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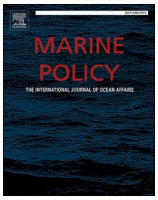

Motivations for compliance in Peruvian manta ray fisheries

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ABSTRACT

Fishermen's compliance with fisheries legislation is influenced by a combination of economic, calculated, normative, and social motivations. Compliance can be enhanced by fishers' inclusiveness within management directives. Since the 2015 fishing ban on the giant oceanic manta ray (*Mobula birostris*) in Peru, there has been no significant decline in the catch of this protected species. Structured questionnaires were administered to small-scale fishers in two fishing communities in northern Peru, exploring their perspectives and attitudes towards compliance motivations as indicators influencing their non-compliant behaviour. Compliance was mostly hindered due to economic hardship, lack of legitimacy towards authorities driven by corruption and low social influence to comply. The diverging motivations to comply in both communities suggest the engagement of fishermen in fisheries management through local policy changes could lead to increased compliance. This study contributes to understanding fishers' non-compliant behaviour in fisheries of lower commercial value.

1. Introduction

The giant oceanic manta ray (*Mobula birostris*) is one of the world's largest batoid fish with a disc width reaching 7 m [1,2], and is found circumglobally in subtropical and tropical waters [3,4]. Long-term monitoring efforts have recorded global declines in sighting frequency of manta rays (*Mobula* spp.) [5] due to bycatch and demands by Asian markets [6]. In Peru, *M. birostris* is the only manta ray species recorded, and its known population is found in northern waters where ocean productivity is high [7]. This productive marine environment drives 47% of Peruvian fisheries to operate in that region, and are primarily carried out on a small-scale where it constitutes the principal source of food and employment for local communities [8,9]. Small-scale fisheries in Peru have a comparable impact to large-scale industrial fisheries [10,11]. Peru's batoid landings represent 11% of the total global batoid landings between 2005 and 2011, more than 20% of which are mobulid landings from northern Peru [12]. Furthermore, landings in that region have increased by five-fold between 1997 and 2011, partly as a result of increasing coastal migration [13]. Manta rays are of low commercial value in Peruvian fisheries and are prone to both target fisheries and bycatch [14]. The expansion of fishing activities within the habitat of manta rays endangers its population as a lack of fishing effort data and manta ray population assessments suggests that increased fishing pressures may result in the collapse of its population [10,11]. To reduce fishing pressures on manta rays, the Peruvian law N°441–2015-PRODUCE enacted in 2015 banned manta ray fisheries, prohibiting its catch and therefore landing, either targeted or accidental, with any type of fishing gear throughout national waters. Regulatory enforcement is in place but insufficient funding is associated with too few and poorly trained officials, scarcely present to sanction non-compliance. In the face of manta population decline, increased pressures from small-scale fisheries in Peru, and a limited decrease in manta ray catches recorded by the Marine Institute of Peru, finding effective approaches to enhance compliance in this fishery is essential to maintaining a viable manta ray population in Peru. Compliance behaviour has previously been investigated with regulations for targeted fisheries, with factors such as the high commercial value of species influencing non-compliant behaviours [10–13]. Exploring

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non-compliance dynamics in fisheries targeting species of less value can help determine the extent to which a species' commercial value influences compliance behaviour.

