Received: 29 August 2023 | Revised: 21 May 2024 | Accepted: 20 July 2024

DOI: 10.1111/cobi.14394

Conservation Biology

CONTRIBUTED PAPER

Community perceptions of invasive species and environmental management in a US island territory

Ann Marie Gawel[1] | **Dara M. Wald**[2] | **Haldre S. Rogers**[3]

[1]Center for Biodiversity and Conservation, American Museum of Natural History, New York, New York, USA

[2]School of Public and International Affairs, Virginia Tech, Blacksburg, Virginia, USA

[3]Department of Fish and Wildlife Conservation, Virginia Tech, Blacksburg, Virginia, USA

Correspondence
Ann Marie Gawel, Center for Biodiversity and Conservation, American Museum of Natural History, 200 Central Park West, New York, NY 10024, USA. Email: anngawel@gmail.com

Article impact statement: Despite historical exclusion from conservation actions, the people of Guåhan exhibit concerns and willingness to act on invasive species.

Funding information
Iowa State University College of Liberal Arts and Sciences Social Science Seed Grant

Abstract

Environmental managers struggle with communicating accurate and relevant information and with gaining trust from the communities they serve, problems that are especially pronounced in minority and colonized communities. An important step in developing successful management strategies is partnering directly with the communities involved, but community perceptions are rarely surveyed thoroughly when developing these strategies. We held discussions with 73 people across 22 small groups about their perceptions of environmental issues, with a focus on invasive species, on the island of Guåhan (Guam), a US island territory with a long and continued history of colonization by Western countries. We conducted these small group discussions with long-time residents to learn about their environmental concerns and perceptions of invasive species and management efforts. Using grounded theory, we identified themes concerning apathy, proenvironmental behaviors, frustrations with efficacy, and disconnectedness from environmental decision-making among residents of Guåhan. Residents expressed feeling disconnected from management decisions, which they critiqued as ineffective, but largely felt helpless to affect. Still, residents related to us their proenvironmental behaviors (e.g., picking up litter and controlling invasive species) and expressed a desire to learn more about management efforts. Our results highlight a clear need for improvement and expansion of engagement with Guåhan residents about environmental management, as well as opportunities to engage with a concerned and potentially proactive community.

KEYWORDS
environmental management, Guam, human perceptions, invasive species, proenvironmental behavior

INTRODUCTION

Understanding community perceptions of environmental issues is a critical step in planning successful conservation strategies. However, many conservation practitioners and researchers still struggle to align their priorities with those of the communities that they work in. This disconnect can be even more pronounced when the communities that they are working in are historically disenfranchised. For example, historically marginalized communities that often suffer environmental injustices disproportionately may not have the power and resources to address issues related to conservation and invasive species management (Brown, 1995; Schell et al., 2020). Indigenous communities' perspectives on and responses to invasive species and other conservation challenges have received little attention in the published literature (Barbour & Schlesinger, 2012; Wehi et al., 2023). More recently, environmental managers have been shifting to codevelopment of conservation strategies with communities that have long been excluded from these processes (Kamelamela et al., 2022; Ticktin et al., 2006; Wehi et al., 2009), but many places have yet to adopt these practices and much more is left to be understand about how to best undertake this codevelopment.

The number of studies focusing on perceptions of invasive species and invasive species management has increased over the past few decades (Estévez et al., 2015; Fraser, 2006; Lewis et al., 2019; Shackleton et al., 2019; Wald et al., 2019). These studies highlight some of the barriers to invasive species

management, which can arise even when the risk associated with an invasive species is urgent and well understood by biological experts. Communities may oppose control of species perceived as charismatic, culturally important, or useful (Estévez et al., 2015). The lethal control of cats in the United States, although supported by avian conservation groups, such as the Audubon Society, is vehemently opposed by animal welfare groups, who prefer nonlethal strategies, such as trap neuter and release (Wald et al., 2013). The damage done by feral pigs in Hawaiian ecosystems is well documented (Nogueira-Filho et al., 2009), but management has been met with opposition by local hunters who value pigs culturally and who want to continue to hunt them (Maguire, 2004). Even if perceptions of a non-native species are largely negative, control methods might be opposed if they are perceived as risky, cruel, ineffective, or culturally insensitive. For example, the Karuk Tribe and other community members in California opposed control for the highly invasive spotted knapweed because the aerial herbicide treatments were perceived as a threat to human health and water resources (Norgaard, 2007). As these examples illustrate, invasive species management projects can be thwarted due to a lack of public involvement and support, even if the control methods are supported by natural resource managers.

The histories of certain communities may also disempower and discourage action. For example, historically marginalized communities who often suffer environmental injustices disproportionately may not have the power and resources to address issues related to conservation and invasive species management (Brown, 1995; Schell et al., 2020). In particular, Indigenous people's perspectives on and responses to invasive species have received little attention in the literature (Wehi et al., 2023). With all this considered, perceptions of environmental threats are varied and contextual—a better understanding of communities' perceptions of an environmental threat is often a necessary precursor to addressing the threat. Further, understanding the history and culture of a particular community is important, as these contexts may affect both perceptions and motivations. Our research considers these cultural and historical contexts, and we explain some of the history, environmental issues, and relevant political and governmental background for our study area below.

As is the case with many other oceanic islands subject to the harms from invasive species (Russell et al., 2017), the island of Guåhan (Indigenous name for Guam) is in need of conservation action due to the presence of multiple harmful invasive species (Fritts & Rodda, 1998; Rodda et al., 2008). Feral pigs (*Sus scrofa*) and Philippine deer (*Rusa marianna*) have been on the island for centuries and damage native habitats as well as people's properties (Conry, 1989; Wiles et al., 1999). Invasive vines, especially the chain-of-love (*Antigonon leptopus*), and the invasive tree *Vitex parviflora* smother or outcompete native plants (Bevacqua & Miller, 2020; Marler, 2020). A number of damaging insect species have been introduced as well. The coconut rhinoceros beetle (*Oryctes rhinoceros*) (hereafter rhino beetle) has damaged many of the island's palm trees, namely coconut trees (*Cocos nucifera*) and betel palms (*Areca catechu*), both of which are culturally important. In addition, little fire ants (LFAs) (*Wasmannia auropunctata*) present a threat to native wildlife, domestic animals, and people (Moore et al., 2015; Raymundo & Miller, 2012). The brown treesnake (*Boiga irregularis*) is responsible for the near-complete disappearance of Guåhan's native forest birds (Fritts & Rodda, 1998; Savidge, 1987) and subsequent societal and ecological impacts (Fritts et al., 1990; Rodda & Savidge, 2007; Rogers et al., 2017).

