Coastal Homeowners' Perceptions and Actions Towards Climate Change:

A Case Study of Hawai'i

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Abstract

Hawai'i is a state vulnerable to climate change due to its geographical location and the fact that it is an island. While one might expect they would have high levels of understanding and feel the responsibility to take action, Hawai'i's homeowners have a complex relationship between their perceptions towards climate change and subsequent actions to reduce their individual impact. This study investigates the relationship between the two. The data for this study was collected through a survey with 37 respondents. To analyze the data, I use patterns looking at certain factors within three main themes - homeowners' perceptions and homeowners' actions based on their perceptions. I analyze the patterns using linear or logistic regressions and correlations when applicable.

The main findings are that the level of threat homeowners feel about climate change strongly influences how anxious they feel about the future state of the climate, but their understanding of climate change had no clear impact on their level of anxiety. Moreover, whether homeowners believed that humans are responsible for climate change did not influence their likelihood of taking climate-positive action, instead, that was very strongly related to how much they believed that individuals' actions make a difference.

Keywords: climate change, perceptions, pro-climate behaviors

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List of Abbreviations

CC	Climate Change
CZM	Coastal Zone Management
FF	Fossil Fuels
NAM	Norm Activation Model
PI	Protective Infrastructure
SLR	Sea Level Rise
SPA	Shoreline Protection Act
VBN	Value-Belief-Norm

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Climate change (CC) threatens the livelihoods of people living on islands, and in extreme cases, threatens to erase islands completely - as is the case for the Maldives. Due to the melting of the Antarctic and Greenland ice sheets, significant rises in global sea levels are likely to occur by 2100 (Thomas et al., 2020). In 2014, the Intergovernmental Panel on Climate Change (IPCC) warned that under the then-current rate of greenhouse gas emissions, sea levels could rise 3.2 feet by the year 2100. More recent projections suggest this level of sea level rise (SLR) could happen as early as 2060 (Sweet et al., 2017). SLR is especially threatening to tropical regions, which will be 16 to 20% more affected than other areas (Keener et al., 2018). Impacts include coastal erosion, flooding, increased exposure to marine hazards, and saltwater intrusion into groundwater. For the state of Hawai'i, 3.2 feet of SLR would flood more than $19 billion worth of land and infrastructure including 38 miles of main roads. Almost 550 Hawaiian cultural sites would be flooded and/or eroded, and about 20,000 residents

Figure 1
3.2 ft Sea Level Rise
(City & County of Honolulu, 2020)

would be displaced (Keener et al., 2018). Recently, the Honolulu tide gauge measured record-high monthly sea levels from June to August 2020 and January to February 2021 (City and County of Honolulu Climate Change Commission, 2023). They found that the island of

O'ahu is especially vulnerable to the impacts of SLR, warning that in addition to the loss of land, roads, and infrastructure, O'ahu could lose 40% of its beaches under the 3.2 feet scenario, as shown in Figure 1 (City & County of Honolulu, 2020; City and County of Honolulu Climate Change Commission, 2023).

A particular concern for Hawai'i is shoreline retreat - a process that leads to the loss of beaches when material (like sediment) is pulled away from the shoreline and is not replenished by new deposits (*Coastal Erosion,* 2023). It can be exacerbated by human interference, for example, building protective infrastructure (PI) - like seawalls - that causes beaches to "drown" (*Coastal Erosion,* 2023). 70% of Hawaiian beaches are already exposed to chronic erosion and shoreline retreat, and more than 13 miles of O'ahu's beaches are covered with PI (*Hawai'i Climate Change Mitigation and Adaptation Commission*, 2017). To illustrate, Figure 2 shows a 52-year difference in Lanikai Beach on the East Coast of O'ahu. In 1968 (top), it was a wide sandy beach, but by 2020 (bottom), more than half of the beach was drowned and unusable due to the construction of sea walls, depicted by the orange line (Ngu et al., 2020). Loss of beaches is already underway and without intervention will only get worse.

Figure 2
Lanikai Beach Shoreline Retreat
(ProPublica, 2020)
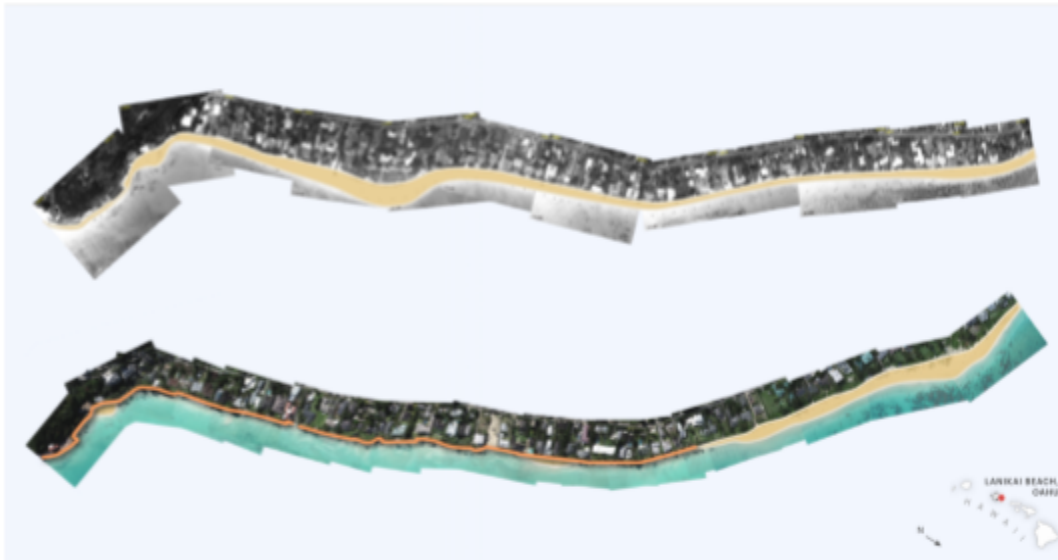
Each county in Hawai'i is required to preserve its beaches and shorelines, and there are laws and programs in Hawai'i aimed at protecting those (Ngu et al., 2020). The Hawai'i Coastal Zone Management (CZM) Program regulates coastal development to ensure they are environmentally safe, socially acceptable, and economically beneficial to Hawai'i's residents and tourists (Hawai'i Department of Business, Economic Development & Tourism, 2011). The CZM Program puts special attention to the effects of shoreline alteration- "improvements and structures" as seen in figures 3 and 4 (*Coastal Zone Management Act of 1972*, 1972).

Figure 3
Sandbags
(Honolulu Star Advertiser, 2020)

Figure 4
Tarps
(Honolulu Star Advertiser, 2020)

The Shoreline Protection Act (SPA) ensures that development cannot happen in the special management area unless the property is under 'imminent threat', meaning that erosion is within 20 feet of the property line (Hawai'i State Legislature, 2022). These permits are temporary solutions, giving property owners up to three years to come up with a more sustainable plan after which they must remove the infrastructure. The development cannot harm the environment, or disrupt access to publicly owned or used beaches, recreational areas, and natural reserves. However, penalties are rarely given and permit extensions are frequently granted (Hawai'i State Legislature, 2022; Ngu et al., 2020).

Despite these efforts, residents may lack awareness of the issues behind PI and its impacts. People may have difficulty grasping the seriousness of climate change because of the 'invisible' causes, faraway impacts, lack of immediate and direct experiences of impacts, doubt about humans' global influence, self-interest, and the complexities and uncertainties of climate change (Moser, 2010). Teaching people about CC is difficult and does not ensure individuals behave more pro-environmentally (Javeline et al., 2019). However, climate catastrophes can

influence people's perceptions and attitudes toward the environment, especially when they are extreme and experienced directly (Pantera et al., 2022). Moreover, experience with climate catastrophes contributes to CC feeling more real, immediate, and local, which minimizes some cognitive barriers to CC actions and increases the probability of people being more concerned about CC (Gifford, 2011; Weber, 2006). Papp (2022) found that people who experience poor environmental conditions are inclined to act pro-environmentally regardless of their environmental protection attitudes. For example, people who experience air pollution due to greenhouse gas emissions are more likely to act pro-environmentally and to believe that the government should do more to tackle CC (Whitmarsh, 2008).

Nevertheless, the motivations and perceptions that lead to climate anxiety and action are complex. Frondel and colleagues (2017) found that personal experience with climate catastrophes is associated with higher risk perceptions, particularly when an individual faces personal damage. A strong risk perception encourages individuals to act to adapt to climate change. For example, coastal residents who estimate higher property risks from SLR and erosion are more likely to invest in PI (McNamara and Keller, 2013). However, some individuals have a high self-perceived understanding of CC but believe that the threat is low because the climate catastrophes they experience are physically and/or temporally distant (Asai et al., 2022). Even among individuals who perceive the risks, they do not necessarily change their actions because they may not believe CC will affect them or that they can not make a difference (Baptiste 2018; Smith, 2018).

I chose to study coastal homeowners in Hawai'i because this target group lives in a community that highly values the environment and because they live on an island where sea level rise and coastal erosion have already had negative impacts. Therefore, I expected

homeowners to be aware of climate change, its impacts, and to act to preserve the environment. I am interested in what influences their actions and makes them feel more or less anxious about the future of the climate. This work aims to help fill the research gap of how perceptions and beliefs influence this vulnerable group's climate anxiety and climate-positive actions. The research question is *how do coastal homeowners in Hawai'i perceive climate change and how does that influence their actions?*

Background to the Research Question

This research question included three themes - homeowners' perceptions, homeowner's actions based on their perceptions, and the influence of experiencing damage on perceptions and actions.

In the first theme, I explore homeowner's perceptions. I look at the relationships between how anxious they feel for the future state of the climate, their perceptions of their understanding of CC, and the broader severity of the climate threat. Next, I look at the relationships between homeowners' level of support for existing PI laws and for increased fossil fuel (FF) taxes, and whether those are influenced by their belief that humans must coexist with the planet to ensure we do not over-exploit it. I am interested in understanding how perceived understanding, perceived risk, and perceived threats are related.

Second, I examine whether homeowners' actions are based on their perceptions and beliefs. This ties to environmental psychology - the study of the relationship between the built and natural environment (Bonnes and Carrus, 2017). First I look at the relationships between the extent to which respondents believe human activities increase the rate of CC, the extent to which they believe individual actions make a difference, and whether they act themselves. Second, I look at the relationships between how anxious homeowners feel about the future climate, their

perceived understanding of CC, and whether they act. I am interested in understanding how perceptions influence environmental behavior.

The final theme looks at the influence of the experience of damage on perceptions and actions. I ask homeowners if they have any experience with the consequences of CC (for example, seeing erosion of their property) and if that has influenced their perceptions.

