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## SPECIALTY SECTION

This article was submitted to  
Global Biodiversity Threats,  
a section of the journal  
Frontiers in Conservation Science

RECEIVED 14 June 2022

ACCEPTED 15 August 2022

PUBLISHED 02 September 2022

## CITATION

Lindley J and Quinn L (2022)  
Perceptions of compliance in  
recreational fisheries: Case study of  
the Peel-Harvey blue swimmer crab  
fishery.  
*Front. Conserv. Sci.* 3:968518.  
doi: 10.3389/fcosc.2022.968518

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# Perceptions of compliance in recreational fisheries: Case study of the Peel-Harvey blue swimmer crab fishery

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Effective recreational fisheries management requires a balance between fisher enjoyment and compliance with regulations and fisher perceptions can be useful to understand whether the balance is right. Our study collected fisher insights *via* an online perceptions survey into compliance within the recreational shore-based Peel-Harvey blue swimmer crab fishery in Western Australia. Overwhelmingly, participants self-reported as complying with regulations; a positive finding for a licence-free fishery. Further, to enable increased quantity and size of available stock and thus overall enjoyment of the fishery, survey participants suggested longer fishery closure periods; harsher noncompliance penalties; more natural and physical surveillance; and greater educational signage in popular fishing areas. These insights challenge existing literature whereby tough regulations are often rejected by fishers and may lead to noncompliance. In a view to achieve a shared goal of a sustainable fishery, we explore survey perceptions against situational crime prevention to optimize compliance, embracing regulator-led 'cooperative compliance' outcomes. Our results are useful not only to this fishery but apply more broadly to other fisheries within and beyond Western Australia.

## KEYWORDS

Recreational fishing, compliance, blue swimmer crab (*portunus pelagicus*), regulation, Western Australia (WA), Peel-Harvey Estuary, situational crime prevention (SCP)

## Introduction

The Western Australian (WA) Department of Primary Industries and Regional Development (DPIRD) has primary responsibility to conserve, sustainably develop and equitably manage its fish resources. While it frequently undertakes fisheries research (see for example [Johnston et al., 2020](#)), motivational and behavioural trends leading to regulatory noncompliance receives less research attention. A longstanding tradition permits participation in shore-based recreational WA Peel-Harvey blue swimmer crab

fishing without a licence, as such demographic and other information ordinarily collected through the licensing process is unavailable and resultant, less is known about the recreational fishers who engage in this fishery unless there is interaction with compliance officers. For shore-based blue swimmer crab fishing in the Peel-Harvey Estuary, fisheries compliance officers patrol waterways and may conduct checks to assess adherence to compliance, including bag daily limits, acceptable size and use of allowable gear and equipment (Department of Primary Industries and Regional Development, 2021). Perceptions about compliance within the fishery can be useful to understand the likelihood of adhering to laws and regulations, including daily catch limits and gear and equipment.

The survey gathered recreational fishers' perceptions of the existing regulatory framework of the blue swimmer crab fishery in WA. The Peel-Harvey blue swimmer crab fishery is an important fishery as it is the world's only Marine Stewardship Council certified commercial and recreational fishery (Marine Stewardship Council, 2016). It therefore requires sustainable, optimized compliance management to maintain this certification and ensure its availability for future generations. Results derived from this research contribute to regulator understanding as to whether the existing compliance framework is suitable. Balancing sustainable and equitable fisheries requires efforts to encourage compliance and to increase risks to engage in noncompliant opportunities.

Literature reveals a common culture of fisheries noncompliance across geographic locations and species. Despite varying mechanisms to set suitable catch limits, manage quotas and monitor and enforce regulations by region, a review of fisheries compliance literature (see for example Bloomfield et al., 2012; Slater et al., 2014; Garza-Gil et al., 2015; McClanahan & Abunge, 2016; Boonstra et al., 2017) determined that while fishers are aware of law relevant to a fishery, a culture of noncompliance is common, but to a varying extent and impact. Our research found the contrary; survey participants were in favor of stronger controls to secure a sustainable fishery.

Enhancing controls should not imply legislative amendments, a point supported by the results in this study. Overarching legislation provides governance for the fishery in each jurisdiction. In WA, the *Fish Resources Management Act 1994* and the *Fish Resources Management Regulations 1995* provide a comprehensive suite of fishery management tools for blue swimmer crab fishing, including the Peel-Harvey Estuary.

Research suggests that achieving a balanced approach of fisher enjoyment and regulation is most desirable (Nielsen, 2003; Grafton et al., 2006; Gutierrez et al., 2011). If the regulatory approach is too lenient, the fishery may become overfished and unsustainable, and if too harsh, it can lead to disenchantment among fishers who may then intentionally

evade the rules. Encouraging compliance *via* incentivising fishers, or *via* the 'carrot approach', as compared to punishing fishers, or *via* the 'stick approach' can provide guidance. While not within the fisheries space, some research suggests that the 'carrot approach' appears to be more effective than the 'stick approach' to encourage compliance (Geest & Dari-Mattiacci, 2013; Su & Cao, 2021), confirmed by research from psychology that suggests most commonly people seek to avoid punishment, suggesting the incentivized 'carrot approach' is more effective (Kubanek, et al., 2015). The 'carrot approach' can be achieved through education and enforcement strategies targeting fishers in varying ways. For example, the 'carrot approach' may involve overt education campaigns that seek to engrain the regulations to minimise likelihood of mistaken noncompliance, however fear of receiving high financial penalties may similarly encourage compliance. If intercepted noncomplying, the high financial penalties would amount to the 'stick approach'. This approach has been selected for this study to the exclusion of others as in WA, regulatory compliance strategies involving education and enforcement exist that intentionally target both the carrot and the stick approaches to achieve a balance in intercepting noncompliance and support for compliance strategies among the participating population.

