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Mālama i ke kai: Exploring psychosocial factors associated with personal and community coral reef conservation behavior on Maui, Hawai'i

Francisca N. Santana[1,2] | **Alana Yurkanin**[3] | **Tiara E. Stark**[3] | **Ekolu Lindsey**[4] | **Nicole M. Ardoin**[1,5,6] | **Gabrielle Wong-Parodi**[5,6,7]

[1]Emmett Interdisciplinary Program in Environment and Resources, Stanford Doerr School of Sustainability, Stanford University, Stanford, California, USA

[2]School for Environment and Sustainability, University of Michigan, Ann Arbor, Michigan, USA

[3]Maui Marine Program, The Nature Conservancy, Makawao, Hawai'i, USA

[4]Polanui Hiu, Polanui, Hawai'i, USA

[5]Environmental Behavioral Sciences, Stanford Doerr School of Sustainability, Stanford University, Stanford, California, USA

[6]Stanford Woods Institute for the Environment, Stanford Doerr School of Sustainability, Stanford University, Stanford, California, USA

[7]Department of Earth Systems Science, Stanford Doerr School of Sustainability, Stanford University, Stanford, California, USA

Correspondence
Francisca N. Santana, School of Environment and Forest Sciences, University of Washington, Anderson Hall, 3715 W. Stevens Way NE, Seattle, WA 98195, USA.
Email: fsantana@uw.edu

Funding information
Office of the Vice Provost of Graduate Education, Stanford University; School of Earth, Energy, and Environmental Sciences, Stanford University

Abstract

Local and community conservation efforts can increase coral reefs' capacity to adapt to climate change. In this community-engaged study, we examine affective dimensions and other psychosocial factors associated with coastal user conservation intentions and behaviors on Maui, Hawai'i. In October and November 2019, we surveyed coastal users ($n = 299$). We found natural place attachment, sense of responsibility, and concern for coral reef ecosystems were positively associated with *personal* conservation intentions; civic place attachment was positively associated with *community* conservation intentions; and natural place attachment was positively associated with signing the Pono Pledge, a voluntary conservation commitment. We found personal and community response efficacy were positively associated with corresponding levels of conservation intentions. Our results provide insights into psychosocial factors that may underpin coral reef conservation behavior and inform partner communications and outreach.

KEYWORDS

affective dimensions, conservation behavior, coral reef conservation, marine conservation, place attachment, pro-environmental behavior, psychosocial factors, response efficacy, sense of responsibility

1 | INTRODUCTION

Coral reef ecosystems are under threat from human activity at multiple scales (Bellwood et al., 2004; Descombes et al., 2015; Hughes et al., 2017). Global climate change is the main driver of coral reef degradation and transformation (Graham et al., 2015; Morrison et al., 2020). Ocean warming and declining O_2 and pH could result in the extinction of approximately 40% of marine life in the next 300 years, with most biodiversity loss in tropical environments, including coral reef ecosystems (Penn & Deutsch, 2022). Local human impacts—such as, overfishing, sedimentation, nutrient pollution, and ocean-based recreation—further degrade and reduce reef resilience (Abelson, 2020; Hughes et al., 2017). However, efforts to protect reefs from human activity can mitigate local stressors and increase reefs' capacity to adapt to climate-related impacts (Hughes et al., 2017).

"Coastal user"[1] decisions can contribute to and improve local and community-based conservation (Bellwood et al., 2019). To protect coral reefs, individuals can take personal, embodied actions or engage in collective, community level behaviors. Yet actions are not always taken because of lack of problem awareness or habit (Gifford, 2011). Psychosocial factors such as attitudes (Bamberg & Möser, 2007), values (Stern et al., 1999), social norms (Cialdini et al., 1990), and efficacy perceptions (Fishbein & Ajzen, 2011) can predict pro-environmental behaviors related to biodiversity conservation. Evidence also suggests that affective dimensions like place attachment (Lewicka, 2011), sense of responsibility (Vaughan & Ardoin, 2014), and resource-specific concern (Larson et al., 2018) are correlated with conservation behavior, yet more research is needed to clarify these relationships and inform potential behavioral interventions (Gifford, 2014; Reddy et al., 2017). We define "affective dimensions" as psychosocial factors measuring emotional involvement with nature (Kollmuss & Agyeman, 2002). Understanding the factors predicting individual conservation behavior is essential to developing effective interventions and encouraging pro-environmental action (Allen et al., 2022; Clayton et al., 2015; Selinske et al., 2018).

We explore how affective dimensions and other psychosocial factors are associated with coastal user conservation intentions and behavior through a community-engaged case study on Maui, Hawai'i. Coral reefs hold great cultural significance for Indigenous Hawaiians (Friedlander et al., 2008) and are valuable for fishing and tourism industries (Cesar & van Beukering, 2004). The Kumulipo (Hawaiian Creation Chant) names the ko'a (∼coral polyp) as the first entity born from the sea, and animals inhabiting coral reefs (e.g., sharks, turtles) are considered 'aumakua (∼manifestations of family gods) (Gregg et al., 2015; Hobson & Chave, 1990). In 2019, over 10 million people visited the Hawaiian Islands generating $18 billion in revenue (Hawai'i Tourism Authority, 2020). Coastal development and tourism, however, contribute to pollution and ocean-based recreation (Friedlander et al., 2008). Studies examining reef co-management have shown that conservation is enhanced by leveraging local ecological knowledge, values, and norms (Ayers & Kittinger, 2014; Barnes et al., 2019; Cinner et al., 2012; Vaughan, 2018); yet few studies have been co-produced with community groups to explore what motivates individual coral reef conservation behavior (Dean et al., 2018; McDonald et al., 2020). To our knowledge, no studies published in peer-reviewed literature have co-developed a survey with local or Indigenous organizations investigating place-specific and culturally significant psychosocial constructs underpinning conservation behavior. Through a partnership with a Hawaiian community organization, Polanui Hiu; conservation NGO, The Nature Conservancy; and researchers at Stanford University, we assess coastal user psychosocial factors, conservation intentions, and enacted behaviors by co-developing and conducting an in-person survey on Maui, Hawai'i. Our study provides insights into the affective dimensions and psychosocial factors that may motivate coastal users to "mālama i ke kai" (∼care for the ocean) in a coral reef environment.