The prevalence of invasive species is intertwined with Guåhan's colonial history. Pigs were introduced by Spanish colonists (Conry, 1989), and brown treesnakes were introduced in military cargo at the end of World War II (Savidge, 1987). The management of these species has also been intertwined with colonialism because of Guåhan's political status as an incorporated territory of the United States. The Department of Defense (DOD) owns almost one third of the island, and federal agencies play a large role in conservation. Therefore, many invasive species management actions are conducted to comply with federal mandates, such as the Endangered Species Act (1973) and Sikes Act (1960), rather than community concerns. Actions by DOD are perceived by the local population as "behind the fence," that is, largely inaccessible and disengaged from the rest of the island (Alexander, 2016). Government of Guam natural resource agencies prioritize US federal mandates because federal counterparts fund a large portion of their work (Joint Region Marianas, 2020; US Department of the Interior, 2017, 2021). For example, the local wildlife agency, Division of Aquatic and Wildlife Resources, funds much of their work through federal grants from agencies, such as the US Fish and Wildlife Service and the Office of Insular Affairs. Therefore, even if the local community and lawmakers were to push for their own priorities, federal priorities tend to take precedence because local agencies are funded to prioritize them.

Guåhan's political status, colonial history, and cultural makeup likely influence residents' perceptions of both the environmental issues and the entities attempting to address these issues. In other colonized islands, there is a disconnect between Indigenous or local populations and colonial governments in speaking about the environment and in how environmental issues are managed. Even what to consider native or non-native in Hawai'i illustrates a disconnect between government biologists and Indigenous Hawaiians (Helmreich, 2005). In Puerto Rico, local communities have negative perceptions of the US Fish and Wildlife Refuge in the militarized island of Vieques (Guzman et al., 2020). Because Guåhan is a territory with a similar relationship to the United States as Puerto Rico, there could also be a similar disconnect between residents and current environmental management strategies, including addressing invasive species.

We focused on invasive species and their management because of the severity of their impacts in Guåhan and the dearth of relevant socioecological studies in this region. Despite the severe impacts of invasive species in Pacific Islands (Hays & Conant, 2007; Rodda & Savidge, 2007), very few studies on public perceptions have been conducted outside of New Zealand or Hawaii (Black et al., 2021; Wald et al., 2019; Warner & Kinslow, 2013). Just as in these other colonized places, we anticipate that variables, such as colonization and militarization of the island (Alexander, 2016; Demeulenaere, 2021; Guzman et al., 2020), may play a role in how residents perceive invasive species and

their management. We sought to explore Guamanians' concerns about invasive species and other environmental issues and their perceptions of environmental management strategies.

METHODS

Study area

Indigenous CHamorus settled the Mariana Islands, an archipelago in the Western Pacific, over 3000 years ago, making them the oldest remote Pacific Island culture (Hung et al., 2011). However, Guåhan, the largest island in the Mariana archipelago, has one of the longest colonial histories in the world, starting with Spanish claims in the 16th century and transitioning to US rule in 1898. It was briefly occupied by the Japanese during World War II (Rogers, 2011). Since World War II, Guåhan has been an unincorporated island territory of the United States. This means the island is ultimately under the jurisdiction of the United States and is subject to US federal laws and regulations. Residents of Guåhan have US citizenship by birth, but, much like residents of other island territories such as Puerto Rico and the US Virgin Islands, they do not share the same political status as residents of the 50 states. They do not pay federal income tax, can elect one nonvoting member to the US Congress, and do not have voting rights in presidential elections. The population size is approximately 170,000, and residents are a mix of ethnicities and cultures. Indigenous CHamoru people comprise the largest group. The next largest groups are Filipino (approximately 37%), White, and those from other Pacific Islands, in decreasing order (US Department of Health & Human Services, 2021).

Small group discussions

We conducted semistructured small discussion groups with adults from across a range of ages, professions, and backgrounds on the island of Guåhan. This allowed us to speak with more people at a given time versus one-on-one interviews. We employed convenience sampling by reaching out to colleagues, friends, and family on the island, some of whom then recruited their own acquaintances to participate with them. We also recruited participants through social media, through personal connections, and by arranging to speak with groups of interest, such as a hunting club, traditional healers at their clinic, the local community college, and environmental professionals and educators. All participants were long-time residents of Guåhan (residents for at least 10 years). Discussion groups consisted of 2–8 persons and were conducted either in person or over video conference between July 2017 and January 2021. One moderator followed a structured script (Supporting Information Appendix) that began by asking participants about their general experiences in nature and then proceeded to ask more specifically about environmental threats, invasive species, and management of these threats and species. All questions and responses were in English because that is the most prevalent and one of the official languages of Guåhan. Audio from conversations was recorded and then transcribed by an anonymous online paid transcription service (rev.com). We proofread the transcripts before analysis. Participants also voluntarily provided demographic information including age, gender, income, and ethnicity. Our script and research plan were approved by the Iowa State Office for Responsible Research Internal Review Board (IRB ID 17–266).

Analyses

We used grounded theory for our research. This is a qualitative approach that allows researchers to detect themes (Makri & Neely, 2021) based on responses from participants rather than based on established hypotheses. This allowed us to identify important themes in the data without a priori assumptions about what we would find. This approach was particularly valuable in this context because very little research on these topics has been done in Guåhan. We had all audio recordings of our discussion groups transcribed and proofread before responses were coded using NVivo software (version 12 Pro; QSR International). We conducted group discussions until we approached a point of saturation for the themes, that is, until quotes from participants addressed the same or similar issues, themes were being heard repeatedly, and no new major themes emerged (Hennink & Kaiser, 2022; Saunders et al., 2018).

Our coding approach included an open review of the transcripts to identify broad themes, followed by a secondary round of coding to refine these themes and identify subthemes. Coding with the established themes was redone 2 months after the original coding to assure consistency. A single coder conducted all rounds of coding and identified the following themes. Theme 1 was apathy, and its subthemes were public apathy as an environmental threat (1a) and lack of concern from local leaders (1b). Theme 2 was individual proenvironmental behaviors, and its subthemes were countering litter (2a) and managing invasive species (2b). Theme 3 was inefficacy against environmental threats, and its subthemes were inefficacy of individual proenvironmental behaviors (3a), lack of response from environmental agencies (3b), and inefficacy of environmental managers (3c). Theme 4 was disconnect from environmental decision-making, and its subthemes were helplessness about military environmental impacts (4a) and disconnectedness from information on invasive species management (4b). The same coder also coded for evidence contradicting these themes to assure the themes still held and were not actively sought out while ignoring parts of the discussions that contradicted these themes. In Tables 1 through 4, we provide a selection of direct quotes from the transcripts that support our themes and, after each, provide contradictory quotes if there were any.

