

**IOT**  
Indian Ocean sea Turtles

# Newsletter 3

May 2020

Project carried out by



In partnership with



We wish all our partners and readers of this newsletter they are not too impacted during this difficult period. Since March 17, the teams of the Indian ocean delegation of Ifremer and LIRMM have been adapting to the current situation in order to be able to continue working while respecting the confinement. Although the tests started in February and early March were put on hold during this period, work continued, particularly on IT developments and administrative aspects.



## RECENT ACTIVITIES



### First tests on the turtles of the experimental platform :

Tests of the new version 3 of the tag began in February with the first tagging of four turtles from the experimental platform in Kélonia. These turtles were successively tagged with a few weeks delay in order to take into account the results of each test for the following tests and to make the necessary adjustments to the algorithms.

A **drone** (UAV) was also used during these tests to track and film the movements of the turtles from the air. These aerial data are then compared to the actual movements recorded by the turtle tags in the pond. The behaviour of each of the tagged turtles was also monitored underwater and an algorithm for the 3D reconstruction of the turtles' trajectory while diving is currently being developed on the basis of these initial tests.

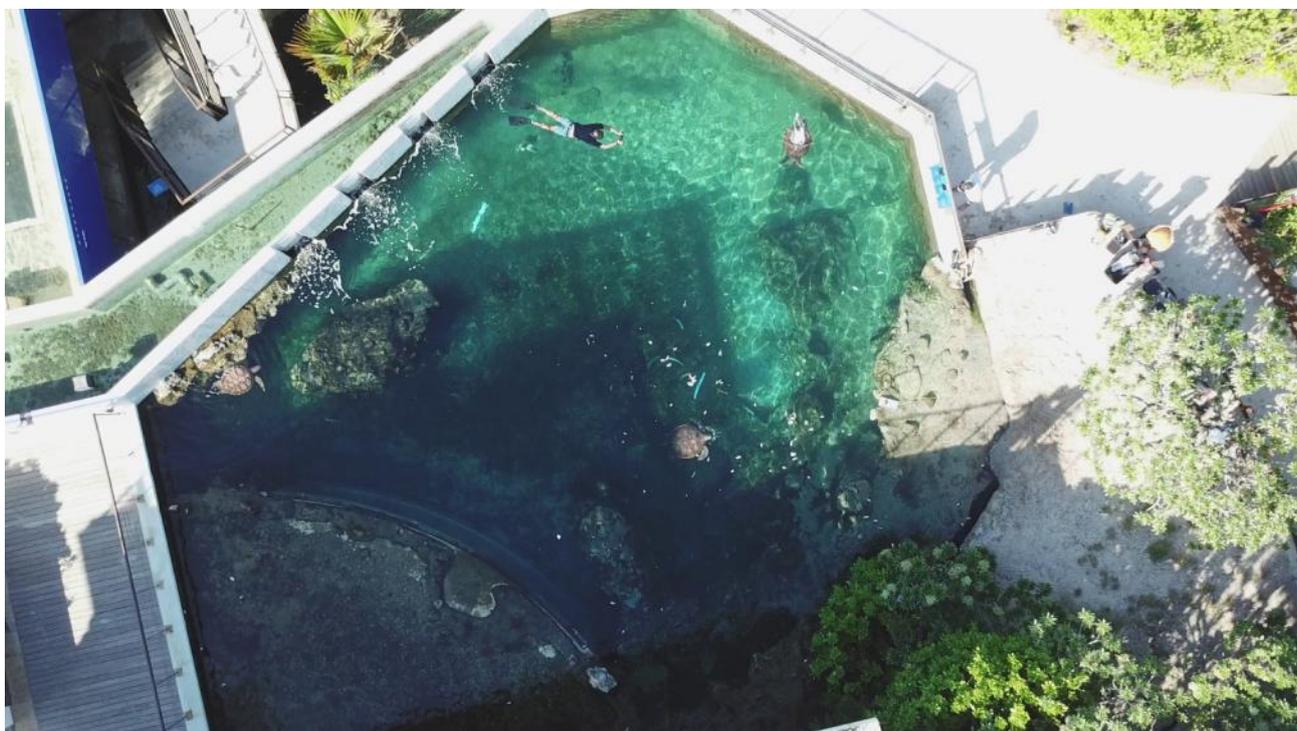
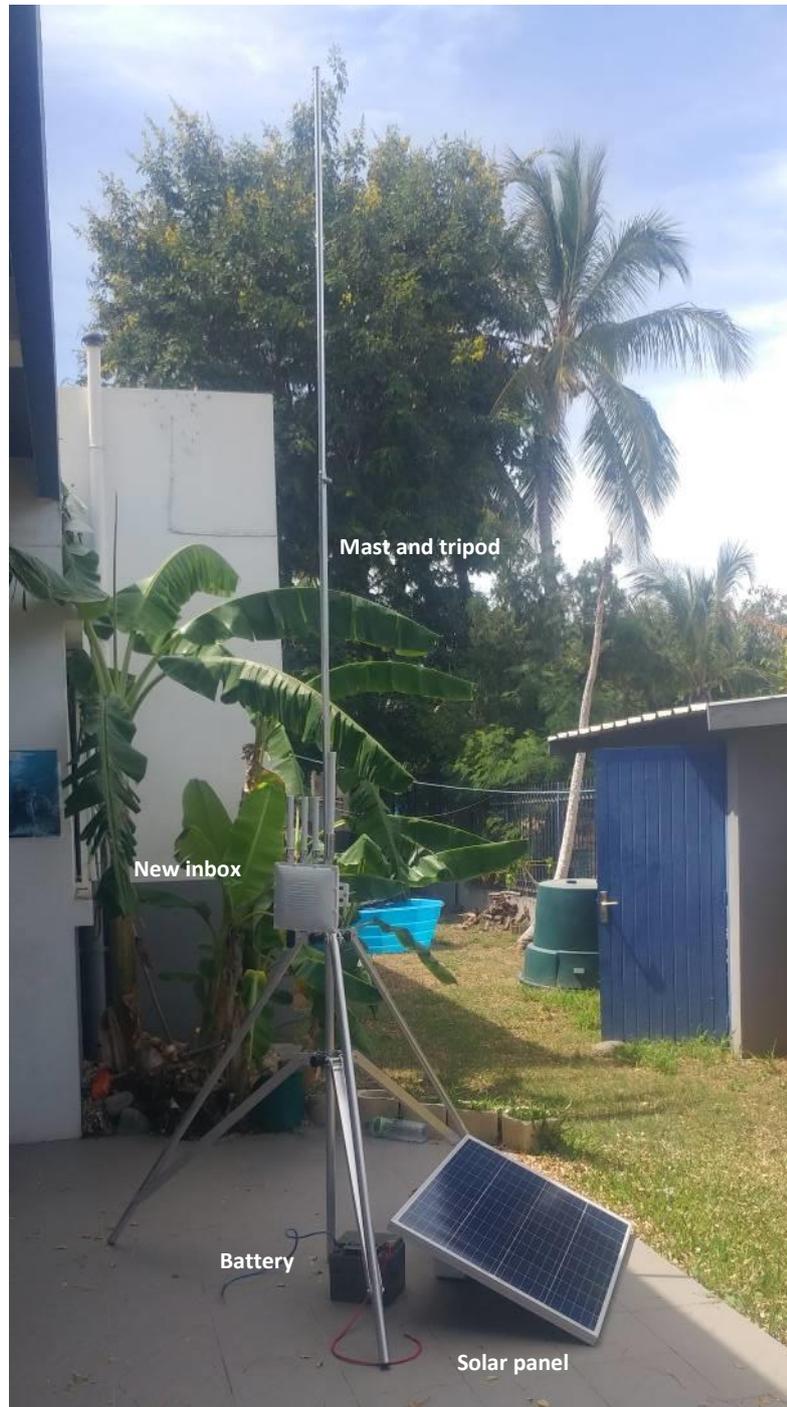


Image taken by the UAV during tests at the Kélonia experimental platform © Pierre GOGENDEAU/IFREMER

These initial tests will resume once the confinement has been lifted, but they have already made it possible, on the one hand, **to validate the overall operating principle of the new algorithms**, i.e. regular GPS positioning when the turtle comes to the surface and the reception of LoRa messages sent by the tag and, on the other hand, **to identify and make a few adjustments**, such as calculating detection thresholds to identify surfacing events.