2 | CONCEPTUAL FRAMEWORK

"Pro-environmental behavior" refers to actions by individuals or groups that protect natural resources and provide benefits to the biophysical environment and sustainability (Larson et al., 2015; Steg & Vlek, 2009). Behaviors include personal, private-sphere actions, such as recycling and community-oriented, public-sphere activities, such as donating to environmental organizations (Larson et al., 2015; Stern, 2000). We define "conservation behavior" as a subset of pro-environmental behavior targeting conservation of threatened places and natural resources, in this case, coral reefs. Coral reef conservation behavior can be divided into *personal* conservation behavior, involving private-sphere behavior (e.g., wearing reef-safe sunscreen) and *community* conservation behavior, involving civic-oriented, public-sphere behaviors (e.g., volunteering for a beach clean-up) (Ardoin et al., 2023). Our study focuses on conservation intentions from these two levels, and two enacted behaviors: a voluntary conservation commitment—the Pono (∼righteousness, balance) Pledge—and provision of an email address to local conservation organizations.

Voluntary commitment-making (i.e., a pledge) promotes pro-environmental behavior (Gifford, 2014; Lokhorst et al., 2013), while providing an email address is a form of technology-based, information-seeking behavior, which supports future environmental learning and durable conservation engagement (Wheaton et al., 2016).

Simply increasing awareness of biodiversity issues does not necessarily lead to behavior change (Reddy et al., 2017; Schultz, 2011); therefore, we examine psychosocial factors relating to coral reef conservation behavior (Clayton & Myers, 2015) with a focus on affective dimensions (see Table 1 for definitions of psychosocial factors). Affective connections to meaningful places and natural resources can be important precursors to pro-environmental and conservation behaviors (Gifford, 2014; Gosling & Williams, 2010; Larson et al., 2018). Relative to other psychosocial factors, research on affective dimensions—such as place attachment, sense of responsibility, and concern—and conservation behavior has been limited (Reddy et al., 2017). Given this, scholars have called for additional research on affective drivers of behavior (Bennett et al., 2017), specifically pertaining to ocean sustainability (Belhabib et al., 2022; van Putten et al., 2018). Such research can improve existing frameworks that have found weak links between knowledge, attitudes, and conservation behaviors (Bamberg & Möser, 2007). A focus on affective dimensions may better honor local and Indigenous peoples' emotional connections and ancestral ties with land and resources (Belhabib et al., 2022; van Putten et al., 2018) and provide a lens examining how such connections relate to conservation action.

2.1 | Affective dimensions

Place attachment, or the positive emotional bond between a person and a place (Lewicka, 2011; Low & Altman, 1992), has been hypothesized to have many dimensions, including place identity and place dependence (Ramkissoon et al., 2012). Several place attachment studies have been conducted in coastal marine settings (Sakurai et al., 2017), specifically coral reef systems (Gurney et al., 2017; Tonge et al., 2015; Wynveen et al., 2012). In an Australian marine park, Tonge et al. (2015) found greater place identity was positively associated with intentions to: take personal actions, tell others to take action, and participate in collective actions. To better distinguish between connections to the biophysical environment as compared to the social, Scannell and Gifford (2010) proposed dividing place attachment into two constructs: natural place attachment and civic place attachment. Studies using these constructs have found positive associations between natural place attachment and pro-environmental behavior (Scannell & Gifford, 2010), as well as negative associations, in the case of invasive species removal (Niemiec et al., 2017). Some studies have found positive associations between

TABLE 1 Definitions of psychosocial factors.

Psychosocial factor	Definition	References
Affective		
Natural place attachment	Emotional bond to place and biophysical environment	Scannell & Gifford, 2010
Civic place attachment	Emotional bond to community and social environment	Scannell & Gifford, 2010
Sense of responsibility	Sense of responsibility for and reciprocity with coral reefs	Vaughan & Ardoin, 2014; Young, 2006
Concern for coral reef ecosystem	Sense of concern or worry about coral reefs on Maui	Larson et al., 2018
Non-affective		
Subjective social norms	Perception of social expectations of close others	Ajzen, 1991
Self-efficacy	Perception of one's ability to take action	Ajzen, 1991; Bandura, 2000; Larson et al., 2015; Rogers, 1975
Personal response efficacy	Perception that personal actions will be effective	Bandura, 2000; Larson et al., 2015; Rogers, 1975
Community response efficacy	Perception that community actions will be effective	Bandura, 2000; Larson et al., 2015; Rogers, 1975
Coral reef health perceptions	Perception of health of coral reefs on Maui	Curnock et al., 2019; Marshall, Marshall, et al., 2019

civic place attachment and community-based environmental behavior (Niemiec et al., 2017; Kyle et al., 2010; Lewicka, 2005), while other studies have shown no associations (Scannell & Gifford, 2010). Given these inconsistent results, further study is warranted into how natural and civic place attachment may motivate different levels of conservation behavior.

Sense of responsibility is another affective dimension related to behavior. This concept is closely connected to the Hawaiian value of kuleana, which has been defined as "a received sense of ancestrally-based responsibility" (Young, 2006). The definition of kuleana is culturally complex, involving elements of reciprocity, accountability, and privilege (Kawelu, 2007; Marlow, 2000). We conceptualize sense of responsibility as inspired by, but not fully capturing, the Indigenous Hawaiian value of kuleana. One study in Hawai'i found, compared with visitors, residents felt a greater sense of responsibility to protect marine resources (Vaughan & Ardoin, 2014). The study theorized that poor resource health perceptions were a component of sense of responsibility, which could predict participation in resource management (Vaughan & Ardoin, 2014); however, this hypothesis was not explicitly tested. Other studies suggest that a sense of personal responsibility mediates relationships between perceptions and behavior (Bamberg & Möser, 2007; Kollmuss & Agyeman, 2002). By testing the relationship between sense of responsibility and conservation behavior in a comprehensive model, we expect to learn about its role in predicting conservation behavior.

Concern for the environment, broadly, has been found to be a precursor to pro-environmental behavior (Dunlap et al., 2000; Larson et al., 2018), as have threat perceptions and concern for ecosystems or natural resources (Bockarjova & Steg, 2014; Keshavarz & Karami, 2016). Related to concern, environmental sensitivity (empathy for the environment) has been found to predict stronger place attachment and pro-environmental behavior as well as mediate the relationship between environmental knowledge and behavior (Cheng & Wu, 2015). Based on this evidence, we anticipate that concern for Maui's coral reef ecosystem will be positively associated with intended and enacted conservation behavior.