Theoretical Framework

An overview of the vulnerability of islands and environmental behavior theories are explained before diving into this study. For a better understanding of the climate specifications for islands, specifics about Hawai'i and environmental perceptions and actions are explained. This is the theoretical framework on which the study is built.

Islands are Especially Vulnerable

Islands need a special focus because they are especially exposed to climate hazards including sea level rise (SLR), increased storm frequency and severity, and heat waves (IPCC, 2019). Climate change (CC) will especially negatively impact coastal properties through SLR, increased extreme weather, and floods, especially in tropical islands (Carlton et al., 2015).

Sea Level Rise

Global sea level is increasing by 3.6 mm annually with consistently higher waves compared to the past century (IPCC, 2019). SLR creates loss of habitats, changes in the geographical location of coastal species, coastal erosion, flooding, and reduced ecosystem services (IPCC, 2019; Soete, 2022). Beaches and shorelines are particularly vulnerable to erosion (Soete, 2022). The consequences of global warming, including SLR, lead to the loss of beaches and the consequent reduction in their recreational use and value (Thomas et al., 2020). Shorelines are also critical for vulnerable animals, such as the native Hawaiian Green Sea Turtle

(*Honu*). Thus, the loss of shorelines is not only damaging to the beauty of Hawai'i but also detrimental to the critical shoreline habitat (Ngu et al., 2020).

In 2015, Anderson and colleagues monitored SLR over ten sites across the Hawaiian Islands to create future projections. 80% of their projections for shoreline retreat by 2050 ranged between 1 and 24 meters, with an average of 5.4 m, increasing to an average of 18.7 m by 2100. Throughout Hawai'i, almost 550 Hawaiian cultural sites would be flooded or eroded, more than 6,500 structures and 25,800 acres of land would be lost, and about 20,000 residents would be displaced (Keener et al., 2018).

Such devastating consequences of climate catastrophes can increase awareness and urge individuals to reconsider their perceptions towards the environment and possibly lead to behavioral changes, public opinion, and policy-making (Pantera et al., 2023; Spence et al., 2012; Steg and de Groot, 2010).

Environmental Behavior

Environmental psychology is a tool that allows us to understand different groups' knowledge, awareness, perceptions, concerns, and behaviors about CC (Thomas et al**.**, 2020). CC is a global fight with individuals playing a role. For instance, relatively easy actions like carpooling and hanging clothes to dry instead of using a dryer would reduce the United States' carbon emissions by 123 million metric tons per year (Dietz et al., 2009). For context, one ton of carbon is equal to 72 train journeys from Amsterdam to Paris (*What Exactly Is 1 Tonne of CO2? We Make It Tangible. - Anthesis-Climate Neutral Group*, 2023).
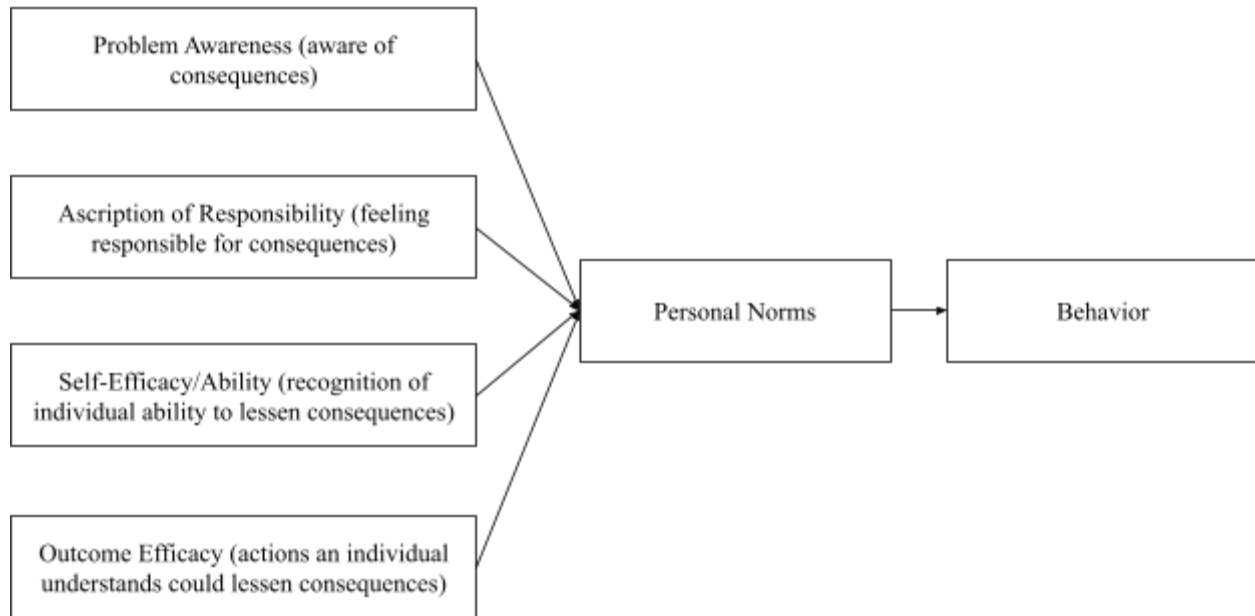
People with altruistic and biospheric values are more motivated to act pro-environmentally (Zehui, 2023). Altruistic values reflect concern for the well-being of others (Martin and Czellar, 2017). People with biospheric values view their individual actions through

their positive and negative impacts on nature, and value environmental protection (Martin and Czellar, 2017). Next to environmental concerns, people also think about their daily lives and tend to invest resources more into immediate concern, rather than more distant CC impacts (Stancioff et al., 2018). Spence and colleagues (2012) have found that natural catastrophes shorten the "psychological distance they have from the threat of climate change**"**, meaning that the threat of CC becomes a lot more real to them personally. This makes people more aware of the pressing issue and more in support of green policies and behaving pro-environmentally (Spence et al., 2012).

Why people do or do not act

Individuals act pro-environmentally when their personal norms and values are aligned with the environment (Steg and Nordlund, 2012). Figure 5 shows the norm activation model (NAM), which states that personal norms are stronger when individuals are aware of the environmental problems their behavior causes, when they feel responsible for the problems, and when they do not shift blame to other actors - such as industries or government (Steg and Nordlund, 2012). Personal norms come in 4 levels - problem awareness, ascription of responsibility, outcome efficacy, and ability or self-efficacy.

Figure 5
The Norm Activation Model
(Adapted from Steg and Nordlund, 2012)

Problem Awareness (aware of consequences)

Ascription of Responsibility (feeling responsible for consequences)

Self-Efficacy/Ability (recognition of individual ability to lessen consequences)

Outcome Efficacy (actions an individual understands could lessen consequences)

Personal Norms → Behavior

Problem awareness is the level at which an individual is aware of the consequences of not acting pro-environmentally. Ascription of responsibility means not only being aware of but also feeling responsible for the negative consequences of not acting (Steg and Nordlund, 2012). Outcome efficacy is the actions an individual understands that could reduce environmental problems. Ability or self-efficacy means an individual's recognition of their ability to minimize environmental problems (Steg and Nordlund, 2012). Suppose an individual is aware of an issue, feels responsible for the negative consequences of acting anti-environmentally, identifies actions they can personally take to reduce those consequences, and recognizes that they can do so. In that case, they will likely act more pro-environmentally (Steg and Nordlund, 2012). Steg and de Groot (2010) conducted an experimental study that manipulated participants' awareness. They gave one group a text stressing the problems of particulate matter emissions and another group a

text that minimized the problem. The group with the text stressing the problem had higher problem awareness, felt more responsible for reducing emissions, felt morally obliged to take a stand, and had higher intentions of acting. In this case, individuals with more awareness, had a higher ascription of responsibility, personal norms, and pro-environmental intentions (Steg and de Groot, 2010).

The value-belief-norm (VBN) theory, visualized in Figure 6, is an extension of the NAM, proposing that an individual's problem awareness depends on their values and worldviews (Steg and Nordlund, 2018). An ecological worldview is a perspective emphasizing the interconnectedness of all living organisms and their environments (Kunchamboo et al., 2021). This worldview acknowledges the interdependence of human societies and natural systems, striving to find a balance between human activities and the environment (Kunchamboo et al., 2021). Figure 6 visualizes how the VBN theory influences individuals' behavior starting from their values and beliefs and how that leads to behavioral differences. The NAM and VBN theories explain people's low-cost pro-environmental behaviors, willingness to change behavior, and political behavior (Steg and Nordlund, 2012).

Figure 6
Visual Representation of the VBN Theory
(Steg and Nordlund, 2018)
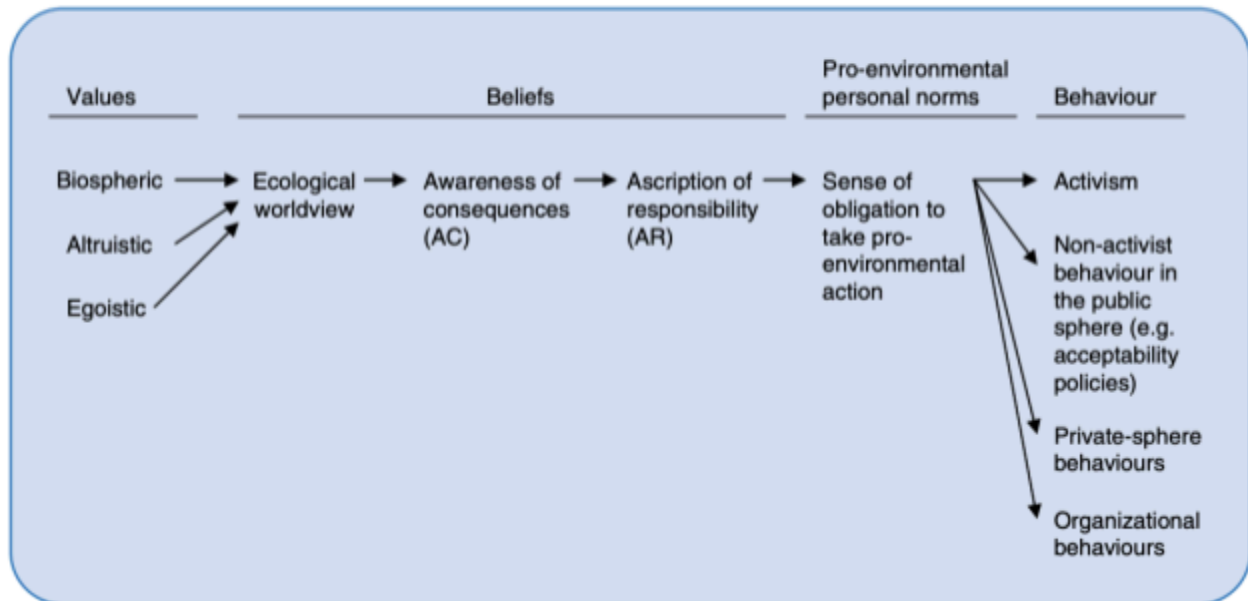
Increased knowledge about the causes, impacts, and possible solutions to CC positively

influences actions and political choices (Javeline et al., 2019). For example, people who are

climate-aware are probably more likely to save energy and advocate for managed retreat away

from vulnerable coastal regions (Alexander et al., 2012). Moreover, a lack of knowledge is

seemingly a barrier to action and undermines public support for pro-climate policies

(Mildenberger and Tingley, 2017). Another reason why people may act is that they feel

'eco-hope'. In the midst of the negative and overwhelming bad news about the environment,

people with eco-hope have an optimistic outlook, perhaps seeking out positive climate news.

