

A synthesis of (non-)compliance theories with applications to small-scale fisheries research and practice

Rodrigo Oyanedel¹  | Stefan Gelcich²  | E. J. Milner-Gulland¹ 

¹Department of Zoology, The Interdisciplinary Centre for Conservation Science, University of Oxford, Oxford, UK

²Center of Applied Ecology and Sustainability (CAPES) & Center for the Study of Multiple-Drivers on Marine Socio-Ecological Systems, Pontificia Universidad Catolica de Chile, Santiago, Chile

Correspondence

Rodrigo Oyanedel, Department of Zoology, The Interdisciplinary Centre for Conservation Science, University of Oxford, 11a Mansfield Rd, Oxford OX1 3SZ, UK.
Email: rodrigo.oyanedel@zoo.ox.ac.uk

Funding information

ANID PIA/BASAL, Grant/Award Number: FB0002; ANID-Becas Chile

Abstract

Non-compliance in fisheries is a persistent challenge for the conservation and sustainable management of the oceans and has particularly acute impacts in small-scale fisheries contexts. Small-scale fisheries often suffer from chronic overexploitation, poor management, lack of enforcement and non-compliance, but small-scale fishers are highly dependent on the ocean as a source of employment and food. Improving our understanding of the determinants of non-compliant behaviours in small-scale fisheries can help develop strategies to prevent and reduce its consequences. Here, we review two main approaches for the study of non-compliant behaviours and crimes more broadly, spanning criminology, economics and psychology. On the one hand, actor-based approaches address the underlying motivations for people to comply or not with regulations. Opportunity-based approaches, on the other hand, assume that non-compliance is not distributed randomly across space and time and focuses on the role that the immediate environment plays in the performance of non-compliant behaviours. We discuss potential applications of actor-based and opportunity-based approaches in guiding small-scale fisheries non-compliance research. Moreover, we provide guiding principles for integrating these approaches in a complementary way, highlighting opportunities and challenges for building a better non-compliance research agenda for fisheries and beyond. Addressing non-compliance is a common challenge for natural resource management in multiple ecosystems. Integrating these two perspectives has the potential to improve both research and practice.

KEYWORDS

conservation, criminology, illegal fishing, IUU fishing, socio-ecological systems, sustainable management

1 | INTRODUCTION

Non-compliance in the fisheries sector is one of the greatest challenges for the sustainable management of the oceans (Agnew et al., 2009; Boonstra & Österblom, 2014; Sumaila, Alder, & Keith, 2006). Non-compliance can undermine management regimes

and create tensions between resource users and regulators, ultimately affecting the sustainability of stocks and the marine ecosystem (Arias, 2015; Cisneros-Montemayor, Cisneros-Mata, Harper, & Pauly, 2013; Lewis, 2015). Small-scale or artisanal fisheries are particularly exposed to the detrimental impacts of non-compliance (Battista et al., 2018; Hauck, 2008). Small-scale fishing communities

This is an open access article under the terms of the Creative Commons Attribution License, which permits use, distribution and reproduction in any medium, provided the original work is properly cited.

© 2020 The Authors. *Fish and Fisheries* published by John Wiley & Sons Ltd

are often located in developing countries that are highly dependent on the ocean as a source of employment and food, but small-scale fisheries also often suffer from chronic overexploitation, poor management and lack of enforcement capacity (Gelcich et al., 2017; McDonald, Mangin, Thomas, & Costello, 2016; Song et al., 2020).

Reducing non-compliance in small-scale fisheries can help in securing livelihoods in the sector and contribute to food security worldwide (Arias & Pressey, 2016; Cohen et al., 2019). As such, understanding how to prevent and reduce non-compliance in small-scale contexts is a critical topic in the fisheries management research agenda. However, studying non-compliance in these contexts is challenging. Governance in small-scale fisheries usually encompasses a great diversity of regulations, informal rules, institutions and legal frameworks (Boonstra, Birnbaum, & Björkvik, 2017; Lindkvist, Basurto, & Schlüter, 2017; Oyanedel, Gelcich, & Milner-Gulland, 2020). This diversity precludes simple classifications of fishers' positions with respect to the set of informal and formal rules and regulations that govern their activities (Boonstra & Hentati-Sundberg, 2015). Moreover, compliance cannot be taken for granted because regulations can be inappropriate for the local context, weak, outdated or unfair, causing resistance from fishers, which further challenges simple assumptions about non-compliance (Keane, Jones, Edwards-Jones, & Milner-Gulland, 2008; Wells, 1992).

Encouragingly, the study of non-compliance is not exclusive to fisheries: there is a large body of theory concerned with non-compliance behaviours and crimes more broadly, spanning many disciplines from criminology to economics and psychology (Becker, 1968; Clarke, 1980; Keane et al., 2008; Nielsen, 2003; Petrossian & Pezzella, 2018). This presents a potential opportunity to apply these approaches to studying non-compliance in small-scale fisheries and other natural resource use contexts. However, current literature is unevenly scattered across geographies, varies in its depth and mode of analysis, and is isolated within disciplinary silos advancing along different trajectories, all of which prevent proper identification of knowledge gaps and biases. This limits the potential of insights from other disciplines to advance the theory and practice of small-scale fisheries compliance research.

Non-compliance can be framed as the interaction of a motivated actor and an opportunity (Figure 1) (Clarke, 1980). On the one side, researchers have concentrated on understanding the underlying motivations for people to comply or not with regulations. These approaches draw mostly on economic (Becker, 1968) and behavioural and psychological theories (Cialdini & Trost, 1998; Ostrom, 1990; Tyler, 1990). In fisheries, one of the first models used to understand motivations for compliance was put forward by Sutinen and Andersen (1985) to analyse the effect of imperfect enforcement on fishers' behaviour. This instrumental vision of fishers' motivations is rooted in Becker's (1968) economic theory of crime and punishment. Building upon this model, fisheries compliance research has focused on accounting for non-economic factors that may influence motivations for compliance, such as legitimacy of regulations (Hatcher, Jaffry, Thébaud, & Bennett, 2000; Kuperan & Sutinen, 1998; Nielsen, 2003) and normative factors (Bergseth & Roscher, 2018;

1 INTRODUCTION	1120
2 ACTOR-BASED APPROACHES	1122
2.1 Instrumental or deterrence model	1123
2.2 Compliance framework	1124
2.2.1 Legitimacy-based motivations	1124
2.2.2 Normative motivations	1124
2.3 Theory of planned behaviour	1125
3 OPPORTUNITY-BASED APPROACHES	1125
3.1 Rational choice model	1125
3.2 Routine activity model	1125
3.3 Crime pattern model	1126
3.4 Methods and tools used in Environmental Criminology and Crime Analysis	1126
3.4.1 Crime script analysis	1126
3.4.2 Risky facilities framework	1126
3.4.3 CRAVED framework	1127
3.4.4 Situational crime prevention	1127
4 BRINGING ACTOR-BASED AND OPPORTUNITY-BASED APPROACHES TOGETHER TO ADVANCE SMALL-SCALE FISHERIES NON-COMPLIANCE RESEARCH	1128
4.1 Non-compliance in small-scale fisheries emerges from both the social and ecological realms	1128
4.2 Choose your battles wisely: improving identification for prioritization in diverse small-scale fisheries systems	1128
4.3 Neither the actor- nor opportunity-based approach on its own fully explains non-compliance in socio-ecological systems such as small-scale fisheries	1128
5 GUIDING PRINCIPLES FOR APPLYING ACTOR-BASED AND OPPORTUNITY-BASED APPROACHES FOR ADVANCING NON-COMPLIANCE RESEARCH	1129
5.1 Analyse which approach better suits what is being studied and the possible policy levers	1129
5.2 Explicitly consider each approach's shortcomings and methodological challenges	1129
5.3 Consider the appropriate timescales at which changes can be detected	1130
6 CONCLUSIONS	1130
ACKNOWLEDGEMENTS	1131
DATA AVAILABILITY STATEMENT	1131
REFERENCES	1131
SUPPORTING INFORMATION	1131

Mackay, Jennings, van Putten, Sibly, & Yamazaki, 2018; Thomas, Milfont, & Gavin, 2016).

However, approaching the study of non-compliance through understanding actors' motivations has shortcomings. First, by focusing exclusively on the individual as the object of study, these theories and approaches do not pay enough attention to the different kinds of non-compliant behaviours. For instance, whilst committed by the same individual, and even for the same reasons, fishing over the quota or using prohibited fishing gears are very different non-compliant behaviours that need to be understood differently (Oyanedel

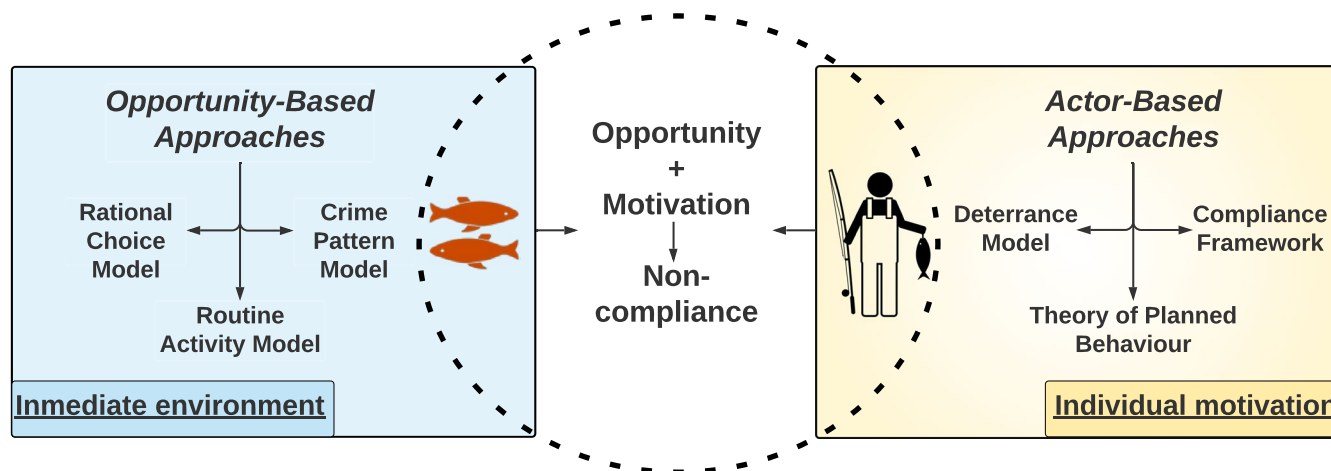


FIGURE 1 Actor-based and opportunity-based approaches for studying non-compliance in small-scale fisheries [Colour figure can be viewed at wileyonlinelibrary.com]

et al., 2020). Failing to account for this diversity can result in poorly tailored preventive measures (Clarke, 1980; Clarke & Felson, 2004; Cornish & Clarke, 1987). Second, the applicability of actor-based theories and approaches for non-compliance prevention is limited by the difficulty of crafting interventions that change the underlying motivations that drive behaviour (Cornish & Clarke, 1987). For instance, whilst normative motivations have been identified as key predictors for compliance in fisheries (Oyanedel et al., 2020; Thomas et al., 2016), changing a group's normative beliefs is challenging or even unfeasible (Cialdini, 2003).

