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RESEARCH ARTICLE

# Pro-environmental values foster support for both general and local ecological management

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**Ecological management (including restoration) of natural habitats is crucial for preserving biodiversity and maintaining ecosystem health. While its ecological significance is apparent, successful management also requires public support and thus has a social dimension. Here, we study (1) pro-environmental values and attitudes toward (2) ecological management in general, and (3) specific restoration actions, clearing and burning junipers aimed at (4) conserving the nationally endangered Apollo butterfly (*Parnassius apollo*), conducted at the locality of the survey (the SW Finland archipelago). An electronic questionnaire designed to gauge these four listed attitudes was distributed among residents and visitors, yielding 230 responses, which were analyzed in a Structural Equation Model framework to reveal a positive correlation (0.57) between individuals' pro-environmental values and their support for ecological management in general. However, the association between pro-environmental values and specific restoration actions at the place of survey and concern about the management target (Apollo) was weaker (0.36 and 0.37, respectively) although positive. The results underscore the importance of fostering environmental values and enhancing community engagement in conservation efforts, as public support of ecological management does not seamlessly align with supporting actions at specific sites. We discuss our findings with respect to the NIMBY and sense of place concepts. This study highlights the critical need to address public concerns and promote transparency in ecological management to better align governmental policies with community sentiments.**

**Key words: biodiversity conservation, community engagement, habitat restoration, nature management, public attitudes, species preservation**

## Implications for Practice

- Emphasize the importance of involving local communities in ecological management initiatives, especially in areas prone to NIMBY (Not in My Backyard) attitudes. This involvement can enhance public support and effectiveness for restoration projects.
- Improve transparency and provide clear justifications for specific ecological management actions, such as habitat restoration, to build trust and mitigate opposition from local stakeholders. Public outreach should link localized actions to broader conservation goals.
- Restoration projects that consider the values and attitudes of various stakeholders while providing clear information about the benefits of habitat restoration for both the environment and the community can help reduce opposition. These efforts can also engage a broader range of supporters and strengthen overall public support for specific activities.

## Introduction

Current and future generations face the challenge of creating sustainable solutions for environmental issues, including pollution, resource depletion, and climate change. These challenges often stem from social dilemmas and a lack of collective action (Ostrom 2009; Bodin 2017; Davidovic et al. 2020). In response, ecosystem restoration has gained increasing attention from governmental agencies, conservation groups, regulators, and the public (Burger 2010). While this growing interest is encouraging, restoration efforts require effective collaboration among public and private stakeholders to ensure success (Burger 2010; Bodin 2017; Indrajaya et al. 2022). Public support is particularly critical, as it drives funding and fosters commitment and engagement from local communities (Burger 2010; Gann et al. 2019).

Understanding the values and attitudes of individuals and local communities is vital for effective ecological management and restoration, particularly for endangered species (Reading et al. 1994; Youngin 2022). Pro-environmental values, encompassing attitudes and concerns that motivate individuals to support and engage in behaviors that favor environmental protection, offer a valuable lens for understanding public support for restoration efforts (Stern & Dietz 1994; Harring & Jagers 2013;

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Davidovic et al. 2020). Studies suggest that individuals with pro-environmental values are more likely to endorse government interventions and environmental policy measures (McCright et al. 2016; Davidovic et al. 2020). Furthermore, public involvement in restoration initiatives fosters community investment, integrates diverse perspectives, and drives meaningful ecological recovery (DeAngelis et al. 2020; Di Sacco et al. 2021).

Restoration aims to prevent habitat degradation and enhance habitat quality, benefiting multiple species and often having considerable ecosystem value (Garratt et al. 2017; Poniatowski et al. 2018; Kija et al. 2020). However, habitat restoration is not just an ecological endeavor but also a social one. The integration of social considerations into ecological studies is crucial (Ostrom 2009), as restoration often involves visible landscape changes that can evoke varied public responses. Therefore, addressing how stakeholders value and perceive restoration actions is essential for fostering support.

