THE SITUATIONAL PREVENTION OF WILDLIFE POACHING IN BUKIT BARISAN SELATAN NATIONAL PARK, SUMATRA, INDONESIA

By

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ABSTRACT

THE SITUATIONAL PREVENTION OF WILDLIFE POACHING IN BUKIT BARISAN SELATAN NATIONAL PARK, SUMATRA, INDONESIA

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This research assessed poaching risks associated with endangered species in Indonesia, examined stakeholder perceptions of risk, and situational factors associated with poaching-related crimes. Wildlife poaching is a global risk that threatens biological, ecological, economic, and socio-cultural systems. Poaching has become increasingly more organized, violent, and lucrative and is now considered a serious threat to regional and global security in addition to biodiversity conservation. As a biodiversity hotspot with the fourth largest human population, Indonesia faces numerous conservation and development challenges including poaching. The contemporary upsurge in wildlife poaching has led to the conservation community to substantially increase traditional enforcement efforts (e.g., rangers, patrols) with a growing acknowledgment of the need to develop more diverse responses to wildlife crime prevention. Situational Crime Prevention (SCP) is a pragmatic application of criminological-based opportunity theories and is appealing for application to poaching because of the immediacy of crime reduction and the proactive, rather than reactive, nature of the techniques aimed to reduce criminal opportunities. Advancing SCP applications within the context of wildlife poaching answers calls to diversify the response, draws on a substantial body of knowledge within criminology, and could provide much needed cost-efficient poaching reduction in the short term. This research merged theory from risk and decision sciences, criminology, and natural resource management to bridge this conservation and criminology gap by using the SCP framework to guide research with field-based conservation practitioners and communities surrounding Bukit

Barisan Selatan National Park (BBSNP) in Sumatra, Indonesia. The broad research objectives of this research were to: 1) Investigate the dimensions of wildlife guardianship (i.e., willingness to intervene) and influence of demographic variables and interdisciplinary constructs (e.g., crime seriousness, risk perception, wildlife value orientations) on intentions to serve as a wildlife guardian; 2) Developed an interdisciplinary, wildlife target suitability model that could serve as an explanatory and predictive tool for understanding poaching within BBSNP; and 3) Used the SCP framework to guide a focus group with conservation practitioners to describe the characteristics that make Sumatran tigers suitable as a poaching target, poacher modus operandi, and to brainstorm strategies under an expanded suite of techniques for SCP.

Data herein provide novel understanding about the willingness of residents in BBSNP communities to intervene as wildlife guardians, advances an ecologically-informed model to understand and predict species-specific targeting by poachers, and captures conservation practitioners' rapid assessment of the SCP of tiger poaching including identification of priority spaces within and around BBSNP where developed techniques need to be implemented. In producing new knowledge this research makes theoretical, methodological, and practical contributions to the extant literature on guardianship, target suitability models, and the SCP framework within the context of wildlife poaching.

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KEY TO ABBREVIATIONS

Bukit Barisan Selatan National Park (BBSNP)

Concealable, Removable, Available, Valuable, Enjoyable, Disposable (CRAVED)

Guardianship Intention Index (GII)

In-demand, Passive, Obtainable, All-purpose, Conflict-prone, Hide-able, Extractable, Disposable (IPOACHED)

Inert, Concealable, Removable, Available, Valuable, Enjoyable, Disposable (ICRAVED)

Intensive Protection Zone (IPZ)

International Union for Conservation of Nature (IUCN)

Non-governmental Organization (NGO)

Rhino Patrol Units (RPU)

Situational Crime Prevention (SCP)

Spatial Monitoring and Reporting Tool (SMART)

United Nations Educational, Scientific and Cultural Organization (UNESCO)

Value, Inertia, Visibility, Accessibility (VIVA)

Wildlife Crime Initiative (WCI)

Wildlife Value Orientations (WVO)

World Wildlife Fund (WWF)

CHAPTER 1

INTRODUCTION

1.1 INTRODUCTION

1.1.1. Background and significance

Poaching, the illegal harvest or taking of wildlife [1], is a global risk with biological, ecological, economic, criminological and socio-cultural impacts. Poaching has historically been characterized as a *folk crime* (Forsyth, Gramling, & Wooddell, 1998) but is increasingly seen as a serious global threat thought to generate between 7–23 billion (USD) annually in black market revenue worldwide (Nelleman et al., 2016). The contemporary upsurge in wildlife poaching has led to a substantial increase in traditional enforcement efforts (e.g., rangers, patrols) and concern is growing with what is seen as the *militarization* of conservation (e.g., Biggs et al., 2017). Additionally, this overreliance on enforcement and punitive deterrence counters evidence from criminological research that these efforts alone are largely ineffective in terms of achieving significant crime reductions (Wellsmith, 2010). Despite growing acknowledgment of the need to develop commensurate community-based approaches to wildlife crime prevention, interventions involving communities are often still regarded as subordinate to enforcement and patrolling (Steinmetz, Srirattanaporn, Mor-Tip, & Seuaturien, 2014). A substantial debate has emerged

[1] For the purpose of this research, wildlife includes non-domesticated terrestrial vertebrates including birds, mammals, and reptiles. Wildlife poaching therefore refers to the illegal taking, alive or dead, components or whole, of non-domesticated terrestrial vertebrates.

between those that seek to increase the quantity and quality of the *boots on the ground* and those that advocate *moving beyond enforcement*.[2]

Rapid population and economic growth in Southeast Asia has led to increased exploitation of mineral and natural resources, deforestation and fragmentation, which brings poachers closer to endangered species (Rayan & Linkie, 2015). Poaching is a primary driver behind the region's dramatic wildlife declines (Steinmetz et al., 2014). Indonesia, an island nation with high biodiversity and the world's fourth largest human population, is a microcosm of the global challenges associated with economic development and endangered species conservation and protection. Strategies that can provide prompt reduction and prevention of poaching while at the same time diversifying the responses, beyond enforcement, and offer a roadmap for more inclusive participation of communities in wildlife crime prevention are needed in Indonesia and beyond. Situational Crime Prevention (SCP) is a pragmatic application of criminological-based opportunity theories, from environmental criminology, and diverges from conventional criminology by focusing on how situational factors create opportunities for crime rather than seeking to understand how criminal dispositions emerge (Clarke, 2008). The SCP approach is appealing for those that seek to reduce and understand wildlife crimes because of the immediacy of crime reduction and the proactive, rather than reactive, nature of the suite of techniques aimed to reduce criminal opportunities over space and time (e.g., Kurland, Pires, McFann, & Moreto, 2017; Lemieux, 2014; Wellsmith, 2010).

Advancing SCP applications within the context of wildlife poachers answers calls to diversify the response (e.g., Biggs et al., 2016) while at the same time *professionalizing*

[2] The International Union for the Conservation of Nature (IUCN)'s Commission on Environmental, Economic and Social Policy has a "Beyond Enforcement Initiative." See https://www.iucn.org/commissions/commission-environmental-economic-and-social-policy

conservation law enforcement (McCann, 2017) efforts by drawing on the substantial body of knowledge within criminology. Emerging evidence from crime scientists suggest that SCP could provide much needed cost-efficient, effective, and empirically based strategies to reduce wildlife crimes in the short term (Kurland et al., 2017). Recent research has investigated the usefulness of SCP to reduce environmental crimes, such as poaching (Pires & Clarke, 2011) and the illegal trade of endangered species (Wellsmith, 2010). However, investigations into the use of SCP to prevent wildlife poaching, such as the adaptation of the 25 techniques of SCP for wildlife poaching (e.g., Lemieux, 2014), have been exclusively conceptualized by criminologist and crime scientists. The overall objective for this study was to bridge this conservation and criminology gap by using the SCP framework to guide research with field-based conservation practitioners and communities surrounding Bukit Barisan Selatan National Park (BBSNP) in Sumatra, Indonesia (Figure 1.1). The broad research objectives of this research were to:

1) Conduct the first investigation into the dimensions of wildlife guardianship (i.e., willingness to intervene) and influence of demographic variables and constructs from criminology, human dimensions of natural resource management, and risk perceptions on intentions to serve as a wildlife guardian.

2) Develop an interdisciplinary, poaching-stage and species-focused target suitability model that could serve as an explanatory and predictive tool for understanding poaching within a protected area such as BBSNP.

3) Used the SCP framework to guide a focus group with conservation practitioners to describe the characteristics that make Sumatran tigers suitable as a poaching target, poacher modus operandi, and to brainstorm strategies under an expanded suite of techniques for SCP.

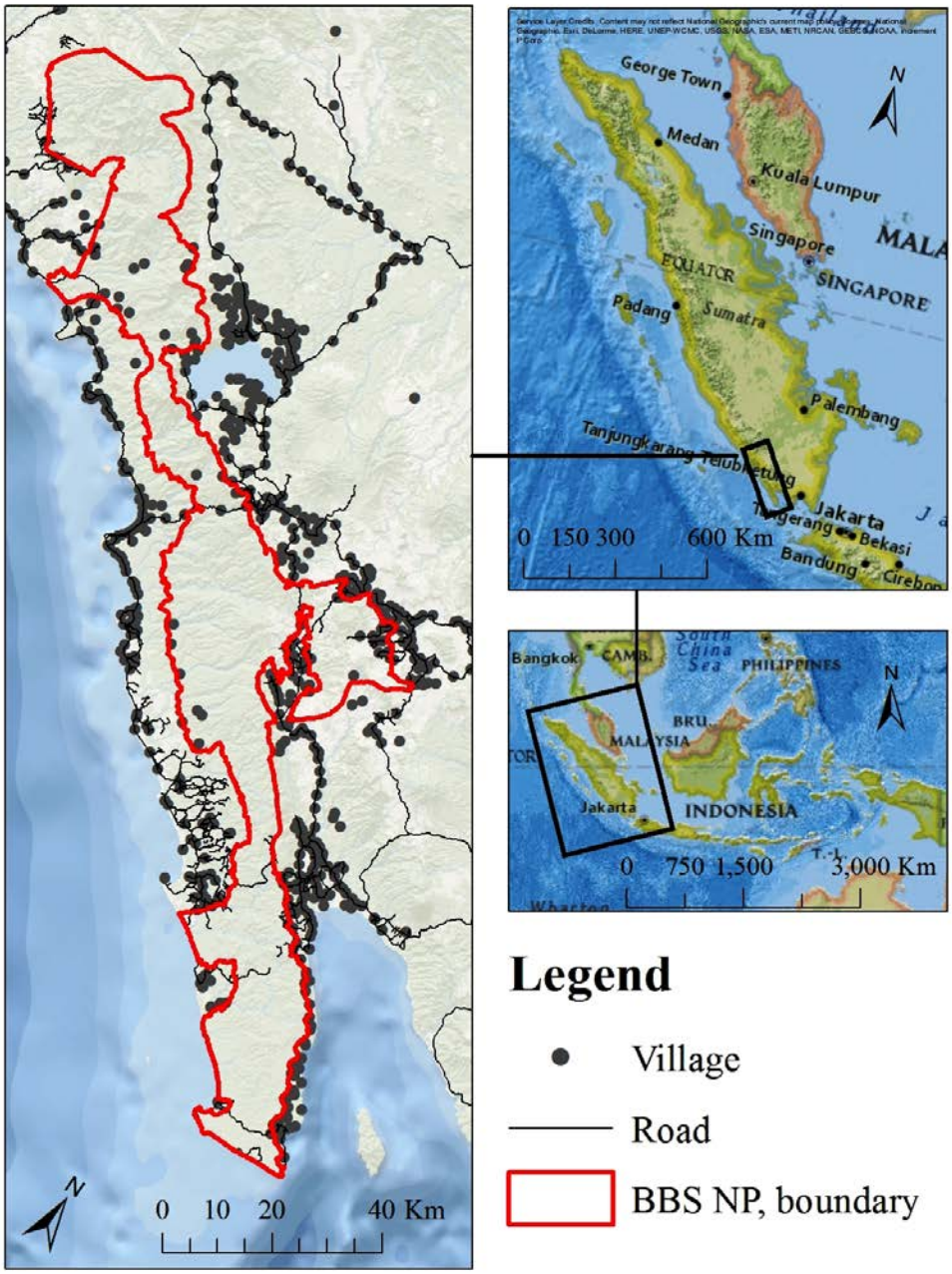
My research used the interdisciplinary conservation criminology framework, which merges theory from criminology, natural resources management, and risk and decision sciences (Gibbs, Gore, McGarrell, & Rivers, 2010) to explore the usefulness of theories and methods from SCP to understand and respond to poaching in BBSNP. I conducted mixed methods research in order to investigate the situational factors that influence poaching of endangered species in BBSNP. Mixed methods, using qualitative and quantitative approaches to collect and analyze research data, provides a more robust understanding of the problem than either methodology provides when utilized alone (Creswell & Clark, 2007). This robust understanding is facilitated by analyzing data collected using mixed methods in a manner that merges, connects or embeds qualitative and quantitative data (Creswell & Clark, 2007). I used a convergent parallel design to test the key dimensions, theories, and approaches of SCP (e.g., target suitability models) as well as the techniques of crime prevention as they relate to wildlife poaching. This design allowed me to compare and contrast qualitative and quantitative data, overlapping each data type's inherent strengths and weaknesses, and improve overall understanding of the problem at hand (Creswell & Clark, 2007).

1.1.2 Research activities and methods

I used in-depth semi-structured interviews with community residents and a focus group with conservation stakeholders from communal, governmental, and non-governmental organizations in BBSNP. A three-day focus group was conducted in May of 2015 in Gisting, the southern province of Lampung, Sumatra, Indonesia, and was used to explore the SCP approach to assess and respond to wildlife poaching in the park. Focus group participants conducted activities that described and assessed poacher modus operandi, characteristics of particular wildlife species that influence species suitability and prevalence as a poaching target, brainstorm and describe

techniques of SCP, mapped illegal activities and the developed described SCP techniques within the park for Sumatran elephants, rhinoceroses, and tigers. In-depth, semi-structured interviews were conducted during two phases in ten villages surrounding the Intensive Protection Zone (IPZ) of BBSNP and explored concepts around crime seriousness, guardianship, psychometric

Figure 1.1: The study site Bukit Barisan Selatan National Park (BBSNP), Sumatra, Indonesia



risk perceptions, and wildlife value orientations, and demographic characteristics. Interviews were conducted in five villages along the southern corridor of the IPZ prior to the start of Ramadan in June 2015 and an additional five villages were interviewed on the west and northern boundary of the IPZ after Ramadan in August 2015. Participation was voluntary with informed consent and in compliance with Michigan State University's Internal Review Board's Human Subjects standards (IRB# x13-237e Category: Exempt 2). This research was conducted with permission and under the research permit of World Wildlife Fund (WWF) Lampung, who also served as the primary organizing organization for focus group research. Both research activities were conducted through and with assistance of the WWF's Lampung office located in Bandar Lampung, Sumatra. This research was funded by a Doctoral Dissertation Improvement Grant through the National Science Foundation's (NSF) in the Division of Social and Economic Sciences, Decision, Risk and Management Sciences (NSF Award #1357869).

1.1.3 Organization of the dissertation

The dissertation has four remaining chapters consisting of four papers and a brief conclusion. The second chapter, *Wildlife guardianship: Understanding local willingness to intervene in the face of wildlife crime*, reports findings from the first known attempt to measure guardianship intentions within the context of wildlife poaching. In this chapter, I analyze the findings from in-depth interviews that measured stakeholders' guardianship intentions via the three dimensions of guardianship: 1) perceived ability to supervise, 2) reported willingness to supervise, and 3) reported willingness to intervene if they witnessed poaching related activities. These three dimensions of guardianship (e.g., Reynald, 2010) were used to create a Guardianship Intention Index (GII). I report how perceptions of poaching crime seriousness and the types of environmental crimes influenced preferences for interventions and tested for relationships

between the dimensions of guardianship and a wide range of demographic variables and constructs from criminology, human dimensions of natural resources management, and risk and decision sciences. When asked what they would do if they saw a known poacher entering the protected area with weapons, the most common response was to turn a blind eye, followed closely by calling authorities, which is one type of indirect intervention, and the direct intervention of communication with the suspect. In general, when examining twelve specific environmental crime scenarios, such as illegal logging (most serious) to fruit collecting in the park (least serious), increases in the perceived seriousness of crime were associated with preferences for indirect interventions of calling the authorities rather than stopping it alone. Demographic variables (e.g., gender, livelihood, village of residence), risk perceptions, and wildlife value orientations were significant in determining a participants' overall GII. These demographic and attitudinal variables were also significant when examining the breakdown between those that said they would intervene (direct or indirectly) and those that reported non-intervention (ignore, monitor). The findings from this line of research have important theoretical implications in terms of understanding demographic and attitudinal dimensions that influence stakeholder willingness to intervene. The practical application of articulating wildlife guardianship as concept, and understanding, monitoring, and increasing the behavior among diverse stakeholders has broad appeal to answer the calls for more effective and inclusive responses to wildlife crime.

The third chapter, *'Hot species': Developing a species-based model to examine wildlife targeted by poachers using expert and community knowledge*, builds on recent adaptations of Clarke's (1999) crime target-suitability framework that seeks to understand how the characteristics of the crime targets themselves (e.g., cars, electronics) affect their likelihood of

being stolen or becoming *hot products* on the illegal market. Criminologists and crime scientists have been adapting this framework known as CRAVED, which examines target suitability based on how *concealable, removable, available, valuable, enjoyable* and *disposable* it is to theft, to understand wildlife species poaching and trafficking (e.g., Moreto & Lemieux, 2015; Pires & Clarke, 2012). This chapter discusses the development of an interdisciplinary target suitability model focused on the poaching stage to predict species vulnerability within a protected area. This model was developed by reviewing criminology and natural resources conservation and management literature, and corroborated by using the opinions and knowledge of local communities living in and around BBSNP, and experts and conservation practitioners with experience in species conservation and protection. Empirical evidence was gathered through face-to-face interviews with community members and a focus group with local conservation representatives from community, governmental and non-governmental conservation organizations. Songbirds, deer, pangolins, and hornbills were found to be more vulnerable to poaching in BBSNP. Results confirmed the dimensions of abundance and availability (*obtainability),* added nuances to the dimensions of concealable (*hide-able*), removable (*extractable*) and supports for the reconceptualization of the value dimension (*in-demand)* to include cultural, ecological and economic values. It is notable that *enjoyable* is absorbed into cultural value. Lastly, two independent dimensions were added to the model, *passive* and *conflict-prone,* due to the fact that live wildlife at the poaching stage varies in its ability to resist the poacher and negative interactions with humans that can exact costs and provoke poaching. The resulting poaching-stage IPOACHED model predicts that species that are *in-demand, passive, obtainable, all-purpose, conflict-prone, hide-able, extractable, disposable,* is designed to predict poacher species targeting behavior in the face of changing species availability and

values in order to help craft more effective strategies to protect the most vulnerable species in any given protected area.

The fourth chapter, *The application of situational crime prevention to protect critically endangered Sumatran tiger (Panthera tigris sumatrae)*, delineated the modus operandi of tiger poachers, described the characteristics of tigers that increased and decreased their suitability as poaching targets, expanded the suite of SCP approaches to six, adding five more techniques, in order to brainstorm diverse strategies for tiger poaching prevention, and mapped prioritized strategies from the expanded SCP toolkit and the hypothesized poaching diffusion within the IPZ of BBSNP. Data was collected during the focus group with conservation stakeholders. Results were used to make general conclusions about the expanded SCP framework and make specific recommendations for the SCP of tiger poaching in the IPZ of BBSNP. The SCP model was expanded from the original five approaches, each approach including five techniques, that includes *increase the effort, increase the risks, reduce the rewards, reduce provocations*, and *remove excuses* (Lemieux, 2014) to include increase the *incentives for compliance.* The model for premeditated tiger poaching developed in BBSNP suggested poaching is conducted in pairs and implicated park officials and military personnel in multiple stages of poaching-related activities, which included providing intelligence (e.g., enforcement activities, target locations) and participating as a local buyer. The main characteristic inhibiting poaching and subsequent trade of tigers is availability, in particular abundance. Unfortunately, it is quite possible that this increased rarity is driving the economic and possibly the cultural value of tigers up on domestic markets as local demand outstrips a dwindling supply, making owning tiger parts more prestigious and expensive (e.g., Hall, Milner-Gulland, & Courchamp, 2008). Strategies that seek to reduce the cultural, ecological, and economic value of dead tigers and *reduce the rewards* to

tiger poachers and traffickers by *disrupting markets* should be a priority. Using the SCP framework participants were successful in thinking beyond simply increasing the boots on the ground, elaborated the new approach of *increase incentives for compliance*, and identified areas where formal surveillance needs to be increased and prioritized communities where diverse approaches (e.g., remove excuses, increase incentives) are needed.

The fifth chapter, *Summary of research findings: Implications for theory, methods, and practice*, summarizes the main research contributions to the extant literature on guardianship, target suitability models, and the SCP framework within the context of wildlife poaching, details the methodological contribution made by further development of visual aids (e.g., Gore & Kahler, 2015) and creation of focus group procedures anchored on SCP, and discusses the practical application of findings within BBSNP and beyond. My research was a field-based empirical examination of concepts, models and techniques from SCP within the context of poaching prevention in an in-danger biodiversity hotspot. This research helps fill knowledge gaps related to the interdisciplinary application of the SCP framework for use by conservation practitioners in a protected area, which is consistent with calls for the need to explore opportunity-reducing approaches to wildlife crime prevention (e.g., Kurland et al., 2017; Lemieux, 2014; Wellsmith, 2010) therefore developing conservation crime science alongside conservation criminology (Kahler & Gore, 2017).

1.1.4 Case study context

Sumatra is Indonesia's western-most island and the sixth largest island in the world with high biodiversity threatened by habitat conversion and poaching. On the island of Sumatra, BBSNP is the third largest protected area (3,568 km^2) covering more than 150 km of the Barisan Mountain range and home to some of the largest tracks of remaining lowland rainforest in

Sumatra (O'Brien, Kinnaird, & Wibisono, 2003). BBSNP, along with Kerinci Seblat (13,895 km^2) and Gunung Leuser (7,927 km^2), is a United Nations Educational, Scientific and Cultural Organization (UNESCO) World Heritage Park designated as a key landscape for recovery of the critically endangered Sumatran tiger (*Panthera tigris sumatrae*) and Sumatran rhinoceros (*Dicerorhinus sumatrensis*) (Pusparini et al., 2017). In 2015, BBSNP officials formally designated 1,000 km^2 of the park's core forest block as an Intensive Protection Zone (IPZ) (Pusparini et al., 2017). In addition to rhinoceros and tiger, the park is home to a number of International Union for Conservation of Nature (IUCN) Red Listed Endangered mammals including the dark-handed gibbon (*Hylobates agilis*), Malayan sun bear (*Ursus malayanus*), siamang (*Symphalangus syndactylus*) Sumatran elephants (*Elephus maximus sumatranus*), and Sunda pangolin (*Manis javanica*). The park is also home to at least 277 bird species, including all species of hornbills (Anggraini, Kinnaird, & O'Brien, 2000) and endangered species such as the helmeted hornbills (*Rhinoplax vigil*), straw-headed bulbul (*Pycnonotus zeylanicus*), and black-and-white laughingthrush (*Garrulax bicolor*).

The lowland rainforest area of what is now BBSNP has a tumultuous history filled with colonial powers, commodity agriculture, political upheavals, economic booms and busts, inter-island migration, development, and contentious waves of evictions and encroachment (Levang, Sitorus, Gaveau, & Sunderland, 2012). BBSNP straddles the province of Lampung and Bengkulu (Anggraini et al., 2000) with Lampung being one of the most impoverished and densely populated provinces in Sumatra (O'Brien & Kinnaird, 1996). Highlights of this history include the establishment of a nature reserve, South Sumatra 1 Nature Reserve, by the Dutch East-Indies in 1935, which was then established as BBSNP in 1982, and was added as a UNESCO World Heritage Site in 2004 (Levang et al., 2012). Commercial logging started to impact Sumatran

forests starting in the 1960s with forest fires intentionally started every few years in the mid-1980s (Whitten, Holmes, & MacKinnon, 2001). Robusta coffee prices started rising in the 1970s, peaked in 1977, fueling mass migrations, encroachment and illegal settlements in BBSNP (Levang et al., 2012). Further, the 1997 Asian financial crisis constricted investments in parks, reduced patrols and the effectively suspended evictions of illegal settlements and agriculture in the park (Levang et al., 2012). By the early 21st century it was estimated that nearly 70% of Lampung's coffee production was within or near BBSNP (O'Brien & Kinnaird, 2003). It is likely that those settled illegally in the park are involved in other illegal activities.

The serious level of agricultural encroachment, legal and illegal logging, and illegal hunting in BBSNP is facilitated by the park's narrow linear shape resulting in over 700 km of the boundary with dense human habitation (O'Brien et al., 2003). Dense areas of agricultural fields, plantations (e.g., oil palm), and villages are clustered on the borders of the park and high levels of deforestation have happened since the park's establishment (McCarthy, Wibisono, McCarthy, Fuller, & Andayani, 2015). Encroachment has been estimated to impact approximately 89,000 hectares or 25% of the park in Lampung province (World Wildlife Fund [WWF], 2013) and has secondary effects as well. For example, those that have planted new coffee plantations in the park have been known to seek wages by providing public transportation services and illegally logging while waiting for their newly planted coffee shrubs to become productive (Levang et al., 2012). Additionally, local politicians use promises of opening access to park resources, an endorsement of illegal activities, as political leverage with area voters (Levang et al., 2012).

Wildlife crime, including poaching and domestic trade of wildlife and wildlife species, is also threat to the biodiversity of BBSNP (Kinnaird, Sanderson, O'Brien, Wibisono, & Woolmer, 2003). Poaching of high-value species such as the critically endangered Sumatran tiger (O'Brien,

Kinnaird, & Wibisono, 2003), Asian elephants (Hedges et al., 2005), and Sumatran rhinoceros (Nardelli, 2014) are known to happen within the park. Additionally, commercial hunting of wild boar (*Sus scrofa*) to meet growing demand by Chinese and Christian Bataks has been documented in Jambi, Sumatra (Luskin, Kelley, & Potts, 2013). It is likely that other forms of wildlife crime such as commercial and subsistence wild meat hunting, trade in wild songbirds (e.g., Jepson, Ladle, & Sujatnika, 2011) and helmeted hornbill ivory (e.g., Beastall, Shepherd, Hadiprakarsa, & Martyr, 2016), for example, are happening within BBSNP given their documentation in other Sumatran protected areas. It is unsurprising that BBSNP is also on UNESCO's List of World Heritage Parks in Danger (Pusparini et al., 2017) given the aforementioned pressure from agriculture, deforestation, encroachment, and illegal extraction of forestry and wildlife resources. Recently there have been efforts to create formal community-based guardianship opportunities in and around BBSNP. For example, WWF established Community Patrol Ranger Units composed of community members, national park's rangers, and WWF staff that patrol community and park areas in addition to communicating with farmers, loggers, and hunters to explain rules, regulations and promote conservation (WWF, 2013). Extending guardianship to communities in and around BBSNP will be essential to achieve more effective wildlife crime prevention given the size of the park, high level of encroachment and agroforestry activities, the presence of high-value species, and impoverished populations that surround it.

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CHAPTER 2

WILDLIFE GUARDIANSHIP: UNDERSTANDING LOCAL WILLINGNESS TO INTERVENE IN THE FACE OF WILDLIFE CRIME

2.1 INTRODUCTION

Poaching is a primary driver behind Southeast Asia's dramatic wildlife declines and, much like many other regions, the focus of efforts to curb poaching has been largely through enhanced patrolling and enforcement (Steinmetz, Srirattanaporn, Mor-Tip, & Seuaturien, 2014). Despite widespread acknowledgment of the need to develop commensurate community-based approaches to wildlife crime prevention, there is little understanding of the most effective approaches (Cooney et al., 2016). Indeed, community-based responses to wildlife crime are often still regarded as subordinate to enforcement and patrolling (Steinmetz et al., 2014) and despite over $350 million being spent in the last five years to tackle wildlife crime and trafficking, the majority of these funds have been designated for increased enforcement efforts (Biggs et al., 2016). Calls to increase research into effective approaches and apply community-based responses and change human behavior in a variety of wildlife crime contexts have reached a critical mass showing up in scientific literature (e.g., Challender, & MacMillan, 2014; Cooney et al., 2016), within collaborative multi-organization efforts, such as the Zero Poaching Toolkit (http://www.zeropoaching.org), and in major international conferences and symposiums. For example, the Beyond Enforcement Initiative by the IUCN, TRAFFIC, and the International Institute for Environmental Development (IIED) has been examining where, when, and how community-level responses can aid in poaching crime reductions holding conferences in Southern and Eastern Africa (South Africa, February 2015), West and Central Africa

(Cameroon, February 2016), and Southeast Asia (Vietnam, November 2016). Recently scholars have identified four pathways to provide for community-level action in response to wildlife crimes, one of which was *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 & Gore, 2015).

Worrell and Appleby (2000) proposed the definition of stewardship as follows: "Stewardship is the responsible use (including conservation) of natural resources in a way that takes full and balanced account of the interest of society, future generations, and other species, as well as private needs, and accepts significant answerability to society (p. 263)." The idea of stewardship as a conduit of conservation and community management is pervasive yet somewhat poorly defined and articulated (Worrell & Appleby, 2000) and varies from being primarily ethics-focused to placing an emphasis on action with a common thread being that stewards care for nature (Lute & Gore, 2014). Stewardship may be problematic in terms of measuring the willingness to intervene in the face of wildlife crime and has to do with three concepts often associated with stewardship, namely that stewardship is: 1) self-regulating in nature, 2) centered around ownership and user rights, and 3) focused on managing species or natural resources (Table 2.1).

First, stewardship education and interventions are often aimed at getting individual stewards to use "informed, responsible action/ behavior on behalf of the environment and future generations (Seng, 2008; p.6)." From a wildlife crime prevention standpoint, this is advantageous to get those that adopt good stewardship beliefs and behaviors to personally comply with the

Table 2.1: Comparison of concepts of guardianship and stewardship

Concept	Guardianship	Stewardship
Definition	A guardian is any person and every person on the scene of a potential crime that may notice and intervene whether they intent to or not.[a] Guardianship can be measured by willingness to intervene and along classified along an action-based continuum ranging from ignoring to indirect and direction interventions.[b]	[T]he responsible use (including conservation) of natural resources in a way that takes full and balanced account of the interest of society, future generations, and other species, as well as private needs, and accepts significant answerability to society.[c]
Concept & primary dimensions	Defined by three critical dimensions (1) willingness to supervise, (2) the ability of guardians to detect crime, and (3) willingness to intervene when faced with crime [b]	Somewhat poorly articulated and defined b and varies from action to ethics focused[d]
Primary focus of concept	Guardians serve as a source of informal crime prevention and control; primarily been studied in relation to property crime prevention in residential urban and suburban environments[f]	Stewards attitudes and actions towards single species, flora and fauna more generally to entire ecosystems; primarily concerned with interactions between steward and 'nature'[d]
Primary audience & application	All citizens, bystanders, members of neighborhoods or communities	Increasing conservation and wise use among landowners with management rights e, or citizens engaged in single species management [d]
Wildlife crime application	Guardians by definition are concerned with the illegal actions of others and the concept can be measured in terms of a continuum of intervention and is a direct measure of crime prevention behaviors among a wide range of stakeholders.	Stewards may be more likely to personally comply with wildlife with regulations and prohibit certain actions among those with shared species management objectives[d]

[a] Hollis-Peel, Reynald , Bavel, Elffiers & Welsh, 2011. [b] Reynald, 2010; [c] Worrell & Appleby, 2000 (p. 263). [d] Lute & Gore, 2014. [e] Benson, Shelton & Steinbach, 1999. [f] Wilcox, Madensen & Tillyer, 2007.

empirical investigation of the effectiveness of shared stewardship to intervene in the face of wildlife crime is lacking. Secondly, wildlife stewardship is often confounded with ideas of land ownership, rights to use wildlife, and the process of states empowering and granting rights to landowners as stewards often giving them a set of standards for good management (Benson, Shelton, & Steinbach, 1999). This can be problematic in some wildlife crime prevention scenarios given the complexity and diversity of community land rights and wildlife management regulations worldwide. For example, in areas where communities do not feel any ownership over wildlife resources or lack the rights for wildlife management and use, stewardship may not be advantageous in the context of wildlife crime. Lastly, stewardship is focused on actions and behaviors directed at natural resources and the environment. For example, the California Invasive Plant Council defines wildland stewardship as "the practice of managing natural areas with particular goals, such as restoring habitat for particular wildlife or plant species and protecting ecosystem function (California Invasive Plant Council [Cal-IPC], 2015; p. 1)." Again, this is advantageous in terms of regulating one's own actions towards wildlife yet provide little guidance for responding to external threats and harmful *human* behaviors such as wildlife crimes (Table 2.1).

