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Understanding and managing compliance in the nature conservation context

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Abstract:

Nature conservation relies largely on peoples' rule adherence. However, noncompliance in the conservation context is common: it is one of the largest illegal activities in the world, degrading societies, economies and the environment. Understanding and managing compliance is key for ensuring effective conservation, nevertheless crucial concepts and tools are scattered in a wide array of literature. Here I review and integrate these concepts and tools in an effort to guide compliance management in the conservation context. First, I address the understanding of compliance by breaking it down into five key questions: who?, what?, when?, where? and why?. A special focus is given to 'why?' because the answer to this question explains the reasons for compliance and noncompliance, providing critical information for management interventions. Second, I review compliance management strategies, from voluntary compliance to coerced compliance. Finally, I suggest a system, initially proposed for tax compliance, to balance these multiple compliance management strategies. This paper differs from others by providing a broad yet practical scope on theory and tools for understanding and managing compliance in the nature conservation context.

Keywords:

Enforcement; conservation; illegal resource use; poaching; natural resource management; behaviour

1. Introduction

Central to nature conservation, from species to ecosystem scales, is the regulation of human activities. Countless regulations are set towards nature conservation; however, noncompliance is often the rule rather than the exception. Illegal wildlife trade; illegal, unreported and unregulated fishing; and illegal timber trade are amongst the largest illicit activities in the world (Haken, 2011). The impacts of noncompliance in the conservation context can be broad. Illegal fishing, for example, affects food security, causes the loss of millions of dollars of catch, and drives overexploitation and environmental degradation (MRAG, 2005). Impacts from noncompliance can be extreme, driving extinctions (Branch et al., 2013; Wilkie et al., 2011), and even the death of poachers and the murder of rangers (Dudley et al., 2013). Surprisingly, compliance receives relatively little focus in the conservation literature when compared to other aspects of conservation. However, key concepts and tools that help understand and manage compliance are dispersed in a wide array of literature, including sociology and economics. This review is aimed at conservation practitioners¹, and it expands on recent contributions by integrating key concepts and tools from other disciplines.

Here, compliance means adherence to rules related to natural resource use and conservation. Compliance can be interpreted as dichotomous or as a gradation of behaviour. As a dichotomy, the term compliance refers to whether a person or system adheres to rules or not. More realistically, as a gradation, compliance refers to the degree of adherence to rules, as when a person breaks some rules but not all, or respects rules most of the time, but not always. A gradation of compliance could be represented by continuous values or categories such as ‘high’, ‘medium’ or ‘low’. So the words ‘compliance’ and ‘noncompliance’ are opposites that, as a dichotomy, allow only two values, or lie at either end of a gradation and allow intermediate values.

Compliance management is improved by understanding the factors describing and causing compliance. Here I explore compliance using the Kiping Method or 5W’s (who?, what?, where?, when?, and—perhaps the most vital—why?). I consider each of the W’s, focusing on ‘why?’, and then suggest a system for managing compliance (Figure 1). Because of the breadth of compliance in the nature conservation context this is not intended to be an exhaustive review, but rather one that enriches the literature, and facilitates discussion and, most importantly—action.

¹ “Practitioners are managers, researchers, and local stakeholders who are responsible for designing, managing, and monitoring conservation and development projects” (Margoluis & Salafsky, 1998, p. 7)