The shortcomings of actor-oriented approaches to studying and preventing non-compliance have fuelled alternative ways to think about non-compliance and crimes more broadly (Clarke, 2016). As such, there has been a growing effort in the criminological literature to examine the situational opportunities that affect the occurrence of non-compliant behaviours, with the underlying premise (whether explicit or not) that non-compliance is mostly a product of opportunity rather than underlying motivation (Brantingham & Brantingham, 1981; Clarke & Felson, 2004; Wortley & Townsley, 2016).

Opportunity-based approaches assume that non-compliance is not distributed randomly across space and time and focus on the role that the immediate environment plays in the performance of non-compliant behaviours (Wortley & Townsley, 2016). Evidence from different studies suggests that, in fact, non-compliant use of, and trade in, natural resources concentrates at specific places, facilities, times and products (Kurland & Pires, 2017; Kurland, Pires, McFann, & Moreto, 2017; Moreto & Lemieux, 2015). This presents a potential opportunity to apply opportunity-based theories and approaches for studying non-compliance in natural resources more generally, and fisheries specifically.

Several studies have applied opportunity-based approaches to guide the study of non-compliance in commercial and recreational fisheries (Davis & Harasti, 2020; Isaacs & Witbooi, 2015; Lindley & Techera, 2019; Marteache, Viollaz, & Petrossian, 2015; Petrossian, Marteache, & Viollaz, 2015; Thiault et al., 2020; Weekers & Zahnow, 2018). However, efforts to apply opportunity-based

approaches in small-scale fisheries contexts are lacking. Including an opportunity-based approach into small-scale fisheries management research and practice has the potential to provide new insights, methods and approaches that can complement the predominant actor-based focus. Whilst the line dividing actor-based and opportunity-based approaches might at times blur, they historically come from different theoretical perspectives, and as such, their application differs. For instance, actor-based approaches may (unintentionally) place the “burden” on the individual fisher – whilst opportunity-based approaches seek to understand how situations create opportunities for non-compliance. Combining these approaches, therefore, can enable researchers to better understand non-compliance, by tackling both the individual theoretical drivers of behaviour and the situations that, in practice, bring opportunities for non-compliance in small-scale fisheries contexts.

Here, we aim to bridge the gap between opportunity-based and actor-based approaches to studying non-compliance in small-scale fisheries and other natural resource use contexts. We structure our paper according to the analytical focus. First, we consider actor-based approaches, which try to explain the underlying motivations for non-compliance. Next, we describe opportunity-based theories, models and frameworks that have been used to study non-compliance more broadly. We then discuss how opportunity-based and actor-based approaches to study non-compliance can be applied in the context of small-scale fisheries. We finish by providing guiding principles on how to bring these approaches together in a complementary way. By doing so, we hope to point to the most pressing opportunities for building a better small-scale fishing non-compliance research agenda and contribute to the study of non-compliance beyond fisheries.

2 | ACTOR-BASED APPROACHES

Several theories and models have been proposed to explain the underlying motivations for actors to comply or not with rules and

regulations (Becker, 1968; Cialdini & Trost, 1998; Ishoy, 2016; Ostrom, 1990; Tyler, 1990). Consequently, fisheries scientists and conservationists have drawn from these theories in order to better understand why fishers comply or not with conservation and management regulations (Arias, Cinner, Jones, & Pressey, 2015; Bergseth & Roscher, 2018; Bova, Halse, Aswani, & Potts, 2017; Kuperan & Sutinen, 1998). Ideally, better understanding what motivates non-compliant behaviours can inform and guide targeted interventions aimed at reducing the incidence of non-compliance (Bergseth & Roscher, 2018; Mackay et al., 2018; Nielsen & Mathiesen, 2003).

Generally speaking, the behavioural, psychological and economic approaches that have been applied for understanding fishers' motivations for non-compliance assume decision-making is similar to the approaches used for compliance with rules more generally (Gezelius, 2002; Keane et al., 2008; Sutinen & Kuperan, 1999). As such, research efforts have been aimed at understanding the diversity of factors that influence decision-making in the context of fisheries, with the underlying premise that reductions in non-compliance can be obtained through manipulating these factors in favour of compliance (Bova et al., 2017; Oyanedel et al., 2020). Below, we describe three conventional approaches that have been used to assess and understand why people engage in non-compliant use of natural resources in general, and fisheries specifically, namely; the Instrumental Model, Compliance Framework and the Theory of Planned Behaviour (Table 1). This is by no means an exhaustive list, but provides parallel, although sometimes overlapping, ways of thinking about why people engage in non-compliant behaviours.

2.1 | Instrumental or deterrence model

The instrumental model (also known as the deterrence model) of compliance has its roots in the economic theory of law, first proposed by Becker (1968). It assumes that, as individuals, actors will calculate the potential costs and benefits of non-compliant behaviours, and will engage in non-compliance when benefits outweigh costs. This calculation is essentially the same than for any actor attempting to maximize utility subject to budget constraints (Sumaila et al., 2006). As such, the level of non-compliance in which a utility-maximizer actor will engage is calculated from the expected reward from non-compliance minus the costs, computed as the probability of detection and sanction multiplied by the severity of the resulting punishment (Equation 1) (Becker, 1968).

$$EU = pU(b - f) + (1 - p)U(b), \quad (1)$$

where EU is expected utility, p is the probability of capture and punishment, U is utility, b is income if undetected, f is fine, and $b - f$ income if punished (Garoupa, 1997).

Sutinen and Andersen (1985) first adapted Becker's model to understand the effect of imperfect enforcement on fisher behaviour. From there, this model has been largely applied in fisheries management to understand how to increase compliance

TABLE 1 Actor-based approaches: Instrumental model, compliance framework and the theory of planned behaviour

Approach	Subcomponent	Description	References in fisheries	References in other natural resources
Instrumental model	Probability of detection Severity of sanction Expected revenue	An actor's compliance decision is based on the calculated potential costs and benefits of the non-compliant behaviour and will decide to engage in non-compliance when benefits outweigh costs	Arias and Sutton (2013), King and Sutinen (2010), Kuperan and Sutinen (1998), Nielsen and Mathiesen (2003)	Bulte and Van Kooten (1999), Damania, Milner-Gulland, and Crookes (2005), Milner-Gulland and Leader-Williams (1992)
Compliance framework	Normative motivations Instrumental motivations Legitimacy-based motivations	An actor's compliance decision is defined by normative, instrumental and legitimacy-based motivations, as well as context-specific economic, social, cultural and institutional variables	Hatcher et al. (2000), Nielsen and Mathiesen (2003), Oyanedel et al. (2020)	Ramcilovic-Suominen and Epstein (2012, 2015), Ramcilovic-Suominen and Hansen (2012)
Theory of planned behaviour	Attitudes towards the behaviour Perceived behavioural control Subjective norms	An actor's decision-making is defined by their intention to perform a behaviour. Intention is shaped by attitudes towards the behaviour, subjective norms and perceived behavioural controls	Bergseth and Roscher (2018), Thomas et al. (2016)	Fairbrass et al. (2016), Shrestha et al. (2012)

(Arias, 2015; Doumbouya et al., 2017; King & Sutinen, 2010; Sumaila et al., 2006). Two main mechanisms by which to increase compliance can be deduced from this model. The first involves increasing the actual probability of detection. This mechanism requires increases in law enforcer numbers, or patrol effort or effectiveness, which are usually costly and can prove ineffective in raising the probability of detection to significant levels if not well-funded (Paternoster, 2010). As such, increasing the real probability of detecting non-compliance can prove challenging or logistically unfeasible, especially in small-scale fisheries contexts that lack proper enforcement capacities or budgets (Muller, Oyanedel, & Monteferri, 2019). An alternative approach involves increasing the perceived probability of detection, using targeted and fear-arousing communication campaigns highlighting the enforcement capabilities of the authorities, such as publicizing technological advances for detection (drones, vessels, etc.) (Bergseth & Roscher, 2018). This could, potentially, be a cost-effective mechanism because such fear-arousing communication campaigns are lower-cost. However, the long-term effectiveness of increasing the perceived probability of detection has not been tested empirically in fisheries. Moreover, evidence from other contexts suggests that this strategy has limited long-term effect if perceptions are not aligned with the truth (Milner-Gulland & Clayton, 2002).

The second mechanism involves increasing penalties. Since increasing detection is usually costly, a more straightforward enforcement strategy is to raise the size of the penalty as to maintain low levels of non-compliance. However, severe penalties might have adverse effects on compliance. For instance, if penalties are perceived as too harsh or unfair, there is a risk of alienating fishers and the emergence of a defiance response from actors that could further increase the prevalence of non-compliant behaviours (Bergseth & Roscher, 2018; Von Essen, Hansen, Nordström Källström, Peterson, & Peterson, 2014). Moreover, theoretical modelling of penalties and the probability of detection suggest that the effectiveness of increasing penalties is minimal without improvements in detection (Leader-Williams & Milner-Gulland, 1993).

2.2 | Compliance framework

The compliance framework was first proposed for forestry contexts to integrate different theoretical models of individual motivations for rule compliance into one analytical framework (Ramcilovic-Suominen & Epstein, 2012). It also includes context-specific economic, social, cultural and institutional variables that might influence individual motivations. This framework compiles different theoretical perspectives of what motivates compliance into three dominant components: instrumental (which relates to the instrumental model described in Section 2.1), legitimacy-based and normative (described below). By doing so, it allows for simultaneous evaluation and comparison of their role in motivating compliance, as well as permitting to include context-specific explanatory variables.