At the same time, the new gateways to receive LoRa messages received in January were tested and functioned perfectly. Below is a picture of some of the equipment (tripod, mast, box, battery, solar panel, antenna) that will make up these gateways on some study sites.



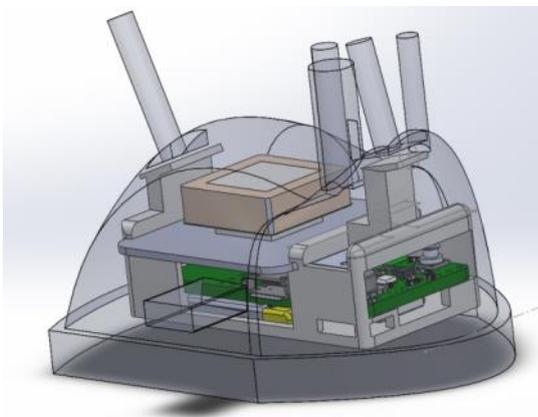
Preconfiguration of a receiving station for the Europa study site © Julien FEZANDELLE/IFREMER



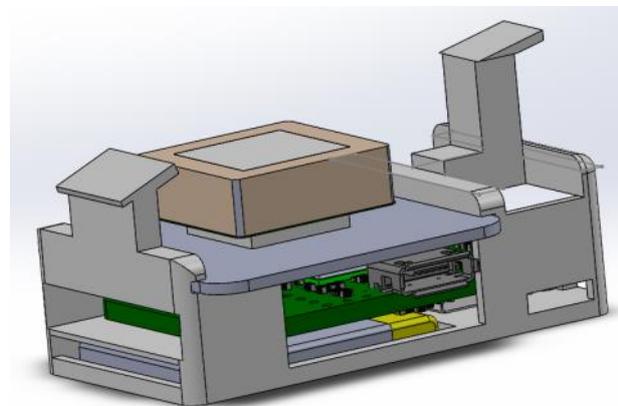
### Tag design update :

The tests carried out on the surface sensors confirmed the need to **reinforce the protection** of the surface sensor electrodes and the base of the LoRa antenna in case of friction of the turtle on an obstacle. This will guarantee the functioning of the tag surface detection sensor which is essential to the activation of the GPS and the transmission of messages. This detection is only possible if the electrical current flowing between the sensors located at the surface of the tag is interrupted. For this purpose, the **mechanical design** of the tag has been reworked. Notches have been added for better protection of the electrodes and the slopes of the design around the electrodes have been increased to allow a better flow of water on the surface of the tag.

A new element has also been added to the tags: an **internal skeleton**. This 3D printed skeleton makes it easier to place the electronic components inside the tag before to apply resin to the tag.



