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DORSAL FIN PHOTOIDENTIFICATION: TOOL FOR LONG TERM STUDIES OF WHITE SHARK (*Carcharodon carcharias*) BEHAVIOUR

Abstract: Studying the behaviour of the White Shark is a recent and big challenge. Optimising the photoidentification of White Shark dorsal fins is a basic goal, in order to compare behavioural information in both immature and mature specimens and between females and males. During a 6 years research, from 2009 to 2014, we observed about 296 sharks and 8 specimens were resighted several times. Data about sex, sizes, environmental conditions and behaviours were collected. This is the first step to develop a more complex database in which include all the observed behaviors for each shark in different environmental conditions over the years. The final goal is to share the information we have collected with other research groups operating in other geographic areas working on other populations of white sharks

Keywords: photoidentification, dorsal fin, behaviour, *Carcharodon carcharias*

Introduction: The top predator *Carcharodon carcharias*, widely distributed in the oceans, has recently been the subject of extensive research concerning population dynamics, genetic, ecotoxicology and behaviour. In particular, in the last two decades, many efforts were carried out in order to get more information about the behaviour (Klimley *et al.*, 1996; Martin 2003; Micarelli *et al.*, 2006; Sperone *et al.*, 2010) of this vulnerable specie, included in the I.U.C.N. red list. This information could be useful to better plan the conservation of this species. Recent researches demonstrated that individual surface behaviour of white sharks in presence of a bait is not a simple stimulus response reflex, but rather a complex tactical situation with plastic responses (Sperone *et al.*, 2012). The white shark is a much more complex animal than imagined just 20 years ago. Recently, the possibility that the dorsal fin can be compared for a long time, more than 22 years, was confirmed (Anderson *et al.*, 2010). This could represent a good tool to study single specimen for a long period, obtaining information about the development of the behaviour in this species.

The photoidentification is a non-invasive method of mark and recapture. The dorsal fins present particular notches in the posterior line which can become typical marks and persist during their life. Towner *et al.* (2013), showed that Darwin program is suitable for matching and cataloguing white shark dorsal fins but they consider that, without consistent effort, it is possible that individual fins which changed would not be successfully matched to the same individual shark: thus fin IDs from the same shark over time can be counted as multiple individuals resulting in an over-estimation of animals. Photographic identification remains a subjective method, since the final decision on identification is taken by the observer based on experience and expertise (Gubili *et al.*, 2009). This research note reports about the first step we made to build a larger database: this will be useful to compare the behaviour of mature and immature sharks, males and females, over the years, and with the growth.

Material and methods: During 6 Scientific expeditions managed by the Centro Studi Squali and occurred between 2009 and 2014, 323 useful photos of dorsal fins were

collected for 296 sharks along Dyer Island in South Africa, where an important population of > 500 great white is yearly present (Micarelli *et al.* 2006; Towner *et al.* 2013). Data were collected between March and April around Dyer Island, 200 km far from Capetown, which hosts about 60,000 Cape fur seals (*Arctocephalus pusillus pusillus*), that represent the principal food resource for the local population of white shark. With a 12 m long boat, we anchored at 100 m close to the island, in 8 m deep waters. Fin photos were collected using 3 digital cameras: 1 CANON model EOS 550, with a SIGMA 70-300 mm lens and 2 with CANON 18-135 mm lenses. Images were then analysed with the program Darwin and the program Photoshop. The operators photographed the fins both sides, left and right. Operators were placed the most perpendicular respect the sea surface. Each photo was numbered and complete with the following additional information: date, day-time, sex and size of the shark, weather conditions and behaviour (social, individual, predatory, investigative). Identification of individual sharks was based on a larger pattern including not only the different notches of the dorsal fin, but also the following characters: caudal fin features, pelvic fin patterns, gill slashes and body patterns, presence of scars and/or ectoparasite (Sperone *et al.* 2012). We assumed that at least 5 same dorsal fin notches must be present in each resighting.

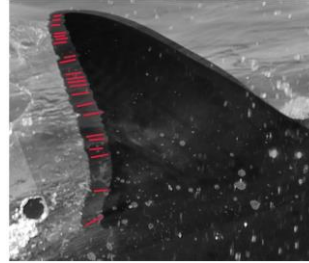
Results and conclusions: The analysis of collected photos showed that the observation of the same animal along the years is a useful tool for behavioural studies; however photo-identification analysis must be very detailed and must include many other information to avoid potential mistakes. During our research, 8 sharks were resighted (pic 1, 2), for all of them were collected also behavioural information, but results are still not significant because number of resightings is too low for an accurate analysis. The challenge is to improve the database of identified and catalogued specimens. Further investigations are needed and are actually in progress, in order to compare the development of the behaviour of sharks over the years.

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Pic.1



Pic.2