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Understanding Community Perceptions of the St. Kitts' "Monkey Problem" by Adapting Harm Reduction Concepts and Methods

Christa A. Gallagher[1], Luis Pablo Hervé-Claude[2], Luis Cruz-Martinez[1] and Craig Stephen[3]*

[1] Center for Conservation Medicine and Ecosystem Health, Ross University School of Veterinary Medicine, Basseterre, Saint Kitts and Nevis, [2] One Health Center for Zoonoses and Tropical Veterinary Medicine, Ross University School of Veterinary Medicine, Basseterre, Saint Kitts and Nevis, [3] School of Population and Public Health, University of British Columbia, Vancouver, BC, Canada

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***Correspondence:**
Christa A. Gallagher
cgallagher@rossvet.edu.kn

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Wicked problems in One Health are associated with dynamicity and uncertainty that require experts, authorities and community members to reach for innovative means of collective inquiry, and collaborative interventions to address the deep social issues at the root of interspecies problems. In this study we explore the value of harm reduction concepts to understand a hundreds of year old issue, the St. Kitts' "monkey problem," which involves the invasive African green monkey (*Chlorocebus sabaeus*) as the cause of deleterious effects on agriculture, but concurrent positive effects on tourism and biomedical research. The harm reduction approach, a systems and settings-based approach with decades of success in public health, can serve as a framework to produce action on persistent societal problems. Harm reduction concepts and methods and participatory epidemiology were used to uncover local perceptions about human-monkey interactions and "meet people where they are" by asking the research question: Are there commonalities in perceptions and values linked to the St. Kitts' "monkey problem" that are shared across diverse representatives of society that can act as a common starting place to launch collaborative responses to this invasive species? Through a series of focus group activities and interviews we found that the Kittitian "monkey problem" is a contentious and dichotomous problem pervasive in most of society that has no single stakeholders nor one solution. Harm reduction helped to map the island's human-monkey system and elucidated an entry point toward tackling this problem through the identification of shared values, and also provided a model for incremental gains that may be achieved. Likening the St. Kitts "monkey problem" to a wicked problem enabled stakeholders to seek more options to manage the problem rather than to conclusively solve it. Frequently mentioned shared values including the protection of farmer crops and backyard harvests likely represent strong entry points to this problem and a jumping-off point to begin collective action toward future improvements.

Keywords: harm reduction, One Health, participatory epidemiology, African green monkey, invasive species, pest control, wicked problem, non-human primate management

INTRODUCTION

Biological invasions and their negative consequences represent One Health problems that burden societies and nature alike and require innovative and collaborative means to address (Conn, 2014; Bojko et al., 2021). This paper applies harm reduction concepts to develop a community-based understanding of the complex of problems centered around the control of the invasive population of African green monkeys (*Chlorocebus sabaeus*; AGM), that has long inhabited the island of St. Kitts in the Caribbean. The "monkey problem" is a widely used local term given to the negative interactions between people and monkeys. It encompasses the spectrum of health, social, and ecological harms caused by the monkeys' encroachment into societal structure and their notorious destructive behaviors (Gallagher, 2020). There have been limited and irregular efforts by the local government to deal with the "monkey problem" as they grapple with deeply embedded conflicting ideas, values, social inequities and scientific uncertainties. There has yet to be consensus among government, researchers, farmers, or other citizens on how to minimize the negative impacts of the monkeys that would be practical, affordable, and socially accepted (Dore, 2018; Gallagher, 2020). Processes to empower people to work together toward mutually beneficial results have been lacking.

St. Kitts is a small island (176 km2) within the twin-island Federation of St. Kitts and Nevis. African green monkeys were transported to St. Kitts and Nevis from West Africa during of the colonial slave trade in the 1600s, and have been part of the islands' landscape ever since (Sade and Hildrech, 1965; McGuire, 1974; Denham, 1987). Lacking natural predators and being generally free of high-consequence diseases (Abbott et al., 2003; Ervin and Palmour, 2003) these highly adaptive animals flourished, resulting in an estimated 40,000 monkeys in 2020 (Dore et al., unpublished), a number equaling St. Kitts' human population. From their arrival until modern day, these monkeys have been viewed as pests and agricultural crop raiders. When the sugar industry prospered large sugar cane plantations, protected by rangers, occupied much of the arable land and kept the monkeys primarily confined within the island's interior (Dore et al., 2018). As their population grew and range expanded, their impacts intensified and spread to urban areas. In 2005 St. Kitts ceased sugar production in favor of tourism as the primary economic driver. Closure of the sugar cane industry changed the agricultural landscape as well as the monkeys' territory. Today, hundreds of small-scale farmers grow crops and raise livestock and poultry where sugar plantations once existed. No longer restricted by rangers, the monkeys have encroached on human-inhabited areas on the island, resulting in increasing human–monkey conflicts.

Crop raiding and the subsequent losses sustained by the islands' farmers is the most prominently documented problem. About 50–75% of St. Kitts' farms face damage from monkeys, and impoverished farmers face economic losses and threats to their livelihood (Dore, 2018). The farmers feel marginalized as they have been mostly left to their own resources to deal with this unrelenting threat. This agricultural loss adds to the islands' food insecurity, and monkey contact with agricultural products risks the transmission of zoonotic disease (Gallagher et al., 2019; Rajeev et al., 2020). Agriculture is a valued and historic industry despite contributing less than 2% of the Federation's GDP each year over the last decade (Statista, 2022). Local farmers defend their right to farm and preserve their farming way of life. Facing climate change the government has identified agriculture as a priority sector for growth, innovation and development to foster economic performance and promote private sector development (Food and Agriculture Organization [FAO], 2011). The relatively uncontrolled monkey population is a perceived impediment to this plan and the agricultural component of the "monkey problem" is the primary focus of attention by the public and government.

African green monkeys also contribute positively to the Federation's culture and economy. First, the local tourism industry capitalizes on the use of AGM to entertain guests. The relatively new tourism industry welcomes over a million international tourists annually (2019 figure, pre-COVID-19) (Department of Statistics, Ministry of Sustainable Development, n.d.). Travel and tourism contribute over 60% of the Federation's GDP (United States Department of State, 2021). Local entrepreneurs known as "monkey men" (officially "primate petting vendors" by the Ministry of Tourism) charge tourists money for holding, feeding and photos with juvenile monkeys. This popular tourist activity takes place all over the island, but happens most frequently at the cruise ship port in the capital city of Basseterre, beaches and other tourist attractions. The African green monkey is a cultural icon and it's image is widely represented on local maps, art, products and government tourism websites for marketing and branding purposes (Muehlenbein et al., 2021). Second, there exist two accredited non-human primate biomedical facilities on St. Kitts for preclinical integrated research and development. Both maintain laboratories and AGM breeding colonies. One of the two facilities exports AGM to foreign biomedical laboratories for research purposes, under the control of the St. Kitts' Ministry of Agriculture (Ervin and Palmour, 2003; Cruz et al., 2021). Monkey trappers capture monkeys in nature for use in biomedical research and also supply "monkey men" with monkeys for use in tourism. Third, monkeys are consumed by some St. Kitts' community members as food which they consider a valued and inexpensive source of meat. Generally this takes place in the home, however, the St. Kitts' Ministry of Agriculture features monkey meat publicly to encourage consumption of local produce and products. Most recently in 2021, the St. Kitts Department of Agriculture was permitted to sell monkey meat for the sole purpose of dog food as an effort to combat the problem of monkeys as an agricultural pest (SKN News, 2021).

After almost 400 years of existence on these Caribbean islands, AGM ecological impact has not been well described. Anecdotally, many scientists and community members believe that the monkeys have had positive and negative impacts on the Federation's ecosystems and have mixed feelings toward the monkeys as a result. In 2017 an Environmental Awareness Group (EAG) conducted a rapid ecological survey of three of St. Kitts and Nevis' protected areas. According to the survey, monkeys were the most widespread and frequently detected invasive

mammal and were recorded in 57% of the timed searches. One expert on the team inferred the AGM had far-reaching ecological impact and placed enormous pressure on native flora and fauna as they consume large quantities of plants and small animals. Also noted was a positive correlation of abundance of monkeys and black rats, who opportunistically consume fruit on the forest floor dropped by monkeys. The team surmised that the monkeys are responsible for high levels of damage to plants and the absence of bromeliads, orchids and other fleshy plant species (Dore, 2019). An ongoing invasive species project by United Nations Environment Programme (UNEP) (2018–2022) is researching the AGM effect on biodiversity. Preliminary reports have demonstrated that monkeys consume a wide range of native fauna. Results are pending for a dietary study (to determine the proportion of native and invasive plants in the AGM diet) and an invasive plant seed dispersal study (to examine the effect of germination rates of invasive plants after AGM digestion of seeds) (personal communication, Kerry Dore, April 27, 2022). Other than these noted efforts, the ecological effects of the monkey population remains scientifically undocumented and the monkeys' holistic ecological niche is still undiscovered, which leaves community members to speculate about their impact.

