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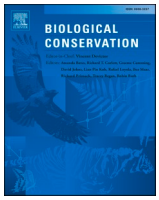

"I let it go:" Quantifying residential guardianship intentions when witnessing wildlife poaching

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ABSTRACT

The need to engage communities in wildlife crime prevention is particularly salient at the poaching stage, especially in biodiverse areas where communities overlap with wildlife, and ample constraints to and concerns about formal law enforcement persist. Guardianship is a concept from criminology that examines the willingness of stakeholders to assume informal roles as protectors and intervene to disrupt crimes. While it is conceptually related to stewardship, elaborating criminology's concept of guardianship in conservation allows us to develop an understanding of situational and motivational factors, and the obstacles and opportunities for increased crime preventing interventions. We developed a Guardianship Intention Index (GII) that quantifies respondents' reported willingness to supervise, perceived ability to detect offenders, and willingness to intervene when witnessing wildlife poaching within communities ($N = 10$) adjacent to or living in Bukit Barisan Selatan National Park, Sumatra, Indonesia. This allowed us to explore potential relationships between guardianship dimensions and attitudinal and demographic characteristics. Among our study population ($N = 400$), we found that demographic and attitudinal dimensions affected respondents' stated willingness to intervene and varied between interveners (e.g., call authorities) and those that stated non-intervention intentions (e.g., join in, ignore, covert monitoring). However, the same respondents that reported a high intention to intervene when witnessing poaching often expressed low willingness to supervise for illegal activities in the park. Parsing out differences in guardianship behavior and attitudes influencing those behaviors provides new entry points for community-based wildlife crime prevention and may facilitate efforts to increase incentives for wildlife stewardship, more broadly.

1. Introduction

Conservation scholars have proposed various pathways to enhance community-level engagement and action in response to wildlife crimes such as poaching. One pathway is to *increase incentives for wildlife stewardship* (Biggs et al., 2016). This conceptualization is largely rooted in the idea that community-based benefit sharing specifically, and enabling ownership and wildlife user rights more generally, is an essential component of motivating individuals for compliance (e.g., Kahler and Gore, 2015). The idea of stewardship as a conduit of conservation and community management has been pervasive (e.g., Bennett et al., 2018). However, until recently, stewardship lacked a clear definition and suffered from deficient conceptualization, which hampered the evaluation and application of the concept as a prescriptive solution for community-based conservation approaches to reduce wildlife crime (Bennett et al., 2018). Turnbull et al. (2020) developed a quantitative stewardship indicator using a grounded theory approach examining reported stewardship behaviors and motivations associated with a marine protected area. Building on earlier conceptual frameworks, these researchers empirically confirmed the existing six actions (e.g., advocacy actions, sustainable use actions) and added a seventh particularly relevant to protected areas: *informal enforcement actions* (Turnbull et al., 2020).

There is an opportunity to further articulate, quantify, understand predicators, and capture the diverse behavioral responses associated with Turnbull et al.'s (2020) stewardship action *informal enforcement*. The criminological concept of guardianship (e.g., Reynald, 2010) examines the willingness of stakeholders to assume an informal role as protectors and intervene to disrupt crimes. The concept of guardians and guardianship is used in crime analysis to understand crime prevention.

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The crime triangle or problem analysis triangle (Clarke and Eck, 2005) operationalizes routine activity theory (Cohen and Felson, 1979) which explains that crime events occur when likely offenders come into contact with suitable targets in time and space in the absence of a capable guardian. The presence of capable guardians therefore reduces the likelihood of criminal violations. Guardianship, as conceptualized by a discipline focused on understanding public crime responses, provides a more robust conceptual articulation in terms of potential demographic, attitudinal, environmental, and socio-cultural influences on this behavior. The concept has three dimensions: 1) the willingness to supervise or monitor criminal violations, 2) the ability of the guardian to detect potential offenders, and 3) the willingness to intervene when faced with a criminal violation (Reynald, 2010). Guardianship has been measured as a behavioral intention (e.g., Reynald, 2010), through direct observation of potential guardian behavior (Hollis-Peel et al., 2012), and at an individual and neighborhood-level (e.g., Wilcox et al., 2007).

Additionally, the variations and intensity of the potential guardian's responses have been investigated in a variety of contexts (see Reynald et al., 2018). There is a continuum of intervention responses that spans from 'ignoring it' to performing both direct (e.g., stopping it alone) and indirect (e.g., calling the authorities) interventions (Reynald, 2010). These responses are often determined by situational factors related to a specific context and are significantly influenced by individuals' sense of responsibility for guarding or protecting targets at risk of violation (Reynald, 2011). Although incentives to intervene and engage in guardianship behavior are often strongest with personal property (e.g., homes, vehicles; see e.g., Reynald, 2011), residents often serve as communal watch guards within their residential communities. Individuals and communities may demonstrate varying degrees of willingness to intervene to protect property, discourage law breaking, or even try serve as handlers, intervening to control potential offenders such as local youth (Reynald, 2010). Guardianship therefore also involves the willingness of stakeholders to intervene or respond to potential offenders, disrupting violations, and has the potential to help us understand community resiliency regarding increasing incidents of wildlife crime in vulnerable conservation areas.