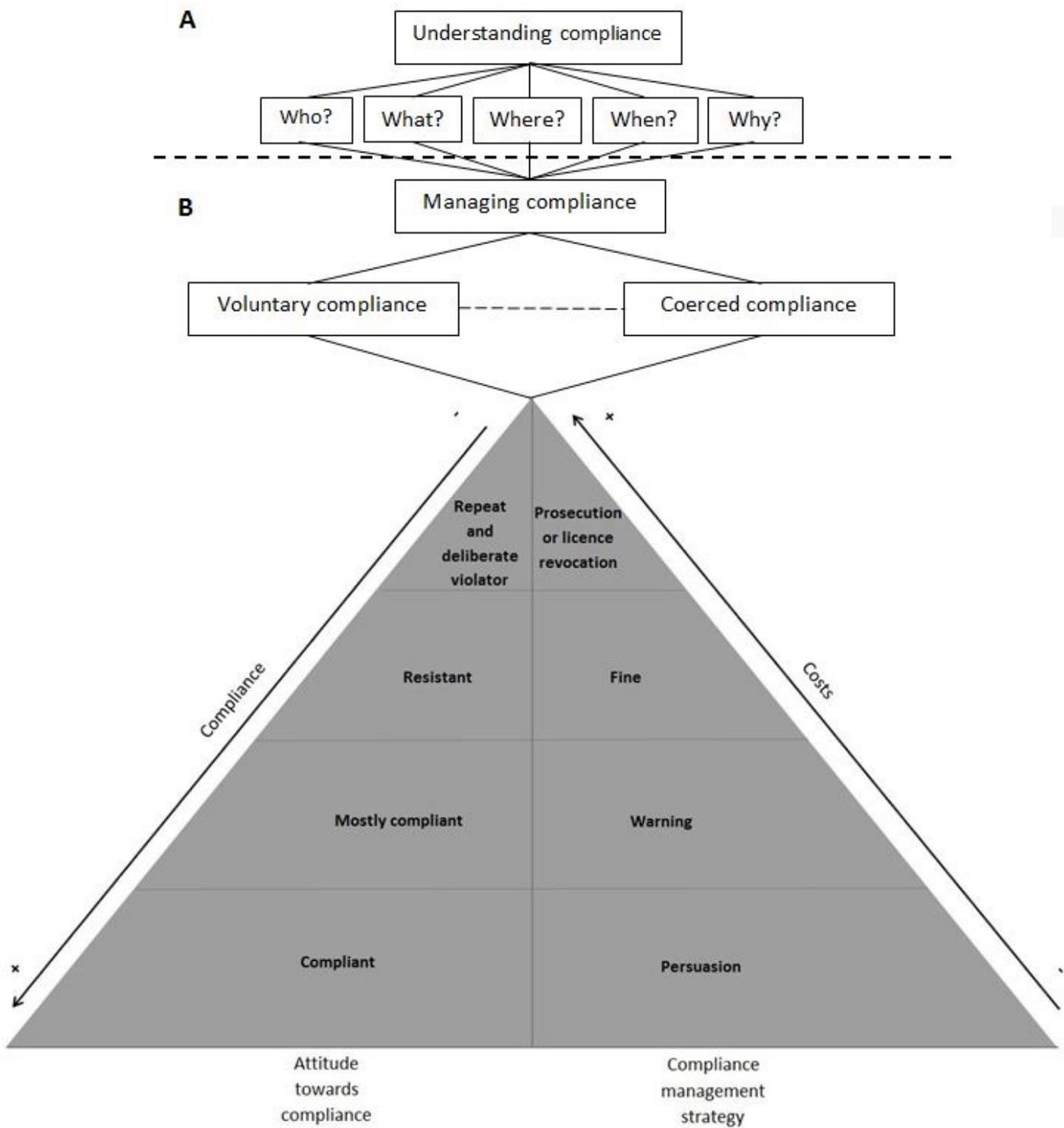


Figure 1. Heuristic of a system for (A) understanding and (B) managing compliance.

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2. Understanding compliance

2.1 The 5W's

Journalists and law enforcement officers typically use the 5W's to gather a complete story. Here I use the same tool, breaking down compliance in the following questions, with no particular order: 1) Who complies (or not)?; 2) What is the noncompliance act?; 3) Where is noncompliance occurring?; 4) When is noncompliance occurring?; and 5) Why is compliance (or noncompliance) occurring?

2.1.1 Who complies or not?

Management interventions can be focused when compliers or noncompliers are known. The answer to this question is usually multilayered. For example: Is it a particular community engaging in illegal activities or a particular group within the community? Several people or just one person? Are they male or female, young or old? Some studies have made these distinctions. In the Calamianes Islands, Philippines, Fabinyi (2007) found that local young males were more likely to fish illegally. Likewise, Cinner (2010) found that the poor were more likely to use illegal destructive fishing gear in Kenya and Tanzania. Noncompliance can also be driven by outsiders (Berkes et al., 2006; Leader-Williams et al., 1990), requiring special attention when designing interventions such as patrols, investigations and awareness campaigns.

Complicity can add layers to this question. Referring to the previous example from the Philippines, one might discover a bigger story when investigating who is an accomplice: who is providing the cyanide that the young illegal fishermen use? And who buys the illegal catch from them? These questions are relevant for compliance management. For instance, campaigns condemning the consumption of wildlife products such as shark fins (Dell' Apa et al., 2014) and ivory (Stiles, 2004) are common. Such campaigns appeal to consumers, raising awareness on facts such as cruelty, and the social or environmental impacts of consuming these products. Similarly, knowing who deals illegal natural resources might be more effective than focusing on immediate noncompliers in the field. Clayton et al. (1997) explain how it can be easier to deter the illegal hunting of a wild pig in Indonesia by focusing on markets and road checks rather than by patrolling the forests for poachers. Additionally, by reducing demand, illegal hunting becomes less profitable for poachers. Unravelling the complicity chain can provide a complete notion of the situation and improve compliance management.

Knowing who complies can also be beneficial. Compliers can provide useful information and positively affect compliance by acting, consciously or not, as enforcers. In Zambia, Jachmann and Billiow (1997) report the success of an enforcement system using investigations aided by cash rewards for information that led to arrests or confiscations. Using this system, arrests became four times more cost effective than foot patrols (Jachmann & Billiow, 1997). In the Great Barrier Reef Marine Park, Australia, people can report illegal activities seen within the Park, such as littering and taking more than the approved number of

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tourists to an area (GBRMPA, 2014). Such reporting mechanisms provide a means of self-enforcement, urging some to comply. Understanding compliers, their traits and motivations, proves particularly useful when trying to answer ‘Why is compliance occurring?’

2.1.2 What is the noncompliance act?

The answer to this question should explain what is being done illegally and in what way (or how). In some cases this can be a simple question to answer. Imagine tourists walking off-track in a protected area. ‘Tourists’ is a broad description for ‘who?’, and should ideally be unpacked to provide more information (e.g., nationality and age), but the noncompliance act (‘what?’) is simple to describe (i.e., ‘walking off-track’) and cannot be unpacked. Nonetheless, sometimes the noncompliance act can be further described. For example, if fishing is the noncompliance act an answer to this question should include the method or gear being used and the target species.