This helps them feel less stressed and more hopeful about the future climate (Lueck, 2007;

Pihkala, 2018).

Factors making people less likely to act include that acting can be both expensive and

intimidating. Also, individuals with low perceived behavior control believe that external factors

influence their behavior, allowing them to reject personal responsibility (Steg and Nordlund, 2012). Due to the costs of acting pro-environmentally, people may adopt self-serving denial, which lessens their feelings of moral obligation (Steg and Nordlund, 2018). They might deny or downplay beliefs in environmental problems or place the blame on others such as on industry. They may also justify their behavior by saying individual actions are insufficient or ineffective in reducing environmental problems (Steg and Nordlund, 2018). Also, 'eco-anxiety', a phenomenon where individuals feel overwhelming stress and hopelessness for the future, can cause people with high levels of climate understanding to feel overwhelmed, and scared by the enormity of the problem. Therefore, these individuals may fail to act, similarly to those who deny CC (Javeline et al., 2019).

Citizens' Response to Climate Catastrophes

The devastating consequences of climate catastrophes, like tsunamis, can serve as wake-up calls, urging individuals to rethink their environmental attitudes and potentially to change their behaviors (Pantera et al., 2023). Individual experience with climate catastrophes has been shown to make CC feel more immediate, local, and real, in turn increasing the concern about CC (Asai et al., 2022; Frondel et al., 2017; Weber, 2006). Moreover, experience with climate catastrophes lessens the psychological distance of CC - individuals perceive CC as affecting them, their family, and their community (Asai et al., 2022). However, although risk perception and CC concerns increase after a climate catastrophe, they fade with time (Konisky et al., 2015; Osberghaus and Fugger, 2022).

The 2010 Deepwater Horizon Oil Spill off the coast of the United States is one of the most widely known environmental disasters of recent years. Bergstrand and Mayer (2017) researched the emotional responses and changes in environmental behaviors of citizens who

lived along impacted coastlines at that time. They found that worries about the effects of the oil spill caused individuals to act more pro-environmentally, such as driving less and reducing water use. Those individuals also said they cared more about other environmental issues, like protecting wildlife and biodiversity (Bergstrand and Mayer, 2017). This shows that exposure to environmental damage causes individuals to rethink and makes them more likely to act upon their behaviors and beliefs.

Methodology

Data Collection

To answer my research question, I developed a survey (Appendix A). I posted a brief description of my research project and a link to the survey on Facebook on March 24, 2024. I also posted it on the Hawai'i page of Reddit on March 24, 2024, and reposted it on April 8, 2024, trying to target a wider audience of coastal homeowners in Hawai'i. In those posts, I stated that by participating in this survey, the respondents gave me consent to use their responses in my research. I also asked respondents to share my survey with anyone they know who has a beach house in Hawai'i.

My survey aims to understand perceptions about CC, beliefs on human influence on CC, environmental behavior, and thoughts about policies trying to reduce CC. My survey contained 17 multiple-choice questions and one question with an option to write in actions respondents take to reduce their individual impact. To understand perceptions about climate change, I asked if they have heard of climate change, how they evaluate their understanding of CC, the extent to which they believe human activities increase the rate of climate change, and if they feel threatened by CC or anxious for the future state of the climate. I asked if they believe humans need to coexist with the planet, their thoughts on policies to increase taxes on fossil fuels (FF),

and laws that require state approval for PI. This indirectly asks about perceptions, because it asks about worldviews, values, and opinions on pro-environmental policies. To understand their actions, I asked their thoughts on the effectiveness of individual actions and if they take action. To understand how experiencing CC influences perceptions and actions, I explicitly asked if they have suffered any loss or damages due to CC and how it has influenced their perceptions and actions. At the end of the survey, I asked if participants would be willing to participate in an interview to further discuss my research, and requested them to write their name and email. Unfortunately, I received very few responses to that question and did not hear back from them when I reached out for an interview, so I did not conduct follow-up interviews.

Adjusting Inconsistencies in Responses

The majority of the questions on my survey are required, but some are only for respondents who indicated yes to a previous question. Respondents should only answer questions 13 and 14 if they answered yes to question 12 - if they have experienced loss or damage due to CC. Questions 13 and 14 should only have 7 respondents (those who had experienced damage), but 14 people responded to question 13, and 17 people responded to question 14. Similarly, respondents should only have answered question 16 if they answered yes to question 15 - if they have had any PI built. There should only have been 2 respondents but 16 responded. Therefore, before analyzing the data, I removed answers to questions 13, 14, and 16 which respondents should not have answered. In the limitations section, I refer to these as 'extra respondents'.

Data Storage

To store my data, I saved survey responses on the University of Groningen X: Drive - secure and only accessible by password and Multi-Factor Authentication. All responses are

anonymous unless participants have chosen to write their name and mode of contact for an

interview. I have not shared or discussed any data outside of the findings in this paper.

Analyzing Patterns

Terms

In the results and discussion sections, I use the following terms for information taken

from the survey responses. Throughout the results and discussion, I put these terms in italics to

make them clear when I use them explicitly as they are listed below.

Table 1

Terms Used Throughout the Results and Discussion

Term	Meaning
Act (or Actions)	Homeowner's individual behaviors that attempt to reduce their carbon footprint (from survey question 9)
Climate anxiety	Homeowners' anxiety about the future state of the climate (from question 5)
Damage	Damage or loss homeowners have experienced due to climate change (from question 12)
Human activities	Homeowners belief in the extent to which human activities increase the rate of climate change (from question 6)

Individual actions	The extent to which homeowners believe their individual actions can help reduce the negative impacts of climate change (from question 7)
Need to Coexist	The extent to which homeowners believe that humans need to coexist with the planet to ensure we do not over-exploit it (from question 10)
Threat	The extent to which homeowners perceive climate change as a threat (from question 4)
Support	The extent to which homeowners are in favor or against existing protective infrastructure laws or increased fossil fuel taxes (from questions 16 and 17)
Understanding	Homeowners' perceived understanding of climate change (from question 3)

Themes and Patterns

Survey responses were synthesized into patterns to simplify the analysis (Appendix C). To facilitate analysis, I converted ordinal responses to numeric values. In all cases, I scaled the values with 1 as the lowest level response, such as "not at all" or "fully don't believe". The

strongest responses, such as "extremely anxious" or "definitely" were given the highest values -

for example, "extremely anxious" in response to question 5 was given a value of 5 (as there were

five possible answers). Data were analyzed using the online statistical tool DataTab [datatab.net].

I used single-variable linear and logistic regressions and correlations to test the significance of

each factor in each pattern. I considered the results significant when the p-value was less than

0.05. I use bubble plots to visualize the distribution of responses for relevant patterns. Within

each of the three themes described above, the specific 'patterns' I assessed were:

Theme 1: Homeowners' Perceptions

Pattern 1: To what extent was homeowners' *climate anxiety* related to perceptions of

climate *threat* and their *understanding* of climate change? This looks at the connection between

perceived *understanding* of CC, the extent to which homeowners feel *threat*, and the level of

climate anxiety homeowners feel. This was analyzed using two linear regressions. The first had

climate anxiety as the response variable and *threat* as the factor. The second regression also had

climate anxiety as the response variable and *understanding* as the factor.

Pattern 2: What is the relationship between *support* for increased fossil fuel taxes and

existing protective infrastructure laws? How is the level of *support* influenced by the belief in the

need to coexist? This looks at homeowners' levels of *support* for the existing policy requiring

state approval before building PI and for increasing fossil fuel taxes. This was analyzed using a

Spearman correlation between the levels of *support* for PI and FF. I use a Spearman correlation

as those are ranked data. I added another layer to this pattern by looking at the role of the

respondent's belief that humans *need to coexist* with the planet in *support* of FF and PI. This was

also analyzed using Spearman correlation.

Theme 2: Homeowner's Actions Based on Their Perceptions

Pattern 3: Does the belief in *human activities* increasing the rate of CC and the effectiveness of *individual actions* influence whether homeowners *act*? This looks at respondents' belief that *human activities* increase the rate of CC, belief that *individual actions* make a positive impact, and homeowner's *actions*. This was analyzed with two logistic regressions. The first had *actions* as the response variable and *human activities* as the factor. The second regression also had *actions* as the response variable and *individual impact* as the factor. I used logistic regressions because *actions* was a nominal (yes/no) response.

Pattern 4: Do *climate anxiety* and perceived *understanding* influence whether homeowners *act*? This looks at how perceived *understanding* and level of *climate anxiety* influence homeowner's *actions*. This was analyzed with two logistic regressions. The first had *actions* as the response variable and *climate anxiety* as the factor. The second regression also had *actions* as the response variable and *understanding* as the factor.

Theme 3: Influence of Damage on Perceptions and Actions

Pattern 5: How does experiencing *damage* influence homeowner's perceptions and *actions*? This looks at the influence of actually experiencing *damage* on homeowners' perceptions and *actions*. Unfortunately, as I only had 7 respondents whose homes experienced damage, there were too few for statistical analysis, however results are summarized.

<div align="center">

Results

</div>

37 people responded to my survey posted on Reddit and Facebook - see Appendix B for full results. The 18 questions are broken up into three themes - homeowners' perceptions, homeowner's actions based on their perceptions, and the influence of experiencing damage on perceptions and actions.

Theme 1: Homeowners' Perceptions

Pattern 1 - Perceived Understanding, Threat, and Anxiety

The first pattern looks at how homeowners' perceived *understanding* of CC and the level of *threat* they feel influences their *climate anxiety*. Linear regressions showed that perception of *threat* was highly significant ($p < 0.001$) in how much *climate anxiety* homeowners experience, whereas their *understanding* of climate change was not ($p = 0.232$).