Much like stewardship, the notion of guardianship and the associated intervention responses, such as calling authorities, have been present in conservation literature and the practitioner's toolbox as desired pro-conservation behaviors (Table 1). Guardians are concerned with the deviant behaviors of others moving beyond personal compliance, to exercise social control and informal enforcement to reduce and prevent wildlife crimes in their communities. So, in much in the same way that Turnbull et al.'s (2020) Local Environmental Stewardship Indicator facilitated the measurement and transferability of stewardship, elaborating criminology's concept of guardianship in conservation allows us to develop an understanding of predictive and motivational factors, and obstacles to and opportunities for increased guardianship.

Table 1
The continuum of guardianship interventions from criminology, with increasing intensity (Reynald, 2010), with examples from conservation research and practice.

Guardianship intensity	Examples in conservation
Non-intervener	
Turn a blind eye	Most common response among surveyed fishers living adjacent to 55 marine protected areas when witnessing poaching was inaction (Bergseth et al., 2018)
Covert monitoring	Tolerating illegal shellfish poaching by those recognized as belonging to the community, Galicia, Spain (Ballesteros and Rodríguez-Rodríguez, 2018)
Intervener	
Indirect interventions	Community patrols dismantle illegal hunting camps and snares in Lao's PDR (Kragt et al., 2019)
Direct interventions	Village monitors and NGOs guard nests of Sulawesi's endemic maleo bird *Macrocephalon maleo* to intercede egg-poachers, Indonesia (Tasirin et al., 2021)
Indirect and direct interventions	Beach goers verbally tried to stop and called authorities on a couple that destroyed five loggerhead sea turtle nest and killed two black skimmer chicks, Anna Maria Island, Florida (Todaro, 2015)

In this study we develop a Guardianship Intention Index (GII) that quantifies respondents' reported willingness to supervise, perceived ability to detect offenders, and willingness to intervene when witnessing wildlife poaching in and around their communities. Quantification facilitates our exploration of potential relationships with attitudinal and demographic characteristics. In order to better understand how respondents viewed the harm or seriousness of wildlife poaching as a crime and wildlife species as a potential target or victim of crime we included the concepts of psychometric risk perceptions and wildlife value orientations (WVO) as they relate to the three dimensions of guardianship and the overall GII. This is supported theoretically because behavior attitudinal factors, such as a sense of responsibility, and the characteristics of the crime itself (e.g., violent, property) have been found to determine guardianship intensity (Reynald et al., 2018).

The theory of psychometric risk perception (Slovic, 1987) is advantageous when considering environmental crime as a socio-environmental risk. For example, risk perception research has been leveraged to understand the retaliatory and illegal killing of wildlife (e.g., Kahler and Gore, 2015; Kahler et al., 2013), and public reactions to emergent zoonotic disease outbreaks (e.g., Hanisch-Kirkbride et al., 2013). Personal experience with the risk and trust in authorities and experts have been found to have considerable impact on risk perceptions with consequences for decision-making and risk-reducing behavior (e.g., Wachinger et al., 2013). Across various contexts of risk research there is a documented discrepancy between the actual degree of risk and risk perceptions with explanations for this gap often focusing on affective judgments, demographic factors, and lack of information (Lecuyer et al., 2022); demonstrating support for the idea that "perception is reality." We used poaching-related risk perceptions as a proxy for poaching risk in the area.

WVO is a conceptual framework and measurement instrument to capture beliefs and value orientations about the nature of human-wildlife relationship, including the appropriateness of human use of wildlife (e.g., hunting, wildlife rights) (Fulton et al., 1996). This approach has been used to examine the acceptability of wildlife management interventions (Jacobs et al., 2014), and explored in international contexts (e.g., Tanakanjana and Saranet, 2007). Within the context of guardianship, we examined WVOs based on the domination and mutualism continuum. Domination value orientations are likely to hold utilitarian views, rate human actions related to wildlife death as acceptable, and believe wildlife management should prioritize human benefits (Jacobs et al., 2014). Those with mutualistic value orientations that are related to feelings of equalitarianism and equality and are therefore more likely to engage in behaviors that improve the security and health of individual wildlife (Jacobs et al., 2014). Accordingly, it would be predicted that those with stronger mutualistic value orientations would be more likely to intervene in the face of wildlife crimes.

We profile the case of wildlife guardianship in Sumatra, Indonesia, highlighting empirical findings from a biodiverse national park situated in a densely populated landscape. We conclude with a synthesis about advancing theoretical development and the practical application of guardianship with regard to community-based wildlife crime prevention. Exploring the theoretical, methodological, and applied aspects guardianship within the context of conservation may enhance efforts to engage communities as partners in wildlife crime prevention (e.g., Biggs et al., 2016) and help us diagnose the extent to which certain precursors for guardianship are present and how to bolster or sustain existing local interventions.

2. Methods

Our research objectives in this study were to:

1) Measure the three dimensions of guardianship, willingness to supervise, ability to detect offenders, and willingness to intervene, to create a Guardianship Intention Index (GII).
2) Examine relationships between the three dimensions of guardianship and the GII to demographic characteristics, the constructs of poaching related risk perceptions, and wildlife value orientations (WVO).
3) Investigate attitudinal and demographic differences between respondents that state they would intervene (i.e., direct, indirect, direct and indirect intervention) and those that stated they would not intervene (e.g., ignore it, covertly monitor).

