Diving impact: Frequentation, diver behavior and consequences on the mediterranenan fish community

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Popularization of recreational scuba diving has increased in recent years, adding a new dimension to the human impacts on aquatic systems. Although impacts at the individual level have been identified, what causes these behaviors and how the Mediterranean fish community responds is not clear. In this research, we studied during high season: (i) the frequentation of a diving site in the bay of Calvi (Corsica, France), using the dive sheets of local diving structures but also taking aerial photographs (ii), the behavior of the divers tby observing their diving practice in 10-minute-increments in order to determine how many contacts they had with the environment, what type of contact there was (voluntary or involuntary) and which part of the body or instrument was involved, and finally (iii) the composition of the fish assemblage (i.e. abundance, size structure and species composition) through Underwater Visual Census (UVC) counts carried out before and after the divers' arrival on site. In addition, a particular attention was paid to patrimonial species, namely the brown grouper (*Epinephelus marginatus*), by noting the size and reaction of the individuals when confronted to divers, according to 5 behavioral typologies: "Close flight <10 m","Distant flight >10 m","Attraction","Indifference" and "Change of position, observation of the diver".

Our results show that the monitored diving site is particularly popular with an average of 82 divers per day during high season. Divers' awareness of the impacts of diving is relatively low and more than 80 % of them made contact with the environment during the diving sesion, with an average of 7 contacts per 10 min. The majority of involuntary contacts involve fins, while the rest of contacts are very diverse, involving both the body and the equipment (octopus, diving bottle, pressure gauge, safety sausage, etc.). Additionally, divers holding a camera are more likely to make intentional contact with the substrate. Divers' experience is also a major factor; their ability to control their buoyancy has an impact on the various types of contacts observed. The divers with good buoyancy control are more prone to make voluntary contact, while divers with poor buoyancy control tend to make more involuntary contact. Fish populations respond differently depending on the species involved. Indeed, Brown meagre (*Sciaena umbra*) and Dusky groupers (*Epinephelus marginatus*) seem to be the most disturbed by the divers' presence. Their biomasses decrease significantly following diving sessions, which indicates an attempt to escape or a desire to hide. We also found that the bigger the groupers, the further away they would flee. On the contrary, small individuals are curious and more likely to show an attraction to diver. Furthermore, there is no significant difference between the "distant flight" and "change of position" behaviors, which shows that large groupers (> 70 cm) are more wary of divers, by observing them, preparing for an escape or even fleeing more than 10 m away. On the contrary, the "Indifference" and "Close flight" behaviors do not show a significant difference, meaning that smaller groupers (50 - 70cm) are less fearful. Lastly, the number of divers per site, their environmental sensitivity and knowledge, their level of technicality, as well as their type of practice determine their impact on the marine environment.
Our research stresses out the importance of delivering messages about the environment and the right conduct to adopt underwater during the pre-diving briefing: divers who received information before diving will potentially make less contact with the marine environment.

Keywords: Diving; Mediterranean fish community; Frequentation; Diver behavior