

Non-removal of the *Posidonia oceanica* 'banquette' on a beach very popular with tourists: lessons from Tunisia

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Abstract. The Mediterranean *Posidonia oceanica* seagrass meadows provide a variety of ecosystem services; one of them is the protection of beaches against erosion, due to the accumulation on beaches of drift dead leaves, which forms what is known as 'banquettes'. In most Mediterranean areas, the *P. oceanica* banquette is considered as waste that has a negative impact on seaside tourism and is therefore removed by the municipal authorities. In fact, it is not only unproven that the *banquette* constitutes a nuisance for tourism, but also, in most cases, its removal has not been insisted on by the majority of beach users. On the contrary, its removal turned out to be an economic and ecological disaster. Interestingly, in an area frequented by international tourists, at Zarzis (southern Tunisia, Mediterranean Sea), thanks to a local initiative, the non-removal of the *banquette* shows that it is compatible with high beach attendance rates, especially when tourists are properly informed about the issue. This is a lesson for local mayors all around the Mediterranean who are being manipulated by tour operators and misleading information.

Keywords: beaches, banquettes of dead leaves, *Posidonia oceanica*, tourism, Tunisia.

R sum . Maintien des banquettes de feuilles mortes de *Posidonia oceanica* sur une plage tr s fr quentee par les touristes : le ons depuis la Tunisie. Les herbiers   *Posidonia oceanica*, une plante   fleurs marine end mique de M diterran e, fournissent   l'homme de nombreux services  cosyst miques ; l'un de ces services est la protection des plages contre l' rosion, gr ce aux banquettes de feuilles mortes de posidonie. Dans la plus grande partie de littoral m diterran en, les banquettes de *P. oceanica* sont consid r es comme des d chets et comme une nuisance pour le tourisme baln aire ; elles sont par cons quent enlev es par les autorit s locales (municipalit s, maires). En r alit , le fait que les banquettes nuisent au tourisme est loin d' tre d montr  ; les enqu tes montrent que l'enl vement des banquettes n'est pas r clam  majoritairement par les usagers des plages, m me non inform s de leur r le, et qu'il est largement rejet  par les usagers inform s. En fait, l'enl vement des banquettes repr sente un d sastre non seulement  conomique mais aussi  cologique. Il est significatif de constater que, dans un secteur tr s fr quente par les touristes internationaux,   Zarzis (Sud de la Tunisie), le non-enl vement des banquettes de feuilles mortes, dans le cadre d'une initiative locale, est compatible avec une fr quentation  lev e par des touristes bien inform s des enjeux. Ceci constitue une le on pour les maires des c tes m diterran ennes, qui se laissent manipuler par des tour-opérateurs et par des informations inexactes.

Mots-cl s : banquettes de feuilles mortes, plages, *Posidonia oceanica*, tourisme, Tunisie.

The *Posidonia oceanica* seagrass beds are well-developed in Tunisia, which is the site of some of the most extensive Mediterranean meadows (Pergent and Kempf, 1993; Hattour and Ben Mustapha, 2013). They provide a variety of ecosystem services. One is the protection of beaches against erosion, due to the accumulation of drift dead leaves, to form what is known as ‘*banquette*’ (Mateo *et al.*, 2003; Astier, 2008; Boudouresque *et al.*, 2010, 2012; Simeone and De Falco, 2013; Pergent *et al.*, 2014; Boudouresque *et al.*, 2016; Boudouresque and Ruitton, 2016). *Posidonia oceanica* meadows are also the ‘sand factory’ that produces sand and exports it towards the beaches (De Falco *et al.*, 2017).