2.1. Study area

Sumatra is Indonesia's western-most island and the sixth largest island in the world with high biodiversity threatened by habitat conversion and poaching. Bukit Barisan Selatan National Park (BBSNP) is Sumatra's third largest protected area (3568 km^2) covering >150 km of the Barisan Mountain range and is a United Nations Educational, Scientific and Cultural Organization (UNESCO) World Heritage Park with a 1000 km^2 forest block designated as an Intensive Protection Zone (IPZ) (Pusparini et al., 2018). The park is home to a number of IUCN designated Endangered mammals, such as Sumatran elephants (*Elephas maximus sumatranus*), Sumatran tiger (*Panthera tigris sumatrae*), and Sunda pangolins (*Manis javanica*), and over 275 bird species (Anggraini et al., 2000). BBSNP has a long history filled with colonial conflicts, commodity agriculture (e.g., coffee, palm oil), commercial logging, political upheavals, economic booms and busts, inter-island migration, development, and contentious waves of evictions and encroachment (Levang et al., 2012). Dense areas of agricultural fields, plantations, and villages are clustered on the borders of the park and high levels of deforestation have been recorded since the park's establishment (McCarthy et al., 2015).

In addition to the aforementioned anthropogenic pressures, illegal trafficking of wildlife and wildlife species threatens the biodiversity of BBSNP and the park is on UNESCO's List of World Heritage Parks in Danger (Pusparini et al., 2018). Research on poaching in Sumatra is more prevalent in Kerinci Seblat National Park north of BBSNP. For example, Risdianto et al. (2016) found changes in techniques deployed for tiger poaching (e.g., increase in snare trap clusters) and increases in Sambar deer (*Rusa unicolor*) poaching during the month of Ramadan in Kerinci Seblat. In BBSNP, a 2015 camera trap survey aimed at determining the density of critically endangered Sumatran tiger and its prey in BBSNP detected high numbers of people illegally entering the park with 20 % of these incidents ($n = 77$) recorded over a 6-month period being armed poachers (Pusparini et al., 2018).

Extending local guardianship in and around BBSNP will be essential for achieving more effective wildlife crime prevention given the size of the park, high level of encroachment, the presence of high-value species for the illegal trade, and human population density that surround it. This research was carried out in 10 villages around the intensive protection zone (IPZ) in BBSNP. Villages were selected based on 1) recommendation of local conservation organization with a long-term presence in the area and relationships with communities, 2) permission of local and relevant community authorities, and 3) close proximity to the IPZ of the BBSNP.

2.2. Sampling and data collection

We achieved objectives with face-to-face surveys consisting of close-ended and open-ended questions related the themes of guardianship (Reynald, 2010), psychometric risk perception (Slovic, 1987), and wildlife value orientations (Jacobs et al., 2014). The survey was concluded with demographic questions; see Appendix A for summary of the English version of the survey guide (Bahasa Indonesian version available upon request).

Five local research assistants were hired and met the following: 1) fluent in English, Bahasa Indonesian (lingua franca and hereafter Indonesian) and other relevant local languages (e.g., Lampungese, Javanese); 2) completed secondary school and were currently enrolled in an undergraduate program at a local college; 3) agreed to work the duration of research activities; and 4) completed a three-day training session before data collection commenced. To reduce desirability bias research assistants were unaffiliated with the environmental NGO that facilitated community selection and were not residents of the sampled communities. The survey guide was translated from English to Indonesian prior to arrival in Indonesia, was back-translated and a final revised translation was reached by consensus of research assistants in order to increase construct validity (Gore and Kahler, 2015). Surveys were conducted in five villages along the southern corridor of the IPZ and five villages on the west and northern boundary of the IPZ. Cluster sampling with probability proportionate to size was used as there were no reliable lists (e.g., addresses, property tax records) of residents in the villages (Bernard, 2006). In each village, research assistants identified *population clusters* (e.g., sub-villages) with the help of local authorities and then the proportion of surveys in each sub-village were allocated based on the best estimate of population (i.e., proportionate to size) in each cluster. A target sample size of 400 respondents in human dimension research is considered adequate to generalize to a population with a 95 % confidence interval (±5 % error margin) (Vaske, 2019); therefore 40 surveys were conducted in each village. Each sub-village zone was sampled, and convenience sampling was used within each village zone (Bernard, 2006).

Survey participants were 18 years or older and were not excluded from participation based on ethnic affiliation, educational attainment, gender, religion, or socio-economic status. Only one participant per household was eligible to participate. Research assistants were flexible in terms of timing of face-to-face surveys to accommodate work schedules, cultural and religious considerations. All survey responses were translated into English and quality checked both in the field and after by research assistants (Gore and Kahler, 2015). Participation was voluntary with informed consent and in compliance with Michigan State University's Institutional Review Board's Human Subjects standards (IRB# x13-237e Category: Exempt 2).

The concept of guardianship was measured through a series of agreement questions aimed to measure willingness to supervise (3 questions), perceptions of their ability to detect potential wildlife crime offenders (3 questions), and an open-ended question about the willingness to intervene (Reynald, 2010) (S1). The open-ended question related directly to wildlife poaching and is stylistically similar to questions used in other crime contexts (e.g., Reynald, 2010)

> "You see someone that people say is a poacher entering a protected area with a firearm, snares, and bags. What would you ordinarily do? Would you ever stop the person yourself?"

Risk perceptions were captured through questions related to dread (i.e., how much they worry about the risk), and cognitive assessments (i.e., perceived seriousness of the consequence, perceived frequency). The respondents were asked to rate the level of dread and consequences to local livelihoods and local wildlife separately on a scale of zero (no risk/not severe) to five (highest risk/severity), and perceived frequency of poaching within BBSNP and in the participants' community (randing from 0 = never happens to 5 = extremely common). Dominance and mutualistic wildlife value orientations were examined using three items each and all variables were coded on a six-point visual scale −3 (strongly disagree) to 3 (strongly agree) with no neutral point to force a response (Appendix A).

