

iOAT
Indian Ocean sea Turtles

Newsletter 1

September 2019

Project carried out by



In partnership with



KEY FIGURES



PROJECT CO-FUNDED BY THE EUROPEAN UNION WITH THE FRAMEWORK OF
THE PO **INTERREG V INDIAN OCEAN 2014 - 2020**



TARGET SPECIES



GREEN TURTLE
(*CHELONIA MYDAS*)

© Anne-Laure CLEMENT/IFREMER

HAWKSBILL TURTLE
(*ERETMOCHELYS IMBRICATA*)

© Brice MILLER/IFREMER



OBJECTIVES



Increasing anthropogenic and climatic pressures on marine ecosystems raise the question of the sustainability of the exploitation and conservation of these marine ecosystems.

Our knowledge of biodiversity, biology and marine ecology has greatly improved, but it remains very fragmented today because of the **complexity of direct observation of the marine environment**. This environment is indeed an extreme environment in many respects: most communication systems are inoperative in water, depth and pressure require expensive and constraining technological developments, corrosion represents a major constraint on the durability of observation systems. Finally, the observation scales of marine species and their migration are potentially enormous (several thousand km for marine turtles). Our understanding of the ecology of marine species movement is therefore lagging far behind that of terrestrial animals, and the information needed to make **appropriate management decisions** is lacking.

The satellite tags used today for wildlife monitoring, including marine turtles, are expensive (>€4,000 per tag), cumbersome, low accuracy and very few technological developments have been made since their first developments in the 1990s. The cost of these tags limits the number of tags that can be deployed and thus the robustness of the resulting quantitative analyses.

The project therefore aims to develop by scientists and for scientists (adapted to their questions) a **new generation of tags** for marine animals by significantly reducing their price and based on new data transmission systems. The system chosen for this project is the **LoRa** (Long Range) transmission system based on connected object technology. In addition to the dramatic increase in the number of connected objects surrounding us in recent years, their low cost, low power consumption, these LoRa transmission modules have the ability to transmit data 40 km away under ideal conditions and determine the position of objects when the GPS system is inoperative using a network of receiving stations that triangulate the position of the signal transmitted for the objects.

The objective of the IOT project is therefore to develop the **first marine turtle movement observation network on the scale of the south-western Indian Ocean basin** through regional scientific cooperation, by developing a new generation of innovative, low-cost and open source tags and receiving stations.

PROJECT KICK-OFF MEETING

On Tuesday **9 July 2019**, the **official launch meeting** of the IOT project was held at the University of La Réunion in the presence of the partners (SIF, TAAF, AFB-PNMM, CNRS-LIRMM, CD Mayotte) alongside the IFREMER Indian Ocean delegation, the project's leader. The exchanges focused on (i) the progress of technological developments and feedback on the mission of the pIOT project, (ii) future missions and deployments on each study site, drawing on the experience of the partners managing these protected areas, as well as (iii) administrative aspects.



IOT project kick-off meeting © Magali DUVAL/IFREMER

From left to right : Nancy BUNBURY/SIF, Jeanne WAGNER/AFB-PNMM, Jennifer APPOO/SIF, Joanna KOLASINSKI/TAAF, Anne-Laure CLEMENT/IFREMER, Pierre GOGENDEAU/IFREMER, Sylvain BONHOMMEAU/IFREMER

By videoconference : Serge BERNARD/LIRMM, Vincent KERZERHO/LIRMM, Mireille QUILLARD/CD de Mayotte, Ali Mari OMAR/CD de Mayotte

EXPLORATORY MISSION IN MAYOTTE



Tsoha bay, Mayotte © Pierre GOGENDEAU/IFREMER

In April 2019, Pierre GOGENDEAU of IFREMER went to Mayotte to carry out an exploratory mission for the **future deployment of the IOT project's receiving stations and tags**. Accompanied by two agents of the Mayotte Country Council, he prospected 4 sites on Grande-Terre and Petite-Terre, taking into account the topography of the sites, the nature of marine habitats and the presence of marine turtles. Deployments in Mayotte are planned for **early 2020**.

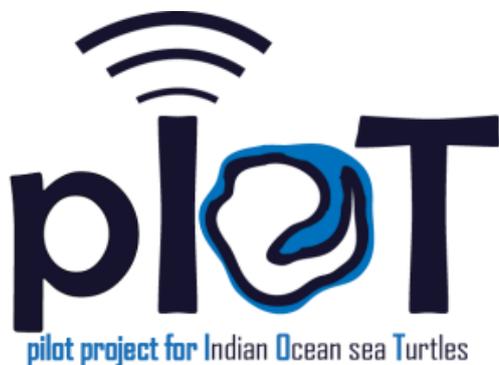
Report of the exploratory mission in Mayotte (French only) :

Gogendeau Pierre (2019). IOT – Indian Ocean sea Turtles. Rapport de prospection : Mayotte.

