

# Does recreational diving alter hawksbill sea turtle foraging behavior? Results from a marine protected area, Honduras

Authors: Christian T. Hayes<sup>1</sup>, Dustin S. Baumbach<sup>2,3</sup>, David Juma<sup>5</sup>, and Stephen G. Dunbar<sup>2,3,4</sup>

## Affiliations:

<sup>1</sup>Department of Science and Mathematics, Cedarville University, Cedarville, OH 45314.

<sup>2</sup>Protective Turtle Ecology Center for Training, Outreach, and Research, Inc. (ProTECTOR). Colton, CA 92324.

<sup>3</sup>Marine Research Group, Department of Earth and Biological Sciences, Loma Linda University, Loma Linda, CA 92350.

<sup>4</sup>Protective Turtle Ecology Center for Training, Outreach, and Research, Inc., Honduras (ProTECTOR - H), Tegucigalpa, Honduras.

<sup>5</sup>School of Public Health, Research Consulting Group, Loma Linda University, Loma Linda, CA 92350.

## Abstract:

Recent studies indicate that recreational diving may cause unintended behavioral changes in marine macrofauna. The hawksbill sea turtle (*Eretmochelys imbricata*) is a critically endangered species encountered by recreational divers in marine protected areas (MPAs) circumtropically. Few studies, however, have examined the impacts of recreational diving on sea turtle behavior. We conducted in-water observations of 61 juvenile hawksbill turtles from June 12 to September 2, 2014 in the Roatán Marine Park (RMP), Roatán, Honduras, to quantify the impacts of recreational diving on hawksbill behavior. We recorded turtle behaviors and the number of behavior bouts to test the effects of diver approach on sea turtle behavior. As a control for diver interactions, we began all observations by recording turtle behavior for approximately 3–5 m, and to test if diver approach affected a change in turtle behavior, we instructed different sized groups of divers (1-4) to slowly approach each turtle. We used the Interactive Individual Identification System (IIS): Pattern (Version 4.0.1) to test for repeat individuals. To test for associations between behavior bouts and behavior time we ran Spearman's correlations. We also ran repeated measures ANCOVAs, comparing the total time turtles engaged in each behavior before and after divers approached turtles. Our results indicate that the amount of time turtles engage in eating, investigating, and breathing activity was correlated with the number of behavior bouts of each behavior. We also found that the amount of time turtles spent eating, investigating, and breathing decreased when approached by divers. Our results suggest diver habituation may negatively impact sea turtle behaviors, however it is unknown if recreational diving has a cumulative effect on turtle behavior over time. We recommend that MPA managers should implement monitoring programs that assess the impacts of tourism on sea turtles. We have established monitoring of hawksbills as representative species of marine habitats which have the potential to be heavily impacted by dive tourism, and provide recommendations for continued monitoring of the resource.