

## ENVIRONMENTAL IMPACT OF DIVING TOURISM ON CORAL REEFS

*Luis Carlos Santander-Botello*  
Universidad de Quintana Roo, México

*Enrique Propin-Frejomil*  
Universidad Nacional Autónoma de México

### DIVING TOURISM

Scuba diving became a popular activity after the invention in 1942-43, by Jaques Cousteau and Emile Gagnan, of the aqua-lung system which started to be sold in France in 1946 and a few years later in Great Britain and the United States. By 1960 diving was already included in the tourist promotion of tropical destinations.

Worldwide, every year close to one and a half million people are certified as divers. Around one million of those get their certification through PADI, which started operations in 1967 with 3.226 certifications and by 2007 had granted, in 40 years, over 16 million diving certificates. In 2007, 38% of certifications were issued in Europe, where Great Britain represented the largest share, 29% in Asia and Pacific region countries, and 33% in the Americas. According to PADI's data, the average age of people getting diving certificates is 27 years old for women, who represent one third of total certifies awarded, and 30 years old for men.

The World Tourism Organization defines diving tourism as the one made by people that travel having as their main purpose scuba diving in a destination selected with criteria about the quality of the diving experience that it offers. However, those conditions are not valid for a large number of people that dive during their visit to tourist locations.

Most academic studies and reports on diving tourism do not provide an explicit definition of diving tourism. In this work diving tourism is understood as the one done by people who practice scuba diving during their visit to locations where such activity is popular.

Diving tourism is an important economic activity for many tourist locations and shows a 7% steady growth rate. By the year 2000, at least 91 countries and territories had tourist locations where diving was a popular activity, and under the WTO definition of diving tourism, its value was close to 5 billion dollars. For some small Caribbean islands the profits received from diving tourism reaches up to 2 million dollars per year.

Diving tourism is a high value activity. In the Caribbean the average expenditure of diving tourists is larger, up to 80%, than the average expenditure of tourists as a whole. Of all tourists to the Caribbean only 10% are divers, but their share on total income from tourism is close to 20%. Nowadays, 28 million certified divers are still active around the world and one third of them make at least one trip per year with the main aim of diving.

Close to 75% of diving tourism is made by people living in the United States and most of them select diving on coral reefs. Diving tourism is an international market since most diving tourists live in developed countries and travel to tropical destinations. Overall, 60% of international diving tourists pick up Caribbean locations for their vacations. In the year 2000, over 3.5 million people dove in the Caribbean Sea. Among divers from the south east region on the United States the days spent diving in the last year were 14.2 with 5.3 days outside their country, mainly in the Caribbean and Mexico.

Diving tourists make up their perception of the environmental condition of a coral reef, through a set of signs such as underwater visibility, quantity of dead, broken or sick coral colonies, variety and size of fishes and area covered by algae. However, it seems difficult to establish a clear cut point or specific set of conditions under which the tourist experience is negative and becomes significant in future selections of tourist destinations.

### **CORAL REEFS AS A SCARCE TOURIST RESOURCE**

Coral reefs are marine habitats defined by their physical structure, by the living organisms associated and by the biological processes that sustain them. Coral reefs are among the oldest living organisms on earth.

Worldwide, coral reefs cover 284.300 square kilometers that represent 0.2% of the total planet surface or 1.2% of all continental lands. In other words, the surface of all coral reefs is slightly larger than France or Spain. Reef construction corals are restricted to marine waters with warm and mild temperatures. Coral reefs are found in over 100 countries and territories within the latitude belt 30° N - 30° S. The distribution of coral reefs on tropical seas is uneven. Over 40% of total coral reefs' surface is found in Southeast Asia alone. By contrast, only 7% of the world coral reefs' surface is found in the Caribbean, and the Bahamas and Cuba, the two countries with more coral reefs in the region, account for 1% each of the world total. On the other hand, Indonesia and Australia account for 35% of total coral reefs surface in the world.

Five hundred million people are dependent upon reefs for food, coast protection and tourist income. Around the world coral reefs goods and services have a 375 billion dollars value, while for the Caribbean it reaches 4.6 billion. In the latter, 21% of its coasts are protected by coral reefs. Some of those coasts have little development but others have large and expensive tourist facilities.

Coral reefs are ecosystems with close physical and ecological interdependence with other coastal ecosystems. Coral reefs may be considered the most productive, diverse, complex and valuable ecosystem in the world. Coral reefs are affected by natural processes and anthropogenic impact. However, global warming, increase in tropical storms, pollution, diseases and plagues have passed from occasional episodes to chronic impact on coral reefs.