There is a need to move beyond stewardship in terms of understanding community responses to wildlife crime. Guardianship is a concept from mainstream criminology (Reynald, 2010) that examines the willingness of stakeholders to assume an informal role as protectors and intervene if necessary to disrupt crimes and has three critical dimensions: 1) the willingness to supervise or monitor crimes, 2) the ability of the guardian to detect potential criminals, and 3) willingness to intervene when faced with a crime (Reynald, 2010). Guardianship can be measured as a behavioral intention (e.g., Reynald, 2010), through direct observation of potential

guardian behavior (Hollis-Peel et al., 2012), at an individual or neighborhood-level (communities) (Wilcox, Madensen, & Tillyer, 2007) or examining how the physical environment affects both the opportunities and effectiveness of the guardians' surveillance activities (Reynald, 2011). Guardianship is complementary to stewardship and it addresses the three problematic limitations discussed above in regards to the wildlife crime. First, according to the three critical dimensions of guardianship outlined above, guardians are concerned with the illegal actions and behaviors of others and therefore have an outward gaze as opposed to the focus of personal responsibility to sensible environmental management as is the emphasis of stewardship. Additionally, there is a continuum of intervention that spans from turning a blind eye to performing both direct (e.g., stopping it alone) and indirect (e.g., calling the authorities) interventions (Reynald, 2010). Secondly, while the incentives to intervene and engage in guardianship behavior are often strongest with personal property (e.g., Reynald, 2009) residents often serve as communal watch guards within their neighborhoods with various 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). Within the urban context, community watch groups are examples of programs designed to increase guardianship and there are examples related to rural areas as well. For example, Pennsylvania has a grassroots proactive crime prevention program, *Turn in a Poacher* (TIP), that gives anglers a TIP card that has the direct number of a conservation officer, who responds immediately to reports of steelhead trout poaching (McSkimming & Berg, 2008). Lastly, guardianship is focused on the willingness of stakeholders to intervene or manage potential offenders. So while stewardship is resource management-based, guardianship is focused on managing deviant human behavior.

2.1.1 Research objectives

Exploring the theoretical, methodological and applied aspects of the criminological concept of guardianship within the context of conservation would be a valuable addition to calls to effectively engage communities as partners in wildlife crime prevention as informal guardians (e.g., Biggs et al., 2016). However, even within the context of conventional criminology understanding the factors that affect decision-making related to guardianship behavior (e.g., Reynald, 2010), such as demographic and attitudinal factors, are poorly understood. Accordingly, as this is the first known attempt to measure guardianship intentions within a conservation context the following exploratory research objectives were set: 1) measure the three dimensions of guardianship to create a Guardianship Intention Index, 2) explore how perceptions of crime seriousness and variations in the types of crime influence preferences for interventions, and 3) examine for relationships between the dimensions of guardianship and a wide range of demographic variables and constructs from criminology, human dimensions, and risk perception research. Below is a review of approaches and theories that may be conceptually related to guardianship behavior namely perceptions of crime seriousness from criminology, wildlife value orientations (WVO) from human dimensions of wildlife management, and psychometric risk perception from risk and decision sciences.

With respect to wildlife crimes, defined here as the illegal capture, killing, trade or trafficking of wild flora and fauna, understanding local opinions related to wildlife crime seriousness is advantageous to understanding overall perceptions of poaching risks. Perceptions of crime seriousness are based on judgments on the harmfulness of outcomes, wrongfulness, criminal intent, economic losses, bodily harm, and offender-victim relations (Shelley et al., 2011). Theoretically, perceptions of crime seriousness may affect a potential guardian's

willingness to intervene as well as the level of intervention. For example, Reynald (2010) found that the preferred intervention was to call authorities (indirect) when the events witnessed seem to be more serious. However, research related to crime seriousness regarding environmental crimes is sparse (for exception see Shelley, Chircos, & Gertz, 2011). To my knowledge poaching of wild flora and fauna has yet to be investigated in terms of crime seriousness relative to traditional street crimes. Shelley et al. (2011) examined three pollution-based crimes against five non-environmental crimes, such as smoking pot, theft, and rape, and found that while pollution-based crimes are seen as serious, there were differences among socio-demographic groups in terms of their perceptions of environmental crime seriousness.

WVO is a conceptual framework and measurement instrument, validated in natural resources management, 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 can be used to understand social group (e.g., hunters vs. animal right activists) as well as individual differences (Teel et al., 2007; Zinn et al., 2002), has been used to examine the acceptability of wildlife management interventions (Jacobs, Vaske & Sijtsma, 2014), and has been explored in international contexts (e.g., Tanakanjana & Saranet, 2007; Zinn & Shen, 2007). Within the context of guardianship, WVOs could be examined 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). On the other hand, those that hold mutualistic value orientations that are related to feelings of equalitarianism and equality, which extends to human-animal relationships, and are 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 crime.

The theory of psychometric risk perception (Slovic, 1987) is advantageous when considering environmental crime as a socio-environmental risk and has been useful in understanding the human dimensions of wildlife management. For example, risk perceptions can influence stakeholders' risk-related decision-making (Gore et al., 2009) and may ultimately influence how individuals think and behave in response to risks (Baird et al., 2009). Stakeholder risk perceptions contribute to evaluating tradeoffs between natural resource management alternatives (Gore et al., 2009) and may influence overall stakeholder support for management actions (Gore et al., 2006). Risk perception research has been used to capture stakeholder perceptions of motivations for noncompliance with wildlife laws (Kahler & Gore, 2012), and estimate the location and severity of poaching related activities (Kahler et al., 2012). Increasing our understanding of the broader ecological, psychological, and sociocultural contexts in which wildlife crime-related risks occur and how these risks impact vulnerable species, environments, economies, communities and human well-being can inform theory and practice. Risk perception is advantageous in relation to poaching as it has been applied in relation to human wildlife conflicts (e.g., Gore et al., 2006) and wildlife poaching (e.g., Kahler et al., 2012; Kahler & Gore, 2012).

2.1.2 Wildlife crime and the residents of Bukit Barisan Selatan National Park (BBSNP), Sumatra Indonesia

Bukit Barisan Selatan National Park (BBSNP), which is the third largest protected area (3,568 km^2) in Sumatra, straddles the province of Lampung and Bengkulu (Anggraini, Kinnaird, & O'Brien, 2000). Lampung is one of the most impoverished and densely populated provinces in

Sumatra (O'Brien & Kinnaird, 1996). Covering more than 150 km of the Barisan Mountain range, this park is home to some of the largest tracks of remaining lowland rainforest and is an important watershed for southwestern Sumatra (O'Brien, Kinnaird, & Wibisono, 2003). The park is home to a number of large mammals including Malayan sun bear (*Ursus malayanus*), Asian elephants (*Elephus maximus*), Sumatran tiger (*Panthera tigris sumatrae*), Sumatran rhinoceros (*Dicerorhinus sumatrensis*), and at least 277 bird species including all species of hornbills (Anggraini et al., 2000). Due to the park's narrow linear shape over 700 km of the boundary is subjected to serious agricultural encroachment, logging and illegal hunting (O'Brien et al., 2003). Encroachment has been estimated to impact approximately 89,000 hectares or 25% of the park in Lampung province (World Wildlife Fund [WWF], 2013). Dense areas of agricultural fields, plantations (e.g., oil palm), and villages are clustered on the borders of the park and high levels of deforestation have happened since the park's establishment (McCarthy, Wibisono, McCarthy, Fuller, & Andayani, 2015). The park has an Intensive Protection Zone (IPZ) is bounded in the north and south by a major highway lined with agricultural, commercial and residential development.

The lowland rainforest area of what is now BBSNP has a tumultuous history filled with colonial powers, commodity agriculture, political upheavals, economic booms and busts, inter-island migration, development, and contentious waves of evictions and encroachment (Levang, Sitorus, Gaveau, & Sunderland, 2012). Highlights of this history include the establishment of a nature reserve, South Sumatra 1 Nature Reserve, by the Dutch East-Indies in 1935, then was established as BBSNP in 1982, and added to the UNESCO World Heritage Sites in 2004 (Levang et al., 2012). Commercial logging started to impact Sumatran forests starting in the 1960s, forest fires intentionally started every few years in the mid-1980s (Whitten, Holmes, &

MacKinnon, 2001), and then the 1997 Asian financial crisis constricted investments in parks, reduced patrols and effectively suspended evictions of illegal settlements and agriculture in the park (Levang et al., 2012). Robusta coffee prices started rising in the 1970s, peaked in 1977, fueling mass migrations, encroachment and illegal settlements in BBSNP (Levang et al., 2012). By the early 21st century it was estimated that nearly 70% of Lampung's coffee production was within or near BBSNP (O'Brien & Kinnaird, 2003). It is likely that those settled illegally in the park are involved in other illegal activities. For example, those that have planted new coffee plantations in the park have been known to seek wages by providing public transportation services and illegally logging while waiting for their newly planted coffee shrubs to become productive (Levang et al., 2012). Additionally, local politicians use promises of opening access to park resources and endorsement of illegal activities (Levang et al., 2012).

Poaching is a threat to the biodiversity of BBSNP (Kinnaird, Sanderson, O'Brien, Wibisono, & Woolmer, 2003). Poaching of high-value species such as the International Union for Conservation of Nature (IUCN) Red Listed Critically Endangered Sumatran tiger (O'Brien, Kinnaird & Wibisono, 2003), Asian elephants (Hedges et al., 2005), and Sumatran rhinoceros (Nardelli, 2014) are known to happen within the park. Additionally, commercial hunting of wild boar (*Sus scrofa*) to meet growing demand by Chinese and Christian Bataks has been documented in Jambi, Sumatra (Luskin, Kelley, & Potts, 2013). It is likely that other forms of wildlife crime such as commercial and subsistence wild meat hunting, trade in wild songbirds (e.g., Jepson, Ladle, & Sujatnika, 2011) and helmeted hornbill ivory (e.g., Beastall, Shepherd, Hadiprakarsa, & Martyr, 2016), for example, are happening within BBSNP. Extending guardianship to communities in and around BBSNP will be essential to achieve more effective wildlife crime prevention given the size of the park, high level of encroachment and agroforestry

activities, the presence of high-value species and impoverished populations that surround it. Recently there have been efforts to create formal community-based guardianship opportunities in and around BBSNP. For example, WWF established Community Patrol Ranger Units composed of community members, national park's rangers, and WWF staff that patrol community and park areas in addition to communicating with farmers, loggers, and hunters to explain rules, regulations and promote conservation (WWF, 2013).

2.2 METHODS

2.2.1 Research approach

The research was carried out in 10 villages around the IPZ in BBSNP, on the island of Sumatra, Indonesia: Kubu Perahu, Pekon Mon, Pemerihan, Serdang, Suka Marga, Sukabanjar, Sukabumi, Sukaraja, Sumberagung, and Sumberejo (Figure 1). 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.

2.2.2 Sampling and data collection

I addressed research objectives with semi-structured interviews consisting of practice exercises and questions related the themes of crime seriousness (Shelley et al., 2011), guardianship (Reynald, 2010), psychometric risk perception (Slovic, 1987), and wildlife value orientations (Jacobs et al., 2014). Practice questions were performed to allow participants to become familiar with ranking exercises and the visual scales (Gore & Kahler, 2015). The ranking exercise was related to a non-threatening subject matter, had the participant rank six common and local foods in order of preference, and had one item where the most prevalent answer was known (i.e., a pork dish in a predominantly Muslim area would be rated as least preferred

because of religious reasons). A follow-up question was meant to gauge their understanding of the visual agreement scales by asking how strongly they agreed or disagreed with the following statement: “I think that [food ranked #1] is unpleasant to eat.” Agreement-scaled response questions were measured using six-point visual scales designed specifically to lessen culturally-driven bias towards neutral response categories (Roster, Albaum, & Rogers, 2006) and to aid participants unfamiliar with scaled responses. The interview was concluded with demographic questions.

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. The interview 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 (e.g., Gore & Kahler, 2015). Interviews were conducted in five villages along the southern corridor of the IPZ prior to the start of Ramadan in 2015 and an additional five villages were interviewed on the west and northern boundary of the IPZ after Ramadan. Cluster sampling with probability proportionate to size (Bernard, 2006) was used as there were no reliable lists (e.g., addresses, property tax records) of residents in the villages. Forty (40) interviews were conducted in each village. In each village, population clusters were identified (e.g., sub-villages) and then the proportion of interviews in each sub-village were allocated based on the best estimate of population in those areas. Each sub-village zone was sampled and convenience sampling was used within each village zone (Bernard, 2006).

Interview 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 interviews to accommodate work schedules, cultural and religious considerations (e.g., prayer times). All interview responses were translated into English and quality checked both in the field and after by research assistants (Gore & Kahler, 2015).

2.3 ANALYSIS

2.3.1 Demographic and descriptive statistics

Data was analyzed using SPSS 24. Descriptive statistics were used to characterize the interview respondents in terms of age, education, ethnic group, gender, household size, including the number of dependents (< 18 years old), marital status, livelihood strategy, and religion. Descriptive statistics were performed on the ranking exercise and visual scale test questions as a check on scale and ranking comprehension; for example, ranking of preference for a pork food item was cross-tabulated by participant religion as eating pork is prohibited by the Muslims faith (e.g., Gore & Kahler, 2015).

2.3.2 Objective one: Dimensions of guardianship

The concept of guardianship was measured through a series of agreement questions aimed to measure willingness to supervise, perceptions of their ability to detect potential wildlife crime offenders, and an open-ended question about the willingness to intervene (Reynald, 2010). Willingness to supervise was measured with three questions based on research by Reynald (2010) and the average of these three questions was calculated for an overall willingness to supervise score (range -3 to 3). The ability to detect offenders was calculated through the average of three questions aimed to understand their perception of their ability to aid wildlife crime

prevention and detect criminal activity (range -3 to 3). Lastly, willingness to intervene was measured through the following open-ended question:

> "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?"

The responses to these questions were coded according to Reynald's (2010) five broad categories of intervention: 1) ignore or turn a blind eye, 2) monitor the activities covertly, 3) indirect intervention (e.g., call authorities), 4) direct intervention (e.g., speak to the offender), and 5) indirect and direct intervention. Scores were assigned as follows -1= join the illegal activity, 0= ignoring, 1= covert monitoring, 2= Indirect intervention, 3= Direct intervention, and 4= Indirect and direct intervention. Uncertain responses were coded as missing. The guardianship intention index (GII) 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 supervise

G= Score related to willingness to intervene

Scores ranged from -8 to 14 where -8 indicates no guardianship intention and 14 indicates the highest level of guardianship intention. To explore the differences between those willing to intervene and those that were not, willingness to intervene scores were recoded into a dichotomous variable: non-interveners (ignore, join the illegal activity, uncertain) and those that intervene (direct, indirect, direct and indirect).

2.3.3 Objective two: Influence of crime seriousness and type

Interview participants were asked to rank 10 general crimes from the most serious to the least (See Appendices C and D for visual aids). The crimes included (in alphabetical order): 1) assault resulting in hospitalization, 2) burglary of 8,000,000 rupiah (~$ 600 USD), 3) corruption, 4) illegal collection of wild animals for the purpose of pets, 5) illegal drug use, 6) illegal logging, 7) illegal taking or killing of wild animals for purpose other than pets, 8) pollution resulting in 10 sick people, 9) theft of 250,000 Indonesian Rupiah (~$20 USD), and 10) vandalism. An importance index representing crime seriousness (CS) (Kahler, Roloff, & Gore, 2013) was calculated to reflect the ordinal rank the participants assigned to a particular crime in relation to the other crimes. The value ranges from 0 to 1 (1=highest important), r is the rank and n is the total number of crimes ranked (n=10):

$$CS = [(r-1)/(n-1)] \times (-1) + 1$$

The poaching crime seriousness index was calculated based on the rank interview participants gave general poaching versus the other nine crimes and various between zero and one.

Frequency tables were calculated for the general and the environmental crime ranking exercises. Respondents were asked to provide reasons why their number one ranked crime was the most serious and why the last ranked crime was the least serious in their opinion. Responses were examined when poaching was ranked first or last and descriptive statistics of those respondents were calculated. Lastly, participants were also asked to think about 12 environmental crime scenarios and identify which of the five categories of intervention they think a community member should do, if any, in the different situations. Environmental crime scenarios were cross-tabulated by intervention category and presented with the environmental crime seriousness rankings.

2.3.4 Objective three: Relationship to selected variables

Data was not weighted due to the non-parametric sampling design and unknown population parameters (Vaske, 2008). 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, Permandi, & Yasmi, 2012). Demographic categories that allowed natural recoding, such as ethnic group to Native Island, were collapsed accordingly.

Analysis of crime seriousness (CS) was discussed above. To measure the psychometric risk perception of poaching summative scales were created using questions related to their perception of dread, consequences, and frequency of localized poaching. These summative scales were created the risk targets of local livelihoods, wildlife and a composite of livelihood and wildlife. The respondents were asked to rate the level of risk and severity of the consequences to local livelihoods and local wildlife separately, rating the risk and severity on a scale of zero (no risk/not severe) to five (highest risk/severity), and perceived frequency of poaching both within BBSNP and in the participants' community (0=never happens, 5=extremely common). The perception of poaching risk to livelihood (P_{liv}) was a simple summative scale of their perception of the dread of the risk (D_l) plus the consequences (C_l) plus the average of the perceived frequency of poaching in the park (F_p) and in the 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 (Kahler, 2010).

Composite poaching risk scores were calculated as follows, where P_c is the composite poaching score, D_l is perceived risk of poaching to local livelihoods, D_w is the perceived risk of poaching to wildlife, C_l is the perceived severity of poaching consequences to local livelihoods,

C_w is the perceived severity of poaching consequences to wildlife, F_p is the perceived frequency of poaching in the park and F_c is the perceived frequency of poaching in the community areas:

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

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

Dominance and mutualistic wildlife value orientations were examined using three items each. 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. Diverging from Jacobs et al. (2014) a k-cluster analysis was used to identify clusters and assign respondents to them (Hoogstra-Klein et al., 2012; Oltedal & Rundmo, 2007). The k-cluster analysis allowed for hybrid or moderate wildlife value orientations (e.g., 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 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.

In order to explore the relationship between respondents' overall stated GII related to wildlife poaching and variables of crime seriousness and psychometric risk perception, including perceived control over poaching Pearson r correlations was conducted (Vaske, 2008). 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, wildlife orientation (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, 2008).

2.4 RESULTS

2.4.1 Demographic and descriptive statistics

Of the 400 interviews, 156 (39%) were women, 244 (61%) were men, and ages ranged from 18 to 88 years old with a mean of 37 years (Table 2.2). The vast majority of respondents were Muslim (97%) and married (89%). There were 12 ethnic groups represented 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 had 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) and among those that did not list agriculture as their primary livelihood activity 9% (n = 35) listed agriculture as their secondary source of livelihood. However, it is very feasible that many respondents engaged in both subsistence and commercial agriculture activities but the manner in which it was recorded made it hard to discern. Accordingly, the following demographic information was selected for inclusion in a correlation analysis: age, education (collapsed into no formal education and elementary, junior high, senior high, post-secondary), gender, dichotomous ethnic group consisting of Sumatran and non-Sumatran ethnicities (Javan, Balinese), and primary livelihood consisting of four categorical variables including agriculture, business and paid labor, professionals (civil servants, journalist, midwife, nurse, teacher), and unsalaried occupations (housewife, student, graduate, nothing).

Table 2.2: Demographics of interview respondents (N = 400) in Bukit Barisan Selatan National Park (BBSNP), June and August, 2015

Characteristic	Descriptive Statistics				
	Min.	Median	Mean	Max.	NA
Age (years)	18	35	37.0	88	1
Household size	1	4	4.4	12	1
Number under 18 living in household	0	0.1	1.4	7	0

	Respondents % (No.)					
Gender	Female	39	(156)	Male	61	(244)
Education	No formal education	2	(6)	Midwifery	< 1	(2)
	Elementary	40	(159)	Vocational school	1	(4)
	Junior high	23	(93)	Bachelors	8	(30)
	Senior high	26	(103)	Masters	< 1	(2)
Ethnic group by island	Bali	2	(9)	Sumatra	21	(85)
	Balinese	2	(9)	Batak	1	(4)
				Japung[a]	< 1	(1)
	Java	77	(306)	Lampungnese	16	(65)
	Javanese	58	(232)	Ogan (Baturaja)	< 1	(2)
	Javanese mixed	2	(9)	Oku	< 1	(1)
	Sudanese	16	(65)	Padangnese	< 1	(2)
				Palembang	2	(8)
				Semendo	< 1	(2)
Marriage status	Married	89	(357)	Unmarried	11	(43)
Primary livelihood	Agriculture	61	(245)	Sales and trade	8	(33)
	Business/ entrepreneur	5	(19)	Student/ graduate	2	(8)
	Civil servant/ government	7	(26)	Midwife or nurse	1	(4)
	Housewife	9	(35)	Nothing	< 1	(1)
	Paid labor	4	(15)	Journalist	< 1	(1)
	Teacher	3	(13)			
Religion	Muslim	97	(389)	Christian	1	(5)
	Hindu	2	(9)			

[a] Japung is a term used for second generation Javanese born in Lampung.

Table 2.3: Descriptive statistics for guardianship dimensions of willingness to supervise, ability to supervise, and willingness to intervene for respondents ($N = 400$) in BBSNP

Guardianship dimension	Min.	Max.	*M*	*SE*	*SD*
Ability to supervise	-2	3	1.58	0.05	0.92
I have the ability to aid in wildlife protection.	-3	3	0.81	0.09	1.79
I would spot someone that doesn't belong quickly.	-3	3	2.17	0.05	0.99
I can tell when someone is up to no good.	-3	3	1.77	0.06	1.21
Willingness to Supervise	-2.33	2.67	0.20	0.06	1.11
My responsibility to watch for illegal activities in the park.	-3	3	-0.53	0.09	1.87
Everyone's responsibility to watch for illegal activities in the park.	-3	3	1.83	0.06	1.19
I have the time to watch for people doing illegal activities in the park.	-3	3	-0.71	0.09	1.74

	Guardianship code[a]	*f*	%
Willingness to Intervene			
Join the illegal activity	-1	2	0.5
Turn a blind eye	0	103	25.8
Covert monitoring	1	2	0.5
Indirect interventions	2	101	25.3
Call authorities	2	99	24.8
Destroy weapons	2	2	0.5
Direct interventions	3	165	41.3
Communicating	3	94	23.5
Physical interference	3	71	17.8
Both indirect and direct interventions	4	24	6.0
Uncertain	missing	3	0.8

a Guadianship code is based on fitting interview responses to Reynald's (2010) five broad categories of intervention (0 = ignore or turn a blind eye to 5 = indirect and direct intervention); join the illegal activity was coded as -1.

2.4.2 Objective one: Dimensions of guardianship

Respondents rated their ability to supervise (M = 1.58, SD = 0.92) higher than their willingness to supervise (M = 0.20, SD = 1.11) (Table 2.3). Overall, 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 (Table 2.3). Turning a blind eye was the second most common response (25.8%, n =103) and about a quarter of respondents (25.3%, 101) said they would call authorities (Table 2.3). 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). 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.

2.4.3 Objective two: Influence of crime seriousness and type

Overall general poaching was ranked fourth (seriousness index= 0.60) out of the 10 general crime scenarios (Table 2.4). Illegal pet collection is also a form of poaching but was seen as the much less serious (seriousness index = 0.32), coming in next to last in the overall ranking. Illegal drug use was the most serious crime. Respondents had a variety of reasons why they thought that poaching was either the least serious crime (n = 9) or most serious (n = 26) crime among the general crime categories (Table 2.5). Education and gender were significant when examining the association between the seriousness index and demographic variables. The mean seriousness index value increased as educational attainment increased from no education-elementary (M = 0.56, n = 165) to post-secondary (M = 0.67, n = 45) (F-value = 3.41, p = 0.02) and was higher among women (men = 0.57; women = 0.63) (F-value = 4.99, p = 0.03).

Table 2.4: Overall ranking for crime seriousness under 10 general crime scenarios and 12 environmental crime scenarios according to interview respondents (*N* = 400) in BBSNP

Crime scenarios	Importance Index[a]	Rank
General crime scenarios		
Illegal drug use	0.83	1
Corruption	0.74	2
Illegal logging	0.63	3
Poaching	0.60	4
Burglary 8,000,000 rupiah (~600 USD)	0.48	5
Pollution resulting in 10 sick people	0.43	6
Assault resulting in hospitalization	0.38	7
Vandalism	0.34	8
Illegal pet collection	0.32	9
Theft 250,000 rupiah (~20 USD)	0.26	10
Environmental crime scenarios		
Illegal logging	0.75	1
Poisoning wildlife	0.70	2
Organized trophy poaching	0.63	3
Selling illegal wildlife product	0.59	4
Taking live animals from the park	0.54	5
Snares and traps	0.53	6
Buying illegal wildlife products	0.52	7
Local poaching for money	0.51	8
Local poaching for food	0.43	9
Collecting pets illegally in the park	0.36	10
Encroachment in the park	0.25	11
Fruit collecting in the park	0.21	12

[a] Importance index is calculated to reflect the ordinal rank that the participants assigned to a particular crime in relation to the other crimes (Kahler, Roloff & Gore, 2013).

Illegal logging was seen as the most serious environmental crime scenario while fruit collecting in the park was the least (Table 2.6). In general there was greater stated intention to intervene, directly or indirectly, for environmental crimes perceived as more serious (Table 2.6). For example, the most serious environmental crime was illegal logging and nearly half of respondents (49.3%, *n* = 197) believed community members should call authorities when they

see illegal logging. Conversely, the majority of respondents (50.5%, *n* = 202) believed that community members should ignore fruit collecting in the park, which was perceived to be the least serious (Table 2.6). However, there were exceptions to this trend in the category stop it alone with similar percentages of respondents reporting this direct intervention for the two most serious and two least serious environmental crimes (Table 2.6).

Table 2.5: Top three reasons why respondents believed poaching was the least serious (*n* = 9) and top three reasons why respondents believed poaching was the most serious (*n* = 26) when ranking poaching among 10 general crime scenarios in BBSNP

Category	Example response	*f*	% of total
	Poaching as least serious		
Doesn't damage the environment	Because it does not damage the environment	3	33.3
Poaching is fulfilling needs	The criminals are forced by their condition to fulfill their needs	2	22.2
Unknown occurrence	Because I never [knew] about [poaching] [sic]	2	22.2
	Poaching as most serious		
Can destroy wildlife/ Cause extinction	Poaching could make wild animals [go] extinct [sic]	9	34.6
Banned, illegal or forbidden	Because it is illegal and prohibited	6	23.1
Kill protected species	Because they kill the protected animals	5	19.2

2.4.4 Objective three: Relationship to selected variables

A Cronbach's alpha was calculated for four items: poaching consequences (*Conseq*.) to local livelihoods and wildlife and perceived dread (*Dread*) of poaching risks to livelihoods and wildlife ($\alpha = 0.67$; $n = 4$). Response items related to the perception of the frequency of poaching in the communities surrounding BBSNP and within the park boundaries were not included in the scale reliability as it can be assumed that these judgments are independent. The differences between the $Risk_{liv}$ and $Risk_{wl}$ means were not significant ($t(399)=0.97$, $p = 0.33$) with a mean

Table 2.6: Opinions on the most appropriate intervention response given different environmental crime scenarios according to interview respondents (N = 400) in BBSNP

		Ignore		Secretly watch		Call authority		Stop it alone		Stop it alone & call authorities	
Environmental crime scenarios	Rank	*f*	%	*f*	%	*f*	%	*f*	%	*f*	%
Illegal logging[a]	1	24	6.0	63	15.8	197	49.3	50	12.5	3	0.8
Poisoning wildlife	2	24	6.0	26	6.5	111	27.8	51	12.8	1	0.3
Organized trophy poaching	3	13	3.3	26	6.5	57	14.3	35	8.8	3	0.8
Selling illegal wildlife product	4	17	4.3	14	3.5	41	10.3	9	2.3	1	0.3
Taking live animals from the park	5	15	3.8	29	7.3	13	3.3	10	2.5	0	0.0
Snares and traps	6	7	1.8	20	5.0	20	5.0	16	4.0	1	0.3
Buying illegal wildlife products	7	7	1.8	10	2.5	22	5.5	22	5.5	0	0.0
Local poaching for money	8	10	2.5	16	4.0	20	5.0	28	7.0	2	0.5
Local poaching for food	9	46	11.5	23	5.8	4	1.0	14	3.5	1	0.3
Collecting pets illegally in the park	10	49	12.3	40	10.0	2	0.5	60	15.0	2	0.5
Planting in the park	11	140	35.0	107	26.8	10	2.5	53	13.3	0	0.0
Fruit collecting in the park	12	202	50.5	106	26.5	4	1.0	49	12.3	2	0.5
All environmental crime scenarios	na	0	0.0	0	0.0	1	0.3	1	0.3	1	0.3
No environmental crime scenarios	na	17	4.3	38	9.5	45	11.3	81	20.3	386	96.5

[a] one person said to call the village chief only

score for the composite poaching risk score of 8.38 (Table 2.7). The relationships between risk, gender and whether or not the respondent was ethnically Sumatran were not significant. The relationships between risk and education [$F(3, 396) = 3.02$, $p = 0.03$], livelihood [$F(3, 396) = 3.65$, $p = 0.01$] and village [$F(9, 390) = 3.75$. $p = 0.00$] were significant.

Table 2.7: Descriptive statistics for constructs related to psychometric risk perception

	Livelihoods				Wildlife				Overall
Statistic	*Dread*	*Conseq.*	*Freq.*[a]	*Risk*	*Dread*	*Conseq.*	*Freq.*[a]	*Risk*	*Risk*
M	3.60	3.53	1.21	8.33	3.55	3.66	1.21	8.42	8.38
SE	0.05	0.06	0.06	0.11	0.06	0.06	0.06	0.11	0.10
Median	4	4	1	8.50	4	4	1	8.50	8.5
Mode	4	4	1	8	4	4	1	9.00	8.5
SD	1.01	1.20	1.14	2.22	1.14	1.12	1.14	2.27	2.07
Range	5	5	5	14.00	5	5	5	14.00	13.5
Min.	0	0	0	1.00	0	0	0	1.00	1.50
Max.	5	5	5	15.00	5	5	5	15.00	15.00

Note. All scores based on valid $N = 400$; missing $N = 0$. Risks to livelihood and wildlife calculated as summative of scaled responses for the perceived dread, consequences (*Conseq.*), and frequency (*Freq.*) of risks to the targets. Overall risk score is a composite of poaching risks to livelihoods and wildlife.

[a] The perceived frequency of poaching was measured by asking respondents the frequency in the community and in the park; the average of these two was used to calculate risk to livelihoods, wildlife, and overall risk.

A three-cluster solution was also found for wildlife value orientations 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 hybrid wildlife value orientation was characterized by moderate domination and strong mutualism orientations and characterized the majority of interview respondents.

Table 2.8: Pearson correlation matrix among guardianship dimensions and Guardianship Intention Index (GII) and research concepts associated with interview ($N = 400$) 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*	.19 **	.11 *	.11 *	.18 **
	p	.00	.02	.03	.00
Crime seriousness	*r*	.02	.08	.05	.02
	p	.63	.12	.25	.73
Risk perception (livelihoods)	*r*	.15 **	.11 *	.12 *	.06
	p	.00	.03	.02	.21
Risk perception (wildlife)	*r*	.08	.14 **	.12 *	.16 **
	p	.11	.01	.02	.00
Risk perception (composite)	*r*	.12 *	.14 **	.10 *	.15 **
	p	.01	.01	.05	.00

** p < .05, two-tailed. ** p < .01, two-tailed.*

Two concepts, perceived control over poaching (1-item indicator) and the composite risk perception score, were significant for all three dimensions of guardianship and the GII according to results from the Pearson correlation (Table 2.8). Crime seriousness was not significant for any dimension. 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 2.8). When 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 2.9).