Harm reduction is a pragmatic approach used in public health to reduce the effects of a persistent harm(s) without necessarily eliminating the offending harm. It's focus on collaborative approaches to interacting determinants of health makes it well-suited to developing a converged understanding and collaborative management of complex One Health problems (Gallagher et al., 2021). Its conceptual foundation is in public health, where it is mostly focuses on harms resulting from high-risk behaviors including drug, alcohol and tobacco addictions, sex work and homelessness in marginalized or underserved populations (Marlatt et al., 2011; Hawk et al., 2015; Jalloh et al., 2017). Prominently recognized since the 1970s and 1980s, its concepts and programs have a global reach and are endorsed and practiced by the World Health Organization, United Nations General Assembly and many other nations (World Health Organization [WHO], n.d.). Harm reduction supports grassroots participatory efforts to engage with public and private experts and authorities to participate in working toward a solution to a problem (Inciardi and Harrison, 2000). It meets people "where they are" with an existing problem and takes incremental steps to minimize harms (British Columbia Ministry of Health, 2005). Harm reduction processes allow flexibility as people and problems fluctuate. It recognizes that behaviors, their associated harms, and proposed solutions are highly dependent on belief systems and culture within a setting, so harm reduction is highly contextual and must be culturally sensitive.

Harm reduction may provide a process for progress on this complex and contentious problem. This approach was taken as the Federation's current management policy and program questions have been focused on reducing the harms associated with the monkeys. The local monkey situation has created substantial concerns for residents and has long been perceived as a dire community problem. This did not, however, limit researchers from exploring the benefits and value that the islands' monkeys represent. The primary objective of this paper was to "meet people where they are" to understand the context of the "monkey problem" that may help elucidate options compatible with the island's belief systems. For this study we were guided by a primary research question: Are there commonalities in perceptions and values linked to the St. Kitts' "monkey problem" that are shared across diverse representatives of society that can act as a common starting place to launch collaborative responses to this invasive species?

MATERIALS AND METHODS

Methods adapted from participatory epidemiology (PE) were used to "meet people where they are" and gain an understanding of the community perspective of the "monkey problem" from involved stakeholders. PE is a form of qualitative research and has been most frequently been used in improving and prioritizing animal disease control (Catley et al., 2012), however it has been used in other veterinary applications such as understanding the socioeconomic impact of animal disease and veterinary public health (Catley et al., 2012; Allepuz et al., 2017). This paper applies PE to invasive species control and management and combines this methodology within an overarching harm reduction framework. Both methods are complimentary in that both are highly dependent on active public and private participation to work on a persistent societal problem. We used the method detailed below to learn who is involved in the "monkey problem" and how, when and where there may be resultant harms. From there we aimed to explore potential options for action that could be acceptable across stakeholders and thus serve as an entry point for collaborative response to the monkey problem.

The study team consisted of a public health veterinarian, two veterinary epidemiologists and a conservation medicine veterinarian. The primary researcher has prior involvement with the St. Kitts' 'Monkey Task Force,' a public-private coalition of local government, academia and biomedical researchers who meet regularly to mitigate the Federation's monkey issues. This provided a basis for understanding the context of the problem and allowed for contextually relevant purposive sampling of stakeholders.

Perspectives from individuals with practical and personal experience with various aspects of involvement in human-monkey interactions in St. Kitts were sought. Purposive sampling followed by snow-ball sampling was used to recruit a diverse compilation of study participants (collectively called stakeholder groups) to take part in semi-structured focus group discussions or interviews (Sharma, 2017). Participant recruitment was completed after no new groups or names were suggested to the primary researcher. Participant focus groups were homogeneous groups primarily based on occupation, to increase comfort and ease of conversation, and to gain information based on a occupational perspectives. Participant demographic data were gathered. Information relayed by participants reflected both personal views, group views and even portrayed views from others in the community they were aware of. Therefore, data includes all 'mentions' and is not necessarily reflective of an

individual or group views and opinions. Collected demographic data were analyzed descriptively.

Data were collected using PE techniques described by Mariner and Paskin (2000), Catley (2005), Catley et al. (2012) and included: Informal interviewing (focus group discussions and key informant interviews); ranking and visualization techniques (proportional piling and mapping). Visualization techniques were only performed among the focus groups (not the key informants) as they are optimal in a group setting (Dunkle and Mariner, 2013). Descriptive analysis was performed on all data. A word cloud was produced of monkey descriptors the primary researcher extracted from the transcripts of the informal interviews and converted into a text portrait (using Adobe Illustrator and Adobe Photoshop). A table was generated to depict key results from the interviews and all other participatory activities that demonstrated the alignment of the "monkey problem" to principles of harm reduction that were derived from the literature (British Columbia Ministry of Health, 2005; Stephen, 2020).

Informal Interviews With Focus Groups and Key Informants (Stakeholder Groups)

Data collection was initiated after an ethically approved consent form (Ross University School of Veterinary Medicine Institutional Review Board #18-07-XP) was signed by study participants. Informal and in-depth semi-structured interviews were carried out between June 2018 to May 2019 by the primary author who asked the questions and facilitated discussions. The interviewer was assisted by two research assistants who scribed the data for visual representation for participants as the sessions progressed. The 60–90 minute face-to-face interviews were audio recorded and took place in settings that were familiar to the various participants. An interview checklist contained a series of pre-determined topics and open-ended questions (ordered from general and less sensitive topics to more specific and sensitive topics) to guide discussions with participants. The interviews centered around the following topics: (1) The monkeys of St. Kitts and the existence of the "monkey problem," (2) People, animals, the environment and respective relationships within the human-monkey system, (3) Harms caused by the monkeys, (4) Shared values at risk due to the monkeys, (5) Existing or prospective options to deal with the "monkey problem," and (6) Unintended consequences of current or proposed options to the "monkey problem." The interviewer maintained flexibility throughout the course of the interviews and deviated questioning to follow relevant leads to expand upon the topics that arose in conversation. Although a harm reduction approach primarily focuses on harms, any positive aspects and benefits brought up by participants about the monkeys were readily received and adequately explored by the interviewer. Research assistants captured the data generated in real time on a large whiteboard that was displayed for the groups to see. To obtain the most comprehensive description of the system all information and perspectives was recorded from each group whether it reflected personal or general knowledge. It was not the aim to reach consensus among participants.

Simple Ranking and Proportional Piling

Following the focus group discussion participants were asked to rank the harms they had listed. The harms mentioned were written on notecards and laid out on a table. Participants then ordered the cards ranking them from greatest to least of importance. Proportional piling was then performed to assign weighting, or graduation of emphasis on the ranked harms. Participants were given one hundred dried beans and asked to assign an agreed number of beans to each harm that illustrated the importance of each harm and priority to address the harm. The exercises were completed once the groups reached consensus.

Mapping

Participants were provided with a large (0.6 × 0.9 m) map of the island placed on a table. They were asked to collectively draw on the map to indicate specific locations where negative human–monkey interactions are known to take place.

Probing and Triangulating

Probing questions were continuously used with each method described above to gather more detailed information to further comprehend the issues, and to verify the internal consistency of the information. Triangulation of multiple data sources and methods was used to cross-check data provided to improve data validity. Triangulation was used within-method when the researcher cross-checked information provided by a participant/s during interviews and participatory exercises. For across-method triangulation, the two most popular local newspapers were searched to gain understanding of how the community has conceptualized the non-human primates of the island in the press. The keywords 'monkey,' 'African green monkey,' 'vervet,' and 'non-human primate' were searched online in the St. Kitts Nevis Observer and the Labor Spokesman. Stories between March 2007- January 2022 that had direct reference to the Kittitian monkeys were included (stories referring to Nevisian monkeys or elsewhere in the world were excluded). The lead researcher (CG) then became familiar with the identified stories meeting the keyword search criteria by reading and re-reading content. CG then generated categories that emerged from the data which denoted the primary type of monkey–human interaction described in the article. The data was descriptively analyzed and the percentage of stories represented in each category was calculated and compared to the community participatory data gleaned from the study.

The interviews and exercises were transcribed word by word and vernacular expressions maintained to preserve data richness. The transcripts from each focus group or interview were reviewed by the primary researcher and the following data was recorded on a data characterization form: participant demographic information; African green monkey descriptors; existence of a "monkey problem"; noted stakeholders and stakeholder relationships; harms caused by the monkeys; benefits of the monkeys; shared values of stakeholders; and

options, responsibility, obstacles, and unintended consequences surrounding local monkey management. Any mention of any of those topics during informal interviews was recorded. Descriptive data analysis included relevant ethnographic text from participants (shown in italics). Criteria for inclusion were text that provided to the audience: (1) substantive contribution/s to increase understanding and perspective, (2) impact to generate new questions, and (3) expression of a socio-cultural lived reality (Richardson, 2000). Candid and detailed accounts in the ethnographic text provide insight into participant's culture, perspective and practices (Reeves et al., 2008).

RESULTS

Participant Demographics

There were 17 key stakeholder groups which consisted of focus groups (n = 12) plus individual interviews (n = 5) (see **Table 1**). Focus group size ranged from three to ten persons and key informant interviews were one to two persons. The study had 76 participants. The participants had balance across sex, age, education, time lived/spent in St. Kitts and diversity of occupations (see **Table 2**). There were participants from all nine parishes on the island, ensuring persons from both urban and agricultural areas were included.

Existence of the "Monkey Problem"

Most of the groups (94%; n = 16/17) agreed that there is a "monkey problem" in St. Kitts. This was determined by the groups direct admission using or agreeing with that terminology, or indirectly by describing various uncontrolled problems that exist between humans and monkeys. The only group that did not substantiate the "monkey problem" was the tourist group, who cited unfamiliarity with the issues (or extent of the issues) the monkeys are causing locally and the associated name for the phenomenon, due to the short period of time they spend in St. Kitts.