Restoration projects frequently face public opposition, particularly when involving changes to local areas. This resistance is often associated with the NIMBY (Not in My Backyard) phenomenon, where individuals oppose local projects while supporting similar initiatives elsewhere (Krause et al. 2014; Boyle et al. 2019). For example, while public opinion generally supports wind energy, local opposition to wind farms often stems from concerns about visual impact, noise, and potential effects on wildlife (Boyle et al. 2019; Rodrigues dos Santos 2021). However, involving local communities in the planning and decision-making stages has proven effective in mitigating such resistance, as demonstrated in the development of wind farms on the Danish island of Samsø (Rodrigues dos Santos 2021). Local communities often possess valuable knowledge that can challenge project promoters' claims and enhance project outcomes, yet the methods for effectively incorporating this expertise into decision-making remain unclear (Rodrigues dos Santos 2021; Pearson & Gorman 2023). Additionally, further exploration is necessary to understand how local communities evaluate risks and benefits and how these evaluations affect their acceptance or rejection of projects (Burningham et al. 2006; Rodrigues dos Santos 2021). Beyond NIMBY, public opposition to restoration often extends to broader issues such as environmental concerns, social justice, community identity, and quality of life (Hager & Haddad 2015; Eranti 2017).

In biodiversity conservation, NIMBY has been less studied than in infrastructure projects, such as wind farms. This study seeks to advance the understanding of NIMBY attitudes in biodiversity conservation by examining how pro-environmental values interact with support for both general and local ecological management. Additionally, we investigate the concept of a "sense of place," which encompasses the emotional, spiritual, and cognitive connections to specific locations (Jorgensen & Stedman 2001; Hausmann et al. 2016). We chose the sense of place because, while place attachment is a key component, the sense of place includes a broader range of interactions and relationships that individuals have with their environments (Jorgensen & Stedman 2001; Nelson et al. 2020). Sense of place influences public perceptions and acceptance of restoration actions, as alignment with local cultural and emotional values can either enhance or hinder support (Pueyo-Ros et al. 2019). Understanding these connections is crucial for fostering human-ecosystems relationships, promoting sustainable practices, and improving conservation efforts (Hausmann et al. 2016; Pearson & Gorman 2023; Dai et al. 2024). Our study builds on these findings by exploring how a sense of place interacts with pro-environmental values in shaping attitudes toward restoration activities.

In this study, we apply the pro-environmental value orientation concept to measure southwest (SW) Finland stakeholders' support for ecological management. We recognize that stakeholders may experience conflicting feelings when comparing their general support for ecological management with acceptance of specific, localized actions. These actions, such as clearing and burning shrubs, aim to conserve the endangered Apollo butterfly (*Parnassius apollo*). The Apollo butterfly is a single insect species whose conservation may not universally justify such measures due to their visible and potentially disruptive impacts (Samways et al. 2020; Matzek & Wilson 2021). To understand these perspectives, we assess respondents' attitudes toward the restoration actions and target species mentioned earlier (Fig. 1). We hypothesize that individuals will vary in their level of pro-environmental values (Berenguer et al. 2005; Franzen & Meyer 2010; Davidovic et al. 2020), which we aim to model in relation to attitudes toward both general ecological management and specific local actions and target species. We further hypothesize that individuals reporting stronger pro-environmental values will show greater support for both general and localized restoration measures, including conservation actions targeted at the Apollo butterfly (Fig. 1). This study contributes to a growing body of interdisciplinary research that integrates ecological, cultural, and social considerations into effective restoration planning (Schulz-Zunkel et al. 2022).

## Methods

### Study Area

Our study investigates the relationship between a pro-environmental value orientation, general ecological management, and specific restoration actions—clearing and burning shrubs—implemented to conserve the Apollo butterfly in the SW Finland archipelago. This region, with its high biodiversity, cultural significance, and tourism, shares characteristics with other ecologically sensitive archipelagos and coastal areas worldwide, where balancing conservation efforts with local acceptance can be challenging (e.g., Zarifsanayei et al. 2018; Balata & Williams 2020; Delgado & Marín 2020).