Mission du 18 au 25 avril 2019. R. RBE/DOI/2019-009

Access to the request on <https://w3.ifremer.fr/archimer/>

FOCUS ON THE PILOT PROJECT « pIOT »



The pIOT "**pilot project for Indian Ocean sea Turtles**" project led by the IFREMER Indian Ocean delegation aims to develop and test in a constraining natural environment (temperature, isolation, sunshine, etc.) and on a site scale, the island of **Europa**, the first prototype of reception stations and innovative tags.

This first test also makes it possible to assess the feasibility of deploying a network to observe the movements and migrations of marine turtles using LoRa new technology.

Thus from 8 to 11 April 2019, part of the team of the pIOT project, bringing together **electronics engineers and marine biologists** from IFREMER, CEDTM (Centre d'Etude et de Découverte des Tortues Marines) and LIRMM (Laboratoire d'Informatique, Robotics and Microelectronics of Montpellier) deployed on the island of Europa in the Scattered Islands, **5** receiving stations and marked **8** juvenile green turtles with the first versions of the new generation tags. This mission took place as part of the rotation of the oceanographic vessel *Le Marion Dufresne* during the scientific campaign of the **Research Consortium "Scattered islands 2017-2020"**.



Receiving station in Europa
© Hugues EVANO/IFREMER



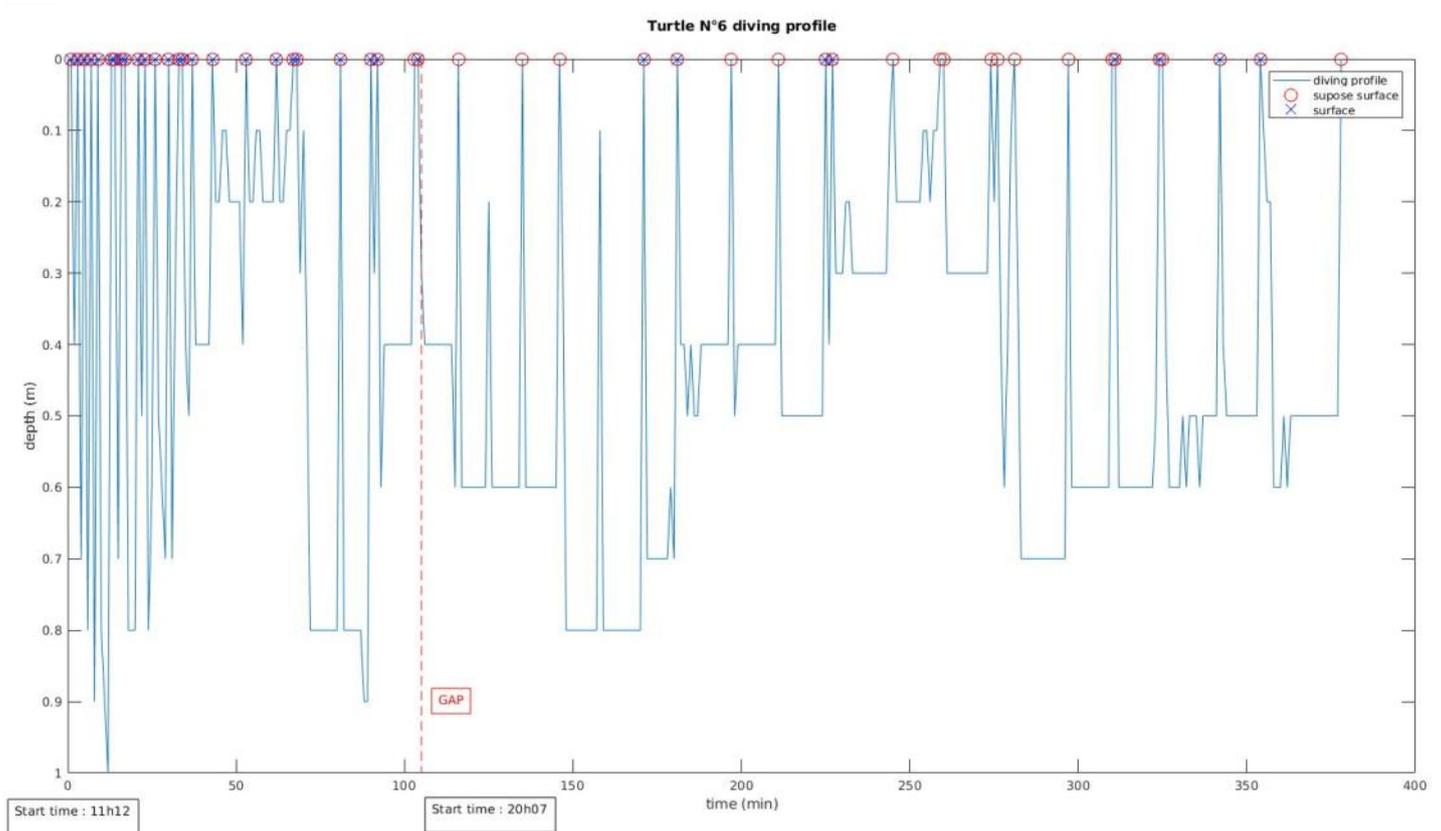
Release of a green turtle equipped with a new generation tag on Europa
© Mayeul DALLEAU/CEDTM