Participant descriptions

We conducted 22 small group discussions, ranging in size from 2 to 8 individuals, for a total of 73 participants. They ranged in age from 19 to 82 years old, with 39 identifying as female and 34 identifying as male. Some participants chose not to

TABLE 1 A selection of quotes from group discussion participants that support and contradict the subthemes under Theme 1, apathy.

Quotes supporting theme	Quotes contradicting theme
1a. Public apathy as an environmental threat	
P16.1: "There's places that are really vigilant like Hawaii. …there was some plant that was invasive and there were (volunteer) crews that went around into people's yards and were digging them up, and *I don't think we have that kind of mentality on the island*."	P11.3: "I think the younger kids are getting better because the educational system is helping with recycling, and I see (name redacted)'s Green Army all over the place. But I think the young kids are better than the older generation when it comes to not trashing the place."
P3.2: "I was gonna say like public awareness or knowledge,… Folks mishandling, even their own land that they find very sacred, in an environmentally damaging way."	
P3.4: "I was trying to think of what makes me most, just angry, and that's *the apathy I think, is one of the things that really really upsets me, that people really just don't care* because they don't appreciate the fact that Guam is so beautiful."	
1b. Lack of concern from local leaders	
P7.1: "I mean you can look at it locally too, *a lot of the leaders don't care* and the ones that do care don't have the political power to stay, so then they would just be set off to the side."	
P10.4: "A lot of the people that are being elected are not environmentalists. They're not thinking of the environment. They're mostly like business people. So, with business people, of course, business comes first."	
P22.2: "…Guam EPA, (referring to the local Environmental Protection Agency) when it was a brand new agency back in the '70s, the local government, the legislature here, would appropriate maybe a million dollars for operations and budget for the EPA. And the federal government would come up with maybe $2 million, a bigger amount. Over the years, that's all eroded, and (now) there's zero from the local legislature."	

identify themselves by ethnicity in survey forms. Therefore, although we do not have exact proportions, we know over half of our participants identified as either CHamoru or Filipino, and the remainder identified as White, as from other Pacific Islands, or did not share this information. Many of the residents we connected with either were involved with environmental organizations (research, management, or educational institutions) or were active resource users, such as hunters, fishers, or traditional healers. This former group consisted primarily of teachers, members of local management agencies, outreach specialists, students in an environmental science college course, and researchers working on environmental topics. A third group included residents with little to no environmental connection, such as firefighters, seniors at community senior centers, and college students not majoring in an environmental field. We considered all respondents together for our analysis.

RESULTS

We describe the themes and responses from participants below and present a selection of quotes from participants that provided good examples of each theme (Tables 1–4).

Apathy

A theme that emerged throughout many of our groups was apathy. Participants viewed apathy as a major threat to Guåhan's environment. Participants rarely implicated themselves but spoke instead about the need for more education and the lack of motivation from other members of the public, local leaders, and environmental management agencies.

Participants voiced complaints about other residents in Guåhan, or the general public in Guåhan, claiming that most were apathetic or ignorant to environmental issues (Subtheme 1a). One participant compared the residents of Guåhan with those in Hawai'i who were volunteering to remove invasive plants, stating that residents in Guåhan did not have the same proactive mentality about combating invasive species. Others expressed frustrations about Guåhan residents not being informed or not caring in general about environmental issues (Table 1).

This frustration among participants about apathy and a general lack of concern about environmental issues extended to local leaders (Subtheme 1b). One participant with knowledge of the agency shared the fact that local legislators used to allocate funds for the Environmental Protection Agency, but now they do not allocate anything, instead forcing the agency to seek US federal grants.

Very few people expressed opinions indicating that other residents or local leaders cared a lot or were passionate about conservation or environmental causes. However, we did find a few quotes expressing positive perceptions of management results, including quotes about successfully containing invasive species (with the exception of vines) and controlling feral pigs (Table 1). These were outnumbered by sentiments expressing frustrations about apathy and lack of awareness of environmental issues, especially concerning invasive species.

TABLE 2 A selection of quotes from group discussion participants supporting subthemes under Theme 2, self-reported proenvironmental behaviors (no contradictory quotes were coded).

Quotes supporting theme
2a. Counteracting litter
P17.1: "So every time we go, we try to leave the beach a little bit cleaner than we found it, with any cans or bottles that people leave around."
P18.1: (referring to a public beach that the participant often visited) "… I made a sign that had plywood and we wrote 'Have a…' and then a big heart… 'do not dump animals, garbage, or anything here."
2b. Managing invasive species
P11.3: "I see African snails, which I have no problem stepping on. The bufo toads, I see lots of bufo toads (cane toads). In fact, I used to go out in my yard every night and kill at least 13 a night…"
P12.1: "I've seen a lot of my family members that have the traps for the brown tree snakes. If they find them, they just cut their heads off. So, that's how they manage it."
P2.3: "Kill snakes when you see them… But certainly, we've had to change habits of keeping doors open or windows open or things like that, because you don't want a snake getting into an area. So, we've already done some of those adaptations."

TABLE 3 A selection of quotes from group discussion participants that support and contradict the subthemes under Theme 3, inefficacy.

Quotes supporting theme	Quotes contradicting theme
3a. Inefficacy of individual pro-environmental behaviors	
P16.1: "I mean I hear lip service about the rhino beetle. But I think … I mean, I've gone to the briefing and I've bought the *tekken* nets. There was a time when I wrapped *tekken* nets up to all the little high leaves… That didn't work."	Moderator: "Would you be supportive of more of those buckets up around to catch more beetles?" P13.1: "Yes. I think we solved the problem, it's not as bad as it used to be, so I think we found the effective way."
P4.3: "Oh, and I have a rhino beetle in a bucket next to my front door that hasn't died after four days."	
3b. Lack of response from agencies	
P9.1: "I spotted a yellow banded hornet… out of the four times that I've called I've never had a live person pick up the phone, and I've never had anybody call me back with any type of a concern, even though on the website they say, "If you see this guy (a certain type of invasive species of concern), call this number."	P7.1: "I think we (agencies) are doing a pretty good job containing things… Not the vines, good luck with that!"
P16.1: "I've seen the ads around the island that says, call 475-PEST or whatever the number is… But then you report it and then …" (participant shrugs)	P15.2: (referring to a public pig-hunting derby) "I think the pigs are smaller. I think they're not as many big ones around because they're hunting them, and they're shooting them."
3c. Inefficacy of environmental managers	
P15.2: "And we're seeing more of these (invasive species) all over. So, whatever they're doing is not working because it's spreading. It's getting worse. It's not getting better."	P18.2: (referring to developing a virus to control the rhino beetle) "Now I have a bit of an understanding about it because when they presented what they have to do to grind up beetles and make the virus, I mean, it's so complicated… I think that would be hard as a scientist to keep trying, keep trying, but it seems like success is eluding you. I was amazed at the resiliency of these people."
P4.3: "Yeah, I think they've put aspirin in little mice and then they kill them (snakes) with that because they drop." Interviewer: "What do you think about those management strategies?" P4.3: "Didn't work, we didn't really follow through."	P20.1: "(speaking about DAWR) I think what they can't tackle, they try to bring awareness to at least. You'll see a lot of flyers and sometimes commercials saying…telling us these are invasive species… Even if they can't immediately tackle them, at least they try and help bring awareness and try to inform the community at least." P10.5: "…I think they're working, they're trying, … but the resources is not there."