Four mechanisms have been recognised to play an important role in motivation for compliance: 1) calculated, 2) normative, 3) social, and 4) economic incentives [15–19]. The calculated motivation is described as the fear of detection and sanction by fishery management authorities following a regulation violation. The normative motivation represents a sense of moral and civic duty to comply, regardless of one's self-interest [19,20]. The normative influence on behaviour has been shown to be moderated by the perceived legitimacy of legislation and the governing authority [21,22]. Two primary elements have been shown to influence perceptions of legitimacy, namely the level of inclusion of fishermen in the decision-making process, and the fisher's experiences with authorities [23]. In Norway and Canada, small-scale fishers have been found to comply with fishery regulations despite low law enforcement, out of civic duty and belief in the legitimacy of authorities [19,24]. Social motivation, in turn, arises from the desire of the person to be approved and respected by individuals with whom they interact [25–27]. For example, driven by civic duty and fear of reprisal from their community, fishermen have been shown to comply with existing regulations due to social pressure even when the benefits of illegal behaviour was high [17, 19,24]. In Danish fisheries, non-compliance with fish quota regulations were largely accepted within the fishery communities, whereas strong norms were observed for the minimum size of fish caught [17]. Aside from the potential impact of the community on Peruvian fishers, the continued catch effort of *M.birostris* in Peru could be explained by the thousand-year-old cultural linkage between Peruvian fishermen and manta rays [28]. Economic incentives relate to the trade-off between economic costs and benefits of carrying out an illegal behaviour [17]. Several studies have shown that economic incentives such as constraints on earnings can enhance non-compliance [15,17,18].

In this study, we investigate factors influencing non-compliant behaviours in fisheries of lower value species, in this case, regarding the catch of *M. birostris*. We specifically look at how compliance mechanisms shape fishers' behaviour in this fishery. We used an open-ended questionnaire in two predominant fishing communities in Northern Peru. Several studies estimating non-compliant behaviour in fisheries have used questionnaires to measure fishers' attitudes, perspectives and knowledge towards fishery, conservation, policy and management measures [17,29,30]. The aim is to understand general patterns of what shapes compliance to help inform future legal conservation strategies to conserve species of low commercial value.

2. Methods

2.1. Study sites

The study took place in two towns in northern Peru, Zorritos and Mancora. Zorritos (3°40.49′S, 80.40.41′W) lies 70 km north of Mancora (4°6.12′S, 81°2.52′W) (Fig. 1). The criteria for the selection of communities were similar population sizes, geographical characteristics, extensive small-scale fishing practices and presence of manta ray fisheries.

2.2. Data collection

The study was approved by the Sociology Committee of the University of Cambridge. Participants provided informed verbal consent, as approved by the ethics committee. Data was collected using a questionnaire consisting of 34 questions covering four topics: demographic profile, fishing activity, species recognition and compliance mechanisms. The questionnaire consisted of closed-ended questions using a three-point Likert Scale (i.e. Disagree/Unlikely, Neutral, Agree/Likely) and several open-ended questions (Appendix 1). Questions were derived from studies on non-compliance mechanisms, with revisions from experts on the topic and by Peruvian scientists to fit the local context. An opportunistic sampling technique was used and questionnaires were delivered on a one-to-one basis between February and March 2018. The method guaranteed anonymity as the questionnaires were coded and no information was taken from respondents that allowed them to be identified. A total of 80 questionnaires were completed (40 in each town).

Data collected for the demographic profile included age, gender, education, immigration and household income sources (see Appendix I, questions 1–6). The fishing activity section gathered data on fishing experience, fishing gears used, the months they were used in, the species fishermen targeted and those caught as bycatch, with a focus on *M. birostris*' fishery. The length of fishing trips and the approximate annual quantity of manta rays caught were also recorded (Ap. I, q.7–16). Because of the low commercial value of some ray species, the species recognition section aimed at assessing fishermen's ability to distinguish *M. birostris* from other ray species occurring in the area, some of which