2.2.1 | Legitimacy-based motivations

Legitimacy-based motivations relate to how the acceptance of decision-making and its outcomes motivate actors to comply with regulations (Levi, Sacks, & Tyler, 2009; Ramcilovic-Suominen & Epstein, 2012). Legitimacy can play a crucial role in motivating compliance, and can also make governance easier and more effective (Jentoft, 1989). There are several and evolving ways to conceptualize and measure legitimacy, but these can be categorized into procedural legitimacy, legitimacy of authorities, and outcome legitimacy.

Procedural legitimacy deals with how collective decision-making processes affect individual motivations for compliance (Tyler, 1990). When decision-making is participatory, transparent and accountable, individuals are more likely to comply (Levi et al., 2009; Ramcilovic-Suominen & Epstein, 2012). Legitimacy of authority has to do with how leaders are perceived, including their perceived capability as decision-makers, and in turn, how that affects individual compliance (Levi et al., 2009). Finally, outcome legitimacy considers the fairness and appropriateness of rules as perceived by those who are affected by them. Rules that are perceived as fair and effective are much more likely to be complied with (Jentoft, 1989; Kuperan & Sutinen, 1998; Nielsen, 2003).

2.2.2 | Normative motivations

The normative component of the framework emphasizes social and personal norms as motivations for compliance. Norms are prescriptions commonly accepted in a group, supporting desirable behaviours and forbidding undesirable ones (Gezelius, 2002; Ramcilovic-Suominen & Epstein, 2015). As such, norms can have a significant effect in strengthening adherence to fisheries rules or reinforcing non-compliance (de la Torre-Castro, 2006). The role of norms as a motivation for compliance has been a topic of increasing interest in literature around non-compliance in fisheries, especially in recreational (Arias & Sutton, 2013; Bergseth & Roscher, 2018; Bova et al., 2017; Thomas et al., 2016) and small-scale fisheries contexts (Arias & Pressey, 2016; Battista et al., 2018; Oyanedel et al., 2020). Normative motivations and the way they affect compliance can be classified in three main categories: personal norms (e.g., individual values regarding the behaviour), injunctive norms (e.g., perceived moral values of a group) and descriptive norms (e.g., perception of what others do) (Cialdini & Trost, 1998; Hatcher et al., 2000; Thomas et al., 2016).

Oyanedel et al. (2020) provide an example of how the application of the compliance framework can aid in understanding small-scale fisheries non-compliance. They assessed non-compliance rates and the motivations behind these behaviours in a small-scale fishery in Chile. They found that whilst 93%–100% of fishers complied with gear or temporal restrictions, only 3% did so for the fishery's quota limit. Legitimacy-based motivations were more important than other motivations in explaining this diversity of fishers' responses towards regulations. Similarly, they found that normative motivations best

predicted the degree of non-compliance with the quota limit, and contextual factors such as the per-fisher quota level (which relates to the instrumental component) explained broader non-compliance patterns.

2.3 | Theory of planned behaviour

The Theory of Planned Behaviour (TPB) is an integrative model widely used in social psychology, which seeks to predict an individual's behaviour (Ajzen, 2011). It focuses on the individual's deliberative decision-making process by understanding their intention to perform a behaviour (Bergseth & Roscher, 2018). It assumes that the stronger the intention, the more likely it is that the individual will perform the behaviour (Ajzen, 2011). Three socio-cognitive factors shape intention in the TPB: attitudes towards the behaviour (e.g., what someone believes about the behaviour), subjective norms (e.g., social pressures associated to the specific behaviour) and perceived behavioural control (e.g., the perception of the difficulty of performing the behaviour). The TPB has been used to understand and predict non-compliance in the context of natural resource management in general, and fisheries specifically (Bergseth & Roscher, 2018; Fairbrass, Nuno, Bunnefeld, & Milner-Gulland, 2016; Shrestha, Burns, Pierskalla, & Selin, 2012; Thomas et al., 2016).

3 | OPPORTUNITY-BASED APPROACHES

Here, we review opportunity-based approaches that have been used to study non-compliance and illegality more broadly, which gather around the Environmental Criminology and Crime Analysis school of thought. Environmental criminologists focus on the environmental (contextual) factors that influence the immediate decision to perform a non-compliant behaviour (Brantingham & Brantingham, 1981; Clarke & Felson, 2004). Environmental criminologists have an applied mission, and they guide their studies towards the development of opportunity-reducing strategies, with the premise that by manipulating crime-causing situations, effective prevention and disruption of non-compliant activities can be obtained (Clarke, 1980, 2016). Environmental Criminology and Crime Analysis have three main operational models, described below: Rational Choice, Crime Pattern and Routine Activity. These models were conceived and initially developed in isolation, but they have similarities and overlaps. As such, they are not exclusive, and their application in practice involves convergence (Wortley & Townsley, 2016).

3.1 | Rational choice model

The rational choice model is built upon the principle that "specific crimes are chosen and committed for specific reasons" (Cornish & Clarke, 1987). In this theory-based model, the premise is that

several factors are considered in the actor's decision to engage in crime. These factors are viewed as *properties* of the circumstances and include the possible payoff, perceived risk or skills needed in the context of the actor's motives, experience, expertise and ability (Cornish & Clarke, 1987). This model implies that the environmental or contextual data that the actor uses can be modified to change their decision to commit a crime.

Whilst this model is similar to Becker's (1968) deterrence model (see Section 2.1), in that it asserts that crimes occur when the anticipated benefits outweigh costs, there are two main differences between these models in how costs and rewards are calculated. First, the rational choice model defines rewards not only in economic terms but also considers the emotional or psychological benefits of a criminal act (Clarke, 1980). Second, the rational choice model does not consider costs only in terms of the probability of detection and sanction but also concerning the particular properties of the crime that can make it costly to perform (such as the level of skill or physical fitness required). The rational choice model is built on the evidence that societies, in general, are incredibly inefficient at delivering economic punishment and therefore making crimes costly (Cornish & Clarke, 1987). In this sense, Cornish and Clarke (1987) assert that Becker's model might be useful in some particular circumstances, but fails to explain most crimes as it does not consider the opportunistic nature of many kinds of crimes and the non-economic rewards and barriers that potential criminals face. Altogether, there is conceptual overlap between the rational choice model and Becker's model. However, the rational choice model is a critical component of several of the tools and methods used in Opportunity-based approaches (see Section 3.4), and as such, its application differs substantially from Becker's model.

3.2 | Routine activity model

The routine activity model has its empirically based roots in the evidence that crime rate trends and cycles are influenced by structural changes in routine activity patterns. This occurs when changes in routine activities affect the convergence in space and time of the three minimal elements for a crime: (a) motivated actors, (b) suitable targets, and (c) the absence of capable guardians (Cohen & Felson, 1979). If any of these elements is missing, crimes do not take place. This model implies that even when the number of motivated offenders is constant, crime rates can change due to changes in suitable targets or the absence of guardians (note: guardians not only means police but could also be regular citizens). Therefore, this model takes user motivations towards non-compliance as a given and studies how spatial-temporal factors of the organization of daily life can help convert criminal inclination into action (Cohen & Felson, 1979).

In their seminal paper, Cohen and Felson (1979) use the routine activity model to explain the paradox that "urban violent crime rates (in the US) increased substantially during the past decade when the conditions that are supposed to cause violent crime have not worsened- have indeed, generally, improved" (Cohen & Felson, 1979).

They hypothesized that the increase in the crime rates in the United States in the 60s was related to changes in the routine activity structures of everyday life in American society. These changes increased the suitability of targets and decreased guardian presence. To test this, they examined the relationship between household unattendance and crime rates. They found a strong and significant positive relationship between these two variables. This analysis suggests that routine activity changes may provide the opportunity for crimes to occur. Societal shifts such as increases in female labour participation, more vacations and higher enrolment in college changed routine activities. This meant that houses were less attended and therefore provided more suitable targets which, in the absence of capable guardians, enabled crimes to occur.

3.3 | Crime pattern model

The crime pattern model's objective is to empirically measure and account for the non-uniformity and non-randomness observed in crime patterns (Brantingham & Brantingham, 1984). This model is based on the idea that people develop a pattern of repetitive activity in their normal life. Understanding the factors that determine the specific spatial patterns of crime is, therefore, necessary to prevent it. This pattern includes nodes (such as the workplace, home, shopping, etc.) and routes between them. Offenders behave in this same way as everyone else and will be more comfortable committing crimes closer to the areas they frequent (Brantingham, Brantingham, & Andresen, 2017; Kinney, Brantingham, Wuschke, Kirk, & Brantingham, 2008). Therefore, the routes and nodes that shape non-criminal activities, influence how criminal activities are shaped as well.

Using the crime pattern model, Kinney et al. (2008) identified crime attractors, generators and detractors. They conceptualized these as nodes whose structure influenced crime patterns. They found that most land-use types acted as detractors, as no crime was detected in them. However, some types of crimes, like assault and motor vehicle theft, concentrated on specific land-use types, such as shopping centres, which therefore acted as crime generators and attractors. This occurred because these were high activity nodes, that attracted large concentrations of victims and offenders. Further, they suggested that better understanding the distribution of the nodes which act as crime attractors, detractors or generators throughout urban areas can help reduce overall crime rates. As such, by better understanding daily life activities and patterns, opportunistic crime can be better prevented and disrupted (Brantingham & Brantingham, 1993).

3.4 | Methods and tools used in Environmental Criminology and Crime Analysis

The rational choice, routine activity and crime pattern models are the theoretical basis of opportunity-based approaches, which fall

under the Environmental Criminology and Crime Analysis school of thought. Several analytical methods have been developed to operationalize and combine the abovementioned models, breaking crime down into specific analysable components in order to propose and design prevention measures. In this section, we review some of these methods, focusing on those that have been used in fisheries or other natural resource management contexts (Figure 2).

3.4.1 | Crime script analysis

Crime script analysis was first proposed by Cornish (1994), based on the premise that crimes are discrete events in space and time, but the realization of the crime itself takes place within a context of many other events. The crime itself is usually the object of study, typically overlooking certain other stages in the crime-commission process (e.g., getting the necessary tools or exiting the setting). The script refers to an “event” schema where there is a causal effect from early to later events; that is, one event in the script enables the occurrence of a later event (Cornish, 1994). By concentrating on the way that events unfold through time, the crime script analysis provides researchers and practitioners with an analytical tool to understand a series of rational, goal-oriented actions (Cornish, 1994). Crime script can operate at different levels of analysis; from specific crime situations where rich information is available, to analysing larger-level scripts or more general crimes.