The SW Finland archipelago is the world's largest in terms of island count (Visit Finland null). It includes thousands of islands spread across the autonomous Åland region and SW Finland, covering 30 municipalities. Among these municipalities are Parainen and Kemiönsaari, which are the focal points of this study and host populations of the Apollo butterfly with the city of Turku, where the species occasionally occurs. Parainen covers approximately 900 $km^2$ of land, while Kemiönsaari

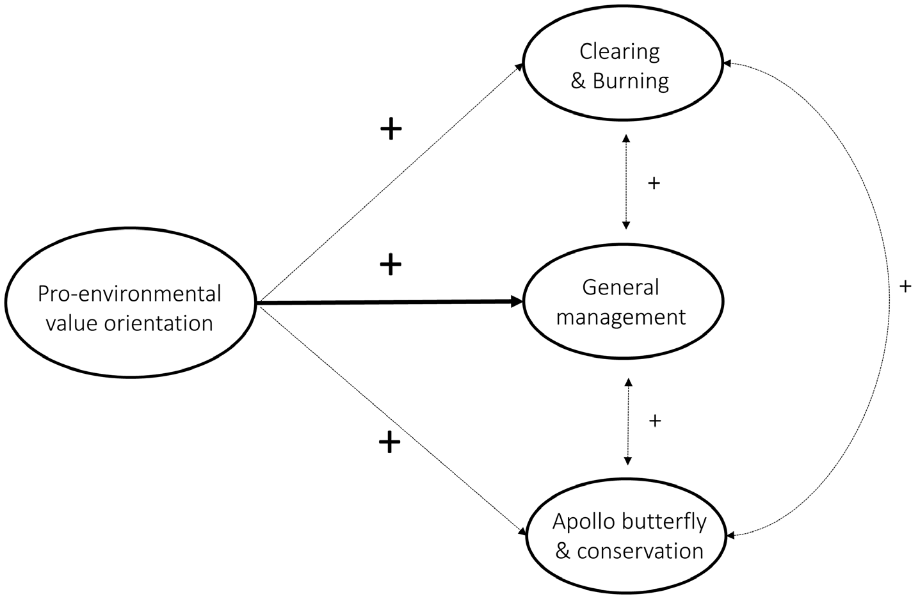


Figure 1. A simplified schematic diagram showing how the concept of the pro-environmental value orientation (labeled "pro-environmental value orientation" in the figure) is applied to study the relationship between value orientation and general ecological management. We expect that individuals reporting pro-environmental values will have a more positive (+) outlook toward general ecological management ("general management"), specific local restoration actions of clearing and burning ("clearing and burning"), and the conservation target, the endangered Apollo butterfly species ("Apollo butterfly & conservation"). The diagram also includes a potentially positive relationship with general ecological management, specific local restoration actions of clearing and burning, and the conservation target, the endangered Apollo butterfly species.

spans around 700 $km^2$, both surrounded by extensive water areas that contribute to their archipelagic character.

The Archipelago Trail attracts ~20,000 tourists annually. The area features rare and endangered species, Natura 2000 sites, a national park, and a UNESCO biosphere reserve, underscoring its ecological significance. With its rich natural, scenic, and cultural landscape, the SW Finland archipelago is an ideal case study for examining attitudes toward ecological management actions. The area features a variety of stakeholders—residents, tourists, entrepreneurs, farmers, and landowners—and has a history of EU-supported restoration projects, providing a distinctive context that may reflect the challenges faced in other ecologically and culturally sensitive regions around the globe.

### Ecology and Restoration Practices for the Apollo Butterfly

The Apollo butterfly, a species protected under the EU Habitats Directive (Annex IV), is experiencing population declines worldwide, particularly in the lowlands of Europe (Nakonieczny et al. 2007; van Swaay et al. 2010; Nadler et al. 2021). Effective habitat management is essential for its conservation, yet many areas lack proper measures, exacerbating the species' decline (Nadler et al. 2021). Finland hosts the northernmost populations of the Apollo butterfly, where the species has one generation annually, overwintering as an egg (Marttila et al. 1991; Fred & Brommer 2003). In spring, Apollo larvae emerge to feed on their sole host plant, orpine (*Hylotelephium telephium*) (Fred & Brommer 2003; Nakonieczny & Kędziorski 2005). These butterflies depend on semi-open habitats, such as rocky outcrops and archipelago islets, where larval host plants grow alongside adult nectar plants like thistles (*Cirsium* spp.) and star thistles (*Centaurea* spp.). The proximity of these resources is critical for their survival (Fred et al. 2006; Fred & Brommer 2010; Kukkonen et al. 2024).