2.3. Data analysis

Data were recorded on paper-based surveys, entered into Excel, cross-checked against hard copies, and imported into SPSS 24. Data was analyzed using SPSS 24. Descriptive statistics were used to further check for irregularities and to characterize the demographics (e.g., age, gender, household size) of respondents. Data was not weighted due to the non-parametric sampling design and unknown population parameters (Vaske, 2019). Demographic categories (e.g., ethnic group, religion) had to be represented in at least 10 % of the sample for inclusion to analysis to help ensure adequate statistical variability (e.g., Hoogstra-Klein et al., 2012). Demographic categories that allowed natural recoding, such as ethnic group to Native Island, were collapsed accordingly.

A novel equation was used to calculate an overall score for a GII which weighted the concept of willingness to intervene, and was calculated as follows:

$$GII = [(S1 + S2 + S3)/3] + [(A1 + A2 + A3)/3] + (2*G)$$

S = Questions (S1, S2, S3) related to willingness to supervise
A = Questions (A1, A2, A3) related to ability to detect potential offenders
G = Score related to willingness to intervene

The open-ended willingness to intervene responses were coded and scores assigned according to Reynald's (2010) five broad categories of intervention: −1 = join the illegal activity (an emergent category based on responses), 0 = ignoring, 1 = covert monitoring, 2 = indirect intervention, 3 = direct intervention, and 4 = indirect and direct intervention. Uncertain responses were coded as missing. Scores ranged from −8 to 14 where −8 indicates no guardianship intention and 14 indicates the highest level of guardianship intention.

To calculate individual risk perception of poaching summative scales were created for the risk targets of local livelihoods, wildlife and a composite of livelihood and wildlife (e.g., Hanisch-Kirkbride et al., 2013). A Cronbach's alpha was calculated for dread and consequences. Response items related to the frequency of poaching in the communities and the park were not included in the scale reliability as these judgments are independent. The perception of poaching risk to livelihood (P_{liv}) was a simple summative scale of dread risk to livelihoods (D_l) plus the consequences to livelihoods (C_l) and the average of the perceived frequency of poaching in the park (F_p) and community (F_c): $Pliv = D_l + C_l + [(F_p + F_c) / 2]$. The summative scale for perceived poaching risk to wildlife (P_{wl}) was calculated using the dread (D_w) and consequence (C_w) to wildlife and the average frequency as stated above. Composite poaching risk scores were calculated as follows:

$$P_c = [(D_l + D_w)/2] + [(C_l + C_w)/2] + [(F_p + F_c)/2]$$

The poaching score has a value between zero (no perception of poaching risk) and 15 (highest poaching risk perception).

Diverging from WVO analysis of Jacobs et al. (2014), a k-cluster analysis was used to identify clusters across the domination-mutualism continuum and assign respondents to them allowing for hybrid WVO (Hoogstra-Klein et al., 2012). Multiple iterations of the k-cluster analysis were run and statistics (e.g., significance, convergence) examined to identify the appropriate number of clusters. Clusters were identified based on the following criteria set forth by Hoogstra-Klein et al. (2012): 1) statistically significant at the $p < 0.05$ level with higher F-values representing divergence among clusters in terms of mean scores for mutualism and domination scores, and 2) a minimum cluster size of 10 % of respondents.

A Pearson r correlation was conducted to explore the relationship between the three dimensions of guardianship, the overall GII, and perceived control over poaching, risk of poaching to livelihoods, to wildlife and the composite risk perception score (Vaske, 2019). One-way ANOVA and independent t-tests were used to compare the means from measures of the three dimensions of guardianship and the GII to respondent education, livelihood, village, WVO cluster assignment (one-way ANOVA), gender, and whether they were non-Sumatran or Sumatran by birth (independent t-test). In order to understand the difference between interveners and non-interveners a chi-square test was used to explore demographic variables (minus age) and wildlife value orientation identities. An independent-samples t-test was conducted to examine the relationships of age, dimensions related to guardianship, psychometric risk perception, and wildlife value orientation (Vaske, 2019).

3. Results

We surveyed 400 participants from June to September of 2015, of which 156 (39 %) were women, 244 (61 %) were men, and a mean age of 37 years (S2). We had a non-response rate of 34.5 % with men accounting for 47.8 % and women accounting for 52.2 % of non-responses respectively. The vast majority of respondents were Muslim (97 %) and married (89 %). There were 12 ethnic groups from three different islands: Bali 2.3 % ($n = 9$), Java 76.5 % ($n = 306$), and Sumatra 21.3 % ($n = 85$). Only 2 % ($n = 6$) of respondents reported no education, 40 % ($n = 156$) had attended elementary school, over a quarter had attended senior high school (26 %, $n = 103$), and 8 % ($n = 38$) had completed some sort of post-senior high education or training. The majority of people reported agriculture as their primary source of livelihood 61 % ($n = 245$) (S2).

3.1. Dimensions of guardianship and Guardianship Intention Index (GII)

Respondents rated their ability to detect potential offenders ($M = 1.58$, $SD = 0.92$) higher than their willingness to supervise ($M = 0.20$, $SD = 1.11$) (Fig. 1). The most common response fit the direct interventions category (41.3 %, $n = 165$) with the majority (57 %, $n = 94$) of direct intervention coming in the form of communication with the suspect (e.g., "Tell them that it is not allowed" Respondent 168) (Fig. 2). Ignoring it (e.g., "I let it go" Respondent 115) was the second most common response (25.8 %, $n = 103$) and about a quarter of respondents (25.3 %, 101) said they would call authorities (Fig. 2). The GII was calculated and had a minimum value of −3.33, maximum of 12.67, with a mean of 5.78 ($n = 397$, $SD = 3.39$). Respondents with a GII of 0 to −3.33 expressed no intention to serve as a wildlife guardian, while the mean GII value indicates a modest intention to serve as wildlife guardian. When viewed as a dichotomous variable the majority of respondents said they would intervene (72.5 %, $n = 290$), while 27.5 % ($n = 110$) said they would not intervene.