Crime script analysis has been applied to study non-compliance in fisheries and seafood fraud. Petrossian and Pezzella (2018) separated the scripts of non-compliant fishing and the seafood fraud process to shed light on the regulations needed to address these crimes. Based on Clarke and Eck (2005), they divided the processes of non-compliant fishing and seafood fraud into the following sequential stages: (a) *preparation* (getting the necessary tools and selecting the target); (b) *entry into the area*; (c) *precondition* (steps towards creating the enabling conditions); (d) *instrumental initiation* (target approach); (e) *doing or carrying out the crime*; (f) *exiting the crime scene*; and (g) *aftermath* (disposing of incriminatory elements or steps to reduce risk of apprehension). By breaking the process into smaller sequential discrete actions, the authors proposed policy responses that act upon these specific stages of the script, such as disrupting the *preparation* stage by providing insurance companies with a list of blacklisted vessels. They argued that these responses required very little involvement from the criminal justice sector. Instead, they stressed the need for collaboration amongst national and international agencies to tackle some of the situational factors at the different stages of non-compliant fishing and seafood fraud.

3.4.2 | Risky facilities framework

The risky facilities framework builds on the premise that “for any group of similar facilities (e.g., taverns, parking lots or bus shelters), a small proportion of the group accounts for the majority of crime

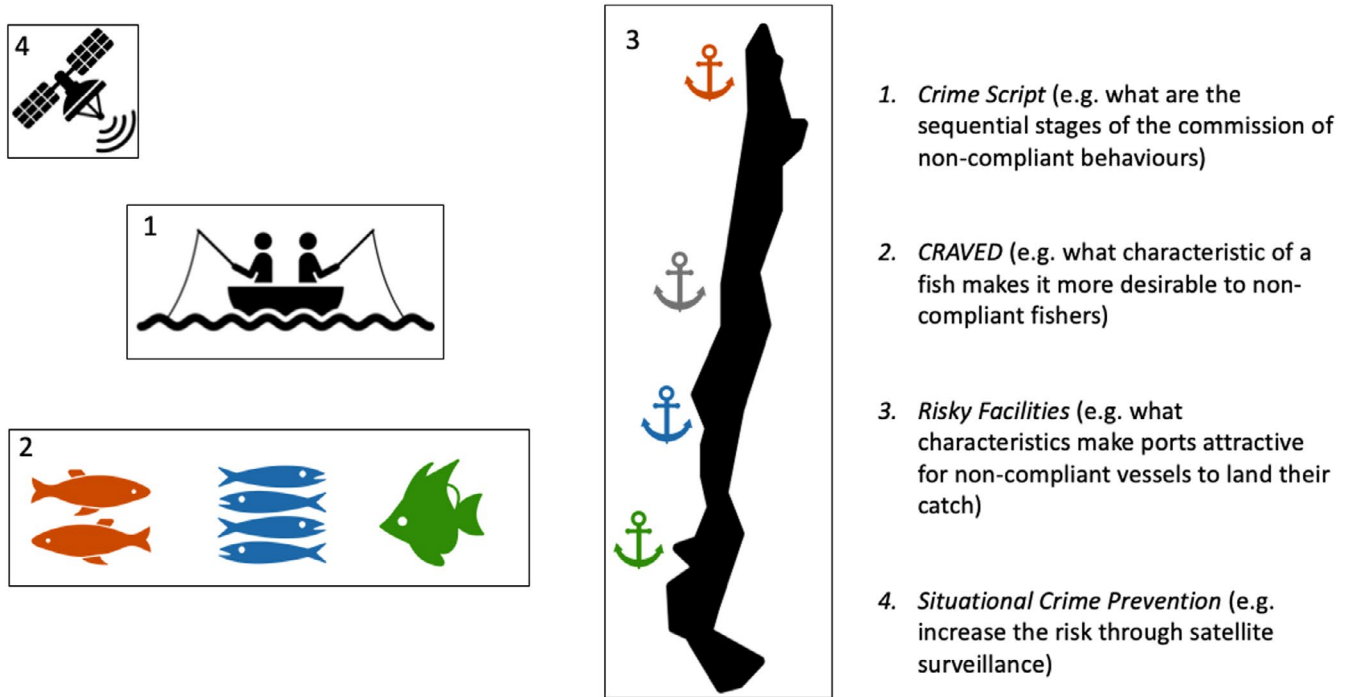


FIGURE 2 Examples of the application of methods and tools from Environmental Criminology and Crime Analysis in the study of small-scale fisheries non-compliance [Colour figure can be viewed at wileyonlinelibrary.com]

experienced by the entire group" (Eck, Clarke, & Guerette, 2007). Whilst several authors have analysed hotspots and map them, the comparison between facilities of the same sort allows identification of specific characteristics that could explain their risk, providing the base to design preventive actions. More practically, this framework allows concentrating of efforts in certain facilities where most crime occurs, instead of targeting a large number of facilities where little crime occurs. Some of the variables identified to influence a facility's risk are size, number and quantity of "hot products" in the facility, location, management effectiveness and design and layout.

Petrossian, Marteache, et al. (2015) applied this framework to study what characteristics make ports attractive for non-compliant vessels to land their catch. To do this, they analysed data on the ports used by vessels that were listed as performing non-compliant fishing by Regional Fisheries Management Organizations (RFMO). They identified a total of 120 ports in 70 countries where these vessels had operated between 2004 and 2009. They found that larger ports that had higher vessel traffic were more visited by non-compliant vessels. Also, ports in countries where non-compliance is more common, corruption is higher and catch inspection schemes were less effective, were also more visited. This points out the variables that could be modified to disrupt non-compliant vessel fishing operations.

3.4.3 | CRAVED framework

The CRAVED framework was first proposed by Clarke and Webb (1999) to analyse what makes some products more attractive for

theft than others. CRAVED stands for: Concealable, Removable, Available, Valuable, Enjoyable and Disposable. These six attributes of a product are hypothesized to make a product more attractive (Clarke & Webb, 1999). For the application of CRAVED, the indicators for each of the attributes must be fitted to the specific crime and product being studied. An indicator of Removable will vary dramatically depending on, for example, the species being studied (Petrossian & Clarke, 2014). This framework helps users to compare the attributes between products and explain changing patterns in crime targets. This framework has been used for studying wildlife products (Moreto & Lemieux, 2015) and fish more specifically (Petrossian & Clarke, 2014; Petrossian, Weis, & Pires, 2015). Petrossian et al. (2015) for instance, found that crab and lobster species that were subject to higher levels of non-compliant fishing were those that were more Available (subcomponent abundant), Valuable and Enjoyable. From this, they provide guidance on how to reduce non-compliance through prioritizing and targeting those identified attributes.

3.4.4 | Situational crime prevention

Situational crime prevention (SCP) was first suggested by Clarke (1980). SCP is a framework that offers a suite of techniques that can help build solutions to prevent crime. SCP techniques are based on an understanding of the processes undertaken to commit a crime. By disentangling the situational features that enable crimes, SCP techniques aim to influence an actor's choice to engage in it. SCP techniques are organized into five categories: increase the effort,

increase the risk, reduce the reward, reduce provocations and remove excuses. Petrossian (2015) applied the SCP framework to study the relationship between non-compliant fishing in 53 countries and local situational factors. She found that non-compliance risk was higher in countries with more commercially important fisheries that were closer to ports of convenience. Similarly, she found that countries with higher management and enforcement capacities had lower levels of non-compliance.

4 | BRINGING ACTOR-BASED AND OPPORTUNITY-BASED APPROACHES TOGETHER TO ADVANCE SMALL-SCALE FISHERIES NON-COMPLIANCE RESEARCH

Small-scale fisheries operate in diverse economic, social and cultural contexts (Cohen et al., 2019), preventing bullet-proof solutions to non-compliance problems (Boonstra et al., 2017; Mahon, McConney, & Roy, 2008; Oyanedel et al., 2020; Song et al., 2020). However, one characteristic that small-scale fisheries share is that their operation depends on both social and ecological factors (Basurto, Gelcich, & Ostrom, 2013; Lindkvist et al., 2017). Considering the socio-ecological nature of small-scale fisheries, we provide an overview of three challenges for researching non-compliance that can be better framed and tackled through bringing actor- and opportunity-based approaches together.

4.1 | Non-compliance in small-scale fisheries emerges from both the social and ecological realms

Small-scale fishers behaviour, and also non-compliance, are strongly determined by the social and economic context in which fisheries operate, which has been described extensively (Gezelius & Hauck, 2016; Hauck, 2008; Mahon et al., 2008; Nielsen & Mathiesen, 2003; Oyanedel et al., 2020; Sutinen & Kuperan, 1999). However, the ecological characteristics of small-scale fisheries are also critical determinants of the availability of opportunities for non-compliance. The inherent spatial and temporal variability of ocean ecosystems makes it highly likely that opportunities for non-compliance vary over a range of temporal and spatial scales. There is growing evidence that this variability results in non-randomly distributed opportunities for non-compliant fishing, which is concentrated in hotspots (Davis & Harasti, 2020; Thiault et al., 2020; Weekers, Zahnow, & Mazerolle, 2019). Identifying these hotspots, and how they vary over time and space, is of crucial importance to understand how environmental context-specific variables produce emergent opportunities for non-compliance. Ignoring the dynamic ecological features of small-scale fisheries contexts will result in an incomplete understanding of why, how and when non-compliant fishing could emerge (Petrossian, 2018). Focusing on the ecological elements of the system is important even though most research has focused on social elements. As such, combining actor-based and

opportunity-based approaches for researching non-compliance in small-scale fisheries can produce more robust results by incorporating both the social and ecological features that determine non-compliant fishing dynamics.

4.2 | Choose your battles wisely: improving identification for prioritization in diverse small-scale fisheries systems

Small-scale fisheries management usually comes with budget constraints affecting the design, implementation and enforcement of rules, from which situations conducive to non-compliance can emerge (Arias et al., 2015; Gelcich et al., 2017). In the low-governance, budget-limited situation of small-scale fisheries it is of utmost importance to prioritize efforts to reduce non-compliance effectively. Here, combining actor-based and opportunity-based approaches can aid in the identification of the most pressing facilities, resources and locations where non-compliance is likely to concentrate. For instance, the Risky Facilities Framework can help identify the ports where non-compliant vessels land their catches (Marteache et al., 2015), or researchers can use the CRAVED model to understand which species are more attractive to non-compliant fishers and which attributes makes them so (Figure 2). Further, research can focus on understanding the social characteristics of places where non-compliance develops. Social disorganization models, for instance, focus on the effectiveness of communities at preventing non-compliance through informal control mechanisms (Sampson & Groves, 1989). Understanding fishers' perception of the legitimacy of rules at the local scale can help predict compliance levels and informal control mechanism that might help prevent non-compliance (Oyanedel et al., 2020; Sampson & Groves, 1989).