The survey results are interpreted against a backdrop of situational crime prevention. Situational crime prevention is a concept that seeks to alter the environmental opportunities for offending in particular settings, acknowledging that motivations to offend (or noncomply) will continue to exist (Clarke, 1997). Clarke's popular criminological approach is proactive, rather than reactive and therefore places the regulator in control. Analysing the situation to understand environmental vulnerabilities that enable offending (or noncomplying) and addressing those opportunities to limit exposure to crime (or noncompliance), proactively seeks to alter motivations and behaviours rather than relying on high financial penalties to reduce recidivism. Given that the majority of noncompliers face a lesser penalty, such as a warning (Lindley & Quinn, forthcoming), altering the environment rather than the motivations and behaviours of noncompliant fishers – which for a licence-free fishery may vary from subsistence to financial profit – is likely to be more successful. Situational crime prevention has been successfully applied in the environmental crime space (Gore et al., 2020) and suits fisheries in WA. At least initially, noncompliance in WA is dealt with administratively rather than criminally, and efforts to target harden are communicated through education to encourage compliance as well as strong approaches in enforcement if noncompliers are intercepted by authorities (the carrot *and* the stick approach).

The Australian Government *via* the Fisheries Research and Development Corporation (FRDC) funded this research to better understand the Peel-Harvey and the South Australian blue swimmer crab fisheries. This survey forms the second part

of the larger project<sup>1</sup> building on analysis of regulator-held quantitative noncompliance datasets (Lindley & Quinn, *forthcoming*) to seek opportunities to develop a balance between fisher enjoyment and optimized compliance outcomes.

To target participant responses, survey questions were devised around five overarching research questions, namely:

- RQ1.** What is the opportunity structure for Peel-Harvey blue swimmer crab fishers to engage in noncompliance?
- RQ2.** What are the perceptions among fishers of the current rules and regulations governing the Peel-Harvey blue swimmer crab fishery?
- RQ3.** How can education be optimized to ensure compliance in the Peel-Harvey blue swimmer crab fishery according to fishers?
- RQ4.** How can enforcement be optimized to ensure compliance in the Peel-Harvey blue swimmer crab fishery according to fishers?
- RQ5.** What is the perceived extent of noncompliance in the Peel-Harvey blue swimmer crab fishery?

In this study, with a focus on compliance underpinned by situational crime prevention we explore perceptions of education and enforcement gaps and opportunities for ‘cooperative compliance’ within the existing legislative regime. The concept of cooperative compliance is well established in the financial services industry, given the complexity of regulations as a voluntary measure for businesses to collaborate with regulators to prevent situations of tax noncompliance occurring. For this study, we define ‘cooperative compliance’ as a proactive, regulator-led method to balance enhanced fisher compliance with enjoyment of engaging in recreational fisheries. This novel approach seeks to empower the fisher to embrace and encourage a sustainable relationship with recreational fisheries for themselves, their family and community. While cooperative compliance can only be effective if it does not increase management risks for the regulator, achieving it can reduce management costs to the taxpayer while maintaining a sustainable fishery. This study confirms the value-add of perceptions to build on existing datasets to inform fisheries compliance strategies within and beyond this fishery and jurisdiction.

## Method

A voluntary and anonymous exploratory online survey was developed on the online survey platform, ‘Qualtrics’, to answer the five research questions presented above. Human research ethics

approval was granted for the online survey on July 15, 2020, by the University of Western Australia Human Research Ethics Office (REF: RA/4/20/5978). The survey was active for completion from November 5, 2021, to December 17, 2021. Like other recent online surveys of this kind (for example, see Spencer et al., 2021), much of the survey was original and designed to capture the variables of interest for this study. Subject matter experts within the relevant government departments determined that the survey questionnaire adequately captured the data of interest. In survey development, consideration was given to ways to elicit truthful responses to survey questions given that underreporting of personal noncompliance is reportedly common in environmental crime (Davis et al., 2020). Anonymity provided due to online surveys reduced likelihood of bias to respond in a more compliant way.

The surveys comprised 10 questions (with nine of the 10 questions containing multiple parts), and included open-ended questions, multiple choice questions, and rating scales (see Appendix B). Questions sought participant perceptions on existing regulations; visibility of noncompliance and illegal fishing; inspections, enforcement and other measures to encourage greater compliance; and barriers to fisher participation and enjoyment. Free text encouraged expanded comments, which we thematically<sup>2</sup> analysed. Given that the fishery is licence-free, we are unable to validate results to sensitive topics, such as personal engagement in noncompliance (RQ 1) and perceptions of illegal activity in the fishery (RQ 5).

The study site of interest was the recreational Peel-Harvey blue swimmer crab fishery in WA. The Peel-Harvey Estuary is an area of approximately 136-square kilometres and comprises a significant habitat for blue swimmer crabs in WA (see Appendix A). It has also been identified as having the highest level of blue swimmer crab noncompliance in WA (Fletcher et al., 2017). The total population of fishers in this jurisdiction is unknown because the fishery lacks licencing or registration requirements. As such, surveying a random representative sample of known fishers was not possible. Instead, we opted for a snowball-style recruitment<sup>3</sup> similar to other recent online surveys of fishers (Howarth et al., 2021). Specifically, the surveys were initially disseminated to government representatives and industry stakeholders who were

<sup>2</sup> No themes were coded in advance. Every question response was scanned through several times. Each question response was summarised and coded with keywords. Then, after scanning through the keywords, responses were grouped into broader coding categories. It was these broader coding categories that were then quantitatively analysed, and supplementary qualitative data pulled out. In essence, coding relied on each response being summarised into descriptive keywords, and then broader categories emerged from related keywords.

<sup>3</sup> Snowball-style recruitment involves using participant referrals to build the sample.

