

Contribution to the Themed Section: 'Marine Protected Areas'

Food for Thought

Effective marine protected areas require a sea change in compliance management

Brock J. Bergseth^{1,*}

¹ARC Centre of Excellence for Coral Reef Studies, James Cook University, Townsville, Qld 4810, Australia

*Corresponding author: tel: +61 47814829; fax: 4725 5043; e-mail: brock.bergseth@myjcu.edu.au

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Conservationists continue to put forth international milestone goals for preserving the world's oceans (e.g. 30%; [World Parks Congress, 2014](#)) while assuming that this protection will be effective. However, most of the world's "protected" oceans are plagued with persistent poaching problems and inadequate management capacity that render these reserves ineffective ([Kelleher et al., 1995](#); [Mora et al., 2006](#); [Gill et al., 2017](#)). Although the term marine protected area can encompass a range of protections, I focus here on no-take marine reserves (NTMRs), and define effectiveness as the ability to reduce or eliminate fishing mortality within their boundaries. There is no doubt that NTMRs can deliver substantial outcomes when effectively managed to ensure high compliance ([Graham et al., 2011](#); [Edgar et al., 2014](#); [Cinner et al., 2016](#); [Gill et al., 2017](#)), but this is more often the exception, rather than the rule. For instance, my colleagues and I recently demonstrated that poaching by recreational fishers in the Great Barrier Reef Marine Park (GBRMP) is significant, and regularly occurs in areas previously thought to be among the best protected ([Bergseth et al. 2017](#)). Specifically, we found no difference in the accumulation of discarded fishing gear between no-fishing and fished zones—which suggests that these no-take zones are receiving the same amount of fishing pressure as areas legally open to fishing ([Figure 1](#)).

The GBRMP has an advanced compliance monitoring programme that uses risk-based planning to guide aircraft-, vessel-, and land-based enforcement patrols, but fishers still believed a primary motivation to poach was the low risk of detection (which is commonplace in most fisheries; [Sutinen et al., 1990](#); [Kuperan](#)

and [Sutinen, 1998](#); [Bergseth et al., 2017](#)). Therefore, ensuring high compliance, and subsequent effective management, requires moving beyond the traditional view of enforcement, and a paradigm shift in the way we consider human behaviour. This does necessitate measuring and understanding the drivers of an illegal activity, but social science disciplines have specialized methods (e.g. self-administration, the unmatched count method, and the random response technique) that can aid these investigations by reducing response bias ([Bergseth et al., 2017](#)). Here, I recommend three avenues to further advance our understanding of compliance in the quest for effective marine reserve management: (i) further consideration of how people process information; (ii) re-conceptualizing how people behave; (iii) designing rules and interactions to shape behaviour.

How people process information

A common misconception in science is that people remain skeptical or fail to embrace scientific findings because they lack adequate information and understanding about the topic, which can be remedied by providing them with more information. Although this "information deficit hypothesis" has been discredited by an expanse of literature (e.g. [Kahan et al., 2012](#)), conservationists often assume that raising awareness will change people's behaviour ([Schultz, 2011](#); [Heberlein, 2012](#)). For instance, many communication projects assume that fishers would comply if they had more information about benefits of reserves (i.e. they produce more and bigger fish, which may be exported). However, we showed how fishers in the GBRMP were already aware of the

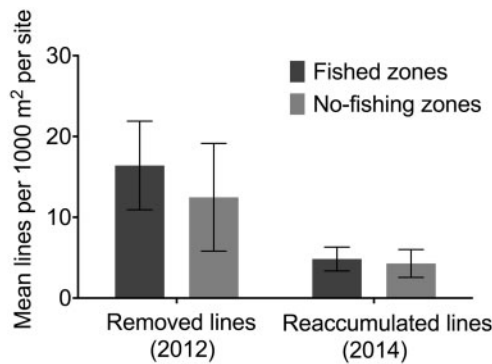


Figure 1. Mean ($\pm 95\%$ CI) number of fishing lines removed (2012) and reaccumulated (2014) per site for fished (dark grey bars) and no-fishing (light grey bars) zones. Adapted from Bergseth *et al.* (2017).