Knowing the methods used for noncompliance can be highly relevant. In case of extractive uses such as hunting and fishing, selectivity is commonly given by the methods used. Methods such as wire snares or nets can be set for targeting particular species, but their selectivity is low and can result in considerable levels of unintended catch. Becker et al. (2013) evaluated wire snare poaching in Zambia and concluded that snares increased the mortality of elephant, lion and wild dogs—all non-target threatened species. Knowledge of the methods used and the species being affected can help estimate the environmental impact of noncompliance and can inform interventions.

2.1.3 Where is the noncompliance occurring?

Knowing the location of noncompliance advises where interventions should be focused. The place where noncompliance occurs can be from geographically widespread (e.g., illegal logging (Laurance, 1998)) to localized (e.g., point pollution in a river). The location of noncompliance can correspond to factors such as features that concentrate flora or fauna (e.g., watering holes, seamounts), isolated places, places near communities or areas of high tourism visitation. Monitoring and the analysis of patrol records can help establish these locations. However, sometimes determining the source location of noncompliance could involve more complex investigations. An example is the illegal trade of plants, animals and their derivatives, where investigations can include intelligence and wildlife DNA forensics—a tool that can establish the species its geographical origin (Ogden et al., 2009). Illegal trade highlights the importance of monitoring and influencing markets, and having the legal tools to sanction those involved at various scales.

2.1.4 When is the noncompliance act occurring?

Knowing the time or frequency of noncompliance helps optimize interventions, particularly patrols. Noncompliance can be opportunistic (Eliason & Dodder, 1999; Milner-Gulland & Leader-Williams, 1992), but it can also respond to natural variables or management actions. When analysing illegal fishing in a marine protected area Arias et al. (2014) found that illegal fishing was more likely to occur around the new moon of the third quarter of the year. The combination of time of the year and lunar phase was likely to

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maximize illegal catch because of oceanographic and ecological reasons. By knowing what the noncompliance act is practitioners could elicit when these acts are occurring because of factors such as seasonality (e.g., vacations, migrations, aggregations) or diel patterns (e.g., nocturnal vs diurnal activity).

Noncompliers are likely to adopt strategies to evade detection, such as acting at night, or when patrols are limited or inexistent. This might have been the case with the previous example—the new moon involves darker nights, potentially reducing the probability of detecting incursions (Arias et al., 2014). Also, noncompliers can learn about the timing and location of patrols. A way to counter this problem is by integrating a degree of randomness in patrols and performing systematic and periodic analyses of patrol records.

2.1.5 Why is compliance or noncompliance occurring?

The previous points described compliance; this point focuses on explaining it. Prior W's clearly define the behaviour (Ajzen & Fishbein, 2005)—they define WHO is doing WHAT, WHEN and WHERE. Finally, 'why?' explains the behaviour.

Practitioners should identify and address the specific factors that are salient for maintaining or improving (hereafter: influencing) compliance (Ham, 2013; St. John et al., 2010). Practitioners will typically benefit more when understanding what influences compliance rather than what influences noncompliance, because compliance is the desired behaviour. However, understanding why people break rules could also help contextualize the problem and design solutions. It is important to clarify that knowing why someone follows a rule is not necessarily the opposite of knowing why someone breaks it. For instance, if some people fish illegally in an area because they believe the area holds more fish, it would be invalid to assume that those who comply do so because they think that there are less fish in the closed area (Arias & Sutton, 2013). Management interventions can have better chances of being successful when the factors influencing compliance are understood.

Perhaps the main reason for why useful information about compliance is distributed so widely in the literature (e.g., sociology, criminology, anthropology, psychology, economics) is because compliance is highly relevant for many fields. Compliance is critical for a functional society. Consequently, there is a long history of trying to understand compliance. In 1775 Cesare Beccaria presented a theory that sparked the field of criminology. Beccaria's theory is that people take rational choices to maximize pleasure and reduce pain, and by doing so they can break rules (Cullen & Agnew, 2006). He proposed that sanctions are necessary, but to be effective these must be clear, well known, proportionate to the offense, quick, and certain. This theory stood alone for nearly a century, influencing reforms in Europe and USA, but was challenged in 1876 by Cesare Lombroso (Cullen & Agnew, 2006). Lombroso, a physician, believed that criminals could be identified by observable physical traits, a theory that was followed by others and later led to eugenics (Winfrey & Abadinsky, 2009). Lombroso's theory was rejected, but he is credited for pioneering the use of the scientific method to explore crime. Some of Beccaria's ideas also persist, such as the responsibility that each person holds for their actions and how the certainty of sanctions reflects on crime (Cullen & Agnew, 2006). Recent theories suggest that compliance is

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explained by a combination of factors such as economics and social norms (Cullen & Agnew, 2006; Tyler, 1990).