Table 2.9: 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	.41	.23	.52	.32
Gender ($df = 398$)[b]	*t*	-2.79 **	-1.20	-2.08 *	-2.84 **
	p	.01	.23	.04	.01
Livelihood ($df = 3$)[a]	*F*	0.70	1.78	4.79 **	5.00 **
	p	.55	.15	.00	.00
Sumatran ($df = 398$)[b]	*t*	1.43	6.91 **	0.12	2.14
	p	.23	.01	.73	.14
Village ($df = 9$)[a]	*F*	2.22 *	1.72	6.07 **	5.44 **
	p	.02	.08	.00	.00
Wildlife value orientations ($df = 2$)[a]	*F*	3.38 *	1.66	4.33 **	5.32 **
	p	.04	.19	.01	.01

[a] One-way ANOVA. [b] Independent T-test.
* $p < .05$, two-tailed. ** $p < .01$, two-tailed.

WVO was significant for two individual indicators of guardianship and the GII [F (2, 394) = 59.848, $p = 0.005$] (Table 2.9). 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 [$M = 4.31$, $SD = 3.83$] were the least intention to serve as a wildlife guardian.

Table 2.10: Chi-square tests between self-reported non-interveners ($n = 110$) and interveners ($n = 290$) for demographic and attitudinal variables in BBSNP

Variable	Non-interveners		Interveners		X^2	p
	f	%	f	%		
Education						
None-elementary	45	27.3	120	72.7	0.96	.81
Junior high	28	30.1	65	69.9		
Senior high	27	27.8	70	72.2		
Post-secondary	10	22.2	35	77.8		
Gender						
Female	52	33.3	104	66.7	4.37 *	.04
Male	58	23.8	186	76.2		
Livelihood						
Agriculture	60	24.5	185	75.5	11.90 **	.01
Business-paid labor	28	41.8	39	58.2		
Professional	7	15.9	37	84.1		
Unpaid occupation	15	34.1	29	65.9		
Sumatran						
Non-Sumatran[a]	83	26.3	232	73.7	0.99	.32
Sumatran	27	31.8	58	68.2		
Village						
Kubu Perahu	11	27.5	29	72.5	42.38 **	.00
Pekon Mon	20	50.0	20	50.0		
Pemerihan	22	55.0	18	45.0		
Serdang	15	37.5	25	62.5		
Suka Marga	10	25.0	30	75.0		
Sukabanjar	6	15.0	34	85.0		
Sukabumi	9	22.5	31	77.5		
Sukaraja	7	17.5	33	82.5		
Sumberagung	4	10.0	36	90.0		
Sumberejo	6	15.0	34	85.0		
Wildlife value orientations						
Strong mutualism	30	28	77	72	9.91 **	.01
Moderate domination	22	45.8	26	54.2		
Hybrid mutualism	58	23.7	187	76.3		

[a] Participants from Bali and Java

* $p < .05$. ** $p < .01$.

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, n = 0.007) (Table 2.10). There were also significant relationships between items related to guardianship, psychometric risk perception, and wildlife value orientation dimensions (Table 2.11). For example, 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 2.11).

Table 2.11: 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		.77
Guardianship dimensions							
Ability to supervise average	1.40	0.95	1.65	0.90	-2.48	*	.01
Willingness to supervise average	-0.26	1.04	0.37	1.09	-5.27	**	.00
Psychometric risk perception							
Poaching risk (people)	8.12	2.55	8.41	2.08	-1.17		.24
Poaching risk (wildlife)	8.00	2.46	8.58	2.17	-2.30	*	.02
Poaching risk (combined)	8.06	2.34	8.50	1.96	-1.88		.06
Perceived control	1.28	1.29	1.58	1.29	-2.06	*	.04
Poaching crime seriousness	0.59	0.25	0.60	0.24	-0.51		.61
Wildlife value orientations							
Domination average	0.64	1.11	0.55	1.14	0.66		.51
Mutualism average	1.69	0.93	1.91	0.80	-2.34	*	.02

* p < .05. ** p < .01.

2.5 DISCUSSION

Community-based responses to the ongoing wildlife crime crisis are in high demand (e.g., Cooney et al., 2016). In order to gain traction on understanding the offenders and most effective responses to wildlife crime, conservation science needs to engage disciplines with the expertise in understanding the criminology and crime science (e.g., Gibbs, Gore, McGarrell, & Rivers, 2010; Gore, 2011). Recent empirical research aimed at understanding poaching behavior has been primarily focused on understanding the behavior of offenders (e.g., Crow, Shelley, & Stretesky, 2013; Kahler & Gore, 2012). Studying guardianship shifts focus of the crime event from understanding criminals, such as poachers, to understanding the decision-making and crime preventative potential of local residents as capable guardians (Hollis-Peel et al., 2012; Reynald, 2010). This addresses an important knowledge gap associated with involving communities in wildlife crime prevention. This was the first known attempt to measure guardianship intentions within the context of wildlife poaching. The findings lay the foundation for understanding theory, methods, and applications of guardianship as a community-based response to wildlife crime.

A high proportion (41.3%) of respondents reported an intention of direct intervention if they witnessed a suspected poacher entering a protected area and the majority of those favored communicating with the suspect rather than physical intervention. However, stopping it alone 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. Further, the second most common response to witnessing a suspected poacher was to turn a blind eye nearly neck and neck with indirect interventions. 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. While it is encouraging that a majority of respondents indicated they would either indirectly or directly intervene caution is warranted as respondents were reporting a behavioral intention to hypothetical situation with a potential for a desirability bias. While willingness to intervene is an important component to understand overall guardianship behavior, a potential guardian's perception of their *ability to supervise* and their *willingness to supervise* are important dimensions as well (Reynald, 2010) and provides further context to interpret results. The same respondents that reported a high rate of interventions if they witnessed a poacher entering a protected area expressed very low willingness to supervise for illegal activities in the park.

However, I found that different environmental crimes scenarios affected preferences for the intensity of intervention as well. This line of inquiry offered a more nuanced understanding of public responses and willingness to intervene across a spectrum of poaching related crimes such as snares, pet collection, and local subsistence versus organized trophy poaching. Generally, the more serious the environmental crime was perceived, the more likely respondents were to prefer calling the authorities and less likely they were to ignore it. There were exceptions to this trend in relation to ignoring non-serious environmental crimes. The two crimes that elicited the most stopping the crime alone responses were the illegal collection of pets (n = 60, 15.0%) and planting in the park (n = 53, 13.3%), both seen as non-serious crimes. This may reflect respondents feeling safe to approach those engaged in what is considered a less serious crime. It may also reflect a higher familiarity with this issue, as the collection of animals such as songbirds is very common in BBSNP (see Chapter 3).

In terms of the relative seriousness of poaching crimes, it was encouraging that overall the respondents believed that poaching was moderately serious as it finished in the top five

among 10 general crime scenarios. There were advantages to capturing the seriousness of poaching in relative terms. For example, capturing the public's rationale behind why specific crimes are seen as either serious or not serious has utility. Themes related to relative harm, law and order and necessity were expressed by the small cohorts of people that perceived poaching as either the least serious (2.3%, $n = 9$) or the most serious (6.5%, $n = 26$) among the 10 general crime scenarios. The most common reason that poaching was seen as the least serious crime was that it *doesn't damage the environment* followed by the responses that *poaching is fulfilling needs* and is of *unknown occurrence.* Those that believed poaching was the most serious crime held some opinions that directly countered those stating it was the least serious. For example, the most common reason poaching was seen as serious was that it *can destroy wildlife or cause extinction*, a statement of harm although not generalized to the environment, and less frequently they stated that poaching was a *frequent occurrence*. Importantly, interventions that can provide livelihood alternatives to BBSNP residents using poaching to fulfill legitimate needs would be advantageous not only to reduce needs-based poaching in the area but to change public opinions concerning the rationalization of illegal behavior. Policy interventions could include increasing the sanctions associated with environmental crimes and raising awareness among judiciaries of the importance of imposing maximum sentences for offenses. For example, in Kerinci Seblat National Park, Sumatra it was found that the fines and prison sentences levied against convicted poachers were a fraction of the maximum allowable by law with fines ranging well within one month of a poacher's estimated salary in the area (Risdianto et al., 2016). Further, these findings indicate an avenue for well-crafted communication campaigns and increased dialogue among stakeholders to clarify harms associated with poaching and provide a clear picture of the prevalence of poaching within BBSNP.

Furthermore, evidence that awareness and communication campaigns can achieve attitude shifts among the public in Indonesia can be found in non-environmental crimes. For example, illegal drug use was seen by far as the most serious crime followed by corruption among interview respondents and may indicate that serious punitive consequences and social campaigns can affect the public's perception of crime seriousness. My research supports the assertion that the government of Indonesia has elevated the perception of the seriousness of illegal drug use and corruption, through heavy punitive consequences related to the former and wide spread social campaigns in terms of the latter, within the public conscious. For example, in order to fight rampant corruption in everything from Indonesia's business to natural resource sectors, the government formulated the *Corruption Eradication Commission (KPK)* (Organisation for Economic Co-operation and Development [OECD], 2016), which uses tip-lines and other reporting mechanisms to fight corruption and there is widespread knowledge of the country's use of capital punishment in regards to drug-trafficking crimes (e.g., *Bali Nine* case of 2015; Kaplan & Larimer, 2015). Data herein also provide a path for the plausibility of social campaigns and communications in the Indonesian context to increase the perceived level of wildlife crime seriousness, draw connections to other crimes perceived as more serious (e.g., wildlife crime as a form of corruption), and develop communication campaigns and mechanisms to increase guardianship via direct interventions and reporting.

Demographic and attitudinal dimensions affected respondents' stated willingness to intervene and varied between interveners (e.g., indirect, direct) and those that stated non-intervention (e.g., join in, ignore, covert monitoring) intensions. Men were more likely than women to intervene, as were those with professional livelihoods (e.g., teacher, civil servants). Additionally, the rate of intervention varied based on village, ranging from 90% of village

respondents choosing intervention to less than half (45%) stating a behavioral intention to intervene. The significance of village membership may indicate that social networks are affecting judgments of poaching crime seriousness, poaching risk, and shared expectations for intervention and should be explored further (e.g., Muter et al., 2013). Lastly, willingness to intervene was positively correlated with respondent's perceived control over poaching, poaching related risk perception, and most common among those that expressed moderate or strong mutualistic WVOs.

However, unlike the environmental crime scenarios discussed above the single-item relative crime seriousness score was not significant for the dimensions of guardianship or the GII, the perceptions of the relative seriousness of different environmental crimes. This may be due to a failure to appropriately capture crime serious and indicate measurement failure. However, psychometric risk perceptions played a prominent role in the dimensions and overall intention index for guardianship. The composite poaching risk perception score, which took into account perceived risk from poaching to livelihoods and wildlife, was significant in all three guardianship dimensions and the overall GII. This may support the idea that estimations of the seriousness of poaching via perceptions of the consequences, dread, and frequency of poaching in the area is associated with intentions to intervene. Additionally, the perception of personal control over poaching risks was significant for all three dimensions of guardianship and the overall GII, which may indicate the importance of personal perceptions of efficacy in managing risks associated with poaching or constraining localized poaching behavior. Further inquiry into alternative measures of perceptions of crime seriousness and dimensions of psychometric risk perception is warranted.

WVOs were also statistically significant to the overall GII in addition the dimension of *willingness to intervene*. The majority of respondents held either moderate or strong mutualistic wildlife value orientations and 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, caution should be used in interpreting how well wildlife value orientations were captured in the cross-cultural context of Sumatra using a quantitative approach measuring dichotomous orientations of domination and mutualism. WVO have been found to be much more nuanced. For example, Tanakanjana & Saranet (2007) found eight WVOs in Thailand using mixed methods questioning. Further research into understanding the connections between WVO and guardianship is warranted as it 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*, which was a common orientation in the Thai study (Tanakanjana & Saranet, 2007), 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.

There are several weaknesses to this study. First, the inherent weakness of this research was the reliance on self-report data from interview respondents and represents a behavioral intention that may be influenced by desirability bias (e.g., Reynald, 2010). Further research should attempt to draw on secondary data sources (e.g., poaching tip-line calls), direct observational methods (e.g., Reynald, 2009), or possibly even quasi-experimentation (Reynald, 2010). Secondly, as the primary goal of this research was exploratory in nature, the survey sought to capture the breadth of possible related constructs at the sacrifice of measurement depth.

Constructs were measured using a reduced number of multi-item indicators and it is likely that this resulted in less than optimal measurement of any one construct limiting the precision of measurement of some constructs, such as WVOs, and lowered the internal reliability, which limits statistical treatment. However, the results of this study provide a compass for more in-depth exploration into the demographic, psychological and sociocultural dimensions that show association with the important conservation construct of guardianship. Further research into guardianship should focus on refining and triangulating measurement of guardianship and have more focused and in-depth questioning on dimensions that are theoretically related and supported by this exploratory research (e.g., perceived crime seriousness, WVO). Additionally, given the complex and semi-random sampling design necessary to conduct research in the vast network of villages and sub villages in rural Indonesia, the results of this research are not generalizable beyond the context of BBSNP.

Additionally, investigation into the effects of social cohesion on guardianship intentions is warranted given the significance of the village within the dimension of willingness to intervene, the theoretical connections between high levels of community cohesion and shared perceptions of risk (e.g., Villarreal & Silva, 2006), and findings that social networks can be significant in perceptions of risk associated with contentious wildlife management issues (Muter, Gore & Riley, 2012). Social cohesion, a proxy measure of the level of informal social control in a community, is often used in criminological studies in an attempt to understand how neighborhood characteristics affect a community's collective responses (e.g., reporting rates) and resilience to crime (Goudriaan, Wittebrood, & Nieuwbeerta, 2006). Theoretically, communities with the closest social networks and high trust between members, or high social cohesion, would be most likely to cooperatively enforce social norms in the face of crime and delinquent behavior

(Villarreal & Silva, 2006). In relation to wildlife crimes, the exploration of social cohesion as well as sociological theories of risk perception would be advantageous in understanding how communities collectively respond to poaching-related crimes.

Future areas for investigation include expanding our understanding of demographic and attitudinal differences between interveners (guardians) and non-interveners. Building theoretical understanding of what influences wildlife guardianship intentions and exploring interventions that may increase wildlife guardianship among diverse stakeholders would 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, such as calling the authorities versus confronting offenders, within different social and regulatory contexts should be explored. Contextualizing stakeholders in terms of their availability for intervention also warrants closer examination. 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 would be advantageous. This would entail aggregating residents that: a) live and work in the closest proximity to wildlife habitat such as the IPZs (guardians against poaching), b) live and work near major transit points such as trail heads, roads and checkpoints (guardians against trafficking), and c) live and work in rural and urban commercial areas such as markets (guardians against trade). This is essential in matching up residents that are both *willing to intervene* and those that are physically *available to intervene*.

Further research is needed to identify the antecedents of wildlife guardianship behavior, understand the factors that affect the essential three components within the context of conservation, and continuing to develop and validate indirect (e.g., behavioral intentions) and

direct measures (e.g., direct observations) of guardianship is essential. Lastly, in addition to expanding understanding of psychological and sociological guardianship theory there are two additional dimensions ripe for research: 1) Understanding how the physical environment either impedes or aids supervision and guardianship (e.g., Crime Prevention Through Environmental Design (CPTED); Reynald, 2011), and 2) the effects of policy and regulatory responsiveness on both individual and collective guardianship behavior. Defining, measuring, and understanding what factors influence local wildlife guardianship behavior is a valuable step in designing communication, education, incentives, and interventions aimed at reducing wildlife crime and engaging local communities in conservation and wildlife crime prevention efforts.

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CHAPTER 3

‘HOT SPECIES’: DEVELOPING A SPECIES-BASED MODEL TO EXAMINE WILDLIFE TARGETED BY POACHERS USING EXPERT AND COMMUNITY KNOWLEDGE

3.1 INTRODUCTION

Wildlife resources represent a significant part of many rural economies, often acting as a alternative resource for rural farmers (Basset, 2005), supporting local livelihoods, serving as a main or supplementary source of protein (Brashares et al., 2014), and generating shared revenue through sustainable use such as ecotourism or legal hunting (Kahler & Gore, 2015). Like anything with value, wildlife is subject to theft or in this case, poaching. However, not all wildlife species are equally targeted for poaching (e.g., Kahler & Gore, 2015; Moreto & Lemieux, 2015; Pires, 2015). For example, the precipitous increase in the poaching of elephants, pangolins, rhinoceroses (Nelleman et al., 2016), and tigers (Global Tiger Recovery Program [GTRP], 2011) has gained attention from international organizations (e.g., United Nations) and mainstream criminologists and crime science researchers (e.g., Moreto & Lemieux, 2015; Nelleman et al., 2016). Evolving from a historical characterization as harmless, rural folk crime (Forsyth, Gramling, & Wooddell, 1998), wildlife is now seen as a hot commodity on global illicit markets and is thought to generate between $7–23 billion (USD) annually on black markets (Nelleman et al., 2016). Understanding what makes a particular species *hot* or more desirable relative to others is important in crafting interventions to protect those species.

Traditionally poaching research has focused predominantly on the poachers themselves (Moreto & Lemieux, 2015), the biological and human consequences of poaching, or the root causes of poaching such as micro-economics and poaching motivations (Kahler & Gore, 2017).

However, with the emergence of conservation criminology (Gibbs, Gore, McGarrell, & Rivers, 2010) [3], and increased interest from mainstream criminologists, poaching-related research is increasingly generating more diverse and robust criminological approaches while incorporating the unique context of wildlife ecology and management (e.g., Gore, 2017). Approaches from criminology that can help elucidate how characteristics of the targets of poaching themselves, individuals of specific wildlife species, affect their propensity to be poached would be a valuable complement to understanding the poachers. One such approach is the use of Clarke's (1999) *crime target-suitability model*, from the field of environmental criminology, which seeks to understand how the characteristics of the crime targets (e.g., car, stereo) themselves affect their likelihood of being stolen or becoming *hot products*. Based on these characteristics, strategies can be implemented to reduce opportunities in the short or long term based on target-specific characteristics (Pires, 2015).

Clarke's (1999) crime target suitability model was built on previous scholarship related to opportunity theories of crime (e.g., routine activity theory) in the late 1970's (Pires & Petrossian, 2016). Cohen and Felson (1979) outlined necessary conditions for a crime to occur, namely that a potential offender finds a suitable target that lacks a capable guardian. They defined the suitability of the target or victim is in terms of its *value, inertia, visibility,* and *accessibility* using the acronym VIVA, with highly valuable and movable objects with high visibility and accessibility being the most vulnerable (Clarke, 1999). VIVA was intended to cover targets of *direct predatory crimes* (e.g., car theft, violent crimes), although it was not elaborated on beyond a cursory paragraph (Clarke, 1999), and made no distinction between animate human victims and

[3] Conservation criminology is an interdisciplinary framework drawing on theories and methods from criminology, natural resources management, and risk and decision sciences (Gibbs et al., 2010).

inanimate objects such as cars (Pires & Petrossian, 2016). Clarke (1999) proposed an alternative model to VIVA by considering the characteristics of the product stolen. In particular, he proposed assessing the offender's ability to conceal and dispose of a target of their theft. This model known as CRAVED, defines the target suitability of *hot products* (e.g., cars, electronics) in terms of how *concealable, removable, available, valuable, enjoyable,* and *disposable* they are perceived to be by offenders (Clarke, 1999).

Rather than a theoretical explanation of target selection by offenders, this crime prevention-based model is grounded in linking vulnerable targets with strategies for protection (Sidebottom, 2012) and has been used to help understand a variety of property-based crime of *hot products* including the theft of cars, bags, and cellphones, shoplifting and domestic burglary (see Pires, 2015 for further discussion and references). Generally, criminologists have applied CRAVED in three ways: 1) as an explanation into the disparities of theft risk between targets, 2) as a predictive tool to anticipate shifting preferences for new targets, or 3) to attempt to capture CRAVED components empirically through crime data (Sidebottom, 2012). A handful of criminologists (e.g., Moreto & Lemieux, 2015; Pires & Clarke, 2011, 2012; Pires & Petrossian, 2016; Sidebottom, 2012) have attempted to measure CRAVED components and explain the theft, poaching or trafficking of fisheries, domestic livestock or wildlife, taking the tool out of its native geography of urban property crimes and into the context of more rural agriculture and natural resources conservation and management (Table 3.1).

3.1.1 CRAVED and wildlife crimes

The earliest attempts to study the utility of CRAVED within a conservation context were investigations of parrot poaching in Central and South America (Pires & Clarke, 2011; 2012).

Table 3.1: Evolution of target suitability models in crime science

Model (Proponents)	Components	Crime applications
VIVA (Cohen & Felson, 1979)	Value, Inertia, Visibility, Accessibility	Not applied, theoretical
CRAVED (Clarke, 1999)	Concealable, Removable, Available, Valuable, Enjoyable, Disposable	Cars, electronics, shoplifting; adaptation to wildlife crime below
CRAAVED (Pires & Clarke, 2011)	Concealable, Removable, Accessible, Abundant, Valuable, Enjoyable, Disposable	Parrot poaching & trade; livestock theft; illegal commercial fishing
CAPTURED (Moreto & Lemieux, 2015)	Concealable, Available, Processable, Transferrable, Useable, Removable, Enjoyable, Desirable	Not applied empirically to date

Pires and Clarke (2011) applied CRAVED to analyze what species of parrots were targeted for the pet trade in Bolivia using secondary datasets, finding that species most commonly found at the market could be characterized as being *enjoyable* and *available*. Importantly, they adapted and revised the component *available* according to two dimensions more suited to wildlife: the species relative *abundance* (population) and its *accessibility* (habitat) to humans (Pires & Clarke, 2011; 2012). They also found that CRAVED components explained parrot poaching behavior in Mexico and concluded that based on theft preferences that poaching was largely opportunistic, as species taken were disproportionately more *abundant* and had juvenile birds easily *removable* from nests (Pires & Clarke, 2012). Pires (2015) further tested the application and generalization of CRAVED by examining multiple illicit parrot markets in seven cities in Bolivia and Peru, finding that species that were more c*oncealable, available, abundant* and *disposable* were most often found in these markets. Another key finding was that parrot species that could be legally

trapped with set harvest quotas, were *concealable* in multiple markets when they were falsely labeled as part of the legal trade (Pires, 2015).

Additional, non-parrot related, applications of CRAVED in agriculture and natural resources are scarce. Siddebottom (2012) found that livestock species (e.g., cattle, goats, chickens, etc) that were more *available* (abundant; all livestock is accessible) and *disposable* were the most commonly stolen across Malawi. Species most commonly caught illegally by commercial fishing vessels were found to be sold more often in ports of convenience or known to have high level of noncompliance (i.e., concealable), more likely caught by long-liners (i.e., removable), abundant, commonly harvested by several known illegal fishing countries (i.e., accessible), larger (i.e., valuable), found in more recipes (i.e., enjoyable), and highly commercial (i.e., disposable) (Petrossian & Clarke, 2014). Additionally, Moreto & Lemieux (2015) advanced the CRAVED tool and proposed a model specifically looking at the marketing of illegal wildlife products, identifying new concepts and a new acronym: CAPTURED (Table 3.1). This model posits that wildlife products that are more *concealable, available, processable, transferrable, useable, removable, enjoyable,* and *desirable* are more likely to be poached or trafficked (Moreto & Lemieux, 2015). Notable changes include the addition of *processable,* recognizing that many wildlife products necessitate processing to enter a market (e.g., ivory is carved, pangolins are de-scaled, sharks are finned and frozen, gorillas are smoked), and *useable* which is related to the perishability of the product (Moreto & Lemieux, 2015). Additionally, CAPTURED reclassified the *disposable* as *transferrable*, in recognition of the fact that some wildlife products are handed down through generations (e.g., Japanese kanji hanko ivory stamps), and *valuable* to *desired* to recognize the non-monetary value of wildlife products (e.g., African muthi medicine) (Moreto & Lemieux, 2015). The adaptations and conceptualization of the relevant dimensions in the brief

evolution of target suitability models for applications in wildlife crimes, such as poaching, trafficking and trade, have been exclusively done by criminologists.

3.1.2 Developing an interdisciplinary poaching stage species-focused approach to understanding wildlife targeted by poachers

This research seeks to build upon the extant knowledge based and advance adaptation and application of target suitability research in a number of ways. Research herein advances criminology by drawing on research, fieldwork, and empirical evidence from the field of natural resources conservation and management. This field offers systematic methods, theories, and knowledge about natural ecosystems, which includes the system dynamics of wildlife populations and their habitats and ways in which humans interact with, value, and behave in response to ecosystems and natural resources therein (Gibbs et al., 2010). Incorporating the human dimensions of wildlife management can range from socio-cultural level inquiry (e.g., management processes, biodiversity conservation) to individual-level analysis (e.g., hunting motivations and participation, species-specific perceptions and values) as well the social networks linking individuals to broader social groups (Decker, Riley, & Siemer, 2012). Human dimensions of wildlife management and conservation sciences can make positive contributions to further adapting, validating, and applying the CRAVED tool in efforts to better conserve and protect the most targeted species as these disciplines specialize in understanding human attitudes and behaviors toward wildlife as well as the behavior, biology and ecology of wildlife targets. For example, researchers in conservation social science have demonstrated how wildlife species can ‘transvalued’ or how they simultaneously have ecological, economic and symbolic values (Kahler & Gore, 2015; Remis & Hardin, 2009). These values can also be thought of in terms of transvalued benefits and costs and can result in increased vulnerability to poaching for some

species (Kahler & Gore, 2015). Drawing on these bodies of knowledge will help move the conceptualization of value beyond monetary terms.

Additionally, Clarke (1999) asserted that the historic rendition of target suitability, VIVA, "by avoiding any consideration of motivation, it neglected the specific motives for theft (p.23)." Motivations for poaching are complex and in many instances poachers have multiple motivations for targeting particular species (Kahler & Gore, 2012; 2015). One important distinction between products of theft, such as electronics and cars, is that wildlife species can cause real or perceived risks and direct (e.g., crop damage) or hidden (e.g., increased labor demands, fear) costs. For example, in northeastern Namibia local conservancy members perceived the most vulnerable species to poaching were characterized as those that posed high ecological (e.g., disease vector to livestock) and economic risks (e.g., crop damage) yet were simultaneously valuable for local subsistence and trade (Kahler & Gore, 2015). These human-wildlife conflicts, such as crop damage, livestock depredation, or human attack, have been known to provoke retaliatory killings in many contexts (Kahler, Roloff, & Gore, 2013). This literature suggested that any poaching-stage species-targeting model take into account wildlife value theories and that wildlife, unlike small electronics, can provoke poaching through ecological, economic and symbolic costs.

Secondly, Moreto & Lemieux (2015) suggested that in order to empirically evaluate the CAPTURED model it would be necessary to gather information about illegal activities beyond official law enforcement data, which could include interviewing poachers, middlemen, informants and local law enforcement in regards to why particular species are more often targeted than others. This research aimed to gather input and knowledge as to what species characteristics drive poachers from the perspective of local communities that live with wildlife

and local representatives from community-based, governmental and non-governmental organizations involved with conservation and protection of wildlife species. Third, the majority of research into what drives the suitability of animal species as targets of crime have focused on species destined for specific-use markets, such as pet markets (e.g., Pires, 2015), livestock for direct consumption (Sidebottom, 2012), or commercial fish species (Petrossian & Clarke, 2014). Moreto and Lemieux (2015) advanced a more nuanced wildlife product-based model, CAPTURED, to understand how wildlife products progress through illicit markets and envision it could be useful in understanding repeat targeting of specific products (e.g., ivory) as well as specific markets such as parrots for pets. Upon review of the literature on wildlife-related CRAVED and CAPTURED, I found that current use of these models has largely been aimed toward understanding the market stage, with the exception of Pires and Clarke (2012), and all that use empirical data have focused on species within a specific genera (e.g., parrots) with very specific uses and markets (e.g., pet trade). My research adds to and complements the above in two specific ways in relation to focus.

First, it is poaching stage-focused and therefore live specimen or *species*-based rather than market focused and *wildlife product*-based. Secondly, my research seeks to develop a model for explanation and prediction of *hot species* within a given conservation area or hot spot. The latter point means that I sought to evaluate wildlife species targeted by poachers in a given location rather than wildlife products on a specific market. For example, the current literature has looked at markets (e.g., pet parrots) from large geographies, such as large market centers in the entire country of Bolivia (e.g., Pires & Petrossian, 2016), while I aimed to build was a model that can be applied at a finer-conservation landscape scale with the hopes that it could be used to predict species targeting efforts in a specific protected area given various markets (e.g.,

bushmeat, pets) in the area. Ultimately the goal is development of a rapid assessment, conservation area tool that can broadly aid in predicting species poaching vulnerabilities across a variety of markets. Once priority markets are identified (e.g., bushmeat, pets) employing a market-specific analysis (e.g., CAPTURED) may provide additional precision. As discussed earlier, the original formulation by Cohen and Felson's (1979) VIVA idea was aimed to understand the suitability of targets for predatory crime, which included animate human beings, and discusses the target's inertia or the relative ease of disabling or moving the target of predatory crimes (Pires & Clarke, 2012). Poaching is a predatory crime by an offender toward a specific species (Mailley, 2014) and during this phase wildlife species are animate, sentient targets with *routine activities* with varying levels of independence of offenders that seek to capture, disable or kill them. Once a poacher has encountered the targeted species, there are two options they have in removing the animal for consumption, trade or sale: as a living or dead specimens. Whether the specimen is usable live or dead will influence the poacher's judgments as to the species' *concealability* and *removability* after harvest. Therefore, when building a model to understand what characteristics of different wildlife species influence targeting at the poaching stage, a species' ability to resist capture and to inflict potential harm on would-be poachers is important. Revisiting and formulating measures of the component of *inertia* is warranted. In summary, if previous wildlife-related CRAVED research was analogous to more traditional uses to understand car theft (e.g., parrot species), I am hoping to understand what items (e.g., wide diversity of species) are most likely to be stolen (e.g., poached) out of particular department store (e.g., protected area). Further advances through interdisciplinary scholarship, to address limitations outlined by previous research, and to continually push the tool by testing application in additional contexts, with more species and genera, and in different stages of the

wildlife crime cycle (e.g., poaching, trafficking, processing, sale and purchase) would be advantageous.

3.1.3 Research objectives

The overall goal of this research was to develop an interdisciplinary, target suitability model that focuses on the poaching-stage of wildlife crime to serve as an explanatory and predictive tool for understanding poaching within a conservation-based management unit. Equally important was that dimensions for this model, based in the criminology and natural resources conservation and management literature, would be corroborated by using the opinions and knowledge of local communities living near protected areas and local experts and conservation practitioners with experience in species conservation and protection. First, a review of the criminology (e.g., VIVA, CRAVED, CAPTURED) and natural resources conservation and management (e.g., wildlife values, human wildlife management) literature informed a preliminary model with adapted and added components: ICRAVED. This model proposes that species that are more *inert, concealable, removable, available* (i.e., abundant, accessible) *valuable* (i.e., positively and negatively transvalued), *enjoyable*, and *disposable* were the most likely to be poached. Secondly, the developed model was tested and revised using empirical evidence gathered from community members and local conservation representatives from community, governmental and non-governmental conservation organizations from Bukit Barisan Selatan National Park (BBSNP), Sumatra Indonesia. Lastly, there was an effort to develop an acronym that was memorable and useful to a wide variety of conservation practitioners in differing contexts, including those where English may be a second or third language. Specific research objectives included: 1) ascertain *hot species* poached in BBSNP, 2) describe the characteristics of these ‘hot species’ in order to challenge and confirm target suitability

dimensions, and 3) revise the proposed model based on empirical data. The remainder of the paper will discuss the BBSNP case study and the revision of ICRAVED using empirical data that lead to the development of the species-focused IPOACHED model: *in-demand, passive, obtainable, all-purpose, conflict-prone, hideable, extractable, disposable.*

3.1.4 Hot Species in Bukit Barisan Selatan National Park (BBSNP), Sumatra Indonesia

Poaching poses risk to species conservation and human livelihoods in many Southeast Asian countries and is a primary driver behind the region's dramatic wildlife declines (Steinmetz, Srirattanaporn, Mor-Tip, & Seuaturien, 2014). Indonesia, the island nation with the world's fourth largest human population, is one such southeast Asian country that has been found to be a source, transit route, and market for the illegal trade of live specimens and their products. Wildlife crimes in Indonesia vary from the high volume, high visibility illegal markets, such as Jakarta's infamous Pramuka Bird Market (Chng, Eaton, Krishnasamy, Shepherd, & Nijman, 2015), wildlife laundering through captive breeding farms (Lyons & Natusch, 2011), to the emergence of online trade of birds through social media sites such as private Facebook groups (Iqbal, 2015). It is hard to overstate the volume or the number of species involved in illicit wildlife markets and many of these species are harvested, bought and sold within the country (e.g., Igbal, 2015). For example, one comprehensive study of three illegal wildlife markets in Jakarta over the course of three days found over 19,000 individual birds from 206 species (Chng et al., 2015). Additionally, an internet search for news coverage of seizures of Sunda pangolins in a period just over 3.5 years (January 2012-July 2015), found 45 seizures on three islands ranging in size from one live individual to a container of over 8,500 kg of dead pangolins, which when converted to individuals represents approximately 11,575 individual animals (TRAFFIC, 2015).