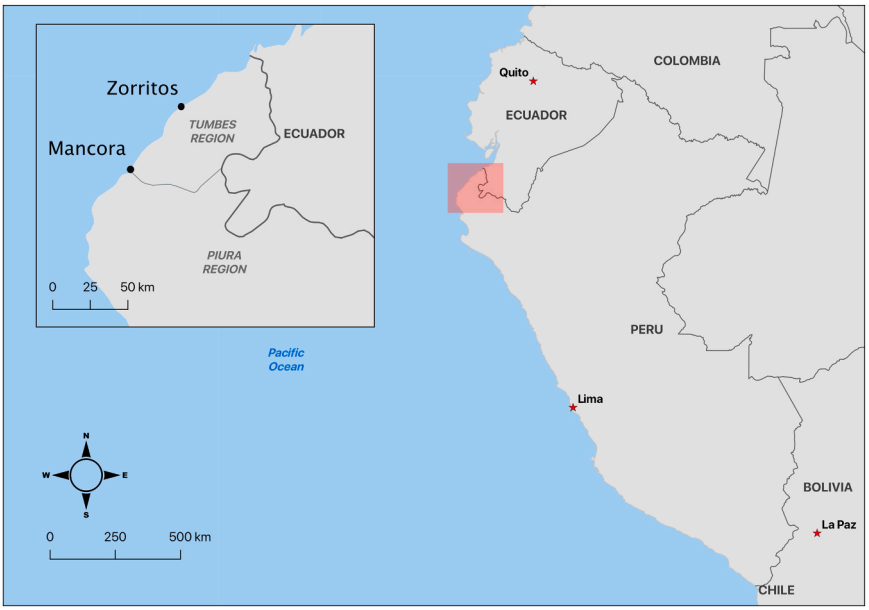

Fig. 1. Map of Peru and the two study sites, Mancora and Zorritos.

were of high commercial value and prone to targeted fishing. Fishermen were shown nine photographs of targeted marine species and asked to identify the species' local name and the characteristics looked at for its recognition (Ap. I, question 17). Three photographs showed highly targeted and valued species as classified by local fishermen (Florida pompano (*Trachinotus* spp.), yellowfin tuna (*Thunnus albacares*) and smooth hammerhead shark (*Sphyrna zygaena*)) and four photographs showed ray species occurring in the area (Munk's devil ray (*Mobula munkiana*), Chilean devil ray (*Mobula tarapacana*), Japanese devil ray (*Mobula japanica*)), two of which showed the Japanese devil ray, the the most targeted species in northern fisheries [12]. Finally, two photographs displayed the giant oceanic manta ray (*Mobula birostris*).

The legislation section contained questions on the extent of understanding of the manta ray fishing ban. Data was first collected on fishermen's awareness and perception of Law N° 441–2015-PRODUCE (Appendix I, questions 18-20). Then, their perceptions and attitudes were explored for the calculated, economic, normative and social motivation instruments. The calculated motivation investigated the perspectives of fishermen regarding the likelihood of detection and sanction by Peruvian fisheries management authorities (Ap. I, q. 21–23). The economic motivation investigated the perception and attitude towards the handling effort of the species, the gear value, the market value of other rays compared to mantas and the benefits of this fishery (Ap. I, 29–31, 34). The normative instrument measured the perception of fishers' duty to comply, the effort authorities should put into enforcing the law and the impact of the law on the marine environment. It also questioned respondents on authorities' corruptibility as an indicator of legitimacy (Ap. I, q. 20, 24–26). The social category explored the extent to which the community, household and peers agreed or disagreed with manta ray fisheries (Ap. I, q. 27, 28a). The strong prevalence of manta rays in Zorritos recently led marine conservation organisations to deliver workshops on the species' role in the ecosystem and the importance of complying with the ban in an effort to reduce its fisheries. To measure the impact of the workshops on fishers'personal norms, fishermen were asked about the role of this ban in the conservation of marine resources (Ap. I, q. q. 32, 33). Finally, the questionnaire recorded the respondents' perspectives on the role of the law in maintaining healthy ecosystems, and the cultural significance and legacy of manta ray fishing to fishermen in both communities (Ap.I, q. 28 b,c).