<sup>1</sup> See Fisheries Research and Development Corporation grant 2019-011. <https://www.frdc.com.au/project/2019-011>.

encouraged to share the survey with relevant peers who are known fishers. The survey was concurrently advertised *via* social media platforms including LinkedIn, Facebook, and Twitter, from November 29, 2021, as well as *via* the official WA Fisheries newsletter, *Catch!*<sup>4</sup> This enabled the research team to leverage prior contacts and those engaged broadly in recreational fishing to disseminate the survey to relevant parties, a method demonstrated to be helpful in snowball sampling (Kirchherr & Charles, 2018). Given non-random sampling was used, it is not possible to infer that the surveyed respondents are representative of the broader population of interest (Szolnoki & Hoffmann, 2013). As such, we are careful not to make such claims in the results interpretation. Recruiting participants through social media platforms does, however, come with the benefit of being highly effective at reaching subpopulations who may be missed with random sampling (Brickman Bhutta, 2012; Schneider & Harknett, 2019). The sampling method used here was also consistent with the exploratory nature of the analysis. Descriptive analyzes and chi-square tests<sup>5</sup> of quantitative survey questions were conducted in *R*. Thematic analyzes of the qualitative survey data involved systematically scanning through qualitative responses, coding the responses, identifying emergent themes in the data, and grouping responses by theme, as well as pulling out representative or novel quotes to supplement the descriptive analyzes.

## Results

A total of 215 respondents completed the online survey, of which two were subsequently excluded due to incoherent text entries throughout the survey (mashing the keyboard and single letter responses throughout). This resulted in a total of 213 respondents who completed the survey and were included in the analysis. The median duration to complete the survey was 27 minutes. The remainder of the results are presented under the relevant research question.

### RQ1. What is the opportunity structure for Peel-Harvey blue swimmer crab fishers to engage in noncompliance?

The median number of trips per calendar year that the survey respondents reported going blue swimmer crab fishing in the Peel-Harvey estuary was eight trips, with the vast majority of respondents selecting a range between zero and 10 trips (66% of

the 213 respondents), or between 11 and 20 trips (22% of the 213 respondents). The majority of respondents also reported catching an average number of blue swimmer crabs per fishing trip within the legal catch limit (10 crabs or less; 78% of the 211 respondents).<sup>6</sup> Of the remaining respondents, 10% reported catching an average of 11-15 crabs per fishing trip, 9% reported catching an average of 16-20 crabs per fishing trip, and 3% reported catching an average of more than 20 crabs per fishing trip. The average number of crabs caught per fishing trip was not statistically different based on how many fishing trips per calendar year respondents reported going blue swimmer crabbing in the Peel-Harvey estuary, ( $X^2(2, N = 161) = 4.77, p = .09$ ).<sup>7</sup> While the test result did not reach conventional statistical significance ( $p < .05$ ), a visual inspection of cases showed that respondents who reported catching an average number of crabs per fishing trip over the legal limit were more likely to have reported going on 10 or more crabbing trips per calendar year (43% of those fishing over the legal limit per average fishing trip reported going on 10 or more crabbing trips per calendar year, compared to 26% of those catching 0-5 crabs per fishing trip on average, and 23% of those catching 6-10 crabs per fishing trip on average).

The majority of respondents (97%;  $n = 206$ ) cited 'never' (63%;  $n = 134$ ) or 'sometimes' (34%;  $n = 72$ ) having their catch inspected during fishing trips, while four respondents reported that their catch was inspected 'about half the time', two reported 'most of the time', and one reported 'always'. A similarly high proportion of respondents (92%;  $n = 196$ ) reported 'never' (44%;  $n = 93$ ) or 'sometimes' (48%;  $n = 103$ ) seeing fisheries inspections officers patrolling while fishing for Peel-Harvey blue swimmer crabs. An additional 12 respondents (6%) reported seeing fisheries inspections officers patrolling 'about half the time', while four indicated 'most of the time', and one indicated 'always'. The average number of crabs caught per fishing trip was not statistically different based on whether respondents had 'never' or 'sometimes' had their catch inspected ( $X^2(2, N = 177) = 1.16$ ,

<sup>4</sup> This newsletter was also advertised via social media platforms.

<sup>5</sup> In some instances where responses were flagged as outliers or belonging to a case with too few responses (and thus violating the assumptions of the chi-square test), that specific response was excluded from that analysis. Upon

<sup>6</sup> Two outliers were excluded from this analysis. These respondents reported average catch estimates over three standard deviations from the mean (both were above 100 crabs).

<sup>7</sup> Respondents who reported catching an average of 16 or more crabs per fishing trip and/or reported going on 21 or more crabbing trips per calendar year were excluded from this chi-square analysis due to the small number of cases precluding meaningful analysis. Having reviewed these excluded fishers' responses in isolation, their qualitative responses are representative of the broader sample. The vast majority reported the need for greater enforcement and harsher penalties, as well as reporting an array of different educational strategies when asked how information should be shared with other fishers.

$p = .56$ ),<sup>8</sup> nor whether respondents had ‘never’ or ‘sometimes’ seen fisheries inspections officers patrolling while fishing ( $X^2 (2, N = 170) = 2.83, p = .24$ ).<sup>9</sup>

## RQ2. What are the perceptions among fishers of the current rules and regulations governing the Peel-Harvey blue swimmer crab fishery?

The majority of the respondents who provided an overall assessment in their free-text comments about the current rules and regulations in the Peel-Harvey blue swimmer crab fishery, reported favorably. Specifically, 87% (121 of the 139 respondents to make a general assessment) made comments that the current rules and regulations were ‘very fair’, ‘fair’, ‘good’, ‘excellent’, ‘reasonable’, etc. However, despite the general consensus that the rules and regulations were fair, a large proportion of respondents stated that they were not being enforced sufficiently. Specifically, 64 respondents (30% of total respondents) indicated that current enforcement of the rules and regulations was insufficient. Respondents cited the need for a greater number of fisheries officers (a greater presence and more frequent and targeted patrols), more random inspections, with some respondents suggesting suitably trained volunteers may fulfill some of these roles. Relatedly, 55 respondents (26% of total respondents) stated that they believe penalties need to be harsher for offenders, in contrast to only three respondents (1% of total respondents) who indicated that they believe the current penalties are fair. It is important to note that a large proportion of respondents also provided feedback on how the rules and regulations could be improved in other ways. Of these respondents, 29 (14% of total respondents) stated that they believe the closed season should be extended to allow the blue swimmer crab stock to recover. For example:

Fisher 6: “Honestly believe the season should still be closed in the peel till 1st January each year though. In general crab sizes in the peel are smaller than most other waterways. Give them a chance to grow a bit over a warmer month.”