Sumatra is Indonesia's western-most island and the sixth largest island in the world with a high biodiversity levels threatened by habitat conversion and poaching. BBSNP is the island's third largest protected area (3,568 km^2) (Anggraini, Kinnaird, & O'Brien, 2000) stretching along 150 km of the Barisan Mountain range. This park is home to some of the largest tracks of remaining lowland rainforest (O'Brien, Kinnaird, & Wibisono, 2003) and home to a number of *hot species* including large mammals, Malayan sun bear (*Ursus malayanus*), Asian elephants (*Elephus maximus*), Sumatran tiger (*Panthera tigris sumatrae*), Sumatran rhinoceros (*Dicerorhinus sumatrensis*), and at least 277 bird species including all species of hornbills (Anggraini et al., 2000). The park has an Intensive Protection Zone (IPZ) which is bounded in the north and south by a major highway lined with agricultural activities (e.g., coffee, palm), commercial and residential development.

Wildlife crime poses risks to the conservation of biodiversity in BBSNP (Kinnaird, Sanderson, O'Brien, Wibisono, & Woolmer, 2003). Crime rates and control efforts are influenced by the park's narrow linear shape that includes over 700 km of boundary edge where serious agricultural encroachment, illegal logging, and poaching occurs (O'Brien et al., 2003). Poaching of hot species such as the critically endangered Sumatran tiger (O'Brien et al., 2003), Asian elephants (Hedges et al., 2005), and Sumatran rhinoceros (Nardelli, 2014) are known to happen within the park (Table 3.2). It is likely that other forms of wildlife crime such as commercial and subsistence wildmeat hunting, trade in wild songbirds for pets (e.g., Jepson, Ladle, & Sujatnika, 2011) and helmeted hornbill 'ivory' poaching (e.g., Beastall, Shepherd, Hadiprakarsa, & Martyr, 2016), for example, are also happening within BBSNP. For example, poaching of wild boar (*Sus scrofa*) to meet growing demand by Chinese and Christian Bataks has been documented in Jambi, Sumatra (Luskin, Kelley, & Potts, 2013).

Table 3.2: Select endangered and critically endangered species found in Bukit Barisan Selatan National Park (BBSNP)

Common name[a] (*Scientific name*)	Description of illegal wildlife trade associated with species	Approximate value (USD)	Population status[b]
Dark-handed gibbon† (*Hylobates agilis*)	In BBSNP deforestation for coffee markets lead to opportunistic capture for pet trade; one of most common gibbons in illegal markets: CITES Appendix I	$50–150 (TRAFFIC report, 2003)	Decreasing
Malayan tapir† *(Tapirus indicus)*	Localized poaching occurs in Sumatra; not likely systematic but rather off-take from accidental snaring, retaliation for crop damage may also occur on Sumatra. In past, Indonesian zoos or private collectors would pay for tapirs: CITES Appendix I	Unknown	Declining in Sumatra; population anticipated to be below 400-500 individuals
Siamang† *(Symphalangus syndactylus)*	Opportunistic collection for illegal pet trade on Sumatra within national parks; one of the heavily traded gibbon species: CITES- Appendix I	$60—220 (TRAFFIC report, 2003)	Decreasing, estimate of 22,390 individuals in BBSNP (2004)
Sumatran elephant†† *(Elephas maximus sumatranus)*	Killed for conflicts with humans, hunted for ivory, food, hide (leather) and other products; live trade used for forestry or ceremonies: CITES Appendix I	Whole $28,200; Tusks $1,800 (Vietnam); Ivory $850/ kg (Asia); Carved ivory $3,000/ kg	Decreasing: estimated 498 individuals (2005) in BBSNP
Sumatran rhinoceros†† *(Dicerorhinus sumatrensis)*	Poaching for horn and medicinal products driving species to extinction: CITES Appendix 1	Horn dagger $14,000; Horn $65,000/ kg; Crushed powder $10 (Vietnam)	Very severe declines of greater than 80% over 20 years; less than 250 individuals overall

[a] IUCN status: † endangered, †† critically endangered.

Table 3.2: (cont'd)

Common name[a] (*Scientific name*)	Description of illegal wildlife trade associated with species	Approximate value (USD)	Population status
Sumatran tiger†† *(Panthera tigris sumatrae)*	High level of conflict and illegal-trade in tiger parts (bones, meat, skins) primarily for domestic markets drives poaching: from 1998-2002 51 tigers per year were killed in Sumatra with 76% for trade and 15% due to conflict:	Dead $5,000; live $50,000; baby $3,200; bone $2,000; bone wine $88; penis $1,300; remains $70,000; skin $35,000	Decreasing: severely fragmented; estimated 40—43 individuals in BBSNP (2003)
Sunda pangolin†† *(Manis javanica)*	Hunting for skins, scales, and meat for local, subsistence-level consumption, and international trade; traded live and dead; scales used for medicinal purposes; targeted hunting is biggest threat on Sumatra: CITES Appendix II (zero quota)	Live $1,000; meat $300/ kg; scales $3,000/ kg	Likely in severe decline in Sumatra by evidence of magnitude of trade
Helmeted hornbills† *(Rhinoplax vigil)*	Heavily targeted by poachers and illegal trade for solid horn or "casque" sold internationally (China largest market); large numbers of illegal hunters of this species found in Sumatra: CITES Appendix I	$1,000/ horn (Beastall et al., 2016)	Severe decline almost disappeared from areas previously abundant on Sumatra (2015)
Black-and-white laughingthrush† *(Garrulax bicolor)*	Captured for live bird trade which is the species primary threat; international imports of sister species G. *leucolophus* were stopped in 2005 due to risk of avian flu and resulted in increase in this species; since likely population dropped rapidly	Two birds for US$100 (2016)	Undergoing considerable decline in Sumatra and become locally extinct in some areas: small population in BBSNP

[a] IUCN status: † endangered, †† critically endangered.

3.2 METHODS

3.2.1 Research approach

This study was carried out in 10 villages around the IPZ and during a three-day focus group held in Gisting, Lampung Province, Sumatra with community, governmental, and non-governmental conservation organizational representatives from BBSNP May 25–27, 2015. The surveyed villages were clustered along the southern and the north, north-eastern boundary villages of Kubu Perahu, Pekon Mon, Pemerihan, Serdang, Suka Marga, Sukabanjar, Sukabumi, Sukaraja, Sumberagung, and Sumberejo. 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 or location within the IPZ of the BBSNP. Focus group participants were selected from BBSNP-based community (e.g., Forum Samabat Gajah (FSG) "Sumatran Elephant Patrols"), governmental (e.g., National Park), and non-governmental (e.g., Tambling Wildlife Nature Center) organizations based on a), the fact that the organization is currently active in BBSNP conservation activities, b) willingness to of representatives to attend the entire focus group, and c) recommendation from World Wildlife Fund (WWF) Lampung.

3.2.2 Sampling and data collection

Data on notable Indonesian seizures and prosecutions was recorded from TRAFFIC's Bulletin publications numbers volume 25 number one (2013) through volume 29 number one (2017) which covers years 2012 through 2016 (http://www.traffic.org). Research objectives were addressed with semi-structured interviews and a three-day focus group comprised of conservation stakeholders with membership in community, governmental and non-governmental organizations in BBSNP. Five Sumatran 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. The interview 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 (e.g., Gore & Kahler, 2015).

Interviews were conducted in five villages along the southern corridor of the IPZ prior to the start of Ramadan in 2015 and five villages on the west and northern boundary of the IPZ after Ramadan in 2015. Cluster sampling with probability proportionate to size (Bernard, 2006) was used as there were no reliable lists (e.g., addresses, property tax records) of residents in the villages. In each village, population clusters were identified (e.g., sub-villages) and then the proportion of interviews in each sub-village were allocated based on the best estimate of population in those areas. Each sub-village zone was sampled and convenience sampling was used within each village zone (Bernard, 2006).

Interview 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 interviews to accommodate work schedules, cultural and religious considerations (e.g., prayer times). All interviews were conducted in Bahasa Indonesia and translated in to English and quality checked both in the field and after by research assistants. Interview participants were asked two open-ended question relevant to ICRAVED: 1) what

species are most often poached in BBSNP, and 2) what are important characteristics of species that are targeted by poachers.

The focus group participants were broken into five mixed groups (e.g., different organizational members) that each conducted a species target ranking activity, creating five posters, with a predetermined set of species relevant to conservation. Species were drawn from the literature on BBSNP as well as discussions with conservation practitioners with experience in the field. Cards were printed on adhesive mailing labels to ease physical ranking. Ranking was conducted by consensus and characteristics were written describing why each species was a target of poachers. After the ranking was finished each group completed two ICRAVED surveys for different species.

3.3 ANALYSIS

3.3.1 Demographic and descriptive statistics

Interview data was analyzed SPSS 24 and focus group data was analyzed in Excel. Descriptive statistics were used to characterize the interview respondents in terms of age, education, ethnic group, gender, marital status, livelihood strategy, and religion. Gender, organization, length of work, role in organization, age, and educational information was collected via consent and demographic survey at the start of the focus group.

3.3.2 Species targeted by poachers in BBSNP

Interview respondents were asked to free list species or genera "most often poached in BBSNP." Simple frequencies are reported for species or genera provided by interview respondents. Due to local differences in common names (e.g., Murai songbird or White-rumped Shama) and differing levels of specificity of reporting (e.g., deer versus Sambar versus muntjac), species are reported in their respective scientific Orders (Infraclass for birds) to aid in

interpreting more general trends. The species or genera ranked during the ICRAVED posters (*N* = 5) focus group activities were analyzed by calculating an importance index which results in an ordinal rank (R) (Kahler & Gore, 2015) that reflects the ordinal rank the groups assigned to a particular species or genera in relation to the other species. The value ranges from zero to one (1=most often poached), r is the rank and n is the total number of species ranked (*n* = 10):

$$R = [(r-1)/(n-1)] \times (-1) + 1$$

The species or genera were reported in the final ordinal ranking determined by the *R*, the range of each species' ranking was reported to provide general insight as to how much agreement there was in species' rankings between the five subgroups (lower range=more agreement in opinions on ranking).

3.3.3 Characteristics of species targeted by poachers in BBSNP

Community perceptions of what characteristics drive poaching of particular species were collected via an open-ended question during interviews. Trained research assistants translated responses. Like responses (e.g., for money, to get money, income) were grouped together through an iterative process and anchored on important dimensions in the proposed IPOACHED model (Gore & Kahler, 2012). Focus group participants provided opinions on the general characteristics that are important for each species poached in an open-ended format on the species ranking posters and filled out species accounts surveys for select species. Qualitative answers were collated and reported for six species or genera, the top-three species poached according to participants and the *big three* flagship species in the park (e.g., elephants, rhinoceroses, tigers), and select results from the species account surveys were reported.

3.4 RESULTS

3.4.1 Demographic and descriptive statistics

Of the 400 interviews, 156 (39%) were women, 244 (61%) were men, and ages ranged from 18 to 88 years old with a mean of 37 years. The majority of respondents were Muslim (97%) and married (89%). There were 12 ethnic groups represented 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 had 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) and among those that did not list agriculture as their primary livelihood activity 9% (n = 35) listing a secondary activity. Data was not weighted due to the non-parametric sampling regime and unknown population parameters (Vaske, 2008).

There were 24 men and one woman present at the focus groups. Focus group participants came from 10 groups including academic (University of Lampung's Indonesian Environmental Information Center), communal organizations (e.g., Friends of the Elephant, Community Mahout Forum), cooperative groups (e.g., Tambling Wildlife Nature Conservation), government agencies (e.g., Balai Konservasi Sumber Daya Alam (BKSDA), BBSNP), and non-governmental organizations (e.g., WWF Lampung, Yayasan Badak Indonesia (YABI) Rhino Patrol Unit). The average age of participants was 34.4 years, with a range of 24 to 64 years. Participants worked at their organizations on average 8.5 years with a range of two months to 32 years. Focus group participants had a variety of roles at their organizations with 44% (n = 11) having some responsibility for patrolling within BBSNP. Educational background ranged from junior high

(0.08%, *n* = 2) to Bachelor's degrees (0.08%, *n* = 2), with the majority of participants having a high school or vocational high school education (52%, *n* = 13).

3.4.2. Species targeted by poachers in BBSNP

The TRAFFIC Bulletins' seizures and prosecution reports for Indonesia contained 24 terrestrial or fresh-water species or genera seized at various locations around the country; marine fisheries related seizures are not reported here. Of Sumatran-related seizures, the most commonly trafficked genera, in terms of numbers of individual animals, were reptiles with one reptile seizure of 2,000 python and 800 monitor lizard skins (i.e., unspecified species) (Table 3.3). Greater green leafbirds (*Chloropsis sonnerati*) were the most commonly targeted songbirds followed by white-rumped shamas (*Copsychus malabaricus*) (Table 3.3). Both species are found in BBSNP. When reviewing all Indonesian illegal wildlife seizures, the majority of seizures of mammal species in Indonesia originated in Sumatra. The most commonly targeted mammal for illegal trade was the pangolin (*Manis spp*.) with the largest seizure occurring in Jambi, Sumatra containing 2.5 tons of meat and 279 kg of scales found in a warehouse (Table 3.3). There was one seizure with direct implications for BBSNP, a 10-year multi-organizational investigation into a dealer in South Sumatra that had sold over 100 tigers (*Panthera tigris*), stuffed by taxidermists, in Lampung among other provinces in Sumatra (Table 3.3). When asked about species targeted in BBSNP a total of 26 species or genera were listed by interview respondents, including five genera or species of birds and three of lizards, while 11.3% (*n* = 45) of respondents provided no species (Table 3.4). According to community interview respondents (*N* = 400) birds (*n* = 245, 61.0%) were common targets for poachers as were sambar deer (*n* = 169, 42.3%), Asian elephant (*n* = 92, 23.0%), Sunda pangolin (*n* = 72, 18.0%), and antelope (i.e., serow) (*n* = 67, 16.8%)

Table 3.3: Illegal wildlife and wildlife product seizures of species found in Sumatra, Indonesia from 2012–2016

Species	Quantity Seized	Origin	Comments & Destination (if known)
Australian Larks (*Mirafra javanica*)	20	East & South Kalimantan (2015)	Seized at Port, Surabaya, Java
Crested Jays (*Platylophus galericulatus*)	2	"	"
Greater Green Leafbirds (*Chloropsis sonnerati*)	2,019	"	5 seizures at port, Surabaya (Java) via passenger vessel
Hill Mynas (*Gracula religiosa*)	581	"	"
Hornbills (unspecified species)	248 beaks	Unknown (2013)	Hong Kong via airport (Jakarta, Java)
Red-eyed Bulbul (*Pycnonotus brunneus*)	1	Kalimantan (2015)	Seized at Port Surabaya, Java
White-Rumped Shamas (*Copsychus malabaricus*)	1,180	Kalamatan (2015)	2 seizures at port Surabaya (Java) via passenger vessel
Pangolin (*Manis spp.*)	189 scales	Unknown (2013)	Hong Kong via Jakarta airport
	91	Sumatra (2015)	Malaysia via boat, 4 crew arrested
	657	Unknown (2016)	Javan house raid (freezers)
	2,500 meat (kg)	Jambi, Sumatra (2016)	Warehouse raid; China (meat, scales), Malaysia, Singapore, Taiwan (meat)
	279 scales (kg)	"	"

Note. Reports extracted from *TRAFFIC Bulletin* Volumes 25–29 (www.traffic.org/Bulletin). Marine species are not presented. Seizures of birds all likely destined for Jakarta's Pramuka bird market. Quotation mark indicates the same response for Origin or Comments & Destination as the cell above.

Table 3.3: (cont'd)

Species	Quantity Seized	Origin	Comments & Destination (if known)
Sambar deer (*Rusa unicolor*)	13 antlers	Pekanbaru, Sumatra (2012)	Found in house of a tanner with tiger, sun bear skins
Slow Lorises (*Nycticebus javanicus*)	238	Sumatra (2013)	En route to markets in Jakarta
	34	Unknown (2016)	West Java via online sale (social media)
Sumatran Orang-utans (*Pongo pygmaeus*)	3	Aceh, Sumatra (2015)	Suspect jailed for 2 years and fined USD 3,700
Sun bears (*Helarctos malayanus*)	4 skins	Pekanbaru, Sumatra (2012)	Tanner's house; DNA tested to determine origin
Tigers (*Panthera tigris*)	11 skins	"	"
	> 100 stuffed skins	South Sumatra (2015)	Sold to buyers in Sumatra, Kalimantan, Sulawesi and Jakarta (10 year period)
Python (species not given)	2,000 skins	Palembang, Sumatra (2016)	East Java via currier truck
Monitor lizards (species not given)	800 skins	"	"

Note. Reports extracted from *TRAFFIC Bulletin* Volumes 25–29 (www.traffic.org/Bulletin). Marine species are not presented. Seizures of birds all likely destined for Jakarta's Pramuka bird market. Quotation mark indicates the same response for Origin or Comments & Destination as the cell above.

(Table 3.4). When considering taxonomic Orders the most commonly targeted were Artiodactyla (e.g., sambar deer, wild swine; *n* = 319, 80%), Infraclass Neognathae (unspecified birds, songbirds, white-rumped shama; *n* = 245, 61%), and Order Proboscidea (Asian elephant; *n* = 92, 23%). Pangolins (*Manis spp.)*, sole member of Order Pholidota, were reported as one of the most targeted species by 18% (*n* = 72) of interview respondents (Table 3.4). Two of BBSNP's flagship species, the Sumatran rhinoceros (*n* =10, 2.5%) and Sumatran tiger (*n* = 38, 9.5%), were not considered prominent targets of poachers by community interview respondents (Table 3.4).

Focus group participants were broken into five subgroups during the ICRAVED activity each ranking 18 predetermined species, genera or guilds. There was a high level of agreement that song birds, sambar/ muntjacs, and pangolins were the most common targets of poachers in BBSNP (Table 3.5). There was a high level of disagreement in regards to the vulnerability of some of BBSNP's flagship species with Sumatran tigers (*M* =7.2, range=10) ranked as fifth, Sumatran elephant (*M* = 8.2, range 11) sixth, Sumatran rhino (*M* = 10.8, range =13) tenth, and Malayan sun bear (*M* = 12.4, range=11) perceived as the tied for 12th most poached (Table 3.5).

3.4.2 Characteristics of species targeted by poachers in BBSNP

The IPOACHED (Figure 3.1) poaching-based, species focused model was created upon reviewing the results of community-based interviews and the focus group activities related to target suitability. IPOACHED predicts that species that are *in-demand* (valuable), *passive* (inert), *obtainable* (accessible, abundant), *all-purpose* (usable), *conflict-prone* (natural resources management), *hideable* (concealable), *extractable* (removable), and *disposable* are more suitable species for poaching and therefore more vulnerable. This model expands on (e.g., passive, conflict-prone), revises some (e.g., in-demand, extractable), and retains essential components of CRAVED (obtainable, hideable, disposable) and CAPTURED (all-purpose) (Figure 3.1).

Figure 3.1: Poaching-stage target suitability IPOACHED model

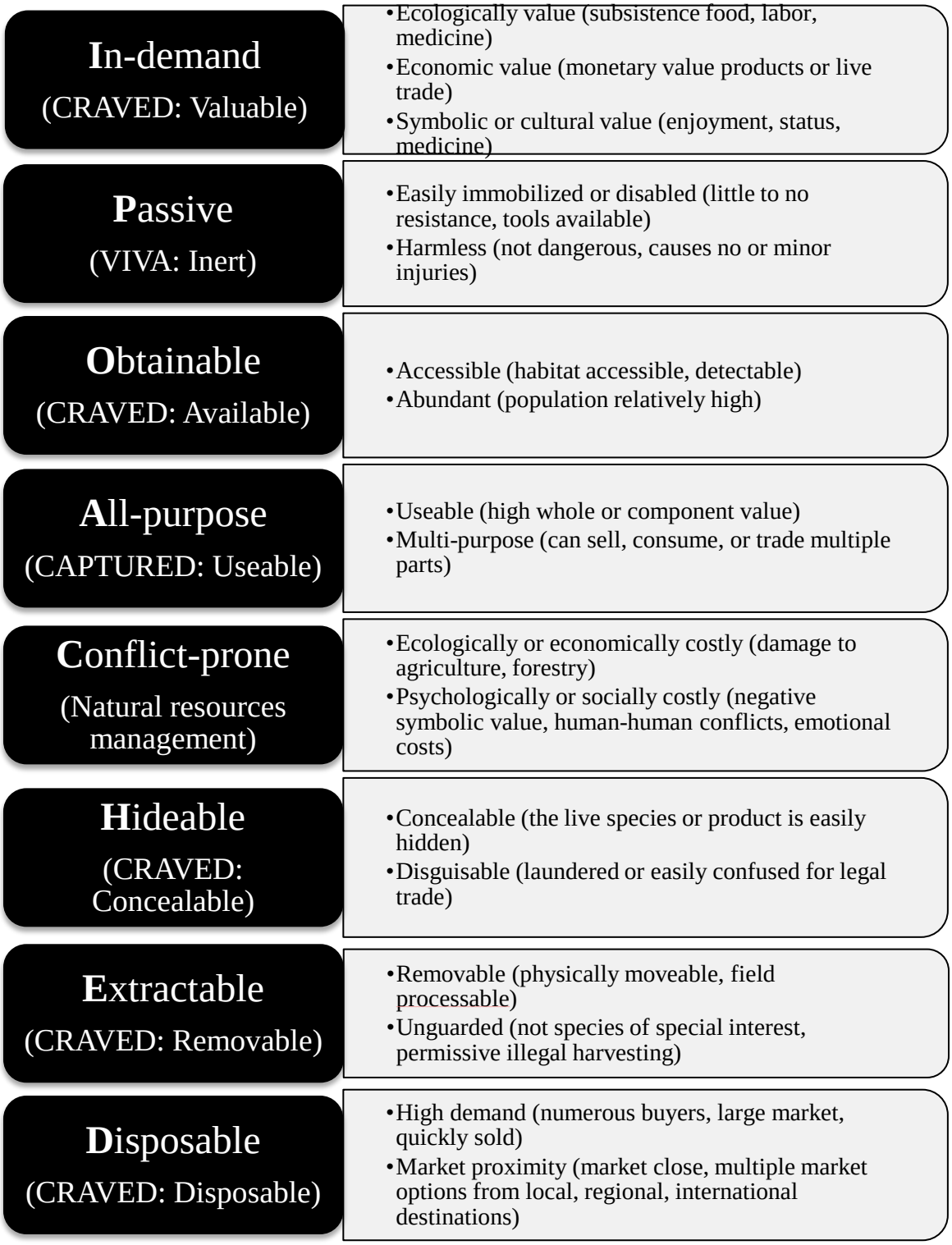

Table 3.4: Species or genera reported as most often poached in BBSNP by interview respondents (N = 400) living in and around the Intensive Protection Zone (IPZ) of BBSNP, June and August, 2015

Common name	Scientific classification	Total	%
General birds	Infraclass Neognathae	193	48.3
Song birds	Clade Passeri	36	9.0
White-rumped Shama	*Copsychus malabaricus*	10	2.5
Patridge	Family Phasianidae	2	0.5
Hornbill	Family Bucerotidae	4	1.0
Sambar deer	*Cervus spp.*	169	42.3
Asian elephant	*Elephas maximus*	92	23.0
Sunda pangolin	*Manis javanica*	72	18.0
Antelope/ serow	*Capricornis spp.*	67	16.8
Wild swine	*Sus spp.*	46	11.5
Snakes	Suborder Serpentes	44	11.0
Turtles	Order Testudines	43	10.8
Sumatran tiger	*Panthera tigris sumatrae*	38	9.5
Monkeys	Family Cercopithecidae	36	9.0
Mouse-deer, Chevrotain	*Tragulus spp.*	27	6.8
Civets	Famly Viverridae	10	2.5
Muntjac	*Muntiacus spp.*	10	2.5
Sumatran rhinoceros	*Dicerorhinus sumatrensis*	10	2.5
Siamang	*Symphalangus syndactylus*	9	2.3
Monitor lizard	*Varanus spp.*	8	2.0
Porcupine	*Hystrix spp.*	8	2.0
Lizards	Suborder Lacertilla	7	1.8
Malayan tapir	*Tapirus indicus*	5	1.3
Squirrel	Family Sciuridae	5	1.3
Fox[1]	Order Carnivora	4	1.0
Gecko	Family Gekkonidae	3	0.8
Sun bear	*Helarctos malayanus*	3	0.8
None		45	11.3

Note. The following species were provided by interview respondents n=1 (0%): Binturung (*Arctictis binturong*), Clouded leopard (*Neofelis spp.*), Dhole (*Cuon alpinus*), hedgehog/ gymnure (*Hylomys spp.*), Sunda slow loris (*Nycticebus coucang*).

[1] Unsure what family, genera or species this refers to but it may be Dhole (*Cuon alpinus*), mongoose (*Herpestes spp.*) or weasel (Family Mustelidae)

Table 3.5: Ranking of the most commonly targeted species by poachers in BBSNP according to focus group participants (N = 25), May 2015

English common	Bahasa	Rank	*M*	Range
Song birds	Burung penyanyi	1	2.2	5
Sambar/ Muntjacs	Rusa/ kijang	2	2.4	5
Sunda pangolin	Trenggiling	3	4.2	2
Hornbills	Rangkok	4	5.4	6
Sumatran tiger	Harimau Sumatera	5	7.2	10
Elephant	Gajah	6	8.2	11
Freshwater turtles	Kura-kura/ labi-labi	7	9.4	14
Civets	Luwak/ musang	7	9.4	8
Snakes	Ular	7	9.4	11
Sunda slow loris	Kukang	8	10.2	10
Wild felids (> 25 kg)	Macan akar	9	10.6	8
Sumatran rhino	Badak Sumatera	10	10.8	13
Bearcat	Binturung	11	11.6	8
Malayan sun bear	Beruang	12	12.4	11
Siamang	Siamang	12	12.4	4
Monkeys/ macaques	Monyet	13	13.6	9
Wild fowl/ pheasants	Ayam hutan	14	14.4	12
Asian tapir	Tapir	15	17.2	2

The previous component of *enjoyable* was absorbed in this poaching-stage model into cultural or symbolic value under *in-demand* (Figure 3.1).

The most common response among survey respondents to species characteristics that drive poaching was they are *in-demand*, with support for cultural or symbolic value (n = 101, 25.3%), ecological value (n = 164, 35.2%), and economic value (n = 234, 58.5%) (Table 3.6). Frequencies do not add up to 100% as participants were allowed to list a single or multiple reasons. There was moderate support for the *conflict-prone* dimension (n = 70, 17.5%) and nominal presence of the dimensions of *passive* (n = 4, 1.0%), *disposable* (n = 2, 0.6%), *obtainable* (n = 1, 3%), and *extractable* (n = 1, 3%). No community-member gave a response that fit to the dimensions of *all-purpose* (né useable) or *hideable* (né concealable) (Table 3.6).

Table 3.6: Community perceptions (N = 400) of what characteristics drive poaching of wildlife species in BBSNP, Sumatra Indonesia as fitted to the proposed IPOACHED model

IPOACHED components (preceding models)	Concepts	Characteristics of species driving poaching	*f*	%
IN-DEMAND (CRAVED: Valuable)	Cultural or symbolic value	Hobby or pet	98	24.6
		Entertainment	1	0.3
		Cute	1	0.3
		Species is very unique	1	0.3
	Ecological value	Consumed	139	34.8
		Daily necessities	14	3.6
		Medicine (e.g., turtle oil)	11	2.9
	Economically valuable	To sell [products]: ivory (n = 9, 2.3%), snakeskin (n = 2, 0.6%)	155	39.0
		High economic value (e.g., leather, meat, tusks)	79	20.1
PASSIVE (VIVA: Inert)	Harmless	Not dangerous	3	0.8
	Easily Disabled	Easy to catch/kill	1	0.3
OBTAINABLE (CRAVED: Available)	Accessible	Easily accessed	1.00	0.30
ALL-PURPOSE (CAPTURED: Useable)				
CONFLICT-PRONE (NA: Natural Resources Management)	Ecological or economic costs	Pests	10	2.6
		Damage to agriculture (e.g., crops, farms)	51	13.1
		Danger to livestock	3	0.8
	Socially contentious	Dangerous, disturbing or threat	5	1.3
		Danger to pets	1	0.3
HIDEABLE (CRAVED: Concealable)				
EXTRACTABLE (CRAVED: Removable)	Removable	Easily removed	1	0.3
DISPOSIBLE (CRAVED: Disposable)	Market size	High market demand	2	0.6

Note. Based on a total sample population of N = 400 respondents. When asked this open-ended question 45 respondents (11.3%) gave no answer or stated they did not know.

According to focus group participants there were a number of IPOACHED characteristics of species that either promote or limit targeting of species by poaching (Table 3.7). All six species or genera, the top three most frequently poached and the 'big three' species of elephants, rhinoceroses, and tigers, were considered valuable in at least one or all three *in-demand* considerations with estimated economic value provided (Table 3.7). The top three most frequently poached species were characterized by compounding dimensions that make these species suitable for poaching, with few if any limiting IPOACHED dimensions (Table 3.7). The big three species were the most economically valuable, with all three also displaying high cultural value, but each were limited by three or more IPOACHED dimensions. For example, all three were considered relatively unobtainable due to low abundance, with tigers and rhinos being both low in abundance and accessibility (Table 3.7).

3.5 DISCUSSION

This interdisciplinary research makes an important contribution to advancing the theories and methods in conservation criminology with critical applications in understanding and preventing wildlife poaching. It is the only study, to my knowledge, that has answered the call to gather information from community members as well as local conservation and law enforcement officials (Moreto & Lemieux, 2015). Additionally, this study created a poaching-stage, species-based model with broad application to examine multi-market bound (e.g., pet, trophy, wild meat) species within a conservation management unit such as a protected area. As this study shows, many species are usable within the household (e.g., consumed, hobby or pet) or more localized or regional markets such as songbirds that traded among households, local and regional markets. CRAVED research has acknowledged that traditional market or trafficking-staged studies may not account for species that by-pass local markets surveyed for more distant markets (Pires &

Petrossian, 2016). From a species-conservation standpoint, predicting the magnitude and species composition and the characteristics that drive the initial poaching-stage in a particular locale is vitally important to direct crime prevention efforts proportionately to species most vulnerable. For example, data herein suggest that species such as songbirds, deer, pangolins, and hornbills are more vulnerable to poaching. This may or may not be an artifact of their relative abundance; these findings would allow enforcement efforts to be adjusted according to the habitats of vulnerable species and the known or suspected trafficking and market locations. These poaching-stage models may also better account for attrition of poached species in markets due to mortality post harvest or specimens exiting markets that are less closely monitored (e.g., household, village level).