2.2 | Other psychosocial factors

Social norms have been found to motivate pro-environmental behavior (Abrahamse & Steg, 2013; Gifford, 2011; Niemiec et al., 2020). Many empirical studies have drawn from the Theory of Planned Behavior (TPB) (Ajzen, 1991), which proposes that subjective social norms, attitudes toward a behavior, and perceived behavioral control (i.e., self-efficacy) are antecedents of behavioral intentions. Despite calls to investigate the relationships between social norms and conservation action in coastal settings (Cinner, 2018; Morrison et al., 2020), empirical research in this area has been minimal. When studied, it has focused on fisheries management (Bennett et al., 2014; Crandall et al., 2018; McDonald et al., 2020). Crandall et al. (2018) found that greater reported subjective social norms were associated with fishers taking resource-conserving actions. To our knowledge, no studies have examined the correlation between subjective social norms and coral reef conservation behavior by recreational coastal users. Building on literature from other settings (Abrahamse & Steg, 2013), we expect that coastal users reporting greater subjective social norms about reef conservation will more likely enact such behaviors.

Self-efficacy and *response efficacy* are commonly observed antecedents to pro-environmental behavior (Bandura, 2000; Larson et al., 2015). Some studies draw on the TPB, while others employ Protection Motivation Theory (PMT), which suggests that behavior is associated with self and response efficacy, as well as threat perceptions (Bockarjova & Steg, 2014; Rogers, 1975). Empirical work has found that self-efficacy predicts climate adaptation (van Valkengoed & Steg, 2019) and aquatic invasive species mitigation behavior (Howell et al., 2015), while response efficacy predicts climate mitigation behavior (Bostrom et al., 2019; Bradley et al., 2020). Bostrom et al. (2019) examined response efficacy at three levels of action (personal, collective, and government) finding collective and government-level response efficacy to be positively associated with support for actions appropriate for each level. To date, research on efficacy has rarely been applied to coastal conservation settings (Howell et al., 2015). We anticipate that self-efficacy will be associated with personal and community-level intentions, while measures of response efficacy (personal and community) will correlate with corresponding levels of conservation intentions.

Perceptions of poor resource health can also relate to conservation behavior, such as in coral reef environments with iconic aesthetic features (e.g., vibrant colors and diverse displays of fish assemblages) (Marshall, Marshall, et al., 2019). Research on visitor experiences in Australia's Great Barrier Reef has found that coastal users develop perceptions of reefs through visual, place-based experiences, such as snorkeling and scuba-diving (Curnock et al., 2019; Marshall, Marshall, et al., 2019). Evidence also suggests that perceptions of reef visual aesthetics (i.e., features of healthy corals—coral topography, fish abundance, and water visibility) are positively associated with satisfaction from interacting with reefs

(Marshall, Marshall, et al., 2019) and, as perceptions of aesthetics decline, protective sentiment increases (Curnock et al., 2019). Therefore, we expect that greater conservation intentions and behaviors will be associated with poorer coral reef health perceptions.

2.3 | Local community knowledge

Pursuing locally and culturally relevant research, realistic interventions, and equitable conservation outcomes requires engagement of local and Indigenous communities (Dawson et al., 2021). Thus, our conceptual framework draws on local and community partner knowledge, values, and experiences. Anecdotal evidence from partner experiences with coastal users supports empirical literature suggesting associations between coral reef health perceptions, concern, and conservation behavior. Partners have noted that, after coastal users personally identify visual features of reef degradation, such as bleaching and algae overgrowth, they are more likely to express concern for worsening coral reef conditions on Maui, and subsequently engage in conservation efforts. Also, local partners were interested in understanding how kuleana may play a role in motivating conservation behavior among coastal residents and visitors.

2.4 | Hypotheses

Based on the literature discussed and our conceptual framework (Figure 1), we hypothesize that natural and civic place attachment, sense of responsibility, concern for the coral reef ecosystem, reported subjective social norms, perceptions of self-efficacy, and perceptions of poor coral reef health, and:

Hypothesis 1. Personal response efficacy will be positively associated with personal conservation intentions (H1).

Hypothesis 2. Community response efficacy will be positively associated with community conservation intentions (H2).

Hypothesis 3. Personal and community response efficacy will be positively associated with likelihood of signing the Pono Pledge (H3a) and providing an email address (H3b).

3 | METHODS

3.1 | Study area and community-engaged research

The study area includes beach parks and ocean access points from Pāpalaua Wayside State Park to Kā‘anapali Beach in West Maui, Hawai‘i, spanning approximately 14 miles of coastline (Figure 2). The study area's coral reef ecosystem is important for Indigenous Hawaiian culture, human recreation, tourism, and ecological functions essential to adjacent marine and terrestrial ecosystems (Gregg et al., 2015; Minton et al., 2020; Sterling, 1998).

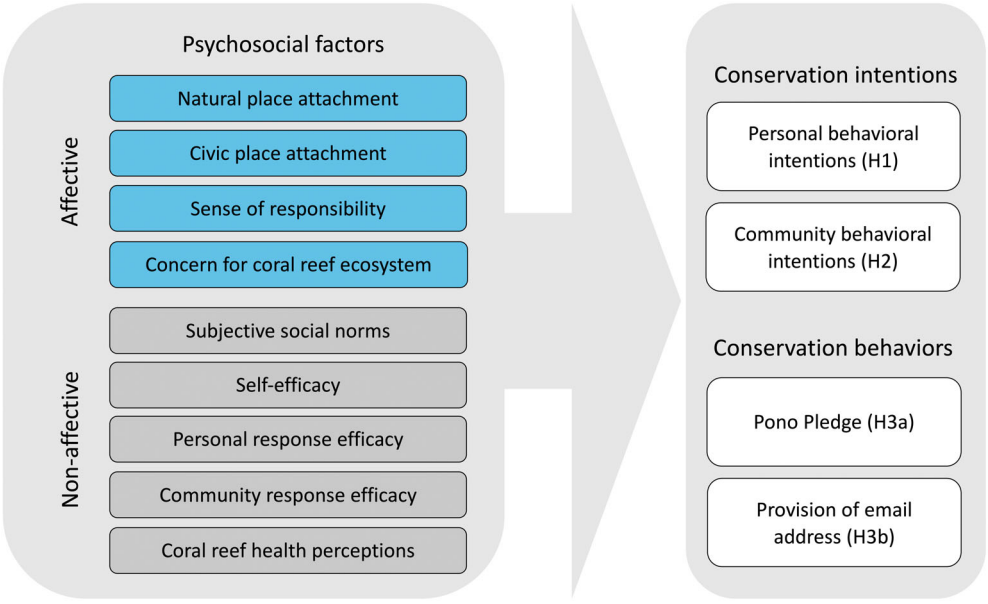

FIGURE 1 Conceptual framework proposing psychosocial factors associated with coral reef conservation intentions and behaviors.