In line with these results, Figure 7 shows a clear increase in *climate anxiety* as *threat* increases. In contrast, there is no clear pattern for higher *climate anxiety* as *understanding* increases (Figure 8).

Figure 7
Respondents' Level of Climate Anxiety in Relation to Threat

Anxiety in Relation to Level of Threat
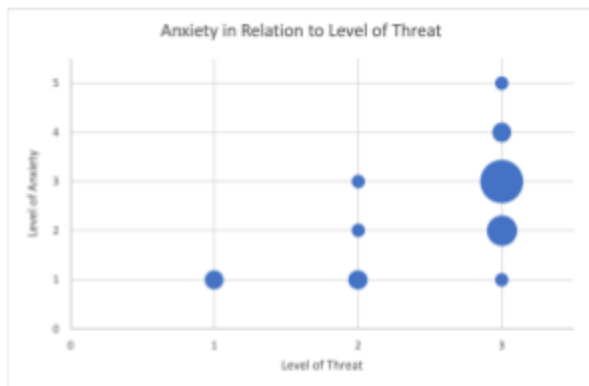
Note. Values of threat are rated from lowest threat ('not a threat'=1) to highest ('major threat' = 3)
Bubble size corresponds with number of respondents

Figure 8
Respondents' Level of Climate Anxiety in Relation to Understanding

Anxiety in Relation to Perceived Understanding
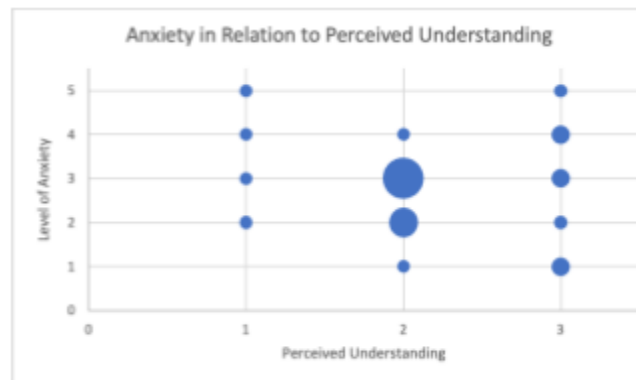
Note. Values of understanding are rated from lowest understanding ('not very well'=1) to highest ('very well Bubble size corresponds with number of respondents

Pattern 2 - Support for Fossil Fuel Taxes and Protective Infrastructure Laws

Pattern 2 compares levels of *support* for increasing fossil fuel (FF) taxes and for existing protective infrastructure (PI) laws - both measuring homeowners' support for government

actions to respond to climate change. The overall degree of *support* for PI and FF was positively

correlated (Spearman r^2=0.34, p=0.039, Figure 9).

The majority of respondents (26/37) were more in favor of protective infrastructure laws

than increasing FF taxes. The median value for *support* for PI was 4 ("somewhat in favor") and 3

for FF ("neither for nor against"). Notably, all respondents who were in favor of FF (values of 4

or 5) were also in favor of PI, whereas the reverse was not the case. The three climate change

skeptics were all opposed to FF, but two were in favor of PI.

Figure 9
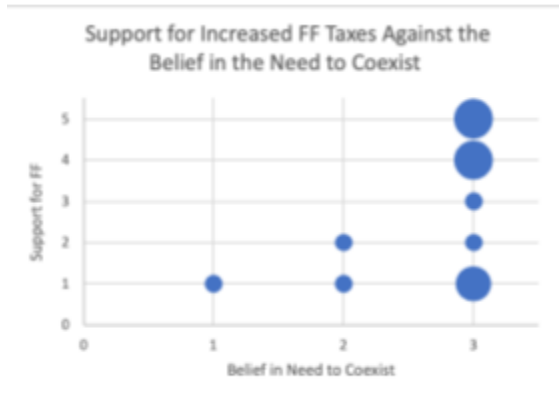*Respondents' Support for Increased Fossil Fuel Taxes and Protective Infrastructure Laws*

Note. Values of support are rated from lowest support ('strongly against'=1) to highest
('strongly in favor'=5)
Bubble size corresponds with number of respondents

Taking this analysis a step further, I factor in the belief that humans *need to coexist* with

the planet to not over-exploit it by looking at correlations between self-reported belief in the *need*

to coexist with *support* for FF taxes and existing PI laws. Belief in the *need to coexist* was

significantly correlated with *support* for both FF (Spearman r^2=0.49, p=0.002) and PI (Spearman

r^2=0.37, p=0.023). *Support* for increased FF highly increases with the belief in the *need to*

coexist (Figure 10). A strong belief that humans *need to coexist* was associated with higher levels

of *support* for PI (Figure 11).

Figure 10
Respondents' Support for Increased FF Taxes Against Belief of the Need to Coexist With the Planet

Support for Increased FF Taxes Against the Belief in the Need to Coexist

Note. Values of support are rated from lowest support ('strongly against'=1) to highest ('strongly in favor'=5) Bubble size corresponds with number of respondents

Figure 11
Respondents' Support for Protective Infrastructure Laws Against Belief of the Need to Coexist With the Planet
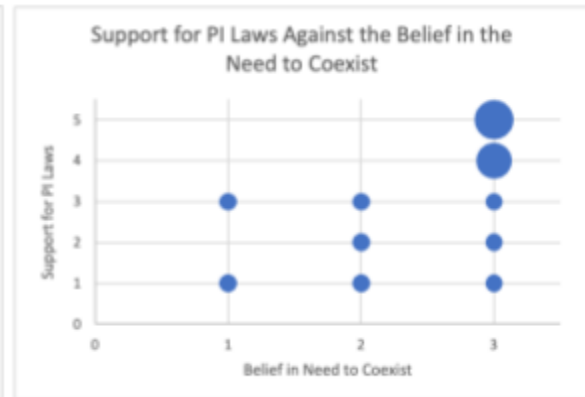
Support for PI Laws Against the Belief in the Need to Coexist

Note. Values of support are rated from lowest support ('strongly against'=1) to highest ('strongly in favor'=5) Bubble size corresponds with number of respondents

Theme 2: Homeowner's Actions Based on Their Perceptions

Looking at how perceptions influence actions, I analyzed patterns relating to belief in

*human activitie*s on CC, anxiety felt, belief in the impact of *individual actions*, and whether

homeowners took *actions*.

Pattern 3 - Human Activities' Influence, Individual Impact and Actions

Pattern 3 looks at an individual's belief that *human activities* increase the rate of CC,

belief that *individual action*s are effective, and whether the respondent *acts* to reduce their

individual impact. The logistic regressions showed that whether homeowners *act* depends

strongly on whether they believe that *individual actions* make a difference (p=0.018), and not on

whether they think *human actions* increase the rate of climate change (p=0.154). Full regression

results are shown in Appendix D.

As seen in Figure 12, the likelihood of whether homeowners *act* increases with the belief that *individual actions* can make a difference. This figure also shows that there are quite a few respondents (21/37) with low belief in the effectiveness of *individual actions* against climate change (values of 1 or 2, meaning, 'definitely not' and 'probably not').

Figure 12
Likelihood of Actions Against Belief of Effectiveness of Individual Actions

Note. The size of the bubble correlates to the size of respondents, and the values on the x-axis range from lowest belief (1= 'definitely not') to highest (5= 'definitely')

Figure 13 shows how those who believe *human actions* increase the rate of CC are slightly more likely to act, but it is not a very clear pattern and is statistically non-significant (p=0.154). Not surprisingly, the three respondents who indicated they did not believe that the climate is changing, also did not believe that *human activities* increase the rate of CC.

Figure 13

Likelihood of Actions Against the Belief of the Impact of Human Activities
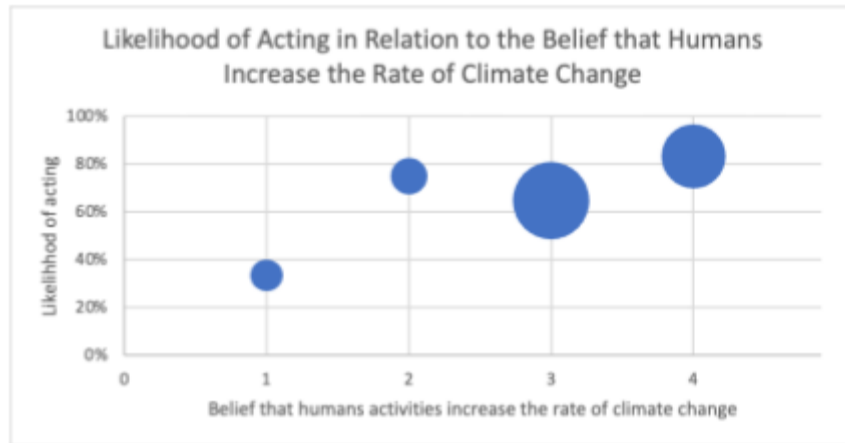
Note. The size of the bubble correlates to the size of respondents, and the values on the x-axis range from lowest belief (1= 'fully don't believe') to highest (5= 'fully believe')

Two respondents felt so strongly that *individual actions* do not make a difference, that instead of indicating whether they *act*, they shifted blame to 'others' and corporations. One stated "*corporations are the real source of climate change and they pawn the blame on us*" and the other stated, "*I don't really think that there's a point to it. Using a plastic straw or using less plastic doesn't make a difference when others have private jets and deplete our resources*". I considered these responses as no, they do not take individual action. These respondents were also the only ones who indicated feeling "extremely anxious".

Pattern 4 - Anxiety Felt, Perceived Understanding, and Individual Action

This pattern analyzes the influence of *climate anxiety* and perceived *understanding* of climate change on whether homeowners *act*. I excluded the two homeowners who responded to the action question with "beach clean-ups", "land clean-ups" or "not littering", as these do not represent actions that reduce individual carbon footprint.

There was no significant relationship between whether homeowners *act* and either their

level of *understanding* of climate change or their level of *climate anxiety* (logistic regressions,

p=0.428 for *understanding* and p=0.957 for *climate anxiety*) indicating that those factors were

not influencing whether respondents *acted*. The full results of the regression are shown in

Appendix D.

Figure 14 shows the distribution of perceived *understanding* and level of *climate anxiety*

for homeowners who *act*. Most of these respondents indicated similar levels of *understanding*

and *climate anxiety* - moderate or high understanding and average *climate anxiety* levels.