In Finland, only four known Apollo populations remain in the Åland Islands and the SW coast, with one previous stronghold now in severe decline (Marttila et al. 1991; Kukkonen et al. 2022). The species struggles under passive protection and suffers from, among other things, afforestation caused by land abandonment (Nakonieczny et al. 2007). Habitat restoration projects across Europe have aimed to reverse these trends by opening landscapes by removing shrubs and trees, which have shown success in mountainous regions (Nakonieczny et al. 2007). Although the effects of such restoration actions remain understudied in Finland, there is evidence that Apollo occupancy increases in rocky outcrops with fewer trees (Kukkonen et al. 2024).

In the Finnish archipelago, traditional management practices like grazing and removing shrubs, including native juniper (*Juniperus communis*), historically maintained open landscapes. However, as residents left the archipelago and traditional practices declined, the islands became overgrown with shrubs and trees. Although junipers are native, they are often considered problematic by ecologists and resource managers because their encroachment and dominance threaten plant communities such as grasslands (Ansley & Rasmussen 2005). For example, juniper encroachment on Sweden's Öland Island has reduced vascular plant diversity and disrupted habitat mosaics (Rosén 2006).

Fire is a key management tool used to counteract juniper encroachment by increasing disturbance frequency, which reduces their competitive dominance (Ansley & Rasmussen 2005). Nonetheless, junipers provide ecological benefits, such as structural variety and cover for wildlife, potentially enhancing local biodiversity (Maser & Gashwiler 1978; Sangüesa-Barreda et al. 2022). This duality highlights the challenges of balancing conservation needs with ecological trade-offs in Apollo butterfly habitats.

### Participants and Recruitment

The questionnaire targeted the population and visitors of SW Finland, receiving 230 responses from individuals aged 15 and over (Table 1). Most respondents (97%, $n = 224$) reported living in Finland, and 61% ($n = 140$) indicated that their home municipality is in SW Finland.

Recruitment involved flyers, email newsletters, and advertisements at the University of Turku, with responses gathered via Webropol (2020, version 3.0) between May and August 2023. The survey was offered in Finnish, Swedish, and English to include diverse stakeholders, including residents, entrepreneurs, tourists, and visitors. By visitors, we mean stakeholders who do not identify as tourists, such as individuals who frequently visit the archipelago for personal or work-related reasons. Flyers targeted populations in Kemiönsaari and Parainen, where the Apollo butterfly occurs.

To assess the representativeness of the study sample, we obtained population structure and educational information from Statistics Finland's database (StatFin 2022). The study sample did not fully represent SW Finland (Table S11).

**Table 1.** Frequencies of the responses to sociodemographic questions in "The Apollo Butterfly and Nature Management in the Archipelago" survey. The total numbers and percentages are presented in the row "Total" and by question groups.

| *Survey data* | F | % |
|---|---|---|
| Gender | | |
| Women | 119 | 52 |
| Men | 99 | 43 |
| Missing | 12 | 5 |
| Age (range 15–78) | | |
| 15–29 years old | 47 | 20 |
| 30–59 years old | 131 | 57 |
| Over 59 years old | 52 | 23 |
| Higher level education; University (bachelor or higher) | | |
| Yes | 167 | 73 |
| No | 63 | 27 |
| Primary role in the archipelago (resident or not) | | |
| Yes; resident (or summer resident or entrepreneur) | 120 | 52 |
| No; other (etc. tourist/visitor) | 110 | 48 |
| Member of any group whose main aim is to preserve or protect the environment | | |
| Yes | 79 | 34 |
| No | 151 | 66 |
| Total | 230 | 100 |

### Survey Design

The survey introduced participants to "nature management," describing it as restoring or maintaining habitats for protected species (more details in Supplement S1). Examples provided included, among others, maintaining bird sanctuaries and eliminating invasive species (Finnish Environment Institute 2023; Law Insider 2024; Metsähallitus 2024).

