in 2011.

Moreover, some results obtained from other programmes (monitoring of beluga whales, reindeer, etc.) are extremely interesting and call into question previous theoretical knowledge of Russian scientific organizations.

Lastly, in 2011, Russian organisations began to implement projects for relating the movements of marine animals obtained through the Argos system to oceanographic data and ice conditions in the areas studied. The preliminary results of this research are interesting and work in this area will continue.

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### NATIONAL REPORTS TO THE JTA (JTA National Report on Current and Planned Argos Use)

Year	2011
Country	SOUTH AFRICA

Role Player 1 – South African Weather Service

Role Player 2 – Institute for Maritime Technology

Role Player 3 – Ezemvelo KZN Wildlife

Role Player 4 – Department of Environmental Affairs

Role Player 5 - Percy FitzPatrick Institute of African Ornithology and DST/NRF Centre of Excellence

# Section 1. Overall Summary

RP1: As active members of the ISABP, IPBIO and IPAB, the South African Weather Service uses the Argos System to transmit data from the drifting weather buoys as well as the fixed stations (on the Islands of South Thule and Tristan da Cunha).

RP2: South Africa receives, archives and makes available Argo float data to its user community and participating organizations via the Southern African Data Centre for Oceanography (SADCO). It is evident that the number of profiles from this source is increasing at a faster rate that from other sources and is especially so in the past 5 -10 year.

It is a perception that the value of this resource has not been realized fully here yet, but that it is an extremely important to continue. A single example of a PhD student using Argo data is provided below in Section 6.

It is proposed here that Argo Executives consider a new parallel technology to cover for the data shortfall on all continental shelf regions (see section3).

RP3: Argos GPS solar PTTs are currently being used for wildlife tracking purposes. These PTTs have been fitted to bearded Vultures whose distribution range covers the Maluti-Drakensberg Mountain range in southern Africa. The project is part of the implementation of the Bearded Vulture conservation Action Plan which aims to determine and address the threats to the species to reduce the decline in population numbers.

RP4: The deployment of 20 loggerhead turtle PTT's at Kosi Bay (Jan 2011 and Dec 2011) will form the single largest deployment for the group. These turtles breed within South Africa where they are protected, but move outside of South African territorial waters where they become susceptible to fishing by-catch.

Presently 10 sub Antarctic fur seals have been satellite tagged and 8 are currently transmitting at the Prince Edward Islands. Two PAT tags will be deployed during 2011,

16 PTT's for seabirds were deployed at Prince Edward Islands and one black footed cat collar was deployed at Kimberly. These are transmitting 5 hours a day to save costs.

RP5: Satellite data is used to quantify the movements of Ground-Hornbills in the Associated Private Nature Reserves of South Africa ranging in the temporal scale from hourly to annually. The patterns of habitat of the more- and less successful breeding groups can now be compared and

linked to satellite and aerial images.

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	Average month	active	PTTs	per	Total PTT.Years
Buoys and others	33				46.2
Profiling floats	16				16
Animals	20				20.2
Fixed stations	2				2
TOTAL	71				84.4

# Section 3. Technological Changes that Affect User Requirements

Role players 3-5 do not have comments on this section

RP1: It was previously reported that additional HRPT stations should be installed to improve the data delivery time. Confirmation has been received that CNES/CLS will install one new station on Ascension Island (South Atlantic) and one at Cape Town. This is very exciting news and we are looking forward to the installation.

RP2. It is proposed here that Argo executives consider development of a similar concept as drifting Argo floats but using a recently proven new retractable technology for the shelf (shallow water) regions as developed by the Institute for Maritime Technology. Further communications to explore this are requested.

### Section 4. User issues, problems, and level of satisfaction with ARGOS

RP1: As mentioned in Section 3, the data delivery time should improve once the two new HRPT stations have been installed. In general the South African Weather Service is satisfied with the service that we receive.

RP2: The number of datasets in the oceanic regions of Southern Africa have contributed significantly to the data pool of information and in some cases exceeded those measured by other means, especially in the past 5 years. This increase in available profile information provided a valuable resource for the local scientific community whom has not really taken large advantage of yet.

RP3: Reduced costs for wildlife monitoring programs are welcome since this program is funded by provincial conservation organisations and donors. This is particularly true for GPS data which cannot be obtained via the website.