New mechanical design of the tag  
© Pierre GOGENDEAU/IFREMER



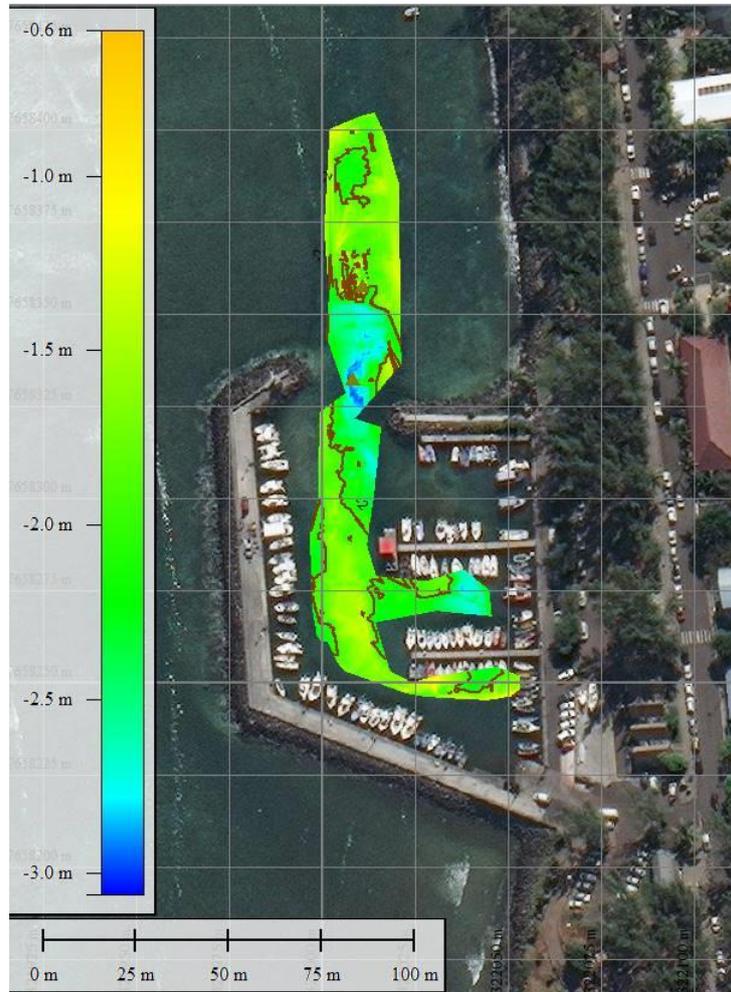
Internal skeleton of the tag  
© Pierre GOGENDEAU/IFREMER



### Tests of the autonomous USV board:

The autonomous USV (Unmanned Surface Vehicle) board developed by IFREMER and the IDOCEAN Company was tested **at sea**, in Saint-Leu in February. Autonomous navigation in an open environment, subjected to waves and current, as well as the single-beam echosounder were tested. The results of these first tests were conclusive and the bathymetry of the prospected zone could be carried out. These bathymetric data will allow in the future improving the geolocation algorithms by coupling the information on the depths of the turtles' movements with that of the bathymetry. The underwater camera placed under the board also worked perfectly.

IFREMER and IDOCEAN continue to work together to make **further improvements** to this autonomous USV board.



Representation of the bathymetry of the test area of the USV autonomous board, port of Saint-Leu © IDEOCEAN



### LIRMM visit to Reunion Island :

At the beginning of March, two researchers from the Montpellier Laboratory of Computer Science, Robotics and Microelectronics (LIRMM), a partner in the IOT project and with which Ifremer has been collaborating for many years on several projects involving electronic developments for marine instrumentation, visited Ifremer's Indian Ocean delegation in Reunion Island. This visit enabled teams from both organisations to **exchange information on the progress** of the project, in particular on the electronic and computer developments carried out for the tags and reception stations, and to **take part in the last tagging test** in Kélonia before the start of the confinement.



Turtle of the experimental platform equipped with a tag under test  
© Pierre GOGENDEAU/IFREMER



## Identification of marine habitat typology:

One of the three technological and scientific objectives of the IOT project is to **identify the types of habitats** (seagrass, coral, sand, etc.) on the various study sites using **high-resolution aerial and satellite imagery**, then to superimpose them on the positions of the turtles, obtained by the tags.



This identification is based on algorithmic developments, work that will be carried out by Pascal Mouquet on the different study sites of the project (Reunion Island, Mayotte, Europa and the Seychelles). The hyperspectral data collected in the different French sites in 2009 and 2010 will be used to classify habitats (grasslands, corals, sands, etc.) and to determine areas favourable to turtles by developing relevant indicators (roughness type). On all sites, satellite image data will be used to determine these habitats at large spatial scales.



