

Title: Shark and Aquaculture Interaction: Misunderstandings and Human Apprehensions

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Abstract: Marine aquaculture is fast developing worldwide, and aquaculture has already surpassed wild catch for many important commercial species. Moreover, aquaculture is an activity that is highly sensitive to the surrounding environment. One of the major debates on aquaculture is attraction of sharks and shark proliferation around cages. The shark-human interaction has for years been complex and difficult to address. Mauritius and Reunion Islands, both located in the south west Indian Ocean have been subject to human-shark arguments based on aquaculture activities. Nevertheless Reunion has suffered from shark attacks while Mauritius has so far been spared of any sort of shark attack excluding provoked ones. Two studies were conducted in both Mauritius and Reunion Islands. For Mauritius, three baited Remote Underwater Videos (BRUVs) system and one unbaited stationary video system method (USV) was used to assess the shark-aquaculture interactions around and inside the fish farm. The three unit of BRUVs were placed 50m next to the floating cages at a depth of 20-25m while the USV was placed at three-specific location under the floating cages at a depth of 20m for monitoring of 30 mins intervals. Additionally, the USV was used during feeding-time (11hr00 a.m) to assess predator aggressiveness. The surveys were conducted on a daily basis for one month and thereafter on a monthly basis from April 2018 till January 2019 both at dusk (17hr00 p.m) and at night from 19hr00 for both methods. Baits used were frozen species of the family scombridae and fresh pieces of *Sciaenops ocellatus*. Video monitorings showed no sharks attraction neither to the baited and unbaited systems nor any visual detection of sharks around the fish cages during feeding times. Over the monitoring periods, 21 sightings of the predatory fish of the genus *Sphyrna* were seen around the floating cages with no interest on the fish inside cages. For Reunion, as part of the CHARC program, two studies were conducted, one based on the use of an underwater camera and one based on acoustic telemetry. The first study consisted of the deployment of a high-definition underwater camera that filmed continuously under the aquaculture cages, during the hours of days (9:00 am to 6:00 pm), for a month. Over the study period, there were 218 shark sightings including 217 bull sharks, alone or in groups, and one nurse shark (*Nebrius ferrugineus*). A large part of these observations is attributed to 8 female bull sharks, with were around 250 cm Lt. The times of presence in the cages were generally low, although variable from one individual to another. The study of shark behavior did not reveal hunting or

aggressive behavior of bull sharks under cages, even when feeding fish. The second study uses acoustic data of bull sharks tagged during the CHARC program. A listening station was deployed under the aquaculture cages from 2012 to 2014. During this period, each time a tagged shark ($N_{\text{bull shark}} = 38$) come around cages, its presence has been recorded. From these data, the number of sharks detected on the aquaculture farm site was studied according to the presence of cages with fish inside, the presence of cages without fish and the absence of cages. The results confirm those obtained using cameras with a variable but relatively low presence of bull sharks on the farm site, in terms of number but also of time of presence (duration during which a shark remains on the site), and this whether there are cages or not and whether fish presence or absence into cages. Based on the findings, marine aquaculture does not seem to attract neither provide suitable conditions for shark proliferations.

Keywords:

Aquaculture, ocean economy, shark, impact.