The factors influencing compliance have been widely studied in the behavioural sciences. Fishbein and Ajzen (2010) offer a highly popular model for predicting, explaining and changing behaviour: the Reasoned Action Model (also known as Theory of Planned Behaviour). The model suggests that three beliefs drive a person's intention to behave, in this case comply, or not. The three beliefs are behavioural beliefs, normative beliefs, and control beliefs. Behavioural beliefs relate to the positive or negative consequences associated to the behaviour (e.g., 'If I comply I will not get punished by the law'). Normative beliefs are the social pressures controlling a person's behaviour (e.g., 'Noncompliance is unacceptable in my social circles'). Control beliefs are factors that ease or hinder behaviour (e.g., 'I don't have the skill or resources to be noncompliant'). So if a person believes that it is easy to comply, that complying will have a positive outcome, and that compliance will be well received by others, there will be a strong intention to comply. There are other theories that can help explain compliance (see for example: Maslow, 1943; Rogers, 1975). However, here I focus on the Reasoned Action Model because it is simple and effective (Beck & Ajzen, 1991; Kaiser et al., 2005).

Behavioural beliefs are people's evaluation of the benefits vs. costs of a specific behaviour. For instance, if a hunter concludes that the consequences of complying with hunting regulations are mostly positive or beneficial (e.g., healthier game populations) the hunter's attitude towards that behaviour will be positive, and vice versa. Several practitioners focus on the behavioural component of compliance, particularly coercion (Becker, 1974; Hauck & Kroese, 2006; Kalron, 2013; Peluso, 1993). Coercion acts as a negative incentive, making actors evaluate the potential benefits and costs of noncompliance and compliance. But positive incentives can also be used to strengthen compliance by influencing behavioural beliefs.

The normative component is particularly important for determining compliance (Tyler, 1990), and it deserves special attention considering that people typically behave in accordance to norms. Cialdini et al. (1991) distinguish three types of norms: personal, descriptive, and injunctive. Personal norms are the moral obligations for engaging or not in a behaviour, with internal sanctions and rewards for doing so (Schwartz, 1973). Descriptive and injunctive norms are social norms that rely on sensed external cues. Descriptive norms are what most others do, whereas injunctive norms are what most others approve or disapprove. So descriptive norms inform behaviours while injunctive norms prescribe and proscribe them (Cialdini et al., 1990).

Personal norms are not part of the Reasoned Action Model but some authors have integrated them into the Model (Harland et al., 1999), and into other, more complex, models (Klößner, 2013). The Reasoned Action Model is a general model of human behaviour, and Fishbein and Ajzen (2010) suggest that, with some exceptions, personal norms do not add explanatory power to their Model. However, exceptions where personal norms help explain behaviour are proenvironmental and prosocial behaviour (Harland et al., 1999, 2007; Schwartz, 1977)—hence, personal norms are relevant for compliance. Feeling morally obliged to comply or regretting noncompliance are examples of how personal norms can

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influence compliance and how these norms can be measured in social surveys (Harland et al., 2007). Also, research shows that long lasting behavioural change can be achieved through personal norms (Matthies et al., 2006). Once personal norms are activated people are likely to engage in positive behaviours because ‘it is the right thing to do’. While not all compliance with environmental rules is driven by morality and altruism some clearly is, therefore practitioners should consider personal norms when trying to understand and influence compliance. Social norms are also highly relevant for compliance because people typically behave according to the behaviour of others (Schultz et al., 2007).

Social norms act as rules guiding behaviour. For instance, there are fishing communities in Indonesia where people do not fish on Fridays because of their religious beliefs (Cinner et al., 2012a). Compliance with these rules can be enforced through social ostracism (Colding & Folke, 2001; Sumner, 1906). Social norms, however, are not necessarily weaker or less effective than formal rules. In fact, long-standing social norms regulating natural resource use can be weakened by the superimposition of formal laws, bringing negative social and environmental impacts. Jones et al. (2008) describe multiple social norms regulating terrestrial natural resource use in Madagascar, and mention that these social norms can be preferable to formal laws that can be poorly enforced by the state. Similarly, Gelcich et al. (2006) argue that the effectiveness of a system to manage kelp and mollusc extraction in Chile faded when it transitioned from a traditional access right system to a government-led co-management system. Compliance dwindled, and ecological resilience and social bonds were weakened. Informal rules and institutions can provide effective conservation and social outcomes.

The effect of social norms on pro-environmental behaviour and compliance is well-studied. Cialdini et al. (1990) assessed the impact that descriptive and injunctive norms have on littering in public spaces. Their results show that the presence of litter encourages further littering. This occurs because the presence of litter generates a descriptive norm of what most other people do, so a highly littered place translates to ‘littering is normal’. To assess the effect of the injunctive norm, researchers placed handbills on car windshields, handbills had messages with varying degrees of proximity to the injunctive norm against littering (i.e., do not litter, recycle, turn out lights, vote, celebrate arts month). By surreptitiously observing people’s behaviour when they reached their cars, researchers noticed that littering of the handbills decreased as the message on the handbill got closer or was identical to the injunctive norm against littering. In other words, people who received handbills with the injunctive message against littering were the least likely to litter the handbill, while those who received the handbill with the message about celebrating arts months were most likely to litter the handbill. This result underlines the importance of delivering specific messages aimed at clearly defined behaviours. General messages (e.g., the typical ‘Save the environment’) are ineffective. Furthermore, poorly designed management interventions aimed at influencing norms can even be counterproductive. For example, signage at a beach with a descriptive statement that ‘Tons of seashells are stolen every year...’ tells visitors that ‘everyone does it’, and could actually increase seashell theft (Cialdini, 2003). These examples demonstrate the relevance of understanding what drives compliance for creating influential interventions.