The immobility detection works to a limited extent.

RP4: Satellite costs to the user are becoming a major proportion of costs with respect to user's budget requests.

RP5: We are very satisfied with the service and performance of Argos. Since the project started, only one set of data has 'gone missing' (not received).

#### Section 5. Successful program use of ARGO

RP1: Since South Africa is in a data sparse region of the Southern Hemisphere, being able to track and monitor the drifting weather buoys is a big advantage.

RP2: Significantly added to the Temperature salinity data pool within the Southern African Data

Centre for Oceanography (SADCO)

RP3: To date 16 Bearded Vultures have successfully been tracked using the Argos system. Valuable data on their seasonal movement patterns and threats to the species (i.e. cause of death) have been obtained.

RP4: ARGOS has been highly successful in revealing the distribution and movement of Top Predators but despite new filters accuracy of standard Ptt reports still show high variation in the 0 codes.

RP5: This study involves satellite tracking of Southern Ground-Hornbills Bucorvus leadbeateri in the Associated Private Nature Reserves (APNR), South Africa. This 180 000 ha privately owned conservation area lies adjacent to Kruger National Park. The conservation status of groundhornbills in South Africa is of grave concern, with the species having lost ca 65% of its range and numbers in the past three generations (100 years). The birds are cooperative breeders, living in groups within which only the dominant pair breeds. However, they disperse singly: successful dispersal thus depends on the disperser joining an existing group. For this reason, their potential for self-reintroduction to areas from which they have disappeared is very low, even if the cause of their initial disappearance is no longer operative. For this reason, managed reintroduction is the only option for recolonisation. This is effected through the harvesting of second chicks (which invariably die in the wild), raising these in captivity to maturity, forming 'managed' groups and releasing these into the wild. This is a very expensive process, making it imperative to ensure that the probability of successful reintroduction and reproduction are maximised. This requires an understanding of optimal habitat configurations for ground-hornbill groups - the primary objective of this study. We have 10 years of reproductive data for the APNR ground-hornbills, indicating that groups vary greatly in their reproductive success. We suspect that much of this variability is explained by habitat quality, but quantifying habitat usage by the birds on the ground is tricky because a) groups occupy exclusive home ranges of ca 100 km<sup>2</sup> (and are therefore difficult to locate), and b) the terrain is such that by the time an observer can approach closely enough to quantify the birds' behaviour, the birds' behaviour changes. Even radio tracking has failed to solve these problems. However, satellite data allow us to quantify movements (plotted on an existing geo-referenced vegetation map) at temporal scales from hourly to seasonally or annually. We can thus compare patterns of habitat usage by successful and less successful groups, and link these to satellite imagery/aerial photography of the same area. Once this is done, we can use GIS technology to identify potential reintroduction sites where habitat configurations are optimal for the birds.

# Section 6. Analysis of Local Operational Issues

Role players 1 and 3 - 5 do not have comments on this section

RP2: Used in naval oceanographic research projects.

Case study – Argo floats data specifically used within an explorative project to predict thermal water column conditions from a single sea surface value (e.g. Remote sensed SST). PhD study in progress.

Compiled by S.Marais and S. du Toit and approved by Johan Stander For the JTA National Report, July 2011

### NATIONAL REPORTS TO THE JTA (JTA National Report on Current and Planned Argos Use)

Year	2011
Country	SPAIN

# Section 1. Overall Summary

Animal tracking dominated Argos activity in Spain in 2011. 45 programs for Wildlife and 13 for Oceanography are currently active. The animal applications track mainly birds, mammals, fish and sea turtles, in importance order.

# Section 2. User Types by family (Table of PTT use by the country)

	Average active PTTs per month	Total PTT.Years
Buoys and others	40	14
Profiling floats	30	2
Animals	330	50
Fixed stations	0	0
TOTAL	400	66

# Section 3. Technological Changes that Affect User Requirements

#### Section 4. User issues, problems, and level of satisfaction with ARGOS

The INGRES Programme, that use the ARGOS SMM (Subsurface mooring monitoring), reported that they are interested in the development of SMS mobile phone alerts, due to the speed in the sending of the message. They need to notice as soon as possible the nearby boats to pick up the measuring instruments when they are moved, so they will prefer to have the option of a sms mobile phone alert.