## Technical documentation :



This period of confinement enabled the team to make progress on the drafting of several technical documents and in particular on **documenting the operation of the equipment for future users** (architecture of the future database, access to servers, computer codes, etc.).

During this interval, which temporarily suspends equipment tests, the results of previous tests are analysed and translated into notes or technical reports by the team.



## Administrative procedures :

Ifremer is continuing the numerous administrative and technical procedures to enable the final deployment of the tags and receiving stations on the various study sites scheduled for 2020 and 2021.

Discussions with partners on **mission planning** are continuing while adapting the provisional timetable to the current situation. The various requests for **regulatory authorizations** for the project are addressed to the public authorities concerned for each of the project territories. Numerous **orders for electronic and mechanical equipment** for the tags and ground infrastructures are placed so that all the necessary equipment can be delivered before the start of tests in the natural environment and then for deployment on the study sites. This period also allowed the finalization of the **project's 2019 annual progress report**.

## UPCOMING ...



### Resuming suspended tests:

The tests that have been **put on hold** over the past few months, notably on the experimental platform in Kélonia, will resume once the containment is lifted.

They concern in particular the latest improved onboard algorithms, the new design and internal skeleton of the tags, as well as the characterization tests of the LoRa radio signal on the water surface (see Newsletter n°2) initially scheduled in February and which could not be carried out due to lack of time.

A new version of the autonomous board will be developed. Among the planned developments, the board will be equipped with solar panels to be autonomous over longer periods of time, an acoustic geolocation system will be integrated in order to be able to track the turtles with the board while taking care not to disturb its behaviour, and the image acquisition system will be improved. The complete design of the board will also be reviewed to ensure a good stability and the integration of these technological developments.



### Hyperbaric chamber tag testing:

The tags will soon be tested in a hyperbaric chamber in order to qualify the **tag's resistance to pressure/depth**. Initially scheduled in May, these tests have been postponed to July/August due to containment. Several tags will be tested with three different resin compositions at the Ifremer site in La Seyne sur Mer.



### Project in perspective:

The IOT team responded to **the "Explorations de Monaco" call** for tenders to take part in a scientific campaign in the Indian Ocean in May/June 2021 on board the research vessel *Le Pourquoi Pas?* The project proposal includes the deployment of the autonomous board on the various study sites (Mauritius and Seychelles) and tests on the deployment of LoRa tags in connection with Ifremer's scientific direction project (*Next project*).

# PARTNER PRESENTATION



The **Montpellier Laboratory of Computer Science, Robotics and Microelectronics** (LIRMM) is a joint research unit of the University of Montpellier (UM) and the National Centre for Scientific Research (CNRS). It is composed of 3 departments whose research activities are in the field of information and communication sciences and technologies.

Teacher-researchers and researchers from the SMARTIES team of the LIRMM are collaborating with IFREMER DOI within the IOT project. Within the framework of this project, LIRMM researchers are participating in the **development of original hardware and software solutions for trajectory algorithms applied to the study of marine turtles**. However, the synergy between these two partners goes beyond this, it extends to other collaborative projects such as POPSTAR/MERLIN IFREMER, FishNChip/ European Maritime Affairs and Fisheries Fund, PROMPT/France Filière Pêche, FLopped/ European Maritime Affairs and Fisheries Fund and Release/Prefecture of Reunion Island- Department of the Environment, Planning and Housing as well as via training through research with the supervision of trainees and PhD students, including Pierre GOGENDEAU since September 2019.

The common lines of research at the heart of all these projects are based on the desire to propose, develop and deploy new technological biologging solutions for the study of marine species such as turtles, tuna, swordfish and billfishes. Within the framework of these collaborations, the LIRMM brings its expertise in the field of electronics and microelectronics developments for living organisms. Its contributions range from the development of integrated circuits (figure 1) to the development of embedded systems (figure 2), the development of implantable electrodes (figure 3) and the implementation of experiments (figure 4).