The following quote illustrates how some participants described the "monkey problem":

> *Monkeys affect everyone on St Kitts, particularly agriculture. . .even domestic household problems. . .even the traffic. They affect that but crop production is the primary one that is affected. . .the true sensitivity of it. Monkeys have easy access to all the crops. . .so that is a big problem. Most people are afraid of them because they can be reactive sometimes, may bite or attack. . . that is the only concern outside of being a nuisance to people and the farmers* (government veterinarian).

The following quote paints the picture of an invasive species that through hundreds of years has become pervasive and part of the fabric of Kittitian society.

TABLE 1 | List of 17 stakeholder groups.

Focus groups (n = 12)	# of persons
Farmers	10
Trappers	4
Monkey vendors (aka Primate Petting Vendors)	5
Community members	10
Monkey Task Force	8
Veterinary university faculty	6
Veterinary university students	8
Medical university faculty	3
Medical university students	4
Tourists	3
Department of Agriculture	4
Ministry of Tourism	4
Key informants (n = 5)	**# of persons**
Government veterinarian and assistant	2
Biomedical veterinarian	2
Department of Agriculture lead (crops)	1
Department of Agriculture lead (food security)	1
Department of Environment (Environmental Health Officer)	1
Total	**76**

Focus groups (n = 12/17) consisted of greater than three people. Those less than three people (n = 5/17) were called key informant groups.

TABLE 2 | Stakeholder demographics.

Demographics	Levels	#	%
Gender	Male	44	57.9
	Female	32	42.1
Education	Primary/High school	18	23.7
	Technical	0	0.0
	College/University	35	46.1
	Postgraduate	23	30.3
Where did you complete your education	St. Kitts and other Caribbean islands	39	48.1
	N. America, Europe, and other	42	51.9
How long have you lived in SK	Short term tourists	3	3.9
	<2 years	17	22.4
	3–20 years	14	18.4
	21–30 years	5	6.6
	30 + year	37	48.7
Age	18–25 years	14	18.4
	26–35 years	16	21.1
	36–45 years	18	23.7
	46–54 years	12	15.8
	55 + years	16	21.1
Occupation	Professionals	26	34.2
	Student	20	26.3
	Skilled farm, forestry, fishery worker	18	23.7
	Tech/assoc. professionals	5	6.6
	Manager	3	3.9
	Service/sales	3	3.9
	Other	1	1.3

 # Refers to the number of stakeholders represented in each level and corresponding percentages (%) for the total number (n) of 76 stakeholders.

Monkeys have grown to associate man with food because man went in their habitat to produce food. an easy source of food. As man came down the slopes the monkeys came along and with that now more food available and with the easy access to food the population has grown over the years. They don't have a natural predator and just like any other animal once you have a good source of food you will multiply, especially when there is no control over your population. . . now they grow accustomed to being around man. They're accustomed to their noises, they're accustomed to man going back and forth and everything. So, they're just assimilated into the everyday life scene (agriculture expert).

The following quotes describe monkeys as a pest and food source respectively:

We have tamarind, guava, cherries, mango, banana, papaya, and every year we kind of pray that we will get some. And then you come home and all the mangos that you were like lookin at and it was like I'll pick those tomorrow. Then, they're in the yard and some of them are bitten- not eaten, bitten. It's just like they pick them off and throw them down. . .they're spiteful animals. . .terrible pests (community member).

. . . if you look at a lot of the Caribbean islands, every one of us, every one of them, has their own unique catch that they use as meat. If ours happened to be monkey, let us eat it, and if people want to, they could eat the monkey. That's another thing that we have to open up shops and selling monkey just like we sell other meat (animal agriculture expert).

All characteristic terms or phrases that participants used to describe the monkeys on St. Kitts were extracted and recorded on the data sheet. After combining similar words/concepts, 40 descriptors were generated. The context of the word or phrase during the interview process was used by the primary researcher to determine how it was emotionally charged: positive, negative or neutral. Of the 40 words/phrases used by participants to describe the monkeys, 63% (n = 25) were negatively charged, 25% (n = 10) were positive and 12 (n = 5) were neutral. The two most frequently used descriptors were 'Pest' and 'Food source'; each mentioned by 76% of the stakeholder groups (n = 13/17) (see **Figure 1**). The size of the descriptors in **Figure 1** was related to the frequency that they were used across the 17 groups (normalized by dividing the word frequency by the maximum word frequency of the words) while the word color represented the assigned emotional charge.

Human–Monkey System

Participants were asked to list who they believed were stakeholders in the St. Kitts' "monkey problem." Here we report the stakeholders who were mentioned by greater than 50% of the 17 groups (from greatest to least cited). Tourists were the most frequently mentioned at 100% (n = 17/17) and farmers were noted by 88% (n = 15/17). Monkey vendors and community members were mentioned by 82% of the groups (n = 14/17). Local government, monkey trappers and biomedical researchers were mentioned by 71% of stakeholders (n = 12/17).

Participants were then asked to list the stakeholder relationships they recognized in the community. Using the same parameters as above, the tourist/monkey vendor was the most noted relationship at 82% (n = 14/17). The farmer/monkey trapper and farmer/government were the next most frequently mentioned at 53% each (n = 9/17).

Figure 2 is a concept map that displays all the reported information, interactions and relationships that were described by the participants. The four main themes of African Green Monkey (AGM) relationships to people and their shared environments were:

(1) AGM in nature. This is the center of the concept map and displays the monkeys in their most natural habitat. Here they were seen to have thrived and believed to have both positive and negative impacts to the environment. It is from this boundary that AGM are extracted through trapping and used in other sectors or culled, and interact with humans that cross into the natural territories through built infrastructure or other human activities. The AGM also move freely into human-occupied spaces.
(2) AGM causing agricultural damage. Monkeys raid local vegetable and fruit crops causing widespread damage and economic losses for farmers. This was believed to result in food safety and security concerns and farmers leaving the profession.
(3) AGM use in tourism. Monkeys are widely used in the local tourism sector of St. Kitts where tourists are permitted to have photographs taken and physical interaction with the animals through monkey vendors, locally known as 'monkey men'.
(4) AGM use in biomedical research. Monkeys are used in preclinical biomedical research on-island and are exported for use in international biomedical research.

In a broad sense, the entire system including the aforementioned subsets and associated links and cycles depicted in **Figure 2** occur under the auspices of the St. Kitts' government (see top of **Figure 2**), however, participants also mentioned the overarching regional and international factors that influence the system including trade and travel (see right side of **Figure 2**).

Clustered Themes From Stakeholder Responses

Participant responses surrounding harms, benefits, shared values and unintended consequences from the transcripts were analyzed. These dimensions had similar and overlapping responses through which six themes emerged: (1) Sociocultural, (2) Physical, (3) Economic, (4) Psychological, (5) Environmental, and (6) Animal welfare (see **Table 3**). Harms were identified across all six themes. Sociocultural, Economic and Environmental themes each had corresponding harms, benefits, shared values and unintended consequences. The sociocultural category held 46% of the total specific stakeholder mentioned topics (n = 22/48). Shared values were identified in all themes except psychological. Options and obstacle responses were typed using different categories and are shown as individual tables later (**Tables 4**, **5**), respectively. All listed dimensions were examined individually, and results below highlight the more frequent responses between groups. Participant