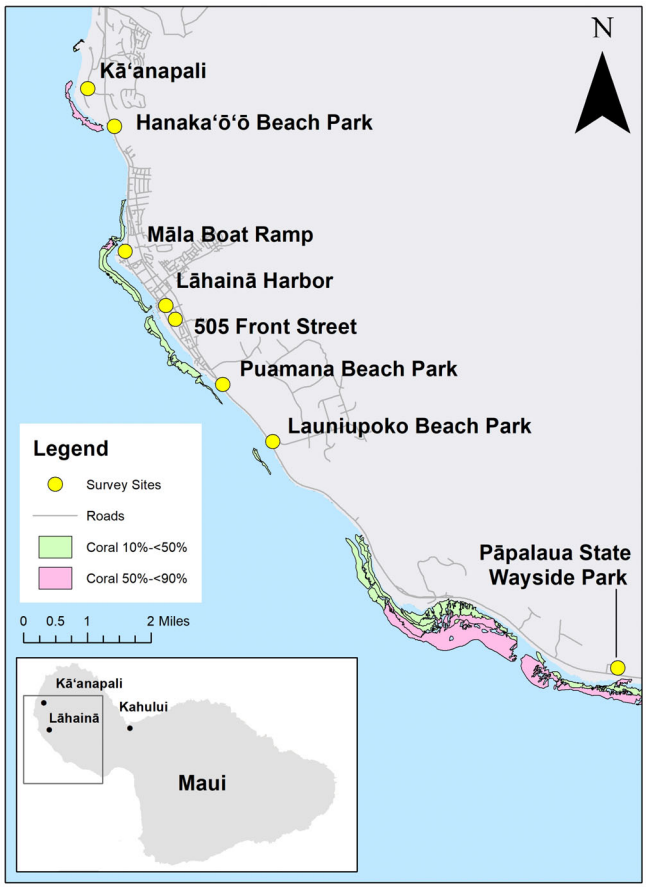

FIGURE 2 Map of West Maui study area.

Ocean-based recreation and tourism are popular, as the reefs create surf breaks and inshore lagoons with calm waters conducive to shore fishing, snorkeling, kayaking, and stand-up paddleboarding. The deeper offshore area has high levels of boat traffic and anchoring due to its proximity to Lāhaina Harbor. The study area includes the extensive fringing Olowalu reef, which harbors some of the oldest and largest coral colonies in the main Hawaiian Islands and acts as a nursery to replenish and populate the reefs of Maui Nui, the grouping of Maui, Moloka'i, Lāna'i, and Kaho'olawe islands (Garling, 2017).

The impacts of human activity in Hawaiian coral reef environments are extensive. Coastal development disrupts reef ecosystem function by increasing nutrient-polluted runoff, triggering algal blooms, and reducing sunlight for photosynthesis in coral symbionts (Crane & Orbach, 2011; Maynard et al., 2019). Ocean-based recreation, such as diving and snorkeling, has been associated with coral damage, breakage, and disease prevalence (Barker & Roberts, 2004; Lamb et al., 2014). Hawaiian coral reefs have shown evidence of contamination by oxybenzone found in sunscreens, which impairs coral recruitment, reduces corals' capacity to adapt to climate variation, and contributes to bleaching (Downs et al., 2022). Despite these dangers, approximately 6000–14,000 tons of sunscreens and beauty products are introduced into reefs globally each year (Downs et al., 2016). In January 2021, Hawai'i became the first US state to ban over-the-counter sales of sunscreens containing oxybenzone and octinoxate; however, visitors can still bring these sunscreen types from elsewhere (State of Hawai'i, 2018).

Like other Hawaiian reefs adjacent to large populations and tourist centers, the reefs within the study area show signs of significant human impacts (Friedlander et al., 2008). The Nā Papalimu O Pi'ilani reef at Polanui was once known for its abundance of fish and edible limu (~algae) (Koike et al., 2018). These resources, carefully tended by kūpuna (~elders), sustained Lāhaina families for generations (Koike et al., 2018). However, coral surveys at Polanui have found the second lowest fish abundance (0.05 g/m^2) and among the poorest coral resilience indicators compared with 30 shallow-water sites across Maui (Maynard et al., 2019). A monitoring survey conducted in 2016 and 2017 at Polanui showed frequent recreational use (40,275 activity-hours/year) and 906 incidents of coral strikes during ocean-based activities (e.g., hit by a paddle or stepped on by a snorkeler) (Koike et al., 2018). In 2020, part of the study area was listed for priority management in Hawai'i's Coral Reef Strategy (State of Hawai'i, 2020).

Our study was community-engaged by design: the research team includes individuals from Polanui Hiu (local, Hawaiian community group), The Nature Conservancy (international conservation NGO with a local presence), and Stanford University. Polanui Hiu works to restore the resources and traditions once practiced along the shores of West Maui. The Nature Conservancy works with Polanui Hiu to engage community members and visitors in monitoring surveys and develop a conservation action plan for the West Maui coastline. To strive for fair and respectful collaboration, our team followed ethical community-based research principles: collaboration between academic researchers and community members at all stages of research, validation, and utilization of multiple knowledge sources, and application of findings to promote social change and justice (Haas Center for Public Service, 2020; Strand, 2003).