1st results

The tests under real conditions made it possible to:

- **validate** electronic equipment, algorithms and computer codes for very low energy consumption tags;
- **confirm** the proper functioning of the receiving stations for 1 month under difficult climatic conditions;
- validate that algorithms designed for marine turtles are **adaptable** to the environment and species.

On the strength of the first results of the pIOT project, IFREMER is now working on the correction and **improvement** of this equipment in order to produce a second, more efficient version, which will be used this time as part of the IOT project, in Reunion Island (end 2019) and Mayotte (2020), then on all the IOT project study sites (TAAF, Seychelles) until 2021.



Diving profile of the turtle N° 6

One of the other objectives of the project is to identify **functional habitats** for marine turtles on the island of Europa. Thus, the **hyperspectral and Lidar data** acquired in 2009 and 2010 on Europa were processed using different algorithms in order to obtain map layers characteristic of the different marine habitats (sand, corals, ...) on which the positions of the newly acquired turtles and those of past projects will be overlaid.

Another work on **bathymetric data** was also carried out, highlighting the fine topography of the bottom and the relief effect that allows a better understanding of the geomorphological reef structure.



Hyperspectral image (visible / PIR) on Europa acquired for Litto3D in September 2009, after correction of saturation and surface effects (Pascal MOUQUET)

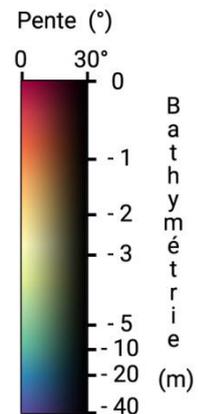
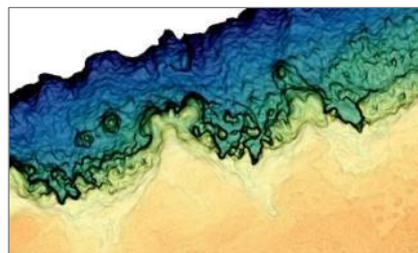
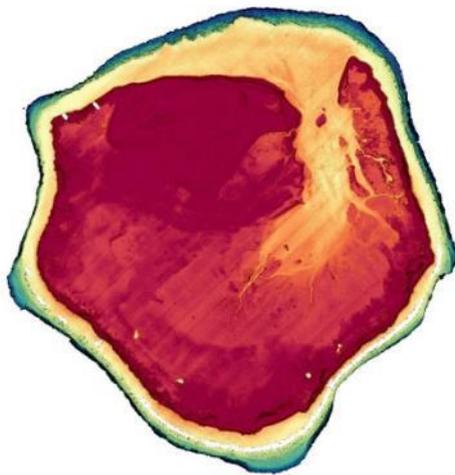
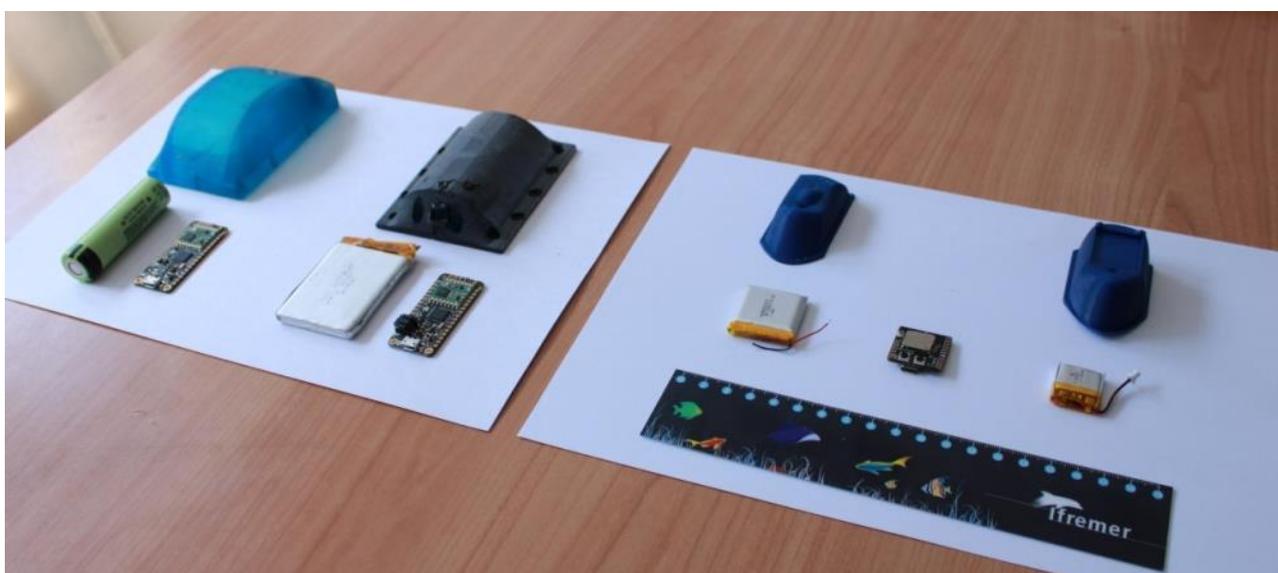