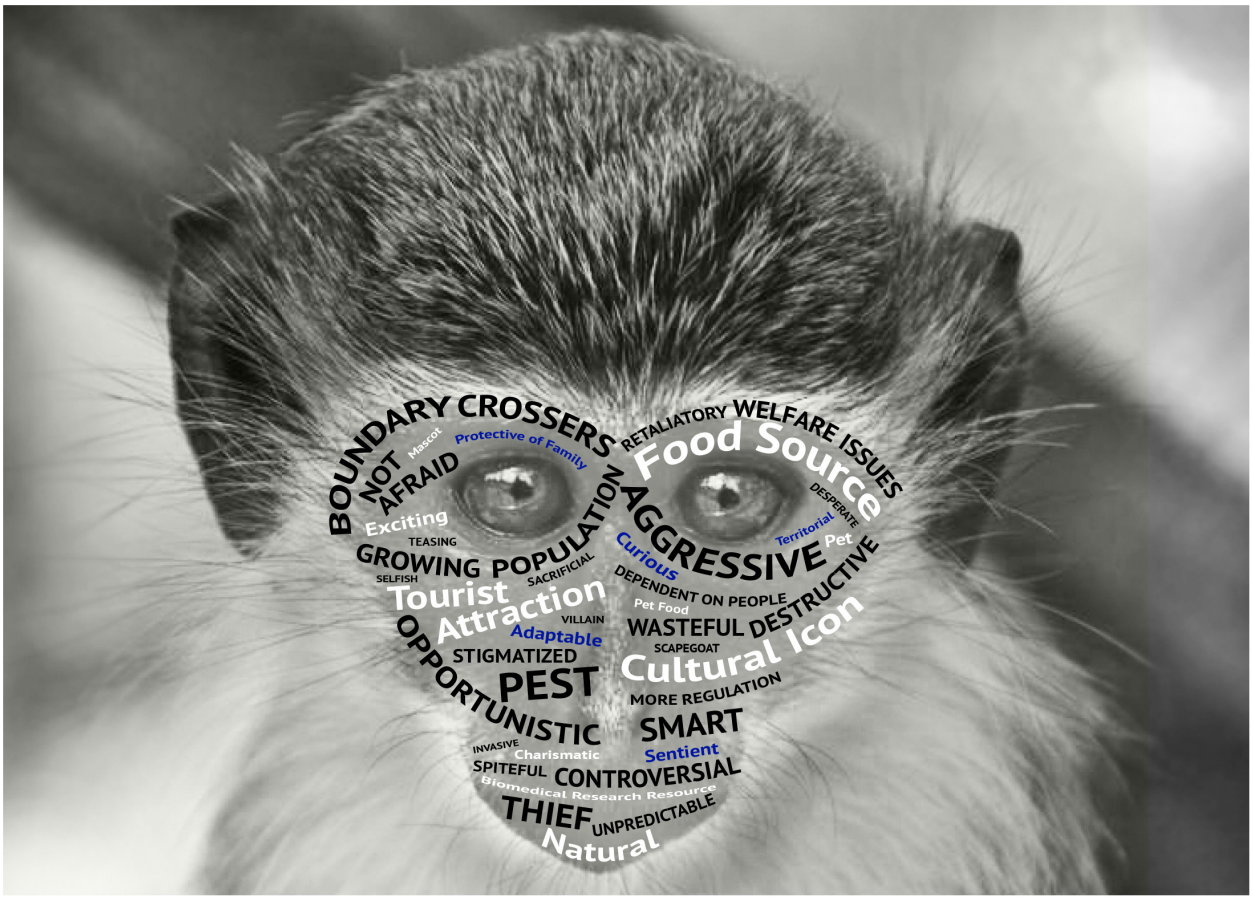

FIGURE 1 | Text portrait of an African green monkey was generated by manually extracting all monkey descriptors from the transcripts of the stakeholder interviews, thematically clustering the descriptors (n = 40) and enumerating them based on frequency of use. A word cloud was generated and converted into a text portrait using Adobe Illustrator and Adobe Photoshop, where the size of each variable represents the relative frequency with which it occurred in the transcripts. Descriptors were assigned valence: positive descriptors are shown in white; negative in black and neutral in blue. Original photo credit: Meghan F. Davis.

quotes are used to illustrate distinctive perceptions among the representative groups.

Harms

There were a spectrum of real and perceived harms that were mentioned across all groups. The most frequently mentioned harms (by at least 50% of the groups from greatest to least) were: agriculture crop damage (94%; n = 16/17), physical injury to residents and tourists (76%; n = 13/17), infectious disease concerns (59%; n = 10/17), personal fruit/garden raiding (53%; n = 9/17) and physical/psychological damage to monkeys from use in tourism or pets (53%; n = 9/17).

Perceptions of agricultural harms are illustrated by the following quotes:

> *Basically, it diminishes your ability to be an effective farmer. You cannot maintain a market. Because you are not even sure if your crops are going to reach the point of maturity and if they do reach the point of maturity if you will be able to harvest because it's a constant battle. . .so we see farming dying. . . it left us empty. How can you take care of yourself and family if you don't have money to spend? You can't. . .you cannot have young persons coming in into farming when they watch you just losing all your crops to the monkeys* (farmer).

> *We are net importers of food. . .so if we ever think that we're going to substitute what we import with what we produce, the monkey is a limiting factor. . . so we have to control that population. It's like we might as well tell the tourists, "When you come bring your own food." I say this because the tourists come in and bring in revenue, but then you send that revenue straight back out by importing food* (agriculture expert).

A medical faculty member shared concerns regarding infectious disease:

> *When people are eating and coming in contact with monkeys in tourism obviously there is a concern of all kinds of zoonotic diseases that might be moving in and out. . . and since we are also coming in contact with the locals. . . obviously that becomes a concern.*

Ranking and Proportional Piling Results

Of the 12 groups, 10 participated in the exercise to rank and weigh harms; two groups opted not to participate (see **Table 6**). All 10 ranked crop damage for farmers as the primary harm

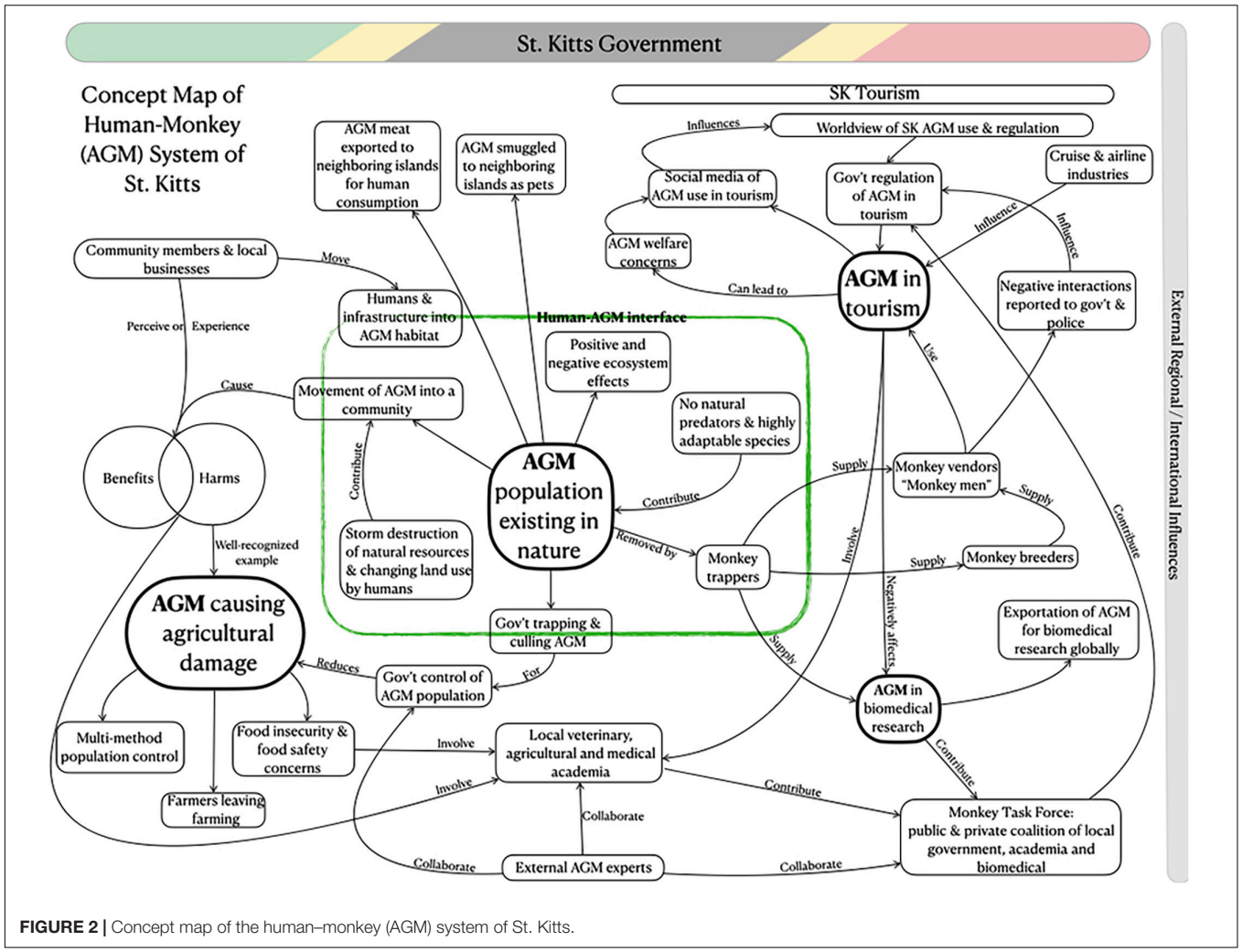

FIGURE 2 | Concept map of the human–monkey (AGM) system of St. Kitts.

and overall it encapsulated 73% (729/1000) of the ranked harms as represented by proportional piling. It was almost 10 times the weight of the next highest ranked harm of public safety (8%; 82/1000), which included personal injury and vehicular accidents involving residents and tourists. Infectious disease concerns and ecosystem damage each had about 5% (53 and 47/1000 respectively), while the remainder of the harms were about 2% (ranging from 9 to 22/1000); important enough to be listed as a concern by some groups, but not considered to be as relevant by most groups.

Human–Monkey Mapping Results

When asked about the locations for negative interspecies interactions, 82% (n = 14/17) groups agreed that the "monkey problem" was multi-locational on the island and it was an island-wide problem. None of the groups identified specific locations on the map, but instead highlighted areas where problems existed that correlated with land use. Multiple areas where problems currently exist include: agricultural (59%; n = 10/17), residential (47%; n = 8/17), urban (35%; n = 6/17), forest (35%; n = 6/17) and beach (24%; n = 4/17) (see **Figure 3**). Five of the 17 groups (29%) circled the entire island on the map after pointing out areas mentioned above to the primary researcher.

One monkey trapper said:

> *Why they [monkeys] difficult to deal with? Because they ain't got no specific area. They could sleep anywhere at any time. . . basically all about of St. Kitts. Because they've [farmers] got crops, monkeys come from mountains and eat crops below. Monkeys will feed from this village to that village and their group will get bigger and bigger, so they spread. . .they spread across to where the food is. . . and even to fruits in your yard.*

A farmer explained the island-wide range of monkeys in this way:

> *Monkeys are a problem if you have farms. So, the monkey population. . . you just take a black paint and you paint the whole thing [the map].*

A Department of Agriculture representative also concluded the widespread presence of the monkeys and subsequent issues:

> *So monkeys really go all over the island. . . the entire island from mountain to sea. A few years ago we might've had some areas where*

TABLE 3 | Thematic clustering of stakeholder perceived harms, benefits, shared values and unintended consequences of the St. Kitts' "monkey problem."