3.2 | Data collection

In-person surveys of coastal users in the study area were conducted in October and November 2019 ($n = 299$, 60.5% response rate), under protocol #52968 approved by the Institutional Review Board of Stanford University. We previously shared the draft survey with partner

affiliates and pilot tested it in two potential survey locations. Survey questions were amended and reordered based on pilot responses and partner feedback. Volunteer survey enumerators consisted of four staff members from partner organizations, seven residents, and the lead author. The survey was conducted using purposive sampling (Teddlie & Yu, 2007) by collecting data at eight frequently visited beach parks and ocean access points in the study area (Table S1). Based on community partner input, we systematically surveyed coastal users at locations popular with visitors, residents, or both. Survey enumerators approached coastal users between 8 a.m. and 6 p.m. on 13 days (weekdays and weekends). Surveys were conducted in daylight to align with park hours and for surveyor safety. Surveyors approached every third person on the beach, surveying up to one person per group. To calculate potential nonresponse bias, we collected and analyzed observable data (visible demographics) for individuals who declined the survey and compared those with demographics of respondents, finding no significant differences.

3.3 | Survey design

Survey items and scale points were co-developed by the research team and adapted from relevant literature (Ajzen, 1991; Rogers, 1975; Scannell & Gifford, 2010; Stern, 2000). (See Table S2 for survey item development details). We wrote construct-specific survey items, with corresponding response scales, rather than statements with agree/disagree responses (Table S2). Agree/disagree scales have been found to be susceptible to acquiescence bias (Krosnick, 2018; Saris et al., 2010). All items, except for demographic variables (resident status, age, gender, and educational attainment) and two enacted behaviors, were asked on a five-point scale (Table S2).

We measured four outcome variables: personal conservation intentions, community conservation intentions, signing the Pono Pledge, and providing an email address. Personal conservation intentions were assessed by seven items referring to commonly observed and impactful behaviors (Table S2). Community conservation intentions were assessed by five items drawing on partner objectives and Stern's (2000) environmental behavior typology (Table S2). Survey items of personal and community conservation intentions corresponded with the list of behaviors used to assess personal and community response efficacy, respectively (Table S2). The Pono Pledge included five statements, with a prompt to select any or all the statements and sign or decline to make a pledge (Table S2). Pledge statements were adapted from an earlier version of the pledge developed by Polanui Hiu as a way for residents and visitors to commit to pono (~righteous, balanced) conduct and respect for Maui's people, culture, and environment. Finally, respondents were invited to provide their email address to be shared with local conservation partners for outreach and education purposes (Table S2).

3.4 | Data analysis

All statistical analyses were conducted using R (version 2023.03.0 + 386). To test the hypothesized factor structure of the measurement model, we conducted a confirmatory factor analysis (CFA) using the "lavaan" package (Brown, 2015) (Table S3). To ensure acceptable internal reliability of created indices, we calculated Cronbach's alpha for predictor variables (Table S3) and outcome variables: personal ($\alpha = 0.91$) and community ($\alpha = 0.90$) conservation intentions. All scores exceeded the lower bound cutoff of 0.7 (Taber, 2018). We conducted Pearson's correlation analysis to test for collinearity among predictor variables. Some variables were moderately, positively correlated ($r = .5–.7$) (Table S4). Before conducting regression analyses, we imputed missing data using the "MICE" package (van Buuren, 2018) using 10 multiple imputations and five iterations. The number of imputed values ranged from 2 (for the indicator "How special are West Maui's coral reefs to you?") to 20 (for the indicator "How committed are you to membership in a local community organization in the future?").

To test our hypotheses, two stages of analysis were conducted. Separate ordinary least squares (OLS) regressions were conducted with all psychosocial factors in Figure 1 predicting intended personal and community conservation intentions. Logistic regressions were conducted with all factors predicting signing the Pono Pledge and providing an email address. Analyses controlled for demographic variables: residency, age, gender, and education.[2] For robustness, analyses were conducted on original and imputed data. Using original data, we tested for multi-collinearity by examining variance inflation factors for predictor variables, finding no issues (Tables S6 and S7) (Thompson et al., 2017). Descriptive statistics are presented using original data; model results reported are from regressions using imputed data. Differences between original and imputed datasets are discussed. The analysis plan for H1–H3 was pre-registered with the Open Science Framework (https://osf.io/j3er9/).

4 | RESULTS

Survey respondents were 29% residents of Maui and 71% visitors from other Hawaiian Islands, the US mainland,

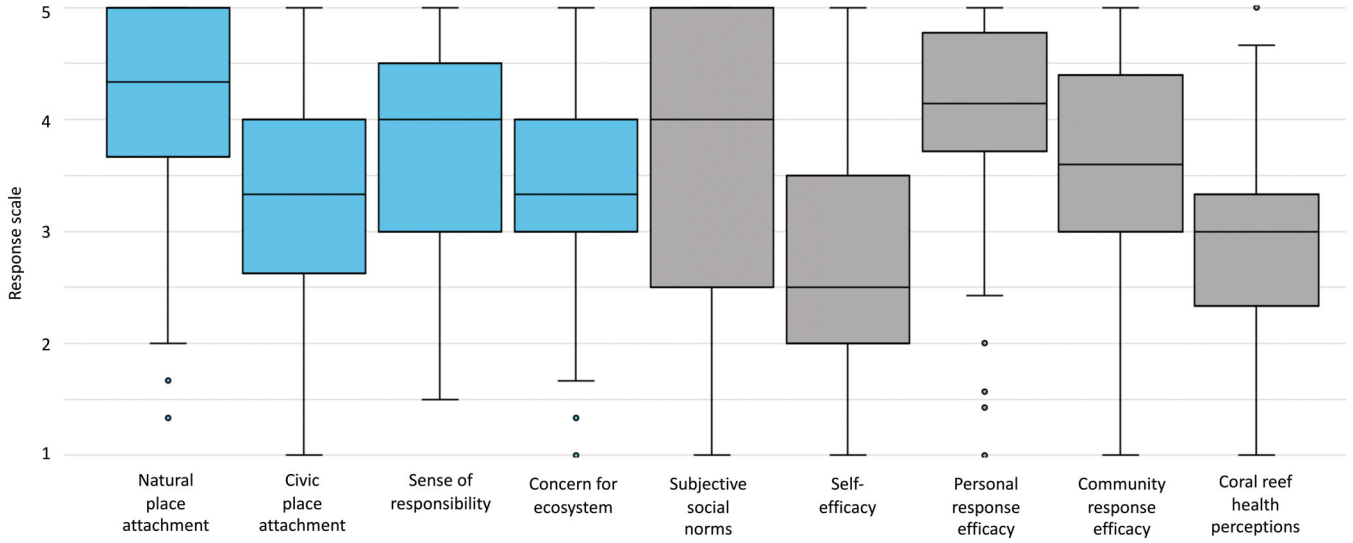

FIGURE 3 Distribution of survey responses by psychosocial factor using original data. Affective dimensions shown in blue and non-affective psychosocial factors in gray. Error bars show 95% confidence intervals.

and international locations. Local partners confirmed that the survey sample was approximately representative of resident and visitor proportions among West Maui coastal users. We also assessed our sample's composition compared to overall demographic characteristics from the Lāhaina Subdivision of Maui County, Hawai'i, which encompasses the study area (US Census Bureau, 2020; Table S5).