Further, it is also likely this poaching-stage, species-focused model provides promising potential to examine what drives species selection for market-specific poachers, such as songbird collectors, within a particular conservation management landscape much like Moreto and Lemieux (2015) discuss the changing importance of CAPTURED components across markets. For example, for the poaching of songbirds dimensions such as *passive*, *conflict-prone*, and *all-purpose* will not likely discriminate between species, while cultural and economic value, (*in-demand*), their abundance and accessibility (*obtainable*), whether they can be disguised in terms of legal trade (*hideable*), and *disposability* on local, regional and international markets will likely determine species harvest. Ideally, market-based models can predict market demand changes that can influence poacher poaching-based models to better predict possible trends in changing *hot species* targeted by poachers. For example, in 2005 due to an outbreak of bird flu, international imports of the white-crested laughingthrush (*Garrulax leucolophus*), a popular pet songbird

Table 3.7: IPOACHED elements of that drive and limit poaching of: a) the top three most frequently poached species or genera, and b) *the big three species* of BBSNP according to focus group participants (N = 25)

a) Species (Rank)	Characteristics[a]	IPOACHED elements driving poaching	IPOACHED elements limiting poaching
Song bird (1)	Approximately $145–1,091 per bird but must be traded live.	In-Demand: cultural & economic value Passive: easily disabled & harmless Obtainable: accessible & abundant Hideable: disguisable Extractable: removable & unguarded Disposable: high demand & proximate markets	All-purpose: component value & multi-purpose
Sambar deer & muntjac (2)	Approximate value $7 per kilogram (sambar).	Passive: easily disabled & harmless Obtainable: accessible & abundant All-purpose: component value Conflict-prone: economically costly Hideable: concealable & disguisable Extractable: removable Disposable: high demand & proximate markets	
Pangolin (3)	Approximately $364 live and $7 per kilogram international markets.	In-Demand: ecological & economic value Passive: easily disabled & harmless Obtainable: accessible All-purpose: whole, component value Hideable: concealable Extractable: removable Disposable: high demand & proximate markets	

[a] Currency was reported in Indonesian Rupiah (Rp) by participants and converted to U.S. dollars (USD) using OANDA currency converter (www. oanda.com) on October 1, 2017

Table 3.7: (cont'd)

b) Species (Rank)	Characteristics[a]	IPOACHED elements driving poaching	IPOACHED elements limiting poaching
Tiger (5)	High economic value of all body parts (~ $2,909 for whole animal)	In-Demand: cultural, ecological & economic value	Passive: easily disabled & harmless
		All-purpose: whole, component value & multi-purpose	Obtainable: accessible & abundant
		Conflict-prone: economically costly	Hideable: concealable & disguisable
		Disposable: high demand & proximate markets	Extractable: removable & unguarded
Elephant (6)	Approximately $255 per 15 cm ivory pipe.	In-Demand: cultural & economic value	Passive: easily disabled & harmless
		Obtainable: accessible	Obtainable: abundant
		Conflict-prone: economically costly	All-purpose: component, whole value & multi-purpose
		Hideable: concealable	
		Extractable: removable	
		Disposable: high demand & proximate markets	
Rhino (10)	Can reach hundreds of millions of Indonesian rupiah (Rp 100,000 ~ $7,273 USD).	In-Demand: cultural, ecological & economic value	Obtainable: accessible & abundant
		Passive: easily disabled & harmless	All-purpose: component value & multi-purpose
		Hideable: concealable	
		Extractable: removable	Hideable: disguisable
		Disposable: high demand & proximate markets	Extractable: unguarded

[a] Currency was reported in Indonesian Rupiah (Rp) by participants and converted to U.S. dollars (USD) using OANDA currency converter (www.oanda.com) on October 1, 2017

species, were halted in Indonesia and in Sumatra there was a dramatic increase in domestic trapping of a related species, the black-and-white laughingthrush (*G. bicolor*), that has led to a sharp population decline and local extinction in some areas of the island (BirdLife International, 2016). Developing robust market-based, songbird-focused CRAVED or CAPTURED models could aid in alerting conservation areas to use up-to-date IPOACHED models to better anticipate what species, if any, in their conservation area may be vulnerable to increased targeting by poachers. Specific measures (e.g., situational crime prevention techniques) can be taken to protect the species the models predict will be most vulnerable, such as the black-and-white laughingthrush above.

Further, this study supports the addition of dimensions, such as *passive* (inertia from VIVA) and *conflict-prone*, and the inclusion of newly proposed *useable (*né *all-purpose* in the IPOACHED model) (Moreto & Lemieux, 2015). Additionally, this study confirms earlier adaptations of CRAVED to illegal wildlife, such as the two dimensions of *availability* (Pires & Clarke, 2011), that legal trade may *conceal* overharvest or illegal wild harvest of species (Pires, 2015), and the reconceptualization of *in-demand* (valuable) and *removable* for poaching-stage, species-based models. First, this study confirms the two components, abundance and availability, as being distinct and equally important in terms of *obtainability*. For example, herds of elephants were cited as being accessible and easily detectable due to their relatively noisy nature, yet not abundant any more due to excessive hunting. This study also confirms that the legal trade in a similar product may serve to conceal or disguise illegal trade as is the case with the sale of wild sambar deer and muntjac meat on markets where other forms of red meat are legally available (e.g., Pires, 2015). Secondly, there was support for the concept of *all-purpose* (né usuable) at the poaching-stage (Moreto & Lemieux, 2015) with species such as sambar deer, pangolin, and

tigers being valued because the whole specimen could be used within the household, local trade, sold for cash on markets or a mixture of uses.

Further, there was support for the reconceptualization of the dimension *in-demand* or *valuable* to include cultural, ecological and economic values. It is notable that in the IPOACHED model, *enjoyable* is absorbed into cultural value. This is also consistent with the literature in terms of entertainment or enjoyment being a motivating factor for legal and illegal hunting (Kahler & Gore, 2012). Cultural values such as the elevated social status and enjoyment of the beauty and song were listed as prominent in targeting songbirds, and it is likely that these cultural values drive the economic value for specific species of songbirds. There was support in the literature, in the empirical data, and field-experience for a reconceptualization of the dimension of *extractable* (né removable), to attend to two primary considerations: the physical act of extracting or removing the specimen and avoiding detection while doing so. The former dimension has been defined previously as the difficulty of accessing the species, such as nests (Pires, 2015) but can also be a product of the specimen's mass according to focus group participants that mentioned a market for elephant feet but the extreme difficulty in physically removing, and concealing, these parts of the animal. This relates to the how easily the species is field processed, a concept proposed in Moreto & Lemieux's (2015) CAPTURED product-based model where it was a stand-alone dimension of *processable* that was highly variable through the market stage yet not considered a key element during the poaching stage. The concept is still relevant, particularly within the concept of the physical removal of the specimen after harvest, however it has been absorbed into consideration under *extractable*.

Additionally, there is evidence from this study and the field experience associated with it that there is a discernable difference between the enforcement effort, detection probability and

risk of punitive consequences based on species. The illegal bird markets and presence of caged birds in virtually every village and roadside restaurant is astonishing in its' volume and in its' visibility to both the public and to law enforcement. Focus group participants discussed both the permissive environment for songbird poaching in BBSNP and the extraordinary efforts made to safeguard the park's remaining rhinoceroses and tigers. Unguarded was added to the *extractable* dimension to capture this disparity in the risk that poachers are detected and face punitive consequences for poaching lower priority species in the area. This finding also highlights the utility of combining official and unofficial data sources to determine species-based poaching trends as official sources may be biased toward heavily guarded, priority species or species more accessible to enforcement.

Lastly, two independent dimensions were added to the IPOACHED model, *passive* and *conflict-prone,* and both are related to the fact that wildlife at the poaching stage is animate, more closely resembling a victim of predatory crime, with interactions with humans that can exact costs and provoke poaching. There was evidence from both community interview respondents and conservation and enforcement practitioners that species vary considerably in how easily immobilized they are once located and the potential they have to inflict serious injury or harm. All three of the species considered most targeted by focus group participants were considered easily disabled and unlikely to inflict serious or even minor injuries, while tigers and elephants were considered difficult to disable and able to cause severe injury or even death to poachers. *Passive,* related to VIVA's inert, was added as a component with species that are easily disabled (little to no resistance, hunted with tools that are available) and not dangerous (causes no or minor injuries) being more likely to be targeted by poachers. This is distinct, as discussed above, from whether a species is *removable* once it has been captured, disabled or killed.

Finally, literature in natural resources conservation and management establishes the connection between human-wildlife conflicts (e.g., crop damage, livestock depredation, humans attacked; hereafter *conflicts*) and increased likelihood of poaching in the form of a method of conflict avoidance, direct retaliation for damage, or support for poaching by outsiders (see Kahler & Gore, 2015 for discussion and research findings). Conflicts with wildlife can extract direct and indirect costs through ecological and economic systems (Kahler & Gore, 2015). For example, in two Namibian conservancies hippopotamuses were a common target of poachers, were perceived to be ecologically risky as potential disease vectors (e.g., anthrax), responsible for a quarter of the wildlife-related deaths in the conservancies and were perceived as economically costly as they were responsible for 15% of total annual damage estimates (Kahler & Gore, 2015). However, many conflict-prone species also have positive economic or subsistence values on illegal markets (Kahler & Gore, 2015), making their poaching like an added-value kill and with dual benefits of reducing risks and costs while increasing income or consumption. Empirical data from this study also supports the addition of the dimension of *conflict-prone* to account for these costs for species such as sambar deer, elephants, sun bears and tigers.

There are a number of limitations associated with this study. First, although this study answers the call for use of more non-official sources of information via interviews with community members, and conservation and enforcement representatives (e.g., Moreto & Lemieux, 2015), I failed to secure sources of official data for species poached in BBSNP meaning I have no official poaching records to compare to participants generated information. Official records and more intensive localized surveys of poached species would provide necessary data to test the model, aid in appropriate quantification of the various components of

each IPOACHED dimension, and adequately assess the usefulness of this model to detect trends in species-targeting within a given conservation area despite species being destined for differing markets (e.g., pets, trophies, wild meat). Further, the community members interviewed living in the IPZ of BBSNP were of unknown compliance status with wildlife poaching laws. It would be useful to identify and prioritize community-based informants and current or former poachers to further calibrate the model and further quantify some of the concepts.

Lastly, focus group participants and antidotal reports from rangers and conservationist in BBSNP reported that one common method of poaching in BBSNP is the use of snares, where a poacher may target one or more species but catch non-targeted species called bycatch. These non-targeted species may comprise a substantial volume of wildlife poached from the park and provide smaller economic rewards but be equally likely to be consumed in the home or enter markets. For example, accidental snaring of the endangered Malaysian tapir was reported in BBSNP with focus group participants citing its lack of desirability due to dietary restrictions in Islam as they are perceived to be related to pigs. This assertion is backed up by IUCN data on tapirs in Sumatra, where numbers are thought to be declining and below 500 individuals, and off-take is likely due to accidental snaring and possibly retaliation for crop damage (Table 3.2). There is evidence elsewhere on Sumatra that pigs are entering the market either through direct targeting or bycatch to be sold to non-Muslims for wild meat (Luskin et al., 2013), therefore it is plausible that tapirs enter illegal markets as well.

Bycatch due to snaring is problematic for poaching and market-based CRAVED, CAPTURED or IPOACHED models, as results may be an artifact of hunting method rather than characteristics of desired species targeted by the poacher. Indeed, additional indiscriminant harvesting methods, such as mist nets and sticky rice for songbirds, may hamper our

understanding of characteristics most sought after by poachers and demands on the market. Conducting IPOACHED-based surveys with community-based informants and current or former poachers as discussed above would aid in identifying which species snare-based poachers are targeting in order to estimate the species composition and scale of the bycatch and determine the economic and logistic parameters of this bycatch entering the illegal market target.

There are several future directions for fruitful research into the proposed IPOACHED model. First, Clarke (1999) discussed theft choices involving personal versus commercial use items, which is relevant to poaching-stage species collection of species for subsistence versus commercial use. In order to better understand decision-making on the part of the poacher when it comes to 'hot species,' models that are based on the different modus operandi of the various actors involved in poaching should be explored (Moreto & Lemieux, 2015). During this study, focus group participants created concept diagrams based on the modus operandi of opportunistic, premeditated, and provoked poachers (see chapter four) but this study failed to link considerations of these different poachers to concepts related to 'hot species.' Additionally, Clarke (1999) discussed the displacement of crime when protecting a hot product and states that within the context of stolen goods there is evidence that displacement is not a foregone conclusion as many thieves target specific products for specific reason that other products may not satisfy. We do not know if poachers in BBSNP are primarily focusing on one market, such as pets or wild meat, or more flexible and opportunistic in their species choices. This is an area of great uncertainty. Lastly, there are several dimensions and components of dimensions of IPOACHED that warrant further consideration and better definition and quantification to make applicable as a tool for protected area management and conservation law enforcement. For example, this study attempted to quantify cultural, ecological, and economic positive values and

costs but further elaboration is warranted. The component of unguarded in regards to a species' extractability, for example, could be quantified based on measures of punitive consequences, enforcement effort within core habitat zones of particular species, a scaled response from law enforcement indicating their likelihood to enforce species-specific regulations, or a combination of the above. Official data will be an important empirical test and aid refinement of IPOACHED and any future poacher (e.g., premeditated) or market-focused (e.g., wild meat) renditions.

There are pragmatic reasons for the geographically focused, poaching-stage, and species-based approach that include but are not limited to: the feasibility of initiating wildlife crime prevention recommendations across a given management unit, recognition that not all poached items end up entering markets or are detected when traded more locally, and need from a biodiversity conservation standpoint to understand which species are most targeted regardless of motivation, market or the charismatic nature of the species involved. Understanding what characteristics drive species-specific vulnerability to poaching is important in predicting criminal behavior in the face of changing availability, values and demand of wildlife products and choosing the most effective strategies to prevent wildlife crime in any given protected area. A variety of factors can influence the uncertainty at the poaching-stage as to which species are most often targeted and why, this includes but is not limited to low detection probabilities, harvested species are consumed, traded or sold locally, or differing enforcement efforts based conservation interest or status. Development of a protected area-based, species poaching-focused model that can accommodate data from official records alongside knowledge and opinions from local communities, on-the-ground conservation practitioners and informants can create a more holistic picture of what species are most vulnerable and help in directing interventions to those most vulnerable species.

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CHAPTER 4
THE APPLICATION OF SITUATIONAL CRIME PREVENTION TO PROTECT CRITICALLY ENDANGERED SUMATRAN TIGER (*Panthera tigris sumatrae)*

4.1 INTRODUCTION

Rapid population and economic growth in Southeast Asia has led to increased exploitation of mineral and natural resources, fueling deforestation and fragmentation that makes tiger habitat more accessible and brings potential poachers within closer proximity to tigers (*Panthera tigris*) and tiger prey (Rayan & Linkie, 2015). In the last 100 years tigers have gone from occupying a vast majority of Southeast Asia to existing in small, fragmented and isolated landscapes in only 12 countries[4] representing a range collapse of over 93% (Stoner & Pervushina, 2013). In 2010, the wild tiger population was estimated to hover at approximately 3200-3500 adults, which represented an estimated 50% loss of the global tiger population within a single decade (Global Tiger Recovery Program [GTRP], 2011). Additionally, of the eight taxonomically recognized subspecies of tigers across the historic range, four have gone extinct since the 1940s (Seidensticker, 2010). Much like other large carnivores around the world, habitat loss, poaching, and prey depletion are primary threats to tigers (Chapron et al., 2008). Due to biological and demographic characteristics, tiger populations are particularly sensitive to poaching; preventing human-caused mortality is currently the highest priority for short-term conservation efforts designed to prevent global wild tiger extinction (Chapron et al., 2008). Despite substantial attempts to increase the number and efficacy of site-based enforcement efforts and reduce demand for and illegal trade of tigers, these large carnivores remain under

[4] Since the release of a 2013 report by TRAFFIC, which stated tigers were present in 13 range countries, Cambodia has declared Indochinese tigers extinct in their dry forests, which were once a tiger stronghold. Ecologists concur that intensive poaching of the tigers and their prey is the principle reason for this extirpation (AFP, 6 April, 2016).

tremendous poaching pressure; demand for tiger body parts remains very high (Stoner, 2014). For example, it is estimated that a minimum of 1,425 tigers were confiscated during 654 seizures of illegal tiger trade intercepted by law enforcement in the remaining tiger range countries from 2000-2012 (Stoner & Pervushina, 2013), which represents approximately 45% of the minimum population estimate in 2010 (GTRP, 2010). Strategies that can reduce and prevent poaching immediately in a variety of contexts are needed to prevent global extinction of wild tigers (GTRP, 2010).

Indonesia is a microcosm of global tiger conservation. Originally home to three out of eight traditionally recognized subspecies, the Sumatran tiger (*P. tigris sumatrae*) is now the last extant island-dwelling species; the Bali tiger (*P. tigris balica*) was declared extinct in the 1940s and the Javan tiger (*P. tigris sondaica*) in the 1970s (Seidensticker, 2010). The Sumatran tiger population is decreasing and severely fragmented among 12 remaining Tiger Conservation Landscapes in 10 national parks, with a majority of the population found in six key protected areas (Linkie et al., 2008). The Sumatran tiger is threatened throughout its range by habitat loss and fragmentation due to illegal and commercial logging, expanded agricultural activities such as palm oil production, mining, and forest fires in addition to prey depletion and tiger poaching for domestic and international markets (Linkie et al., 2003). Listed as Critically Endangered on the International Union for Conservation of Nature (IUCN) Red List, the Sumatran tiger population was estimated to be 400–500 island wide in 2007 (Linkie, Wibisono, Martyr, & Sunarto, 2008), falling to an estimated 325 in 2012 (Stoner & Pervushina, 2013) and a mere 250 adults in 2015 (Rifaie, Sugardjito, & Fitriana, 2015) (Table 4.1). The forests where tigers live are multi-use and overlap with human activities that have been characterized by high human-wildlife conflicts with little organized response (Nyhus & Tilson, 2004). For example, 146 people were killed, an

additional 30 injured and at least 870 livestock were lost to tigers in the less than 20 years from 1978 to 1997; these conflicts undermine tiger conservation efforts (Nyhus & Tilson, 2004); an estimated 15% of all tigers killed from 1998 to 2002 were killed due to conflict (Table 5.1).

Bukit Barisan Selatan National Park (BBSNP), which is the third largest protected area (3,568 km^2) in Sumatra, is home to some of the largest tracts of remaining lowland rainforest on the island (O'Brien, Kinnaird, & Wibisono, 2003). BBSNP is a UNESCO World Heritage Park, and along with Kerinci Seblat (13,895 km^2) and Gunung Leuser (7,927 km^2), is a key landscape designated for recovery of the critically endangered Sumatran tiger (Pusparini et al., 2017). These parks are also on UNESCO's List of World Heritage Parks in Danger (Pusparini et al., 2017). BBSNP's linear shape means the park has over 700 km of boundary and is subjected to serious agricultural encroachment, logging and illegal hunting (O'Brien et al., 2003). The park is located within the provinces of Bengkulu and Lampung, the latter of which is one of the most impoverished and densely populated provinces in Sumatra (O'Brien & Kinnaird, 1996). Lampung is characterized as having dense areas of agricultural fields, plantations (e.g., oil palm), villages clustered adjacent to the park border, and high levels of deforestation since park establishment (McCarthy, Wibisono, McCarthy, Fuller, & Andayani, 2015). Encroachment has been estimated to impact approximately 25% of the park in Lampung (~ 89,000 hectares) (World Wildlife Fund [WWF], 2013) and by the early 21st century it was estimated that nearly 70% of Lampung's coffee production was within or near BBSNP (O'Brien & Kinnaird, 2003).

In addition to habitat loss through agricultural encroachment and illegal logging, direct poaching of tigers and their prey has been documented in BBSNP (e.g., O'Brien et al., 2003). For example, a 2002 study on tiger and tiger prey density estimated the BBSNP tiger population at 40–43 individuals within the entire park and identified illegal hunting of tigers and tiger prey,

in addition to increasing habitat loss, particularly in the central and northern portions of the park, as serious threat to the park's tigers (O'Brien et al., 2003). In 2015, BBSNP officials formally designated 1,000 km^2 of the park's core forest block as an Intensive Protection Zone (IPZ) (Pusparini et al., 2017). Importantly, O'Brien and colleagues (2002) failed to detect a single tiger within the now designated IPZ (Table 4.1). This IPZ was established primarily to secure the small population of critically endangered Sumatran rhinoceros (*Dicerorhinus sumatrensis*) but managers also hoped the IPZ would benefit other endangered species including Asian elephants (*Elephas maximus*) and Sumatran tiger populations (Pusparini et al., 2017). Shortly after IPZ was established, researchers performed a baseline population estimation for tigers and tiger prey and estimated the tiger population to be 28–29 adult tigers (2.8 per 100 m^3) with a rich prey base including muntjac deer (*Muntiacus muntjak*) and wild pigs (*Sus scrofa*) found in 85–95% of the area and sambar (*Rusa unicolor*) found to be present in 61% of the area surveyed (Pusparini et al., 2017).

However, they also documented 22-armed poachers, in 14 incidents, in addition to unarmed bird poachers and non-timber forest product collectors on camera traps for a total of 77 incidents within six months of observations (Pusparini et al., 2017). Improving and diversifying the law enforcement response in this core zone of BBSNP was identified as being essential to halting the severe population declines of Sumatran tigers and other endangered species (e.g., O'Brien et al., 2003; Pusparini et al., 2017). Engaging the field of criminology and crime science to adapt proactive crime prevention techniques, such as Situational Crime Prevention (SCP), is a promising field of inquiry that can inform the implementation of diverse and empirically-based interventions to address chronic wildlife poaching in the near term (e.g., Kahler & Gore, 2017).

Table 4.1: Description of the protection status, populations, poaching, and wildlife trade associated with the Sumatran tiger

Characteristic	Description
IUCN status	Critically Endangered (CR) by Red List in 1996[a]
Protected status in Indonesia	Act no.5 (1990) Conservation of Living Resources and their Ecosystems lists only the Sumatran and now extinct Javan tiger subspecies as totally protected.[b]
	Party to CITES since 1978 and has CITES-enabling legislation (Category 1)[b]
Species population status	Decreasing and severely fragmented among 12 Tiger Conservation Landscapes in 10 national parks[a]
	Estimated at 400–500 in 2007 with 342–506 thought to occur in 6 key protected areas[a]
	Estimated at 325 in 2012[b]
BBSNP population status	Estimated 40–43 individuals at a density of 1.6 (1.2–3.2) per 100 km3 in 2003 with no tigers detected in the Intensive Protection Zone (IPZ)[c]
	Estimated to be 28–29 adult tigers (2.8 per 100 km3) within the IPZ only in 2017[d]
Illegal wildlife trade	High level of conflict and illegal-trade in tiger parts (bones, meat, skins) primarily for domestic markets drives poaching[a]
Approximate value	Dead $5,000; live $50,000; baby $3,200; bone $2,000; bone wine $88; penis $1,300; remains $70,000; skin $35,000[a]
Poaching description	1998–2002 51 tigers per year were killed in Sumatra with 76% for trade and 15% due to conflict[a]
	31 seizures of 44 total tigers from 2000–2009[b]
	11 seizures of 50 total tigers from 2010–2012[b]
	20% (3 tigers) were of bone/skeleton, 7% (1) carcass, 7% (1) live and 66% (10) skin/skin piece from 2010–2012[b]
Notable arrests and seizures in Sumatra	11 skins found in the house of a tanner in Pekanbaru along with 13 Sambar deer antlers (December 2012)[a]
	Over 100 stuffed skins were confiscated from a person selling to buyers over a 10 year period with an investigation starting in 2009 in South Sumatra (February 2015)[a]

[a] Linkie, M., Wibisono, H.T., Martyr, D.J. & Sunarto, S (2008). [b] Stoner, S.S. & Pervushina, N. (2013). [c] O'Brien, T.G., Kinnaird, M.F. & Wibisono, H.T. (2003). [d] Pusparini, W., Batubara, T., Surahmat, F., et al. (2017).

4.1.1 Situational Crime Prevention (SCP)

Situational Crime Prevention (SCP) is a pragmatic application of criminological-based opportunity theories, (Clarke, 2008; Wellsmith, 2010), which employs methods to address context-specific crimes and has developed a set of 25 techniques that fit under five broad crime reducing approaches aimed at diminishing criminal opportunities over space and time (Wellsmith, 2010). The theoretical basis of SCP comes from environmental criminology, which diverges from conventional criminological by focusing on how situational factors create *opportunities* for crime rather than seeking to understand how criminal *dispositions* emerge (Clarke, 2008). Advocates of the SCP approach acknowledge the sound rationale behind dispositional theories while challenging the notion that these less tenable criminal inclinations and motivations must be fully understood before proceeding with prevention measures that reduce criminal opportunities (e.g., upbringing, psychological disadvantages) (Clarke, 2008).

The SCP approach is appealing for those that seek to reduce and understand wildlife crimes because of the immediacy of crime reduction and the proactive, rather than reactive, nature of the techniques (e.g., Kurland, Pires, McFann, & Moreto, 2017; Lemieux, 2014; Wellsmith, 2010). Recent research has considered the conceptual usefulness of SCP to reduce environmental crimes, such as poaching (Pires & Clarke, 2011) and the illegal trade of endangered species (Wellsmith, 2010). Importantly, engaging criminological theories, methods and practitioners can lead to development of a suite of SCP techniques appropriate for wildlife crimes based on an extensive knowledge base into criminal behavior and prevention (Kurland et al., 2017). Research into the application of SCP to combat wildlife crimes has grown in recent years among criminologists and appears to trend with the intensification of wildlife crime into a large global illegal market estimated to generate $7–23 billion annually (Nelleman et al., 2016).

Routine activity theory, crime pattern theories, and the rational choice perspective form the theoretical basis of the SCP approach (Clarke 1995; 2008; Lampe, 2011) and provide opportunities to understand wildlife crime from a criminological standpoint. It is worth stating that the original development and application of the SCP-relevant theories, approaches, and methods discussed below were largely focused on understanding crime in urban areas where crime targets or victims were humans or human property. Routine activity theory postulates that criminal opportunities arise through the confluence of three necessary components in time and space: 1) a *motivated offender*, 2) an *available target*, and 3) a *lack of guardianship* (Cohen & Felson, 1979). The interaction of these three components is mediated through the daily routine activities (e.g., work, leisure) that govern how each move through time and space (Felson & Cohen, 1980). For example, Crow, Shelley and Stretesky (2013) found that poachers in Florida were often participants in lawful hunting, fishing and recreational activities and were aware of and drawn to areas of high concentration of potential targets supporting routine activity theory. In other instances, poachers may not be drawn to an area to targeted a particular species but rather live in close proximity with wildlife, overlap with wildlife through daily activities, and come into conflict with targeted species, such as crop damage or livestock depredation (e.g., Kahler & Gore, 2015). Additionally, wildlife crimes, such as poaching, often take place in rural areas where targets are more plentiful and a paucity of formal guardianship, due to lack of financial and human resources, is common (Crow et al., 2013).

While routine activity theory seeks to understand how daily activities of offenders and victims influence the likelihood of interactions, crime pattern theory seeks to understand how the physical environment influences patterns of convergence, in space and time, of offenders and targets (Wellsmith, 2010). This theory states that activity is shaped by the physical environment,

which concentrate crimes along main activity paths, such as edge environments where undesirable behavior may go unnoticed, and where activities of the crime target overlap with offenders creating *hotspots* of crime (Brantingham & Brantingham, 2008). Thus, unraveling wildlife poaching necessitates examining the temporal and spatial distributions of wildlife species and how humans, potential guardians and offenders, move through these environments. Examining the spatial and temporal relationships associated with illegal harvest of fisheries, forestry, and wildlife species have been conducted within the natural resource management discipline (e.g., Haines et al., 2012; Watson, Becker, McRobb, & Kanyembo, 2013). For example, white-tailed deer (*Odocoileus virginianus*) poaching was found to be temporally related to mid to late autumn evenings in forests and riparian habitat types with variable topography and proximity to roads (Haines et al., 2012).

Finally, the rational choice perspective focuses on understanding how the offender perceives a criminal opportunity (Wellsmith, 2010). This involves, in large part, the decision-making process of a rational actor as they evaluate the costs (e.g., risks) and benefits (e.g., instrumental, non-instrumental) of becoming involved in a crime given their analysis of the immediate circumstances and situations surrounding the opportunity (Clarke, 1995). This theory postulates that when someone commits a crime, such as tiger poaching, they have done so because their perception of the situation has led them to believe the benefits (e.g., tiger products) outweigh the risks (e.g., getting caught) (Clarke, 2008). For example, under Indonesian law the killing, possession, trade or trafficking in protected species, live, dead or in parts, carries a maximum penalty of approximately $11,000 USD (2006 rate) and five years in prison (Ng & Nemora, 2007). However, Risdianto et al. (2016) found that fines and prison sentences in Kerinci Seblat National Park, Sumatra were much lower, with the average prison sentence being one year

(three to 36 month range) and an average fine of $106 USD per person ($8 to $383 USD range), which is approximately one month's salary for a poacher in the area. Further, the harshest prison sentence of three years was the result of the suspect being in possession of an illegal firearm in addition to tiger body parts (Risdianto et al., 2016).

Poaching is not always motivated by economic profits. Motivations for wildlife poaching are diverse and can include meeting subsistence needs, retaliation for crop damage or livestock depredation to poaching as a form of social protest to conservation, rules and authority (Kahler & Gore, 2012). The rational choice perspective assumes that any person is capable of committing a crime given the opportunity (Pires & Moreto, 2011). This is of particular importance to wildlife crimes because the motivations for poaching are diverse (Kahler & Gore, 2012), the benefits can be substantial, the opportunities plentiful, and the risks are insignificant for most violations. This is why many researchers and practitioners feel that natural resource violations are common (e.g., Eliason, 2012). There is utility in viewing wildlife poachers as rational actors and dispelling with misconceptions that they are somehow more deviant or pathological than the average citizens. Understanding the cognitive calculations made by offenders and how the physical environment and activity patterns of guardians, poachers, and wildlife species lead to opportunities for wildlife can facilitate the development of SCP techniques tailored to wildlife crimes (Wellsmith, 2010).

The contemporary upsurge in wildlife crime has led to increased expenditures on traditional enforcement efforts (e.g., rangers, patrols) (Biggs et al., 2016). There is a compulsion among many conservationists to rely on increased levels of enforcement and punitive deterrence to dissuade wildlife crimes despite evidence from criminological research that enforcement and deterrence approaches are largely ineffective in terms of achieving significant crime reductions

(Biggs et al., 2016; Steinmetz, Srirattanaporn, Mor-Tip, & Seuaturien, 2014; Wellsmith, 2010). However, although there is a growing acknowledgment of the need to develop commensurate community-based approaches to wildlife crime prevention, interventions involving communities are often still regarded as subordinate to enforcement and patrolling (Steinmetz et al., 2014). A substantial debate has emerging between those that seek to increase the *boots on the ground* and effectiveness of traditional enforcement and those that advocate *moving beyond enforcement* and concerned about what they see as the *militarization* of conservation (e.g., Biggs et al., 2016; McCann, 2017). Advancing SCP applications within the context of wildlife crimes answers calls to diversify the response (e.g., Biggs et al., 2016) while at the same time *professionalizing* conservation law enforcement (McCann, 2017) efforts by drawing on the substantial body of knowledge within criminology. Further, the pragmatic advantage to the SCP approach is it reduces criminal opportunities in the near term (e.g., Wellsmith, 2010) while not constraining the implementation of longer-term interventions aimed to reduce crime and sociological drivers of crime. Below I discuss the current application of SCP in wildlife crime prevention and introduce a sixth SCP approach, increase the incentives for compliance, which is particularly relevant to increasing the involvement of communities in wildlife crime prevention.

4.1.2 Expanding the SCP approach: Increasing the incentives for compliance

Currently, the SCP model offers a typology of 25 opportunity-reducing techniques, which are classified under five approaches that are meant to divert offenders and targets away from each other, increase effective guardianship, and/or influence the offender's decision-making process away from crime. These include: 1) increase the effort, 2) increase the risks, 3) reduce the rewards, 4) reduce provocations, and/or 5) remove excuses (Lemieux, 2014). Although wildlife crime research has largely been explored by researchers from conservation sciences, a

recent in-depth review of conservation literature found wildlife crime reduction methods used by conservationist conceptually aligned with the SCP approaches associated with *increasing the risk, removing excuses of non-compliance*, and *reducing provocations* (Kurland et al., 2017). The primary focus of Sumatran tiger poaching prevention has been increasing the risks to poachers and to a lesser extent reducing provocations. For example, Linkie et al. (2015) found that effectiveness of law enforcement patrols was significantly bolstered when responding to local informant network leads increasing the detections of snares, for example, by over 40% in a key tiger conservation area in Sumatra. The SCP strategy of *strengthening formal surveillance* has been identified as critical for conservation of tigers and to reduce tiger prey depletion (Pusparini et al., 2017). For example, in Kerinci Seblat National Park in west-central Sumatra increasing the number of staff in Tiger Protection and Conservation Units led to greater success in terms of arrests and confiscation of chainsaws and snares, which are often set for key tiger prey species (Linkie et al., 2003).