2.3. Data analysis

The data was analysed using the R software version 3.5.0 (R Core Team 2017). For all analyses, a *p*-value of 0.05 was considered statistically significant. A Cronbach's alpha was used for questions in each motivation instrument (normative, calculated, social and economic), but the low scores of $\alpha = 0.2$ to $\alpha = 0.4$ did not show acceptable reliability and as such questions were analysed independently. Responses to open-ended questions were manually coded and categorised by response-types (yes, no, don't know, not willing to answer) and grouped by theme (Ap. I, q. 20–22, 27, 34, 36). Responses to the open-ended question 12 regarding bycatch in fisheries were only grouped by theme. A hierarchical coding was applied and similar responses were grouped to analyse perceptions in each town. For the open-ended questions on fishermen's awareness of the law (Ap.I, q. 18 18, 19), fishers were only considered to be aware of the law if they stated it was illegal to catch and land manta rays, and fines were imposed for breaking the law.

Linear regression models we performed did not show significant differences in responses between towns, demographic variables and compliance motivations. Differences were only observed between manta ray sightings and catches. If there were significant differences, the results of both communities were presented individually. A Pearson's Correlation was performed to look at the differences between towns regarding usage of the different gear types over a year period. A one-way ANOVA was used to investigate differences in species recognition skills between the study sites.

3. Results

3.1. Demographic profile

The age range of the 80 fishers interviewed was 23–84 years old (median = 49; mean = 50; S.E. = 1.5) (Table 1). Fishermen spent an average of 29 years in the fishing sector (median = 49; S.E. = 2.4). Overall, 41% of fishermen were living away from their natal villages and for 57% of them, fishing represented their only source of household income. Their households were wer composed of 4 members on average. By a majority, the only source of household income was provided by fishermen (78%). Of the respondents, all were male, 38% owned their own boat, 11% were captains and 51% were crew members. No significant relationships were found between demographic variables and species recognition, awareness of the law and compliance motivations.

3.2. Fishing activity

The most common fishing gears used were gillnets (89%), followed by fishing rods (21%) and longlines (19%) (Table 2). Of the fishermen employing gillnets, 69% solely used gillnets throughout the year. The Pearson's Correlation showed a negative linear relationship between gillnets and longlines ($R^2 = -0.61$, $t = -2.44$, $df = 10$, $p = 0.035$). Therefore, fishermen across town would either solely use gillnets or alternate between the use of longlines and fishing rods. Manta rays were principally caught in surface gillnets in offshore waters. In Zorritos, fishing trips lasted about 3–4 days, with a mean catch of 44 manta rays per boat per year (median = 8, S.E. = 176). In Mancora, where fishing trips lasted 7–12 days, fishers reported variable annual catches of manta rays per boat (median = 50, mean = 305, S.E. = 522). A regression model showed higher sightings of mantas correlated with higher catches of the species ($p = 0.031$, Estimate = 0.36, SE = 0.16, $t = 2.22$). Through the open-ended questions, fishers explained that some manta ray catches were targeted in both Zorritos and Mancora, but the remaining catches were accidental. Across towns, 72% of fishers stated low fishery productivity was recurring more often due to increasing numbers of individuals partaking in fishing activities, leading fishers to increasingly target manta rays. Regarding the species' bycatch, fishermen untangled live manta rays, but when fishers' quotas were not met or when fishery productivity was low, they opportunistically landed them. Fishermen mentioned that the lack of alternative livelihoods drove them to resort to illegal fishing.

In both communities, fishermen reported the abundance of manta rays was similar (43%) or higher (38%) compared to when they started fishing. Responses were inconclusive in Zorritos regarding catches, but fishermen in Mancora stated there were fewer catches of the species (68%). Finally, both communities reported less manta ray landings (63%). Fishermen from both communities believed the population size

Table 1
Demographic characteristics of questionnaire respondents in Zorritos and Mancora.