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Lastly, control beliefs—people’s perceptions of what can ease or hinder a particular behaviour—can also influence compliance. Examples of control beliefs are knowledge, skills, time, money, weather and equipment. While some control beliefs cannot be managed by the governing institution (e.g., weather), others can be identified and addressed. Knowledge, for instance, is typically used to foster desirable behaviours. In a meta-analysis of recycling behaviour Hornik et al. (1995) found that consumer knowledge about recycling was the strongest predictor of recycling. Nevertheless, another control belief such as the lack of a recycling program can act as a strong barrier against recycling, even for a person with overall strong and positive beliefs about recycling. Thus, an institution that wants to foster a particular behaviour can provide knowledge on why and how to perform it, but should, if possible, also offer services or facilities to ease behaviour performance. Managing institutions can apply one or multiple interventions to either facilitate or obstruct peoples’ control over a particular behaviour. Interventions can have varying degrees of complexity and success. For instance, a managing institution can use brochures or signs to inform about the illegality of using particular gear; information can remove knowledge barriers (e.g., people not knowing about the regulation). Another intervention could be aimed at banning the possession and importation of particular gear (e.g., spearguns in Seychelles), obstructing access to that gear. However, in some cases illegal gear can be cheap and simple to build (e.g., wire snares). Interventions are context specific, just as the relative importance of control beliefs, normative beliefs and behavioural beliefs.

To answer ‘why?’ social surveys are required, although modelling can be used to understand the implications of different motivations for compliance or noncompliance (Table 1). The popularity of the Reasoned Action Model makes it easily accessible, and by including personal norms it is a powerful tool for understanding compliance. There are guides for the application of the Model and the subsequent crafting of interventions (Fishbein & Manfredo, 1992; Ham, 2013), including freely available material (Ajzen, 2013; Ham et al., 2009; Ham et al., 2008). The need for social sciences to understand and manage compliance stresses the fact that conservation is mainly about managing people—not plants, animals or landscapes (Balmford & Cowling, 2006; Schultz, 2011).

- **Additional considerations: Magnitude of compliance**

Low compliance can render a rule ineffective, so high compliance is desired. However, the magnitude of compliance must be defined. It is simplistic to think that the magnitude of compliance is based on the number of people complying or not. For example, consider a forest that has two people logging illegally. The same two loggers can have very different impacts depending on factors such as the characteristics of the forest, whether they use axes or chainsaws, or if they log trees once a year or daily. In this case the number of people, frequency, gear and location are key when considering the magnitude of compliance. ‘Who?’, ‘what?’, ‘when?’ and ‘where?’ can provide a robust estimate of the magnitude of compliance. Answering ‘who?’ qualitatively or quantitatively establishes the amount of noncompliers; ‘what?’ describes the action; ‘when’ describes the frequency of noncompliance; and ‘where’ describes the location (e.g., area and sensitivity). These four factors should be considered when evaluating the magnitude of compliance. However, sometimes it is only necessary to confirm the presence or absence of compliance, for example to determine someone as guilty or innocent.

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Rules are directed at targets (e.g., water, forests, and fish); therefore the magnitude of compliance could be estimated indirectly through measurable traits on those targets (e.g., water quality, forest coverage, and fish biomass). The magnitude of compliance can also be estimated through methods such as social surveys. This means that the magnitude of compliance can be established in several ways and it can have a multiple units of measurement (Table 1). The magnitudes of compliance can be used to establish baselines to monitor and evaluate interventions.

An example that illustrates the importance of fully describing compliance and its magnitude is fishers' exploitation of fish spawning aggregations. Several coral reef fish, such as the Nassau grouper (*Epinephelus striatus*), form large reproductive aggregations. These aggregations are predictable in space and time, and the species grows slowly and is late to mature. Hence, the Nassau grouper is highly vulnerable to overfishing. Noncompliance with conservation measures set for Nassau grouper have caused alarming population declines (Sadovy de Mitcheson et al., 2008). This species is typically spearfished by divers who know the time and place of these aggregations. Therefore, common methods for managing the Nassau grouper fishery are temporal and spatial closures, and speargun regulations.

2.2 Methods to study compliance

A particular obstacle exists when studying compliance with conservation regulations. Compliance is expected—morally, socially or legally. Hence, a high bias can result if inadequate methods are used to study compliance. When social surveys are used to gauge compliance, noncompliers could refuse to participate or provide deceitful responses. Nevertheless, several methods exist to circumvent these obstacles (Table 1). Practitioners can choose methods depending on which of the 5W's requires answers. Budget, labour demand and technological requirements also influence method selection (Gavin et al., 2010). Social surveys are typically the simplest method and can provide large amounts of information, but have the potential for response or non-response bias. However, they can be used in conjunction with additional elements that reduce bias (Jaccard & Blanton, 2005). Specialized questioning techniques (Table 1), ensuring confidentiality or anonymity, underlining the importance of accurate data, and using neutral interviewers (e.g., students instead of government staff) can all reduce bias in social surveys.

Table 1. Methods for studying compliance. Adapted from Bergseth et al. (2013) and Gavin et al. (2010).