Individual proenvironmental behaviors

Although participants remarked about apathy on the part of others, many participants reported personally conducting proenvironmental activities. Anecdotes of this were often volunteered before we asked participants to share whether they did anything to manage environmental threats (Table 2).

Many anecdotes from participants regarded trash cleanups or illegal dumping, which was often cited as a major threat by participants in our groups (Subtheme 2a). Participants also described their individual actions to manage multiple invasive species, but especially brown treesnakes and rhino beetles (Subtheme 2b). Many of these actions were on a small scale, around their houses or properties, and usually involved

TABLE 4 A selection of quotes from group discussion participants that support and contradict the subthemes under Theme 4, disconnect from environmental decision-making.

Quote supporting theme	Quote contradicting theme
4a. Inability to counter military's environmental impacts	
P9.2: "That's part of it. I mean, the footprint of the military is evolving here… It was mentioned earlier Marines is going to cause more lands being taken, and we see the effects already here."	P23.1: (Asked about which areas were pristine) "Probably the military protected areas."
P10.1: "We have these badlands in the south so what we're doing is we're working on reforestation project, which we're planting trees on the ridge-lands. And I find it sad and ironic that on the other end of the island, the military is getting ready to bulldoze acres and acres of old-growth limestone forest. It just seems like a contradiction."	P7.1: "In Northwest Field of Andersen (a military base), I would classify it as primary limestone forest. There is very little invasive species, most of it is just native and there is barely any human traffic in there." P7.2 "That is probably because it is extremely blocked off to the public community."
P10.4: "Because for me, growing up,…you just comprehend that whatever the military does despite our voice locally, it doesn't go anywhere… They still have that final say to build despite our concern about what we have, you know."	P9.1: "That's pristine, yeah. It's very controlled too in the restricted area. You can't go down there any time you feel like it. Every time the range is up it's closed, so I guess that helps it to stay pristine, yeah."
P9.1: "I think the military and the government didn't really understand the impact when they decided to spray the whole freaking island…"	
4b. Disconnect from information on invasive species management	
P15.1: "Yeah, but the LFAs, other than some little YouTube thing out of UOG (University of Guam), I wouldn't think anything was happening. Yeah. I assume there is, but I don't know."	
P15.2: (referring to snake-control efforts using helicopters) "I think the helicopter program, it is effective, but we don't really see many statistics, so it's really hard to tell."	
P16.1: (speaking about snake traps around airports) "Well, it must be effective, but they're not giving positive feedback. So we don't really know what's going on. We just see it there. And we assumed the reason it's surrounding the airport, you know is cause it works, right?"	

killing the species. However, some participants also adapted their lifestyles or infrastructure on their properties to avoid impacts from these invasive species, for example, assuring doors and windows are well sealed to avoid incursion from brown treesnakes.

There were no quotes contradicting this theme. In other words, participants did not make any statements suggesting that they were opposed to performing proenvironmental activities.

Inefficacy against environmental threats

Many participants shared concerns about whether or not different environmental management strategies were effective (Table 3). Participants shared concern about the inefficacy of control techniques that had been promoted through outreach campaign (Subtheme 3a). For example, an outreach campaign about protecting palm trees from rhino beetles had promoted using traditional fishing nets (*tekken*), which were placed in palm trees to deter damage. However, we spoke to multiple participants who tried this technique, but were disappointed by the results. Another subtheme (3b) was a perceived lack of response from environmental agencies. Local outreach campaigns about invasive species provided Guåhan residents with a number to call to report sightings and other issues, but participants shared their frustrations about getting no response when reaching out to environmental agencies. Not only were participants frustrated with a lack of response when they wanted to address invasive species, they seemed frustrated with the results of invasive species management actions carried out by environmental agencies (Subtheme 3c). The quote about aspirin and mice in Table 3 refers to a project to control brown treesnakes at a landscape level by dropping dead mice laced with acetaminophen—which is toxic to snakes—out of helicopters in order to reach more remote forested areas. Although participants did not have very specific criticisms of management efforts, they did express dissatisfaction and even despair at the apparent lack of results. One participant pointed out the many invasive species that have arrived recently and the fact that none have been eradicated.

Despite an obvious frustration with environmental management agencies, some participants also expressed sympathy, commenting on how overwhelming the problems are, how these professionals are limited by a lack of resources or support, and how they are at least trying.

Participants also expressed support for some management strategies that they were aware of, such as plastic buckets with beetle pheromone used to capture rhino beetles, strategies that address the LFA problem, invasive plant control, and increased hunting to eradicate feral pigs, with one participant noting the annual pig-hunting derby and how they believed it was helping to control the size of pigs (Table 3).

Disconnect from environmental decision-making

Even among participants who were closely affiliated with agencies, a large number of participants in our groups expressed that they felt disconnected or uninformed about environmental management, especially the management of invasive species. Not only did they report that they felt uninformed, they also perceived themselves as powerless in the face of some major environmental impacts and decisions concerning these impacts (Table 4).

Almost every group we spoke to mentioned the US military and their presence in Guåhan. All quotes shared here (Table 4) were spoken in the context of different major environmental impacts, such as ongoing development to support the increase in presence of US Marines in Guåhan or past events such as spraying insecticides after transferring Vietnamese war refugees throughout the island in the 1970s. One participant spoke about losing more land to the US military and their expanding footprint on the island, whereas another shared their frustration with how military development seems to be counteracting any positive effects that local agencies and volunteers may be having with reforestation efforts.

When we asked participants about invasive species in Guåhan, many stated that they felt uninformed about invasive species management, so we report on quotes expressing a disconnect from information on invasive species management (Subtheme 4b). One species that participants wanted to learn more about was the LFA, a relatively new introduction to Guåhan. Another participant referred to the program to control brown treesnakes with acetaminophen-laden mice, and another spoke about traps that are visible around airports and seaports to remove brown treesnakes, preventing them from invading other locations. Many participants named specific invasive species and specific strategies to manage them (e.g., snake traps); however, they expressed unfamiliarity with some aspects, such as whether other techniques were tried or the extent or success rates of certain management tools.