Variables	Zorritos	Mancora
Mean age (S.E.)	52 (2.4)	51 (2)
Mean years of fishing experience (S.E.)	30 (2.3)	29 (2.5)
Highest level of education reached (%)		
Primary school	38	41
Secondary school	56	53
Tertiary education	6	6
Mean household size (S.E.)	4 (0.3)	4 (0.2)
Members bringing a household income (%)		
One member (Fisherman)	40	58
Two members	48	23
Three members	12	13
More than three members	0	6

Table 2
Characteristics of fishing activities in Zorritos and Mancora.

Variables	Zorritos	Mancora
Mean fishing trip duration in days (S.E.)	3 (1.3)	10 (2.1)
Mean yearly manta ray catch (S.E.)	44 (176)	305 (522)
Fishing Gear Usage (%)		
Gillnet	88	92
Longline	28	10
Fishing rod	33	5
Purse Seine	8	8
Bottom Trawl	8	0
Gear linked to manta ray bycatch (%)		
Gillnet	93	90
Longline	7	10

of manta rays would increase in the future but they feared it as they mentioned rising accidental catches would lead to greater damages in nets.

3.3. Species recognition

Across both communities, 69% of fishermen recognised at least 50% of all species shown, with all species of high commercial value (target species) recognised (Fig. 2). Additionally, 25% recognised more than half of all ray species, and 48% recognised manta rays in both pictures shown.

3.4. Motivations for compliance

Economic motivation was the most prevalent factor influencing non-compliant behaviour in Mancora whereas the normative instrument was most common in Zorritos. A vast majority of fishermen indicated manta ray fisheries incurred high costs and low benefits (99%). It was widely acknowledged by fishermen (93% across both communities) that the market value of other ray species (on average 0.50 USD/kg) was significantly higher than the manta ray's value (on average 0.15 USD/kg) due to its perceived lower meat quality. Furthermore, 90% stated manta ray fisheries entailed high efforts and risks when when unentangling and handling the animal, worsened by the limited space on boats. Fishers further mentioned their salaries were around 300 USD per month and it could cost them up to 1 800 USD to repair nets damaged by manta ray entanglements.

Zorritos' fishermen had higher normative incentives to comply, with 70% of respondents stating it was their duty to comply with the law, compared to 38% in Mancora (Fig. 3). Across communities, the majority stated the manta ray fishing ban was reasonable, 89% in Zorritos believing it had a positive impact on the ocean ecosystem, compared to 52% in Mancora. Manta rays were further seen as an important part of fishermen's culture and legacy in Zorritos (63%) compared to fishermen in Mancora (48%). However, although most fishers interviewed wished for authorities to be stricter in enforcing the law, they perceived the ban as illegitimate due to catches being generally accidental. Financial corruption was prevalent in both towns with 56% of respondents in Zorritos and 77% in Mancora noting that authorities refrained from using sanctions when the law was breached as fishermen resorted to bribing authorities. Fishermen stated owners of bigger fishing boats bribed authorities the most, in turn leading authorities to allow them to carry out increased illegal activities including increased landing of protected species.

Fishermen had low social motivations to comply. According to 62% of respondents from both towns, the wider community and household members did not get involved in fisheries. Fishermen sometimes offered manta ray meat to the community, who would then turn a blind eye on illegal fishing activities. Household members showed a higher concern for income than concerns for the legality of fishermen's actions. Peers' opinions were also not important to fishermen, with 58% stating each

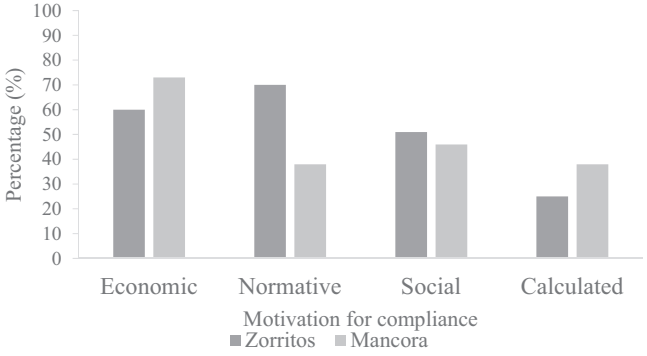

Fig. 3. Influence of the different compliance mechanisms (economic, normative, social and calculated) on Peruvian small-scale fishers, determining the nature of non-compliant behaviour to the ban on manta ray fisheries in both study sites (Zorritos and Mancora).