Methods	Examples	Units	5 W's					References
			What	Why	When	Where	Who	
Social surveys	Expert elicitation, random response technique, perceived compliance, item count, self-reporting	proportions, likert scales, geographic, effort	✓	✓	✓	✓	✓	(Arias & Sutton, 2013; Cinner et al., 2012b; Nuno et al., 2013)
Modelling	predictions of illegal resource use and resource dynamics, spatiotemporal patterns	absolute measures (e.g., effort, biomass) and response ratios	✓	✓	✓	✓	✓	(Ainsworth et al., 2012; Jachmann & Billiow, 1997; Keane et al., 2012)
Law enforcement records	Foot or vehicle based patrol records, legal proceedings	number of detections, arrests/citations, prosecutions, absolute measures (e.g. time and area)	✓	×	✓	✓	✓	(Akella & Cannon, 2004; Arias et al., 2014; Holmern et al., 2007)
Direct observation	Surreptitious or open observation	number or proportion of detections, absolute measures, effort	✓	×	✓	✓	✓	(Cialdini et al., 1990; Davis et al., 2004; Schill & Kline, 1995)
Indirect observation	Discarded or set gear (e.g., traps, bullet casings), carcasses, animal behaviour, markets	absolute measures, flight initiation distance	✓	×	✓	✓	×	(Clayton et al., 1997; Januchowski-Hartley et al., 2012)
Remote sensing	Forest cover, satellite tracking, drones	absolute measures	✓	×	✓	✓	✓	(Brooke et al., 2010; Kuemmerle et al., 2009; Lein, 2009)
Forensic studies	Genetic and chemical analysis	absolute measures	✓	×	✓	✓	✓	(Mak et al., 2005; Ogden et al., 2009)

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3. Managing compliance

Not all people comply, and not all of them comply for the same reasons. Hence there is a need for comprehensive compliance management strategies, even when compliance is prevalent. Compliance can be voluntary or coerced, and each strategy should correspond to a particular type of individual: varying from the always compliant to the repeat and blatant offenders (Figure 1). Perverse outcomes can arise when a strategy is misapplied. For example, a hiker who unintentionally enters a closed area in a National Park by being unaware about the closure or unskilled at navigation would likely benefit from persuasive communication (e.g., signs, brochures or talks from rangers). However, a hunter who repeatedly and knowingly enters that same area would be more likely to comply if subjected with a punitive strategy (e.g., fine, gear confiscation, imprisonment). If these two strategies were applied inversely, the result would be business as usual for the illegal hunter, and an antagonized hiker. Understanding compliance helps the design and application of management strategies.

3.1 Voluntary compliance

Practitioners should aim for voluntary compliance. A high degree of voluntary compliance is preferred because it: 1) reflects that most users are assertive about the benefits of compliance, 2) provides a buffer when costly enforcement is paused (e.g., patrol unit breaks down) and 3) confirms effective governance and management. I define voluntary compliance as that which is performed purposefully as an act of approval with the rules or institutions, either when punishment is applicable or not. Levi (1989) uses the term 'quasi-voluntary compliance' when punishment is applicable to noncompliance, or as stated by Hart (1994, p. 198) 'voluntary cooperation in a coercive system'. The main tools used to promote voluntary compliance are legitimacy, incentives, alternatives, and persuasive communication.

3.1.1 Legitimacy

Voluntary compliance requires constant input from the regulating institution. Positive opinions about the regulating institution will generate a sense of legitimacy and in turn increase voluntary compliance (Tyler, 1990). Empirical studies in the conservation context support the value of legitimacy to influence compliance. McClanahan et al. (2006) mention the perception of legitimate regulations as the likely explanation for high compliance in the absence of regular enforcement in traditionally managed areas in Indonesia and Papua New Guinea. Hønneland (2000) reported similar conclusions when studying fishermen in the Barents Sea; some enforcement was necessary to ensure compliance, but it was not as significant as the perception of legitimate regulations, procedures and authorities.

A governing institution expects positive results on natural resources from rule compliance, for instance clean water and increased biomass. In exchange for their compliance, natural resource users will typically expect not only positive results on the natural resources, but also evidence of efforts on behalf of the governing institution to ensure those positive results. The perceived effectiveness and justness of the efforts done by the managing institution will dictate the degree of legitimacy granted to the institution (Levi et al., 2009). Regulating institutions can reduce or increase compliance through their actions.

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Some noncompliance for example can be explained as a response to what natural resource users believe is illegitimate (Stern, 2008). It is therefore the regulating institution's task to ensure legitimacy (Knopf & Dustin, 1992). This feedback loop calls for the inclusion of social, economic and political contexts in early stages of conservation initiatives (Ban et al., 2013).

3.1.2 Incentives

Incentives can take multiple forms, such as awards and public recognition, information and training, and monetary/financial incentives (Stonehouse, 1996). Incentives can be granted to regulators as well as natural resource users. Jachmann (2008) reports how rangers from different protected sites in Ghana improved work performance when they started competing against each other, and when information about their performance was made public. In this case the incentive was recognition. Incentives can improve interventions; however, incentives can sometimes backfire (Fehr & Falk, 2002).