The *banquette* of *P. oceanica* dead leaves, together with the beach dune and foredune, constitute a unique ecosystem that characterizes the Mediterranean Sea; this ecosystem harbours an extraordinary range of biological diversity, with dozens of species, plant and animal, which are specific to it (Boudouresque *et al.*, 2017a). For millennia, and even at the beginning of the era of seaside tourism, until the 1970s, humans had no difficulty in coexisting with the *banquette* (Boudouresque, 2010; Boudouresque *et al.*, 2017a). Since then, along most of the Mediterranean shores, tour operators, stakeholders and mayors of coastal municipalities have increasingly regarded the *banquette* as waste that has a negative impact on seaside tourism. Dead *P. oceanica* leaves – together with large amounts of sand – have therefore been removed from the beaches and transported to a landfill (or sometimes pushed, using mechanical earth movers, towards one end of the beach). As a result, the now unprotected beaches have been steadily eroded, and attempts are made – unsuccessfully – to compensate the erosion by costly sand replenishment (Guala *et al.*, 2006; Conseil Scientifique des Iles de Lerins and CREOCEAN, 2011; Boudouresque *et al.*, 2017a and references therein; Otero *et al.*, 2017; Vu *et al.*, 2017; Martín Prieto *et al.*, 2018; Vu, 2018). In addition, the fate of the dead leaves of the *banquette* is to return, sooner or later, to the sea; burying it in landfills deprives coastal ecosystems of an important source of carbon and nutrients, with a negative impact on captures of the fisheries (Boudouresque *et al.*, 2016; El Zreli *et al.*, 2016).

As suggested by Boudouresque *et al.* (2017a, 2017b), it is uncertain whether tourists would in fact request ‘clean’ beaches without dead *P. oceanica* leaves, and this could be just the biased perception of tour operators and local mayors. Surveys of beach users reveal that, even if uninformed about the role of the *banquette*, their opinion is mixed and often much more positive than supposed (Conseil Scientifique des Iles de Lerins and CREOCEAN, 2011; Martin, 2017; Bergthold, 2017). Maintaining in place the *P. oceanica banquette*, as at Porquerolles Island (Port-Cros National Park, France), with information boards explaining the ecological issues, results in a very favourable perception by the public, who overwhelmingly support this initiative and frequent these beaches

(Serantoni, 2015; Boudouresque *et al.*, 2017a). In addition, a study of the cost of removing dead leaves and the resulting sand replenishment, compared to the cost of non-removal of dead leaves (possible loss of beach use), reveals that the removal of the *banquette* is conspicuously more expensive than maintaining it (Otero *et al.*, 2018).

Posidonia oceanica is protected by law in France and in some regions of Spain. The protection concerns dead or living parts of the plant and includes therefore the *banquette*. Annex II of the Barcelona Convention establishes a list of ‘endangered or threatened species’ that includes *P. oceanica* (Pergent, 1991; UNEP, 2000, 2009; Boudouresque and Bianchi, 2013; Verlaque *et al.*, 2019). However, the inclusion of a species within the Barcelona convention does not imply that the species is actually protected by the countries which ratified the convention. This is unfortunately the case in Tunisia, where no law protects *P. oceanica*. The destruction of *P. oceanica* meadows and the removal of the *banquette* from the beaches are therefore legal, although APAL (*Agence de Protection et d’Aménagement du Littoral* - National Agency for protection and management of the littoral) plays a positive role in trying to restrict the removal of the *banquette* by local authorities.

<p><u>l'hénomène des Algues</u></p>
<p>Chers Clients, Nous vous informons que les algues n'est qu'un phénomène naturel. Les plages sont protégées en Tunisie par l'APAL (Agence de Protection et d'Aménagement du Littoral). Afin de préserver les cotes tunisiennes et éviter l'érosion du sable de notre littoral, il est interdit d'enlever les algues vues leur effet protecteur. Les algues qui s'abattent sur notre plage seront déplacées vers les cotés de l'hôtel afin que la mer puisse les enlever naturellement. Nous vous remercions pour votre compréhension et de votre soutien de la nature.</p>
<p><u>Seaweed phenomenon</u></p>
<p>Dear Guests, We would like to inform you that the seaweed is a natural phenomenon. The Beaches in Tunisia are protected by local authorities L'APAL (Agency de Protection et de l'Aménagement du littoral). In order to preserve the Tunisian Coasts and avoid sand erosion, it is not allowed to take out the seaweed because of their protection effect. We will move them on the extreme side of our beach and the sea will naturally move them. Thank you for your understanding and your support of nature.</p>
<p><u>Fenomeno delle Alghe</u></p>
<p>Gentili Clienti, Vi informiamo che le alghe costituiscono un fenomeno naturale. Le spiagge in Tunisia sono protette dall'APAL (Agenzia di Protezione e Gestione del Litorale). Al fine di preservare le coste tunisine ed evitare l'erosione della sabbia del nostro litorale, è vietato rimuovere le alghe, vista la loro funzione protettiva. Le alghe presenti sulla nostra spiaggia verranno spostate ai lati dell'hotel in modo che il mari possa rimuoverle naturalmente. Vi ringraziamo per la vostra comprensione e il Vostro sostegno alla natura.</p>
<p><u>Zur Info</u></p>
<p>Liebe Gäste, Hiermit möchten wir Sie informieren, dass SEEGRAS-ALGEN, die man findet und sieht entweder im Meer oder am Strand des Hotels: EIN NATUR PHÄNOMEN ist (Natur Erscheinung). Zeigt auch, dass das Meer lebt und gesund ist. In Tunesien die ganze Küste wird vom staat Geschützt (Umweltschutz-Ministerium), dieser Phänomen selber ist eine beste Lösung und Schutz vor dem Boden abtragung und San- Erosion an der Küste. Es ist streng verboten diese Algen weg zu nehmen, wir übergeben das, die natur selber:Die Entsorgung (Ebbe und Flut). Wir verlassen uns auf ihr verständnis und die Unterstützung der Natur. Mit Freundlichen Güssen</p>