4.3 | Neither the actor- nor opportunity-based approach on its own fully explains non-compliance in socio-ecological systems such as small-scale fisheries

Understanding the interaction of actor- and opportunity-based approaches when studying non-compliance in small-scale fisheries can provide useful insights into the socio-ecological nature of non-compliance. For instance, Oyanedel, Keim, Castilla, and Gelcich (2018) describe a quite unexpected form of non-compliance that could be better understood based on the interaction of actor-based and opportunity-based approaches. Using the randomised response technique (Fox & Tracy, 1986; Lensvelt-Mulders, Hox, van der Heijden, & Maas, 2005), they empirically assessed the proportion of divers that violated several rules of a territorial user right for fisheries (TURF) system in a small-scale context in Chile. They found that 46% of fishers who belonged to unions with user rights non-compliantly fished with the consent of their union leaders (they were non-compliant because the catch was not reported to authorities). On the one hand, normative and legitimacy-based motivations for

non-compliance were aligned for these fishers, as they were authorized by their leaders to do so. On the other hand, there is evidence that TURF areas are more prolific fishing grounds, and as such are more attractive for fishers, which provides an opportunity-based account for this behaviour (Gelcich et al., 2017; Gelcich, Godoy, Prado, & Castilla, 2008). Further, the authors provide an explanation for this behaviour that can help complement the understanding of this form of non-compliance: "Because fisher unions find it too complicated, costly, or useless to officially report their catches, they are not reporting to authorities, even if they fish within legal margins (respecting the minimum size and closures)" (Oyanedel et al., 2018). As such, this form of non-compliance behaviour could be prevented through opportunity-based approaches such as those found in situational crime prevention, more specifically, "removing the barrier."

5 | GUIDING PRINCIPLES FOR APPLYING ACTOR-BASED AND OPPORTUNITY-BASED APPROACHES FOR ADVANCING NON-COMPLIANCE RESEARCH

Here, we propose three guiding principles to help bridge the gap between these two types of approaches to advance non-compliance research in small-scale fisheries and natural resource use contexts in general.

5.1 | Analyse which approach better suits what is being studied and the possible policy levers

One fundamental difference between actor-based and opportunity-based approaches is that the former puts the individual at the centre of the study whilst the latter does exactly the opposite (Clarke & Felson, 2004; Cornish & Clarke, 1987; Keane et al., 2008; Kurland et al., 2017). The socio-ecological setting of small-scale fisheries (and other natural resource use contexts) allows for a variety of actors, processes and circumstances to converge. As such, some of the vast arrays of research questions that can be framed around the problem of non-compliance could be better fitted to actor-based approaches and some to opportunity-based approaches. However, it is essential also to consider the applied consequences of the research questions; the type of policy levers available and the context the research is trying to inform (Ramcilovic-Suominen & Epstein, 2015; St John, Keane, & Milner-Gulland, 2013). In contexts where changing the properties of the products or situations that give rise to opportunities for non-compliance might be challenging or unfeasible, research needs to focus on actors' motivations for non-compliance. A situation like this can arise in cases where natural resource users are easy to locate, organized and geographically attached, but where external market or ecological dynamics provide extensive opportunities for non-compliance. In such cases, research can focus on the behavioural motivations that influence natural resource users to comply or not with regulations. Since in these cases it is possible to locate

and identify fishers, potential interventions to change motivations are feasible.

Conversely, there are cases where changing actors' motivations might be too challenging, and interventions will be better focused on the attributes that give rise to non-compliance opportunities. In these cases, research will be of better use if it focusses on the properties of places, products or circumstances that give rise to these opportunities. For instance, there are contexts where there is no register or high mobility of natural resource users, that prevents the proper identification of motivations for compliance or eventual interventions to address them. In such cases, research might be better directed at identifying which species are the most targeted by non-compliant users and what attributes make these species attractive (CRAVED model). Similarly, research can focus on identifying the *modus operandis* of the non-compliant activity and the several steps needed for the process to develop (crime script analysis) (Petrossian & Pezzella, 2018). Insights from research on these topics can help inform policies that might reduce non-compliance without having to intervene with the actors involved, but instead, focus on the opportunities for non-compliance.

5.2 | Explicitly consider each approach's shortcomings and methodological challenges

Actor-based and opportunity-based approaches have different ways to study non-compliance, and each has limitations in how they could be applied in natural resource use contexts. On the one hand, opportunity-based approaches rely heavily on the ability to identify the products and discrete locations in time and space where non-compliance occurs (Brantingham et al., 2017; Brantingham & Brantingham, 1981, 1984; Clarke & Webb, 1999). However, this can be challenging in natural resource management contexts, which poses an essential limitation for applying opportunity-based approaches (Gavin, Solomon, & Blank, 2010; Keane, Jones, & Milner-Gulland, 2011). Whilst enforcement and infringement records are sometimes available, they are not always good indicators of where and when non-compliance occurs (Critchlow et al., 2017; Keane et al., 2011; O'Kelly, Rowcliffe, Durant, & Milner-Gulland, 2018a). This is because enforcement is reactive and non-random in nature, therefore, data from this activity is inherently biased (Keane et al., 2008; O'Kelly, Rowcliffe, Durant, & Milner-Gulland, 2018b). A second source of bias arises because enforcement acts as a deterrent, subsequently changing resource user behaviours and further reducing the ability of enforcement records to detect true non-compliance trends (Keane et al., 2011). However, advances in encounter data analysis and modelling have proven useful to disentangle confounding factors and biases, leading to a better interpretation of infringement records (Critchlow et al., 2015; Underwood, Burn, & Milliken, 2013). This, in turn, can help to identify hotspots and temporal trends in non-compliance. Examples of the application of these models can be found for snare detection (O'Kelly et al., 2018b), elephant carcasses (Burn, Underwood, & Blanc, 2011) and ivory seizure

data (Underwood et al., 2013). Properly accounting for and dealing with these biases is critical for applying opportunity-based approaches in natural resource use contexts.

On the other side, one of the major limitations of actor-based approaches for studying non-compliance relates to the difficulty of approaching actors who are involved in non-compliant behaviours (Kuk, 1990; Oyanedel et al., 2018; Solomon, Gavin, & Gore, 2015). Non-compliance is a sensitive topic, and it is to be expected that people involved in the activity will be reluctant to participate in research projects aimed at reducing its incidence. This poses a major challenge for applying actor-based approaches since for the Compliance Framework and the Theory of Planned Behaviour (and to a lesser extent the Instrumental Model), methods rely on surveys or questionnaires that require actor participation (Fairbrass et al., 2016; Oyanedel et al., 2020; Ramcilovic-Suominen & Epstein, 2012). The difficulty is especially prevalent in natural resource use contexts where mistrust in scientists can be common (Shirley & Gore, 2019). However, there are ways to get around this problem and induce participation, such as protecting actors' confidentiality thereby reducing non-response rates and social desirability bias (e.g., under-reporting of behaviours that are socially undesirable or over-reporting those that are desirable) (Bova, Aswani, Farthing, & Potts, 2018). These include doing electronically based surveys (Thomas et al., 2016), the randomized response technique (Blank & Gavin, 2009; Fox & Tracy, 1986; Oyanedel et al., 2018), the unmatched count technique (Hinsley, Nuno, Keane, St John, & Ibbett, 2019; Lavender & Anderson, 2009) and the ballot box method (Bova et al., 2018). Whilst none of these methods can assure full participation or sincere responses, they do increase responses rates and can provide more transparent assessments of non-compliant behaviour and its motivations. Further, by using these confidential methods, retaliation or negative consequences for research participants can be prevented if methods are appropriately applied and presented (e.g., not reporting port-level aggregate results that might cause fishers from a particular port to be targeted).

5.3 | Consider the appropriate timescales at which changes can be detected

The time scales at which research on actor- and opportunity-based approaches need to be conceptualized and performed differ. This is because the interventions proposed by actor- and opportunity-based approaches have different time horizons. As such, actor- and opportunity-based approaches can complement each other through the temporal scale of the interventions that are put in place to address non-compliance. By bringing together these two approaches, the underlying causes of non-compliance in fisheries can be tackled, whilst also providing shorter-term gains in compliance.

On the one hand, altering the underlying motivations that drive behaviour is a long-term effort (Clarke, 1980). As such, research aiming to understand trends in how actor-based approaches might affect non-compliance must incorporate into its design the time

horizon at which some of these underlying motivations might start to change. For instance, the social norms approach (SNA) has been proposed as a way to increase compliance with recreational fisheries regulations (Bova et al., 2017). The SNA uses targeted advertizing campaigns to correct misconceptions of the proportion of people that engage with undesirable or non-compliant behaviours (Berkowitz, 2005). By doing so, it aims to change descriptive norms (e.g., perception of what others do) as a way to motivate compliance. However, for this approach to be effective, at least half of the population should exhibit the appropriate (compliant) behaviour (Bova et al., 2017; Perkins & Berkowitz, 1986). As such, the time horizon needed for these advertizing campaigns to have the intended effect might be significant, because of the need to assess and bring compliance levels up to the point where the SNA can be applied.

On the other hand, from their inception, opportunity-based approaches have relied on short-term, trial and error assessment of interventions to prevent non-compliance (Kurland et al., 2017; Weisburd, 2018). As such, research guided by opportunity-based approaches can help to design interventions that can be implemented in short timeframes. Techniques from Situational Crime Prevention allow for empirically based analysis of potential changes in non-compliance that can be detected over short time periods. Petrossian and Marteach (2018) provides a good account of the type of interventions that can be informed by Situational Crime Prevention and its application in fisheries, its time frames and potential results.

6 | CONCLUSION

Sustaining fisheries and other natural resources into the future requires the reduction of non-compliance. This is especially pressing in settings where the impacts of non-compliance are more acute because of poor management, lack of enforcement capacity and the high dependence of users on natural resources for employment and food. Addressing the non-compliant use of natural resources requires us to push research frontiers to provide frameworks and insights that translate into practical actions and plans. Understanding how the transition from theory to practice has been achieved in other disciplines dealing with non-compliant activities can make this easier to achieve.