Fisher 14: “The season opening needs to be delayed until the vast majority of crab stocks have reached 135mm. Stocks should be monitored by fisheries by setting traps up the Harvey and around the Peel. When 80% of stock reaches the criteria then the season declared open (same as the prawning industry) If this is late December due to seasonal fluctuations the so be it, if the criteria is not reached until mid January then that’s when the season opens...”

Fisher 92: “Crabbing season needs to be completely overhauled to reflect available crab stocks and the quality of stocks given their potential to grow as the water temps rise.”

17 respondents (8% of total respondents) stated that they believe a licence should be introduced for land-based blue swimmer crab fishers in the Peel-Harvey estuary. For example:

Fisher 25: “Also why not licence the process, as a boatie and crafisher [sic] I need to pay for the luxury to catch crayfish, why not crabs? This money could be used for more surveillance!!”

Fisher 147: “People should be required to hold a license and lose it if caught with undersized or excess crabs. A license will assist in promoting regulation requirements and assist officers on patrol.”

Fisher 124: “Bring in a recreational license to scoop, so people can’t deny they don’t know the rules.”

Figure 1 shows a breakdown of factors that reduce or impact blue swimmer crab fishers’ enjoyment when fishing in the Peel-Harvey estuary.

A large proportion of respondents (35% of all respondents) made free-text comments indicating that low stock numbers or a lack of legal sized crabs negatively impacted their enjoyment when blue swimmer crab fishing in the Peel-Harvey estuary.

## RQ3. How can education be optimized to ensure compliance in the Peel-Harvey blue swimmer crab fishery according to fishers?

Figure 2 shows a breakdown of the ways in which information should be shared with fishers according to Peel-Harvey blue swimmer crab fishers.

<sup>8</sup> Respondents who reported catching an average of 16 or more crabs per fishing trip and/or reported having their catch inspected ‘about half the time’, ‘most of the time’, or ‘always’ were excluded from this specific chi-square analysis due to the small number of cases precluding meaningful analysis, but reincluded for subsequent analyses, providing they were not also outliers/belonging to a case with too few responses for chi square analysis. Their qualitative responses, however are representative of the broader sample

<sup>9</sup> Respondents who reported catching an average of 16 or more crabs per fishing trip and/or reported having seeing fisheries inspections officers patrolling ‘about half the time’, ‘most of the time’, or ‘always’ were excluded from this chi-square analysis due to the small number of cases precluding meaningful analysis.

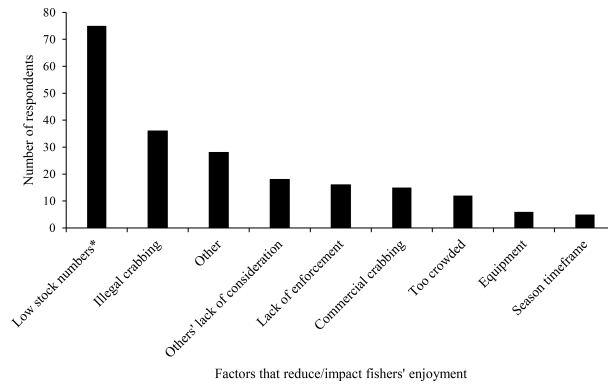


FIGURE 1

Factors that reduce or impact blue swimmer crab fishers' enjoyment when fishing in the Peel-Harvey estuary. Note: \*Low stock numbers includes comments relating to 'lack of legal sized crabs'. Factors derived from free-text responses.

Many of the respondents who cited increasing signage, suggested using more multilingual signs, and ensuring signs are permanently displayed (rather than temporarily) at all popular crabbing access points. For example:

Fisher 69: "I see the crabbing banners you have up at boat ramps, island point, yunderup areas and around town. But I think more areas need to be covered with PERMANENT signage. Also in different language (which you already do)."

Fisher 82: "Signs at popular crabbing spots. I have actually bugged up when I first started crabbing and thought the limit was 12 crabs so it's easy done."

There was some overlap in the 'fisheries officers on the ground' comments with having more fisheries officers for enforcement purposes, reflecting the already established perception among a large proportion of respondents that greater enforcement of the rules and regulations is needed. However, many of these comments related solely to information provision. Many respondents ( $n = 42$ ) also suggested mandatory recreational licences for land-based fishers as a means to share compliance information, for example:

Fisher 12: "Everyone needs a licence! Even those wading in. It would ensure that they at least have received a copy of the rules."

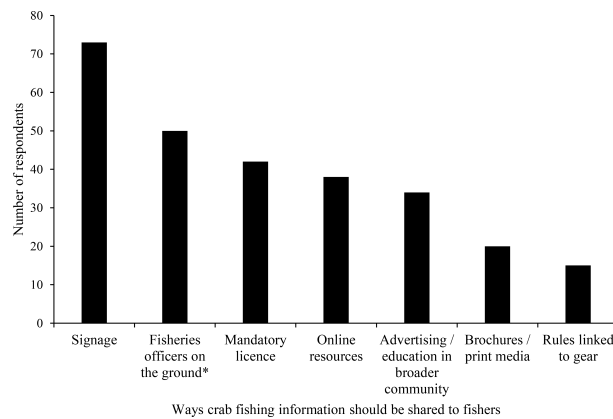


FIGURE 2

Ways in which information about crab fishing should be shared with fishers according to Peel-Harvey blue swimmer crab fishers. Note: \*Fisheries officers on the ground includes comments relating to fisheries volunteers performing information-sharing duties. Themes derived from free-text responses.