The SEFAS 78 Programme (Animal tracking) would like to increase the position accuracy up to six decimal positions. Reduce the error range of locations and finally they comment that the ArgosDirect service is probed to be very expensive.

The price of the service is a point that all the programs that have contact us have commented.

# Section 5. Successful program use of ARGOS

#### Section 6. Analysis of Local Operational Issues

## NATIONAL REPORTS TO THE JTA (JTA National Report on Current and Planned Argos Use)

Year	2011	
Country	SWEDEN	
Below are status for ARGOS program of Thomas Alerstam, Lund University reported		

#### Section 1. Overall Summary

Satellite tracking of migrating birds (projection 1204)

# Section 2. User Types by family (Table of PTT use by the country)

	Average active PTTs per month	Total PTT.Years
Buoys and others		
Profiling floats		
Animals	20	2,5
Fixed stations		
TOTAL		

# Section 3. Technological Changes that Affect User Requirements

# Section 4. User issues, problems, and level of satisfaction with ARGOS

Tomas Alerstam is satisfied with the support Argos is giving to the research program.

# Section 5. Successful program use of ARGO (good news)

#### Section 6. Analysis of Local Operational Issues

Year	2011	
Country	SWEDEN	
Below are status for ARGOS program of Susanne Åkesson, Lund University reported		

No active trackers during 2011

#### Section 1. Overall Summary

Tracking migration of sea turtles and sea birds

#### Section 2. User Types by family (Table of PTT use by the country)

	Average active PTTs per month	Total PTT.Years
Buoys and others		
Profiling floats		
Animals		
Fixed stations		
TOTAL		

Section 3. Technological Changes that Affect User Requirements

Section 4. User issues, problems, and level of satisfaction with ARGOS

# Section 5. Successful program use of ARGO (good news)

Section 6. Analysis of Local Operational Issues

# NATIONAL REPORTS TO THE JTA (JTA National Report on Current and Planned Argos Use)

Year	2011
Country	SWITZERLAND

# Section 1. Overall Summary

Different users are working on several projects all of which involve animal tracking (mainly birds, one project on mammals in Africa, one on sharks in the Atlantic Ocean). At the moment there are still some conventional Argos PTTs working on animals (some of them since more than 8 years), but in 2011 and presumably also in the future, only combined Argos-GPS PTTs were and will be applied. So all applications are within the following 3 themes: bird migration, animal conservation, marine ecosystems. As a rule and due to problems in finding founds, all project work with only few PTTs.

# Section 2. User Types by family (Table of PTT use by the country)

	Average month	active	PTTs	per	Total PTT.Years
Buoys and others					
Profiling floats					
Animals	30				1.59
Fixed stations					
TOTAL	30				1.59

# Section 3. Technological Changes that Affect User Requirements

Instrumental: Size / weight of the PTTs

<u>Data processing</u>: longer access to archive; acces to data by smart mobile phones ("app" for iPhone, any android system).

Added value: improved map quality on the web acces (visualizing localisations).

# Section 4. User issues, problems, and level of satisfaction with ARGOS

No special problems.

# Section 5. Successful program use of ARGOS

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Section 6. Analysis of Local Operational Issues

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#### NATIONAL REPORTS TO THE JTA (JTA National Report on Current and Planned Argos Use)

Year	2011
Country	United Arab Emirates

# Section 1. Overall Summary

The United Arab Emirates started the satellite tracking programme in 1994 through the National Avian Research Center (NARC) of the Environment Agency – Abu Dhabi, primarily for studying movement and migration of the Asian Houbara. So far nearly 350 Asian Houbara have been tagged and tracked. In 2005, EAD started tracking programme for flamingos and other birds and so far nearly 45 birds have been tagged and tracked. In 2010 the Emirates Wildlife Society-WWF started a satellite tracking programme for the marine turtles in the Arabian Gulf Region.