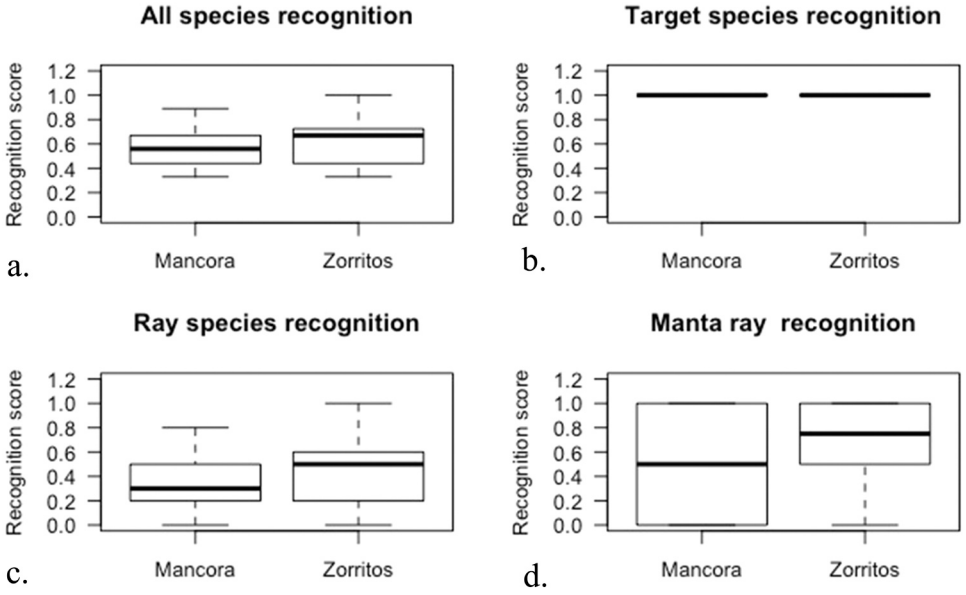

Fig. 2. Recognition score of the 7 different species shown in the questionnaire, a score of 0.0 = 0% species recognition ability, 1.0 = 100% recognition ability. (a) shows species recognition ability of the 7 species shown, (b) shows the target species recognition ability (3 species), (c) shows ray species recognition skills (4 species) and (d) shows manta ray recognition ability. Bold lines represent the median, the lower and upper edges of the boxes represent the first and third quartiles, and whiskers denote the maximum and minimum values.

focused on their own fisheries activities but were aware of others' illegal behaviour. However, in the open-ended questions, a vast majority of respondents (91%) mentioned they would change their fishing habits to reduce manta ray bycatch, which they were already trying to achieve via radio communication with peers to avoid areas where *M. birostris* was sighted.

In both communities, the calculated motivation was the weakest motivator (Fig. 3). Of the 76% of fishermen that were aware of the law banning manta ray fisheries, only 26% knew about its sanctions. Fishermen in Zorritos had a different perception on how the law affected them, 70% did not perceive the law affected their fishing activities as manta catches were often accidental and so they should not be fined. In Mancora, 68% expressed contrary views. As a bycatch, it was perceived as unfair to be sanctioned ($p = 0.003$, Estimate $= -1.70$, SE $= 1.4$, $z = 0.5$). In Zorritos, 21% of respondents perceived it likely that authorities would detect them landing manta rays, and 40% stated it was likely authorities would impose a fine. Three respondents (1%) from Zorritos had been detected catching manta rays, with one respondent saying he had been reported by authorities but was not given any sanction. Fishermen in Mancora perceived it likely they could be detected by authorities if they landed manta rays (57%), with a majority mentioning they could be sanctioned (68%). To avoid detection, illegal catches were mostly landed at night when authorities were not present. If they were controlled, fishermen would claim the meat belonged to a different non-controlled species, reporting that authorities had low species recognition skills.

