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TOPICS/SUBMISSION THEMES: • **Human dimension of coastal communities:**

Ten years monitoring of Reunion Island MPA recreational uses

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In urbanised coastal environments, Marine Protected Areas (MPAs) are designed to protect biodiversity while integrating human activities. Despite directly impacting the environment, the range of coastal recreational activities broadly contribute to human well-being, through providing users with a cultural, recreational and aesthetic experiences. It is now acknowledged that the integration of users in scientific monitoring frameworks and decision-making contributes to the effectiveness of conservation through producing revenues and encouraging social acceptance. As a result, managing and monitoring recreational activities within these regulated environments is slowly being considered and integrated into MPA dashboards.

The Natural Marine Reserve of La Reunion (RNMR) was established in 2007 along a fringing reef. The reef extends over forty kilometres along the western coast from Cap La Houssaye to Etang-Salé. Over the past decades, the west coast has been prone to rapid urbanization. The consequent increase of the coastal activity has highlighted new issues among which the potential impacts on the environment and conflicts that may result. Against a backdrop of the shark crisis, coastal activity has increased since 2010 and is seen through a marked growth in the number of coastal facilities, the island population (+6,7%) and the number of tourists (+9,5%).

This presentation will show how the long-term monitoring of the recreational uses of the Reunion Island MPA (2010-present) has provided the managers with indicators aimed at assessing the direct human pressure and the effectiveness of the management. This observation of human activities and uses of resources has been supported by different programs that sometimes have different objectives. Currently, the monitoring is supported by the observatory of sciences of the University of La Reunion island (OSU-Reunion) and its partners (DEAL, RNMR).

Based on the methodology developed in Lemahieu *et al.* (2010), flights in a ultralight aircraft were carried out 8 times/year on Sundays between 3:00 and 3:30 p.m between 2010 and 2019. Photographs were taken continuously in order to record of the activities on the beaches and in the reef areas within the RNMR perimeter. The users, falling into 14 categories of uses e.g. swimming, sunbathing, surfing, scuba diving or fishing, were manually counted and data were entered into a database. Parallel to that, a GIS database was created to spatially-represent the data using the regulation spatial grid provided by the RNMR (27 sectors). The resulting

database spans 10 years and is managed by DBMS PostgreSQL, an open source object-relational database system that works well with the relational databases of GIS. On Ermitage sector, spatial data on geolocalized users was crossed with hyperspectral images and Lidar data of the local reef (projects Spectrhabent-OI / Bioindication). This cross analysis enabled the researchers to address the topic of localized human pressure on reefs.

Two broad types of results are available from analysing the database. Firstly, the database enables us to analyse the intensity and distribution of coastal uses over time. Considered as being accurate indicators of the pressure, peak usage was reached on a public holiday, the 11th of April, 2011 with 11084 users on the beach in the RNMR. In 2018, high scores were recorded at a higher frequency since more than 10,000 users were counted during 3 out of the 8 annual flights i.e. 10862 on the 18th of February, 10630 on the 13th of May and 10,475 on the 15th of April.

Ermitage Nord was found to be a sector where the evolution in the usage has been significant with a 10% average contribution to the global usage in 2018. A recent increase in the number of facilities, the proximity to popular spots (Roches-Noires) and the fact that the site is integrated into an urban environment can possibly explain this increased attractiveness. Parallel to this, the usage of « open-sea » beaches (no reefs) has remained low on this account of a set of decrees and governmental orders to close the sites to the public following a series of shark attacks. In Ermitage Sanctuaire and Trou d'Eau the usage importantly increased too. Secondly, the crossing of user data and Spectrhabent-OI reef data highlighted areas where high level of human activities were correlated to a low to non-existent coral cover mainly localized in sandy back-reef zones. In a previous 2009 assessment, these areas were already showing same kind of substrate types, and sectors like Ermitage Nord was shown to be vastly colonised by algae and seagrass. High rates of coral cover in these sectors are confined to the reef crest areas where the exposure to human activity is lower in comparison to the back reef and reef flat.

In a changing social, political and demographic context, 10 years of spatially-referenced coastal uses and activity data offer scientists and decision-makers a chance to understand the landscape evolution and address the human-environment interactions. This study allows us to monitor the usage, the activities at different spots over time, and the response to changes in a context of rapid development. The database allows researchers to address a range of topics. The most popular is the utilisation of data for the spatial analysis of human pressure on the environment. This study is a demonstration of engagement within the RNMR for the inclusion of the human dimension in their management and to ensure that the social-ecological methodological framework is being used to guarantee the success of the MPA.