3.2. Relationship of GII to attitudinal and demographic variables

Comparing the means from the GII and gender [female ($M = 5.18$, $SD = 3.46$); male ($M = 6.16$, $SD = 3.30$); $t(395) = -2.835$, $p = 0.005$], livelihood [$t(3) = 5.004$, $p = 0.002$], and village [$t(9) = 5.443$, $p = 0.000$] were significant (Table 2). A three-cluster solution was found using k-cluster analysis for WVOs (Hoogstra-Klein et al., 2012) after examining results from multiple cluster solutions using a k-means cluster analysis. Two clusters were characterized by either domination or mutualism while the third was a hybrid value orientation. Clusters sizes and the means difference between the summative mutualism score and domination score:

1. Strong mutualism (cluster size 26.8 %, $n = 107$, $M = 8.46$, $SD = 2.86$)
2. Moderate domination (cluster size 12.0 %, $n = 48$, $M = -2.98$, $SD = 3.74$)
3. Hybrid (cluster size 61.3 %, $n = 245$, $M = 3.13$, $SD = 2.28$)

The differences between the means of these clusters were statistically significant [$F(2,397) = 330.04$, $p < 0.001$]. The majority of respondents

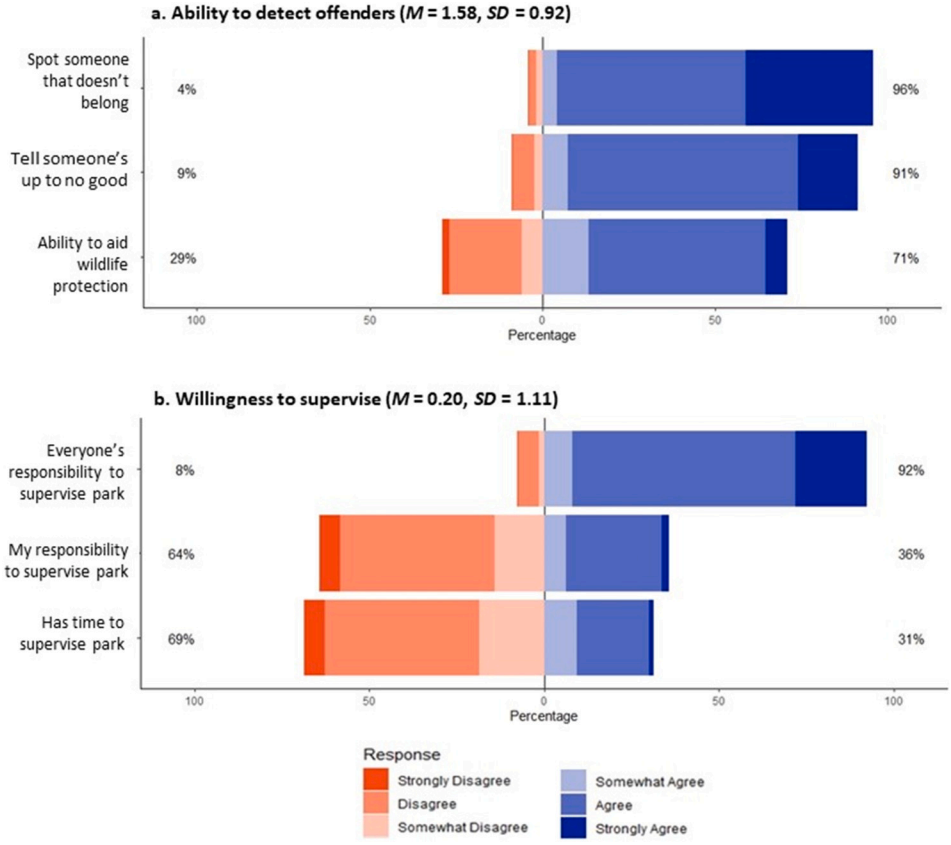

Fig. 1. Percentage of survey respondents (N = 400) that strongly disagreed to strongly agreed with constructs related to (a) their perceived ability to detect offenders in Bukit Barisan Selatan National Park (BBSNP), and (b) their stated willingness to supervise for illegal behavior in BBSNP, Sumatra, Indonesia. Constructs are measured on agreement scales from −3 (strongly disagree) to 3 (strongly agree) with percentages that disagreed (left) and agreed (right) displayed along the y-axis.

