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Using compliance data to improve marine protected area management

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ABSTRACT

Measuring the 'level of compliance' has emerged as a key performance indicator for MPA success internationally. Accurate interpretation of quantitative and qualitative compliance data is critical for determining which compliance activities contribute to specific management outcomes. To demonstrate the value of enforcement data in effective MPA management, more than 5000 enforcement actions from 2007 to 2013 from five New South Wales (NSW) Marine Parks were analysed. Specifically, it was tested whether through time: (i) the number of enforcement actions standardised by surveillance effort declined-indicating that 'general deterrence' was being achieved; (ii) the number of repeat offenders decreased-indicating that 'specific deterrence' was being achieved; (iii) the number of 'local community' enforcement actions standardised by surveillance effort declined-indicating growing support for marine parks was being achieved at the community level; and (iv) the percentage of young offenders (<25 yr) had declined-indicating that education programs targeting young adults were successful. Results indicated that general deterrence was not being achieved, with offence rates being relatively stable between years. In contrast, compliance measures were achieving individual deterrence, with the percentage of repeat offenders being very low (0.13–0.83%). Although compliance strategies may be making some progress in improving local compliance in some marine parks, the overall offence rate of local communities was concerning. The data suggested that there were major differences in compliance rates among age groups of offenders over time, although the percentage of young offenders declined over time in three marine parks. Over the six-year data collection period, there was no discernable improvement in compliance rates in most NSW Marine Parks. Overall, the significant value of collecting and analysing information on enforcement activities for MPAs was demonstrated, an often neglected aspect of their management world-wide.

1. Introduction

The critical role of compliance in marine conservation and sustainable use governance has been widely recognised. Many international institutions and conventions share a common aim of establishing and strengthening authorities and mechanisms that deliver effective legal governance, compliance programs and enforcement [1,2]. Over the last decade, there has been a shift in emphasis from quantity to quality of Marine Protected Areas (MPAs), including an emphasis on effective management, through an integrated approach to regulation and enforcement [3,4]. Despite this, inadequate MPA compliance is frequently observed and this can result in little or no environmental protection being afforded to the MPA, as well as a diminishing of community support [5–8]. Consequently, there is an urgent need for improved compliance to ensure long-term effectiveness of MPAs [9,10]. It is not surprising that measuring the 'level of compliance' has emerged as a key performance indicator for MPA success world-wide [11–14].

Compliance performance indicators are generally developed to facilitate analysis of compliance activities and enforcement trends, as well as, comparisons of the effectiveness of specific management actions and approaches [15]. Ideally, findings from compliance monitoring are fed back into compliance planning through adaptive management to improve MPA performance. Critical to the success of this approach is the accurate interpretation of quantitative and qualitative compliance data, with the aim of determining which compliance activities are responsible for specific management outcomes (e.g. determining whether a targeted media campaign or increased surveillance resulted in an observed reduction in enforcement incidents). For this research, 'compliance' is defined as the state of conformity with the law, and

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'enforcement' as the set of actions that a management agency takes to correct or halt behaviour that fails to conform to the law [15].

Compliance performance is generally measured against intended objectives of the compliance program [16]. Information that can be used to evaluate compliance performance includes: direct and indirect observation of non-compliance; law enforcement records; stakeholder surveys; expert opinion; and scenario modelling [17]. Compliance performance measures for MPAs are often categorised as either input, output or outcome indicators [17]. 'Input indicators' include the effort that is put into compliance, such as the number of compliance officers, number hours of patrols and size of budget. 'Output indicators' represent the product of compliance effort, such as the number of enforcement actions, amount of penalties received, number of successful prosecutions or amount of seized equipment. Output indicators provide a "sense of enforcement" and the extent to which deterrence is being used to bring about compliance [16]. For example, compliance rates have been described as one of the best overall measures of compliance success, which makes sense when higher compliance rates are a primary goal for most compliance programs. 'Outcome indicators', such as an observed increase in the size of target fish species, show the effect that compliance has on protecting of conservation values. Outcome indicators generally require careful scientific monitoring and analysis, and are often not sufficient on their own for assessing the effectiveness of compliance activities because conservation values are influenced by factors outside compliance actions [1]. For example, it is extremely difficult to determine the role enforcement has in conserving biodiversity, compared with other considerations, such as MPA design and management or external fisheries management policies.

Input, output and outcome indicators all have limitations [18]. Notably, they do not measure spatial and temporal patterns of non-compliance, nor their degree or their duration. They are also not reliable if data is not consistently recorded or interpreted correctly. For example, a high compliance rate could be the result of poorly planned patrols occurring in the wrong place and time, rather than no illegal actions taking place [19]. Being aware of indicator limitations and how they are measured is critical in compliance evaluation. Moreover, using a range of indicators to evaluate the effectiveness of compliance programs can minimise the uncertainty associated with using a single indicator [16,20,21]. However, it is widely acknowledged that analysis of enforcement data represents a critical part of a compliance performance evaluation and improved management of MPAs.