Among affective dimensions, respondents reported higher levels of natural place attachment than civic place attachment. Respondents reported high levels of sense of responsibility and moderate levels of concern for the coastal ecosystem. Moderate levels of subjective social norms were reported, and coral reefs were reported to be in "fair" health (i.e., moderately healthy). Respondents reported higher levels of personal response efficacy as compared to self-efficacy and community response efficacy (Figure 3). (See Table S3 for variable means and SDs, including resident and visitor differences).

Survey respondents reported high levels of personal conservation behavior intentions ($M = 4.47$; $SD = 0.71$) and lower levels of community conservation behavior intentions ($M = 3.04$; $SD = 1.09$). Approximately 84% of respondents signed the Pono Pledge and 46% provided their email address.

In partial support of H1, natural place attachment, sense of responsibility, concern for the coastal ecosystem, and personal response efficacy were positively associated with personal conservation intentions (Table 2). When using non-imputed data, the significance of the association between natural place attachment and personal conservation intentions was below the 95% confidence interval (Table S6). In partial support of H2, civic place attachment, self-efficacy, and community response efficacy were positively associated with community conservation intentions (Table 2).

Finally, in partial support of H3a, natural place attachment was positively associated with a greater likelihood of signing the Pono Pledge (Table 3). For every one unit increase in reported natural place attachment, a respondent was nearly three times as likely to sign the pledge. No significant associations ($p < .05$) were observed between other psychosocial variables and the pledge or between any psychosocial variables and provision of an email address H3b. There were no significant differences in the models of imputed versus non-imputed data for H2 (Table S6) and H3 (Table S7).

5 | DISCUSSION

In this case study, we investigated the extent to which affective and other psychosocial factors were associated with coral reef conservation intentions (personal and community), signing the Pono Pledge, and sharing an email address. In our results, several affective dimensions were positively associated with intended and enacted conservation behavior, providing evidence of their importance in our study context and possibly other conservation settings. Our results also suggest that motivations of personal versus community-level conservation behavior may be related to corresponding levels of response efficacy (personal and community) and place attachment types (natural and civic). Finally, engagement with local

TABLE 2 Estimated coefficients, standard errors, 95% confidence intervals, and *p*-values of predictor variables regressed on intended personal and community conservation behavior with complete cases using multiply imputed data.

	Intended personal conservation behavior				Intended community conservation behavior			
Predictor variables	**β**	**SE**	**CI**	***p***	**β**	**SE**	**CI**	***p***
Affective								
Natural place attachment	**0.15**	**0.06**	**0.03, 0.27**	**.02**	−0.07	0.11	−0.29, 0.14	.49
Civic place attachment	−0.02	0.04	−0.10, 0.06	.62	**0.29**	**0.07**	**0.14, 0.43)**	**<.001**
Sense of responsibility	**0.16**	**0.05**	**0.05, 0.26**	**.004**	0.03	0.09	−0.15, 0.2	.74
Concern for coral reef ecosystem	**0.07**	**0.03**	**0.00, 0.14**	**.04**	0.09	0.06	−0.02, 0.21	.12
Non-affective								
Subjective social norms	−0.02	0.03	−0.08, 0.04	.55	0.04	0.05	−0.06, 0.14	.45
Self-efficacy	0.07	0.05	−0.01, 0.16	.10	**0.39**	**0.07**	**(0.25, 0.54**	**<.001**
Personal response efficacy	**0.35**	**0.06**	**0.23, 0.46**	**<.001**	0.03	0.10	−0.16, 0.22	.77
Community response efficacy	0.02	0.05	−0.08, 0.11	.77	**0.22**	**0.08**	**0.06, 0.38**	**.01**
Coral reef health perceptions	−0.00	0.05	−0.10, 0.10	.93	−0.02	0.09	−0.19, 0.15	.81
Resident[a]	−0.06	0.08	−0.22, 0.10	.47	−0.03	0.15	−0.31, 0.26	.85
Age	−0.00	0.00	0.00, 0.00	.79	−0.01	0.00	−0.01, 0.00	.07
Female[b]	0.08	0.07	−0.05, 0.21	.21	0.07	0.11	−0.14, 0.28	.52
Education[c]								
Associate's or Bachelor's degree	**0.25**	**0.08**	**0.10, 0.39**	**.001**	0.09	0.13	−0.16, 0.34)	.48
Graduate degree	**0.19**	**0.09**	**0.01, 0.38**	**.04**	0.14	0.16	−0.16, 0.45	.36
Constant	1.24	0.29	0.66, 1.81	<.001	−0.12	0.53	−1.17, 0.93	.82
R^2	0.44				0.43			
Adjusted R^2	0.41				0.41			

Note: Bolded values indicate $p < .05$; $n = 299$.
[a]Reference class is visitor (non-resident).
[b]Reference class is male.
[c]Reference class is high school diploma or less.

and Indigenous community partners helped inform an inclusive, culturally relevant survey design. Our findings can be leveraged by researchers examining the psychosocial roots of conservation behavior and by Maui-based partners to design coastal user education and outreach.

We found that natural place attachment, sense of responsibility, and coral reef ecosystem concern were positively associated with personal conservation intentions; natural place attachment was positively associated with signing the Pono Pledge; and civic place attachment was positively associated with community conservation intentions. In place-based conservation settings, we propose that including affective dimensions in measurement models alongside more commonly examined psychosocial factors (e.g., attitudes, efficacy perceptions) may improve the predictive ability of such frameworks.

Our finding that sense of responsibility was associated with personal conservation intentions suggests that feelings of responsibility for, and reciprocity with, coral reefs can lead to tangible, embodied conservation actions—such as swimming slowly near marine life or packing out trash. This finding suggests a link with scholarship drawing on the norm-activation model (Schwartz, 1977), which examines the role of personal norms (self-based standards of behavior) in driving conservation actions (Steg & Groot, 2010). Across conservation-related studies, personal norms have been found to have a larger effect on behavioral intentions than subjective social norms (Niemiec et al., 2020). Future research could consider assessing sense of responsibility along with personal norms using validated measures to examine how closely the concepts relate or interact.