Respondents were also presented with a picture of the Apollo butterfly (Fig. 2) and introductory information about the species. In the survey section on clearing and burning, participants learned that removing juniper aims to enhance the Apollo butterfly's habitat by expanding open rocky areas and increasing meadow vegetation, that is, nectar plants.

Three example sites from the archipelago were shown in pictures: (1) a site with no nature management, (2) a site where junipers were cleared and burned less than a year ago, and (3) a site where this was done more than a year ago (Figs. 3–5). Following this information, respondents answered mandatory questions and statements.

A pre-test was conducted with 10 respondents to ensure the questionnaire's length, wording, format, and question order were appropriate. Some of these respondents were selected for their expertise in nature management or fluency in the survey languages (Finnish, Swedish, and English). Experts in nature management, who work in the field and contribute to official communications, provided feedback on terminology and phrasing to ensure that the survey was clear and culturally relevant. Their input was limited to improving the accuracy and accessibility of the survey and did not influence the study design. Statements were designed to address the study question on nature management and the concrete examples provided. For environmental concern (pro-environmental value orientation), we used five statements from the ISSP (2020) – Environment IV Questionnaire, four of which have been used in previous studies (e.g., Franzen & Meyer 2010; Franzen & Vogl 2013; Davidovic et al. 2020).

Responses were recorded on a five-point Likert scale (e.g., "strongly disagree" to "strongly agree"), with options for "Can't choose" and "Prefer not to answer" treated as missing data (Table 2). Participation was restricted to respondents aged 15 and over, verified by an initial screening question. Survey completion took approximately 12 minutes.

Informed consent was obtained from the participants when they provided their responses. Before answering questions, participants were informed about the survey's purpose, the voluntary nature of their participation, their right to withdraw at any time, and the anonymity of their responses.

### Statistical Modeling

**Exploratory Factor Analysis (EFA).** Exploratory Factor Analysis (EFA) was used in the initial stage of analysis to identify the underlying relationships between a set of observed variables (factor indicators) and determine the number of continuous latent variables (factors) required to explain the correlations among them (Muthén & Muthén 2017). EFA was performed on all 25 variables derived from survey statements measuring attitudes (Table S1). However, due to our limited sample size and the planned model's complexity, we reduced the number of variables to 16 (Table 2). Maximum likelihood estimation with robust standard errors (MLR) accounted for missing data, and geomin rotation was applied under the assumption that the latent variables were correlated. The number of latent variables was set at four based on the preliminary hypothesis and variable content.

Figure 2. This picture of the Apollo butterfly was used in the questionnaire with the information: "This is a picture of an Apollo butterfly (*Parnassius apollo*). The Apollo butterfly is an endangered species in Finland. It is Finland's largest butterfly, with a wing span of 62–94 mm (2.48–3.76 in.). The Apollo butterfly is easy to recognize and difficult to confuse with other Finnish butterfly species. The Apollo butterfly's habitats include semi-open rocky areas and archipelago islets where orpine grows. Adult butterflies can be seen in meadows near the cliffs, feeding on, for example, thistles and star thistles." The questionnaire provided this information to introduce the species and its habitats to participants.

**Confirmatory Factor Analysis (CFA).** Confirmatory Factor Analysis (CFA) is a tool used to measure the relationship between a latent variable and its observed variables (indicators) (Mueller & Hancock 2015). This means the indicators are assumed to be causally affected by the underlying latent variable. Our research was mainly based on the results of EFA and a preconceived hypothesis of an environmental concern framework (e.g., Franzen & Vogl 2013; Davidovic et al. 2020), specifically pro-environmental value orientation (Fig. 1). We used a CFA to create a model with pro-environmental value orientation as a latent variable, measured using reflective indicators (statements in the questionnaire). Indicators measuring each latent variable were correlated as required for reflective indicators (Kline 2016). The fully standardized parameter estimates for the factor loadings were reported to compare the relative differences between the indicators. Factor loadings indicate how much the factor explains the variation in an observed variable (Byrne 2013). For instance, a high loading, typically above 0.7, indicates a strong relationship between the observed variable and the factor. The result of the CFA, i.e., the factor "pro-environmental value orientation," was used in Structural Equation Modeling (SEM).