Figure 14
Distribution of Understanding and Climate Anxiety for Respondents Who Act

Note. The size of the bubble correlates to the size of respondents, and the values on the axes
from lowest understanding or anxiety (1= 'not very well' or 'not at all anxious') to highest
(3= 'fully believe' or 5 = 'extremely anxious')

Figure 15 shows the distribution of perceived *understanding* and level of *climate anxiety*

for homeowners who did not *act,* with no clear patterns evident.

Figure 15

Distribution of Understanding and Climate Anxiety for Respondents Who Did Not Act

Note. The size of the bubble correlates to the size of respondents, and the values on the axes from lowest understanding or anxiety (1= 'not very well' or 'not at all anxious') to highest (3= 'fully believe' or 5 = 'extremely anxious')

Theme 3: Influence of Damage on Perceptions and Actions

Pattern 5 - The Influence of Damage on Perceptions and Actions

The final pattern fits into its own theme. There were only seven respondents who experienced *damage* related to climate change, so there is not sufficient data for statistical analysis, but the results are still of interest. All seven respondents indicated that experiencing *damage* changed their *perceptions* - making them believe more in CC. However, only four respondents indicated they *acted* more pro-environmentally. The three respondents did not change their *actions*, including one who indicated the *damage* definitely made them change their perception.

Discussion

The analysis of results is broken up into three themes, mirroring those of the results section - homeowners' perceptions, homeowner's actions based on their perceptions, and the influence of damage on perceptions and actions.

Theme 1: Homeowners' Perceptions

Pattern 1 - Perceived Understanding, Threat, and Anxiety

The first pattern looks at how homeowners' perceived *understanding* of CC and the level of *threat* they feel influences their level of *climate anxiety*. Among Hawai'i homeowners, increased perceived severity of *threat* was strongly associated with higher levels of *climate anxiety*. There is a lack of literature explaining how levels of *threat* influence *climate anxiety* related directly to climate change. It is often mixed with levels of *understanding*, as expanded on below. However, previous studies have found that there is a general relationship between perception of threat and anxiety. This relationship is sometimes manifested as individuals acting selfishly instead of in a way that benefits society or not wanting to expose themselves to threatening stimuli (Cui et al., 2023; Valdespino, 2019; Van Overmeire et al., 2021).

For the Hawai'i homeowners involved in this study, there was no association between climate *understanding* and *climate anxiety*. Previous research on this topic has shown very mixed results, with in some cases individuals with a high *understanding* feeling less *climate anxiety*, possibly due to a sense of eco-hope (Lueck, 2007; Pihkala, 2018). Similarly, other studies have found that increased understanding reduces *climate anxiety* (Crandon et al., 2022; Townsend et al., 2018; Zacher and Rudolph, 2023).

However, in other cases, it has been shown that individuals with higher levels of *climate anxiety* may deliberately avoid becoming better informed on climate change as a way to shield themselves from overwhelming anxiety (Aberg et al.,2022; Kapeller and Jäger, 2020; Myers, 2014). Furthermore, Javeline and colleagues (2019) found that in some cases, an increased *understanding* of climate change may lead to a sense of despair, anxiety, and stress, and therefore do not *act*.

These conflicting findings show that increased knowledge or *understanding* has a complex relationship with how anxious homeowners feel for the future, probably varying a lot among homeowners based on their personal norms and the type of understanding they have of climate change.

Pattern 2 - Support for Fossil Fuel Taxes and Protective Infrastructure Laws

Pattern 2 compares levels of *support* for increasing fossil fuel taxes (FF) and for existing protective infrastructure laws (PI). The generally high *support* for both of these indicates that these homeowners have altruistic and biospheric values, meaning they are receptive to non-monetary incentives, like environmental feedback and seeing societal benefits (Bamberg and Möser, 2007; Gneezy et al., 2011; Martin and Czellar, 2017; Zehui 2023). In both cases, there are costs to homeowners but they still *support* them because they value the benefits to the environment, themselves, and other citizens - enjoying the beach, cleaner air, and a healthier environment. Perhaps, homeowners are more likely to pay because they live on an island and therefore are quicker to experience the negative impacts of climate change (Thomas et al., 2020). Another possible explanation is that the strong sense of shared community in Hawai'i may encourage homeowners to have more consideration for beach-goers and therefore feel more responsibility to act in everyone's interests.

I expected homeowners to be most supportive of existing PI laws because it is easier to see the impact of PI - where there is no more beach. Whereas, the impact of FF may be more abstract because the impacts manifest as slower consequences like increased temperatures and rising sea levels (Nunez, 2019). I compared these levels of *support* to the belief that humans *need to coexist* with the planet, meaning that humans need to find a balance between *human activities* and the environment. In line with my expectations, homeowners who indicated a higher belief in

the *need to coexist* were *supportive* of increased FF taxes and even (slightly) more in support of

existing protective infrastructure laws. Other studies have shown that believing in the *need to*

coexist with the planet can influence monetary preferences (Geng et al., 2015; Kuhnen and

Knutson, 2011). Individuals' concerns for the environment and society are intertwined, where

people are more willing to pay for things that benefit individuals rather than abstract

environmental causes (Kuhnen and Knutson, 2011). Moreover, individuals typically think more

about their day-to-day lives and thus invest resources into issues they deem of immediate

concern instead of more distant CC impacts (Stancoiff et al., 2018). Many Hawai'i homeowners

have likely seen how other PI has drowned out the beaches, making it more of a daily concern

that could increase their sense of responsibility for reducing those impacts. Whereas the impacts

of fossil fuels might be harder to conceptualize and be a less immediate threat, thus not getting as

much (monetary) attention (Spence et al., 2012), Hawai'i coastal homeowners in this study were

almost as equally supportive of fossil fuel taxes as infrastructure laws. Perhaps these

homeowners were especially closely connected to the looming impacts of climate change among

this group.

Theme 2: Homeowner's Actions Based on Their Perceptions

Pattern 3 - Human Activities' Influence, Individual Impact and Actions

This pattern looks at what motivates respondents to *act* to reduce their climate impact.

Specifically, the importance of the strength of their beliefs that *human activities* increase the rate

of CC and that *individual actions* make an impact. Here, results showed strongly that the belief

that *individual actions* can make a difference was very important, but a more general belief that

humans actions are responsible for climate change was not a clear factor motivating *action*.

The strong importance of belief in the effectiveness of *individual actions* has been shown by many other studies of pro-environmental behavior. For example, the perception of how effective *individual actions* are in reducing emissions is a significant factor in motivating sustainable practices (Murray and DiGiorgio, 2021; Wynes et al., 2020). Moreover, Wynes and colleagues (2020) found that one reason for *inaction* is that individuals underestimate their impacts, for example, the carbon emissions associated with air travel and eating meat.

Other studies have also shown that a general belief that *human activities* increase the rate of climate change is a weak influence on *action*. For example, in the case of energy conservation, individuals do not trust that the rest of society will take collective action against climate change (Lübke, 2021). Perhaps homeowners who indicated they believe in the *need to coexist* for climate change but do not *act*, similarly feel it is pointless for them to *act* alone.

One reason why two respondents shifted blame very strongly away from individual actions to corporations could be that their personal norms are weaker and, as can be a common reaction, they find it easier to blame other factors than making lifestyle changes that would benefit the environment (Steg and Nordlund, 2012).

Pattern 4 - Anxiety Felt, Perceived Understanding, and Individual Action

Pattern 4 looks at the influence of *climate anxiety* and perceived *understanding* of climate change on whether homeowners *act*. There were no significant relationships between homeowners' *climate anxiety* or their climate *understanding* concerning whether they *act* or not.

Climate anxiety can encourage individuals to *act* in some situations and can induce extreme eco-anxiety, or 'eco-paralysis', in others. Individuals with higher self-efficacy typically feel lower levels of *climate anxiety* and are more likely to *act* because they are confident in their ability to take effective *action* (Innocenti et al., 2023). Also, people with high awareness and a

sense of responsibility are likely to *act* despite feelings of anxiety (Steg and Nordlund, 2012). Perhaps some homeowners who take *action* find that it helps them relieve feelings of *climate anxiety*. This was the case in Finland, where individuals felt more inclined to take concrete steps towards climate change mitigation and subsequently felt less anxious. Moreover, surrounding themselves with sustainability initiatives helped give individuals from that study a sense of agency and self-efficacy (Sangervo et al., 2022).

In contrast, some individuals with high levels of *climate anxiety* feel 'eco-paralysis', feeling eco-anxiety to the point where they feel unable to *act* (Innocenti et al., 2023; Javeline et al., 2019; Usher et al., 2019). This might be the case for some homeowners, who may feel *climate anxiety* to the point of feeling helplessness and hopelessness, undermining their ability to *act* (Usher et al., 2019). Without a sense of responsibility and awareness of the problem - which in this case can be seen as feeling high levels of *climate anxiety* - individuals tend not to *act* (Steg and Nordlund, 2012). The conflicting literature could explain why *climate anxiety* is not very influential in why homeowners *act* or do not *act*.

Next, I look at the relationship between perceived *understanding* of CC and whether respondents *act*. I expected that homeowners with a higher self-reported *understanding* would *act* to reduce their individual impact. While the logistic regression showed no significant relationship, many respondents who reported a fairly or very good *understanding* of CC take *action*. This is in line with research by Alexander and colleagues (2012), which found that people who are more climate-aware and have more knowledge are more likely to save energy or advocate for managed shoreline retreats. However, other homeowners who also indicated increased climate *understanding* might feel overwhelmed by their climate knowledge, scared that they can not do anything, and therefore do not *act*. Moreover, taking *action* often includes

personal sacrifice and life changes with uncertain success to the point where even people with increased climate knowledge may feel the cost outweighs the benefits (Lorenzoni et al., 2007). Some people may feel empowered by climate *understanding* to make an effort, and some people may feel the complete opposite. The mixed findings from the current study suggest that increased *understanding* does not necessarily influence pro-environmental behavior, as found in other research (Hart and Nisbet 2012; Mildenberger and Tingley, 2017; Pidgeon 2012).

The two respondents who shifted blame were the only homeowners who indicated feeling extremely anxious about the future. They may feel like the problem of climate change is so big and out of their hands. Studies have found that individuals may shift the blame, and thus the responsibility to *act*, of CC to big corporations instead of making a change in their own lives (Collins, 2020; Heede, 2022; Steg and Nordlund, 2012). These two respondents likely feel that the looming *threat* of CC can only be solved through major changes and see big corporations as the major emitters that they are. They may think that their individual *actions* would be useless compared to what corporations can do.

Theme 3: Influence of Damage on Perceptions and Actions

Pattern 5 - The Influence of Damage on Perceptions and Actions

The final pattern analyzes how experiencing loss or *damage* changes an individual's *perceptions* and *actions*. It is difficult to draw clear conclusions from the answers of the seven respondents who had experienced *damage*. Further research is needed to determine a definite pattern between these three factors specific to Hawai'i's coastal homeowners.

