Shipping and environmental pressure: Ship-whale interactions off the Guadeloupe archipelago

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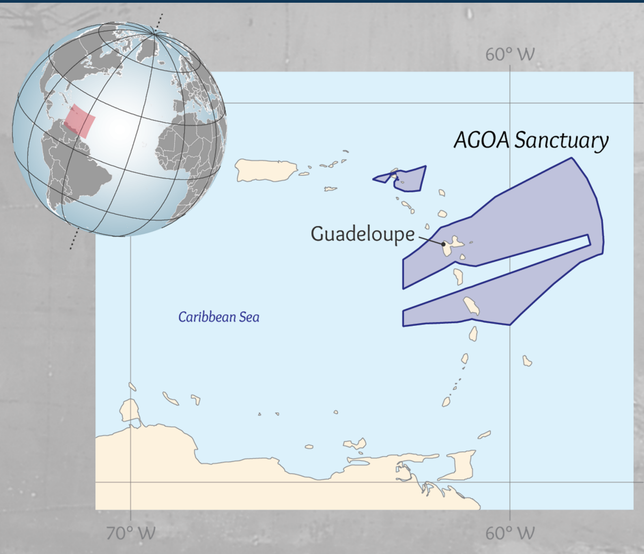
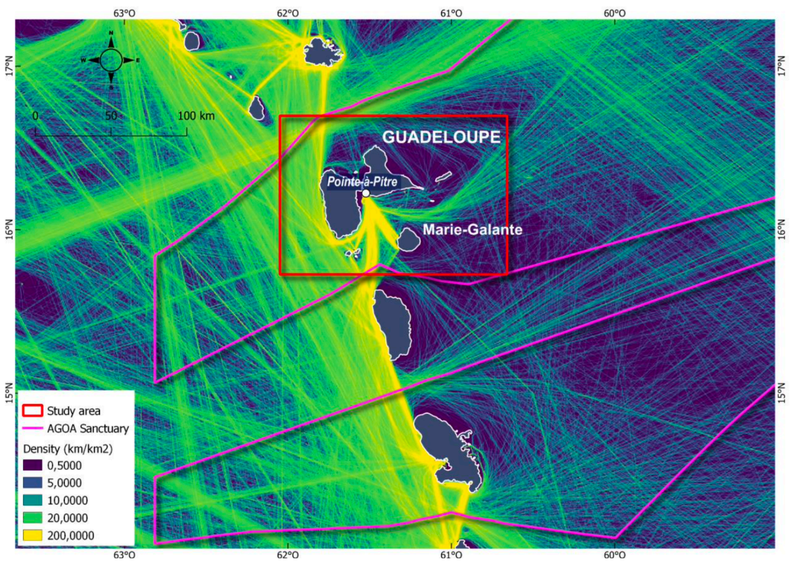


The Guadeloupe archipelago is home to a rich and precious marine biodiversity that concerns all levels of food webs, including marine mammals. **More than 20 species** of cetaceans have been listed in the archipelago, which is part of the **Agoa sanctuary**, a marine protected area in the French Caribbean waters dedicated to marine mammals. **Some species are well known**, abundant throughout the year (bottlenose dolphins, sperm whales) or only during certain periods determined by their migratory routes, such as humpback whales. **Other species are rarer**, difficult to observe and data are lacking to estimate their status in the archipelago.

Maritime traffic is an activity **growing locally** in the context of the expansion of the **Grand Port Maritime de Guadeloupe**. Its potential and real **impacts on marine ecosystems** are particularly difficult to decipher.
For cetaceans, considered here both as emblematic and sentinel species of the quality of the natural environment, **the impacts can be direct** (collisions, disturbances) or **indirect** (noise or chemical pollution).

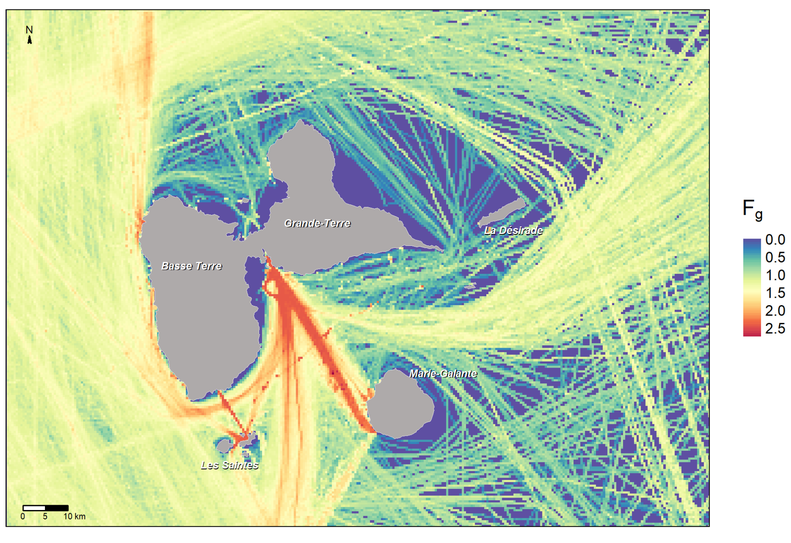
We studied the interactions between cetaceans and maritime traffic in the Guadeloupe archipelago, using complementary approaches.