Fisher 106: “Licenced so everyone is then given access to the rules. Doesn’t [sic] have to be a charge for it but just a registration.”

Fisher 116: “Ensure everyone who crabs has a licence (make it free or charge \$1) but require applicants to answer three or four questions relating to crabbing regulations before it is issued.”

Fisher 135: “I actually believe that a licence is not a bad way to go. Even just for a small fee. That way, the rules and regulations can be conveyed to the licence holder at the time of licence issue and there is no way that they can plead ignorant to the rules. The signs and information at boat ramps is good but people will argue that “they just didn’t see it”.”

The most common time period derived from free-text responses relating to the optimal time to educate fishers was prior to the crabbing season start or during the start of the crabbing season ( $n = 41$ ), though many respondents suggested information should be shared throughout the whole year ( $n = 39$ ). A similar theme emerged regarding perceptions of the frequency with which education programs should be delivered to fishers, with the most common themes being ‘as often as possible’, ‘all the time’, or ‘daily’ ( $n = 81$ ). With respect to more specific times to share compliance information with fishers, 32 respondents suggested weekends, 22 respondents suggested evenings or at night, and 18 respondents suggested mornings. Novel suggestions about how fishers could best be educated on the fishery rules and regulations included introducing a free course attached to a mandatory licence:

Fisher 17: “when licenses are mandatory, offer a free course for people to attend that have just got their license so they are educated and ready to go.”

A competition to gain insight into what is being taken and where:

Fisher 43: “Possibly a competition similar to the Salmon slam to gain insight into what is being caught where and when.”

Fisher 191: “I believe a lot is already being done. However, being involved with local fishing clubs or even promoting a competition style fishing day with tagged crabs could increase awareness and greater involvement with this fishery.”

Quick response (QR) codes linking to simple rules:

Fisher 84: “Qr codes to take you to tsimple [sic] rules in all languages.”

As well as volunteer fisheries officers providing education services to other fishers:

Fisher 95: “Open up to the locals a chance to become a VFO to educate only. Give them a high visibility vest. A head torch. A hat. Insect repellent A portable table for educational material. With a portable spot light a led lighting. Make them visible. Free crab measures...”

#### RQ4. How can enforcement be optimized to ensure compliance in the Peel-Harvey blue swimmer crab fishery according to fishers?

Figure 3 shows a breakdown of how often respondents felt fisheries inspectors should be active in the Peel-Harvey blue swimmer crab fishery. As depicted in the Figure, ‘4 times a day’ was the most common frequency selected by respondents (35% of the 208 respondents to answer), while the next most common frequency selected was ‘2 times a day’ (selected by 28% of the 208 respondents to answer).

Figure 4 shows a breakdown of the best times to inspect fishers’ catches according to respondents. As depicted in the Figure, the two most frequently selected times were on the weekend: specifically, on weekend mornings (65% of the 208 respondents to answer) and weekend evenings (57% of the 208 respondents to answer), although weekday mornings and weekday evenings were also well-represented answers.

The most common themes derived from respondents’ free-text responses concerning additional suggestions on how to better enforce rules and regulations in the Peel-Harvey estuary, were increasing the enforcement presence ( $n = 82$ ; 32% of all respondents), harsher penalties ( $n = 29$ ; 14% of respondents), and more targeted inspections ( $n = 26$ ; 12% of respondents). Comments relating to the use of more targeted inspections included:

Fisher 1: “Target inspections around periods of crab abundance, good weather and peak fishing generally.”

Fisher 57: “Publicised Road block blitz seem to work. Invite a news crew along. Do that 4-5 times a season.”

Fisher 29 “Drones could give better and quicker coverage of different areas to allow fisheries officers to target their efforts to busy spots or problem areas. CCTV in heavy use areas such as under the bridges.”

The survey asked respondents to provide a yes or no response as to whether DPIRD should be supported by other groups to help control or reduce noncompliance. The majority of respondents indicated that they believed DPIRD should be supported by other groups ( $n = 162$ ; 81%). The most common

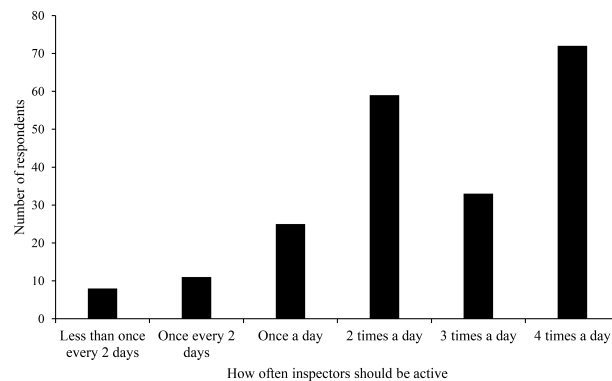


FIGURE 3

How often fisheries inspectors should be active according to Peel-Harvey blue swimmer crab fishers. Note: 208 respondents answered the question. Respondents were only able to select one option.

group identified by respondents to support DPIRD in helping to control or reduce noncompliance was the community ( $n = 50$ ), with local council rangers second to this ( $n = 32$ ). Of the respondents who suggested that the community should support DPIRD, 22 specifically mentioned enlisting volunteer fisheries officers to inspect catches; 10 mentioned introducing a mechanism whereby fishers could report suspicious fishing activity and attach photographic or video evidence; and six mentioned using a Neighborhood Watch approach. Comments included:

Fisher 3: “Bring back the volunteer fisheries officers. The yellow shirts were a deterrent.”

Fisher 7: “Neighbourhood watch programs but when a call is made an officer needs to attend as this does not happen very often.”