Human-wildlife conflicts, such livestock depredation, can lead to retaliatory killings and conservation programs have often sought to develop compensation programs to reduce these provocations (Kurland et al., 2017; Kahler et al., 2013). For example, in a communal conservancy in Namibia documented poaching records (e.g., arrests, snares, firearm incidents) were spatially correlated with areas where residents reported having the highest risk of human-wildlife conflict (Kahler et al., 2013). Human-tiger conflicts, including attacks resulting in human mortality and injury and livestock depredation, and retaliatory killings are of conservation concern in Sumatra's forests, including BBSNP, where people and tigers overlap (Nyhus & Tilson, 2004; Wibisono & Pusparini, 2010). Translocation of livestock depredating carnivores, conceptually related to reducing the rewards by *removing the target*, is a decades-long

conservation tool to reduce human-wildlife conflicts and a practice that has increased among problem tigers in Sumatra (Priatna, Santosa, Prasetyo, & Kartono, 2012). Although critiques of SCP, such as its limitations within the context of organized crime (e.g., Lampe, 2011) and the possible diffusion of crime (e.g., Guerette & Bowers, 2009), are common in the criminology literature, so too are defenses of its adaptability and effectiveness (e.g., Bullock, Clarke & Tilley, 2010; Guerette & Bowers, 2009). Emerging evidence from crime scientists suggest that SCP could provide much needed cost-efficient, effective, and empirically based strategies to reduce wildlife crimes in the short term (Kurland et al., 2017).

A substantial amount of conservation work to date has been focused on changing local attitudes to conservation through education and extension (e.g., Waylen, McGowan, Group, & Milner-Gulland, 2009), generating and sharing revenue from sustainable use of wildlife resources (e.g., Kahler & Gore, 2015), often in hopes to reduce local poverty-driven overexploitation, and promoting cooperative management and *extending guardianship* of natural resources such as with community-based management schemes or Payments for Ecosystem Services incentive programs (e.g., Kurland et al., 2017). Many of the conservation-based wildlife crime intervention are not designed, implemented, monitored or assessed drawing on the knowledge, methods, and theories from criminology or crime science, which are disciplines with expertise in understanding deviant behavior and crime prevention (Kurland et al., 2017). Additionally, published conservation-based attempts to reduce wildlife crime in the near term often use maligned methods or non-situational techniques such as education, which are not optimal for producing immediate reduction of crimes needed to secure decreasing wildlife populations (Kurland et al., 2017). Conversely, although there is an increasing interest among criminologists and crime scientists in wildlife crimes and the application of SCP, including an

edited book (Lemieux, 2014), these strategies designed by criminologists have yet to be implemented and field tested (Kurland et al., 2017).

4.1.3 Research objectives

The overall objective for this study was to bridge this conservation and criminology gap by presenting the SCP framework to field-based conservation practitioners to structure the description of and brainstorm responses to wildlife poaching in BBSNP, Sumatra, Indonesia. Results herein are related to descriptions of the suitability of tigers as crime targets, tiger poacher modus operandi, suggested strategies for the SCP of tiger poaching, participatory mapping of prioritized SCP approaches and hypothesized poaching diffusion in the IPZ of BBSNP. Additionally, two faculty members at Michigan State University associated with the Department of Fisheries and Wildlife and School of Criminal Justice proposed a sixth SCP approach, increase the incentives for compliance, drawing on the literatures that unite conservation criminology. This sixth approach has five associated techniques: a) use local residents as guardians and place managers; b) increase transparency and clear management process; c) co-operative extension, education, d) increase the economic incentives of local communities, and e) increase the risks of detection. This research explores this expanded SCP framework with six approaches and 30 techniques. Specific objectives were: 1) delineate the modus operandi of tiger poachers in BBSNP including tools, the crime script (steps), and network; 2) describe the characteristics of tigers that increase and decrease their suitability as targets of crime in BBSNP, 3) use the expanded SCP framework to brainstorm diverse strategies for creation of a SCP tiger poaching prevention toolkit, and 4) map prioritized strategies from the SCP tiger toolkit and the hypothesized poaching diffusion within the IPZ of BBSNP. Results were used to make general

conclusions about the expanded SCP framework and make specific recommendations for the SCP of tiger poaching in the IPZ of BBSNP.

4.2 METHODS

4.2.1 Research approach

A three-day focus group was held in Gisting, Lampung Province, May 25 – 27, 2015, with community, governmental, and non-governmental conservation organizational representatives from BBSNP. Focus group participants were selected from BBSNP-based community (e.g., Forum Samabat Gajah (FSG) "Sumatran Elephant Patrols"), governmental (e.g., National Park), and non-governmental (e.g., Tambling Wildlife Nature Center) organizations based on: a) the fact that the organization is currently active in BBSNP conservation activities, b) a willingness of representatives to attend the entire focus group, and c) the recommendation from WWF Lampung. Gender, organization, length of work, role in organization, age, and educational information was collected via consent and demographic survey at the start of the focus group.

Research objectives were achieved during the three-day focus group. The focus group activity instruments were translated from English to Indonesian prior to the start of the workshop and provided to participants. Participants were broken into five mixed subgroups (e.g., different organizational members) that each conducted SCP activities as outlined below. Only tiger and sambar-related results are presented here.

4.2.2 Objective one: Poacher modus operandi description

The participants used a *think thief* like approach (e.g., Lasky, Fisher & Jacques, 2016) to discuss three types of wildlife poachers: a) premeditated, b) opportunistic, and c) provoked (see Cornish and Clark, 2003 for modus operandi-based typology). Each of the five subgroups

created a conceptual model for each of the three types of wildlife poachers by: 1) brainstorming the motives, opportunities or provocation to poach an animal, and identifying the vital or important steps, 2) identifying every person and interaction that a poacher has within their network in order to poach, 3) arranging the different steps and people in a logical order and creating conceptual model, and 4) repeating the process for the other two types of poachers.

4.2.3 Objective two: Suitability of tigers as a poaching target

Each subgroup created a poster with a predetermined set of species in BBSNP, which were drawn from the literature on BBSNP as well as discussions with conservation practitioners with experience in the field. Participants hierarchically ranked species from the most often targeted by poachers to the least. Rank order was confirmed by consensus and characteristics were written describing why each species was a target of poachers. After the ranking one group completed a detailed target suitability survey for select species, including Sambar and tiger, and included concepts on availability and accessibility, poaching tools, species resistance to poaching, cultural, ecological, and economic value, and market-based information.

4.2.4 Objective three: Building a SCP toolkit for tigers

Each subgroup was provided with a set of worksheets that corresponded to one full approach (e.g., increase the risks), with the five corresponding techniques (e.g., *strengthen formal surveillance*), and one technique from the newly introduced increase the incentives for compliance approach. Subgroups worked together to brainstorm strategies that fit under each of the techniques and were instructed to indicate what type of poachers (direct, opportunity, provoked) and wildlife species, especially elephants, tigers and rhinos that it would protect. One participant presented each of their subgroup's toolkit to the entire group and comments, additional strategies, and discussion followed. Additional strategies and comments were added to

subgroup folders but not described in terms of poacher type and species protected. A SCP toolkit key was created for each strategy.

4.2.5 Objective four: Participatory SCP strategy mapping

Two subgroups mapped poaching activities and SCP for Sumatran tigers (northern IPZ, southern IPZ). Participants completed the mapping activity in two stages. Stage one they mapped important local features (e.g., trails), distribution and/or movement of tigers and Sambar, and poaching activities such as snares, hunting camps and paths (Kahler et al., 2013). Stage two mapping activities were completed after the participants built a toolkit for SCP (i.e., list of specific strategies under SCP techniques). Participants reviewed the maps and current poaching activities and then discussed where specific strategies in their toolkit should be placed within the IPZ to protect tigers. Each strategy in the toolkit was limited in use to a maximum of three high, three medium, and three low priority choices, every approach had to be used at least once, but not every strategy had to be used. Color-coded stickers represented these priority interventions and each tool was labeled with a number (i.e., strategy) and a letter (i.e., tool). Lastly, participants reviewed the original areas of poaching, the placement of poaching interventions (SCP strategies), and were instructed to *think-like-a-poacher* mapping where they believed poacher activities would shift after the interventions were in place (poaching crime displacement).

4.3 ANALYSIS

4.3.1 Demographics of focus group participants

Demographic information collected at the start of the workshop using a simple survey attached to a consent form was entered into Microsoft Excel and descriptive analysis was performed on participant demographic data.

4.3.2 Objective one: Poacher modus operandi description

The participant-created poacher modus operandi models were digitized from hand-drawn models and translated using Google Translate.

4.3.3 Objective two: Suitability of tigers as a poaching target

The species or genera ranked during the target suitability activities (n = 5) were analyzed by calculating an importance index *(I*) (Kahler & Gore, 2015) that reflects the ordinal rank the groups assigned to a particular species or genera in relation to the other species. The value ranges from 0 to 1 (1=most often poached), r is the rank and n is the total number of species ranked (n = 10):

$$I = [(r-1)/(n-1)] \times (-1) + 1$$

The species or genera were reported in the final ordinal ranking determined by the *I*, the mean rank was calculated based as was the range of their ranking, which provides general insight as to how consistent the rankings were between the five subgroups (lower range=more consistence in opinions on ranking).

4.3.4 Objective three: Building a SCP toolkit for tigers

Strategies described on the worksheets were compiled under the original designation associated with the strategy and approach provided to the subgroup. The output recorded on the worksheets were translated by a professional transcriptionist and Indonesian research assistants and the translated documents were entered into a Microsoft Excel worksheet. Strategies were examined and those that did not fit into their assigned strategy or approach were reassigned based on literature (e.g., Lemieux, 2014). SCP strategies are not meant to be mutually exclusive and may fit under multiple techniques and approaches For the purpose of this paper, strategies that were hypothesized to protect tigers or all species including tigers are presented.

4.3.5 Objective four: Participatory SCP strategy mapping

Digital photographs were taken of the maps after participants completed stage one and two of mapping activities and the digital images were rectified with the geo-referenced maps used to generate the original large format maps (Kahler et al., 2013) using GIS (ESRI, 2014). Strategies from the SCP toolkit were entered as points, lines, and polygons onto the map and the prioritization and approach recorded for each one. First spatial data was created for each SCP toolkit features (points, line, polygons), which provided specific strategy and approach data and assigned a low, medium or high priority for the strategy in that specific location. Secondly, situational features such as deer presence, tiger presence, hunt camps, hunting paths, encroachment features (e.g., farms within protected area boundary) were entered as points, lines or polygons as indicated. Third, hypothesized crime displacement points were added. The SCP strategy points prioritization values were converted to a raster that resulted in a continuous surface of which represents high to low prioritization of SCP strategy implementation across the study area. Inverse Distance Weighting interpolation on associated priority for each SCP strategy across the study region where priority =5, medium priority = 3, and low priority = 1 (Kahler et al., 2013). All spatial analyses were conducted ArcGIS Desktop version 10.2 (ESRI, Redlands, CA).

4.4 RESULTS

4.4.1 Demographics of focus group participants

There were 24 men and one woman present at the focus groups. Focus group participants represented 10 organizations including academic (University of Lampung's Indonesian Environmental Information Center), communal organizations (e.g., Friends of the Elephant, Community Mahout Forum), cooperative groups (e.g., Tambling Wildlife Nature Conservation),

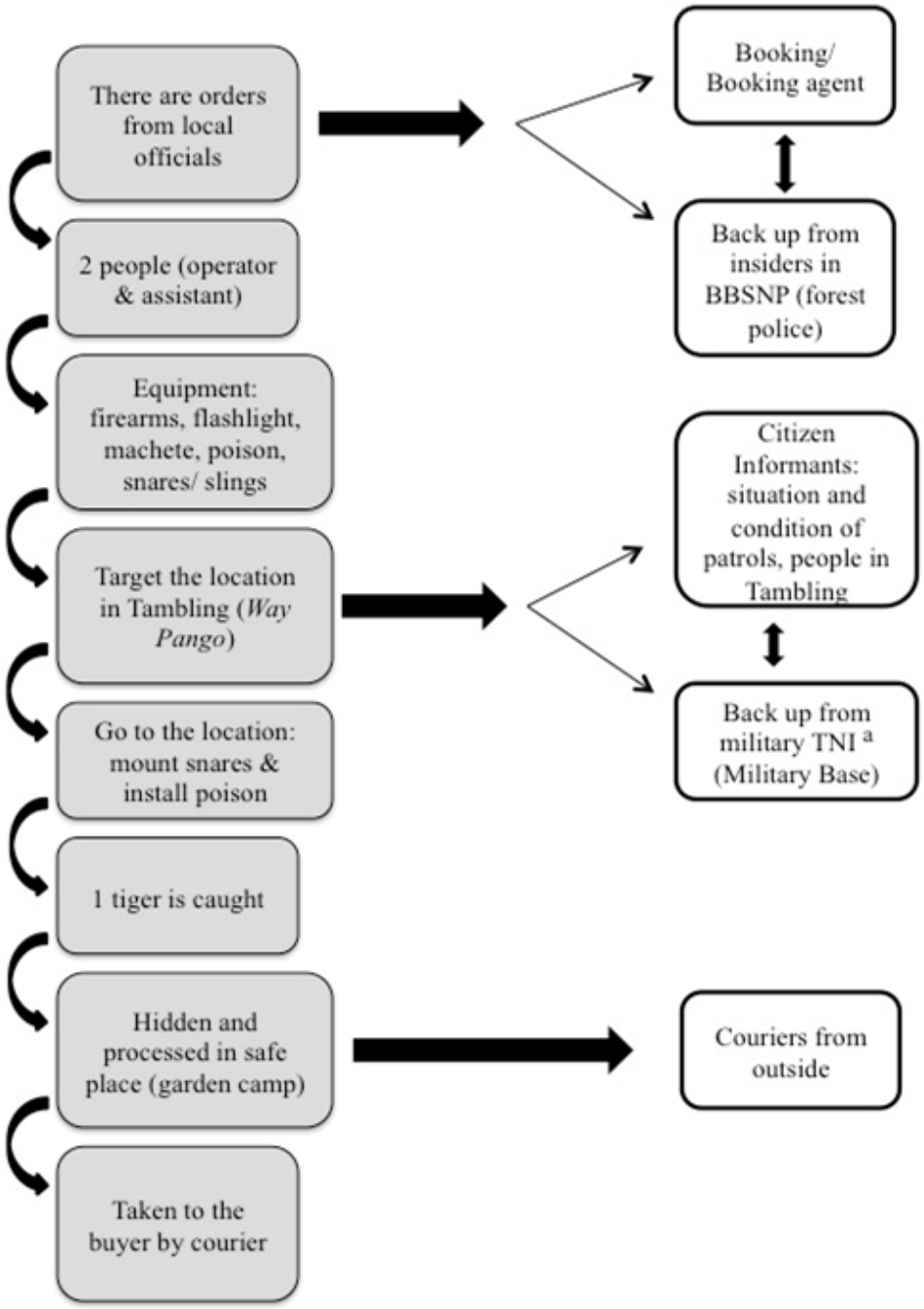
government agencies (e.g., Balai Konservasi Sumber Daya Alam (BKSDA), BBSNP), and non-governmental organizations (e.g., WWF Lampung, Yayasan Badak Indonesia (YABI) Rhino Patrol Unit). The average age of participants was 34.4 years, with a range of 24 to 64 years. Participants worked at their organizations on average 8.5 years (mode 15 years) with a range of two months to 32 years. Focus group participants had a variety of roles at their organizations with 44% (n = 11) having some responsibility for patrolling within BBSNP. Educational background ranged from junior high (0.08%, n = 2) to Bachelor's degrees (0.08%, n = 2), with the majority of participants having a high school or vocational high school education (52%, n = 13).

4.4.2 Objective one: Poacher modus operandi description

A tiger specific premeditated poaching model was created and while no tiger-specific opportunistic poaching model was created, participants stated that opportunistic poaching of tigers most often occurred during the premeditated poaching of sambar deer (tiger prey). Three non-species specific provoked poaching models were created and one elephant-specific and one sambar deer specific provoked model was created. This chapter focuses on presenting the premeditated poaching of tigers in BBSNP.

Participants mapped the steps, tools and interactions that premeditated tiger poachers, generally in teams of two, use to target tigers within BBSNP (Figure 4.1). The participants discussed the most common form of poaching in BBSNP was by laying snares and poison (type unspecified) specifically for tigers. Participants were not directed during this activity to focus exclusively on the IPZ and instead discussed the targeting of tigers in the Tambling Wildlife Nature Conservation (TWNC) area in the southern most area of the park. Authorities were implicated in participating in tiger poaching during two distinct phases of the crime sequence,

Figure 4.1: Conceptual model of tiger poaching in Bukit Barisan Selatan National Park (BBSNP)



[a] *Tentara Nasional Indonesia* (TNI) is the Indonesian National Armed Forces

including the initial order where participants said they booked the order (e.g., have a buyer) and provided intelligence to the poachers (e.g., enforcement routes) in terms of information from national park forest police (Figure 4.1). Additionally, participants said that the Tentara Nasional Indonesia (TNI), the Indonesian National Armed Forces, assigned at military bases in addition to civil informants provide necessary information regarding the situation, conditions on the ground, patrols and personnel at the target location (Figure 4.1). Information provided by TNI and civilian informants is used to target the location to mount snares and install poisons and the tiger is then hidden and processed in a garden camp until the poacher hands the killed tiger to the courier (Figure 4.1).

4.4.3 Objective two: Suitability of tigers as a poaching target

Overall tigers were ranked 5th out of the 18 predetermined species, genera or guilds that the subgroups ranked with an mean ranking of 7.2 and range of 10 indicating a high level of disagreement among the subgroups in terms of how often tigers are poaching targets (see Table 3.5). Tigers were characterized as possessing high value both economically and culturally, having high component value with multiple products (e.g., skin, teeth, claws), were conflict prone (i.e., economically costly), and very disposable on illegal markets with a high demand and proximate market including regional cities and local collectors (Table 4.2). Conversely, certain characteristics of tigers make poaching them difficult including that they are dangerous and difficult to disable, are not abundant or easily accessible, and are protected by rangers (guarded) (Table 4.2).

4.4.4 Objective three: Building a SCP toolkit for tigers

Participants generated a total of 87 strategies associated with 29 techniques; controlling for drugs and alcohol was not described, and 65 strategies were applicable to tigers (Appendix).

Table 4.2: Suitability of tigers as a target of poachers and description of tiger poaching in Bukit Barisan Selatan National Park (BBSNP) according to focus group participants (N = 25), May, 2015

IPOACHED dimension	Increase / Decrease	Descriptive	
In-demand	Inc.	Culturally valuable	The symbol of power and authority, a keystone species in BBSNP, used for amulets, can raise the social status of those owning tiger products, and kept in personal collections
		Ecologically valuable	Used for medicinal purposes
		Economically valuable	High economic value of all body parts (~$2,909 USD for whole animal)
Passive	Dec.	Easily immobilized or disable	Live tigers are difficult to disable but poachers use firearms, snares, and poisons to disable them
		Harmless	Rated very dangerous to people causing severe injury or death
Obtainable	Dec.	Abundant	Considered not abundant
		Accessible	Considered not easily accessible and distant to daily activities of most of the population
All-purposed	Inc.	Useable	high value whole or in its component parts; domestic demand aids sale of usable (non-perished) items onto near markets
		Multi-purpose	High value of nearly all parts, traded live, stuffed, bones, claws, teeth, skin, whiskers
Conflict-prone	Inc.	Ecologically and economically costly	Depredates livestock and pets, and competes for resources (prey)
		Psychologically or socially costly	Dangerous can cause serious injury or death

Note. Characteristics for tigers are provided based on the target suitability model, IPOACHED, to what degree tigers are in-demand, passive, obtainable, all-purposed, conflict-prone, hideable, extractable, and disposable. Characteristics of tigers associated with IPOACHED model are predicted to decrease (Dec.) or increase (Inc.) their likelihood to be targeted by poachers

[a] http://www.arkive.org/tiger/panthera-tigris/factsheets, retrieved 9 /15/16. [b] Stoner & Pervushina, 2013

Table 4.2: (cont'd)

IPOACHED dimension	Increase / Decrease	Descriptive	
Hideable	Dec.	Concealable	Whole and component value very high; weight ranges from 100–150 kg and would be difficult to conceal whole[a]
		Disguisable	Many components (e.g., skin, teeth) hard to disguise, however Indonesian law only protects Javan and Sumatran subspecies and at least one suspect has avoided prosecution because DNA test failed to determine subspecies[b]
Extractable	Dec.	Removable	Easily field processable but weight ranges from 100–150 kg a that would need to be carried over difficult terrain
		Unguarded	Severe punishment deters poachers
Disposable	Inc.	High demand	Market demand is high and poached tigers can be quickly sold
		Market proximity	Domestic demand is high with markets from regional cities to international destinations.

Note. Characteristics for tigers are provided based on the target suitability model, IPOACHED, to what degree tigers are in-demand, passive, obtainable, all-purposed, conflict-prone, hideable, extractable, and disposable. Characteristics of tigers associated with IPOACHED model are predicted to decrease (Dec.) or increase (Inc.) their likelihood to be targeted by poachers

[a] http://www.arkive.org/tiger/panthera-tigris/factsheets, retrieved 9 /15/16. [b] Stoner & Pervushina, 2013

Of the strategies generated (n = 87) participants described 64.4% (n = 56) in terms of what types of poachers they deter and what species they protect. The participants believed that 24 out of the 56 described strategies would protect all species, one was tiger specific, and an additional 18 were thought to protect select species (e.g., elephants) including tigers for a total of 43 (76.8%) of the described strategies being relevant to tigers. Of the total 87 strategies participants described under the 29 techniques, 24 (27.6%) had to be reclassified to better fit the techniques as traditionally conceptualized by criminologists. Particularly problematic techniques included

target hardening, control access to facilities, assist compliance, and use locals as place managers and guardians. Further, strategies that were assigned to assist natural surveillance (*n* = 2) were switched with strategies assigned to strengthen formal surveillance (*n* = 2). No strategies were provided for the strategy of control alcohol and drugs as participants cited strict government control and no relevance to poaching activities (Table 4.3).

4.4.5 Objective four: Participatory SCP strategy mapping

The participants mapped a total of 284 points representing SCP strategies within the IPZ the majority (52.1%, *n* =148) designated as high priority, a further 38.4% (*n* = 109) as medium priority, and the remaining 9.5% (*n* = 27) as low priority (Table 4.4). The most common approach chosen by participants to prevent tiger poaching in the IPZ was *increase the eff*ort (31.0%, *n* = 88), followed by *increase the risks* (21.8%, *n* = 62), *reduce the provocations* (12.7%, *n* = 36), *increase the incentives for compliance* (12.3%, *n* = 35), *reduce the rewards* (11.6%, *n* = 33), and *remove the excuses* (8.5%, n =24) (Table 4.4). The preference for the approach increase the effort was driven by the use of strategies to deflect offenders, which accounted for 56.8% (*n* = 50) of the approach's total (Table 4.4). The second most frequent strategy was *disrupt markets* (*n* = 25, 75.8% of *reduce the reward*s), followed by *extend guardianship* (*n* = 22, 35.5% of *increase the risks*) (Table 4.4).

SCP strategy mapping is reported at the approach level in order to aid interpretation and avoid disclosing exact techniques and strategies that may be used in specific locations. Examining the spatial distribution of perceived sambar deer and tiger presence, hunt camps and

Table 4.3: Selected strategies provided by focus group participants (N = 25) under the techniques and approaches of the Situational Crime Prevention (SCP) framework for tigers in BBSNP

INCREASE EFFORT	INCREASE INCENTIVES	INCREASE RISKS
1. Target Harden	6. Local residents as guardians	11. Extend guardianship
GPS collar	Improve awareness	Community conservation cadres
Camera trap	Community development	Police & military conservation cadres
2. Control access to facilities	7. Increase transparency	12. Assist natural surveillance
Spy camera (drones, CCTV)	Promotion for outstanding employees	Light installation
Increase community patrols	Increase salary/ welfare employees	Use local customs
3. Screen exits	8. Cooperative extension, education	13. Reduce anonymity
Watchtowers in entrance/ exit	Empowerment through non-formal education	Local informants
Portals on public road access	Authorities give socialization	
4. Deflect Offenders	9. Increase economic incentives	14. Use place managers
Open/ close access alternately	Increase income of surrounding villages	Employee recruitment
Guard posts		
5. Control tools	10. Increase risks of detection	15. Strengthen formal surveillance
Firearm raids in villages	Use informants	Camera traps
Firearm inspections	Village, community leaders	Closed circuit TV

Table 4.3: (cont'd)

REMOVE EXCUSES	REDUCE PROVOCATION	REDUCE REWARDS
16. Set Rules	21. Reduce frustrations & stress	26. Conceal target
Awareness using local customs	Assist villagers with tools for conflict mitigation	Patrol surrounding area
Conservation movies (local actors)	Prevention actions for HWC	Use firecrackers to keep species away
17. Post Instructions	22. Avoid disputes	27. Remove target
Signposts	Establish a communication forum	Locate in strategic areas
Community/ religious leaders awareness		
18. Alert conscience	23. Reduce temptation & arousal	28. Identify property
Encouragement board	Foreclose animal body parts	GPS collar
Removing myths	Pro-green candidates	Install chips/ legality certificates
19. Assist compliance	24. Neutralize peer pressure	29. Disrupt markets
Compensation for anti-tiger shelters	Empower conservation cadres	Fake online sale ads
Provide access to clean water	Door-to-door awareness	Guidance for species collectors
20. Control drugs and alcohol	25. Discourage imitation	30. Deny benefits
Not applicable	Put posters related to poaching activities	Media campaigns

paths, snares, encroachment, villages, and the most dominant approaches of *increase the effort* and *increase the risk* revealed priority areas within the core tiger and prey habitat and near areas of encroachment (Figure 4.2). The remaining four approaches, increase incentives for compliance, reduce provocations, reduce the rewards, and remove the excuses, were placed predominantly in the villages and along roads within proximity of or directly on the IPZ boundary, although some SCP strategies were placed on the western coast with the furthest being approximately less than 15 km away from the park boundary (Figure 4.3). The interpolated surface creates a SCP intervention priority-based map and when interpreted with understanding from the approach-based maps, it revealed high priority areas to increase the effort and risk on the interior of the IPZ to the northeast and in the central-southwest (Figure 4.4). Additionally, high priority human population centers were clustered in the southwest, central east and west, and northeast and northwest (Figure 4.4).

4.5 DISCUSSION

Applying and adapting the SCP approach in a participatory manner with conservation practitioners was advantageous in structuring the description of diverse strategies aimed to prevent tiger poaching in the IPZ. Refinement of this approach can help the conservation community systematically describe the situational conditions of their particular crime problems, enhance protection of threatened species, and heed the calls for more inclusive crime prevention measures that move *beyond enforcement*. For example, applying SCP within the context of Sumatran tiger poaching helps answers the call to increase the effectiveness of poaching prevention (e.g., Pusparini et al., 2017) as it draws on theories, methods, and empirical evidence from the fields of criminology and crime science to provide immediate crime reduction through targeted opportunity-driven interventions (Kurland et al., 2017; Lemieux, 2014). However, the

Figure 4.2: Participant-generated map of proposed location of SCP approaches (increase the effort and risks) and situational features (e.g., snares) associated with tiger poaching in the Intensive Protection Zone (IPZ) of BBSNP, Sumatra Indonesia

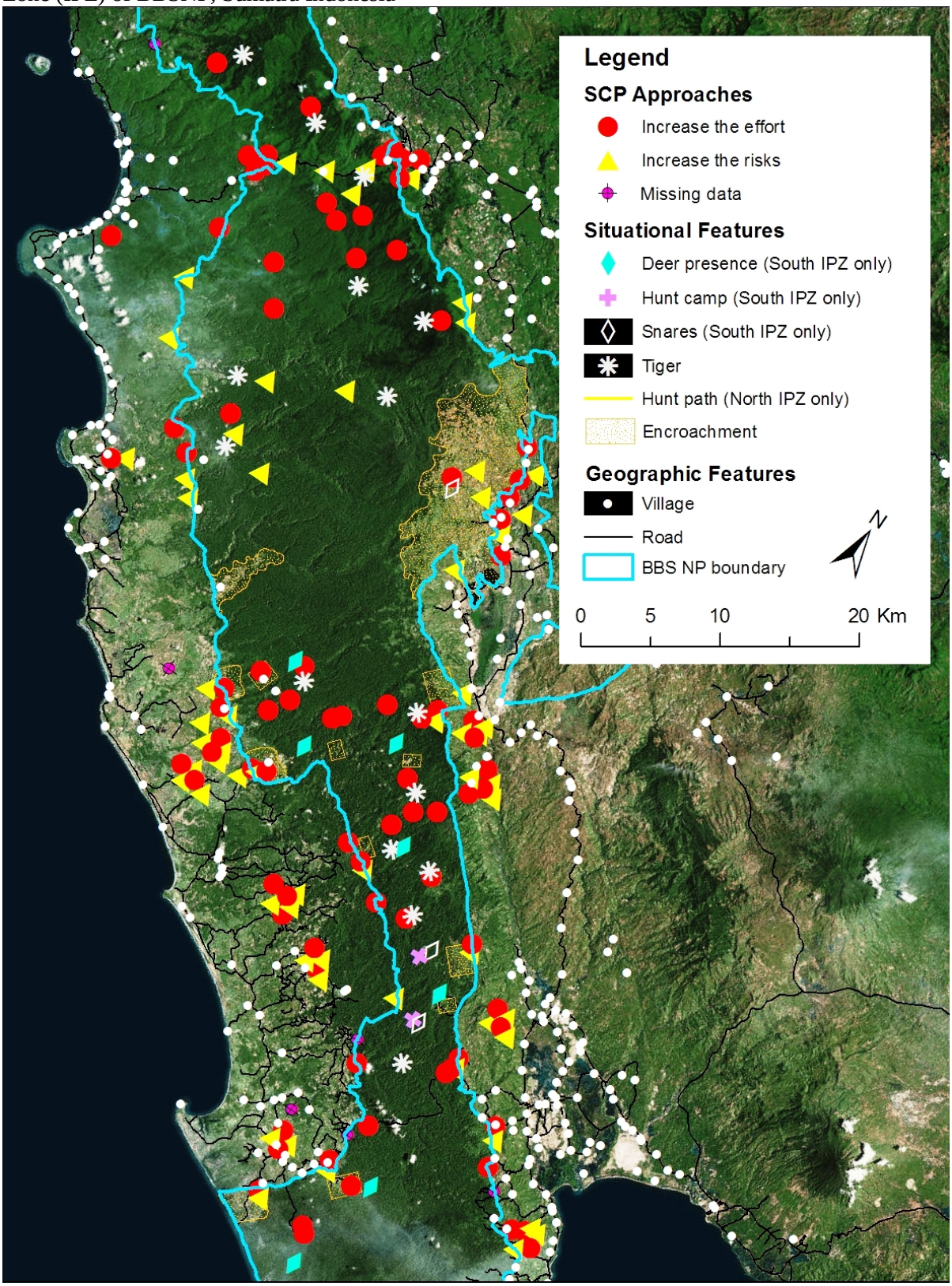


Figure 4.3: Participant-generated map of proposed location of SCP approaches (increase the incentives for compliance, remove excuses, reduce benefits and rewards) and situational features associated with tiger poaching in the IPZ of BBSNP, Sumatra Indonesia