We found a positive association between concern for Maui's coral reef ecosystem and personal conservation intentions, confirming community partner experience that individuals showing negative affect in response to coral reef degradation are more likely to engage in conservation. However, this only provides evidence of a link

TABLE 3 Estimated odds ratios, coefficients, standard errors, 95% confidence intervals, and *p*-values of predictor variables regressed on enacted behaviors with complete cases using multiply imputed data.

	Logistic regressions									
	Pono pledge					**Provision of email**				
Predictor variables	**Exp(β)***	**β**	**SE**	**CI**	***p***	**Exp(β)***	**β**	**SE**	**CI**	***p***
Affective										
Natural place attachment	**2.83**	**1.04**	**0.34**	**0.37, 1.71**	**<.001**	1.30	0.26	0.26	−0.25, 0.77	.32
Civic place attachment	0.76	−0.27	0.26	−0.78, 0.24	.29	1.28	0.25	0.17	−0.08, 0.58	.13
Sense of responsibility	0.86	−0.15	0.24	−0.62, 0.56	.93	1.30	0.26	0.17	−0.53, 0.33	.66
Concern for coral reef ecosystem	1.23	0.21	0.19	−0.16, 0.58	.26	1.09	0.09	0.14	−0.18, 0.36	.53
Non-affective										
Subjective social norms	0.88	−0.13	0.18	−0.48, 0.22	.46	0.89	−0.12	0.12	−0.36, 0.12	.35
Self-efficacy	0.97	−0.03	0.30	−0.62, 0.32	.55	0.90	−0.10	0.11	−0.07, 0.59	.12
Personal response efficacy	1.15	0.14	0.30	−0.45, 0.73	.64	0.99	−0.01	0.23	−0.46, 0.44	.97
Community response efficacy	0.92	−0.08	0.27	−0.61, 0.45	.77	1.06	0.06	0.19	−0.31, 0.43	.73
Coral reef health perceptions	1.46	0.38	0.30	−0.21, 0.97	.22	0.87	−0.14	0.20	−0.53, 0.25	.49
Resident[a]	1.28	0.25	0.46	−0.65, 1.15	.58	0.97	−0.03	0.32	−0.66, 0.60	.92
Age	**0.96**	**−0.04**	**0.01**	**−0.06, −0.02**	**.01**	1.00	0.00	0.01	−0.02, 0.02	.56
Female[b]	**2.80**	**1.03**	**0.37**	**0.30, 1.76**	**.01**	0.93	−0.07	0.25	−0.56, 0.42	.80
Education[c]										
Associate's or Bachelor's degree	1.80	0.59	0.44	−0.27, 1.45	.18	0.87	−0.14	0.30	−0.73, 0.45	.63
Graduate degree	1.28	0.25	0.46	−0.81, 1.15	.58	0.97	−0.03	0.32	−0.39, 1.09	.92
Constant	-	−1.76	1.67	−5.03, 1.51	.29	-	−1.88	1.16	−4.15, 0.39	.11
R^2	-					-				
Adjusted R^2	-					-				

Note: Bolded values indicate $p < .05$; $n = 299$.
[a]Reference class is visitor (non-resident).
[b]Reference class is male.
[c]Reference class is high school diploma or less.
*Odds ratio.

between concern and conservation behaviors at the personal, not community, level. This finding also relates to the "affect heuristic," a psychological concept suggesting that negative emotions lead to increased risk perceptions and risk-mitigating behavior (Slovic et al., 2007; Terpstra, 2011). It also suggests that scholarship on "reef grief" (a negative emotional response to coral bleaching and mortality) (Marshall, Adger, et al., 2019) may be applicable to understanding the motivations of personal coral reef conservation behavior.

In our results, different types of place attachment (natural and civic) were associated with personal and community conservation intentions, respectively. These findings contribute to empirical literature examining natural and civic dimensions of place attachment (Niemiec et al., 2017; Scannell & Gifford, 2010), providing evidence that the level of behavior may be connected to the object of attachment. A socio-cultural component of place attachment may be important when examining motivations to engage in civic-oriented activities (e.g., volunteering for a conservation organization). In future studies, differentiating between natural and civic place attachment could be a useful way to predict different levels of conservation behavior. Natural place attachment was the only psychosocial factor significantly associated with respondents signing the Pono Pledge. This could be because many pledge statements described personal, embodied interactions with the biophysical environment, not the human community on Maui (e.g., "I will leave lava rocks, sand, and natural features as originally

found"). Notably, pledge statements referred holistically to marine *and* terrestrial places on Maui, yet natural place attachment indicators referred specifically to coral reefs. This suggests that emotional bonds to coastal resources may also relate to conservation behavior in terrestrial environments.

Different levels of response efficacy were associated with corresponding conservation behaviors, and self-efficacy was associated with community-level behavior. These findings validate work examining response efficacy at different levels (personal, collective, government) (Bostrom et al., 2019), and suggest that, in conservation settings, evaluating response efficacy by well-established behavioral categorizations (Stern, 2000) can be useful when examining relationships between response efficacy and behavioral outcomes. Self-efficacy was only associated with community intentions and not personal intentions, even though we hypothesized associations with both behavioral levels. Although self-efficacy has been extensively studied, it has been inconsistently measured across studies and therefore may be, as Bostrom et al. (2019) suggest, a less-reliable latent construct than response efficacy.

The knowledge and values of local and Hawaiian community partners, who interact regularly with coastal users through outreach and education, were essential to building a realistic understanding of coral reef conservation behavior on Maui and designing an inclusive survey. Including sense of responsibility in our model allowed us to engage with culturally relevant concepts describing complex human-nature relationships and guiding behavior in Hawai'i among Indigenous Hawaiians and other residents (Gould et al., 2019; Vaughan, 2018). Important to note, our measure of sense of responsibility does not fully capture a concept as complex and nuanced as kuleana, as understood by Indigenous Hawaiians. Although sense of responsibility could be relevant for all coastal users in West Maui, the reciprocal and community-oriented understanding of kuleana as granting rights *and* responsibilities for natural resources may be more appropriately applied to the decisions of island residents.