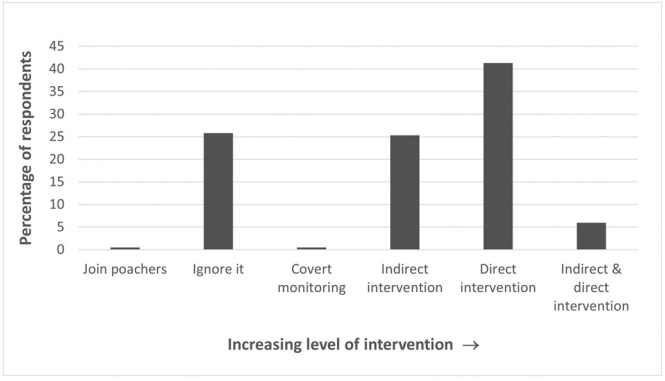

Fig. 2. Stated behavioral intention of respondents ($N = 400$) when asked their willingness to intervene if they witnessed a known and armed poacher entering Bukit Barisan Selatan National Park, Sumatra Indonesia. Open ended responses [a] were recoded according to Reynald's (2010) broad categories of intervention.
[a] "Join poachers" (i.e., co-offending) is an emergent category based on responses ($n = 2$). Three ($n = 3$) respondents (0.80 %) stated they were uncertain what they would do.

were assigned to the hybrid cluster characterized by moderate domination and strong mutualism orientations. WVO was significant for two indicators of guardianship and the GII [F (2, 394) = 59.848, $p = 0.005$] (Table 2). Those that typified a centrist-moderate mutualism orientation [$M = 6.02$, $SD = 3.25$] had the highest intention to act as a wildlife guardian, followed by those with a strong mutualism orientation [$M = 5.89$, $SD = 3.37$], and lastly those with moderate domination orientations [$M = 4.31$, $SD = 3.83$].

Table 2
Comparisons of means from dimensions of guardianship and Guardianship Intention Index (GII) among demographic groups wildlife value orientations of respondents ($N = 400$) in BBSNP.

Comparison of means among groups		Ability to supervise ($N = 400$)	Willingness to supervise ($N = 400$)	Willingness to intervene ($N = 397$)	GII ($N = 397$)
Education ($df = 3$)[a]	F	0.96	1.46	0.75	1.19
	p	0.41	0.23	0.52	0.32
Gender ($df = 1$)[b]	t	−2.79**	−1.20	−2.08*	−2.84**
	p	0.01	0.23	0.04	0.01
Livelihood ($df = 3$)[a]	F	0.70	1.78	4.79**	5.00**
	p	0.55	0.15	0.00	0.00
Sumatran ($df = 1$)[b]	t	1.43	6.91**	0.12	2.14
	p	0.23	0.01	0.73	0.14
Village ($df = 9$)[a]	F	2.22*	1.72	6.07**	5.44**
	p	0.02	0.08	0.00	0.00
Wildlife value orientations ($df = 2$)[a]	F	3.38*	1.66	4.33**	5.32**
	p	0.04	0.19	0.01	0.01

[a] One-way ANOVA.
[b] Independent t-test.
* $p < 0.05$, two-tailed.
** $p < 0.01$, two-tailed.

A Cronbach's alpha of poaching-related risk perception was within acceptable limits ($\alpha = 0.67$; $n = 4$). The differences between the $Risk_{liv}$ and $Risk_{wl}$ means were not significant ($t(399) = 0.97$, $p = 0.33$) with a mean score for the composite poaching risk score of 8.38. There were correlations between the GII and control over poaching [$r = 0.178$, $n = 400$, $p = 0.000$], perception of poaching risk to wildlife [$r = 0.160$, $n = 400$, $p = 0.001$], and the combined poaching risk score [$r = 0.153$, $n =$

400, $p = 0.002$] (Table 3).

3.3. Interveners and non-interveners

Chi-square analysis of non-interveners ($n = 100$) and interveners ($n = 290$) revealed significant relationships between gender (X^2 (1, $N = 400$) = 4.37, $p = 0.037$), livelihood (X^2 (3, $N = 400$) = 11.90, $p = 0.008$), and village (X^2 (9, $N = 400$) = 42.38, $p < 0.001$) demographic variables and wildlife value orientations (X^2 (2, $N = 400$) = 9.91, $p = 0.007$). There were significant relationships between items related to guardianship, psychometric risk perception, and WVO dimensions (Table 4). The average rating for willingness to supervise was significantly different for non-interveners ($M = -0.26$, $SD = 1.04$) and interveners ($M = 0.37$, $SD = 1.09$) responses; t (398) = −5.27, $p < 0.001$ (Table 4).

Table 4
Independent samples t-test for variance of means for non-interveners ($n = 110$) and interveners ($n = 290$) in BBSNP.

Variable	Non-interveners		Interveners		t(398)	p
	M	*SD*	*M*	*SD*		
Age	36.81	10.41	37.19	11.85	−0.30	0.77
Guardianship dimensions						
Ability to supervise average	1.40	0.95	1.65	0.90	−2.48*	0.01
Willingness to supervise average	−0.26	1.04	0.37	1.09	−5.27**	0.00
Psychometric risk perception						
Poaching risk (people)	8.12	2.55	8.41	2.08	−1.17	0.24
Poaching risk (wildlife)	8.00	2.46	8.58	2.17	−2.30*	0.02
Poaching risk (combined)	8.06	2.34	8.50	1.96	−1.88	0.06
Perceived control	1.28	1.29	1.58	1.29	−2.06*	0.04
Wildlife value orientations						
Domination average	0.64	1.11	0.55	1.14	0.66	0.51
Mutualism average	1.69	0.93	1.91	0.80	−2.34*	0.02

* $p < 0.05$.
** $p < 0.01$.

