Designing a miniature electronic tag for jellyfish tracking

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Rhizostoma pulmo is one of the most abundant jellyfish in the Mediterranean Sea. Its outbreaks have undeniable negative socio-economic and ecological impacts. To date, there are very few measurements of jellyfish growth rates in the literature, and no measurement of individual growth and sexual differentiation processes *in situ*, as this requires the ability to recapture the same individual in the environment.

Some jellyfish species realize their entire life cycle in Mediterranean lagoons. For example, Bages-Sigean lagoon harbors a perennial population of *R. pulmo* since 2014 unabling the study of this jellyfish growth in the natural environment. We plan to collect and tag individuals, and to carry out repeated biometric measurements on these organisms (umbrella size, wet weight, gonad maturity index). For subsequent recapture and further measurements on those same individuals, we have developed a tag that allows the jellyfish to be sporadically geolocated. Data are transmitted via the LoRa-WAN network.

Numerous technical issues need to be taken into account for this development: in particular the volume and weight of the tag to limit the impact on the animal, the hanging technique, a reliable geolocation and transmission system, a maximum energy autonomy for a minimum volume.

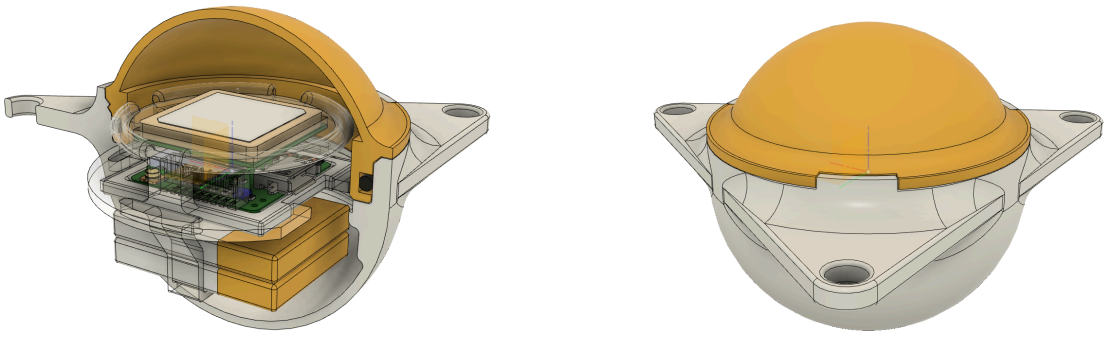

Figure 1 : Prototype of the float for jellyfish tracking

Our approach is structured along two lines: firstly, we plan to estimate and understand the impact of our brand on the jellyfish displacement, and secondly, to carry out deployments lasting for several days. Some preliminary experiments have already been carried out involving comparisons between a jellyfish equipped with a float and a free float, known as a reference float, which drifts with the swell. The results seem to indicate that there is no impact on the movement of the tagged jellyfish.

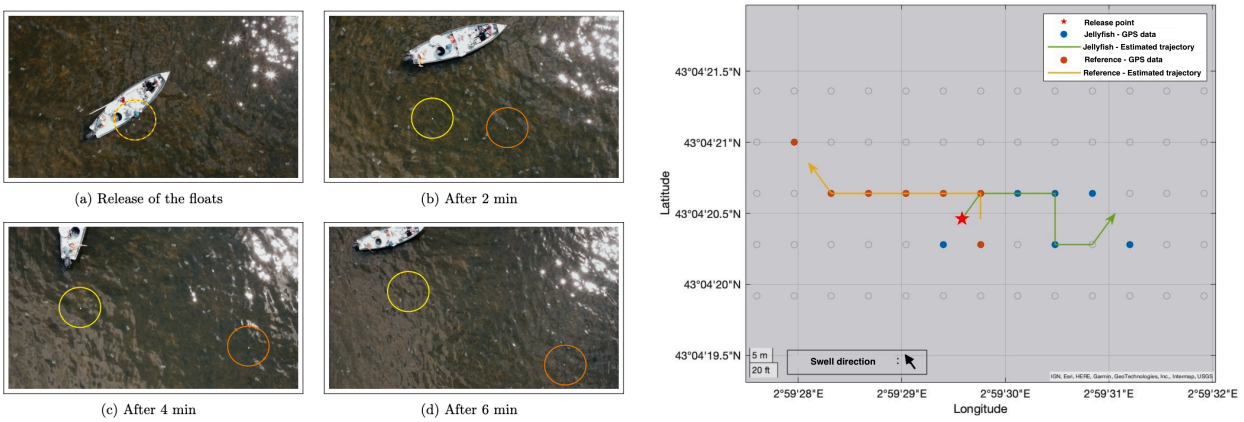

Figure 2 : Trajectory of the reference float and of a tagged jellyfish.

The methodology for real-time tracking of jellyfish involves the use of GPS tags attached to the individual, which transmit their position via the LoRa network. Furthermore, the use of GPS allows for highly accurate geolocation (precision of 10m) of the individual within the lagoon, facilitating the recapture of the tagged jellyfish. Orange LoRa network coverage of the lagoon has been tested. It has been validated that LoRa communication is effective all over the lagoon. To validate the effectiveness of our tracking system, we have also simultaneously deployed control tags and tagged jellyfish to determine the direction of movement between the jellyfish and the tag. In our experiments, the size of the tags varied to assess their impact on the swimming behavior of the jellyfish. Additionally, different sizes of jellyfish were chosen (from 22 cm to 38 cm) to determine the impact of the floats on their swimming behavior.

Preliminary results from our float size studies suggest that there is no significant impact of the float on jellyfish movement. In addition, we observed a period of readaptation in tagged jellyfish after tagging, corresponding to the resumption of normal activity. Further experiments are needed to fully characterize this phenomenon and our previous results. In 2023, we plan to expand our experiments by using a wider range of jellyfish sizes, recording the movements of tagged and untagged jellyfish through drone video and deploying tags for longer periods. This will allow us to make more robust conclusions about the impact of our tagging methodology on jellyfish behavior and to study individual movements and growth.