Here, we have shown how integrating actor-based and opportunity-based approaches can trigger new ways to explore non-compliance in small-scale fisheries. Moreover, these principles and approaches are generalizable to other natural resources and contexts, such as the illegal wildlife trade. Illegal wildlife trade has similarities with small-scale fisheries in that they both operate in the intersection of social and ecological systems. The diversity of ways that natural resources are used and managed precludes simple solutions to curtailing non-compliant use ('t Sas-Rolfes, Challender, Hinsley, Veríssimo, & Milner-Gulland, 2019). However, acknowledging that non-compliance can be framed as the interaction of a motivated actor and an opportunity serves as a starting point for broader applicability of our approach to other contexts and settings.

As demonstrated here, building a better research agenda on non-compliance issues in small-scale fishing should include active engagement with experiences and approaches from other natural resource management settings. The theoretical underpinnings of actor-based and opportunity-based approaches, as well as their integrated application, are the same whether the social-ecological system is terrestrial or marine. As such, these approaches provide a bridge through which collaboration between researchers studying non-compliant use of natural resources in a range of settings can be promoted. The application of these approaches can provide cross-learning opportunities and better identification of knowledge gaps and biases. Thereby, it could unleash the potential of collaborative studies for advancing the theory and practice of non-compliance research in natural resource management contexts. Understanding the commonalities and specificities of contexts where non-compliance occurs could be a critical step towards better managing and maintaining the natural resources we depend on.

ACKNOWLEDGEMENTS

We acknowledge funding from ANID PIA/BASAL FB0002 and ANID-Becas Chile. We thank Millennium Nucleus Center for the Socioeconomic Impact of Environmental Policies (CESIEP) and the Walton Family Foundation. SG and EJM-G were supported by Pew Marine Fellowships.

DATA AVAILABILITY STATEMENT

Data availability not applicable to this article as no datasets were generated or analysed during the current study.

ORCID

Rodrigo Oyanedel  <https://orcid.org/0000-0003-2359-4641>

Stefan Gelcich  <https://orcid.org/0000-0002-5976-9311>

E. J. Milner-Gulland  <https://orcid.org/0000-0003-0324-2710>

REFERENCES

- Agnew, D. J., Pearce, J., Pramod, G., Peatman, T., Watson, R., John, R., & Pitcher, T. J. (2009). Estimating the worldwide extent of illegal fishing. *PLoS One*, 4(2), e4570. <https://doi.org/10.1371/journal.pone.0004570>
- Arias, A. (2015). Understanding and managing compliance in the nature conservation context. *Journal of Environmental Management*, 153, 134–143. <https://doi.org/10.1016/j.jenvman.2015.02.013>
- Arias, A., Cinner, J. E., Jones, R. E., & Pressey, R. L. (2015). Levels and drivers of fishers' compliance with marine protected areas. *Ecology and Society*, 20(4), 19.
- Arias, A., & Pressey, R. L. (2016). Combatting illegal, unreported, and unregulated fishing with information: A case of probable illegal fishing in the Tropical Eastern Pacific. *Frontiers in Marine Science*, 3(13), 1–4. <https://doi.org/10.3389/fmars.2016.00013>
- Arias, A., & Sutton, S. G. (2013). Understanding recreational fishers' compliance with no-take zones in the Great Barrier Reef Marine Park. *Ecology and Society*, 18(4), –. <https://doi.org/10.5751/ES-05872-180418>
- Basurto, X., Gelcich, S., & Ostrom, E. (2013). The social-ecological system framework as a knowledge classificatory system for benthic small-scale fisheries. *Global Environmental Change*, 23(6), 1366–1380. <https://doi.org/10.1016/j.gloenvcha.2013.08.001>
- Battista, W., Romero-Canyas, R., Smith, S. L., Fraire, J., Effron, M., Larson-Konar, D., & Fujita, R. (2018). Behavior change interventions to reduce illegal fishing. *Frontiers in Marine Science*, 5, 403. <https://doi.org/10.3389/fmars.2018.00403>
- Becker, G. S. (1968). Crime and punishment: An economic approach. *Journal of Political Economy*, 76(2), 169–217. <https://doi.org/10.1086/259394>
- Bergseth, B. J., & Roscher, M. (2018). Discerning the culture of compliance through recreational fisher's perceptions of poaching. *Marine Policy*, 89, 132–141. <https://doi.org/10.1016/j.marpol.2017.12.022>
- Berkowitz, A. (2005). An overview of the social norms approach. In L. Lederman, & L. P. Stewart (Eds.), *Changing the culture of college drinking: A socially situated prevention campaign* (pp. 193–214). Cresskill, NJ: Hampton Press.
- Blank, S. G., & Gavin, M. C. (2009). The randomized response technique as a tool for estimating non-compliance rates in fisheries: A case study of illegal red abalone (*Haliotis rufescens*) fishing in Northern California. *36*(2), 112–119. <https://doi.org/10.1017/S037689290999004X>
- Boonstra, W. J., Birnbaum, S., & Björkvik, E. (2017). The quality of compliance: Investigating fishers' responses towards regulation and authorities. *Fish and Fisheries*, 18(4), 682–697. <https://doi.org/10.1111/faf.12197>
- Boonstra, W. J., & Hentati-Sundberg, J. (2015). Classifying fishers' behaviour. An invitation to fishing styles. *Fish and Fisheries*, 17(1), 78–100. <https://doi.org/10.1111/faf.12092>
- Boonstra, W. J., & Österblom, H. (2014). A chain of fools: Or, why it is so hard to stop overfishing. *Maritime Studies*, 13(1), 1–20. <https://doi.org/10.1186/s40152-014-0015-4>
- Bova, C. S., Aswani, S., Farthing, M. W., & Potts, W. M. (2018). Limitations of the random response technique and a call to implement the ballot box method for estimating recreational angler compliance using surveys. *Fisheries Research*, 208, 34–41. <https://doi.org/10.1016/j.fishres.2018.06.017>
- Bova, C. S., Halse, S. J., Aswani, S., & Potts, W. M. (2017). Assessing a social norms approach for improving recreational fisheries compliance. *Fisheries Management and Ecology*, 24(2), 117–125. <https://doi.org/10.1111/fme.12218>
- Brantingham, P. J., & Brantingham, P. L. (1981). *Environmental criminology*. Beverly Hills, CA: SAGE.
- Brantingham, P. J., & Brantingham, P. L. (1984). *Patterns in crime*. New York, NY: Macmillan.
- Brantingham, P. L., & Brantingham, P. J. (1993). Nodes, paths and edges: Considerations on the complexity of crime and the physical environment. *Journal of Environmental Psychology*, 13(1), 3–28. [https://doi.org/10.1016/S0272-4944\(05\)80212-9](https://doi.org/10.1016/S0272-4944(05)80212-9)
- Brantingham, P. J., Brantingham, P. L., & Andresen, M. A. (2017). The geometry of crime and crime pattern theory. In R. Wortley, & M. Townsley (Eds.), *Environmental criminology and crime analysis* (2nd ed., pp. 98–115). New York, NY: Routledge.
- Bulte, E. H., & Van Kooten, G. C. (1999). Economic efficiency, resource conservation and the ivory trade ban. *Ecological Economics*, 28(2), 171–181. [https://doi.org/10.1016/S0921-8009\(98\)00048-2](https://doi.org/10.1016/S0921-8009(98)00048-2)
- Burn, R. W., Underwood, F. M., & Blanc, J. (2011). Global trends and factors associated with the illegal killing of elephants: A hierarchical bayesian analysis of carcass encounter data. *PLoS One*, 6(9), e24165. <https://doi.org/10.1371/journal.pone.0024165>
- Cialdini, R. B. (2003). Crafting normative messages to protect the environment. *Current Directions in Psychological Science*, 12(4), 105–109. <https://doi.org/10.1111/1467-8721.01242>
- Cialdini, R. B., & Trost, M. R. (1998). Social influence: Social norms, conformity and compliance. In D. Gilbert, S. Fiske, & G. Lindzey (Eds.), *The handbook of social psychology*. New York, NY: McGraw-Hill.