Numerous studies have found that experiencing *damage* due to climate change makes the *threat* feel more real (Frondel et al., 2017; Pantera et al. 2022, Konisky et al., 2016). A clear example is the case of a Salisbury Beach resident who stated he "*wasn't a believer in global*

warming or ocean levels," but, "*historically, there's no precedent to this, so … I'm willing to consider things that … I previously [disregarded]*" (*This $600k Defense Against Sea Level Rise Could Have Lasted 3 Years. It Was Destroyed in Less Than a Day*, 2024). Experiencing *damage* can be very shocking and makes the issue of CC less abstract (Javeline et al., 2019; Spence et al., 2012). Although the sample size is very small, responses from this study are consistent with those earlier findings, in that all respondents indicated that *damage* changed the way they perceive climate change.

Taking *action* is the next step. Perhaps not all homeowners changed their *actions* because it involved difficult lifestyle changes or unrealistic costs. Alternatively, as in the case of the Caribbean fisherman, these homeowners may feel that the *damage* is already inevitable, and their *actions* make no difference (Baptiste, 2018).

A case study in Germany showed that individuals affected by flooding were more interested in climate protection measures. However, some victims who experienced the most *damage* felt they could not *act* effectively, partly because of budget constraints but also psychological factors like denial and fatalism, similar to eco-anxiety (Osberghaus and Demski, 2019). Perhaps some homeowners experienced high levels of *climate anxiety* and felt powerless, or in some cases denied that climate change caused the *damage*. As studies have shown, experiencing climate *damage* can lead to changes in political behavior, such as increased voting for costly pro-climate measures and green politicians after Hurricane Sandy in New Jersey (Elliott et al., 2023; Hazlett and Mildenberger, 2019; Rudman et al., 2013). Therefore, homeowners who experienced *damage* but did not change their *actions* might still have changed or influenced their voting or political preferences. Further research is needed to understand why some homeowners changed their *actions* and some did not.

Inconsistencies in Responses

As previously stated, several respondents answered questions that were not intended for them. Perhaps those 'extra respondents' answered by putting themselves in the position of experiencing damage to their property or if they would have PI installed. Another possible explanation is that someone they know - such as their neighbors, friends, or family members - had experienced damage due to CC or had PI installed. Then the respondent might have thought about what they would do or possibly taken inspiration from their acquaintance who had experience.

Next, looking at the respondents who indicated beach/land clean-ups and not littering. While these actions help to reduce the impact of pollution, it does not help to reduce climate change. It is interesting that one individual who claimed to understand CC fairly well was a part of this. The survey question asked about actions to reduce their individual impact, which I included to mean their carbon impact. Perhaps both respondents confused general climate change and environment-related issues, such as litter. Research has shown that people associate beach clean-ups with action against CC because of the impact it has on the environment (Battisti et al., 2020; Power, 2021). While this benefits the environment, it is not all directly connected to climate change.

<div align="center">

Limitations and Future Research

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Limitations

There were several challenges and limitations to the study. As my primary source of data collection is an online survey, and very few respondents were willing to have a follow-up interview and then did not answer when I reached out, I was not able to explore the patterns I found more deeply. Interviews would have been beneficial to confirm patterns - to get a more

in-depth understanding of people's perceptions, actions, and how they are influenced by experiencing damage or loss to their property. Interviews would also have better allowed me to determine how serious a respondent is about the survey, to help explain the study's objectives and answer any questions (Nayak and KA, 2019), and to check if the participants were coastal homeowners. Although my description of the survey and the top of the survey itself stated that I only wanted to hear from coastal homeowners in Hawai'i, I got a comment on Reddit that said they are not a coastal homeowner and took the survey anyway, apparently not realizing until they had submitted it. Unfortunately, I could not remove this respondent because I did not know which submission they sent in. I was also unable to contact them as they left no indication of which respondent they were.

Participation rates in online surveys tend to be very low compared to in-person surveys, which is one explanation for the limited number of respondents. This type of survey also cannot account for a group of possible respondents - those who lack computer and internet skills and those who did not see the link (Nayak and KA, 2019).

I posted my survey on my personal Facebook pages, targeting people I know in Hawai'i who have a home on the coast or know someone who does. Due to the small size of respondents, this survey is not a generalizable sample and is not representative of the population. Initially, I did not plan to post my survey on Reddit, so I did not include a question asking which Hawaiian island they lived on. In retrospect, this would have helped to see if there were certain patterns for certain islands.

It would have been especially beneficial to get more survey respondents who had experienced damage due to climate change and more people who installed protective infrastructure. It would also have been interesting to have more respondents who did not believe

in CC. This would better allow for conclusions to be drawn about the effect of belief in CC on perceptions and actions. If I lived, or conducted research, in Hawai'i, I could be more proactive with data collection - going door to door, reaching out to realtors, researching especially affected areas, and asking people living there. Perhaps also there would have been a higher willingness to be interviewed if I was based in Hawai'i or could provide local contact details.

Survey Formatting and Questions

I encountered obstacles with formatting and wording my questions. Question 9 in my survey was "do you try to reduce your individual impact on the environment?", with the options "no", "yes by (fill in below)", and a blank space to fill in an answer. I imagined that the same words would be filtered together to make an overall count of the same actions respondents do, however, the form created a new section of the pie chart for every response. It would have been better to create main categories of action, such as recycling, taking public transportation, walking, air drying clothes, and buying second-hand.

Future Research

Originally, I planned to investigate how experiencing CC-related damage influences perceptions and actions. With more participants who had experienced climate change, researchers could find the real impact of damage on their perceptions and actions. It would also be beneficial to have more respondents who are skeptical about climate change. This would aid the researchers in understanding the role of belief in CC and whether damage makes them believe in CC more.

Furthermore, more research is necessary to research the role of installing PI. What leads homeowners to install PI? Is it extreme damage? Are their homes more at risk because their neighbor installed it so excess water floods into their property? Were the homes with PI already

installed as a selling point? Or did the homeowners not consider it? Questions such as these would help the researcher understand why homeowners installed PI and whether they had thought about the environmental impacts that come from them.

Conclusions

This study analyzed how coastal homeowners in Hawai'i perceive climate change and how that influences their actions. These key findings included that there is not a simple relationship between understanding climate change and the level of anxiety as a result. Instead, feelings of anxiety were much more related to expectations of the severity of the climate threat. Regarding motivators for climate action, the only strong driving factor was the belief in the effectiveness of individual human actions, as without that, homeowners were more likely to shift blame or not act, perhaps out of feeling helpless. None of the other factors considered - level of climate anxiety, level of understanding of climate change, or even extent of the belief that humans were responsible for climate change - had strong relationships with the likelihood of acting to reduce their individual impact. This suggests that to encourage more people to act, emphasis must be put on showing how impactful individual actions can be and what individuals can do to make a difference. Simply focusing on things that promote climate anxiety or emphasize human responsibility is unlikely to be effective.

Due to the small sample size of only 37 participants, conclusions can not be generalized to the larger population of coastal homeowners. However, there was often consistency with previous research, which supported the main findings from this study about drivers of climate anxiety and motivations for climate action. However, even within this small sample size, it was clear that there is a lot of variability in how individuals respond to and relate to climate change and how that might alter their behavior or perceptions. Further studies with large sample sizes

and more successful targeting of individuals who had experienced climate damage are necessary

to provide further insights.

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Appendix A

Facebook and Reddit Post with Survey

Aloha,

As part of my bachelor's degree, I am writing a research paper about how the impacts of climate change influence coastal homeowners' perceptions and actions, looking specifically at Hawai'i. I would really appreciate it if anyone with a house on the beach in Hawai'i could take my survey, it will take about 5 minutes :) All results will be anonymous. By filling in this form, you give your consent to include your responses as a part of my data. Please share the link with any coastal homeowners you know in Hawai'i!

My research question is "How do coastal homeowners in Hawai'i perceive climate change and how does that influence their actions?" With this, I want to investigate how homeowners understand climate change and its impacts and if their perception has changed from seeing erosion along the beach and/or damage to their homes. I also want to investigate what they do to protect their homes from damage - if they install a sea wall or other infrastructure - and if they understand what that means for the environment.

1. Have you ever heard of climate change?

    a. Yes

    b. No

If you answered yes to the last question, answer the rest of the questions.

If you answered no to the last question, skip to question 7.

2. Do you believe that the world's climate is changing?

    a. Yes

    b. No

3. How would you evaluate your understanding of climate change?

    a. Very well

    b. Fairly well

    c. Not very well

    d. Not at all

4. To what extent do you perceive climate change as a threat?

    a. Major threat

    b. Minor threat

    c. Not a threat

5. The term 'climate anxiety' refers to overwhelming feelings of discomfort and anxiety for the

    current and future state of the climate, to what extent do feel climate anxiety?

    a. Extremely anxious

    b. Very anxious

    c. Somewhat anxious

    d. Not very anxious

    e. Not at all anxious

6. To what extent do you believe that human activities increase the rate of climate change?

    a. Fully believe

    b. Strongly believe

    c. Somewhat believe

    d. Strongly don't believe

    e. Fully don't believe

7. Do you feel like your individual actions help reduce the negative impacts of climate change?

    a. Definitely

    b. Probably

    c. Somewhat

    d. Probably not

    e. Definitely not

8. How often do you think about how your actions impact the environment?

    a. Daily

    b. About once a week

    c. About once a month

    d. About once a year

    e. Never

9. Do you try to reduce your individual impact on the environment?

    a. No

    b. Yes by (fill in below)

    c. Other:

10. Do you believe humans must coexist with the planet to ensure we don't overexploit it?

    a. Definitely

    b. Somewhat

    c. Not at all

11. Did you consider how climate change (ex. sea level rise or erosion) could impact your

     property before buying your home?

     a. Definitely

     b. Somewhat

     c. Not at all

12. Have you suffered any loss or damages to your property due to climate change (ex. sea level

     rise or erosion)?

     a. Yes

     b. No

13. If yes, has it changed your perspective on climate change, for example by making it seem

     more "real"?

     a. Definitely

     b. Somewhat

     c. Definitely not

14. If yes, have you taken more actions to reduce your individual impact on climate change (ex.

     using public transport more often or turning off appliances when they're not in use)?