As discussed earlier, norms can have a strong effect on compliance. People can comply predominantly because they believe it is morally correct and because it is socially accepted. Nevertheless, the introduction of external incentives can change motivations to comply, giving dominance to behavioural (economic) beliefs over normative beliefs. So the motivation to comply can shift: from a positive moral stance, to the expectations of an economic transaction. This shift has been documented in psychology and economics (Deci et al., 1999; Frey & Jegen, 2001). An example of this effect (called 'hidden costs of reward' or 'crowding-out effect') in the conservation context is portrayed by tradable emission rights, where a company has a 'licence to pollute' and therefore the moral motivations to lessen pollution are greatly reduced because pollution is legitimized (Frey, 1999). In a small artisanal fishing community in Costa Rica fishermen receive money from a nongovernment organization to buy fuel for patrolling a fishing area; fishermen patrol voluntarily using their boats and they rotate shifts (A. Arias pers. obs.). Fishermen benefit from patrols because they deter the use of illegal nets within the fishing area, and the financial costs of buying the fuel themselves would be high. However, one must question whether fishers' motivation to patrol the area would remain if (or mostly likely 'when') this external incentive disappears. In fact, while some fishers mentioned increased catch as a result of patrols, several argued that they should receive a salary for patrolling (A. Arias pers. obs.). Despite good intentions from the organization providing the fuel, fishers' motivations seem to have been negatively affected. Practitioners should be cautious when applying incentives as these can have unaccounted consequences that can become difficult or impossible to reverse.

3.1.3 Alternatives

Undesired practices can be replaced by more desirable alternatives. Because this approach aims to draw people's attention from practices that are environmentally undesired, Franz Tattenbach suggested the term 'conservation by distraction' (Ferraro & Simpson, 2002). These distractions are typically introduced through alternative livelihoods and are central in integrated conservation and development projects. Introducing alternative goods, such as western synthetic medicine to replace traditional medicine, can also be considered within this approach (Milner-Gulland & Rowcliffe, 2007). There are successful examples of conservation by distraction, such as cases of ecotourism (Ferraro & Hanauer, 2014; Wunder,

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2000). However, as with positive incentives, alternatives can bring damaging and unintended consequences if they are not well designed and managed. Sievanen et al. (2005) describe how seaweed farming projects were introduced in the Philippines, particularly to reduce fishing pressure. Seaweed farming offered benefits such as partially reducing fishing, some people earning more money and farms attracting fish. But seaweed farming also brought perverse outcomes such as attracting outsiders to the small villages where farming was taking place, people using mangrove wood to build farms, pollution from discarded materials, and boom and bust cycles caused by market fluctuations and disease outbreaks. Mixed results from the introduction of alternatives have been reported elsewhere (Baker et al., 2013; Gettleman, 2015), raising an important caveat when using alternatives to influence behaviour.

3.1.4 Persuasive communication

Through communication a person can be persuaded to comply voluntarily. Studies show that when persuasive communication successfully activates in a person's mind it can reinforce, change or create new beliefs (Ham, 2013). Hence, persuasive communication can significantly enhance the likelihood of voluntary compliance. Large scale communication efforts such as education and outreach campaigns can be expensive (Alder, 1996; McKenzie-Mohr, 2000), particularly in remote areas with limited media resources such as radio and television, but compared to enforcement, they can offer broader benefits such as environmental knowledge and pro-environmental behaviour (Leisher et al., 2012). Note, however, that increased knowledge does not necessarily translate to behavioural change (Schultz, 2002).

As mentioned previously, understanding what drives compliance can help design communication strategies. By applying key knowledge on behavioural sciences, such as the Reasoned Action Model and personal norms, practitioners can strengthen their communication efforts. Using persuasive communication, informed through the Reasoned Action Model and personal norms, Brown et al. (2010) describe how visitors were influenced to pick up litter in a Tasmanian National Park. Practitioners created two signs with thought-provoking titles ('What will you do when you see it' and 'If not you, who?') followed by short sentences related to the titles and the target behaviour (litter pick up in the Park). The signs increased litter pickup by 15-20%. Littering was considered to be the outmost visitor problem in the Park, so by increasing visitor litter pick up the Park possibly influenced a positive behaviour on visitors (i.e., litter pick up), improved its appearance by having less litter, and reduced management costs by having visitors, not staff, picking up litter (Brown et al., 2010).

Persuasive communication, however, is a tool that does not influence everyone. Persuasive communication is particularly effective for managing uninformed and inexperienced actions that result in noncompliance. But persuasive communication is ineffective for dealing with people who have ingrained beliefs resulting in deliberate and persistent noncompliance—these cases usually require coercion (Roggenbuck, 1992; Tyler, 1990).

3.2 Coerced compliance

Coercion can be an effective strategy to deter noncompliance and to ensure people that noncompliers will be penalized. Levi et al. (2012) suggest that effective coercion can strengthen an institution's legitimacy by indicating competence. So although coercion forces compliance, it can be linked to legitimacy and, consequently, it can also be linked to voluntary compliance (Figure 1B).