4. Discussion

The most common driver of non-compliance in manta ray fisheries in northern Peru comes from the economic incentives to sustain livelihoods, followed by a lack of legitimacy given to authorities and low social influence. The majority of fishermen have to provide for entire households and most do not have access to alternative livelihoods. Fishing activities are dependent on catch weight and species type, leading fishermen to resort to risking illegal catches to reach quotas and sustain families. These key findings suggest non-compliant behaviours in fisheries are similar between fisheries of high and low economic value.

The reliance on fishing as a sole livelihood to support entire families negatively affects local compliance with marine conservation and management initiatives across fisheries [32–35]. Strategies focusing on the relationships between local livelihoods and ecosystems are essential to achieve sustainable fisheries [34,36–38], alongside approaches addressing poverty reduction and alternative livelihood opportunities [34,37,39]. Non-compliance is further affected by recent and more pronounced declines in higher valued species [40]. Given the perceived low likelihood of being detected and sanctioned by authorities, most fishermen deem the economic benefits of catching manta rays outweigh the costs of being sanctioned. Thus, fishermen in the two communities are increasingly taking risks by intensifying their fishing efforts towards less economically important species such as manta rays, confirming the findings from studies of European and African fisheries [17,18,30,41,42]. The reduced capacity of authorities to recognise this lower-valued species provide an incentive for fishers to be less compliant with its fishing ban. When quotas are met, fishermen actively try to avoid manta ray catches, but as bycatch generally occurrs in tuna fishing grounds, the lack of gear selectivity hinders bycatch mitigation actions. Approaches to compliance may include restrictions in gear types. As manta rays are known for exhibiting a seasonal pattern, gillnets could be restricted during the peak of the manta ray season [8,31].

Corruption in the form of bribes and the perceived illegitimacy of authorities throughout fisheries makes fishermen less prone to comply with fishing regulations regardless of the species' commercial value. It explains fishers' limited knowledge of the sanctions because these are negotiated and as a result renders enforcement ineffectual [43–45]. Thus, the observed patterns from Mancora and Zorritos are in line with behavioural trends evidenced in non-compliant studies [16,17,46,47]. Fishermen from Zorritos areprimarily compelled to comply with the ban through feelings of strong moral duty. They more strongly perceive manta rays as having an important role in marine ecosystems and the law as beneficial for preserving healthy ecosystems. Although stakeholders like conservation organisations may promote stronger moral obligations to comply as observed in Zorritos, support from regulatory bodies is essential for behaviours to effectively change [48–50]. In the Peruvian case, the lack of legitimacy given to authorities and the need to sustain households may overrule individuals' moral judgement [16,51]. It has also been suggested that compliance based on personal norms is difficult to maintain if it is realised that peers are not complying [52,53]. Similarly, in Ghana, fishers perceived non-compliance as morally unacceptable but their economic needs and paucity of alternative livelihoods took precedence over their personal norms [51]. Fishermen also perceive the law as illegitimate due to the significant bycatch occurring in this fishery. This renders compliance difficult as fishermen are unwilling to abide by it, perceiving the ban to be unsuitable for the local fishery context. The solutions put forward to tackle corruption and illegitimacy perceptions at a local level align with strategies for increased compliance, including enhancing fishers' participation in management [17,46,47,54,55]. The diverging drivers of non-compliance between towns suggest that local fishing policy implementation may better influence compliance.