Theme	Dimension	Specific topics mentioned by stakeholders	# (%)
Sociocultural	Harms	Infectious disease concerns	10 (59%)
		Farmers leaving the profession	4 (24%)
		Social conflict between stakeholders	3 (18%)
		Biomedical research issues with domesticated monkeys	1 (6%)
	Benefits	Biomedical research	9 (53%)
		Human food source	8 (47%)
		Education	2 (12%)
		Pet food	1 (6%)
	Shared values	Sustainable agriculture	5 (29%)
		Personal safety during monkey interactions	4 (24%)
		Social cohesion between stakeholders	2 (12%)
		Positive worldview of St. Kitts	2 (12%)
		Recognition of the farming life	1 (6%)
		Preservation of 'wild' monkeys	1 (6%)
	Unintended consequences	Fear of extirpation	8 (47%)
		Conflict with animal rights groups	7 (41%)
		Negative worldview of St. Kitts and decreased tourism	6 (35%)
		Social conflict between stakeholders	4 (24%)
		Cultural loss with less monkeys	3 (18%)
		Potential for increased crime/guns	3 (18%)
		Underground market of monkey meat	2 (12%)
		Negative effect on biomedical research with non-naïve monkeys	1 (6%)
Physical (personal/ property)	Harms	Physical injury to residents/tourists	13 (76%)
		Personal fruit/garden raiding	9 (53%)
		Physical injury to companion animals	8 (47%)
		Vehicular accidents involving monkeys	3 (18%)
	Shared values	Personal food autonomy	8 (47%)
		Safety for residents/tourists	2 (12%)
		Safety for companion animals	1 (6%)
Economic	Harms	Crop damage for farmers	16 (94%)
		Damage to tourism industry with negative social media of monkey use	2 (12%)
	Benefits	Tourism revenue	15 (88%)
	Shared values	Food security for residents	15 (88%)
	Unintended consequences	Less income from monkey related activities	3 (18%)
		Decreased trade due to increased food security	1 (6%)
Psychological	Harms	Fear of monkeys	3 (18%)
	Benefits	Biophilia	4 (24%)
		Positive human emotions elicited from pet monkeys	2 (12%)
Environmental	Harms	Ecosystem damage	6 (35%)
	Benefits	Positive ecosystem role	6 (35%)
	Shared values	Healthy sustainable ecosystem	1 (6%)
	Unintended consequences	Negative biodiversity effects	9 (53%)
		Solutions causing ecosystem damage	4 (24%)
		Monkey displacement	4 (24%)
		Alterations in monkey behavior	3 (18%)
Animal welfare	Harms	Physical/psychological damage to monkeys from use in tourism or pets	9 (53%)
		Unnatural control of monkey population	2 (12%)
	Shared values	Safe and well monkey population	2 (12%)

#, In the table refers to the number of stakeholder groups (n = 17) and their corresponding percentages.

> *there were no monkeys. You might've seen one monkey now and then, you know. It's, it's not like that now. It's basically all over the island. . . nowadays humans and monkeys live together, and there are many problems.*

Benefits

Stakeholders were asked to contribute responses to the real and perceived benefits of the African green monkeys of St. Kitts. Overall there were less benefits cited than harms. As an economic benefit, tourism revenue was mentioned by most groups (88%; n = 15/17). AGM use within biomedical research was cited by 53% (n = 9/17). Their use as a local food source was mentioned by 47% (n = 8/17) of groups.

An individual from the Ministry of Tourism highlighted the positive contribution of monkeys to tourism:

> *Among the tourists, different persons come and they are fascinated. They are small and cute.*
>
> *They want to touch them, to hold them. . . we see it as unique attraction for the destination. The green monkeys are iconic when it comes to St. Kitts, they're like a mascot. People identify the monkey with St. Kitts and St. Kitts with the monkey. It gives us an opportunity to build our story about the island. They are part of biodiversity and part of who we have become. . .they have evolved just like us you know. It's part of our culture, history. . . everything. There is a place for them.*

A second positive contribution was verbalized by a biomedical veterinarian:

> *The African green is free of so many diseases, they are a really good resource in research. . .it's a unique opportunity we have here in*

TABLE 4 | Categorization of stakeholder perceived options of the St. Kitts' "monkey problem."

Option category	Specific options mentioned by stakeholders	# (%)
Interventions directed at monkeys	Cull	10 (59%)
	Relocate to reserve for ecotourism	10 (59%)
	Deterrence	10 (59%)
	Harvest for human and/or pet food	8 (47%)
	Confinement using feeding stations	5 (29%)
	Sterilization	4 (24%)
Modifying human activity	Alter farming strategies	6 (35%)
	Younger people and innovation to farming	1 (6%)
Modifying human behavior	Increase awareness and education regarding monkeys	6 (35%)
	Alter human–monkey interactions	3 (18%)
Governance	Increased regulation of monkey use	7 (41%)
	Increased education regarding monkeys	7 (41%)
	Increased funding toward monkey issues	6 (35%)
	Creation of jobs to divert from the tourism use of monkey	2 (12%)
Environmental intervention	Restore natural food and reforestation	5 (29%)
Research	Different research projects and initiatives	5 (29%)

#, In the table refers to the number of stakeholder groups (n = 17) and their corresponding percentages.

TABLE 5 | Categorization of stakeholder perceived obstacles of the St. Kitts' "monkey problem."

Obstacle category	Specific obstacles mentioned by stakeholders	# (%)
Related to government	Lack of recognition of the "monkey problem"	6 (35%)
	Primary focus on tourism	4 (24%)
	Government bureaucracy/stagnation	4 (24%)
	Lack of political will	4 (24%)
	Lack of legislation/enforcement	3 (18%)
	Politicization of the "monkey problem"	3 (18%)
	Government is not proactive	2 (12%)
	Lack of support for trappers	1 (6%)
	Government competing with farmers	1 (6%)
	Government misappropriation of funds	1 (6%)
	Misperception of farmers and farming	1 (6%)
Related to community members	Disconnect between wild animal interaction and animal welfare	2 (12%)
	Cultural awareness	2 (12%)
	Negative perception about reducing monkey population	2 (12%)
	Lack of shared values	1 (6%)
	Lack of trappers	1 (6%)
Common to government and community members	Lack of funding	10 (59%)
	Knowledge gaps and sharing of information	9 (53%)
	Lack of attention to the "monkey problem"	5 (29%)
	Lack of related research	3 (18%)
	Lack of expertise	3 (18%)
	Lack of liability for monkeys/"monkey problem"	1 (6%)
Related to the problem	Variability of stakeholders and options	3 (18%)
	Negative triggering event has not happened to initiate response	3 (18%)
	Other wildlife interfering with solutions (wild pigs)	2 (12%)
	Expense of solutions	1 (6%)
	Public health issues with slaughter/consumption of monkeys	1 (6%)
Related to external influence	Negative worldview of reducing monkey population	4 (24%)
	Social media	1 (6%)

#, In the table refers to the number of stakeholder groups (n = 17) and their corresponding percentages.

the Caribbean to take advantage of. And it definitely contributes so much to science. They have tremendous scientific value.

Shared Values

Obtaining shared value responses was the most challenging line of questioning to the focus groups and individual interviews. Shared values were described as what participants cared about and feared they could lose due to the monkeys, if the "monkey problem" remained largely uncontrolled. The most frequent shared values, all centered around agriculture, were food security for residents at 88% (n = 15/17) followed by personal horticulture for residents at 47% (n = 8/17). Community members were concerned with large-scale agricultural damage to crops by the monkeys leading to national food insecurity, but also losing the capability to produce fruits and vegetables in their own backyards.

The following quotes illustrate food insecurity concerns:

I worry that in a few years we won't have any crops. . .the persons tryin' to do backyard farming and the real farmers (community member).

How about the ability to feed ourselves? We don't have that because of the monkeys (Monkey Task Force).

Unintended Consequences

To consider adverse effects that could occur as a result of attempts to control the island's "monkey problem" participants were asked to voice their ideas surrounding unintended consequences. The most frequent responses centered around problems that could occur with a marked decrease in the number of island monkeys should they be culled. Fifty-three percent of groups (n = 9/17) expressed concern about negative biodiversity effects that could result from less monkeys while 47% of groups (n = 8/17) feared an extirpation of St. Kitts' monkeys.

The following two quotes demonstrate the importance of the monkeys as a national symbol and some fears regarding their elimination:

TABLE 6 | Stakeholder ranking and proportional piling of harms within the "monkey problem."

Ranking and proportional piling of harms	Farmers	Monkey trappers	Monkey vendors	Community members	Monkey Task Force	Veterinary university faculty	Veterinary university students	Medical university faculty	Medical university students	Dept. of Agriculture	Row total
Crop damage for farmers	83	100	89	94	36	76	57	55	66	73	729
Public safety*			6	1	22	4	31	14		4	82
Infectious disease concerns						4	7	21	17	4	53
Ecosystem damage	7				23	4			13		47
Property damage**				5		4				13	22
Animal welfare issues			5			4	5				14
Physical injury to companion animals						4		10			14
Social conflict between stakeholders									4	6	10
Negative worldview of St. Kitts and damage to tourism					10						10
Farmers leaving the profession	10										10
Fear of monkeys					9						9
Total assigned points	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**1000**

**Personal injury/vehicular accidents involving residents and/or tourists. **Damage by monkeys raiding personal fruits/garden. The numbers in the table represent the number of beans (n = 100) assigned to each harm from the relative stakeholder group. 10/17 groups were selected to participate in the ranking and proportional piling exercise as 5/17 groups were considered key informants. 2/10 groups (tourists and Ministry of Tourism) opted out of the activity.*

> *A sense of cultural loss might be an unintended consequence. You know, if you were to get rid of all these animals. I mean, I remember when I first came here a long time ago everybody recognized the animals were pests, but they were kind of proud of them as well. They would see them and be up in the mountain, and they weren't coming in the yard, they weren't doing anything back then. So people would only talk about them in a friendly way. It's only the last 20 years that this idea that we're in full blown competition with the animals. . . so it's part of the cultural tradition here. So, I think if people had a lot of mangoes they would miss the monkeys* (Monkey Task Force).