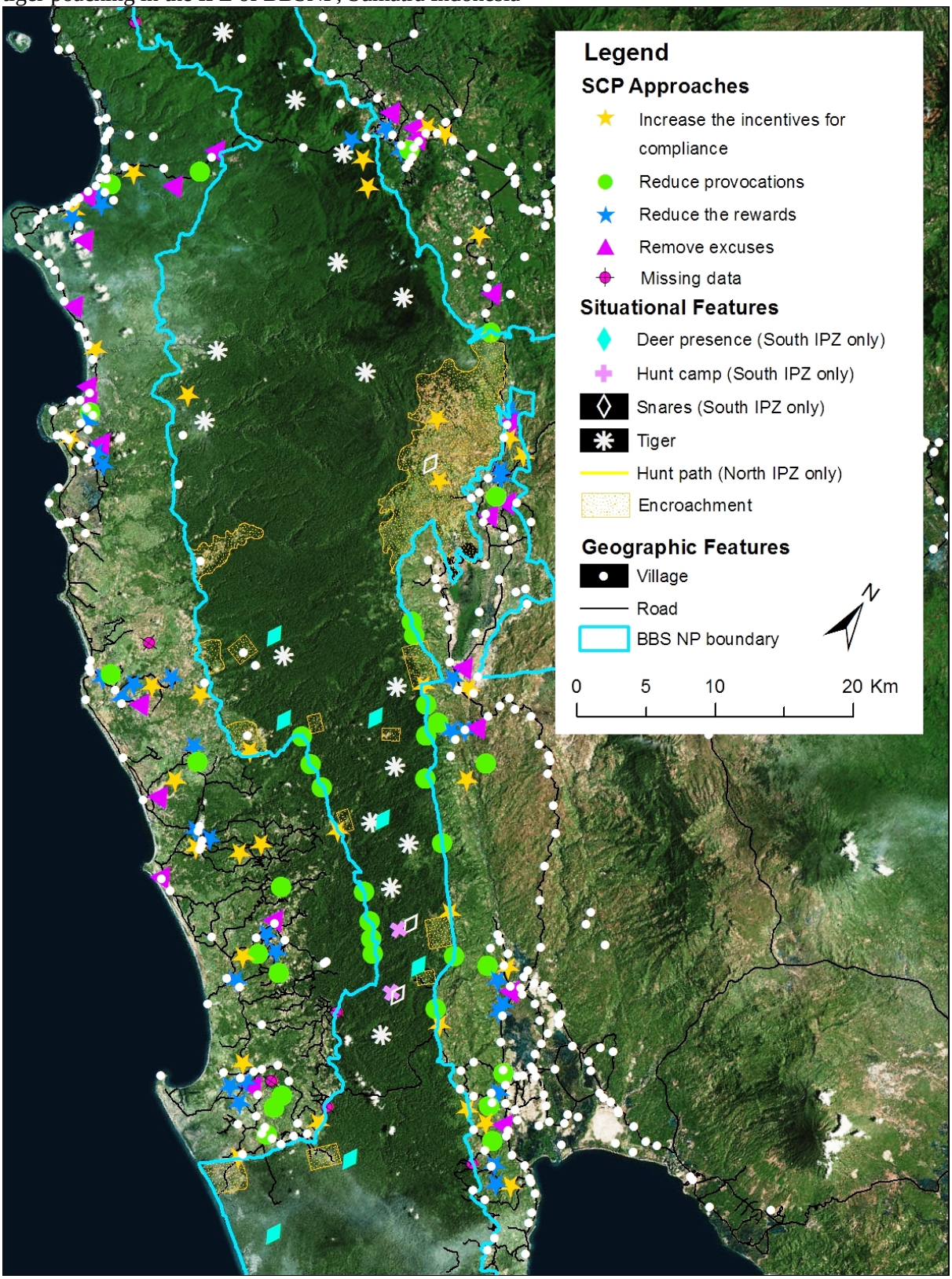
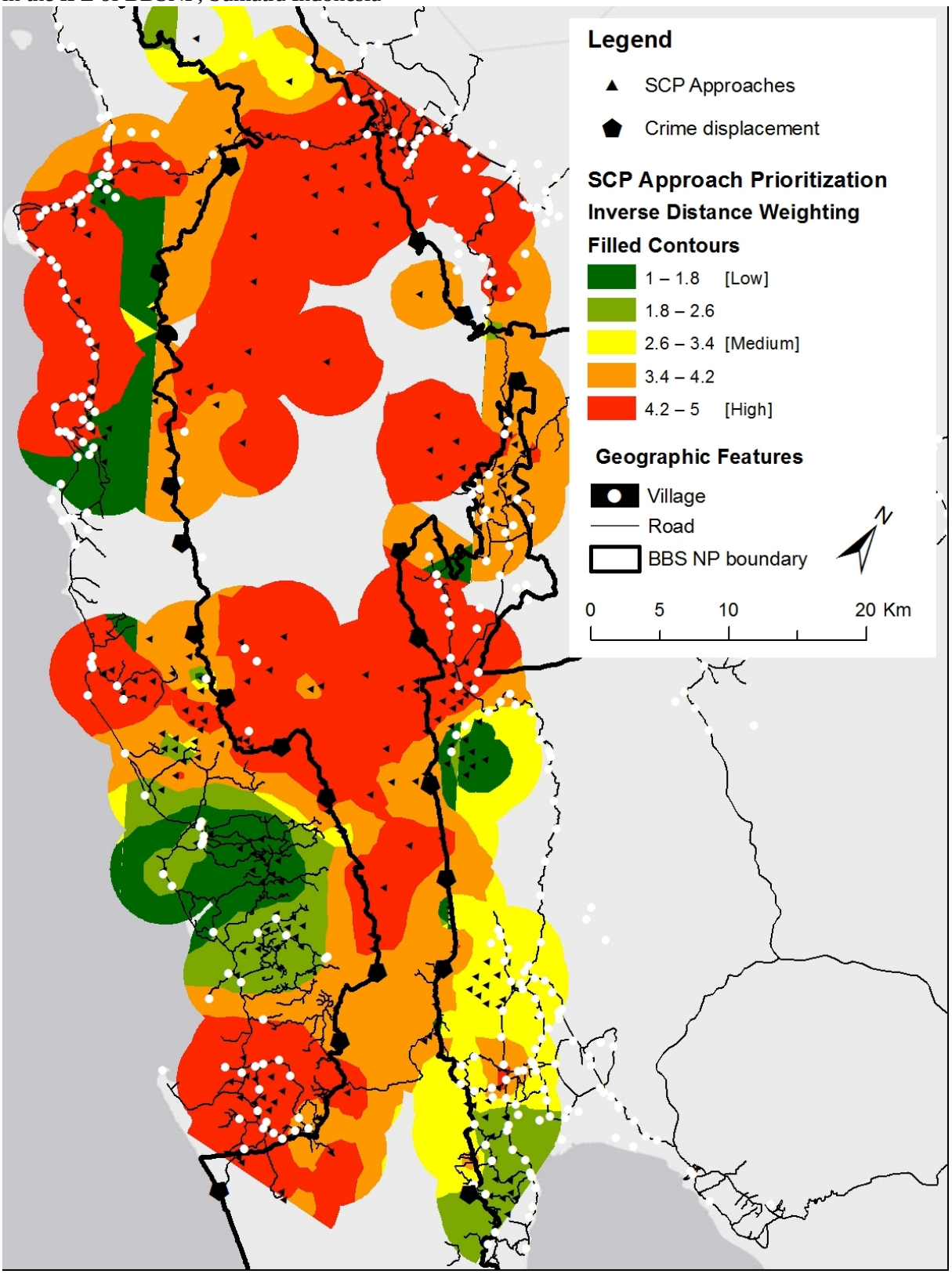


Figure 4.4: Participant-generated map of prioritized SCP approaches, interpolated to show a prioritization surface, and the hypothesized displacement of poaching post intervention associated with tiger poaching in the IPZ of BBSNP, Sumatra Indonesia



SCP framework also aided in diversifying the crime prevention response from what has been previously used, which has been overly reliant on law enforcement and deterrence-based punishment (Wellsmith, 2010). Further, when applied in a participatory manner, including community-based, governmental, and non-governmental conservation stakeholders, applying the SCP framework can also answer calls to move beyond enforcement, address the needs of communities, and increase community participation in wildlife crime prevention (e.g., Biggs et al., 2016). For example, developing strategies associated with the SCP techniques of *reduce frustration and stress* and *avoid disputes* to address human-tiger conflicts is responsive to community concerns and conservation needs. Lastly, the addition of a sixth approach, *increase the incentives for compliance*, strengthens and extends techniques and options to expand guardianship, increase transparency and clear management process, and provide incentive-based crime prevention options to the community.

The conservation literature related to understanding poachers has largely been focused on economic and subsistence-based motivations (Kahler & Gore, 2012). Understanding and addressing the fundamental root causes of poaching, such as demand or poverty[5], will always be an important component of the response as it suggests policies and strategies for longer-term change. However, there is a need to design complementary short-term strategies for wildlife poaching prevention, such as SCP, which requires understanding the modus operandi of poachers in the area, the specific strategies, steps and people involved, in order to better craft specific intervention to disrupt the crime and reduce risk. Organized crime groups or premeditated poaching pairs, rather than opportunistic locals, are increasingly associated with tiger poaching

[5] There are various theories on the drivers of environmental crime, which is beyond the scope of this chapter. For example, the recent UNEP-INTERPOLE report (Nelleman et al., 2016) discusses various drivers or root causes of environmental crime including: poverty, demand, organized crime, and permissive environments.

particularly in Nepal and Russia (Stoner & Pervushina, 2013). The model for premeditated tiger poaching developed in BBSNP also suggested poaching is conducted in pairs. How do these offenders overcome possible deficiencies in information about the local physical environment and the activities of guardians (e.g., rangers) and their targets? Answers to this question may be found in both the literature and in the participant-generated model depicting the modus operandi of tiger poachers in BBSNP. For example, park officials and military personnel were implicated by participants in multiple stages of poaching-related activities, including providing intelligence to poaching groups as to enforcement activities and targeting specific locations within the protected area but also as the buyer at the local level. Similarly, government and military personnel have been implicated in Sumatran tiger trade in Kerinci Seblat National Park to the north of BBSNP (Linkie et al., 2015). In order to address the participation of Indonesian authorities in the poaching of tigers and other wildlife species in Sumatra, further development and implementation of strategies to *reduce the anonymity* and *discourage the imitation* of corrupt rangers as well as increasing institutional *transparency and clear management processes* is necessary. In the future, deconstructing the tools, steps, and people associated with poaching and explicitly brainstorming possible interventions for each action would be advantageous.

Similarly, detailed understanding of what characteristics of specific species affect their targeting by poachers (see chapter three) can lead to better understanding of the opportunity structures that lead to repeat poaching of specific species (Moreto & Lemieux, 2015). Understanding which characteristics, such as species value or accessibility, are potentially driving the targeting of specific species by poachers is useful in formulating and prioritizing SCP strategies to reduce targeting (see chapter three). From my research it is clear that the main characteristic stakeholders in BBSNP perceive to be inhibiting poaching and subsequent trade is

availability, in particular abundance. Unfortunately, it is quite possible that this increased rarity is driving the economic and, possibly, the cultural value of tigers up on domestic markets as local demand outstrips a dwindling supply, making owning tiger parts more prestigious and expensive (e.g., Hall, Milner-Gulland, & Courchamp, 2008). Techniques that seek to reduce the cultural, ecological, and economic value of dead tigers and *reduce the rewards* to tiger poachers and traffickers by *disrupting markets* should be a priority. For example, Kurland et al. (2017) suggested strategies for *disrupting markets* by providing a substitute for the marketable product (e.g., domestic protein), monitoring markets, and increased surveillance of online markets. The latter, surveillance of online trade, is an identified need for tigers as there is evidence that improved enforcement and policing may have caused displacement of tiger trade to online markets in some areas (Stoner, 2014). Indeed, participants discussed one such market disrupting strategy related to tigers by suggesting the use of fake online sales ads presumably to catch those seeking to illegally purchase online, which would disrupt markets by making their secrecy questionable once word gets out there are online sting operations (Table 4.3). Lastly, there is a considerable debate about whether tiger farms meant to increase the supply of legal tiger products will sufficiently *reduce the rewards* by *denying benefits* to poachers by driving the cost of tiger products down (Kirkpatrick & Emerton, 2010). However, critiques of this this approach often state that maintaining demand for tiger products will likely stimulate further poaching (Kirkpatrick & Emerton, 2010) and possibly open up avenues for other types of wildlife crimes, such as laundering poached tiger products through legal tiger farms (e.g., Lyons & Natusch, 2011).

The participant-generated SCP toolkit for tiger protection was successful in getting these BBSNP conservation stakeholders to think above and beyond simply increasing ‘boots on the

ground' via *strengthening formal surveillance* (Table 4.3). Participants elaborated on strategies such as *extending guardianship* to increase risks, *setting rules* to remove excuses, and *reducing frustration and stress* to reduce provocations on. For example, strategies such as creating conservation cadres, small group specifically in wildlife regulations, among community groups, police and military units were suggested to *extend guardianship* and to *neutralize peer pressure* to engage in illegal activities. Participants specified a particular community group, the Masyarakat Peduli Hutan dan Satwa (MPHS) or Forest and Animal Care Community, for collaboration with forest rangers in the most vulnerable areas in order to *extend guardianship*. Certain SCP strategies under the traditional approach such as *deny benefits* to reduce rewards, *assist compliance* to remove excuses, *reduce anonymity* to increase the risks, and *target hardening* lacked depth of options and may have suffered from lack of conceptual clarity or limited feasibility within the context of tiger poaching prevention. For example, participants originally classified numerous strategies, such as firearm raids in villages, as an example of *target hardening* and reclassification of the stated strategies left one option, the use of GPS collars, as a *target hardening* strategy. Additionally, translocation of wildlife has been used as a tool to *reduce frustration and stress* associated with problem animals, such as problem tigers, removing vulnerable targets and releasing them in better protected and less inhabited areas (Priatna et al., 2012) and may also serve to *conceal targets* within less penetrable protected area interiors. However, the feasibility of this tool depends heavily on the behavior, biology, and ecological characteristics of the species in question (Priatna et al., 2012). It may very well be that the application of target-based SCP strategies, such as *target hardening, concealing* or *removing targets*, is limited within the context of the wildlife poaching stage of the crime script (see Moreto & Lemieux, 2015).

All five strategies under the new approach, *increase incentives for compliance* were salient to these conservation practitioners. For example, the conservation literature and programs are filled with strategies aimed to increase economic incentives (e.g., ecotourism), using local residents as guardians and place managers (e.g., community-based conservation), and cooperative extension and education programs. However, the performance of such conservation programs in terms of behavioral change in communities has been called into question (e.g., Waylen et al., 2009). Therefore any formulation of strategies under these techniques should pay careful attention to the extant literatures in conservation and criminology, be developed with specific poaching reduction goals with appropriate monitoring and evaluation indicators (Kurland et al., 2017). Two new techniques under the approach increase incentives for compliance, *local residents as guardians and place-managers* and *increase the risks of detection*, were so conceptually close to existing techniques that their distinction needs elaboration to justify consideration under a separate strategy versus specifying added dimensions under existing approaches. For example, while meant to provide more specificity, the technique of using *local residents as guardians and place managers* to increase incentives would not likely vary in conception from the existing strategies of *extend guardianship* and *use place managers* to increase the risks if clarified to include formal and non-formal arrangements. Further, examples of formal or compensated extension of guardianship and place-management responsibilities to residents can be given as an example of *increasing the economic incentives*. Lastly, the technique *of increase the risk of detection,* which participants related to increasing the efficiency of enforcement rather than the quantity, could clearly be elaborated within several techniques associated with *increase the risks* and in particular *strengthen formal surveillance*. For example, patrols responsive to local informant tip-offs were found to be more effective in terms of arrests

and snare removals than patrol routes not informed by local informants in Kerinci Seblat National Park, Sumatra (Linkie et al., 2015). Investigating alternative strategies for increasing the incentives for compliance is warranted.

One alternative technique to increase incentives for compliance is to draw on normative incentives and disincentives for compliance (Kahler & Gore, 2012). For example, Kurland et al. (2017) stated that while normative approaches are not part of the SCP suite of techniques, it has been acknowledged that using regulatory and normative approaches simultaneously can have a meaningful effect on increasing compliance. Although I would argue that techniques such as *neutralize peer pressure* and *discourage imitation* could have normative orientations depending on how they are formulated, it begs to question whether conservation criminologists should attempt to articulate a technique to *increase normative control* under the new increase the incentives for compliance approach and better articulate the socio-cultural opportunity structures that give rise to environmental crime. For example, the concept of *handlers* is a routine activities-based concept that has received little attention in terms of criminology (Tillyer & Eck, 2011) and is to my knowledge completely absent in conservation. Handlers are people that use pro-social control of offenders and with their effectiveness increasing with social closeness, willingness to intervene due to personal investment, they have ample opportunities to intervene, and knowledge about what prompts the offender to commit the crime (Tillyer & Eck, 2011). Understanding how handlers can be recruited, motivated, and leveraged to reduce recidivism, repeat offenses among poachers, would be advantageous in a wide variety of conservation contexts. Increasing normative control, through the leverage of socio-cultural norms, community-groups, or traditional authorities also answers the call for more pro-community wildlife crime prevention.

Lastly, the participatory mapping of the developed SCP toolkit by conservation practitioners revealed the preferences and perceptions of effectiveness that these practitioners had in relation to poaching prevention techniques and their perception of the hotspots of tiger poaching within the IPZ of BBSNP. Just over half (52.8%) of the techniques chosen and prioritized by participants were related to more traditional enforcement and deterrent strategies aimed to increase the effort needed by and increase the risks to poachers. While this is unsurprising, given the reliance on such techniques in conservation (e.g., Wellsmith, 2010), there were important nuances with this finding. For example, the most commonly used technique within the increase the risk approach was *extending guardianship* through conservation cadres and better engagement and collaboration between governmental agencies and communities (Table 4.4). Additionally, using *local residents as guardians and place managers* was the most commonly applied technique to increase the incentives for compliance. These results indicate a perception among these conservation practitioners that community guardianship, and by extension increasing community involvement in crime prevention (e.g., Biggs et al., 2016), will increase protection of tigers in the IPZ when implemented alongside more traditional enforcement and deterrence strategies such as *deflecting offenders*, and *assisting natural* and *strengthening formal surveillance*.

Examining the participant generated mapping of priority SCP approaches highlights contemporary hotspots of premeditated poaching efforts where formal surveillance may need to be increased, such as within the core zones of the IPZ, and aid in identifying and prioritizing communities where diverse approaches and strategies (e.g., remove excuses, increase incentives) are needed. For example, the southern boundaries of the IPZ, including the narrow neck, was an area of high priority in terms of increasing efforts, incentives, and risks and removing excuses,

Table 4.4: Approaches, techniques, and strategies for the SCP of tiger poaching in BBSNP chosen and mapped by focus group participants (N = 25) within the Intensive Protection Zone (IPZ), May, 2015

Approach (No., % of total)	No.		
Techniques (No., % of Approach)	High	Med.	Low
Increase the Effort (n = 88, 31.0%)			
Control access to facilities (n = 14, 15.9%)			
Installing spy cameras (drone, CCTV, camera trap)	8	3	0
No specific tool given or illegible tool code	3	0	0
Control tools/ weapons (n = 17, 19.3%)			
Firearms inspections by authorities	0	2	3
Firearms raid program	1	3	0
Improve coordination between associated parties	2	3	3
Deflect offenders (n = 50, 56.8%)			
Camera trap installation	16	0	0
Increase personnel at security guard posts	8	8	6
Open and close the access alternately	1	0	0
Patrolling back and forth around the hunting areas	5	6	0
Screen exits (n = 7, 8.0%)			
Installing CCTV in entrance access and strategic locations	2	0	0
Portals on public road passes through the park	0	1	0
Watchtowers in entrance-exit access	3	0	0
No specific tool given or illegible tool code	1	0	0
Increase the Incentives for Compliance (n = 35, 12.3%)			
Cooperative extension, education (n = 16, 45.7%)			
Empowerment since early childhood education	3	0	4
Encouragement signs to love the forest	5	0	0
Related authorities (Forestry Service, BKSDA etc.) give socialization	4	0	0
Increase economic incentives of local communities (n = 5, 14.3%)			
Community Development	1	2	2
Increase risks of detection (n = 2, 5.7%)			
Improve personnel	2	0	0
Local residents as guardians and place managers (n = 12, 48.0%)			
Increase community patrol (Forest Rangers' Community Partners [MMP], Friends of the Earth [KPA], Informants)	6	6	0
Increase the Risks (n = 62, 21.8%)			
Assist natural surveillance (n = 12, 19.4%)			
Install lights	6	6	0

Table 4.4: (cont'd)

Approach (No., % of total)	No.		
Techniques (No., % of Approach)	High	Med.	Low
Increase the Risks (n = 62, 21.8%)			
Extend guardianship (*n* = 22, 35.5%)			
Conservation cadres	3	14	0
MMP	1	0	0
Socializing the role and function of MMP and MPHS to the community	0	4	0
Reduce anonymity (*n* = 13, 21.0%)			
Local informant	3	10	0
Strengthen formal surveillance (*n* = 15, 24.2%)			
Camera trap	3	0	0
More guards	5	7	0
Reduce the Provocations (*n* = 36, 12.7%)			
Avoid disputes (*n* = 9, 25.0%)			
Establish a communication forum	3	3	3
Discourage imitation (*n* = 8, 22.2%)			
Put posters related to poaching activities	7	1	0
Reduce frustrations and stress (*n* = 19, 52.8%)			
Install security posts	1	2	0
Make trenches for barrier	15	0	0
Create a group for conflict mitigation	1	0	0
Reduce temptation and arousal (*n* = 1, 2.8%)			
Awareness/ socialization	1	0	0
Reduce the Rewards (*n* = 33, 11.6%)			
Disrupt markets (*n* = 25, 75.8%)			
Boards/ banners	0	4	0
Install boards about protected species in the collector's area	2	7	0
Seminars/socialization	3	7	2
Identify property (*n* = 8, 24.2%)			
Quarantine/ banners from Forestry Service about the protected species	2	6	0
Remove the Excuses (*n* = 24, 8.5%)			
Alert conscience (*n* = 5, 20.8%)			
Encouragement board to help keeping and sustaining forest	5	0	0
Post instructions (*n* = 6, 25%)			
Signposts (prohibition, encouragement and penalty)	6	0	0
Set rules (*n* = 13, 54.2%)			
Make a model conservation village	7	3	3

and reducing provocations and rewards. This has implications for increasing connectivity to a potential source population of tigers residing in the Tambling Wildlife Nature Conservation (TWNC) area of BBSNP, south of the IPZ. The TWNC area covers 48,153 hectares of the South BBSNP and is managed via cooperative agreement between the Artha Graha Peduli Foundation and the Ministry of Forestry (TWNC, 2017). This intensively managed and protected area has a tiger rehabilitation center, has received translocate tigers (Priatna et al., 2012), and is believed to have some of the highest densities of tigers in BBSNP (e.g., Pusparini et al., 2017). Biologists, conservation practitioners, communities, and crime scientists should work together to assess the feasibility, most appropriate measures, and overall priority to increase poaching prevention in the southern IPZ and enhance connectivity between the IPZ and the TWNC area. Lastly, while the participatory mapping process is an effective tool to gather perceptions about poaching risks in the landscape (Kahler et al., 2013) it is sensitive to the issue of scale (e.g., less specificity and accurateness at larger spatial scales) and was conducted at larger spatial scales. Specificity and accurateness would increase by breaking the IPZ into smaller zones and conducting these finer-scaled exercises with a wider range of stakeholders (e.g., farmers, women, etc) intimately knowledgeable about the area in question. Further, results would benefit greatly from integration of existing tiger population occupancy estimates, such as results from the baseline camera trap efforts by Pusparini et al. (2017) and enforcement efforts, such as data from the Spatial Monitoring And Reporting Tool (SMART) used in BBSNP. Results herein could be used to guide prioritization of areas where greater opportunities exist for poaching and the participatory SCP approach could be applied within these finer spatial scales and with a variety of communal, governmental and non-governmental organizations as discussed above.

In the end, the suitability of SCP's central theories to understand wildlife crimes and the techniques to help prevent them, will likely depend on the species in question, the context of the crimes associated the species of interests, and the ability of researchers to draw upon disciplines with theories and methods necessary to understand the biological, ecological and sociological situations that enable wildlife poaching and other related crimes. Conservationists can also carefully consider key limitations of SCP. For example, the SCP approach has been criticized for ignoring the psychological factors, such as perceptions of risk, which facilitate crimes and motivate offenders (Lampe, 2011). In relation to wildlife poaching, the questions of *why* these crimes take place at the micro-level will persist and are of importance in terms of insuring that regulatory interventions do not impinge human rights and limit environmental and social justice. Integration of research related to the socio-cultural dimensions of conservation sciences and policing approaches that facilitate small-scale and locally identified problem-solving techniques, such as community or problem-oriented policing, will be necessary to craft longer-term crime reduction strategies aimed to address the fundamental causation of why poaching persists (e.g., Wellsmith, 2010). Additional revision of this participatory, conservation-based SCP approach should include elaboration on potential SCP techniques and strategies for specific aspects of the poaching problem, such as snare placement in wildlife habitat, which can be facilitated by detailed description of a local typology of poacher and their associated modus operandi.

Further, in the spirit of increasing involvement of communities in wildlife crime prevention (e.g., Biggs et al., 2016) and to increase criminological rigor through implementation, monitoring and assessment (Kurland et al., 2017), it would be useful to further structure SCP toolkit development activities in a way that requires participants to specify the stakeholder group responsible for implementing, monitoring, and assessing each strategy. Collaboration between

communities, conservation practitioners and criminologists should aim to establish essential baseline parameters, such as wildlife populations and illegal activity estimates, and work toward developing appropriate mechanisms to monitor and assess the effectiveness of SCP interventions (Kurland et al., 2017). This novel participatory SCP approach developed herein can facilitate more effective collaboration between conservation groups and criminologists and lead to creating a knowledge base about the suitability of SCP to deal with wildlife crimes more generally and suggests much needed interventions within specific wildlife crime scenarios, such as the poaching of the critically endangered Sumatran tigers.

APPENDIX

APPENDIX**:** Full SCP toolkit developed the protection of tigers in BBSNP by focus group participants (N = 25)

INCREASE THE EFFORT
Control tools or weapons
Firearms raid program and inspections in collaboration with police in areas prone to illegal firearm ownership
Improve the coordination to educate people [on the] use of guns in accordance to the law and procedure
Control access to facilities
Installing spy cameras (drone, Closed Circuit Television (CCTV), camera trap)
Deflect offenders
Build brick fence along public road in select areas
Electric fencing in select areas of the park
Increase personnel at security guard posts
Open and close the access alternately
Patrolling around the most used hunting areas
Screen exits
Installation of portal on a public road that passes through the area to ease inspections
Installing CCTV in entrance access and strategic locations
Watchtowers in entrance-exit facilities
Target harden
GPS-collar
INCREASE THE INCENTIVES FOR COMPLIANCE
Co-operative extension, education
Socialization by Forestry Service, BKSDA (Natural Resource Conservation Body), NGOs and Police
Empowerment through education (early childhood, non-formal such as Scouts, etc)
Encouragement signs to love the forest to make people aware and proud of the forest around them
Seminars/ workshops working toward agreements on poaching prevention
Increase economic incentives of local communities
Community development to improve welfare, increase incomes, and build support for conservation
Compensation for villages chosen as model conservation villages
Provide facilities for clean water, micro-hydro development (energy) and solar cells to help provide alternative livelihood strategies
Increase risks of detection
Improve personnel [e.g., training]
Informants located in vulnerable areas
Locate rangers in strategic areas
Increase transparency and clear management process
Increase operational budget, patrol facilities, transportation to improve outcomes
Increase the employees' income and welfare (e.g., salary raise, bonuses)
Promotion for outstanding employees

APPENDIX: (cont'd)

INCREASE THE EFFORT – continued
Local residents as guardians and place managers
Increase community patrol (Forest Rangers' Community Partners, Friends of the Earth (KPA), informants) to get more information
Establishment of village regulations system on the species and forest protection and sanctions given to violators (e.g., social and punitive sanctions)
Village's respected figures report suspicious outsiders immediately to park officials
INCREASE THE RISKS
Assist natural surveillance
Local custom
Extend guardianship
Establishing a new community group
MPHS (Masyarakat Peduli Hutan dan Satwa = Forest and Animal Care Community) work with forest rangers in vulnerable areas
Recruit conservation cadres and cadres from police and soldiers
Socializing the role and function of MMP and MPHS to the community
Reduce anonymity
Selection of local informant recruitment
Local informant (surrounding community) give information to the rangers and officials
Strengthen formal surveillance
Camera trap & CCTV installed in strategic locations
More guards
REDUCE PROVOCATIONS
Avoid disputes
Communication forum for organizations to avoid misunderstandings
Discourage imitation
Making posters associated to hunting and other conservation crimes aimed to shape society's mindset that poaching is a crime
Neutralize peer pressure
Choosing and empower conservation cadres to spread conservation information to their peers (e.g., youth organizations, such as Karang Taruna (youth org), scouts, English clubs, Remaja Islam Masjid (religious youth orgs))
Door-to-door approach to explain the importance of conservation to the people
Reduce frustrations and stress
Compensation for making anti-tiger shelters for villagers, such as barbed wire to people with livestock preyed on my wildlife
Give trainings human-wildlife conflict mitigation and improve national park officials' response time to cases of wildlife damaging crops and livestock
Preventive actions before species get out of the park
Reduce human activities inside the park
Reduce temptation and arousal
Foreclose on confiscated animal body parts
Raising awareness and education

APPENDIX: (cont'd)

REDUCE THE REWARDS
Conceal targets
Translocate animals to better protected areas away from threats (e.g., use stun guns, nets, open-space vehicles)
Deny benefits
Newspaper, magazines, TV and radio to make people understand that buying protected species is illegal
Disrupt markets
Boards/ banners especially in traditional markets
Investigation (traps) through online ads
Periodic guidance for local species collectors
Replacing the icon of protected species with other materials so that poaching will can be reduced
Identify property
GPS Collar
Install microchips on species
Quarantine/ banners from the Forestry Service explaining rare and non-rare species
Remove targets
Translocate animals to better protected areas away from threats (e.g., use stun guns, nets, open-space vehicles)
REMOVE EXCUSES
Alert consciousness
Awareness through community leaders/ religious figures
Encouragement board to protect and sustain the forest
Assist compliance
No tiger relevant example given
Control drugs and alcohol (No answer given)
Post instructions
Campaigns on T-shirts
Prohibition boards, encouragement boards, penalty boards
Set rules
Awareness using local custom (folktales)
Establishing a model conservation village
Make movie about conservation for surrounding communities using local actors and folktales

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CHAPTER 5

SUMMARY OF RESEARCH FINDINGS: IMPLICATIONS FOR THEORY, METHODS, AND PRACTICE

5.1 INTRODUCTION

This dissertation fills knowledge gaps related to the interdisciplinary application of the situational crime prevention (SCP) framework for use by conservation practitioners in a protected area, which is consistent with calls for the need to explore opportunity-reducing approaches to wildlife crime prevention (e.g., Kurland, Pires, McFann, & Moreto, 2017; Lemieux, 2014; Wellsmith, 2010). The interdisciplinary orientation of the conservation criminology framework provided theoretical, methodological, and application-based benefits. Drawing on theories and methods from criminology, natural resources management, and risk and decision sciences allowed me to conduct a more detailed investigation of the unique interconnections between humans (guardians, offenders) and the environment (physical context, species) (Gore, 2011). For example, criminological theories such as guardianship posit a way to understand a bystanders responses when witnessing a crime, while risk and decision sciences help elucidate perceptions of the consequences, dread, frequency, and amount of personal control stakeholders feel they have over these risks. Risk-based theories (e.g., psychometric risk perception) and methods (e.g., participatory risk mapping have also been found to be useful in understanding poaching-relevant phenomenon such as human-wildlife conflicts (e.g., Kahler, Roloff, & Gore, 2013) and species-specific risk perceptions (Kahler & Gore, 2015). Natural resources conservation and management provides insight into perspectives related to the nature of the relationship between people and wildlife (e.g., wildlife value orientations). Practically,

criminology provides strategies aimed to reduce criminal behavior in the short and long term, while natural resources conservation and risk and decision sciences provide expertise on engaging diverse publics to manage and mitigate complex socio-ecological problems.

My research was a field-based empirical examination of concepts, models and techniques from SCP within the context of poaching prevention in an in-danger biodiversity hotspot, Bukit Barisan Selatan National Park (BBSNP), Sumatra, Indonesia. Data herein provide novel understanding about the willingness of residents in BBSNP communities to intervene as wildlife guardians to prevent wildlife poaching, advance an ecologically-advised model to understand and predict species-specific targeting by poachers, and capture conservation practitioners' rapid assessment of tigers as poaching targets, tiger poachers, an expanded suite of SCP techniques that reduce opportunities for tiger poaching, and description of priority spaces within and around BBSNP where these techniques need to be implemented. In producing new knowledge, this research makes theoretical, methodological, and practical contributions to the extant literature on guardianship, target suitability models, and the SCP framework within the context of wildlife poaching. I discuss key implications for theory, methods, and practice from this research below [6].