- Cisneros-Montemayor, A. M., Cisneros-Mata, M. Á., Harper, S., & Pauly, D. (2013). Extent and implications of IUU catch in Mexico's marine fisheries. *Marine Policy*, 39(1), 283–288. <https://doi.org/10.1016/j.marpol.2012.12.003>
- Clarke, R. V. (1980). Situational crime prevention. *British Journal of Criminology*, 20(2), 136–147.
- Clarke, R. V. (2016). Situational crime prevention. In R. Wortley, & M. Townsley (Eds.), *Environmental criminology and crime analysis* (386–303). New York, NY: Routledge.
- Clarke, R. V., & Eck, J. E. (2005). *Crime analysis for problem solver*. Washington, DC: Center for Problem Oriented Policing.
- Clarke, R. V., & Felson, M. (2004). *Routine activity and rational choice*. New York, NY: Routledge.
- Clarke, R. V., & Webb, B. (1999). *Hot products: Understanding, anticipating and reducing demand for stolen goods*. London, UK: Home Office, Policing and Reducing Crime Unit, Research, Development and Statistics Directorate.
- Cohen, E. L., & Felson, M. (1979). Social change and crime rate trends: A routine activity approach. *American Sociological Review*, 44(4), 588–608.
- Cohen, P. J., Allison, E. H., Andrew, N. L., Cinner, J., Evans, L. S., Fabinyi, M., ... Ratner, B. D. (2019). Securing a just space for small-scale fisheries in the blue economy. *Frontiers in Marine Science*, 6(171), 1–8. <https://doi.org/10.3389/fmars.2019.00171>
- Collins, S. E., Witkiewitz, K., & Larimer, M. E. (2011). The theory of planned behavior as a predictor of growth in risky college drinking. *Journal of Studies on Alcohol and Drugs*, 72(2), 322–332. <https://doi.org/10.15288/jsad.2011.72.322>
- Cornish, D. B. (1994). The procedural analysis of offending and its relevance for situational prevention. *Crime prevention studies*, 3, 151–196.
- Cornish, D. B., & Clarke, R. V. (1987). Understanding crime displacement: An application of rational choice theory. *Criminology*, 25(4), 933–948. <https://doi.org/10.1111/j.1745-9125.1987.tb00826.x>
- Critchlow, R., Plumptre, A. J., Alidria, B., Nsubuga, M., Driciru, M., Rwetsiba, A., ... Beale, C. M. (2017). Improving law-enforcement effectiveness and efficiency in protected areas using ranger-collected monitoring data. *Conservation Letters*, 10(5), 572–580. <https://doi.org/10.1111/conl.12288>
- Critchlow, R., Plumptre, A. J., Driciru, M., Rwetsiba, A., Stokes, E. J., Tumwesigye, C., ... Beale, C. M. (2015). Spatiotemporal trends of illegal activities from ranger-collected data in a Ugandan national park. *Conservation Biology*, 29(5), 1458–1470. <https://doi.org/10.1111/cobi.12538>
- Damania, R., Milner-Gulland, E. J., & Crookes, D. J. (2005). A bioeconomic analysis of bushmeat hunting. *Proceedings of the Royal Society B: Biological Sciences*, 272(1560), 259–266. <https://doi.org/10.1098/rspb.2004.2945>
- Davis, T. R., & Harasti, D. (2020). Predictive modelling of illegal fishing in no-take marine protected areas. *Fisheries Management and Ecology*, 27(3), 292–301. <https://doi.org/10.1111/fme.12412>
- de la Torre-Castro, M. (2006). Beyond regulations in fisheries management: The dilemmas of the “Beach Recorders” Bwana Dikos in Zanzibar, Tanzania. *Ecology and Society*, 11(2). <https://doi.org/10.5751/ES-01876-110235>
- Doumbouya, A., Camara, O. T., Mamie, J., Intchama, J. F., Jarra, A., Ceesay, S., ... Belhabib, D. (2017). Assessing the effectiveness of monitoring control and surveillance of illegal fishing: The case of West Africa. *Frontiers in Marine Science*, 4(50). <https://doi.org/10.3389/fmars.2017.00050>
- Eck, J. E., Clarke, R. V., & Guerette, R. T. (2007). Risky facilities: Crime concentration in homogeneous sets of establishments and facilities. *Imagination for Crime Prevention*, 21, 225–264.
- Fairbrass, A., Nuno, A., Bunnefeld, N., & Milner-Gulland, E. J. (2016). Investigating determinants of compliance with wildlife protection laws: Bird persecution in Portugal. *European Journal of Wildlife Research*, 62(1), 93–101. <https://doi.org/10.1007/s10344-015-0977-6>
- Fox, J. A., & Tracy, P. E. (1986). *Randomized response: A method for sensitive surveys*. Thousand Oaks, CA: SAGE.
- Garoupa, N. (1997). The theory of optimal law enforcement. *Journal of Economic Surveys*, 11(3), 267–295. <https://doi.org/10.1111/1467-6419.00034>
- Gavin, M. C., Solomon, J. N., & Blank, S. G. (2010). Measuring and monitoring illegal use of natural resources. *Conservation Biology*, 24(1), 89–100. <https://doi.org/10.1111/j.1523-1739.2009.01387.x>
- Gelcich, S., Cinner, J., Donlan, C. J., Tapia-Lewin, S., Godoy, N., & Castilla, J. C. (2017). Fishers' perceptions on the Chilean coastal TURF system after two decades: Problems, benefits, and emerging needs. *Bulletin of Marine Science*, 93(1), 53–67. <https://doi.org/10.5343/bms.2015.1082>
- Gelcich, S., Godoy, N., Prado, L., & Castilla, J. C. (2008). Add-on conservation benefits of marine territorial user rights fishery policies in central Chile. *Ecological Applications*, 18(1), 273–281. <https://doi.org/10.1890/06-1896.1>
- Gezelius, S. S. (2002). Do norms count? State regulation and compliance in a Norwegian fishing community. *Acta Sociologica*, 45(4), 305–314. <https://doi.org/10.1177/000169930204500404>
- Gezelius, S. S., & Hauck, M. (2016). Toward a theory of compliance in state-regulated livelihoods: A comparative study of compliance motivations in developed and developing world fisheries. *Law and Society Review*, 45(2), 435–470.
- Hatcher, A., Jaffry, S., Thébaud, O., & Bennett, E. (2000). Normative and social influences affecting compliance with fishery regulations normative. *Land Economics*, 76(3), 448–461. <https://doi.org/10.2307/3147040>
- Hauck, M. (2008). Rethinking small-scale fisheries compliance. *Marine Policy*, 32(4), 635–642. <https://doi.org/10.1016/j.marpol.2007.11.004>
- Hinsley, A., Nuno, A., Keane, A. M., St John, F., & Ibbett, H. (2019). Asking sensitive questions using the unmatched count technique: Applications and guidelines for conservation. *Methods in Ecology and Evolution*, 10(3), 308–319. <https://doi.org/10.1111/2041-210X.13137>
- Isaacs, M., & Witbooi, E. (2015). Fisheries crime, food security and small scale fisheries in South Africa: Is it a case of bigger fish to fry? *Marine Policy*, 105, 1–11. <https://doi.org/10.1016/j.marpol.2018.12.023>
- Ishoy, G. A. (2016). The theory of planned behavior and policing: How attitudes about behavior, subjective norms, and perceived behavioral control affect the discretionary enforcement decisions of police officers. *Criminal Justice Studies*, 29(4), 345–362. <https://doi.org/10.1080/1478601X.2016.1225362>
- Jentoft, S. (1989). Fisheries co-management. Delegating government responsibility to fishermen's organizations. *Marine Policy*, 13(2), 137–154. <https://doi.org/10.1016/j.gerinurse.2014.03.003>
- Keane, A. M., Jones, J. P. G., Edwards-Jones, G., & Milner-Gulland, E. J. (2008). The sleeping policeman: Understanding issues of enforcement and compliance in conservation. *Animal Conservation*, 11(2), 75–82. <https://doi.org/10.1111/j.1469-1795.2008.00170.x>
- Keane, A., Jones, J. P. G., & Milner-Gulland, E. J. (2011). Encounter data in resource management and ecology: Pitfalls and possibilities. *Journal of Applied Ecology*, 48(5), 1164–1173. <https://doi.org/10.1111/j.1365-2664.2011.02034.x>
- King, D. M., & Sutinen, J. G. (2010). Rational noncompliance and the liquidation of Northeast groundfish resources. *Marine Policy*, 34(1), 7–21. <https://doi.org/10.1016/j.marpol.2009.04.023>
- Kinney, J. B., Brantingham, P. L., Wuschke, K., Kirk, M. G., & Brantingham, P. J. (2008). Crime attractors, generators and detractors: Land use and urban crime opportunities. *Built Environment*, 34(1), 62–74. <https://doi.org/10.2148/benv.34.1.62>
- Kuk, Anthony YC (1990). Asking sensitive questions indirectly. *Biometrika*, 77(2), 436–438. <https://doi.org/10.1093/biomet/77.2.436>