> *Because everybody trying to get rid of them. . .what if all the mechanisms we try to put in place work? People catching, and people eating, the veterinary, getting the fertility rate down. Then everybody eating and everybody catching for biomedical research. . .we can see a problem where we go from too many. . . to none. The national animal gone. And then we going to lose work, people will be out of work because we have these monkey places that provide work for a lot of our people. . .and all those places have to close* (Dept. of Agriculture representative).

A biomedical veterinarian commented on the potential ecological consequences of a decreased AGM population:

> *Places in the world where they've tried to eradicate a pest there is are negative consequence to another species, whether it be flora and fauna or an actual biological species you did not realize they were controlling or supporting. . .so we have to be strategic and methodical.*

Options

Stakeholders were asked what options exist to combat the problems caused by the monkeys (see **Table 4**). This included options that have been used as well as those that they might envision may contribute to solutions. Once options were collected and combined with like solutions eliminated, 16 options remained and were categorized into the following: (1) Interventions directed at monkeys, (2) Modifying human activity, (3) Modifying human behavior, (4) Governance, (5) Environmental intervention, and (6) Research. Overall, 100% of the groups offered multiple options, 41% (n = 7/17) specifically voiced that there is no single solution and 29% (n = 5/17) recommended a monkey management plan follow an integrated approach. More options revolved around actions directed at monkeys (38%; n = 6/16) and included both lethal and non-lethal choices. The most frequent options cited by participant groups were culling, relocating monkeys to a reserve for ecotourism and deterrence (each 59%; n = 10/17), followed by harvesting monkeys for human and/or pet food at 47% (n = 8/17). Options that involved government interventions included the second largest category of options at 25% (n = 4/16).

The following quote depicts the desire for an integrated approach:

> *It has to be an somewhat integrated approach. . .a group solution. . .no one person could handle it because the monkeys are everywhere, everybody seems to be affected by the monkeys. So it encompasses everybody to find any solution to get rid of these. . .no*

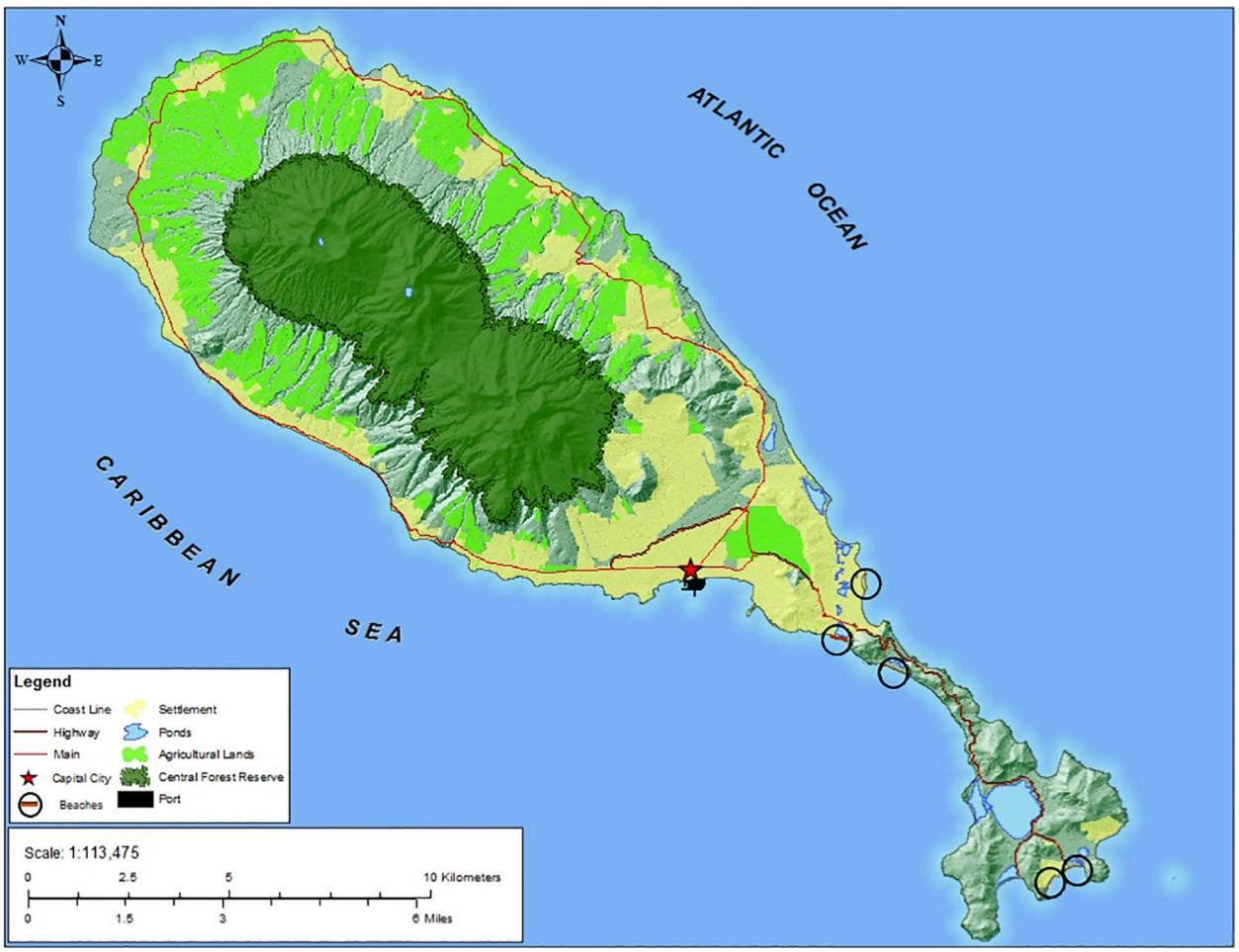

FIGURE 3 | The map depicts land use areas that were provided by the Department of Physical Planning, Ministry of Sustainable Development, St. Kitts upon request of the primary researcher to demonstrate agricultural, residential, urban, forest and beach areas of St. Kitts. Urban and residential areas can not be delineated, so they are shown together as settlements. Map was generated using ArcMap (Esri) and was freely distributed for use. Adverse human–monkey interactions were documented in all above land use types throughout the entire island.

one person, no one solution could handle this problem. Farmers are always trying their very best to reduce the damage that monkeys do but farmers alone can't do it. . .so here is where maybe the government come in and maybe from a scientific standpoint help with reducing the fertility of these monkeys to have less numbers. . . trap the monkeys, maybe some of them catch them for food, so everybody has to be a part of it to get rid of this problem. . .so the solution rests with everybody (government veterinarian).

Obstacles

A list of 29 obstacles was generated by the groups and clustered in five themes to: (1) government, (2) community, (3) common to government and community, (4) the problem, and (5) external influence (see **Table 5**). The two most frequent responses were under the category of common to government and community and were: lack of funding (59%; n = 10/17) and knowledge gaps and sharing of information at 53% (n = 9/17). The greatest number of obstacles posed by groups were government related category and represented 38% of all obstacles mentioned.

One participant noted:

I think not having a full understanding of the scope of the problem and viable solutions is an obstacle. They talk about the monkey problem but nobody really has a clear idea in their mind what a solution would look like. . . at what point do we have to get to when we say there is no monkey problem. . . reducing numbers so they're just not impacting agriculture, or are we talking about getting rid of the monkeys? I think this is a first step and agreeing that there is a problem at least (veterinary faculty).

A community member expressed the government concerns in this way:

Honestly for me the biggest problem before you even get to the problem of dealing with the issue of bureaucracy and people dragging their feet, is I don't think government actually recognizes or accepts the monkey issue is an issue or accepts it's an issue. They know it's a problem, but I don't think they actually accept this as a real issue.