Coral reefs degradation started to be recorded in the 1980s. With observations on more than 1000 reefs during 1997 to 2001, the program Reef Check concluded that coral cover in reefs surfaces has dropped to 32% and that high value fishes have disappeared in many sites, or their sizes and numbers are sharply reduced. According to the last edition of *Status of Coral Reefs of the World*, 19% of coral reefs have already been lost, while 15% are under serious threat to disappear in the next 20 years.

Scientific knowledge on coral reefs resilience and about the combined impact of stresses is limited. However, it is clear that the addition of any source of stress multiplies the impact of every source of stress. Therefore, the increase of natural and anthropogenic impact on coral reefs make them more vulnerable to the impact of diving tourism, and the impact of the latter make reefs more vulnerable to other impacts. Reducing diving tourism impacts on reefs, through management tools, can be done locally and improves coral reefs resilience.

### **DIVING TOURISM IMPACTS ON CORAL REEFS**

Direct impacts of diving tourism in coral reefs are a real and significant source of negative change. It was in the 1990s when the number of studies concerned with the impact of diving tourism in coral reefs started to rise. The objectives, methods, scope and results of such studies are highly diverse. Nonetheless it is possible to differentiate perspectives, of which more than one can be present in the same study or report: a) identification and quantification of direct impacts; b) discussion about limits of tourist use and/or carrying capacity; c) proposals and critiques of other environmental management tools; d) explanations about structure and distribution change of species; e) recognition about the importance of the physical and biological uniqueness of every diving site, and; f) emphasis on the significance of the patterns of tourist use and tourist behavior in the characteristics and magnitude of direct impacts.

In academic studies about tourism the concept of carrying capacity was widely criticized during the 1980s and 1990s. However, in studies about diving tourism the proposal of using carrying capacity is still a trend. Different proposals formulated for different sites suggest that divers' carrying capacity for a coral reef is between 4000 to 7000 per year, giving an average of 11 to 19 divers daily. Examples around the world show that such an average is far away from what happens on popular diving destinations. Given the uneven time distribution of visitors to diving sites it is possible to find sites with peaks of up to a 1000 divers per day.

Carrying capacity is a concept widely mentioned but rarely applied to diving sites. One important reason that makes difficult the use of carrying capacity as a tool for coral reef conservation is that features such as topography, depth, current, patterns of use and divers behavior are not considered when it is calculated.

Marine protected areas (MPA) with coral reefs have in zoning the main management tool to prevent impacts from tourism and also use different criteria such as no take (fishing), no use of anchors, restrictions in ways to interact with marine life, and other standard rules. Rarely, if ever, is possible to find coral reefs conservation policies that address the issue of the specific characteristics of each diving site regarding its physical

and biological attributes and its patterns of tourist use. These items have, on their own and in combination among them, a significant part in explaining the specific nature and magnitude of diving tourism direct impact.

Standard measures and tools help in conservation but fall short of a tailored made set of measures based in the specificity of every site. Site specificity shows how carrying capacity is elastic, changing the number of desired divers with any change in any of the variables that explain impacts. For Cozumel's MPA, a well established international diving destination in Mexico with over 20 scuba diving sites, a study made by the authors gave clear indication that the variables that affect the nature and impact in every site are:

- Site type (wall or platform; with or without cannons and tunnels)
- Type of dive (drift)
- Large or small coral heads
- Fast, medium or slow current
- Time and space patterns of divers distribution
- Perceived aesthetic value of the site
- Effectiveness of existing conservation rules
- Type and number of direct contacts experienced by divers
- Marine life searched (big or small)
- Underwater practices by diving guides (environmental surveillance or degradation compliancy; direct interaction with marine life or not; taking divers through narrow spaces or not; etcetera)
- Divers' profiles (from frequent visitors to cruise ship passengers; from highly experienced and technical divers to people doing resort diving -visitors without an open waters certificate)
- Direct impacts from other tourist activities

Knowledge of the above items, added to standard measures, can help to design behaviors and profiles for divers and guides that increase the number of visitors to a site, while reducing negative impacts. Certainly, there are limits to the number of visitors and there are serious every day difficulties for a conservation management program for 20 plus sites; but the scarcity, value and natural and anthropogenic threats to coral reefs justify the effort required.

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