To demonstrate the value of enforcement data analysis in effective MPA management, hypotheses were tested from the New South Wales (NSW) Marine Parks compliance plan [22] using enforcement data from 2007–2013 across a network of MPAs in NSW, Australia. This included data from five coastal marine parks located over eight degrees of latitude and encompassing more than 100 individual "no-take" marine sanctuaries. Specifically, it was tested whether through time: (i) the number of enforcement actions (offences) standardised by surveillance effort had declined-indicating that 'general deterrence' was being achieved; (ii) the number of repeat offenders had decreased-indicating that 'specific deterrence' was being achieved; and, (iii) the number of 'local community' enforcement actions standardised by surveillance effort had declined-indicating growing support for marine parks was being achieved at the community level. An age-offender curve was also developed from the compliance data to test whether: (iv) the percentage of young offenders (<25 yr) had declined-indicating that education and community awareness programs targeted at children and young adults were taking affect.

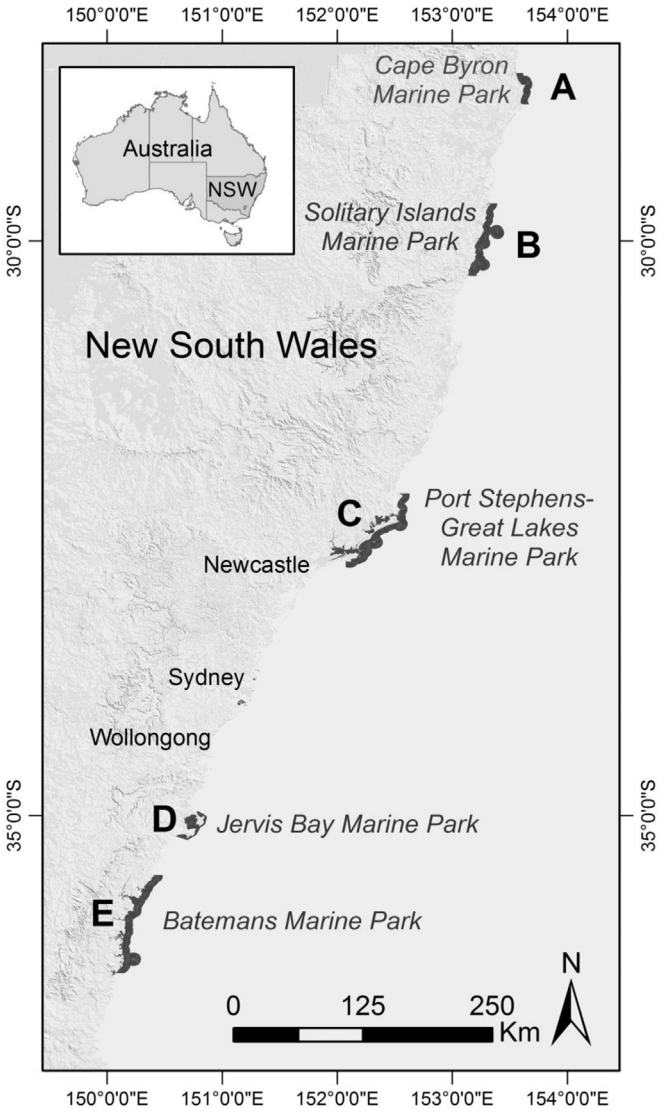

Fig. 1. Map showing the locations of the five marine parks included in our study along the NSW coast (Australia).

2. Methods

2.1. Study area and management arrangements

Data included five NSW multi-use marine parks (MPAs) located adjacent to the east coast of mainland Australia (Fig. 1) in "State" waters (i.e. within 3 nautical miles (nm) of the coast). From north to south, these were the Cape Byron Marine Park declared in 2002 (CBMP, 22,200 ha. with 28% no-take zones), Solitary Islands Marine Park, declared in 1998 (SIMP, 71,500 ha., with 12% no-take zones), Port Stephens-Great Lakes Marine Park declared in 2005 (PSGLMP, 98,150 ha., with 17% no-take zones), Jervis Bay Marine Park, declared in 1998 (JBMP, 21,500 ha., with 20% no-take zones) and the Batemans Marine Park, declared in 2006 (BMP, 84,500 ha., with 19% no-take zones). Together these marine parks include approximately 29% of NSW marine waters, and contain 110 individual no-take zones that make up 17.5% of the overall marine park coverage [23].

Each marine park is managed under the *NSW Marine Parks Act* 1997 and Regulations. The objectives of this Act aim to conserve marine biodiversity, and also allow for ecology sustainable uses. The legislation requires each marine park to have a management