Fisher 191: “Potentially bringing something similar to dobbing in a hoon on the roads by submitting videos/ photographic evidence would be good.”

Fisher 198: “I believe that we should be able to make a phone call and be able to get someone in a timely fashion to patrol this problem.”

Relatedly, several respondents suggested FishWatch reporting should be encouraged more often,<sup>10</sup> for example:

Fisher 196: “...FishWatch reporting should be encouraged.”

Fisher 135: “Fishwatch reporting is good but it has to be acted on quickly before the offenders take off.”

Fisher 29: “Other government agencies may work and advertising FISHWATCH more often.”

Despite a reasonably large number of respondents citing ‘the community’ as a group that should help support DPIRD in controlling and reducing noncompliance ( $n = 50$ ), there was also a similar number of respondents who expressed disapproval or concern with the notion of ‘shared regulation’ with the community ( $n = 40$ ). Most of these respondents appeared to interpret shared regulation as empowering recreational fishers to intervene with/ confront suspected rule-breakers, and were concerned with the potential for vigilantism and conflict arising, for example:

Fisher 64: “I am afraid of vigilante style groups getting started, I would leave it to the professionals, just hire more of them”

Fisher 101: “I don’t think it is a good idea for other recreational fishers or volunteers to get involved in enforcement activities. They are not as well trained as the DPIRD officers.”

Fisher 116: “Reporting to authorities (DPIRD/Fish Watch) is adequate and appropriate for members of the community. The concept of crab inspired vigilantism is a concern, especially if people try to ‘enforce’ regulations such as inspecting a catch, detaining or confiscation etc.”

Fisher 199: “This is a tough issue for private individuals to start policing fishers given the security concerns of individuals or groups getting aggressive towards those volunteers trying to enforce it. I have seen this first-hand.”

This split between those in favor of shared regulation and those not in favor was also apparent in the response to the

<sup>10</sup> FishWatch is an existing 24/7 phone line for members of the public to report suspected illegal fishing activity.



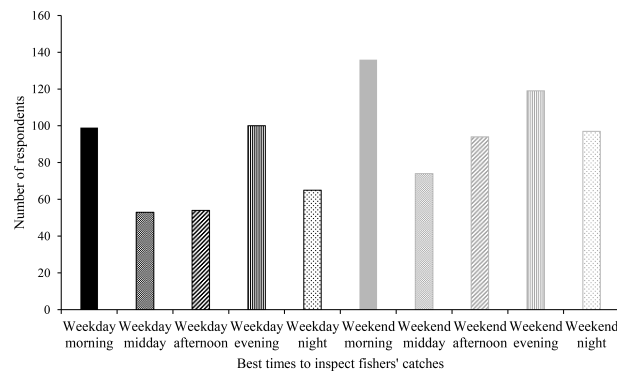


FIGURE 4

The best times to inspect fishers' catches according to Peel-Harvey blue swimmer crab fishers. Note: 208 respondents answered the question. Respondents were able to select multiple responses.

question relating to whether or not there were barriers to shared regulation in the fishery. Approximately half of the respondents ( $n = 109$ ; 53% of the 207 respondents to answer) indicated that they did not believe there were any barriers to shared regulation, while the other half of respondents ( $n = 98$ ; 47% of the 207 respondents to answer) indicated that they did believe there were barriers to shared regulation. The most common barriers identified were the risk of conflict between fishers and shared regulators, potential emergence of vigilante groups, risks to personal safety, and the related concepts of a lack of training and professional standards of shared regulators.

## RQ5. What is the perceived extent of noncompliance in the Peel-Harvey blue swimmer crab fishery?

Figure 5 shows a breakdown of how often respondents saw other fishers in the Peel-Harvey blue swimmer crab fishery who were not following the rules. As depicted in the Figure, the vast majority of respondents indicated that they had at least 'sometimes' seen other fishers breaking the rules, while only 9% of respondents indicated that they had 'never' seen other fishers breaking the rules.

Despite the large proportion of respondents to indicate that they had at least sometimes seen other fishers breaking the rules, 50 percent of respondents indicated that they had 'never' formally reported noncompliance.<sup>11</sup>

<sup>11</sup> The remaining breakdown of responses was: 28% indicated that they 'sometimes' formally report noncompliance, 4% indicated that they formally report noncompliance 'about half the time', 6% indicated that they formally report noncompliance 'most of the time', and 13% indicated that they 'always' formally report noncompliance.

## Discussion

In this section, we discuss the results from the compliance perceptions survey with a view to understand perceived gaps and opportunities to optimize compliance, drawing on situational crime prevention. While perceptions data represent a sample of the population which do not necessarily reflect that of the broader population of fishers or community more widely, they provide insight into an otherwise cryptic population as licences are not required for recreational shore-based participation in blue swimmer crab fishing in WA. Specific to fisheries compliance, Garza-Gil et al. (2015) found that community fishers valued engagement with the regulator. As such, compliance survey results can usefully guide regulators in determining appropriate education and enforcement directions, following situational crime prevention. Regulator-led cooperation with the fishing community can optimize compliance outcomes.

Cooperative compliance seeks to empower the fisher to want to comply. This can be achieved through enhancing education and enforcement strategies. Enhancing the information communicated to include the *why*, may be more effective than just communicating the *what*. For example, in WA in 2015-16 the international standard-setting body, the Marine Stewardship Council (MSC) certified its first recreational fishery, the iconic WA Peel-Harvey blue swimmer crab fishery. Maintaining this as a sustainable recreational fishery is a high priority for DPIRD, however information about the certifier and what the certification means for the fishery, and beyond, may not be commonly known among the recreational blue swimmer crab fishing community. Indeed, communicating with the recreational fishing community as to why the fishery may even require regulatory controls may be necessary to encourage compliance (McClanahan & Abunge, 2016). Without broad knowledge transfer, there may be lesser incentive to comply.

