

# THE USE OF AUTONOMOUS VEHICLES IN THE SUSTAINABLE MANAGEMENT OF COMMERCIAL WHALE WATCHING ACTIVITY - MARCET PROJECT

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Recent technological developments have made current unmanned systems realistic alternatives to traditional methods of studying marine animals. Benefits include longer campaign duration, safer missions, mission repeatability, reduced operating costs, and are already considered essential tools in marine observation, both in research and in industry. PLOCAN, within the framework of the MARCET II Project (INTERREG MAC2/4.6c/392) provides technologies for the acoustic detection of cetaceans and noise measurement, using surface vehicles (e.g. the Wave-Glider SV2). In addition to a weather station, CTD, dissolved O<sub>2</sub> and hydrocarbon sensor, this autonomous vehicle is equipped with a towed hydrophone (PAMbuoy – one-element), which incorporates automatic detectors of cetacean vocalizations (PAMGuard). To date, in the context of the MARCET network, several missions have been carried out with the Wave-Glider in Macaronesia: in the Canary Islands and Madeira. MARCET II key objective is the establishment of ecological and environmental sustainability criteria, based on the use of advanced techniques of operational oceanography, as well as the monitoring and sanitary surveillance of resident cetaceans in Special Areas of Conservation (SACs) of special interest for whale-watching, using as bioindicators the bottlenose dolphin, *Tursiops truncatus*, and the pilot whale, *Globicephala macrorhynchus*, to evaluate risk factors of anthropic origin. The results of one of the missions with a Wave-glider in the framework of MARCET's network are presented.

## Introduction



Thanks to the tool that the MARCET Network already created, through the MARCET project, the harmonization of work protocols and their integration to protect and conserve the cetacean populations of Macaronesia from a multidisciplinary point of view, and the knowledge acquired on the current situation of the tourism sector associated with the activity of observing these species in the region, MARCET II project was born. This project has the aim of increasing the evaluation of said activity as a model of

sustainable economic development in the Macaronesian archipelagos (Azores, Madeira, Canary Islands and Cabo Verde), thus enhancing the ecotourism market niche that this activity represents, and, at the same time, establishing sustainability criteria applied to resident cetaceans. For this, MARCET II is technically structured around three specific objectives, the first (OE1), considered key for the establishment of ecological and environmental sustainability criteria, integrates the use of advanced

techniques of operational oceanography, as well as monitoring and sanitary surveillance of cetaceans residing in marine protected areas and of special interest for carrying out such ecotourism activity in Macaronesia, using as main indicator species the bottlenose dolphin and the pilot whale to assess risk factors of anthropic origin linked to these marine areas.

## METHODOLOGY AND RESULTS

### Methodology

The departure of the mission took place at the Taliarte Harbour in Gran Canaria. The deployment of the vehicle was carried out with a crane and once at sea it was towed with a zodiac, to the starting point of the mission. Three people were needed on the boat to carry out the manoeuvre and one person on land to turn on the sensors and take over the piloting once the mission starts. The vehicle has a two-way communication system based on IRIIDIUM RUDICS satellite communication. The piloting and control of the vehicle is carried out through a dedicated website provided by the manufacturer (Wave Glider Management System (WGMS ©)). A piloting schedule was made in such a way that they are covered 24 hours a day.



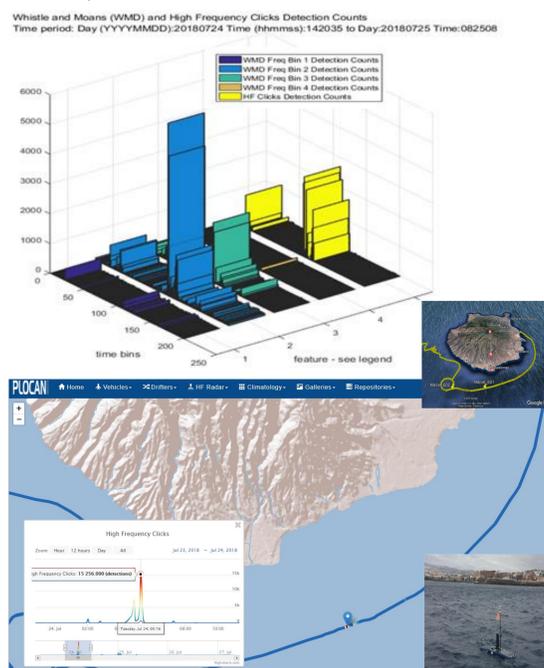
WaveGlider SV2 and Pambuoy ready to be deployed