Despite the military's negative environmental impacts arising again and again in these discussions, participants also pointed out some positive conservation aspects of their presence in Guåhan. These examples usually concerned how military lands remained more pristine than lands outside of the bases because they were hard to access by people and therefore remained more intact (Table 4).

DISCUSSION

We explored Guamanians' perceptions of invasive species, other environmental issues, and environmental management strategies. We detected some consistent themes among participants, including judgments of other residents and leaders and perceptions of their own influence with regard to environmental outcomes. Participants keyed in on apathy among the general public and decision-makers as a major challenge for conservation in Guåhan. They also expressed frustrations with efficacy of conservation strategies at multiple levels, including their own actions and those of environmental agencies and managers. Many groups spoke about how disconnected and powerless they were in the face of environmental impacts because they were not informed of management efforts and their concerns were ignored by, for example, the US military. These themes will likely raise alarms with conservation managers who are facing a potentially disaffected and frustrated island community. However, the prevalence of self-reported positive conservation actions (e.g., picking up litter and controlling invasive animals) and a desire for more information and involvement, especially with invasive species management, highlight opportunities for a more informed community engaged in local conservation efforts.

Apathy, along with a lack of awareness, is commonly cited as a roadblock to progress by environmental activists in many communities, but actual prevalence of apathy about environmental challenges is overblown (Frantz, 2022; Lertzman, 2009). Similarly, lack of awareness is also overstated as a barrier to positive environmental change, and efforts to improve "environmental awareness" have limited effects on behavioral or policy changes (Landry et al., 2018; Sturgis & Allum, 2004). Our results suggest that residents of Guåhan are similar to many residents in the United States in that they underestimate the support their fellow residents have for environmental actions. In addition, the misconception that minority or non-White populations are especially apathetic to environmental causes is still prevalent in the United States (Pearson et al., 2018). This misconception could be exacerbating the underestimation of residents in Guåhan because the population is majority non-White.

Despite lamenting about apathy, many participants spoke about proenvironmental individual actions they have undertaken. Although this type of self-assessment predictably came from participants affiliated with environmental groups, it was at least as common in discussions involving participants with no environmental connections; therefore, this was not likely a product of a self-selecting group of participants. Our participants may have been inflating assessments of their own proenvironmental actions, a behavior found by other scholars (Gamba & Oskamp, 1994; Lesic et al., 2018). This dissonance of themes—the asymmetry among participants between self-reported proenvironmental behaviors and apathy among others—is consistent with existing theory regarding judgment of behaviors. People often assess themselves differently from the way that they assess others and unconsciously judge others by different criteria than they would apply to themselves (Pronin et al., 2004). Our results align with studies pointing to this disparity in a multitude of different judgments, including people's own biases, their tendency to make hypocritical statements, and even the disparity between assessing their own and others' driving abilities (Delhomme, 1991; Hale & Pillow, 2015; Pronin, 2008). Because our participants were exhibiting this dissonance, local conservation managers may want to highlight more opportunities for community involvement. This would not only capitalize on the proclivity for proenvironmental actions by residents, but also provide avenues for residents to see each other performing these actions, perhaps

improving their perceptions of their fellow residents. In addition, this approach would challenge the still prevalent narrative of apathy by providing a positive example of community-engaged conservation actions.

Residents' perceptions that management strategies are ineffective in generating the desired results could lead to future unwillingness to engage or adopt recommended management actions (Kollmuss & Agyeman, 2010; Maguire, 2004). Multiple participants expressed frustrations with getting no response from agencies when they were prompted by educational materials to contact agencies and with individual actions being ineffective. This is a concerning finding and one that could lead to decreased perceptions of self-efficacy or even learned helplessness if efforts are not made to include residents in managing Guåhan's pressing environmental issues. "Learned helplessness" is a psychological term referring to an unwillingness to act to avoid adverse impacts because of a previous lack of control over those impacts (Abramson et al., 1978). It has been linked to despair about large-scale environmental issues, such as the overwhelming speed and impact of climate change, even when concern was high among study subjects (Landry et al., 2018). We raise it in this context because of the possibility that repeated lack of response to residents' efforts could amplify perceptions of exclusion from environmental activities and dampen public enthusiasm for engagement in management efforts that are perceived as federally controlled. For Guåhan residents, we saw some evidence of despair when talking about invasive species management, but despair was even more pronounced when talking about the US military's impacts on the local environment.

There may be a need to address and promote self-efficacy if, as our findings suggest, some participants feel helplessness around invasive species management. Perceptions of self-efficacy can heavily influence an individual's behavior (Ajzen, 2002). These perceptions can enhance motivation to continue a behavior if positive change is perceived, as has been demonstrated in many examples regarding human health, such as dietary changes or smoking habits (Gwaltney et al., 2009; Prestwich et al., 2013). Perceptions of self-efficacy have also been explored as an influence on proenvironmental behavior. Belief of self-efficacy can have a positive effect, as in an example from farmers in Minnesota practicing natural resource stewardship because they were encouraged by their past successes and abilities (Perry & Davenport, 2020). Diminished environmental self-efficacy can have a negative effect, leading to loss of motivation or abandonment of proenvironmental behaviors, as demonstrated by studies on personal action to combat climate change (Salomon et al., 2017).

Current governmental structures for conservation in Guåhan, especially with regard to invasive species, demonstrate barriers to public engagement. This approach also emphasizes the need to adopt a framework for invasive species management (such as the one developed by Shackleton et al. [2019]) that includes sociocultural factors, such as distrust, power dynamics, and apathy toward regulatory institutions and policies. We saw federal influence over management actions sometimes left participants in the dark, as when participants expressed confusion or misstated what was happening with the aerial mouse drops for brown treesnakes. Even more conspicuous in our discussion groups was participants' perceived helplessness in the face of any actions by the military. The US military is a major player in conservation issues, but they report to leaders who are not on island and who have little impetus to seriously consider local concerns (Na'Puti & Bevacqua, 2015). Further, they have an extensive history of environmental damage through the development and continued expansion of bases that occupy almost one third of the island's land mass (US Fish & Wildlife Service, 2017). Even outside of the military, established models of conservation in the United States still ignore the knowledge of Indigenous populations (Domínguez & Luoma, 2020; Hessami et al., 2021), and conservation in Guåhan is no exception. This is mirrored in other colonized places where Indigenous peoples are faced with Western styles of conservation that do not necessarily take into account the learned history and extensive relationships that these populations have with the natural world (Adams et al., 2014; Cámara-Leret et al., 2019). Although we provide some insights into local perceptions in Guåhan, we strongly encourage future studies into how best to move forward with conservation developed in partnership with residents, especially Indigenous leaders.