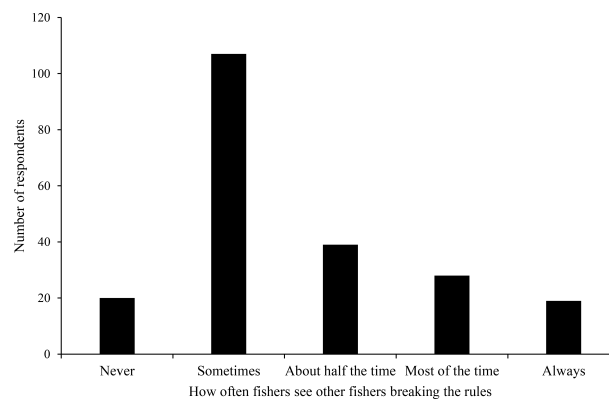


FIGURE 5

How often blue swimmer crab fishers saw other fishers in the Peel-Harvey blue swimmer crab fishery who were not following the rules. Note: All 213 respondents answered the question. Respondents were only able to select one option.

Optimising compliance in the blue swimmer crab fishery can be achieved in two overarching ways:

- Enforcement – administrative changes by the regulator to the fishery; and
- Education – targeting fishers to encourage altered behaviors when engaging in the fishery.

To find opportunities for enhancing compliance within the existing legislative regime, situational crime prevention is useful to review the opportunity structure in which crime/noncompliance is high, rather than focusing on the motivations and behaviors of fishers. Accepting that there will always exist people who are motivated to offend/noncomply (Clarke, 1997: p4), it is essential that regulators look to adopt measures that increase the difficulty and risks associated with noncompliance as a means of encouraging compliance. While initial costs to implement measures to prevent noncompliance may be high, the ongoing benefit of situational crime prevention approaches is through reduced regulator engagement, though ongoing monitoring is essential. The following sections draw on the present survey results and available literature.

## Enforcement

Understanding how fishers seek enjoyment from the fishery can enable enhanced compliance outcomes. Survey participants were asked what would reduce or impact on their enjoyment while fishing for blue swimmer crabs. Resoundingly, the most common response was ‘low stock numbers’, followed by ‘undersized crabs’. Suggestions to extend season closures, or piloting limited participation to weekends to assist stock growth indicates survey participants accept and support sustainable

approaches to managing the fishery involving incentivized regulatory approaches to compliance (*the carrot approach*) (Geest & Dari-Mattiacci, 2013), as it will likely lead to greater enjoyment through increased size and availability of crabs. Recent perceptions research focused only on WA, supports these compliance strategies (Obrego'n et al., 2020).

Nine percent of survey respondents indicated that they had ‘never’ witnessed noncompliance in the Peel-Harvey blue swimmer crab fishery. This may imply there is a culture of noncompliance within the fishery, however 63% indicated they ‘never’ have had their catch inspected and 92% indicated they ‘never’ or only ‘sometimes’ see fisheries compliance officers on patrol. As we cannot determine the rate of inspection against participant numbers, we must infer inspections are too infrequent.<sup>12</sup> Despite the use of 24-hour thermal technology to capture fisher movement (including capturing noncompliance at three popular fishing locations within the Peel-Harvey Estuary (Taylor et al., 2018)) and the use of camera and drones to survey fisher engagement (Tate et al., 2020), without increased visibility of fisheries compliance officers the perceived risk of interception is low.

Without visible and regular surveillance, illegal fishing will likely continue. A large proportion of respondents indicated the existing regulations are enforced insufficiently and more than a quarter indicated penalties should be harsher. Working within the existing regulatory regime, compliance officers may issue infringements more frequently than warnings (Lindley & Quinn, forthcoming), enhancing a tough stance on compliance (*the stick*

<sup>12</sup> DPIRD fisheries compliance officers operate on rotational shifts during all times of the year, including during seasonal closures. Due to the considerable size of the Peel-Harvey Estuary (see Appendix A), patrolling all popular and less common fishing areas can be challenging. Officers also attend to noncompliance ‘tip offs’ from the public.

approach) (Geest & Dari-Mattiacci, 2013). Against situational crime prevention, high visibility of physical and natural surveillance can increase the perceived risk of interception of (would be) offenders/noncompliers (Cornish & Clarke, 2003). To counter this perception, the regulator (DPIRD) working alongside the local area manager (City of Mandurah) may consider deploying measures with low ongoing costs to increase the risk of interception, such as increased area and carpark lighting at night to decrease opportunity for stealth activity; and installation of lockable gates that are locked outside patrolling hours at viable entry points to limit vehicle entry. Further, consistent year-round patrols must compliment education strategies to inform potential (noncompliant) participants during low<sup>13</sup>, shoulder and closed seasons as serious noncompliers are more likely to operate during anomalous periods when surveillance is known to be low(er).

Limited visibility of formal regulators may be supported by informal approaches, harnessing cooperative compliance. For example, cooperative compliance may include trained volunteer enforcement officers wearing either high visibility vests, or plain clothed who can capture footage and report back to regulators. Some survey participants indicated reservations as to volunteer enforcement approach operationally, with concerns of the potential for vigilantism, inciting violence among fishers, and/or potentially cause a rift in the recreational fisher community. Research on shared informal/formal operational fisheries compliance suggests that it should remain within the remit of the regulator (Garza-Gil et al., 2015). Instead, volunteer education officers could support the sharing of regulations in a less threatening manner, as is the case in other parts of Australia and the world (New South Wales Department of Primary Industries, 2022; U.S. Fish and Wildlife Service, 2022). Alternatively, participants suggested introducing a fee-paying licence for blue swimmer crab fishers. Doing so could support the funding of additional education and compliance strategies. For example, respondents indicated that recruitment of more compliance officers or community volunteers who have capacity to inspect more catches coming to shore would reduce noncompliance.