1 - The marine traffic was mapped in detail using AIS data.
400 million ship positions registered during the whole year 2019 were analysed



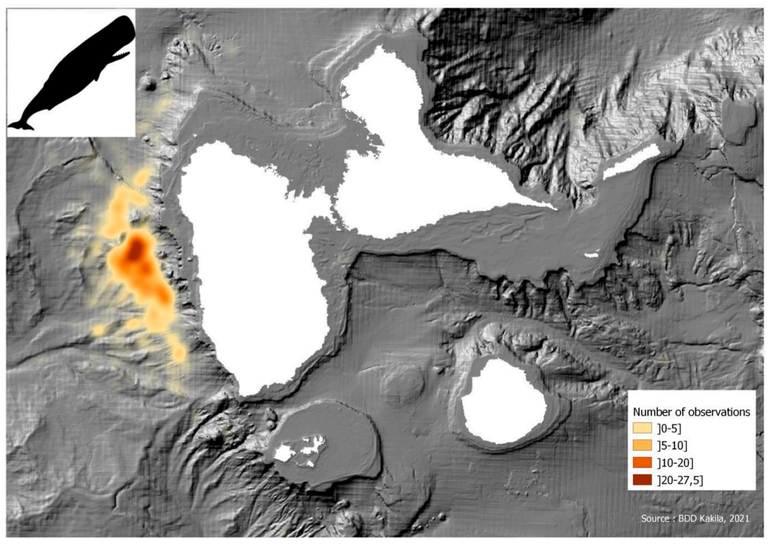
Shipping trajectories density around Guadeloupe and the Agoa sanctuary en 2019

2 - Cumulative pressure of the marine traffic was estimated
in terms of intensity, occupancy and speed



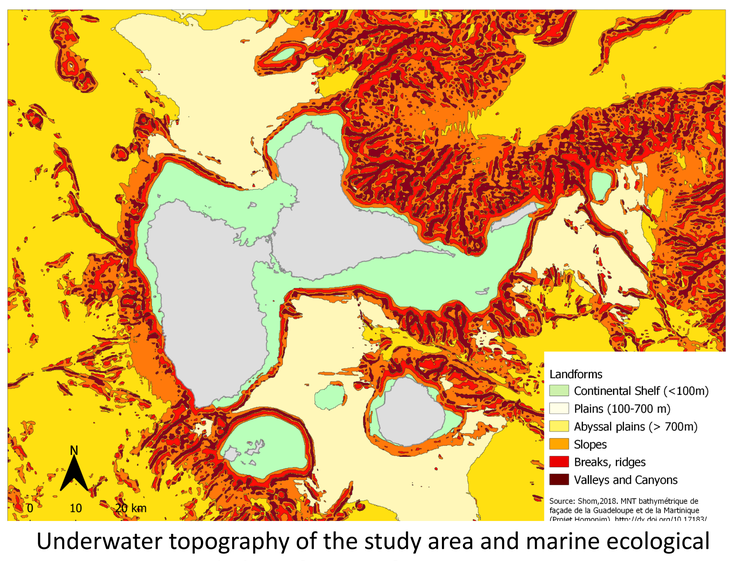
The shipping pressure expressed by the cumulative score of the intensity, occupancy and speed indices

3 - The presence of cetaceans was studied over the long term through citizen science monitoring.
4704 observations of 21 species were gathered in an open access database named *Kakila**
**Kakila* means "who is there?" in Guadeloupean creole



Example of heat maps constructed from the *Kakila* database, showing sightings of a cetacean species, the sperm whale (*P. macrocephalus*).

4 - Cumulative pressure of the marine traffic and cetacean habitat preferences were compared to underwater topography



Underwater topography of the study area and marine ecological habitat features for cetaceans

These comparative analyses highlight and specify potentially negative interactions between certain cetacean species and marine traffic in several areas of the Guadeloupe archipelago.
e.g. the most plains-dependent species (such as Fraser's dolphins and short-finned pilot whales) have to face the heavy traffic between Pointe-à-Pitre and Marie Galante. Speed pressure impacts are high at the surface of sperm and beaked whale preferred habitats, highlighting an increased risk of direct collision for these species. Humpback whales and pantropical spotted dolphins face the greatest risk of disturbance from high average vessel traffic occupancy in the shallow continental shelf waters.

Such promising results encourage us to extend the study. In particular:
- **by improving the cetacean presence data (including by using environmental DNA-based approaches),**
- **by integrating hydrological variables to the habitat characterization,**
- **by extending the AIS data analysis over several years to study the chronological variations (monthly and interannual).**

The identification of marine mammal conservation hotspots in Guadeloupe, as well as mitigation proposals, are the goals of our study.

Further readings
Coché L. et al. (2021) **Kakila database**: Towards a FAIR community approved database of cetacean presence in the waters of the Guadeloupe archipelago based on citizen science. ***Biodiversity Data Journal***. https://doi.org/10.3897/BDJ.9.e69022
Madon B. et al. (2022) Pairing AIS data and underwater topography to assess **maritime traffic pressures on cetaceans**: Case study in the Guadeloupean waters of the Agoa Sanctuary. ***Marine Policy***. In press

International Symposium of Labex DRIIHM - 2022
Inter-Disciplinary Research Facility on Human-Environment Interactions - ANR-11-LABX-0010
20-22 june 2022 - Nantes (France)