Although we have confidence in our themes, our study had some limitations. We employed convenience sampling by reaching out to our colleagues at the university, community college, and local agencies who work in conservation and to personal contacts because a few of us have lived and worked in Guåhan for many years. Perhaps because of the nature of the topics being advertised for discussion or because of our connections to the conservation community in Guåhan, this sample included residents with stronger connections to nature. However, themes that emerged in the more environmentally connected group were consistent with the groups that did not have such a connection. In addition, our work was interrupted by the COVID pandemic, which meant conducting some discussions over Zoom, which may have excluded residents with limited access to internet. Further, new post-COVID conditions may have contributed to amplified emphasis on environmental action and public engagement. Of note, before the last 4 discussion groups at the end of 2020 and beginning of 2021, the community was alerted to the discovery of brown treesnakes on Dåno, an islet off the coast of Guåhan that was managed as a refuge for native birds, including endangered ko'ko' (endemic rail) (*Hypotaenidia owstoni*). These birds were introduced just over a decade before and had received international media attention as one of only 2 birds to recover from extinction in the wild (Lazarus, 2019). A volunteer effort sprung up to remove brown treesnakes from the island (University of Guam, 2021) as the community awaited plans for larger scale control from government agencies. It is possible that this example of community engagement contributed to increased salience of this theme for our participants.

Despite the numerous challenges outlined above, we see bright spots in the potential for developing effective public engagement with invasive species management in Guåhan. This is particularly important because plans for island-wide

control of any invasive species will require public buy-in for access to private lands and for support of local agencies using public resources for these efforts. Beyond those practicalities, we see comanagement with local residents, especially Indigenous CHamoru communities, in Guåhan as an ethical imperative. Instead of viewing communities as potential barriers to conservation action, they should be the leaders in enacting positive conservation change. We hope our study provides some insights into how to best begin that process. We see hope from our participants' eagerness to perform proenvironmental behaviors and from the fact that environmental volunteer opportunities, such as the annual fanihi (fruit bat) count and the recent program to catch brown treesnakes on Dåno, have no trouble garnering volunteers (Pacific News Center, 2014; O. Terrel, personal communication) Kastner & Terral 2023. Guåhan's residents still appear to show concern and willingness to act on environmental issues, meaning, if given the necessary information and tools to succeed, as with the fanihi count and the snake-catching activities described above, there is promising potential for community-driven conservation successes.

ACKNOWLEDGMENTS

We thank our volunteer participants and the organizations that helped us recruit participants, including the University of Guam, the Inarajan Mayor's Office, the Inarajan and Mangilao Senior Centers, J. Kerr at the Guam Community College, the Håya Foundation, Sagan Kotturan CHamoru, and the Guam Department of Agriculture. This study was made possible through funding by Iowa State University College of Liberal Arts and Sciences Social Science Seed Grant (2017). We also thank the reviewers and the guest editors for this special issue. We thank K. Nelson for assistance with discussion group logistics.

ORCID

Ann Marie Gawel https://orcid.org/0000-0001-5611-8700

REFERENCES

Abramson, L. Y., Seligman, M. E., & Teasdale, J. D. (1978). Learned helplessness in humans: Critique and reformulation. *Journal of Abnormal Psychology*, *87*(1), 49–74.

Adams, M. S., Carpenter, J., Housty, J. A., Neasloss, D., Paquet, P. C., Service, C., Walkus, J., & Darimont, C. T. (2014). Toward increased engagement between academic and indigenous community partners in ecological research. *Ecology & Society*, *19*(3), Article 5. https://doi.org/10.5751/ES-06569-190305

Ajzen, I. (2002). Perceived behavioral control, self-efficacy, locus of control, and the theory of planned behavior. *Journal of Applied Social Psychology*, *80*(6), 2918–2940.

Alexander, R. (2016). Living with the fence: Militarization and military spaces on Guåhan/Guam. *Gender, Place & Culture*, *23*(6), 869–882.

Barbour, W., & Schlesinger, C. (2012). Who's the boss? Post-colonialism, ecological research and conservation management on Australian Indigenous lands. *Ecology Restoration & Management*, *13*(1), 36–41. https://doi.org/10.1111/j.1442-8903.2011.00632.x

Bevacqua, R. F., & Miller, R. H. (2020). *Invasive vines of Guam*. University of Guam.

Black, A., Garner, G., Mark-Shadbolt, M., Balanovic, J., MacDonald, E., Mercier, O., Wright, J., Calver, M., Black, A., Garner, G., Mark-Shadbolt, M., Balanovic, J., MacDonald, E., Mercier, O., Wright, J., & Calver, M. (2021). Indigenous peoples' attitudes and social acceptability of invasive species control in New Zealand. *Pacific Conservation Biology*, *28*(6), 481–490.

Brown, P. (1995). Race, class, and environmental health: A review and systematization of the literature. *Environmental Research*, *69*(1), 15–30.

Cámara-Leret, R., Fortuna, M. A., & Bascompte, J. (2019). Indigenous knowledge networks in the face of global change. *Proceedings of the National Academy of Sciences of the United States of America*, *116*(20), 9913–9918.

Conry, P. (1989). *Ecology of the feral pig on Guam*. Guam Department of Agriculture, Division of Aquatic and Wildlife Resources Report.

Delhomme, P. (1991). Comparing one's driving with others': Assessment of abilities and frequency of offences. Evidence for a superior conformity of self-bias? *Accident Analysis and Prevention*, *23*(6), 493–508.

Demeulenaere, E. (2021). Prutehi Litekyan: A social movement to protect biocultural diversity and restore indigenous land sovereignty on Guåhan. In S. Acabado & D. Kuan (Eds.), *Indigenous peoples, heritage and landscape in the Asia Pacific* (pp. 54–71). Routledge.

Domínguez, L., & Luoma, C. (2020). Decolonising conservation policy: How colonial land and conservation ideologies persist and perpetuate indigenous injustices at the expense of the environment. *Land*, *9*(3), 11–14.

Estévez, R. A., Anderson, C. B., Pizarro, J. C., & Burgman, M. A. (2015). Clarifying values, risk perceptions, and attitudes to resolve or avoid social conflicts in invasive species management. *Conservation Biology*, *29*(1), 19–30.

Frantz, C. M. P. (2022). To create serious movement on climate change, we must dispel the myth of indifference. *Nature Communications*, *13*, Article 4780.

Fraser, A. (2006). *Public attitudes to pest control: A literature review* (DOC Research & Development Series 227). Department of Conservation.

Fritts, T. H., McCoid, M. J., & Haddock, R. L. (1990). Risks to infants on Guam from bites of the brown tree snake (*Boiga irregularis*). *American Journal of Tropical Medicine and Hygiene*, *42*(6), 607–611.

Fritts, T. H., & Rodda, G. H. (1998). The role of introduced species in the degradation of island ecosystems: A case history of Guam. *Annual Review of Ecology and Systematics*, *29*(1998), 113–140.