The overall absence of social sanctioning in both towns towards illegally caught species suggests sanctions imposed between commercial and lower-valued species are similar. Offering a part of fishers' catch to the local communities could act as a deterrence mechanism for individuals to sanction fishers for their behaviour. Fishers avoid reporting their peers' illegal fishing practices. This would be a costly behaviour because fishers want to: avoid conflict and reprisal for their own illegal behaviours, have a sense it is not their responsibility to report peers and because illegal behaviour is seen as a survival strategy [56]. On the other hand, Gezelius (2002) found fishermen in Norway complied with rules through moral norms [19]. Unlike in Peru, Norwegian fishermen had strong social links and high transparency with the local law enforcement which may act more strongly towards non-compliant behaviours if they occur. Increased competition among fishers for commercially viable species may result in greater social consequences for those exceeding the morally supported extent of illegal activities.

Fishermen showed reduced manta ray recognition capacity compared to more valuable commercial species. This may be explained by the presence of several other low-value ray species in northern Peru which are not highly targeted. This aspect may influence their belief that manta ray populations are increasing. The low recognition capacities can also be explained by a significant amount of accidental take of manta rays because of the unselective gear used, but fishermen resort to opportunistically exploiting this species. They do so to compensate for poor catches and for the costs endured when accidental catches occur, accounting for damaged equipment and personal risks when handling the animal. Non-compliance towards lower value species' legislation appears to be directly related to the stock status of high-value species. This behaviour is a threat to the Peruvian manta population and demonstrates the importance of implementing improved compliance mechanisms to reduce fisheries' shift towards targeting lower-value species. With s alterations in the abundance and distribution of target species caused by climate change which is projected to intensify [57,58], current efforts need to increase to prevent economic strains in a nation highly reliant on marine resources.

In this study we used questionnaires to obtain information about the behaviour of fishermen, including behavioural aspects that covered illegal activities. This can lead to social desirability bias with respondents providing answers that may be viewed more favourably by others but which do not necessarily reflect the truth [59–61]. Biased answers may also come from fishers' fear of reprisal by peers or

authorities [62,63]. For this study, the knowledge of this ban may have driven fishermen to report similar sightings frequency and reduced landing of manta rays compared to when they first started fishing. Direct questioning renders it difficult to accurately measure the extent of the effectiveness of this ban. Tools for social research like the Randomised Response Technique (RRT) can reduce this bias but was not feasible for this study as it requires large sample sizes and has complex rules that may be difficult to understand [59,64,65]. Within this research, fishermen provided a degree of openness to questions with reports of landing manta ray meat at night, and intentionally targeting manta rays when catch quotas were not met. Interview settings and anonymity of respondents may have assisted in obtaining truthful answers.

This study suggests that motivations behind non-compliance are mostly driven by economic incentives and illegitimacy towards authorities, with social and calculated motivations having a minimal influence on fishers' behaviours. All these elements were also found in compliance studies investigating fisheries of high-value species. The main difference may be opportunistic exploitation of this lesser-valued species in Peru. Furthermore, the lack of manta ray identification skills by both fishers and authorities seems to play a significant role in compliance which would not be the case with main target species. Poverty reduction mechanisms, the integration of fishermen in the decision-making process for local management and access to alternative livelihood opportunities could enhance compliance to the manta ray fishing ban but this requires a thorough understanding of the socio-economic context of the communities.

CRediT authorship contribution statement

Lucie Guirkinger, Isabel Ender, Jonas Geldmann and Mark Ramsden carried out the conceptualisation of the study. All authors developed the methodology of the study, and worked on its validity and reviewed and edited the paper. Stefany Rojas and Lucie Guirkinger conducted the research. Lucie Guirkinger and Charley Lenton-Lyons carried out the formal analysis. Mark Ramsden Jonas Geldmann did the oversight of the research activity and execution of the research. The latter authors with Lucie Guirkinger did the project administration. Lucie Guirkinger did the funding acquisition.

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Competing interest statement

Declarations of interest: none.

Appendix A. Supporting information

Supplementary data associated with this article can be found in the online version at doi:10.1016/j.marpol.2020.104315.

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