Rather than seeking community support for intercepting noncompliance, another example of cooperative compliance is to enhance formal reporting of noncompliance incidents. This approach may be equally as effective, safer, and require less coordinated effort. Despite most survey respondents indicating that they have witnessed noncompliance, 50 percent have never formally reported the incident to authorities. Developing strategies to enable simplified noncompliance reporting appears

to be an opportunity for the regulator. Methods such as visible quick response (QR) codes, or in app noncompliance reporting with GPS, as well as options to upload photo and/or video footage could also be effective and minimize the need to complete time consuming and detailed (online) forms, or relying on telephoning a hotline. Ensuring that regulators are providing opportunities for all generations of recreational fishers will assist in communicating a strong message of compliance intergenerationally within families and communities.

## Education

Participants were also asked their views on education strategies to enhance compliance. DPIRD already adopts a range of educational strategies such as large multi-lingual temporary banners erected near popular fishing spots, permanent signage at beach access points and car-parks, mobile illuminated trailer signs, dedicated educational outreach programs, and social and digital media detailing the rules (for instance, an app published by Recfishwest, and the DPIRD Fisheries website). Additionally, DPIRD has a strategic communication plan, using media articles to promote sustainable fishing messages and seek to deter by publicly broadcasting newsworthy apprehensions and court outcomes. In addition to these strategies, survey participants suggested that installing permanent multi-lingual signage in popular fishing locations would be a valuable addition. Annual licencing enables regulators to communicate current regulations, often at the start of the fishing season. For licence-free fisheries such as the WA shore-based blue swimmer crab, email subscriptions and social media posts are integral.

Unlike traditional communication means, social media enables short, fast, cost-effective and frequent communications. The use of species-focused handles and hashtags will likely centralize those engaging through shares, likes and follows – a form of cooperative compliance – and useful for a licence-free fishery. Survey respondents suggest regulators should be communicating with their target populations at the start of the season opening (41 of the total respondents) continuing throughout the year (39 of the total respondents) and at a frequency of as often as possible (81 of the total respondents) would be suitable to enhance compliance.

Sharing the responsibility through adopting cooperative compliance with the wider fishing community may bring about a willingness to comply and to report noncompliance. Garza-Gil et al. (2015) found that community fishers valued participation in regulatory development, as such compliance survey results can usefully guide education and enforcement directions. Embracing the recreational fishing community's views, though pilots, consultative feedback, and perceptions surveys are essential methods to ensure the balance between fisher enjoyment and compliance is met. This message must underpin a successful

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<sup>13</sup> During the colder months, crabs of any size are less likely to be visible and therefore capture more challenging, however the continued patrolling cements the regulator's commitment to enforcement, limiting opportunity for unsuspecting noncompliers.

cooperative compliance strategy. However, there is certainly the need to consider that those willing to complete a survey on fisher compliance would be likely among those who often comply with the existing rules. As such, there is potential that if regulatory changes to the education and enforcement strategies are adopted to control noncompliance, overall fisher enjoyment may reduce, which may lead to greater noncompliance as has been evidenced in other studies around the world.

## Conclusion

Balancing fisher enjoyment and compliance is essential to promote and manage sustainable recreational fisheries. This research presented recreational fisher perceptions about compliance and regulation of the Peel-Harvey blue swimmer crab fishery. As this is a licence-free fishery, little is known about the participating fishing community and as such, these perceptions data fill a gap in knowledge while acknowledging self-reporting limitations that this subpopulation does not necessarily reflect the wider fishing community. Alongside other available data sources, such as regulator-held quantitative noncompliance instances data (Lindley & Quinn, *forthcoming*), perceptions can provide insight that may be useful to shape the future of the regulation and educational approaches to this fishery.

The results of the data analyzed in this paper provided two important findings: first, most survey participants self-reported compliance with take limits set for the fishery. This is a useful finding as there is lack of clarity around participation numbers, their effort and take as participation in the shore-based blue swimmer crab fishery is permitted without a licence. Second, the participants overwhelmingly agreed that the enforcement response efforts, including increased surveillance and enforcement presence, higher penalties, and more targeted inspections would be welcomed alongside enhanced education opportunities to optimize compliance within the fishery. Against a backdrop of situational crime prevention, whereby the regulator proactively addresses vulnerabilities to limit opportunity for noncompliance the adoption of cooperative compliance strategies, a branch of regulator-led prevention, empowers the fisher to engage more closely with the fishery and work with the regulator to achieve a shared goal to protect the fishery and ensure its sustainability for the long-term. These results have potential application within and beyond this fishery and jurisdiction.

## Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

## Ethics statement

The studies involving human participants were reviewed and approved by University of Western Australia Human Research Ethics Office (REF: RA/4/20/5978). The patients/participants provided their written informed consent to participate in this study.

## Author contributions

JL: Conceptualization, Methodology, Writing – Original Draft, Review and Editing, Supervision, Visualization; LQ: Methodology, Software, Data Curation, Formal Analysis, Writing – Original Draft. All authors contributed to the article and approved the submitted version.

## Funding

The authors would like to thank the Fisheries Research and Development Corporation on behalf of the Australian Government for supporting this research by funding from overarching project ‘2019-011: Optimising Compliance Outcomes in Recreational Fisheries’. The authors are also grateful for in-kind support from the University of Western Australia, the Western Australian Department of Primary Industries and Regional Development (DPIRD), the South Australian (SA) Primary Industries and Regions South Australia (PIRSA) and Victorian Fisheries Authority.

## Acknowledgments

The authors would like to acknowledge Dr Timothy Green, Western Australian Department of Primary Industries and Regional Development (DPIRD) and Randel Donovan, South Australian (SA) Primary Industries and Regions South Australia (PIRSA) for their valuable feedback on early drafts of this manuscript. The authors would also like to thank the editors and reviewers for comments on previous versions of this manuscript.

## Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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