Gamba, R. J., & Oskamp, S. (1994). Factors influencing community residents' participation in commingled curbside recycling programs. *Environment and Behavior*, *26*(5), 587–612.

Guzman, A., Heinen, J., & Sah, J. (2020). Evaluating the conservation attitudes, awareness and knowledge of residents towards Vieques National Wildlife Refuge, Puerto Rico. *Conservation and Society*, *18*(1), 13–24.

Gwaltney, C. J., Metrik, J., Kahler, C. W., & Shiffman, S. (2009). Self-efficacy and smoking cessation: A meta-analysis. *Psychology of Addictive Behaviors*, *23*(1), 56–66.

Hale, W. J., & Pillow, D. R. (2015). Asymmetries in perceptions of self and others' hypocrisy: Rethinking the meaning and perception of the construct. *European Journal of Social Psychology*, *45*(1), 88–98.

Hays, W. S. T., & Conant, S. (2007). Biology and impacts of Pacific Island invasive species. 1. A worldwide review of effects of the small Indian mongoose, Herpestes javanicus (Carnivora: Herpestidae). *Pacific Science*, *61*(1), 3–16.

Helmreich, S. (2005). How scientists think; about "natives", for example. A problem of taxonomy among biologists of alien species in Hawaii. *Journal of the Royal Anthropological Institute*, *11*(1), 107–128.

Hennink, M., & Kaiser, B. N. (2022). Sample sizes for saturation in qualitative research: A systematic review of empirical tests. *Social Science & Medicine*, *292*, Article 114523. https://doi.org/10.1016/J.SOCSCIMED.2021.114523

Hessami, M. A., Bowles, E., Popp, J. N., & Ford, A. T. (2021). Indigenizing the North American model of wildlife conservation. *Facets*, *6*, 1285–1306.

Hung, H., Carson, M. T., Bellwood, P., Campos, F. Z., Piper, P. J., Dizon, E., Bolunia, M. J. L. A., Oxenham, M., & Chi, Z. (2011). The first settlement of Remote Oceania: The Philippines to the Marianas. *Antiquity*, *85*, 909–926.

Joint Region Marianas. (2020). *Final Joint Region Marianas Integrated Natural Resources Management Plan*. Author.

Kamelamela, K. L., Springer, H. K., Ku'ulei Keakealani, R., Ching, M. U., Ticktin, T., Ohara, R. D., Parsons, E. W., Adkins, E. D., Francisco, K. S., & Giardina, C. (2022). Kōkua aku, Kōkua mai: An Indigenous consensus-driven and place-based approach to community led dryland restoration and stewardship. *Forest Ecology and Management*, *506*, Article 119949. https://doi.org/10.1016/J.FORECO.2021.119949

Kastner, M., & Terral, O. (2023). "Establishing a Volunteer Group to Assist in the Eradication of Invasive Brown Treesnakes from Islan Dåno' (Cocos Island), Guam." *Human-Wildlife Interactions*, *17*(2), Article 11. DOI: https://doi.org/10.26077/825a-353b

Kollmuss, A., & Agyeman, J. (2010). Mind the Gap: Why do people act environmentally and what are the barriers to pro-environmental behavior? *Environmental Education Research*, *8*(3), 239–260.

Landry, N., Gifford, R., Milfont, T. L., Weeks, A., & Arnocky, S. (2018). Learned helplessness moderates the relationship between environmental concern and behavior. *Journal of Environmental Psychology*, *55*, 18–22. https://doi.org/10.1016/J.JENVP.2017.12.003

Lazarus, S. (2019). "The Guam rail was extinct in the wild for nearly 40 years. Now it's back." CNN World. Dec. 19, 2019. https://edition.cnn.com/2019/12/19/world/guam-rail-brought-back-from-extinction-in-wild-scn-c2e-intl-hnk/index.html

Lertzman, R. A. (2009). *The myth of apathy: Psychoanalytic explorations of environmental degradation* (Doctoral dissertation). Cardiff University.

Lesic, V., De Bruin, W. B., Davis, M. C., Krishnamurti, T., & Azevedo, I. M. L. (2018). Consumers' perceptions of energy use and energy savings: A literature review. *Environmental Research Letters*, *13*(3), Article 033004. https://doi.org/10.1088/1748-9326/aaab92

Lewis, C. L., Granek, E. F., & Nielsen-Pincus, M. (2019). Assessing local attitudes and perceptions of non-native species to inform management of novel ecosystems. *Biological Invasions*, *21*(3), 961–982.

Maguire, L. A. (2004). What can decision analysis do for invasive species management? *Risk Analysis: An Official Publication of the Society for Risk Analysis*, *24*(4), 859–868.

Makri, C., & Neely, A. (2021). Grounded theory: A guide for exploratory studies in management research. *International Journal of Qualitative Methods*, *20*, 1–14. https://doi.org/10.1177/16094069211013654

Marler, T. E. (2020). Three invasive tree species change soil chemistry in Guam forests. *Forests*, *11*(3), Article 279.

Moore, A., Jackson, T., Quitugua, R., Bassler, P., & Campbell, R. (2015). Coconut rhinoceros beetles (Coleoptera: Scarabaeidae) develop in arboreal breeding sites in Guam. *Florida Entomologist*, *98*(3), 1012–1014.

Na'Puti, T. R., & Bevacqua, M. L. (2015). Militarization and resistance from Guåhan: Protecting and defending Pågat. *American Quarterly*, *67*(3), 837–858.

Nogueira-Filho, S. L. G., Nogueira, S. S. C., & Fragoso, J. M. V. (2009). Ecological impacts of feral pigs in the Hawaiian Islands. *Biodiversity and Conservation*, *18*(14), 3677–3683.

Norgaard, K. M. (2007). The Politics of Invasive Weed Management: Gender, Race, and Risk Perception in Rural California. *Rural Sociology*, *72*(3), 450–477.

Pacific News Center. (2014). *DVIDS: First large-scale survey at Andersen AFB sets baseline for threatened species—PNC News First*. PNC Guam.

Pearson, A. R., Schuldt, J. P., Romero-Canyas, R., Ballew, M. T., & Larson-Konar, D. (2018). Diverse segments of the US public underestimate the environmental concerns of minority and low-income Americans. *Proceedings of the National Academy of Sciences of the United States of America*, *115*(49), 12429–12434.

Perry, V., & Davenport, M. A. (2020). An inductive framework of self-efficacy to understand and support farmers in conservation agriculture. *Journal of Soil and Water Conservation*, *75*(2), 198–208.

Prestwich, A., Kellar, I., Parker, R., MacRae, S., Learmonth, M., Sykes, B., Taylor, N., & Castle, H. (2013). How can self-efficacy be increased? Meta-analysis of dietary interventions. *Health Psychology Review*, *8*(3), 270–285.

