



Research article

Influence of settings management and protection status on recreational uses and pressures in marine protected areas



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ABSTRACT

Coastal populations and tourism are growing worldwide. Consequently outdoor recreational activity is increasing and diversifying. While Marine Protected Areas (MPAs) are valuable for mitigating anthropogenic impacts, recreational uses are rarely monitored and studied, resulting in a lack of knowledge on users' practices, motivation and impacts. Based on boat counts and interview data collected in New Caledonia, we i) explored factors affecting user practices and motivations, ii) constructed fine-scale pressure indices covering activities and associated behaviors, and iii) assessed the relationships between user practices and site selection. User practices were found to depend on protection status, boat type and user characteristics. Pressure indices were higher within no-take MPAs, except for fishing. We found significant relationships between user practices and settings characteristics. In the context of increasing recreational uses, these results highlight options for managing such uses through settings management without jeopardizing the social acceptance of MPAs or the attainment of conservation goals.

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1. Introduction

Marine protected areas (MPAs) are a key instrument for ecosystem-based management of coastal areas. Faced with increases in population (Duedall and Maul, 2005) and recreational activity (Sidman and Fik, 2005; Widmer and Underwood, 2004) in coastal areas, MPAs are valuable for mitigating anthropogenic impact (Gray et al., 2010) by regulating practices at given areas and for specific periods. Meta-analysis at a regional or global scale show that MPAs have positive effects on marine ecosystems, e.g. increased fish-related metrics such as species richness (Claudet et al., 2008; Côté et al., 2001; Halpern and Warner, 2003; Lester et al., 2009; Mosquera et al., 2000; Stewart et al., 2009), density (Claudet et al., 2008; Côté et al., 2001; Maliao et al., 2009; Molloy et al., 2009; Mosquera et al., 2000), biomass (Halpern and Warner, 2003; Lester et al., 2009; Stewart et al., 2009) and size of

organisms (Halpern and Warner, 2003; Lester et al., 2009). In addition, positive effects of MPAs have also been observed for habitat (see Pelletier et al., 2005 for review). Consequently, thanks to the protection provided by MPAs from local stressors (e.g. overexploitation), the expected benefits of MPAs can include greater ecosystem resilience to global stressors such as climate change (Molloy et al., 2009; Francour, 1994; Hughes, 2003).

Most MPAs allow recreational uses, at least through boat access (Shivlani and Suman, 2000; Smallwood et al., 2012) and even fishing (Toropova et al., 2010), with only 12.8% of MPAs being no-take areas (Wood et al., 2008). Because outdoor recreational activities are developing worldwide (Cole, 1996; Ceballos-Lascrain, 1996; Pickering and Hill, 2007), the question arises of the potential environmental impacts caused by recreational users (see reviews by Davenport and Davenport, 2006; Hardiman and Burgin, 2010; Whitfield and Becker, 2014). Numerous studies based on field data considered both the intensity and nature of the pressure, with regard to assessing impacts of recreational uses upon biotic habitat (Backhurst and Cole, 2000; Liu et al., 2012; Juhasz et al.,

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2010; Leujak and Ormond, 2008; Milazzo et al., 2002; Hasler and Ott, 2008; Zakai and Chadwick-Furman, 2002), fishes (Codarin et al., 2009) and mammals (Rako et al., 2013). Thus there is a strong need for managers to assess pressures from recreational users in terms of both quantitative and qualitative data, so as to encourage appropriate remediation and thus ensure the attainment of MPA goals.

Unfortunately, data and knowledge on recreational users is either scarce or lacking because the social aspects of MPAs have been studied less than their ecological aspects (Christie et al., 2003; Farr et al., 2014; Gruby et al., 2015; Le Corre et al., 2012; Sutton, 2005). The situation is somewhat different for fisheries, where the social effects of MPAs on commercial fishers have been studied more than the social effects on recreational users (see Mascia et al., 2010 for a review). In existing studies, the number of recreational users has been identified as the main measurement required for protected area management (Griffin et al., 2010). Such information is particularly useful when explicitly described over space and time (Eagles et al., 2002). Moreover, activities (e.g. fishing) have been taken into account to describe practices of recreational users and their distribution in space and time (Mangi and Austen, 2008; Smallwood et al., 2013). However, users' practices concern both the activity itself and how it is practiced. Behavior is precisely defined in this study as the way a given activity is undertaken. Such qualitative information is particularly useful when associated with user counts for assessing the impact of recreational user on environmental and social conditions (Le Corre et al., 2012). However, unlike fisheries-related studies, which consider fishing behaviors (fishing tactics, e.g. the targeted species and the fishing gear) in order to assess fishing pressure and distribution (Pelletier and Ferraris, 2000), recreational users' behaviors have not been taken into account for impact assessment. Such knowledge is also relevant for planning and managing recreational uses. For instance, quantifying and ranking sites according to the number of users visiting them, and being able to anticipate related behaviors, may help to identify potential management actions, either regulatory or related to amenities and education, aimed at controlling visitor flows and practices. In a multiple-use park, such quantification and ranking provides guidance for selecting appropriate management actions for different sites and zones.