4. Discussion

The growth of the illegal wildlife trade in many contexts has outstripped the financial investments and human capacity to respond with formal law enforcement, increasing calls to identify effective community-based responses to a variety of wildlife crimes (e.g., Biggs et al., 2016). The need to engage communities in wildlife crime prevention is particularly salient at the poaching stage—the first step in the illegal wildlife trade chain—where local communities overlap with wildlife, and there are ample concerns over constraints to pragmatic law enforcement. Additionally, there are increasing concerns about the human rights implications of increased formal law enforcement or militarization within marginalized communities where 'the war on poaching' is often waged (Duffy et al., 2019). Engaging local communities in efforts to respond to and prevent wildlife poaching is a somewhat unmet policy priority (Cooney et al., 2017).

It is possible that knowledge gaps associated with involving communities in crime prevention is contributing to this lack of realization. This research to help fill these gaps by constructing a novel quantitative and replicable method to measure guardianship intentions within the context of wildlife poaching. The findings contribute to understanding theory, methods, and applications of guardianship as a community-based response to wildlife crime. Studying guardianship shifts the focus of crime events within the community from understanding criminals, such as poachers, to understanding the decision-making and crime preventative potential of residents as capable guardians (Hollis-Peel et al., 2012; Reynald, 2010). Here, we discuss our measurement of guardianship and its relationship to poaching within the context of the community.

Wildlife guardianship may manifest as a range of interventions, including physical intervention and verbal confrontation. Parsing out differences in guardianship behavioral intentions and attitudes influencing those behaviors provides new entry points for intervention and helps set expectations for change. For example, a moderate proportion (41.3 %) of respondents reported an intention to directly intervene if they witnessed a suspected poacher entering a protected area and the majority of those favored communicating with the suspect rather than physical intervention. This is contrary to previous research on guardianship against crime in urban residential communities where most residential guardians expressed a preference for indirect interventions, such as calling authorities, rather than direct intervention (Reynald, 2010).

However, it is important to acknowledge that in some situations intervention through a verbal confrontation could be a less desirable intervention than calling the authorities if offenders are not deterred by these confrontations and face no social or punitive consequences. Conversely, for example, locals may be reluctant to call the authorities when witnessing wildlife crimes if those authorities are perceived as corrupt. Relatively high levels of corruption in Indonesia have been found to facilitate encroachment into protected areas such as BBSNP (Levang et al., 2012), wildlife trafficking (e.g., Wyatt et al., 2018), and illegal logging (e.g., Ji et al., 2018). Research related to crime seriousness in the study context revealed corruption as the second-most serious crime among ten crime scenarios ranging from assault to poaching to theft and illegal drug use (see Kahler, 2018). Empirical research is required to identify which forms of intervention are most effective in discouraging offenders within different sociocultural and regulatory contexts.

The behavioral intention of ignoring a suspected poacher was statistically equal to those that reported a behavioral intention of indirect interventions. Previous research on guardianship against crime in urban

Table 3
Pearson correlation matrix among guardianship dimensions and Guardianship Intention Index (GII) and research concepts associated with survey ($N = 400$) responses in BBSNP.

		Ability to supervise ($N = 400$)	Willingness to supervise ($N = 400$)	Willingness to intervene ($N = 397$)	GII ($N = 397$)
Control over poaching	*r*	0.19**	0.11*	0.11*	0.18**
	p	0.00	0.02	0.03	0.00
Risk perception (livelihoods)	*r*	0.15**	0.11*	0.12*	0.06
	p	0.00	0.03	0.02	0.21
Risk perception (wildlife)	*r*	0.08	0.14**	0.12*	0.16**
	p	0.11	0.01	0.02	0.00
Risk perception (composite)	*r*	0.12*	0.14**	0.10*	0.15**
	p	0.01	0.01	0.05	0.00

* $p < 0.05$, two-tailed.
** $p < 0.01$, two-tailed.

residential communities also revealed residential guardians who admitted they would turn a blind eye to crimes they witnessed, however in contrast to the current study findings, this group represented a small minority of respondents (Reynald, 2010). These results should be interpreted with caution, however, as both studies include the potential for a desirability bias and our measurements in the current study focused on behavioral intention to a hypothetical situation. Lastly, although willingness to intervene is a critical component of overall guardianship behavior, a potential guardian's perception of their *ability to detect potential offenders* and their *willingness to supervise* are important dimensions as well (Reynald, 2010). For example, the same respondents that reported a high rate of intended interventions if they witnessed a poacher entering a protected area often also expressed very low willingness to supervise for illegal activities in the park. This suggests that while respondents are highly likely to intervene if they witness poachers in protected areas, they are much less likely to proactively supervise and keep an eye out for poachers.

Additionally, two respondents (0.5 %), a statistical anomaly, provided answers that challenged the existing characterization of interventions in the face of crime: they reported an intention to join the illegal activity. Although these responses do not emerge as statistically important, they do highlight the important fact that not all responses to illegal activity will be underpinned by prosocial and pro-environmental principles of guardianship and stewardship. Future research in this area is required to probe the extent to which this sub-group of "joiners", whose response is to join in the illegal activity they witness rather than try to stop it, has the potential to undermine wildlife guardianship within these communities. When we consider this group of "joiners" in conjunction with the respondents who indicated they would "ignore or turn a blind eye" to potential poachers, it raises the importance of developing our understanding about the extent to which poaching may be considered normative or beneficial to some of these communities, and how informal guardianship mechanisms are affected by this.

