





How to characterize SCUBA diving sites for regional and local-scale management needs?

Elodie ROUANET¹, Patrick ASTRUCH¹, Bruno BELLONI¹, Adrien GOUJARD¹, Sylvaine IZE², Anne SALVADO², Marion BRICHET³

¹: GIS Posidonie, OCEANOMED/MIO, Aix-Marseille Université, Campus de Luminy, 13 288 Marseille cedex 09 / ²: Agence Française pour la Biodiversité, antenne Méditerranée, 26 rue de la République, 13 001 Marseille ³: Direction Interrégionale de la Mer Méditerranée, 16 rue Antoine Zattara, CS 70 248, 13 331 Marseille cedex03 / Contact : <u>elodie.rouanet@univ-amu.fr</u> et <u>www.mio.univ-amu.fr/gisposidonie/</u>

> important erate major

minor

moderate

Abstract

New tools are needed by MPA managers to improve the management of diving sites within the European Marine Strategy Framework. A categorization method of the French Mediterranean diving sites has been proposed. An environmental issue level has been defined and a categorization index developed for a better application of the regional public policies and for the settlement of effective local action plans in SCUBA diving management.

Introduction

The French Mediterranean coast (continental and Corsica Island) is a hot spot for SCUBA diving. Diversity of species and seascapes, different types of dives (natural, wreck, depth) and good meteorological conditions attract many French and European SCUBA divers (figure 1). About 550 dive centers are located on the coastal administrative departments, which accommodate about 70-75 000 of individual divers per year. In order to implement the European Marine Strategy Framework Directive, a method for the categorization of diving sites is proposed for a



Methods

The method developed aims to be generic, homogenous along the French coast and replicable on other geographical areas (temperate and tropical as well). Several criteria have been selected to be systematically assessed to the site: (1) conservation status of natural habitats (European Habitats Directive assessment), (2) habitat sensitivity to human pressures, (3) frequentation by divers, (4) pressure related to other activities, (5) seascape value, (6) management level (presence of environmental managers with effective SCUBA diving action plan), and (7) level of ecological and uses knowledge. A score is allocated at each criteria value (table 1).



Crossing the first 5 criteria enables the definition of the environmental issue level (EIL):

		,	FII
_	10(FII) - FII		

Results and discussion

The categorization method was applied to 170/400 natural SCUBA diving sites inventoried along the French Mediterranean coast encompassing wreks and underwater trails. Table 2 delivers the 8 categories defined according to SCUBA diving pressure, management and knowledge levels. Two spatial scales are considered in results :

1 = a large-scale categorization of diving sites useful for the implementation of the public policies;
2 = a local-scale for MPA managers providing information about the actions to be taken.

 Table 2. Characteristics of the 8 categories of natural diving sites.

Category	SCUBA diving	Management level	Knowledge level	Number of SCUBA diving sites		
	pressure			Total	EIL > 3	Cl > 1
1	high	moderate to high	moderate to low	27	10	0
2	high	low	moderate to low	69	17	28
3	moderate	low	moderate to low	22	0	3
4	low	high	high	2	0	0
5	high	high	high	12	5	1
6	low	moderate to low	moderate to low	18	0	0
7	moderate	moderate to high	moderate to low	4	0	0
0	high	modorato	modorato	16	Λ	0



By subtracting the sixth criteria at environmental issue level, a categorizing index (CI) is obtained



The accuracy of the obtained value is qualified by the following seven criteria (K).

Table 1. Definition and score of the criteria allowing the categorization of SCUBA diving sites.

Criteria	Score	Definition		
Conservation status	1	Excellent		
	2	Good		
	3	Low		
Habitats sensitivity	1	Very low		
	2	Low		
	3	Moderate		
	4	High		
	5	Very high		
SCUBA diving pressure	1	< 100 divers/ha/y		
	2	100 - 250 divers/ha/y		
	3	250 - 1 000 divers/ha/y		
	4	1 000 - 2 500 divers/ha/y		
	5	2 500 - 5 000 divers/ha/y		
	6	> 5 000 divers/ha/y		
Other activity pressure	1	HI < 0.1		
(calculation method of human impacts – HI : Holon <i>et al.,</i> 2015	2	0.1 < HI < 0.6		
	3	0.6 < HI < 2.1		
	4	2.1 < HI < 8		
	5	8 < HI < 10		
	6	HI > 10		
Seascape value	$S = 1 + \frac{2x}{3}$	z seascape index		
(see <u>www.medobs-sub.org</u> for the calculation method of seascape index)	The total o	¹¹⁷ f Seascape index range between -23 and 117		
Management level	1	Limited or inexistant management		
8	2	Limited presence of manager, <i>a minima</i> one measure but no evaluation		
	3	Presence of manager, a minima one measure		
	4	Asset manager, several measures, some of them < 5 years		
	5	Asset manager, several measures, some of them > 5 years		
Knowledge level	1	No data, no expert estimates		
	2	No data, old expert estimates		
	3	Old data, recent expert estimates		
	4	Recent but incomplete data, recent expert estimates		
	5	Recent and complete data		





Figure 2. Map of the natural diving sites' categorization.

Bibliography

- Holon F., Mouquet N., Boissery P., Bouchoucha M., Delaruelle G., Tribot A.S., Deter J., 2015. Fine-scale cartography of human impacts along French Mediterranean coasts: a relevant map for management of marine ecosystem. *PloS ONE* 10, e0135473.
- La Rivière M., Aish A., Gauthier O., Grall J., Guérin L., Janson A.L., Labrune C., Thibaut T., Thiébaut E., 2015. Méthodologie pour l'évaluation de la sensibilité des habitats benthiques aux pressions anthropiques. Rapport SPN 2015-69. MNHN. Paris, 52 pp.
- La Rivière M., Michez N., Aish A., Bellan-Santini D., Bellan G., Chevaldonné P., Dauvin JC., Derrien-Courtel S., *et al.*, 2016. Evaluation de la sensibilité des habitats benthiques de Méditerranée aux pressions physiques. Rapport SPN 2015-70. MNHN. Paris, 101 pp.
- Personnic S., Boudouresque CF., Astruch P., Ballesteros E. Blouet S., *et al.*, 2014. An Ecosystem-Based Approach to assess the status of a Mediterranean ecosystem, the *Posidonia oceanica* seagrass meadow. PLoS ONE: e98994

Acknowledgments

We thank MPA managers and the French Underwater Federation for assistance for data. This work was funded under the Action plan for the marine environment which is part of the European Marine Strategy Framework Directive.