To obtain such information, direct observation methods such as counting recreational users have been used to determine their spatio-temporal distribution (Valentine et al., 1993), either per boat category (Smallwood and Beckley, 2008; Smallwood et al., 2012; Widmer and Underwood, 2004) or per activity (Liu et al., 2012; Smallwood and Beckley, 2008; Smallwood et al., 2011, 2012). In addition, questionnaire-based surveys provide specific information on users' socio-economic characteristics, motivations, perceptions and practices (see Gray et al., 2011 for a review). In the light of a quantitative assessment of user pressures, it is necessary to combine results from boat and visitor counts with those from such questionnaire-based surveys.

MPAs are attractive for recreational activities (Gonson et al., 2015; Shivilani and Suman, 2000; Smallwood et al., 2012), for various reasons, including environmental, social and geographic context-specific considerations. Such environmental, managerial and social conditions affect the quality of users' experience and thus their satisfaction (Clark and Stankey, 1979). Previous studies showed that recreational users in coastal areas were able to identify their preferred settings in accordance with managerial, social and natural conditions (Gray et al., 2010; Roman et al., 2007; Shafer and Inglis, 2000; Sorice et al., 2007). To better understand users' choices, questionnaire-based surveys can be implemented using the recreation opportunity spectrum (ROS) framework (Clark and Stankey, 1979). ROS is based on the hypothesis that recreational

users' experience and motivation to visit a given site can be formalized in terms of a combination of environmental, managerial and social factors (Clark and Stankey, 1979). ROS has been applied to outdoor recreation in marine environment (Sorice et al., 2007; Uyarra et al., 2009; Roman et al., 2007) and in particular within marine parks (Gray et al., 2010; Shafer and Inglis, 2000). However, in these studies, there was no account taken of the effect of MPAs on settings preferences, nor was there any quantification of users with regard to preferential settings. In contexts where access to sites is not regulated, such an approach may help managers to identify the most effective management measures for each site, by channeling visitors and favoring specific practices.

In this study, we first investigated the effects of MPAs on recreational users' practices and motivations near the main urban center of New Caledonia, using a questionnaire-based survey. Then, by combining questionnaires and boat count data, we estimated pressures for a range of activities and behaviors, as well as user site selection criteria. In a third step, we examined the influence of protection status on these pressure estimates and investigated the relationship between motivation and practices. Finally, we identified recreational users' settings preferences for each site and discuss results from a management perspective.

2. Materials and methods

2.1. Study site

In the lagoon facing Noumea city, the main urban center of New Caledonia (180,000 population in 2014 (ISEE, 2014)), coral reef islets are popular destinations for recreational users (Gonson et al., 2015; Jollit et al., 2010). Over the last thirty years, the southern province of New Caledonia has established twenty-one MPAs for terrestrial and marine conservation purpose. Almost half of these MPAs are close to Noumea (Fig. 1). They have two distinct protection statuses, the first being "Natural Reserve" (NR), where fishing and shellfish and wood collection are prohibited. On NR islets, fires are allowed only in barbecues installed by MPA managers, and forbidden elsewhere. The second type of MPA is the "Sustainable Management of Resources Area" (SMRA). Each SMRA has its own management plan and rules. Those rules also generally forbid extractive practices, but commercial activities for visitors are permitted. SMRAs aim to support economic development, usually entailing the presence of amenities and organized collective boat transportation. For example Maître (Fig. 1), which lies off Noumea, has a kite-surfing school, a hotel and a restaurant and is serviced by three shuttle transport companies.

Our study focuses on 6 islets comprising three MPAs (two NRs and one SMRA) and three islets without any protection status (Fig. 1). On Maître islet, which is the SMRA islet considered in this study, restrictions on fishing, wood collection and fires are similar to those of NR islets. The 6 islets differ with regard to their land surface area, distance from Noumea (which has the most marinas and launch ramps), the nature and extent of onsite amenities, and regulations. Around all of these islets speed activities (kite-surfing, wind-surfing and jet-skiing) are allowed. According to ROS (Clark and Stankey, 1979), The SMRA (Maître) is a "modern islet", with easy access by continuous rotation of taxi-boats, a number of amenities and tight restriction on extractive activities and lighting fires. Both NR (Larègnère and Signal) may be classified as "semi-modern" settings. Compared to the SMRA, they have fewer amenities and are less accessible, being further from Noumea and with taxi-boat fares three or four times higher. The three non-protected islets (OR) don't have the same ROS status. Pandanus may be termed a "semi-primitive islet", as it is remote from Noumea, though close to the coast north of the city. There are no regulations

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