benefits of reserves, and cited better catches as the primary motivation to poach (Bergseth *et al.*, 2017). When combined with the low perception of detection while poaching (as mentioned earlier), this suggests that extolling the benefits of marine reserves could result in the perverse outcome of encouraging fishers to poach, especially when reserves lack enforcement capacity, which is demonstrably widespread (Gill *et al.*, 2017). Thus, enforcement alone is not enough to ensure high compliance, necessitating further understanding of the drivers of human behaviour.

Re-conceptualizing how people behave

Traditional models of human behaviour are often based on the economic premise of human beings as rational actors who make decisions based on the costs and benefits associated with the behaviour (e.g. Becker, 1968). However, extensive research from social science disciplines illustrates that human behaviour is not always rational, and is heavily influenced by the norms surrounding them (Ostrom, 1998; Cialdini, 2003; Keizer and Schultz, 2011). This notion was recently validated in a recreational fisheries context, where social norms (e.g. the social acceptability of poaching, and whether others poached), had the greatest influence on fishers' compliance behaviour (Thomas *et al.*, 2016). Accordingly, quantifying the effect of social norms on fishers' compliance can guide behavioural interventions that utilize trusted leaders in the fishing community to increase the social pressure to comply, whether by emphasizing the social unacceptability of poaching, and/or the proportion of fishers that comply with regulations (Abrahmase and Steg, 2013; Arias, 2015; Thomas *et al.*, 2016). Personal norms are also important for pro-environmental behaviour (Harland *et al.*, 2007), so messages that lever morality and stewardship beliefs may also be useful for increasing compliance (e.g. Schultz *et al.*, 2007). Yet, considerable research gaps still exist in this area. For instance, little is known about how poaching norms are transmitted or diffused in fisher populations. However, social network analyses could be applied to examine if poachers learn from one another (i.e. social learning), or associate in criminally inclined subgroups (i.e. subculture theory), which would further inform pertinent behaviour change strategies (e.g. Abrahmase and Steg, 2013).

Designing rules and institutions to shape behaviours

Eleanor Ostrom's seminal work on environmental commons problems illustrates how the structure of institutions can facilitate cooperative management of natural resources (Ostrom *et al.*, 1999). In brief, institutions are the rules and norms, both formal and informal, that people use to shape behaviour and interactions in daily life. The importance of particular institutional designs for successful management has been demonstrated in numerous resource systems (e.g. Cox *et al.*, 2010; Ramclivoic-Suominen and Epstein, 2012; Epstein, 2017). For example, compliance in co-managed coral reef fisheries was higher when graduated sanctions (i.e. increasing punishment severity with number or severity of infringements) were present (Cinner *et al.*, 2012). However, the degree of management effectiveness will likely be determined by the extent that institutions reflect and address local socio-economic conditions, such as equity, livelihood, and poverty concerns (e.g. Cinner, 2007; Gurney *et al.*, 2014). Accordingly, stakeholders are more likely to comply, and enforce other's compliance, when they can participate in decision-making processes (e.g. DeCaro *et al.*, 2015; Epstein, 2017). Although considerable knowledge gaps exist in our understanding of how to use institutional design to shape compliance in NTMRs, this could be addressed by applying game theory experiments in the field that examine fishers' compliance decisions under changing rules and designs.

The avenues described here are substantial departures from traditional views of enforcement and compliance management. Yet, the need for a sea change in compliance management is evident, given the growing number of studies that describe the relative inability of most marine reserves to effectively manage poaching (e.g. Mora *et al.*, 2006; Gill *et al.*, 2017). This transformation will undoubtedly be accompanied by growing pains, wicked problems, and continued failures in management, but as Albert Einstein once said 'Often in evolutionary processes a species must adopt to new conditions in order to survive' (Amrine, 1946).

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