3.2.1 Enforcement

Enforcement is a tool that can help increase compliance. Effective enforcement is a chain with four links. First, the probability of detecting offenses; second, the probability of arrest or citation given detection; third, the probability of prosecution given arrest or citation; and fourth, the probability of conviction given prosecution (Akella & Cannon, 2004). Enforcement acts as a negative incentive, it makes people weigh economic decisions: the benefits of acting illegally vs. the chances and repercussions of getting caught doing so. Effective enforcement can be complex to manage because of the diverse steps or 'links' involved, requiring strong institutions to ensure deterrence. In developing countries enforcement is commonly weak (Akella & Cannon, 2004). But even in wealthy countries enforcement is only capable of detecting a small fraction of infringements (Stern, 2008; Sutinen & Kuperan, 1999). Additionally, enforcement is significantly expensive in both land and sea. In the Great Barrier Reef Marine Park, Australia, enforcement accounts for approximately 30% of the management costs (McCook et al., 2010). In India, approximately 60% of the forest department's budget is spent on enforcement (Robinson et al., 2010). Enforcement should therefore be used efficiently.

Enforcement should be targeted, and targets exist in space and time. For instance, Arias et al. (2014) determined the spatial and temporal distribution of illegal fishing in a marine protected area, helping to inform patrol effort. Enforcement can also become more efficient through investigations. As mentioned previously, markets can be good places to gather information about acts of noncompliance. In Costa Rica, a manager reported seeing unusually large fish being sold in a market adjacent to a no-take marine protected area at a time when patrol boats were inoperative (M. Chavarría, pers. comm.). Larger fish are expected within no-take marine protected areas, so this observation suggested that illegal fishing was taking place. Investigative work is key for targeting offenders, including corrupt officers (Sundström, 2012). A major reform of South Africa's fisheries compliance system allowed solving high profile cases through investigative work and a specialized environmental court (Hauck & Kroese, 2006). However, Hauck and Kroese (2006) mention that this reform was focused on enforcement and, despite several benefits, there was a need to shift towards a system that prioritized voluntary compliance. Some enforcement is typically necessary, but it should be coupled with strategies that foster voluntary compliance.

3.3 Balancing compliance management strategies

Tax compliance has made considerable progress in managing compliance and can provide lessons for nature conservation. The Australian Taxation Office, applies a model which strives for voluntary compliance and relies on graduated sanctions (Braithwaite & Braithwaite, 2001). The model assumes that most people are compliant and applies a 'softer'

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approach, such as persuasion, then gradually increases sanctions according to the number and severity of violations. Costs can be reduced by directing expensive and resource intensive measures to the smaller proportion of noncompliers (Figure 1) who do the most damage. Furthermore, through graduated sanctions, the model is more likely to be deemed as legitimate. Applying strong sanctions at once can not only be seen as illegitimate, but can have adverse effects such as increasing the chances for bribery and violence, foster the investment in methods to avoid detection, stronger defences in court, and having a stronger effect on the poor (Keane et al., 2008; Robinson et al., 2010). Similar to how ‘positive incentives’ could legitimize environmental harms (e.g., tradable emission rights), negative incentives such as sanctions can legitimise noncompliance (Gneezy & Rustichini, 2000), highlighting the importance of making the sanction proportional to the infraction to reduce this effect. Whilst some regulatory agencies possess the legal framework allowing graduated sanctions, others might have to undergo policy and legislation changes to allow it. Political will is crucial for effective compliance management (Gibson, 1999).

Practitioners should focus on building and strengthening a wide base of voluntary compliance. People commonly follow the behaviour of others (Cialdini & Goldstein, 2004; Schultz et al., 2007), so compliance can become the norm, at least in the immediate time frame. However, the opposite also applies. Compliers are unlikely to indefinitely tolerate the burden of noncompliance (i.e., free riding and degraded goods), so compliance can progressively deteriorate as compliers defect (Levi, 1989). These thresholds can be difficult to locate because they depend on dynamic factors such as norms, punishment, and rewards (Fehr & Fischbacher, 2003; Ostrom, 2000). In practice, knowing that these thresholds exist is useful, acting as encouragement for staying away from them by striving for a strong base of voluntary compliance.

Despite the preference for a strong base of voluntary compliance in some cases noncompliance predominates (Arias et al., 2014; Laurance, 1998), requiring prompt action to stop further degradation of the environment and compliance. Cases with high noncompliance can resemble the pyramid in Figure 1B, but with an inverted factor order. However, the relationship between attitudes toward compliance and compliance management strategies remains the same. Enforcement can offer fast results by disrupting the economic incentives that drive noncompliance, allowing time for other strategies to come into effect.

4. Conclusion

Noncompliance can render a rule ineffective—defeating the rule’s purpose. Nature conservation requires compliance. The concepts and tools that I describe here provide solid foundations for compliance management in the nature conservation context. However, the operationalization of compliance management is context dependent and requires ongoing adaptation. The multiple examples provided in this review demonstrate the diversity of ways in which compliance managers can gather information and devise interventions. Interventions can work through coercive or voluntary compliance; with the ultimate goal of building and maintaining a wide base of voluntary compliance. The strong link between effective conservation and human behaviour highlights the need to eliminate barriers between disciplines. Compliance management in the nature conservation context has been gradually progressing towards the integration of knowledge and methods from different disciplines such as environmental, behavioural, and risk and decision sciences (Gibbs et al., 2010). As

this transdisciplinary progress continues, the linkages between scholars and managers should be strengthened through the exchange of knowledge and needs. The difficulties that compliance managers face present abundant opportunities for problem-solving and for translating research into action.

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