Pronin, E. (2008). How we see ourselves and how we see others. *Science*, *320*(5880), 1177–1180.

Pronin, E., Gilovich, T., & Ross, L. (2004). Objectivity in the eye of the beholder: Divergent perceptions of bias in self versus others. *Psychological Review*, *111*(3), 781–799.

Raymundo, M. L., & Miller, R. H. (2012). Little fire ant, *Wasmannia auropunctata* (Roger) (Hymenoptera: Formicidae), established at several locations on Guam. *Proceedings of the Hawaiian Entomological Society*, *44*, 85–87.

Rodda, G. H., Fritts, T. H., & Chiszar, D. (2008). The disappearance of Guam's wildlife and conservation. *Bioscience*, *47*(9), 565–574.

Rodda, G. H., & Savidge, J. A. (2007). Biology and impacts of Pacific island invasive species. 2. *Boiga irregularis*, the brown tree snake (Reptilia: Colubridae). *Pacific Science*, *61*(3), 307–324.

Rogers, H. S., Buhle, E. R., HilleRisLambers, J., Fricke, E. C., Miller, R. H., & Tewksbury, J. J. (2017). Effects of an invasive predator cascade to plants via mutualism disruption. *Nature Communications*, *8*, Article 14557.

Rogers, R. F. (2011). *Destiny's landfall: A history of Guam* (Revised). University of Hawai'i Press.

Russell, J. C., Meyer, J. Y., Holmes, N. D., & Pagad, S. (2017). Invasive alien species on islands: Impacts, distribution, interactions and management. *Environmental Conservation*, *44*(4), 359–370.

Salomon, E., Preston, J. L., & Tannenbaum, M. B. (2017). Climate change helplessness and the (de)moralization of individual energy behavior. *Journal of Experimental Psychology: Applied*, *23*(1), 15–28.

Saunders, B., Sim, J., Kingstone, T., Baker, S., Waterfield, J., Bartlam, B., Burroughs, H., & Jinks, C. (2018). Saturation in qualitative research: Exploring its conceptualization and operationalization. *Quality and Quantity*, *52*(4), 1893–1907.

Savidge, J. A. (1987). Extinction of an island forest avifauna by an introduced snake. *Ecology*, *68*(3), 660–668.

Schell, C. J., Dyson, K., Fuentes, T. L., Roches, S. D., Harris, N. C., Miller, D. S., Woelfle-Erskine, C. A., & Lambert, M. R. (2020). The ecological and evolutionary consequences of systemic racism in urban environments. *Science*, *369*(6509), Article eaay4497. https://doi.org/10.1126/SCIENCE.AAY4497

Shackleton, R. T., Richardson, D. M., Shackleton, C. M., Bennett, B., Crowley, S. L., Dehnen-Schmutz, K., Estévez, R. A., Fischer, A., Kueffer, C., Kull, C. A., Marchante, E., Novoa, A., Potgieter, L. J., Vaas, J., Vaz, A. S., & Larson, B. M. H. (2019). Explaining people's perceptions of invasive alien species: A conceptual framework. *Journal of Environmental Management*, *229*, 10–26.

Sturgis, P., & Allum, N. (2004). Science in society: Re-evaluating the deficit model of public attitudes. *Public Understanding of Science*, *13*(1), 55–74.

Ticktin, T., Whitehead, A. N., & Fraiola, H. (2006). Traditional gathering of native hula plants in alien-invaded Hawaiian forests: Adaptive practices, impacts on alien invasive species and conservation implications. *Environmental Conservation*, *33*(3), 185–194.

University of Guam. (2021). *Snake hunting with volunteer group Friends of Islan Dåno*. Pacific Daily News. https://www.guampdn.com/news/local/snake-hunting-with-volunteer-group-friends-of-islan-d-no/video_0e33dc85-89b0-54be-9869-842a28c12539.html

US Department of Health and Human Services. (2021). *Guam - 2020 - III.B. Overview of the State*. https://mchb.tvisdata.hrsa.gov/Narratives/Overview/27e602c4-2c10-46fb-8300-4d3a17ba5fe4

US Department of the Interior. (2017). *Interior provides $409,885 to Guam to mitigate infestations of the coconut rhinoceros beetle and little fire ant; protect natural resources*. https://www.doi.gov/oia/intl/interior-provides-409885-guam-mitigate-infestations-coconut-rhinoceros-beetle-and-little-fire

US Department of the Interior. (2021). *Interior announces $4.1 million to fight the brown tree snake on Guam*. https://www.doi.gov/oia/press/Interior-Announces-%244.1-Million-to-Fight-the-Brown-Tree-Snake-on-Guam

US Fish and Wildlife Service. (2017). *Reinitiation of the 2015 Biological Opinion on the Department of the Navy's Relocation of U.S. Marine Corps from Okinawa to Guam and Associated Activities on Guam*. Author.

Wald, D. M., Jacobson, S. K., & Levy, J. K. (2013). Outdoor cats: Identifying differences between stakeholder beliefs, perceived impacts, risk and management. *Biological Conservation*, *167*, 414–424.

Wald, D. M., Nelson, K. A., Gawel, A. M., & Rogers, H. S. (2019). The role of trust in public attitudes toward invasive species management on Guam: A case study. *Journal of Environmental Management*, *229*, 133–144.

Warner, K. D., & Kinslow, F. (2013). Manipulating risk communication: Value predispositions shape public understandings of invasive species science in Hawaii. *Public Understanding of Science*, *22*(2), 203–218.

Wehi, P. M., Kamelamela, K. L., Whyte, K., Watene, K., & Reo, N. (2023). Contribution of Indigenous Peoples' understandings and relational frameworks to invasive alien species management. *People and Nature*, *5*(5), 1403–1414.

Wehi, P. M., Wilson, D. J., Stone, B., Ricardo, H., Jones, C., Jakob-Hoff, R., & Lyver, P. O. B. (2009). Managing for cultural harvest of a valued introduced species, the Pacific rat (*Rattus exulans*) in Aotearoa New Zealand. *Pacific Conservation Biology*, *27*, 432–441.

Wiles, G. J., Buden, D. W., & Worthington, D. J. (1999). History of introduction, population status, and management of Philippine deer (*Cervus mariannus*) on Micronesian Islands. *Mammalia*, *63*(2), 193–216. https://doi.org/10.1515/mamm.1999.63.2.193

SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

How to cite this article: Gawel, A. M., Wald, D. M., & Rogers, H. S. (2024). Community perceptions of invasive species and environmental management in a US island territory. *Conservation Biology*, *38*, e14394. https://doi.org/10.1111/cobi.14394