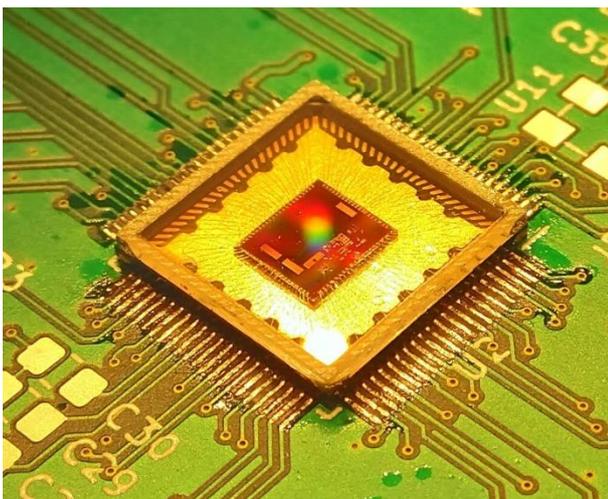


Figure 1: integrated circuit for bioimpedance measurement  
© LIRMM



Figure 2: FishNChip card  
© LIRMM

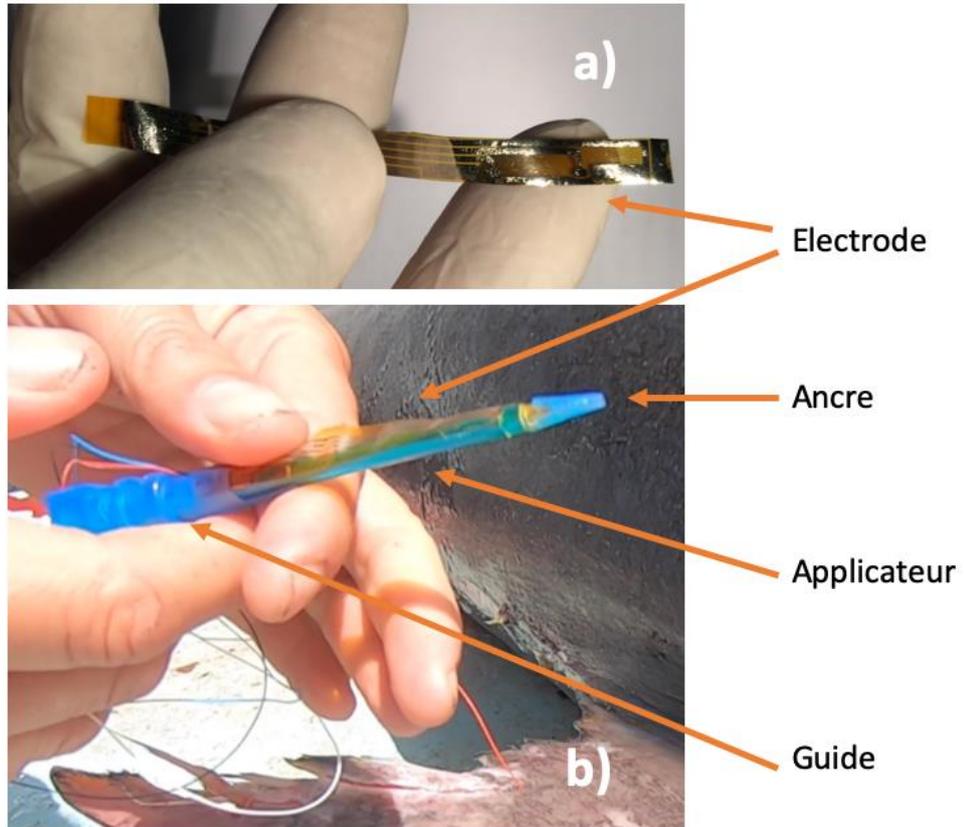


Figure 3 a/ biocompatible flexible electrode, b/ rapid electrode implantation system  
© LIRMM