- Kuperan, K., & Sutinen, J. G. (1998). Blue water crime: Deterrence, legitimacy, and compliance in fisheries. *Law & Society Review*, 32(2), 309. <https://doi.org/10.2307/827765>
- Kurland, J., & Pires, S. F. (2017). Assessing U.S. wildlife trafficking patterns: How criminology and conservation science can guide strategies to reduce the illegal wildlife trade. *Deviant Behavior*, 38(4), 375–391. <https://doi.org/10.1080/01639625.2016.1197009>
- Kurland, J., Pires, S. F., McFann, S. C., & Moreto, W. D. (2017). Wildlife crime: A conceptual integration, literature review, and methodological critique. *Crime Science*, 6(4), 1–15. <https://doi.org/10.1186/s40163-017-0066-0>
- Lavender, J. M., & Anderson, D. A. (2009). Effect of perceived anonymity in assessments of eating disordered behaviors and attitudes. *International Journal of Eating Disorders*, 42(6), 546–551. <https://doi.org/10.1002/eat.20645>
- Leader-Williams, N., & Milner-Gulland, E. J. (1993). Policies for the enforcement of wildlife laws: The balance between detection and penalties in Luangwa Valley, Zambia. *Conservation Biology*, 7(3), 611–617. <https://doi.org/10.1046/j.1523-1739.1993.07030611.x>
- Lensvelt-Mulders, G. J. L. M., Hox, J. J., van der Heijden, P. G. M., & Maas, C. J. M. (2005). Meta-analysis of randomized response research. *Sociological Methods & Research*, 33(3), 319–348. <https://doi.org/10.1177/0049124104268664>
- Levi, M., Sacks, A., & Tyler, T. (2009). Conceptualizing legitimacy, measuring legitimating beliefs. *American Behavioral Scientist*, 53(3), 354–375. <https://doi.org/10.1177/0002764209338797>
- Lewis, S. G. (2015). Bags and tags: Randomized response technique indicates reductions in illegal recreational fishing of red abalone (*Haliotis rufescens*) in Northern California. *Biological Conservation*, 189, 72–77. <https://doi.org/10.1016/j.biocon.2014.09.024>
- Lindkvist, E., Basurto, X., & Schlüter, M. (2017). Micro-level explanations for emergent patterns of self-governance arrangements in small-scale fisheries – A modeling approach. *PLoS One*, 12(4), 1–23. <https://doi.org/10.1371/journal.pone.0175532>
- Lindley, J., & Techera, E. (2019). Using routine activity theory to explain illegal fishing in the Indo-Pacific. In S. Hufnagel, & A. Moiseienko (Eds.), *Criminal networks and law enforcement (Criminal N)*. Abingdon, UK: Routledge.
- Mackay, M., Jennings, S., van Putten, E. I., Sibly, H., & Yamazaki, S. (2018). When push comes to shove in recreational fishing compliance, think 'nudge'. *Marine Policy*, 95, 256–266. <https://doi.org/10.1016/j.marpol.2018.05.026>
- Mahon, R., McConney, P., & Roy, R. N. (2008). Governing fisheries as complex adaptive systems. *Marine Policy*, 32(1), 104–112. <https://doi.org/10.1016/j.marpol.2007.04.011>
- Marteache, N., Viollaz, J., & Petrossian, G. A. (2015). Factors influencing the choice of a safe haven for offloading illegally caught fish: A comparative analysis of developed and developing economies. *Crime Science*, 4(32). <https://doi.org/10.1186/s40163-015-0045-2>
- McDonald, G., Mangin, T., Thomas, L. R., & Costello, C. J. (2016). Designing and financing optimal enforcement for small-scale fisheries and dive tourism industries. *Marine Policy*, 67, 105–117. <https://doi.org/10.1016/j.marpol.2016.02.003>
- Milner-Gulland, E. J., & Clayton, L. (2002). The trade in babirusas and wild pigs in North Sulawesi, Indonesia. *Ecological Economics*, 42(1–2), 165–183. [https://doi.org/10.1016/S0921-8009\(02\)00047-2](https://doi.org/10.1016/S0921-8009(02)00047-2)
- Milner-Gulland, E. J., & Leader-Williams, N. (1992). A model of incentives for the illegal exploitation of black rhinos and elephants: Poaching pays in Luangwa Valley, Zambia. *Journal of Applied Ecology*, 29(2), 388–401.
- Moreto, W. D., & Lemieux, A. M. (2015). From CRAVED to CAPTURED: Introducing a product-based framework to examine illegal wildlife markets. *European Journal on Criminal Policy and Research*, 21(3), 303–320. <https://doi.org/10.1007/s10610-014-9268-0>
- Muller, M. R., Oyanedel, R., & Monteferrri, B. (2019). *Marine and fisheries policies in Latin America: A comparison of selected countries*. Abingdon, UK: Routledge.
- Nielsen, J. R. (2003). An analytical framework for studying: Compliance and legitimacy in fisheries management. *Marine Policy*, 27(5), 425–432. [https://doi.org/10.1016/S0308-597X\(03\)00022-8](https://doi.org/10.1016/S0308-597X(03)00022-8)
- Nielsen, J. R., & Mathiesen, C. (2003). Important factors influencing rule compliance in fisheries lessons from Denmark. *Marine Policy*, 27(5), 409–416. [https://doi.org/10.1016/S0308-597X\(03\)00024-1](https://doi.org/10.1016/S0308-597X(03)00024-1)
- O'Kelly, H. J., Rowcliffe, J. M., Durant, S. M., & Milner-Gulland, E. J. (2018a). Robust estimation of snare prevalence within a tropical forest context using N-mixture models. *Biological Conservation*, 217, 75–82. <https://doi.org/10.1016/j.biocon.2017.10.007>
- O'Kelly, H. J., Rowcliffe, J. M., Durant, S., & Milner-Gulland, E. J. (2018b). Experimental estimation of snare detectability for robust threat monitoring. *Ecology and Evolution*, 8(3), 1778–1785. <https://doi.org/10.1002/ece3.3655>
- Ostrom, E. (1990). *Governing the commons: The evolution of institutions for collective action*. Cambridge, UK: Cambridge University Press.
- Oyanedel, R., Gelcich, S., & Milner-Gulland, E. J. (2020). Motivations for (non-) compliance with conservation rules by small-scale resource users. *Conservation Letters*, e12725. <https://doi.org/10.1111/conl.12725>
- Oyanedel, R., Keim, A., Castilla, J. C., & Gelcich, S. (2018). Illegal fishing and territorial user rights in Chile. *Conservation Biology*, 32(3), 619–627. <https://doi.org/10.1111/cobi.13048>
- Paternoster, R. (2010). How much do we really know about criminal deterrence? *Journal of Criminal Law and Criminology*, 100(3), 765–824. <https://doi.org/10.4324/9781315258089-2>
- Perkins, H. W., & Berkowitz, A. D. (1986). Perceiving the community norms of alcohol use among students: Some research implications for campus alcohol education programming. *Substance Use and Misuse*, 21(9–10), 961–976. <https://doi.org/10.3109/10826088609077249>
- Petrossian, G. A. (2015). Preventing illegal, unreported and unregulated (IUU) fishing: A situational approach. *Biological Conservation*, 189, 39–48. <https://doi.org/10.1016/j.biocon.2014.09.005>
- Petrossian, G. A. (2018). A micro-spatial analysis of opportunities for IUU fishing in 23 Western African countries. *Biological Conservation*, 225, 31–41. <https://doi.org/10.1016/j.biocon.2018.06.011>
- Petrossian, G. A., & Clarke, R. V. (2014). Explaining and controlling illegal commercial fishing: An application of the craved theft model. *British Journal of Criminology*, 54(1), 73–90. <https://doi.org/10.1093/bjc/azt061>
- Petrossian, G. A., & Marteache, N. (2018). Environmental criminological perspectives on illegal, unreported, and unregulated fishing. In W. D. Moreto (Ed.), *Wildlife crime: From theory to practice*, (38–61). Philadelphia, PA: Temple University Press.
- Petrossian, G. A., Marteache, N., & Viollaz, J. (2015). Where do “undocumented” fish land? An empirical assessment of port characteristics for IUU fishing. *European Journal on Criminal Policy and Research*, 21(3), 337–351. <https://doi.org/10.1007/s10610-014-9267-1>
- Petrossian, G. A., & Pezzella, F. S. (2018). IUU fishing and seafood fraud: Using crime script analysis to inform intervention. *Annals of the American Academy of Political and Social Science*, 679(1), 121–139. <https://doi.org/10.1177/0002716218784533>
- Petrossian, G. A., Weis, J. S., & Pires, S. F. (2015). Factors affecting crab and lobster species subject to IUU fishing. *Ocean and Coastal Management*, 106, 29–34. <https://doi.org/10.1016/j.ocecoaman.2015.01.014>
- Ramcilovic-Suominen, S., & Epstein, G. (2012). Towards an analytical framework for forest law compliance. *International Forestry Review*, 14(3), 326–336. <https://doi.org/10.1505/146554812802646611>
- Ramcilovic-Suominen, S., & Epstein, G. (2015). The impacts of deterrence, social norms and legitimacy on forest rule compliance in Ghana.

- Forest Policy and Economics*, 55, 10–20. <https://doi.org/10.1016/j.forpol.2015.03.006>
- Ramcilovic-Suominen, S., & Hansen, C. P. (2012). Why some forest rules are obeyed and others violated by farmers in Ghana: Instrumental and normative perspective of forest law compliance. *Forest Policy and Economics*, 23, 46–54. <https://doi.org/10.1016/j.forpol.2012.07.002>
- Sampson, R. J., & Groves, W. B. (1989). Community structure and crime: Testing social-disorganization theory. *American Journal of Sociology*, 94(4), 774–802. <https://doi.org/10.1086/229068>
- Shirley, E. A., & Gore, M. L. (2019). Trust in scientists and rates of non-compliance with a fisheries rule in the Brazilian Pantanal. *PLoS One*, 14(3), 1–16. <https://doi.org/10.1371/journal.pone.0207973>
- Shrestha, S. K., Burns, R. C., Pierskalla, C. D., & Selin, S. (2012). Predicting deer hunting intentions using the theory of planned behavior: A survey of Oregon big game hunters. *Human Dimensions of Wildlife*, 17(2), 129–140. <https://doi.org/10.1080/10871209.2012.649885>
- Solomon, J. N., Gavin, M. C., & Gore, M. L. (2015). Detecting and understanding non-compliance with conservation rules. *Biological Conservation*, 189, 1–4. <https://doi.org/10.1016/j.biocon.2015.04.028>
- Song, A. M., Scholtens, J., Barclay, K., Bush, S. R., Fabinyi, M., Adhuri, D. S., & Haughton, M. (2020). Collateral damage? Small-scale fisheries in the global fight against IUU fishing. *Fish and Fisheries*, 21, 831–843. <https://doi.org/10.1111/faf.12462>
- St John, F., Keane, A. M., & Milner-Gulland, E. J. (2013). Effective conservation depends upon understanding human behaviour. In D. W. Macdonald, & K. Willis (Eds.), *Key topics in conservation biology* 2, (344–361). Oxford, UK: Wiley-Blackwell.
- Sumaila, U. R., Alder, J., & Keith, H. (2006). Global scope and economics of illegal fishing. *Marine Policy*, 30(6), 696–703. <https://doi.org/10.1016/j.marpol.2005.11.001>
- Sutinen, J. G., & Andersen, P. (1985). The economics of fisheries law enforcement. *Land Economics*, 61, 387. <https://doi.org/10.2307/3146156>
- Sutinen, J. G., & Kuperan, K. (1999). A socio-economic theory of regulatory compliance. *International Journal of Social Economics*, 26(1–3), 174–193. <https://doi.org/10.1108/03068299910229569>
- 't Sas-Rolfes, M., Challender, D. W. S., Hinsley, A., Veríssimo, D., & Milner-Gulland, E. J. (2019). Illegal wildlife trade: Scale, processes, and governance. *Annual Review of Environment and Resources*, 44(1), 201–228. <https://doi.org/10.1146/annurev-environ-101718-033253>
- Thiault, L., Weekers, D., Curnock, M., Marshall, N., Pert, P. L., Beeden, R., ... Claudet, J. (2020). Predicting poaching risk in marine protected areas for improved patrol efficiency. *Journal of Environmental Management*, 254, 109808. <https://doi.org/10.1016/j.jenvman.2019.109808>
- Thomas, A. S., Milfont, T. L., & Gavin, M. C. (2016). A new approach to identifying the drivers of regulation compliance using multivariate behavioural models. *PLoS One*, 11(10), 1–12. <https://doi.org/10.1371/journal.pone.0163868>
- Tyler, T. R. (1990). *Why people obey the law*. Princeton, NJ: Princeton University Press.
- Underwood, F. M., Burn, R. W., & Milliken, T. (2013). Dissecting the illegal ivory trade: An analysis of ivory seizures data. *PLoS One*, 8(10), e76539. <https://doi.org/10.1371/journal.pone.0076539>
- Von Essen, E., Hansen, H. P., Nordström Källström, H., Peterson, M. N., & Peterson, T. R. (2014). Deconstructing the poaching phenomenon. *British Journal of Criminology*, 54(4), 632–651. <https://doi.org/10.1093/bjc/azu022>
- Weekers, D. P., & Zahnow, R. (2018). Risky facilities: Analysis of illegal recreational fishing in the Great Barrier Reef Marine Park, Australia. *Australian and New Zealand Journal of Criminology*, 52(2), 368–389.
- Weekers, D. P., Zahnow, R., & Mazerolle, L. (2019). Conservation criminology: Modelling offender target selection for illegal fishing in marine protected areas. *British Journal of Criminology*, 59(6), 1455–1477. <https://doi.org/10.1093/bjc/azy074>
- Weisburd, D. (2018). Hot spots of crime and place-based prevention. *Criminology and Public Policy*, 17(1), 5–25. <https://doi.org/10.1111/1745-9133.12350>
- Wells, M. (1992). Biodiversity conservation, affluence and poverty: Mismatched costs and benefits and efforts to remedy them. *Ambio*, 21, 237–243. <https://doi.org/10.2307/4313933>
- Wortley, R., & Townsley, M. (2016). *Environmental criminology and crime analysis* (2nd ed.). New York, NY: Routledge.

How to cite this article: Oyanedel R, Gelcich S, Milner-Gulland EJ. A synthesis of (non-)compliance theories with applications to small-scale fisheries research and practice. *Fish Fish*. 2020;21:1120–1134. <https://doi.org/10.1111/faf.12490>