The next quote from a farmer depicts the extreme frustration farmers share regarding the island's monkeys:

> *. . . as long as you hear monkey you're so fed up with the monkey talk and the monkeying around that you prefer not to be any part of any monkey business. For us to be here it means that we have some kind of hope that something can be done. It's not that nothing can be done. . . it's that nothing have been done constructive to reduce the monkey population.*

Common Themes

Two themes emerged in conversations surrounding the "monkey problem." The first was the dichotomy regarding the existing interspecies problem. The monkeys are viewed as both a harm and a benefit for the island. They are a dreaded pest on the one hand and a valuable resource on the other, considering their use as food and biomedical research. Next is the opposition of the agricultural sector versus the tourism sector in their respective acceptance and tolerance of the monkeys. These divergent groups view the monkeys with strong polarity; the former seeing them as income stealing and the latter as income generating. One farmer said "*We have a country that the attraction is the same as the problem which is kind a strange. The attraction of the monkeys for the tourists. . . but it's still a problem for the locals and farmers.*" A second farmer remarked "*Being a farmer, you get no kind of recognition but providing food. Food! Providing food! If you're in the hotel and tourist industry you get all the recognition. . .you a farmer, you pushing the wheelbarrow.*"

Relatedly a Dept. of Agriculture representative said:

> *You get little charms at every port shop on island and the charm for St. Kitts was a monkey. I was highly annoyed because it's such a symbol of destruction in the agriculture sector. So on one hand we're praising it and we're happy about it and it's helping tourism. . . and on the other hand it's destroying our vital sector in the economy.*

Those involved in tourism greatly appreciated the economic benefits the monkeys offer and were keen to showcase them. In describing tourist-monkey experiences a monkey vendor said "*It's the dream. They feel like in America they can only see them in the zoo, so when they come here, and they can interact with them and they can hold them and take pictures with them it's amazing to them. So, people anxious to get to St. Kitts port, just to meet the monkeys.*"

A dichotomy also existed between those that seek to reduce the island's monkey population and those that see them as vital biodiversity and intend to protect them from harm or interference. The plight of the local farmer in facing agricultural crop loss is so severe many have absolute contempt for the monkey, with one farmer quoted as saying "*the only way I see a monkey is a dead monkey.*" Others value their niche in the ecosystem and inherent value as unique local wildlife, and as a community member commented "*The monkeys have such a story here. These are sentient beings. They are intelligent and we need to treat them humanely. They feel and they think. . . and you'll see them with their little babies and their nursing and they're playing-they have familial connections. They're like a human family.*"

The second theme is the concept of balance. The initial example of balance was that many groups called for Kittitian communities to co-exist harmoniously with nature, including monkeys. Secondly, they verbalized that any control interventions taken should be balanced between existing stakeholder interests. The island monkey population could be reduced to protect farming, but not eliminated, so as not to negatively impact tourism and biomedical research. The final example of balance was the call for there to be consideration of the balance within ecosystems, meaning the positive effects of the monkeys as apex predators should be recognized as well as their negative impact on native biodiversity. The following quotes demonstrate the call for balance:

> *The monkeys are an animal. . . they don't know they're doing something bad. There are ways and means to control them. We got ways like human could live, farmers could live, and monkeys could live. It would take a fair amount of support. But if you get the people who have the knowledge to deal with that, they would deal with that and get it balanced. It could be balanced* (monkey trapper).

> *Think about their balance that they play with the ecosystem of St. Kitts. Like what's their role? I think the biggest issue is going to be finding the balance. How much is too much? How much is too little? How do we know that we're at a good place. . .It's just a balance that we need to figure out* (community member).

Responsibility for the "Monkey Problem"

The tourist group, refrained from answering the responsibility question due to perceived lack of knowledge of the governance of St. Kitts. Ninety-four percent of groups (n = 15/16) believed that the St. Kitts' government holds the primary responsibility for dealing with the culmination of problems involved with the "monkey problem." Eighty-eight percent of the groups (n = 14/16) named specific departments of government responsible; agriculture, tourism, health, environment and education departments were mentioned. The most common department named for most governmental responsibility was Department of Agriculture at 63% (n = 10/16) which holds primary governmental oversight of monkey management in St. Kitts.

A community member said:

> *This is not just an agricultural problem. This is an issue that the government needs to handle. They need to realize that this is a serious issue and whether it is by way of policy decision at the cabinet level or actual legislation, something needs to be done so that there is a clear understanding of how we deal with the monkey problem. Because there is nothing either in policy or legislation.*

Newspaper Results

The search of two local newspapers yielded 33 stories involving monkeys over the last 15 years. A 2008 piece was the first story and was the only one during the 2007–2013 timeframe. The years 2014–2021 had 97% (n = 32) of the news stories. Five main categories emerged from the news stories. They were referenced in relation to: (1) agriculture (67%; n = 22), (2) tourism (12%; n = 4), (3) biomedical research (9%; n = 3), (4) nature (6%; n = 2), and (5) human-monkey physical conflict (6%; n = 2). These public and unprompted findings reflect the monkey topics the community has dialogued and mirror those generated via

our community studies. Focusing on the top three most frequent categories, the agricultural stories chronicled the damage to crops by monkeys and woes of the farmer, while the tourism and biomedical stories highlighted the presence and use of the monkeys in a positive light.

Alignment of the "Monkey Problem" to Harm Reduction

The application of prominent features of the St. Kitts' "monkey problem," elucidated from study participants, to 10 key harm reduction principles (see **Table 7**) demonstrated that the island's invasive species problem was strongly aligned to the guiding harm reduction principles found in the literature. Every harm reduction principle cited had a corresponding application directly related to the "monkey problem." Researchers gleaned that the harm reduction approach could be a useful approach to gain some resolution for this long-standing local wildlife issue.

DISCUSSION AND RECOMMENDATIONS FOR THE WAY FORWARD

The African green monkey population of St. Kitts finds itself in between humans fiercely arguing over its final disposition. This situation has evolved from a "problem" to a national argument as public and private individuals and groups vie for rights and values for themselves or on the monkeys' behalf. Summarizing the "monkey problem" from these results we can deduce that it is a multi-faceted complex problem entangling many diverse and divergent stakeholders in St. Kitts. The "monkey problem" was not seen as just one problem, but instead a multitude of polarizing societal sub-problems. The diversity in stakeholders influenced the way that monkeys were perceived and utilized between and among groups. There were widespread places across the entire island where harmful human–monkey interactions occur. There was a diversity of opinions as to the options available to deal with this interspecies problem and even the unintended consequences if action is undertaken to decrease the AGM population. Due to the interconnections between groups and overlapping interests and priorities, there can be no single solution to address the concurrent harms that will not have deleterious effects to other sectors. Any action/s taken must recognize and embrace the complexity and craft solutions that will balance existing and even potential harms and benefits of the island's monkey population.

Monkeys are continuing to cause immense agricultural damage resulting in economic losses for already struggling farmers, even threatening the future of farming in St. Kitts. This was the predominant harm described, but also notably the most important shared value (protection of agriculture). With such pervasive stakeholder agreement, it could serve to be an important unifying factor. There were many other community harms (both real and perceived) expressed by stakeholder groups that need to be addressed. The physical and psychological consequences of being extracted from nature and utilized in the tourism industry created a new sub-set of concerns and opinions by stakeholders on the monkey's behalf. To certain stakeholder groups, specifically tourism and biomedical, the AGM population is an important resource to preserve and protect. This species' demand and use in global biomedical research has greatly increased in recent years as they have been established as a valuable animal model for human diseases and conditions (Freimer et al., 2008). The AGM has contributed to many scientific discoveries and advancements, including the development of SARS-CoV-2 vaccines and treatments (Hartman et al., 2020; Blair et al., 2021; Chang et al., 2021). Efforts to severely reduce or eliminate the monkeys could result in substantial negative effects for these sectors and also have cascading effects into much of Kittitian society, especially any damage to tourism as the island has moved from agriculture to a tourism-based economy (United States Department of State, 2021).

As solutions to the "monkey problem" are sought and implemented it will be advantageous to consider the importance of attempting to strike a balance to this heavily contested issue. Finding this equilibrium will fall largely on government as, despite the whole community awareness of the "monkey problem," no one group seemed willing to take this on as a cause and create tangible action. Since government was seen as the entity holding primary responsibility for this issue it will have to assume the leading role to concurrently protect the island's agriculture from further damage and loss and promote AGM for positive gain in tourism and biomedicine. Lastly, government should also recognize the unique environmental niche that the AGM population of St. Kitts has been supporting and direct some attention and activities toward the maintenance of this species in their natural habitat, and not entirely a species to exploit for income, science or meat.

The St. Kitts and Nevis' monkey problem is well known locally. It comes up in casual conversation between community members and has appeared in gray literature and scientific research, but to date primarily presented through the agricultural perspective highlighting the plight of farmers (Dore, 2018; Dore et al., 2018). The federation is not alone when it comes to tenacious monkey issues. African green monkeys inhabit a few other Caribbean islands including Barbados, St. Martin/St. Maarten and Tortola (Dore, 2017). Globally there are numerous urban locations where humans co-exist with non-human primates including but not limited to: vervet monkeys (*Cercopithecus aethiops pygerythrus*) in KwaZulu-Natal, South Africa (Patterson et al., 2017); chacma baboons (*P. ursinus*) in the Cape Peninsula South Africa (Hoffman and O'Riain, 2012); rhesus macaques (*Macaca mulatta*), bonnet macaques (*Macaca radiata*) and Hanuman langurs (*Semnopithecus entellus*) in India (Sharma et al., 2011) and long-tailed macaques (*Macaca fascicularis*) in Singapore (Yeo and Neo, 2010). In varying degrees all these areas have experienced similar menacing-type problems directly related to negative monkey behavior like crop raiding, personal injury and property damage. Furthermore, in some areas these monkey issues have been reported as incendiary and have chronically stressed social and political systems as those entities endeavor to make improvements to decrease interspecies conflict (Govindrajan, 2015). Non-human primates are particularly difficult species to manage due to their intelligence and social

TABLE 7 | Alignment of the St. Kitts' "monkey problem" with harm reduction principles.