     a. More

     b. Same

     c. Less

15. Have you had any PI built to protect your home (ex. tarps or seawalls)?

     a. No

     b. I bought my house with it already built

     c. Yes

d. Thinking about it/ planning to

16. If yes, have you thought about how that would impact the environment?

   a. Yes

   b. Somewhat

   c. No

17. Increasing taxes on fossil fuels like oil, gas and coal is a way the government can reduce emissions to lessen climate change. To what extent are you in favor or against Hawai'i increasing taxes on fossil fuels?

   a. Strongly in favor

   b. Somewhat in favor

   c. Neither for nor against

   d. Somewhat against

   e. Strongly against

18. Existing laws require state approval to get sandbags, tarps and sea walls around a home. To what extent are you in favor or against this policy?

   a. Strongly in favor

   b. Somewhat in favor

   c. Neither for nor against

   d. Somewhat against

   e. Strongly against

Thank you for your time! If you are willing to participate in an interview (of about 45 mins) to further discuss climate change and the impact of PI, please put your name and email here and I will reach out :)

Appendix B

Results of the Survey

1. Have you ever heard of climate change?
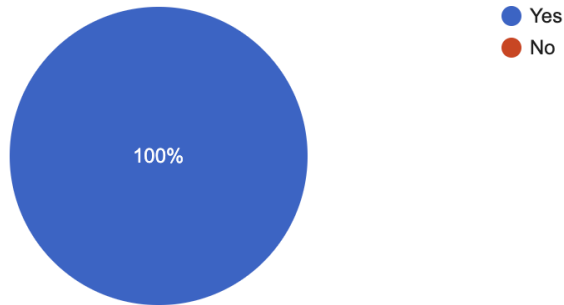
2. Do you believe that the world's climate is changing?
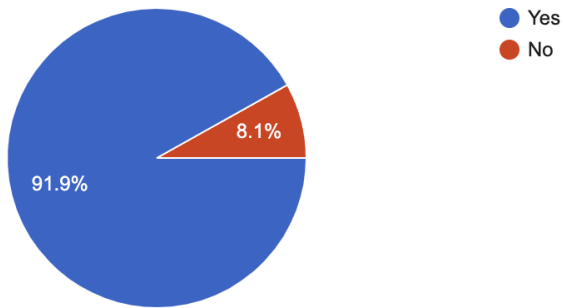
3. How would you evaluate your understanding of climate change?
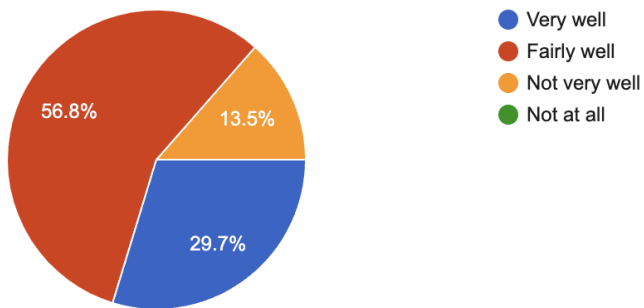

4. To what extent do you perceive climate change as a threat?
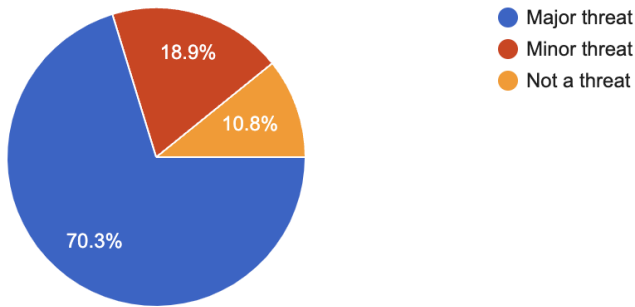
5. The term 'climate anxiety' refers to overwhelming feelings of discomfort and anxiety for the current and future state of the climate, to what extent do feel climate anxiety?
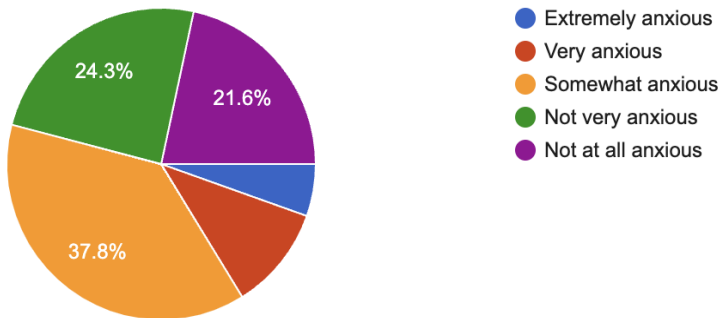
6. To what extent do you believe that human activities increase the rate of climate change?
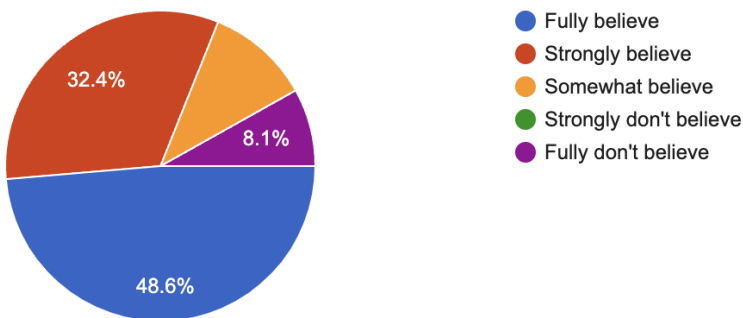
7. Do you feel like your individual actions help reduce the negative impacts of climate change?
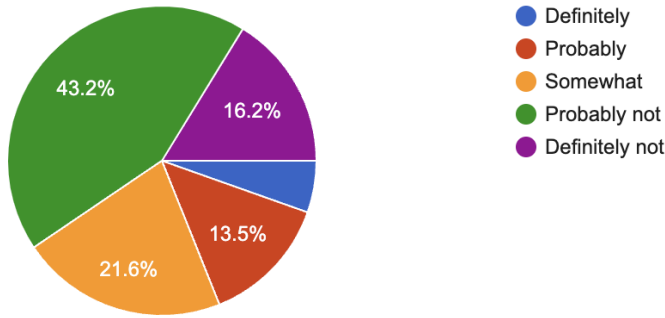
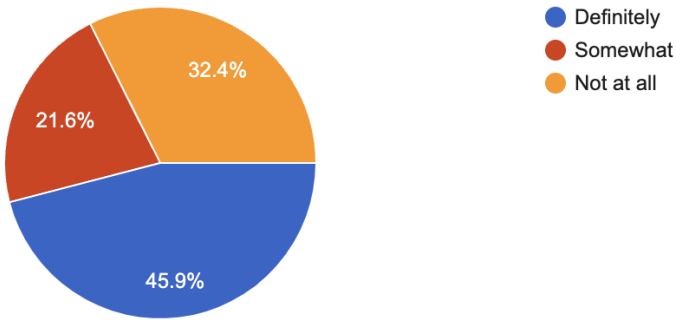8. How often do you think about how your actions impact the environment?
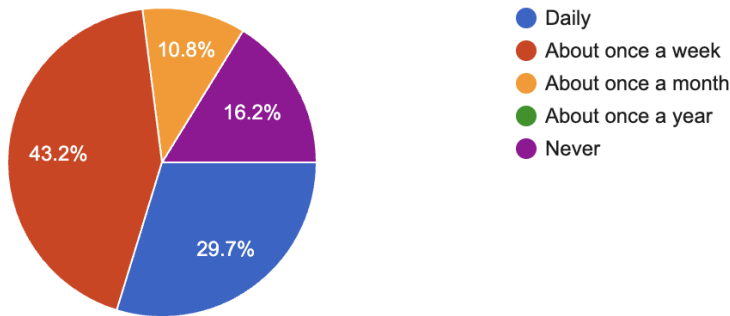
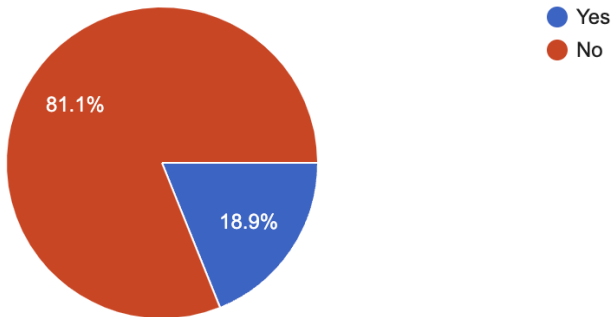9. Do you try to reduce your individual impact on the environment?

10. Do you believe humans must coexist with the planet to ensure we don't overexploit it?
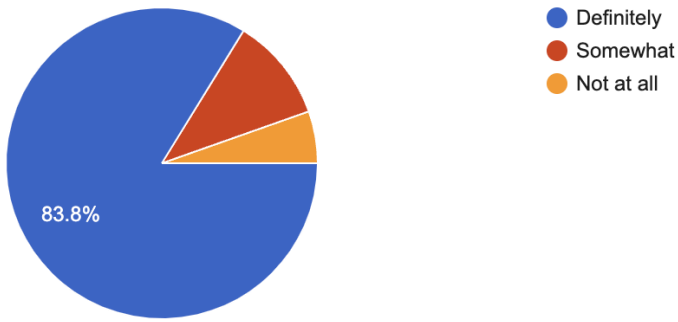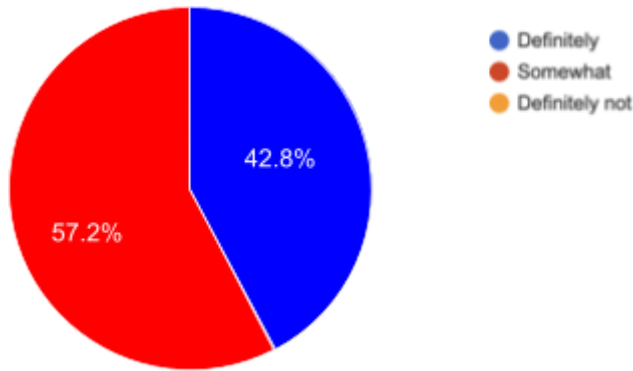
11. Did you consider how climate change (ex. sea level rise or erosion) could impact your property before buying your home?