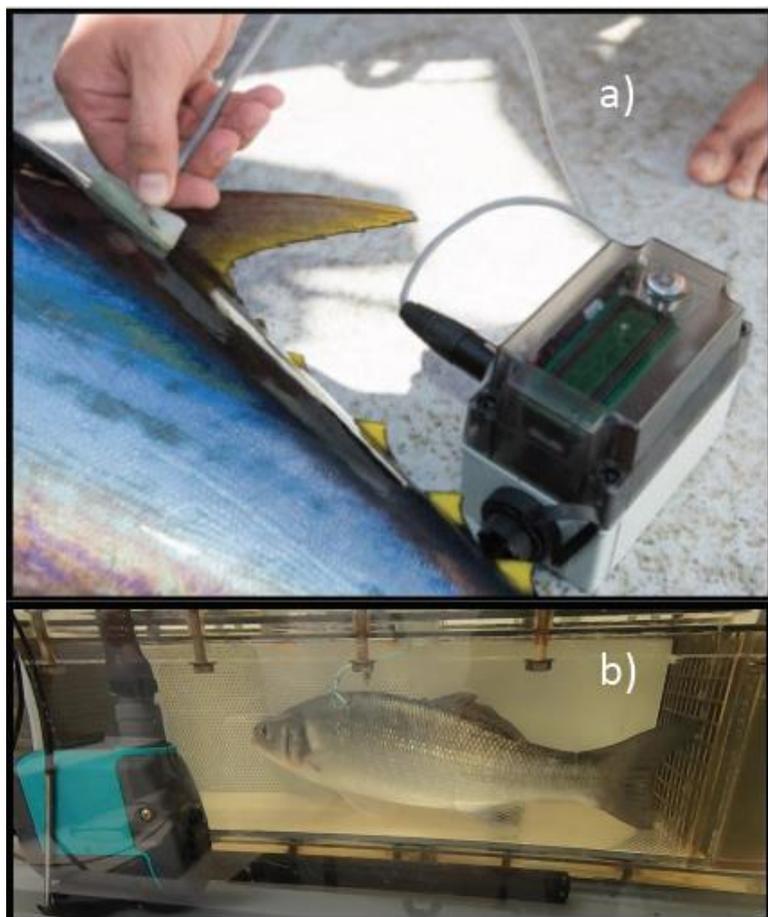
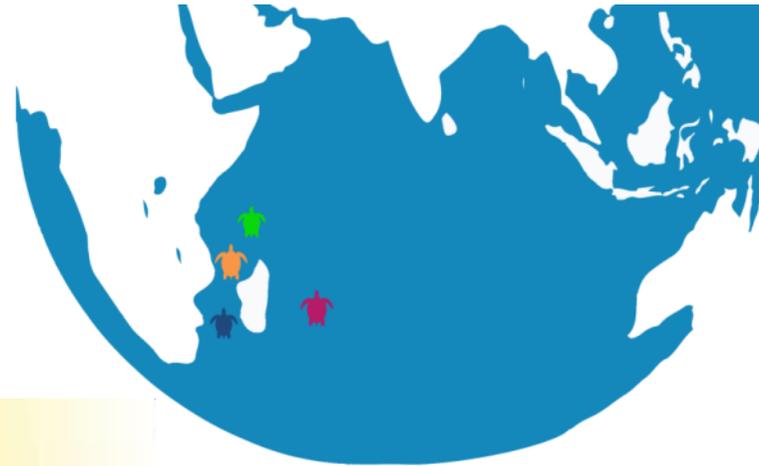


Figure 4 a) bioimpedance measurement on marking operation b) bio-impedance measurement on a European seabass in a swimming tunnel © LIRMM