Illustration of the PEMNTE image (fusion between bathymetry and slope) on Europa (left). In the centre, comparison between the bathymetry representation alone (top) and the PEMNTE representation (bottom), on high resolution enlargements. On the right, legend of the PEMNTE layer (Pascal MOUQUET)

TECHNOLOGICAL DEVELOPMENTS

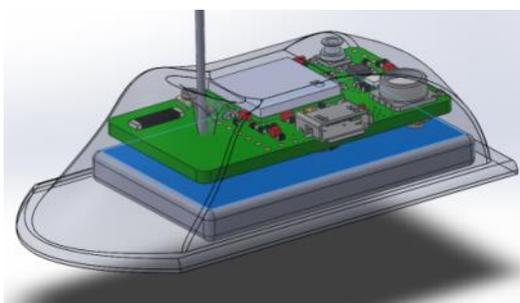
Since 2018, many technological developments have been carried out by IFREMER and its partners, in particular LIRMM, first as part of the pIOT project and then the IOT project. Thus between version 0 and version 2 under development, the weight of the tags has been reduced from **more than 100g to less than 20g**, their size from 9x7x3cm to 5.5x3.5x1.7cm. The size of the battery has also decreased considerably, the number of sensors has increased even though the size of the electronic board has been halved. Version 2 of the tag will include an external antenna as well as an internal antenna to overcome the problems of breaking the external antenna against coral or rocks. The composition of the box will be of better quality and a version 2.2 will even accommodate a small **solar panel** on the top of the tag.



Evolution of technological developments of innovative tags

© Pierre GOGENDEAU/IFREMER

From left to right : version 0, version 1 (deployed in Europa), version 2.1 (without solar panel), version 2.2 (with solar panel)



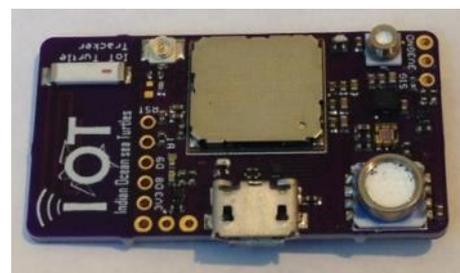
3D representation of version 2 of the tag

© Pierre GOGENDEAU/IFREMER



Prototype of the box of version 2 of the tag, with location of the solar panel - future electronic board of version 2