Harm reduction principle	Corresponding application as described from the St. Kitts' "monkey problem"
Involves multiple parties who differently experience the benefits or harms caused by the ultimate source of the problems	The "monkey problem" was described as a complex and decades-long issue and involving a diverse set of stakeholders with competing interests and priorities.
Focuses on minimizing harmful effects rather than condemning the inciting harm or delaying action until the ultimate source of the problem can be eliminated	There is frustration with the inattention to addressing the harms arising from the monkey-problem while people wait for the 'best' solution to be discovered.
Community members have different perceptions and experiences with the problem and the harms is causes	The monkey problem is not a single problem. People experience problems and benefits differently depending on where they reside in the problem-space.
Incrementally reduces priority effects of a multi-faceted persistent problems without necessarily eliminating the ultimate source of the problem and the harms it causes	There were few calls for eradication of the monkeys, but instead a desire to seek options to decrease the frequency and scale of negative consequences caused by the monkeys while protecting their positive contributions.
A shared value or vision supports collective action despite conflict and uncertainty over the entire problem	Although there is existent dichotomy and disunity, there was a common recognition of the need to decrease harmful societal agricultural losses as well as injury and disease threats to residents, tourists and the monkeys.
Encourages broad inclusivity and people to coalesce around a harm/problem despite stakeholder conflict and scientific (and other) ambiguity	Inclusivity occurs at a central level (Monkey Task Force) and with agriculture problems but not yet with the full suite of harm arising from the problem.
Prioritizes harms and builds on achievable steps over time based on a broad range of available and acceptable resources	Irregular and disjointed attempts have been made to control the monkeys, but larger-scale and more methodical and comprehensive efforts to minimize harms have been lacking.
Pragmatic approach to meet people and problem "where they are" to develop socially acceptable and feasible community solutions	The entirety of the "monkey problem" is not experienced by all people but there were shared values that support food security for residents, personal horticulture and health for residents and monkeys as acceptable targets for action.
Acknowledges a person's right to self determination; is supportive of informed decisions made by individuals and does so in a neutral humanistic way	The ripple effects of actions in one sector were seen to have implications for income generation, island ecosystem integrity and other social outputs (ex. biomedical research) that could affect people's options for employment, income and self-determined work were uncovered.
Respects basic human rights and non-judgmental attitude toward people and the harm/problem	No member of the monkey-problem system were 'vilified' apart from people's concerns about government inaction or accountability.

Harm reduction principles used in the table were derived from two sources, British Columbia Ministry of Health (2005) and Stephen (2020).

and ecological adaptability. Despite the recognition and longevity of these global monkey problems, they continue to confound experts and authorities and adequate solutions are lacking. Anecdotally, interventions have provided only short-term relief.

Our study was initiated to attempt to grasp how the local communities with different relationships with the monkeys viewed the "monkey problem." This was done in alignment with the settings-based harm reduction principle of "meeting people where they are" in order to find common values and visions for action using available knowledge, resources and capacity (Boucher et al., 2017; Hawk et al., 2017). While many public and private programs serve to reduce harm at the human-animal interface, there are few examples of the successful application of the harm reduction approach outside of public health. Where it has been used it was done so in a wide range of health scenarios to: advance understanding of climate-driven health risks in the circumpolar north (Ruscio et al., 2015); control Rift Velley Fever in Sudan (Hassan et al., 2017); strengthen food and nutrition security in Tanzania and Zambia (Bagnol et al., 2016); manage environmental harms to wildlife in Canada (Stephen et al., 2018) and improve rabies response planning and implementation in northern Australia (Degeling et al., 2018). The St. Kitts' "monkey problem" has many features of a problem suited to a harm reduction approach (see **Table 7**). There are complex social dimensions preventing understanding and consensus, further stagnating mitigative actions. The lack of social will and proven methods make monkey eradication an unlikely and socially undesirable solution. Harm reduction presents a way to collaborate toward solutions that are community based and community driven, but at the same time can be supported by authorities when mutually agreed upon and developed. As this approach favors incremental interventions and is highly contextual in addressing societal problems (Jalloh et al., 2017), it can serve as an important methodology for approaching solutions to this pervasive national issue.

One way forward may be to frame the St. Kitts' "monkey problem" as a wicked problem. First described over 50 years ago (Rittel and Webber, 1973) wicked problems are messy, lack definition, are multi-causal and widely-interpretative and for which solutions are not evident or inscrutable. Labeling the Kittitian "monkey problem" as a wicked problem may push experts and authorities to leave conventional reductionist thinking which invariably applies simple solutions to intractable issues. Considering multiple conflicting perspectives and values in wicked problems these tactics do not work, and may even worsen a problem as unintended consequences of interventions were not considered from a systems' viewpoint. Wicked problems require a new paradigm, a narrative with innovative thinking and novel strategies to deal with the enormous challenges enveloping them including complexity, dynamicity

and uncertainty (Waltner-Toews, 2017). Integrated interventions designed to address deeper-seeded issues at the crux of a problem like conflicting values and social and political inequities, are what is called for when facing wicked problems. Lee et al. (2022) suggested that the global management of urban rats is a wicked problem, and strategies employed to sustainably manage these commensals must comprehensively map the extent of infestations and their underlying social, economic and political causes. Approaching the rat problem by confronting upstream determinants will likely lead to multiple concurrent options that will serve to make incremental gains in the problem over time. The urban rat situation, as well as the urban "monkey problem" does not likely have one single solution.

Wicked problems may not be solvable in any final and definitive manner (Rittel and Webber, 1973; Whyte and Thompson, 2012). Attempts at improving wicked problems must address their context as they are uniquely embedded in place and time. They are also paradoxical as without a definitive solution, judgments have to be made between fixed goals and alternatives and *status quo* versus change (Brown, 2010). Likening the St. Kitts "monkey problem" to a wicked problem enables involved stakeholders to seek more options to manage the problem rather than to conclusively solve it. Harm reduction concepts and methodologies may be well suited for application toward complex and wicked problems. This approach exemplifies the collective inquiry required for wicked problems where a greater understanding of the whole is sought while respecting the perspectives of those contributing knowledge (Brown, 2010). This approach, as applied in our study, called for examination of the whole messy human-monkey system in St. Kitts to examine how this system functions, and subsequently identified an entry point to begin collective action. Frequently mentioned shared values including the protection of farmer crops and backyard harvests likely represent strong entry points to this problem and a jumping-off point to begin collective action toward future improvements.

Voice of support for the monkeys was heard in our interviews but was overshadowed by the socioeconomic complexities, wants and needs of other stakeholders. Future work should encourage the agency of the non-human primates involved in this debate to protect their safety, health and security in their natural habitat. A conservation veterinarian, an ethnoprimatologist, and animal/nature supporters participated in this study however future work looking at equitable and fair solutions would benefit from a broader perspective, including ethical, ecological and social expertise to address the concerns and values reported by study participants. Health promotion, the progenitor of harm reduction, incorporates the notion of reciprocal care between society and the natural world and focuses on socioecological determinants for a holistic approach to health and wellness for individuals and communities (Gallagher et al., 2021). The inextricable link between health and ecology is tantamount to both approaches.

Limitations

Although the researchers aimed to be comprehensive in stakeholder involvement some groups or individuals may have been overlooked and we are therefore unable to say that our study participants are a representation of the total population of St. Kitts. There may also be some professional bias as focus groups and key informants were based on their respective occupations. Both of these are common biases existing in PE, however the cross-checking of data through triangulation and continuous probing within the participatory methodologies collectively functioned to reduce any bias and increase the validity of the results.

Information from the focus group or key informant interviews did not necessarily reflect consensual views and instead reflected general community perceptions. For this reason, the collected data represented what was mentioned by the 17 stakeholder groups, which was not always agreed upon within groups, and should not be taken as adopted views or preferences. As it will be important to gain representative views from stakeholder groups to inform interventions for this interspecies problem, future work can focus on capturing consensual viewpoints from focus groups and key informants.

CONCLUSION

The St. Kitts' "monkey problem" while unique to this island location is just one example of a complex One Health problem that spans human, animal and environmental domains. These types of problems are complex because they involve many diverse stakeholders that hold a wide spectrum of experiences, perceptions, needs, attitudes and behaviors that make it very challenging to define the nature and scope of a problem and seek solutions. In this study we have examined the St. Kitts' "monkey problem," a hundreds of year old problem, with a harm reduction lens. Under the framework of harm reduction we used PE to present a collective view of this persistent societal problem to help elucidate steps toward the promotion of actionable change that is practical, and socially acceptable. Future work should be geared toward discovering the ways and means to diminish harms for some stakeholders while protecting the beneficial aspects of the valuable resource in the African green monkey of St. Kitts, and concurrently seeking to respect and preserve the life and habitat of this iconic species.

The harm reduction approach provided a fresh look at a very old problem. It was particularly helpful in this study as it encouraged collective inquiry, in the form of inclusivity and participation, to learn about a chronic interspecies problem that has continued to befuddle and divide Kittitian society. This approach provided knowledge gains surrounding the complexity of the human-monkey system and demonstrated possible entry points toward solutions to this problem through the identification of shared values. Harm reduction concepts and methodologies impart to communities, experts and authorities that an approach to a problem does not have to be one solution for all, but instead a series of incremental gains over time designed to

build cohesion and collaboration, both strong foundations for the sustainability of helpful options.

DATA AVAILABILITY STATEMENT

The original contributions presented in this study are included in the article/supplementary material, further inquiries can be directed to the corresponding author/s.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by Ross University School of Veterinary Medicine Institutional Review Board. The participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

CG and CS designed the study and wrote the manuscript. CG was responsible for all qualitative data collection. CG and CS conducted analyses and interpretation of the participatory work supported by LH-C and LC-M. CG, CS, LH-C, and LC-M reviewed and edited the manuscript. All authors contributed to the manuscript and approved the submitted version for publication.

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