**Programme 01440 (NARC-IFHC)**: The Argos programme run by NARC, now under the International Fund for Houbara Conservation (IFHC) aims to study the ecology of the Asian Houbara Bustard over its distribution range, collecting information on migration pattern (routes, speed, dates of migration...), bird behavior, survival, breeding behavior. PTT are deployed mainly in UAE and Kazakhstan, but also in less numbers in Yemen, Iran and the Kingdom of Saudi Arabia. Other aspects of the programme include post-release monitoring of rehabilitated falcons (survival, migration routes), and the study of the ecology of the Arabian Bustard in Yemen. All transmitters used in this programme are produced by Microwave Telemetry.

By the end of 2011, 155 additional PTTs are planned to be deployed and another 170 PTTs in 2012. Therefore, it is expected that as many as 300 PTTs might be active by the end of 2011 and up to 350 in 2012, depending on mortality and losses.

**Programme 03763 (RENECO):** Working on behalf of the IFHC, RENECO, a private company mandated by IFHC to run the programme of conservation of the Houbara Bustard, has also deployed 6 transmitters on Asian Houbara in Uzbekistan. This programme is sponsored by Dubai Emirate.

**Marine Turtle Conservation Project 04189 (EWS-WWF):** It is a three year research project to monitor post-nesting Hawksbill turtles in the Gulf region to identify their migratory routes and key foraging grounds. Since 2010 EWS-WWF has monitored a total number of 44 post-nesting hawksbill turtles with 39 transmitters active in 2011 (of which 24 were deployed in 2011 and 15 in 2010). Of the 39 transmitters that signaled during 2011, 22 continue to be active till now.

The program is regional with Hawksbill turtles tagged in UAE, Iran, Oman and Qatar. The program plans to tag another 20-25 turtles in 2012. All turtles have been tagged with Sirtrack transmitters K1G 191A.

**Programme 03567 (EAD):** The Argos programme run by the EAD is focused on birds, largely some waterbirds and birds of prey. Currently 14 PTTs are working and by the end of 2011 another 4 birds would be fitted with satellite transmitter. The programme is targeted to document movement and migration patterns of key species of wintering and breeding birds and other ecological information. In 2012 about 12 PTTs are planned to be deployed and is expected that around 20 PTT would be working by end of 2012. All birds have been tagged with Microwave Telemetry Inc. satellite transmitters.

# Section 2. User Types by family (Table of PTT use by the country)

	Average active PTTs per month	Total PTT.Years
Buoys and others	None	None
Profiling floats	None	None
Animals	None	None
Houbara & Others (1440) & 03763	305	166.67
Marine Turtle Programme (04189)	39	17.04
Birds Program (3657)	15	9.6
Fixed Stations	None	None
TOTAL	359	193.31

#### Section 3. Technological Changes that Affect User Requirements

Overall improvement in data delivery time is needed. It would be very useful to get Argos and GPS locations nearly in real time, i.e. decrease the gap between time of the locations and accessibility to the information.

Additionally development of a service providing movement alerts or mortality alerts by email or text message (sms) according to user defined criteria

# Section 4. User issues, problems, and level of satisfaction with ARGOS

More reliability in determining flight altitude and also problems with mirror locations need to be resolved. Argos has been continuous trying to improve the services and supporting users in various ways. Although the new Kalman filtering was supposed to provide much better and more accurate information, we don't see such changes. Users also expect reduced Argos tariff, particularly for programmes which are using large number of transmitters.

#### Section 5. Successful program use of ARGOS

UAE has successfully used Argos for tracking animals and birds. Use of technology has helped in in determining migration routes, measuring survival, and identifying breeding events for Asian Houbara.

Satellite tracking on flamingos has established origin, migration routes and stopovers sites of flamingos wintering in the UAE besides helping in the discovery of a new breeding colony of flamingos in the country in 2009. Tracking of other species has also provided some new and interesting information which is essential for the conservation of species, both locally and internationally.

The use of Argos system for tracking marine turtles, scientists were able to analyse the signals from post-nesting hawksbill turtles to identify migration routes, create density plots and map potentially new and key foraging grounds used by the tagged turtles.

#### Section 6. Analysis of Local Operational Issues

Most of the records gathered by turtle tagging programme are of Class A and B quality, towards the lower end of the accuracy range which is linked to the extreme northern range for this species, whereby the satellites are picking them up at the extremes of their range. However, overall this

does not impact the project results, since location plots are used to identify a fairly straight line from one signal to another and hence identify the potential migration routes of the turtles.

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