© Pierre GOGENDEAU/IFREMER



EXPERIMENTAL PLATFORM

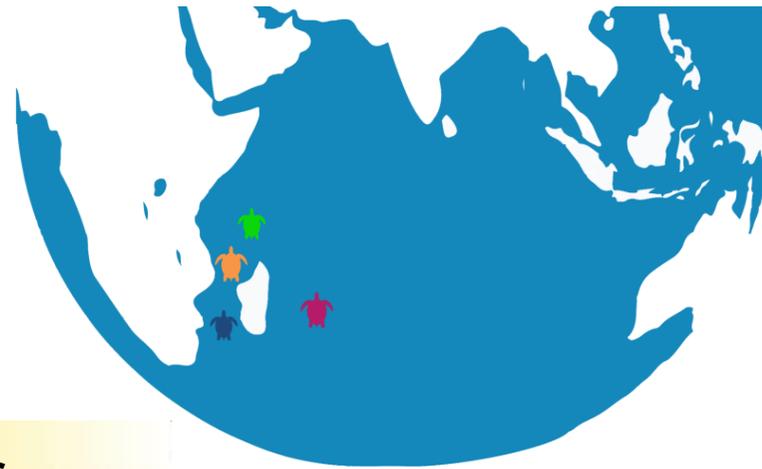
Before deploying the future prototype tags and receiving stations on the 4 study sites, tests must be carried out in a controlled environment that is similar to those encountered in a natural environment, so that engineers and technicians can check that they are working properly (waterproofing of the new tags, signal transmission, etc.) and make the necessary adjustments.

Following the award of the **public contract** n°19/1000076 in August 2019 as part of the IOT project, Kélonia-Réunion des Musées Régionaux will provide IFREMER and its partners with an **experimental platform**. It will include **tanks** with marine turtles and **deployment areas** for receiving stations, with the aim of testing future equipment and prototypes.

Kélonia will also provide **support for the system's deployments**, in particular to equip marine turtles and install reception stations. Its experts will also provide feedback on the **behaviour of equipped turtles**.



Experimental platform of Kélonia, St Leu
© Anne-Laure CLEMENT/IFREMER



Test and deployment sites and periods:

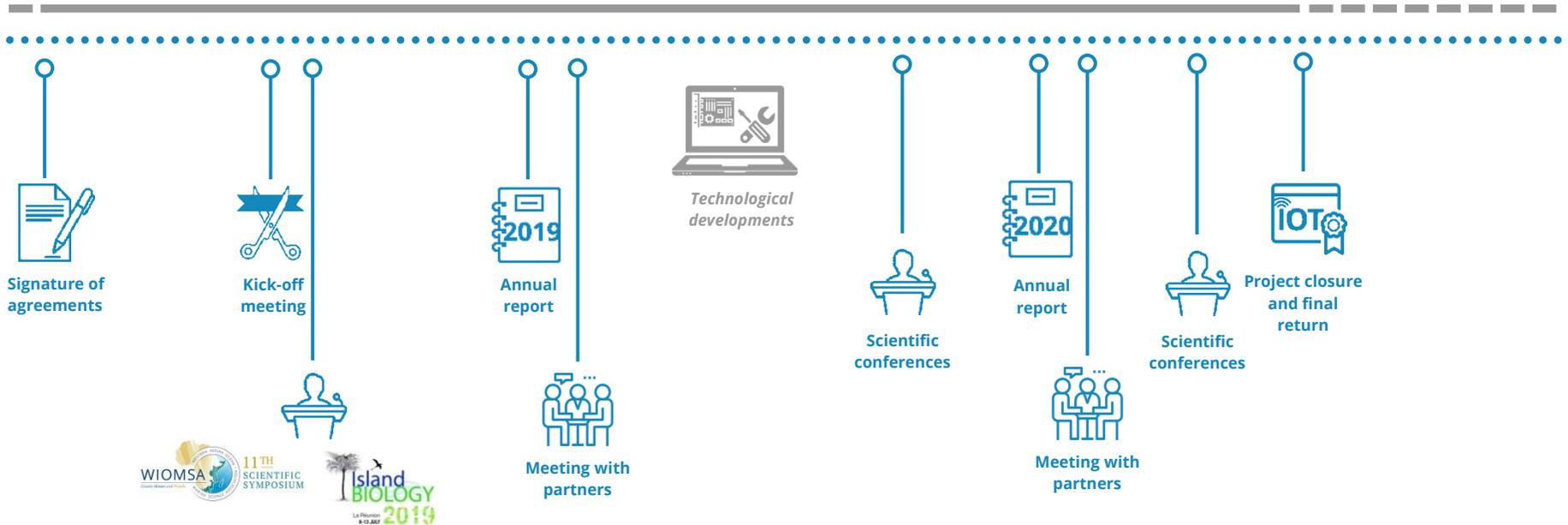
Reunion Island

Mayotte Island

Scattered Islands (TAAF)

Aldabra Island (Seychelles)

PROGRAMMING AND PROGRESS





To know more about it, visit the web site :

<https://wwz.ifremer.fr/lareunion/Projets/Innovations-technologiques/piOT-2018-2020-IOT-2018-2021>

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