A better understanding of what motivates personal as compared to community behavior can inform targeted outreach and messaging strategies by local community partners (Metcalf et al., 2019) and address audience-specific barriers to action (Asah & Blahna, 2012). In communications, partners could leverage natural place attachment in signage and interpretive materials to promote personal behaviors relevant to embodied reef interactions (e.g., swimming, snorkeling). Based on our finding that greater civic place attachment is associated with intentions to engage with community organizations and their priorities, partners could target messaging on volunteering or donating to audiences already displaying a strong community connection (e.g., members of canoe or surf clubs). To create durable behavior change, partners could invest in fostering emotional connections between coastal users and West Maui's coral reefs and community. The literature discussing the roots of place attachment provides insights into this approach (Jorgensen & Stedman, 2006; Lewicka, 2011).

The willingness of many respondents to sign the Pono Pledge (84%) also speaks to the potential of the pledge to motivate coastal users to take conservation action at the personal-level. However, given that the pledge only required a signature and no further follow-up engagement, it is a limited measure of commitment to behavior change. Future research could examine how conservation pledges could more effectively elicit personal behavior change by activating personal or social norms, increasing the specificity of the commitment, or combining a focus on the pledge's nature-benefits with an ingroup framing (i.e., relating the activity to the respondent's community) (Jacobs et al., 2021; Lokhorst et al., 2013). Or if pledge signers were made public, this could activate social norms and create increased community accountability.

6 | LIMITATIONS

One limitation was that our study did not draw on a representative sample of coastal users. Hence, we are not able to generalize to the larger population in the study area. Also, although we collected data on residence time and race/ethnicity (e.g., Native Hawaiian or Pacific Islander), we did not observe enough variation in our sample to include these demographics in our analyses. Future studies of place attachment and sense of responsibility in a Hawaiian context should consider including such data, as these factors may manifest differently based on demographics.

Due to the labor-intensive nature of an in-person survey in coastal environments, we were limited by resources and time to conducting a cross-sectional study. Our results cannot speak to the causal nature of psychosocial factors on behavior; rather, our results only identify associations. Future work aiming to investigate causal relationships between proposed variables could employ a behavioral intervention or longitudinal study design. Also, we acknowledge that even if local efforts to conserve coral reefs are successful, the primary drivers of coral reef decline are global (Hughes et al., 2017; Morrison et al., 2020). By focusing on individual conservation behavior our work cannot address the scope and

scale of climate-related drivers of coral degradation (Bellwood et al., 2019).

Finally, we acknowledge limitations of using the Pono Pledge and provision of email as proxies of conservation behavior. Although we observed variability across psychosocial factors, we only observed one significant association with uptake of the Pono Pledge (natural place attachment) and no significant associations between factors and providing an email address. This could be because of how little variation we observed among pledge responses (84% of respondents signed) and because weak associations between psychosocial factors and provision of an email address are impossible to detect at our chosen level of statistical significance ($p < .05$), given the statistical power of our model and sample size. Supporting this notion is the fact that the p-values of estimated associations for civic place attachment and self-efficacy with provision of email address are close to significance at the 90% level (Table 3). Alternatively, it could be that factors not measured in this study, and unrelated to the factors measured, primarily determine respondents' willingness to provide an email address. For example, given the number of emails that people receive per day, it is possible some respondents were uninterested in receiving additional emails, even with strong conservation intentions. In future studies, we suggest using alternative outcome variables to measure conservation behavior, such as an option to donate to coral reef conservation or "follow" a conservation organization's social media account.

7 | CONCLUSION

Human activities drive threats to global marine biodiversity (Descombes et al., 2015; Hughes et al., 2017); therefore, developing successful conservation programs and policies requires understanding and changing human behavior (Schultz, 2011). To address local threats to coral reef biodiversity, conservation scientists, managers, and communities are increasingly looking to behavioral theories and approaches to predict and explain human decision-making and to design interventions that reduce human impacts (Clayton et al., 2015; Selinske et al., 2018). To contribute to these efforts, we examined psychosocial factors, focusing on those with affective dimensions, associated with conservation behavior in a coral reef environment. Through the lens of behavioral theory, Indigenous Hawaiian values, and a community-based approach, we provide both broad insights that can inform future research into conservation behavior in coastal settings and improve local and community partner education, outreach, and future interventions with coastal users.

AUTHOR CONTRIBUTIONS

Francisca N. Santana: Conceptualization, methodology, software, formal analysis, investigation, data curation, writing—original draft, writing—review & editing, visualization, project administration. **Alana Yurkanin:** Conceptualization, methodology, software, investigation, writing—original draft, writing—review & editing, project administration. **Tiara E. Stark:** Conceptualization, methodology, investigation, writing—original draft, writing—review & editing, visualization. **Ekolu Lindsey:** Conceptualization, methodology, investigation, writing—original draft, writing—review & editing. **Nicole M. Ardoin:** Conceptualization, methodology, resources, writing—review & editing. **Gabrielle Wong-Parodi:** Methodology, resources, writing—review & editing, supervision, funding acquisition.

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CONFLICT OF INTEREST STATEMENT

The authors declare no known conflicts of interest that could have influenced this work.

DATA AVAILABILITY STATEMENT

Deidentified survey data used in this study are available upon request.

ORCID

Francisca N. Santana https://orcid.org/0000-0002-9168-9282
Tiara E. Stark https://orcid.org/0000-0002-6586-6695
Nicole M. Ardoin https://orcid.org/0000-0002-3290-8211
Gabrielle Wong-Parodi https://orcid.org/0000-0001-5207-7489

ENDNOTES

[1] We define individuals who interact with coastal places and natural resources through recreation and/or fishing as "coastal users." We acknowledge the term "user" may imply associations with anthropocentric, utilitarian values that emphasize the environment's provision of goods and services to humans. Our intention is not to privilege such values as they do not fully embody the range and complexity of human relationships to natural resources

and the environment. We use this term, however, in alignment with the preponderance of literature in this area. For an in-depth discussion of values underpinning human-nature relationships, see Braito et al. (2017).

[2] We also conducted analyses examining residents and visitors separately. However, as the resident sample was considerably smaller ($n = 83$) than the visitor sample ($n = 213$), we elected to report these results in Tables S8–S11 in the SI as the findings may not be as robust as those using the full sample of coastal users.

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