5.2 THEORETICAL IMPLICATIONS

5.2.1 Advancing a theory on wildlife guardianship

Guardianship examines the willingness of stakeholders to assume an informal role as protectors and intervene if necessary to disrupt crimes and shifts focus of the crime event from understanding criminals, such as poachers, to understanding the decision-making and crime preventative potential of local residents as capable guardians (Reynald, 2010). This addresses an

[6] The theoretical, methodological, and practical implications for the previously published chapter two, Conservation Crime Science (Kahler & Gore, 2017) are not discussed.

important knowledge gap associated with involving communities in wildlife crime prevention and was the first known attempt to measure guardianship intentions within the context of wildlife crime. My research advanced a Guardianship Intention Index (GII) based on respondents' perceptions of their ability to supervise, their stated willingness to supervise, and their willingness to intervene the latter of which was measured based on Reynald's (2010) continuum of intervention ranging from turning a blind eye to performing both direct (e.g., stopping it alone) and indirect (e.g., calling the authorities) interventions.

Additionally this exploratory research examined a breadth of demographic variables and attitudinal concepts (e.g., crime seriousness, risk perception, wildlife-value orientation) that theoretically may influence stakeholder willingness to serve as a wildlife guardian. Participants' GII score and the breakdown of those that said they would intervene versus those that reported an intention to not intervene varied significantly based on the participants' gender, livelihood, and village of residence, and attitudinal measures, such as perception of control over poaching, perceptions of risk, and wildlife value orientations (WVO). Taken as a whole this theoretically suggests that guardianship intensions are complex and likely formed through a variety of individual, psychological, and socio-cultural dimensions. For example, the decision to intervene when witnessing an environmental crime may relate to their underlying beliefs about the nature of human-wildlife relationships (WVOs), how harmful the activity is overall (risk perception), and how much control a person feels they have over the activity, which may be affected by the persons gender. Guardianship intensions differed by village of residence, livelihood, and gender. Theoretically this may suggest that men and women differ in their perception of personal efficacy in responding to or risk from intervening during a crime or that village-based differences may be driven by social networks, collective efficacy or social cohesion (e.g., Reynald, 2011);

further empirical investigations are warranted to understand these theoretical relationships. Findings from this line of research have important theoretical implications in terms of our understanding of demographic and attitudinal dimensions that influence wildlife guardianship intentions and build a theoretical foundation to conduct in-depth analysis and articulate the structure and magnitude (e.g., structured equation modeling) of the influence of these variables in the furture. Further research into guardianship should focus on refining and triangulating measurement of guardianship and have more focused and in-depth questioning on dimensions that are theoretically related to and supported by this exploratory research (e.g., perceived crime seriousness, WVO).

Building theoretical understanding of what influences wildlife guardianship intentions and exploring interventions that may increase wildlife guardianship among diverse stakeholders would be a valuable addition to our understanding of effective community-based responses to wildlife crime. Further research is needed to better define wildlife guardianship and understand the factors that affect the essential three components within the context of conservation and continuing to develop and validate indirect (e.g., behavioral intentions) and direct measures (e.g., direct observations) of guardianship is essential. Lastly, in addition to continued exploration of the psychological dimensions (e.g., demographics, risk perception, wildlife value orientations) that influence individual's guardianship-related decision-making, research into the theoretical components of community-level guardianship behaviors and dimensions such as ecometric measures of social cohesion (e.g., Goudriaan, Wittebrood, & Nieuwbeerta, 2006) and network and social contagion effects (Muter, Gore & Riley, 2013) are warranted.

5.2.2 IPOACHED: A species-based model to examine wildlife targeted by poachers

Recent adaptations of Clarke's (1999) crime target-suitability framework known as CRAVED [7] to understand wildlife species poaching and trafficking (e.g., Moreto & Lemieux, 2015; Pires & Clarke, 2012; Pires, 2015) lacked full theoretical integration from the conservation sciences and empirical input from conservation practitioners and communities that live with wildlife. The development of the IPOACHED model fills this gap and builds a stronger theoretically based model that focuses on the poaching stage of wildlife crime during which wildlife targets are live specimens. The resulting poaching-stage IPOACHED model predicts that species that are *in-demand, passive, obtainable, all-purpose, conflict-prone, hide-able, extractable, disposable*, is designed to aid protected areas in the prediction of species targeted by poachers across a broad range of markets (e.g., bushmeat, pet) and motivations (e.g., retaliation, safety). Results confirmed the dimensions of abundance and availability (*obtainability)* and added nuances to the dimensions of concealable (*hide-able*) and removable (*extractable*). The empirical data supported the reconceptualization of the value dimension (*in-demand)* to include cultural, ecological and economic values posited in transvaluation theory (Remis & Hardin, 2009) and supported by research on poaching vulnerability in Namibia (Kahler & Gore, 2015). It is notable that *enjoyable* is absorbed into cultural value. Further, this study supports the addition of the dimensions theoretically present in criminology and conservation-based literatures: *passive,* inertia from Visible Inert Valuable Available (VIVA), and *conflict-prone* based on human-wildlife conflict and retaliation literatures. For example, *passive* was added as a

[7] CRAVED examines the characteristics of crime targets based on how *concealable, removable, available, valuable, enjoyable* and *disposable* they are and how these characteristics shape the propensity of crime towards particular crime targets.

component with species that are easily disabled (little to no resistance, hunted with tools that are available) and not dangerous (causes no or minor injuries) being more likely to be targeted by poachers. This is distinct from whether a species is *removable* once it has been captured, disabled or killed. This research supported the inclusion of newly proposed *useable* dimension (Moreto & Lemieux, 2015) and is presented as *all-purpose* in the IPOACHED model.

There are several future directions for fruitful research into the proposed IPOACHED model. One limitation of my study was the failure to secure sources of official data for species poached in BBSNP to complement the knowledge and opinions of communities and conservation practitioners. Official records and more intensive localized surveys of poached species would provide necessary data to test the model, aid in appropriate quantification of the various components of each IPOACHED dimension, and adequately assess the usefulness of this model to detect trends in species-targeting within a given conservation area despite species being destined for differing markets (e.g., pets, trophies, wild meat). Additionally, in order to better understand decision-making on the part of the poacher when it comes to 'hot species,' models that are based on the different modus operandi (e.g., opportunistic, premeditated, provoked) of the various actors involved in poaching is a fruitful area of future research (Moreto & Lemieux, 2015). Lastly, there are several dimensions and components of dimensions of IPOACHED that warrant further consideration and better definition and quantification to make applicable as a tool for protected area management and conservation law enforcement. For example, this study attempted to quantify cultural, ecological, and economic positive values and costs but further elaboration is warranted. The component of unguarded in regards to a species' *extractability*, for example, could be quantified based on measures of punitive consequences (e.g., fines), enforcement effort within core habitat zones of particular species, a scaled response from law

enforcement indicating their likelihood to enforce species-specific regulations, or a combination of the above. Development of a protected area-based, species poaching-focused model that can accommodate data from official records alongside knowledge and opinions from local communities, on-the-ground conservation practitioners and informants can create a more holistic picture of what species are most vulnerable and help in directing interventions to those most vulnerable species.

5.2.3 The application of SCP to prevent tiger poaching in Bukit Barisan Selatan National Park (BBSNP)

My research draws on theory and practice from natural resources management and expands the traditional five techniques of SCP to add a sixth approach based on *increasing the incentives for compliance*. The addition of this sixth approach strengthens the SCP framework as it incorporates best practices and strategies from natural resources management, such as cooperative extension and education and increasing transparency in management processes, and provides an avenue for increased interaction between the criminology and conservation community. The conservation literature is filled with strategies aimed to increase economic incentives (e.g., ecotourism), using local residents as guardians and place managers (e.g., community-based conservation), and cooperative extension and education programs. However, the performance of such conservation programs in terms of behavioral change in communities has been called into question either because many interventions fail to establish a baseline and track behavior change or because programs, such as education, deliver anticipated knowledge and awareness of species threats but fail to change behavior (e.g., Waylen, McGowan, Group, & Milner-Gulland, 2009). Therefore it is critical that formulations of strategies under these techniques are built on knowledge found in the extant literatures in conservation and criminology

and are developed with specific poaching reduction goals with appropriate monitoring and evaluation indicators (Kurland et al., 2017).

Furthermore, my research advanced a novel poacher typology based on modus operandi rather than motivations, which was salient to conservation practitioners and helped guide their discussion of manageable interventions to remove opportunities and provocations associated with poachers. The conservation literature related to understanding poachers has largely been focused on motivations (Kahler & Gore, 2012) and while addressing the fundamental root causes of poaching is an important component to achieve sustainable change, there is a need to design complementary short-term strategies for wildlife poaching prevention. Advancing theories and understanding in regards to *how* poachers operate, including the environmental, political, regulatory, and sociocultural spaces they navigate will facilitate the creation of more effective and context specific interventions to disrupt the crime and reduce risk. Lastly, it has been acknowledged that using regulatory and normative approaches simultaneously can have a meaningful effect on increasing compliance (e.g., Kahler & Gore, 2012; Kurland et al., 2017). Future research into understanding the theoretical underpinnings of how existing and newly developed techniques for SCP achieve the desired wildlife crime reduction across a range of poachers with different motivations and modus operandi is needed.

5.3 METHODOLOGICAL IMPLICATIONS

5.3.1 Visual interview aids

This research adapted previously developed visual scales (Appendix A), which had been found to be advantageous in human dimensions research in Madagascar and Namibia (Gore & Kahler, 2015). In addition to magnitude-based visual scales (e.g., how much risk), a six-point visual agreement scale was created. Initially I designed three different versions of these visual

agreement scales and the most culturally appropriate and visually relevant scale was chosen through discussions with an Indonesian graduate student at Michigan State University and research assistants in Sumatra (Appendix A). The resulting scales proved useful and efficient for data collection in the field by research assistants. Following recommendations in Gore and Kahler (2015), illustrations were provided to interview participants to clarify what constituted wildlife (e.g., terrestrial vertebrates) and what is not considered wildlife (e.g., domesticated animals, insects, fish) in order to insure construct validity (Appendix B). Lastly, crime cards were developed using vector images and translated Indonesian headers to capture a survey respondent perceptions of crime seriousness in a relative, ordinal ranked manner. Black and white vector images were chosen to reduce any association with specific groups of people and to provide visual consistency across categories of crime. There were 10 general crime cards created that incorporated 'street crimes' (e.g., assault, theft, vandalism) alongside environmental crimes (e.g., illegal logging, pet collection, poaching) (Appendix C) and a set of 12 environmental crime cards (e.g., bushmeat hunting, encroachment, organized poachers) (Appendix D). This method of crime serious ranking was advantageous in reducing survey fatigue and facilitated questions related to the preferred intervention (turn a blind eye to direct and indirect intervention) based on specific crime scenarios.

5.3.2 Focus group procedures

This research adapted some of my previous focus group procedures, such as risk ranking and mapping (Kahler, Roloff & Gore, 2013), drew on methods from criminology (e.g., Lasky, Fisher, & Jacques' (2016) 'think thief'), and created new systematic ways of directing brainstorming and collecting data using techniques and theories from SCP. I had the opportunity to further adapt, develop, and create additional conservation crime science based rapid

assessment procedures as an independent consultant for World Wildlife Funds' (WWF) Wildlife Crime Initiative (WCI). Over the course of two years I facilitated the creation of a Community Based Wildlife Crime Prevention (CBWCP) framework, which draws on concepts from Community and Problem-Oriented Policing, Intelligence-Led Policing, and SCP, creating three manuals for CBWCP implementation at WWF sites globally. One of these manuals, the Manual of Site-Based Exercises, is a detailed step-by-step guide to rapid assessment exercises aimed to fill identified knowledge gaps and brainstorm additional community-based crime prevention strategies. These exercises built off of my work with WWF-Lampung in BBSNP, were revised and added to for workshops in WWF-Cameroon's Jengi South East Forest Program and WWF-Cambodia's Eastern Plains Landscape. The CBWCP framework materials, including the implementation guide, training-of-the-trainers manual and manual of site-based exercises, are currently under internal and external review. The intention, once finalized, is provide these manuals within the global WWF network to rapidly assess wildlife crime scenarios using methods with a foundation in criminology and crime science.

5.4 PRACTICAL IMPLICATIONS

5.4.1 BBSNP

Findings from the three-day focus group with BBSNP conservation stakeholders generated site-specific information relevant for SCP of wildlife poaching within the park and in the surrounding communities. Subgroups presented their findings to the larger groups and detailed discussions often took place and while I failed to capture some of these conservations due to language barriers, I can only hope that there were practical implications due to this knowledge generating and sharing activity within the BBSNP conservation network. The hardcopies of all focus group procedures (e.g., SCP toolkit, maps) were left with WWF-

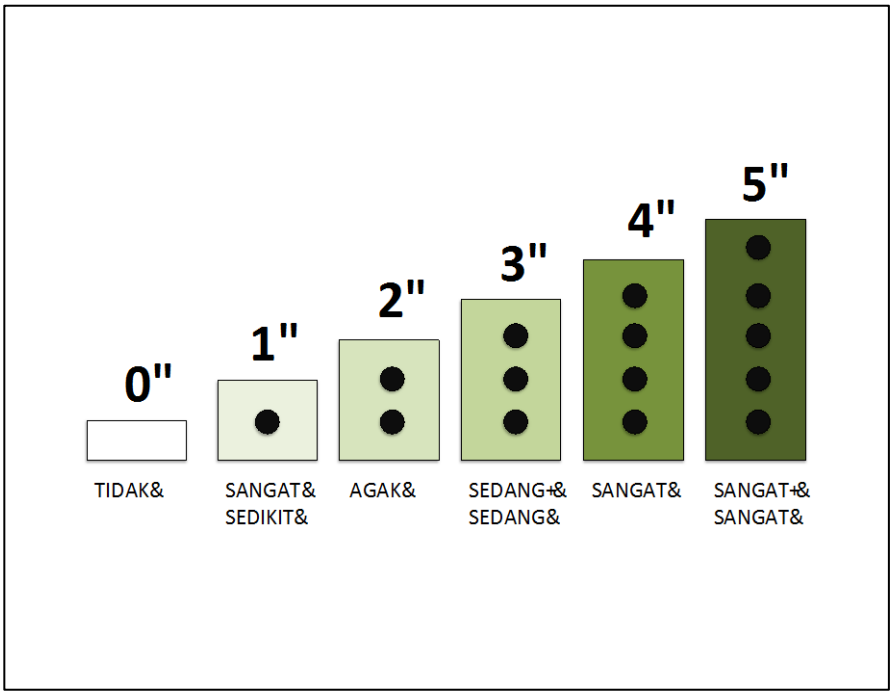
Lampung for use for planning and many participants took photographs of these outputs to return to their organization. A colleague visiting the WWF-Lampung office in January of 2016 reported that the large-format laminated BBSNP map with the SCP toolkit had been used, at least to some capacity, to implement select SCP strategies (B. Long *personal communication*). A *Preliminary Findings Report* was compiled, in English, based on the focus group findings and personally delivered to and discussed with the WWF-Lampung office by the aforementioned colleague who was working for WWF-US at the time. Additionally, the focus group procedure manual was translated into Bahasa Indonesia and provided in hard and digital form to all focus group participants. This facilitates the replication of the provided methodologies to evaluate additional wildlife crime scenarios independent of myself as a foreign researcher. All publications that result from this research will be provided to relevant conservation organizations, as will any spatial databases created once finalized. Lastly, the SCP toolbox that was generated and the maps of these SCP techniques to prevent poaching of the critically endangered Sumatran elephants, rhinoceroses, and tigers are complementary to biodiversity and enforcement data being collected in BBSNP (e.g., Spatial Monitoring and Reporting Tool [SMART]). Ultimately the principles learned, outcomes from this preliminary research, and assessment tools generated (e.g., IPOACHED, SCP toolkit development) provides a foundation to help facilitate future participatory and theoretically grounded adaptations of the wildlife crime-problem solving process. Further, the process can be replicated with diverse stakeholder groups including communities, conservation organizations, enforcement agencies, and policy-makers to identify synergies in approaches that prevent wildlife crime as well as interventions tailored to each groups unique role and relationship to wildlife crimes from poaching to purchase of illegal wildlife and wildlife products.

6.4.2 Beyond Sumatra

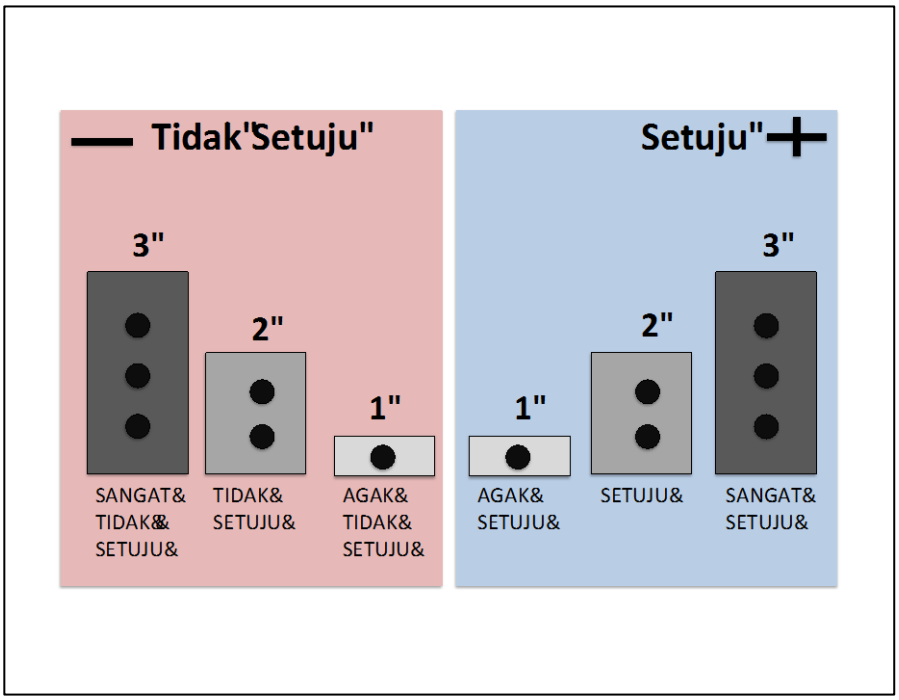
The theoretical findings and methods developed are applicable beyond the context of BBSNP, Sumatra, Indonesia. Studying guardianship shifts focus of the crime event from understanding criminals to the crime preventative potential of local residents (Reynald, 2010) and addresses an important knowledge gap associated with involving communities in wildlife crime prevention. Advancing wildlife guardianship theory will facilitate better design and implementation of communication, education, incentives, and interventions aimed at reducing wildlife crime and engaging local communities in conservation and wildlife crime prevention efforts. Furthermore, the IPOACHED poaching-stage model has practical applications that include but are not limited to: initiating wildlife crime prevention recommendations across a given management unit, detection of poached items that do not enter markets or are traded on local, hard to monitor markets, and is a model that can accommodate data from official records alongside knowledge and opinions from local communities, on-the-ground conservation practitioners and informants. Lastly, additional strategies, techniques and approaches developed and elaborated in one conservation context can be considered and evaluated for use in additional contexts. For example, the theories and methods used for this research were adapted, expanded upon, and revised to create the CBWCP framework, which once finalized can increase interdisciplinary responses to wildlife crime.

APPENDICES

APPENDIX A: Visual scales used in Indonesia
(a) Magnitude-based visual scale



(b) Agreement-based scale



APPENDIX B: Visual aid defining the concept of wildlife in Bahasa (Indonesian)

!

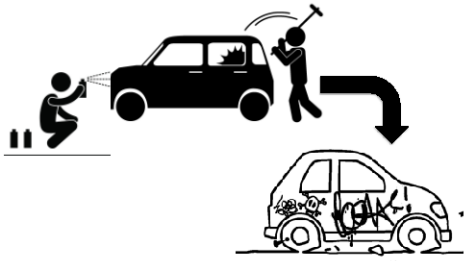
Ke$ka!kami!menanyakan!Satwa!liar,!maksdunya!adalah!binatang7binatang!yang!ditemukan!di!area!sekitar!Anda,!termasuk!burung!dan!rep$I!seper$!kadal!dan!ular!yang!ditemukan!di!sekitaran!Anda.!Kami!$dak!mengkategorikan!ikan!sebagai!satwa!liar.!Satwa!liar!dapat!termasuk!dari!binatang7binatang!berikut!dan!binatang!!yang!mirip!dengan!binatang7binatang!ini.!!

!!

Satwa!liar!$dak!termasuk!binatang!peliharaan,!seper$!yang!dikembangbiakkan!atau!yang!dipelihara!manusia,!seper$!hewan!ternak.!Satwa!liar!bukanlah!termasuk!hewan7hewan!yang!dijinakkan/dipelihara!seper$!Anjing!dan!Kucing.!Satwa!liar!di!sini!bukan!termasuk!ikan!atau!insek$sida!seper$!nyamuk,!!laba7laba!atau!kupu7kupu.!!

APPENDIX C: General crime scenario cards in Bahasa used for crime seriousness ranking

Aksi vandalism/ merusak mobil

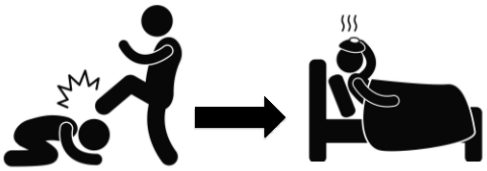


a.

Berburu dan membunuh satwa yang dilindungi secara legal

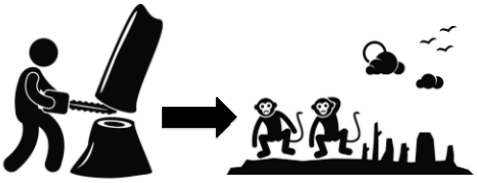
b.

Berkelahi yang menyebabkan luka serius pada seseorang



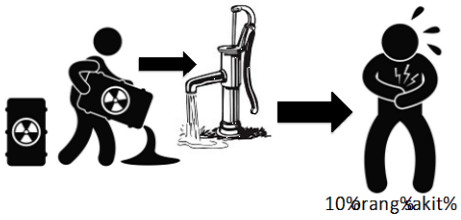
c.

Ilegal loging



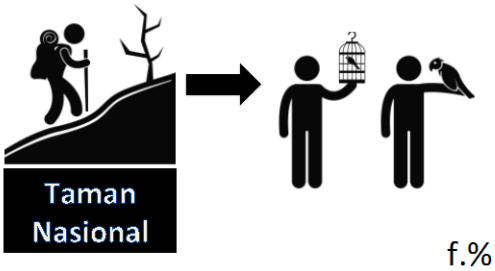
d.

Membuang bahan@bahan kimia dapat menyebabkan 10 orang sakit



e.

Menangkap burung yang dilindungi dan dijadikan burung peliharaan



f.

APPENDIX C: (cont'd)

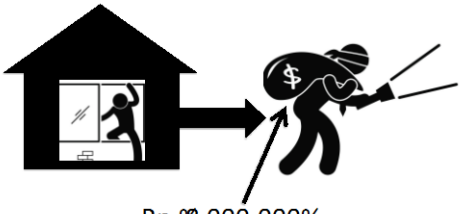
Mencopet uang Rp. 250,000

g.

Menjual obat terlarang

h.

Merusak rumah, kemudian mencuri uang Rp. 8,000,000

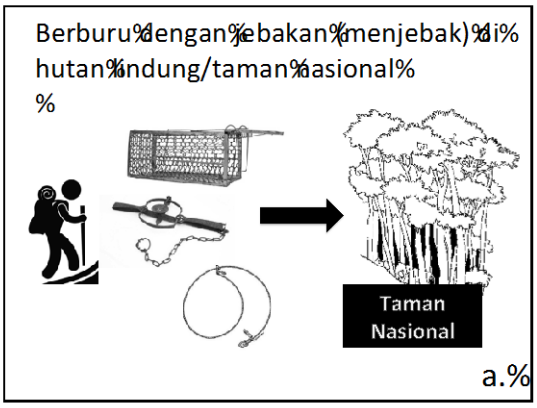


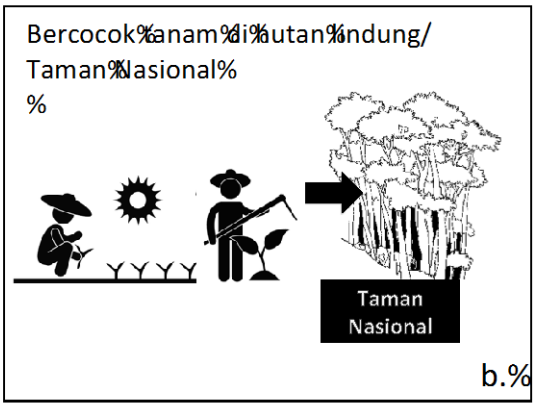
i.

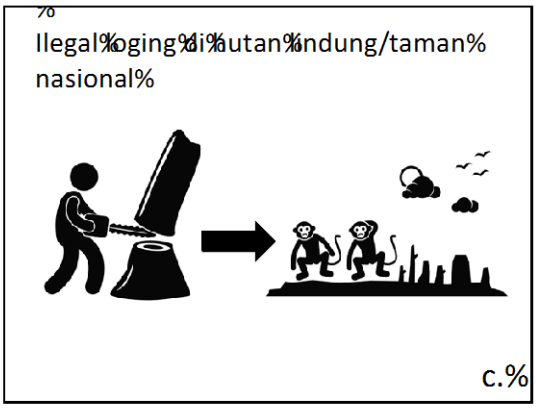
Pejabat korup yang menerima uang suap dari bisnis

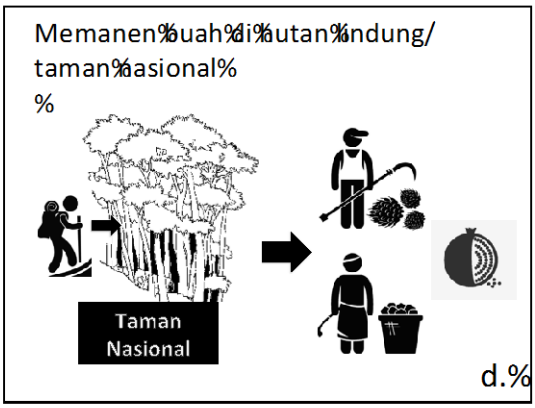
j.

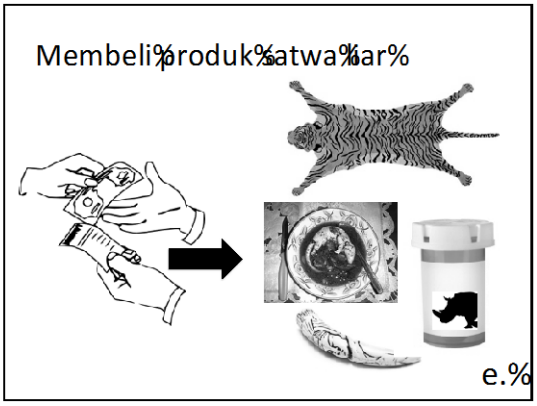
APPENDIX D: Environmental crime scenario cards in Bahasa used for environmental crime seriousness ranking

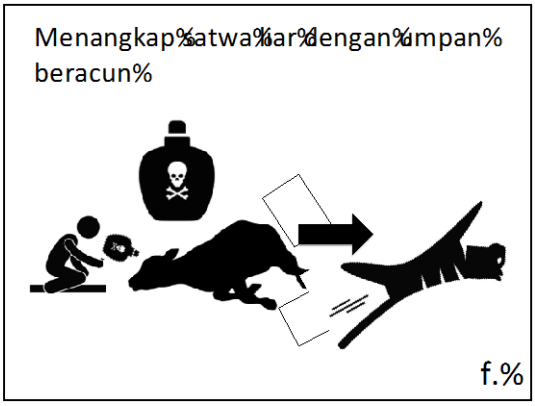




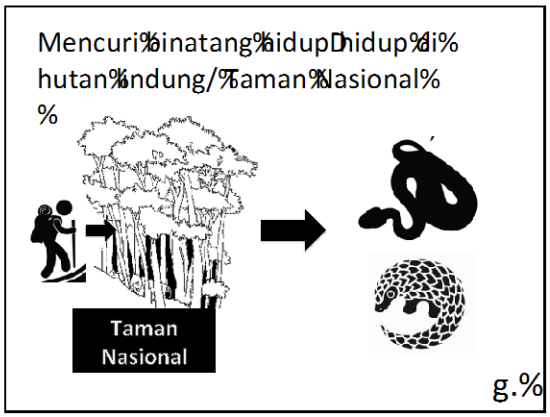


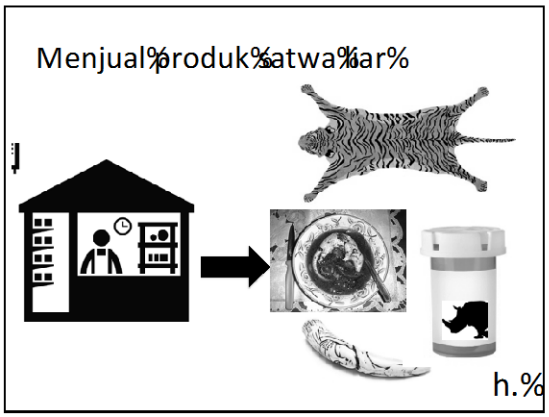


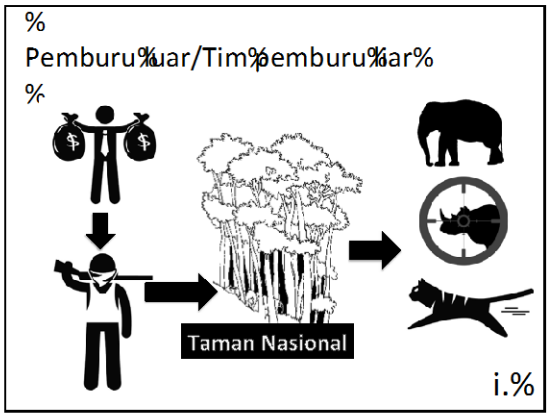


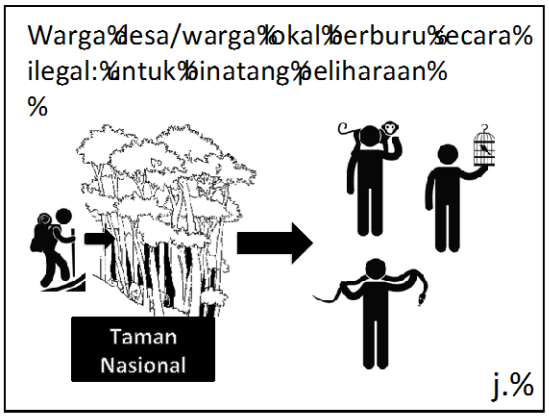


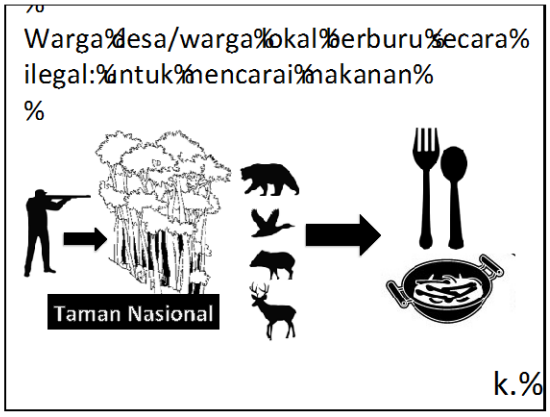
APPENDIX D: (cont'd)

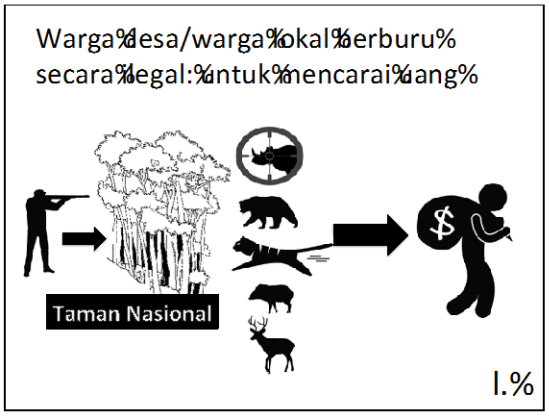












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