Results did not equivocate demographic and attitudinal differences between those with intentions to intervene (guardians) and non-interveners. Building theoretical understanding of what influences wildlife guardianship intentions and exploring interventions that may increase wildlife guardianship among diverse stakeholders could be a valuable addition to our understanding of effective community-based responses to wildlife crime. Additionally, understanding the relative effectiveness of different interventions on preventing wildlife crime, within different social and regulatory contexts should be explored. Further, contextualizing stakeholders in terms of their availability for intervention also warrants closer examination. Guardianship actions and intentions are notably underpinned by the built environment and situational factors, which generates opportunities for natural surveillance and supervision (Reynald, 2009; Hollis-Peel et al., 2012). For example, given the significance of the respondent's village, geographically based sampling techniques that target respondents based on their proximity to various activities along the wildlife crime chain of events (e.g., poaching, trafficking, markets) would be advantageous. This is essential in matching up residents that are both *willing to intervene* and those that are physically *available to intervene*.

Guardianship behavior is predicated upon specific attitudinal characteristics and the intensity of the guardianship response has been found to be associated with demographic characteristics (e.g., Reynald et al., 2018). Among our study population, demographic and attitudinal dimensions affected respondents' stated willingness to intervene and varied between interveners and those that stated non-intervention intensions. Men were more likely than women to intervene, as were those with professional livelihoods (e.g., teacher, civil servants). Findings about the relationship between gender and intervention are mixed and dependent on the situational context of the crime event and the type of intervention employed but there is some evidence to suggest that men are more likely to intervene directly in violent or high-severity situations than women, and men are more likely to intervene as guardians against male perpetrators (see Mainwaring et al., 2022). The rate of intervention varied based on village, ranging from 90 % of village respondents stating a behavioral intention to intervene to less than half (45 %). The significance of village membership may indicate that social networks are affecting judgments of poaching risk, and shared expectations for intervention and should be further explored. Lastly, willingness to intervene was positively correlated with respondents' perceived control over poaching, poaching related risk perception, and most common among those that expressed moderate or strong mutualistic WVOs. Taken together, these results provide empirical evidence to support the notion that wildlife stewardship and wildlife guardianship tap into dimensions that are intimately interlinked.

The majority of respondents held either moderate or strong mutualistic wildlife value orientations. Our findings are theoretically supported in the literature that states those with more mutualistic value orientations are more likely to find killing of wildlife unacceptable in any circumstance than those with value orientations characterized with high levels of domination (Jacobs et al., 2014). However, it is unclear how well WVOs were captured in the cross-cultural context of Sumatra using a quantitative approach measuring dichotomous orientations of domination and mutualism. WVOs have been found to be much more nuanced. For example, Tanakanjana and Saranet (2007) found eight WVOs in Thailand using mixed methods questioning. Additional inquiry into the connections between WVO and guardianship may help frame communications and interventions designed to bolster intervention rates. For example, if the predominant WVO in an area is the *concern for human safety*, messages about reporting poaching and building community resistance to dangerous poaching activities could be framed in terms of ensuring the safety and security of communities and other legitimate resource users in the area.

Our results are ideally interpreted within the context of the study design. The ten communities selected were suggested and introductions facilitated by an NGO to ease obtaining permission from relevant traditional authorities and to meet general geographic criteria around the IPZ. Further, within each community we used cluster sampling with probability proportionate to size and criteria to select individuals; this is a non-parametric (non-random) sampling protocol which further restricts generalizability. Additionally, data collection relied on face-to-face interviews with respondents and represented a behavioral intention that may be influenced by desirability bias (e.g., Reynald, 2010). Multimodal strategies such as secondary data sources (e.g., poaching tip-line calls), direct observational methods (e.g., Reynald, 2009), or possibly even quasi-experimentation (Reynald, 2010) could help overcome this potential bias.

We would be remiss not to mention that most of the research on guardianship behaviors are based in Global North and urban-semi-urban contexts. Replicating foundational criminological work on guardianship (e.g., Reynald, 2009, 2010) in Global South communities would allow us to validate, challenge, or revise relevant guardianship factors and better understand how socio-cultural contexts interact with these factors. We acknowledge constructs were measured using a reduced number of multi-item indicators. It is likely that this resulted in suboptimal measurement of any one construct limiting the precision of measurement of some constructs, and lowered the internal reliability, which limits statistical treatment. However, study results provide a roadmap for navigating future in-depth exploration into the attitudinal, demographic, and sociocultural dimensions associated with wildlife guardianship.

4.1. Conclusions

Enhancing guardianship behavior in communities living adjacent to and in expansive protected areas with high level of encroachment, the presence of high-value species and impoverished human populations, such as BBSNP, will be essential to achieve more effective wildlife crime prevention. Applied social scientists are likely to continue building evidence in support of action that enhances community-level engagement

and action in response to wildlife crimes. Parsing out differences in guardianship behavior, including which attitudinal, demographic, and situational factors may amplify or attenuate guardianship responses, provides new entry points for community-based wildlife crime prevention and may facilitate efforts to increase incentives for informal enforcement. Efforts to increase incentives for wildlife stewardship more broadly, may be accelerated by interdisciplinary thinking about guardianship as a measure of local willingness to prevent wildlife crime through informal enforcement.

CRediT authorship contribution statement

All authors have read and approved this submitted revision. The article is our original work, is unpublished, and is not under consideration for publication elsewhere.

Declaration of competing interest

We have no conflicts of interest to report.

Data availability

Data will be made available on request.

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Appendix A. Supplementary data

Summary of relevant survey questions with visual aids (Appendix S1). Demographic information of survey respondents (Appendix S2) is available online. The authors are solely responsible for the content and functionality of these materials. Queries (other than absence of the materials) should be directed at the corresponding author. Supplementary data to this article can be found online at https://doi.org/10.1016/j.biocon.2022.109829.

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