12. Have you suffered any loss or damages to your property due to climate change (ex. sea level rise or erosion)?

13. If yes, has it changed your perspective on climate change, for example by making it seem more "real"? *pie chart shows adjusted values


14. If yes, have you taken more actions to reduce your individual impact on climate change (ex. using public transport more often or turning off appliances when they're not in use)? *pie chart shows adjusted values
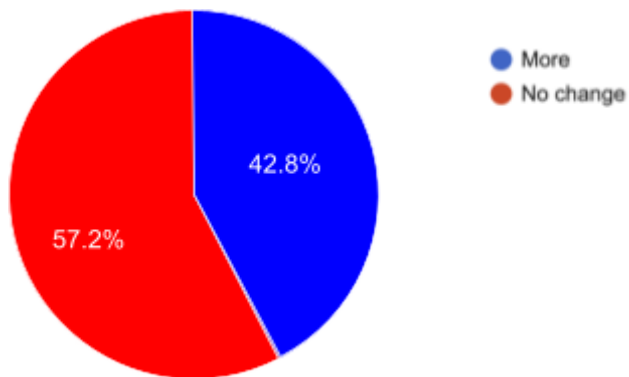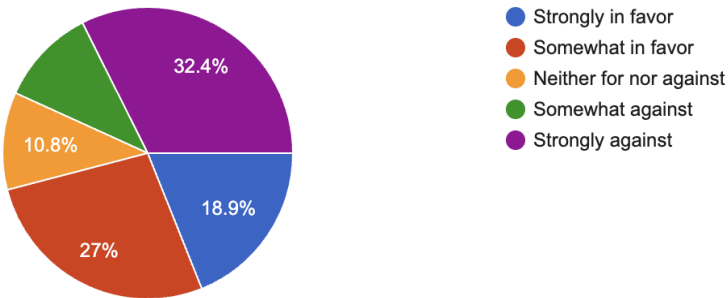

15. Have you had any PI built to protect your home (ex. tarps or seawalls)?
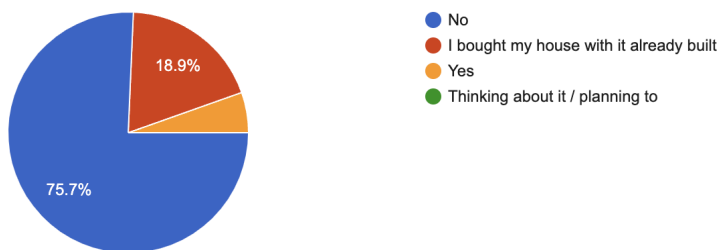
16. If yes, have you thought about how that would impact the environment? *pie chart shows adjusted values
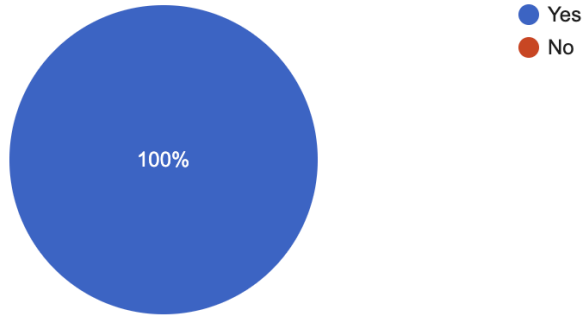
17. Increasing taxes on fossil fuels like oil, gas and coal is a way the government can reduce emissions to lessen climate change. To what extent are you in favor or against Hawai'i increasing taxes on fossil fuels?

18. Existing laws require state approval to get sandbags, tarps, and sea walls around a home. To what extent are you in favor or against this policy?

Legend:
- Strongly in favor
- Somewhat in favor
- Neither for nor against
- Somewhat against
- Strongly against
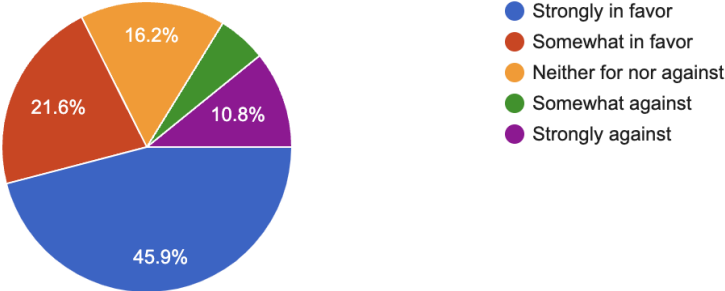
Appendix C

Tables with Patterns

*N indicates the frequency of responses

Table 2

Perceived Understanding, Threat, and Anxiety Felt for the Future State of the Environment

Perceived understanding	Perceived threat	Anxiety	N
FW	MT	sA	10
FW	mT	NAA	1
VW	MT	sA	2
VW	MT	EA	1
VW	mT	NAA	2
FW	MT	NVA	5
FW	mT	NVA	1
VW	MT	VA	2
NVW	MT	NVA	1
NVW	MT	VA	1
FW	mT	sA	1

NVW	mT	sA	1
NVW	MT	EA	1
VW	MT	NVA	1
NVW	mT	NVA	1
FW	MT	VA	1
FW	NT	NAA	1
VW	NT	NAA	2
VW	MT	NAA	1

Note.   FW: Fairly well   MT: Major threat   EA: Extremely anxious

VW: Very well   mT: Minor threat   VA: Very anxious

NVW: Not very well   sA: Somewhat anxious

NVA: Not very anxious

NAA: Not at all anxious

Table 3

The extent to which Homeowners Believe Humans Need to Coexist with the Planet and their Views Towards Increased Taxes on FF and Existing Laws for State Approval of PI

Coexisting with the planet	Fossil Fuels	Protective Infrastructure	N

D	sF	sF	4
D	NFNA	sA	1
D	SA	NFNA	1
D	SA	SF	1
D	SF	SF	5
NAA	SA	NFNA	1
D	SA	sF	1
D	sF	NFNA	1
D	NFNA	SA	1
D	sF	SF	2
D	SF	sF	1
D	SF	NFNA	1
S	sA	sA	1
D	SA	SF	2
D	sF	SF	3
D	NFNA	SF	1

S	SA	SA	1
D	sA	SF	2
D	NFNA	NFNA	1
D	SA	SA	1
D	sA	sF	1
S	sA	SF	1
NAA	SA	SA	1
S	SA	NFNA	1
D	SA	sF	1

Note.   D: Definitely   SF: Strongly in favor   sF: Somewhat in favor

S: Somewhat   NFNA: Neither for nor against   sA: Somewhat against

NAA: Not at all   SA: Strongly against

Table 4

Belief in Human Activities Increasing the Rate of CC, Impact on Individual Actions, if

Homeowners Take Action

Human Activity	Individual Actions	Do you act?	N
SB	PN	Y	6
FB	P	Y	3
SB	DN	N	1
FB	D	Y	2
FB	PN	Corporations are to blame/don't think there's a point when 'others have private jets and deplete our resources' (counted as N)	1
sB	DN	N	1
SB	DN	Y	1
FB	S	Y	2
FB	PN	Y	1
FB	S	Y	3
SB	S	Y	2

FB	PN	N	5
sB	P	Y	1
SB	P	Y	1
SB	S	N	1
FDB	PN	Y	1
FDB	DN	N	2
sB	DN	Y	1
sB	PN	Y	1

Note. SB: Strongly believe   D: Definitely   Y: Yes

FB: Fully believe   P: Probably   N: No

sB: Somewhat believe   PN: Probably not

FDB: Fully don't believe   S: Somewhat

DN: Definitely not

Table 5

Perceived Understanding, Level of Anxiety, and If Homeowners Take Action

Perceived Understanding	Level of Anxiety	Do they take individual action?	N
FW	sA	"doing bare minimum	1

		of not littering, participating in land/beach cleanups, etc."	
FW	sA	Y	9
FW	NAA	N	2
VW	sA	Y	1
VW	EA	"Corporations are the real source of climate change and they pawn the blame on us" (counted as N)	1
VW	NAA	N	2
FW	NVA	Y	5
VW	NAA	Y	3
FW	sA	N	1
FW	NVA	N	1
VW	VA	Y	2

NVW	NVA	N	2
NVW	VA	Y	2
NVW	sA	Beach clean ups	1
NVW	EA	"I don't really think that there's a point to it. Using a plastic straw or using less plastic doesn't make a difference when others have private jets and deplete our resources." (counted as N)	1
VW	NVA	Y	1
FW	VA	N	1
FW	NAA	Y	1
VW	sA	N	1

Table 6

If Homeowners Experienced Damage and how it has changed their Perceptions and Actions

Damage	Change in belief	Change in action	N
Y	D	M	2
Y	S	M	2
Y	S	N	2
Y	D	N	1

Note. M: More   N: No change

Appendix D

Regression Results

Table 7

Pattern 1. Analysis Regression with Homeowners' Climate Anxiety as the Dependent Variable and their Perceptions of Climate Threat as the Independent Variable

	Coefficient	Standard Error	p-value
Constant	-0.08	0.58	.887
Climate Threat	1.01	0.22	<0.001

Note. Linear Regression: Anxiety ~ Climate Threat

$r^2=0.38$, n=37

Table 8

Pattern 1. Analysis Regression with Homeowners' Climate Anxiety as the Dependent Variable and their Perceived Understanding of Climate Change as the Independent Variable

	Coefficient	Standard Error	p-value
Constant	3.29	0.65	<0.001
Perceived Understanding	-0.35	0.29	0.232

Note. Linear Regression: Anxiety ~ Climate Change Understanding

r^2=0.04, n=37

Table 9

Pattern 3 Analysis. Regression with Whether Homeowners Act on Climate Change as the Dependent Variable and their Belief in Whether Humans Increase the Rate of Climate Change as the Independent Variable

	Coefficient	Standard Error	p-value
Constant	-1.04	1.27	0.416
Human Activities	0.59	0.41	0.154

Note. Logistic Regression: Action ~ Humans Responsible

r^2=0.06, n=37

Table 10

Pattern 3 Analysis. Regression with Whether Homeowners' Act on Climate Change as the Dependent Variable and Whether Individuals' Actions make a Difference as the Independent Variable

	Coefficient	Standard Error	p-value
Constant	-0.75	0.65	0.252
Individuals Actions	1.14	0.48	0.018

Note. Logistic Regression: Action ~ Individuals' Actions

r^2=0.21, n=37

Table 11

Pattern 4 Analysis. Regression with Whether Homeowners Act on Climate Change as the Dependent Variable and their Level of Anxiety for the Future State of the Climate as the Independent Variable

	Coefficient	Standard Error	p-value
Constant	0.61	0.87	0.483
Climate Anxiety	0.02	0.33	0.957

Note. Logistic Regression: Action ~ Climate Anxiety

r^2=0.00, n=35

Table 12

Pattern 4 Analysis. Regression with Whether Homeowners Act on Climate Change as the Dependent Variable and their Perceived Understanding of Climate Change as the Independent Variable

	Coefficient	Standard Error	p-value
Constant	-0.35	1.30	0.787

Perceived Understanding	0.46	0.58	0.428

Note. Logistic Regression: Action ~ Climate Change Understanding

$r^2=0.02$, n=35