Data was collected from 23rd to 27th of July 2018 on the way and at the Mogan SAC south of Gran Canaria. Data collected can be seen in the table below:

Variable	Sensor	Sampling frequency
CTD	Sea Bird Scientific	1 min
Dissolved Oxygen	Sea-Bird Scientific	1 min
Meteorological Station	Airmar 200 WX	10 min
Acoustics	Pambuoy (Decimus system) de S. A instruments	50kHz, continuous recording with automatic bioacoustic detectors

### Results

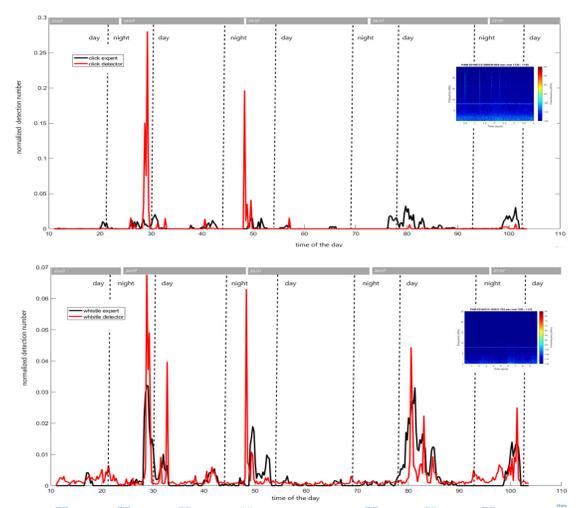
In this mission a total of 227 km summed up the Wave-glider effort. Data collected, as well as the track were uploaded in real time to PLOCAN's observatory platform: <http://obsplatforms.plocan.eu/vehicle/USV/35/>. A total of 93 hours of recordings were obtained and processed through the Pamguard automatic detectors. Automatic detections can be seen in the graphs below for a sample of the period and the track between the points ED1 and ED2.



Pamguard automatically detected approximately 92 000 clicks and around 16 000 whistles.

### Independent validation of the results

Independent validation of Pamguard detections was performed by a third-party and supervised by the authors to evaluate Pamguard's detection capability when used as one element towed hydrophone array on a surface autonomous vehicle. The recordings were processed manually and a comparison between those and the automatic detectors was performed as seen in the figures below for clicks and whistles, as well as examples of spectrograms.



Of the 92 629 clicks detected by Pamguard, 30568 were confirmed and of the 16603 whistles detected, 2158 were confirmed as true positive detections. Positive Predictive Value (PPV) or Precision and the True Positive Rate (TPR), Recall or Sensitivity, as well as the F-Score were calculated for both clicks and whistles:

Indicator	Cetacean clicks (%)	Cetacean Whistles (%)
Precision	33	13
Sensitivity	22	19
F-Score	26	16

## RESULTS DISCUSSION AND CONCLUSIONS

The use of autonomous vehicles for the management of SACs has been increasing in the past years and the advantages are undeniable. According to recent reviews self-powered autonomous surface vehicles (ASVs), such as PLOCAN's Wave Glider that have a passive acoustic monitoring system built-in can be valuable when it is intended to monitor cetacean populations. However, the slow movement of the vehicle together with the high percentage of the false positives could lead to an overestimation of the

populations. More detailed analysis are needed, including an adjustment of the detection parameters of Pamguard and a re-analysis of its performance to be able to tune in and increase the quality of detections. Adding another hydrophone element to the acoustic array would also increase the quality of detections allowing for directionality on the cetacean vocalizations and thus improve the habitat and density models for the SACs.

Both MARCET (MAC / 1.1b / 149) and MARCET II ( MAC2/4.6c/392)

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