**Test and deployment sites and periods:**

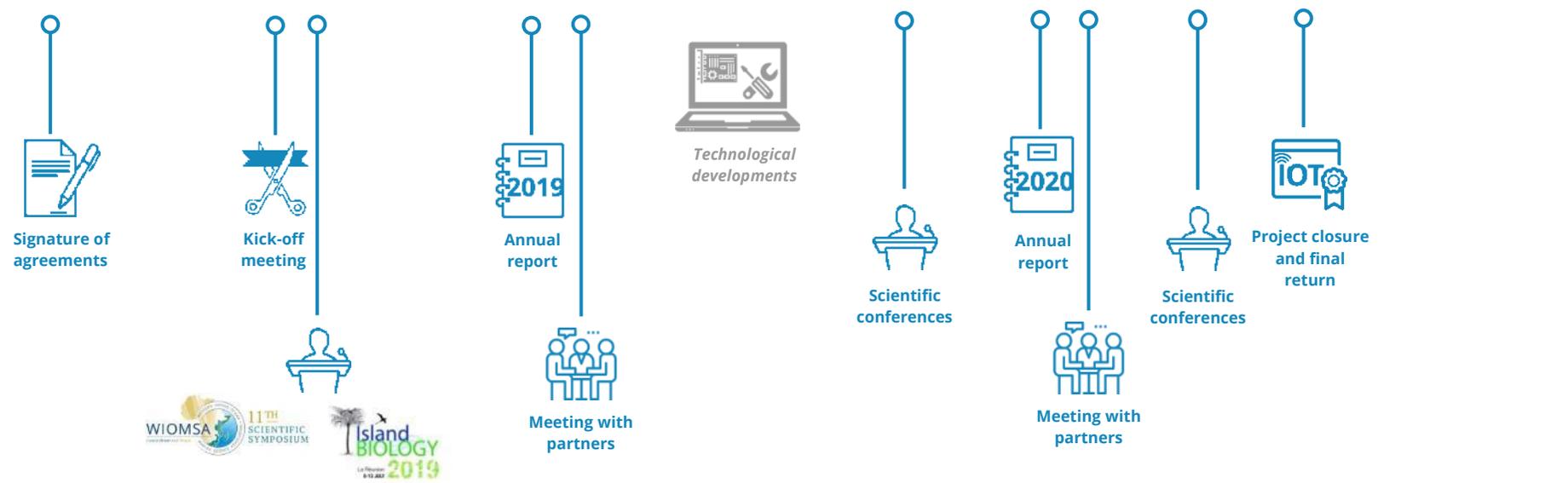
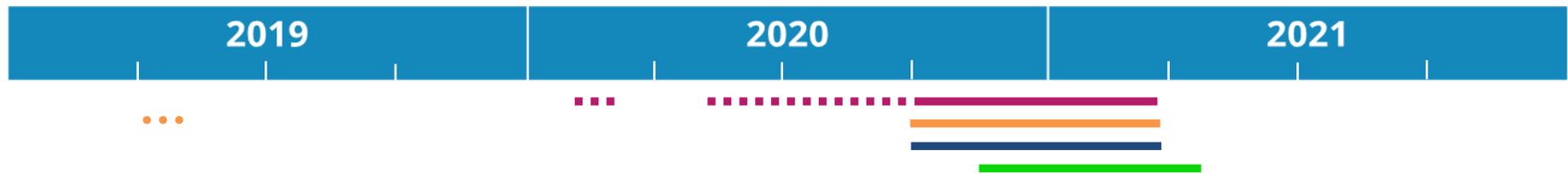
**Reunion Island:**  
 ■■■ tests  
 — deployment

**Mayotte Island:**  
 ●●● prospecting  
 — deployment

**Scattered Islands (TAAF):**  
 — deployment

**Aldabra Island (Seychelles):**  
 — deployment

## PROGRAMMING AND PROGRESS





**To know more about it, visit the web site :**

[https://www.ifremer.fr/lareunion\\_eng/Projects/Technological-innovations/piOT-2018-2020-IOT-2018-2021](https://www.ifremer.fr/lareunion_eng/Projects/Technological-innovations/piOT-2018-2020-IOT-2018-2021)

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