Figure 1. Information board in French, English, Italian and German on Zarzis beach, Tunisia. The panel explains to tourists why dead leaves of *P. oceanica* are important for beach protection. They refer to it as ‘seaweed’, which is obviously incorrect, but can be easily understood by tourists little aware of the correct nomenclature of the living world. The board claims that the removal of the *banquettes* is not allowed, which, unfortunately, is not the case. Photo © Charles-François Boudouresque.

Tunisia is the holiday destination of 5 to 7 million tourists each year. Tunisia targets cultural tourism (Carthaginian, Roman and Arab history), SSS tourism (sea, sand and sun) and sustainable and responsible tourism. The perception of the importance of the environment by the general public and environmental education in Tunisia are relatively high, compared to the majority of the Mediterranean countries. Environmental impact assessment (*Etude d'Impact Environnemental – EIE*) is imposed by the legislation, although this legislation is in need of extensive improvement to comply with the criteria of the World Bank (Pergent and Kempf, 1993; Pergent-Martini and Le Ravallec, 2007).

Here, we report the case of Zarzis beach, in a very popular resort, Zarzis, in southern Tunisia. Despite the lack of legislation in Tunisia concerning *P. oceanica*, and relying on the supposed authority of the APAL, tourism officials in Zarzis maintain the *banquette* on the beach, provide information for beach users (Fig. 1), and have proved that the *banquette* does not impact the attendance of tourists when they are properly informed: despite the presence of non-removed *P. oceanica banquette*, and thanks to the information boards, the beaches of Zarzis are very popular (Fig. 2, 3, 4, 5).



Figure 2. Non-removal of the *P. oceanica banquette* in front of an upmarket hotel with a majority of European tourists in Zarzis (southern Tunisia). Photo © Jean-Marie Astier.



Figure 3. Non-removal of the *P. oceanica banquette* in front of an upmarket hotel with a majority of European tourists in Zarzis (southern Tunisia). Note the presence of bathers and recreational boats. Photo © Jean-Marie Astier.



Figure 4. Non-removal of the *P. oceanica banquette* in front of an upmarket hotel with a majority of European tourists in Zarzis (southern Tunisia). Note the presence of bathers and recreational boats. Photo © Jean-Marie Astier.

Unfortunately, the good practice we describe here at Zarzis is not general. In neighbouring Djerba Island, another Tunisian seaside tourism hotspot, as in most Tunisian beach resorts, the *P. oceanica banquette* is pushed further inland or to the edges of the beaches. Some of these beaches are being eroded, which has led local authorities to question their practices.

Removing the *P. oceanica banquette* is an economic and ecological disaster: it results in catastrophic beach erosion, costly and fruitless sand replenishment, the destruction of the high heritage value beach-dune ecosystem and the decline of fish captures by artisanal fishers (Boudouresque *et al.*, 2017a; Otero *et al.*, 2018; Vu, 2018). This practice is all the more absurd as the public, especially if properly informed, fully accept the non-removal of the *P. oceanica banquettes*. The Zarzis case is a lesson for mayors around the Mediterranean who are being manipulated by tour operators and misleading information.



Figure 5. Non-removal of the *P. oceanica banquette* in front of an upmarket hotel with a majority of European tourists in Zarzis (southern Tunisia). Note the presence of bathers. Photo © Jean-Marie Astier.

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