**Structural Equation Modeling (SEM).** We applied SEM to examine the relationship between pro-environmental value orientation, attitudes toward nature management in general, local

Figure 3. The questionnaire used this picture as an example of a site where no nature management is carried out.

Figure 4. The questionnaire used this picture as an example of a site where junipers have been cleared and burnt as a nature management measure (less than 1 year after the measures), with information that the removal of the juniper is intended to improve the habitat conditions of the Apollo butterfly by increasing the open rocky areas and meadow vegetation.

Figure 5. The questionnaire used this picture as an example of a site where junipers have been cleared and burnt as a nature management measure (more than 1 year of restoration measures), with information that the removal of the juniper is intended to improve the habitat conditions of the Apollo butterfly by increasing the open rocky areas and meadow vegetation.

habitat restoration examples of clearing and burning, and a target species of the restoration, the Apollo butterfly (Fig. 1). SEM tests theories quantitatively and relies on error factors (Kline 2016). The main advantage of SEM is the possibility of constructing multiple-indicator latent (unobserved) constructs that represent constructs of scientific interest while accounting for measurement error. SEM is a research method that describes a study's causal processes using a series of structural

**Table 2.** The latent and their indicator variables (i.e., statements) with reliability test results (Cronbach's $\alpha$). Indicator variables with "*" before code have been used in previous studies (Franzen & Vogl 2013; Davidovic et al. 2020) to measure environmental concern and/or pro-environmental value orientation. This table contains the 16 questions used after the variable reduction (Table S1 contains all of the 25 questions asked). The respondents could choose an option on a five-point Likert scale from 1 = strongly disagree to 5 = strongly agree with a statement presented or from 1 = very unwilling, not at all concerned to 5 very willing or very concerned to answer the two questions asked (6. and 11c.). The variables with reversed scales, meaning that 5 strongly disagree and 1 strongly agree with the statement, are presented in the column Scale with code rev. The mean values of variables are presented in column Mean, and the number of answers, i.e., sample size, in column *n*. Each statement included "Can't choose" and/or "Prefer not to answer" options, treated as missing values. The survey received 230 responses in total.

| *Latent & reliability* | | *Indicator variable (i.e., statements)* | *Scale* | *Mean* | n |
|---|---|---|---|---|---|
| Pro-environmental value orientation | *11c. | How willing would you be to accept cuts in your living standard to protect the environment? | 1–5 | 3.85 | 226 |
| | 12e. | Many of the claims about environmental threats are exaggerated | 1–5 rev | 4.25 | 223 |
| | *6. | Generally speaking, how concerned are you about environmental issues? | 1–5 | 4.25 | 229 |
| | *12a. | It is just too difficult for someone like me to do much about the environment | 1–5 rev | 4.35 | 229 |
| Cronbach's $\alpha = 0.767$ | *12b. | I do what is right for the environment, even when it costs more money or takes more time | 1–5 | 3.95 | 227 |
| Management (i.e., nature management) | R1 | I am interested in visiting a site where nature management is carried out | 1–5 | 4.18 | 222 |
| | R2 | The coastal nature needs nature management | 1–5 | 4.65 | 218 |
| | R3 | Nature management should be avoided | 1–5 rev | 4.66 | 221 |
| Cronbach's $\alpha = 0.692$ | R4 | Nature management is important | 1–5 | 4.79 | 225 |
| Clearing & burning | CB1 | Clearing and burning as part of nature management should be avoided | 1–5 rev | 3.98 | 202 |
| | CB2 | Clearing and burning are harmful to nature | 1–5 rev | 3.75 | 197 |
| | CB3 | Clearing and burning as part of nature management is acceptable | 1–5 | 4.18 | 223 |
| Cronbach's $\alpha = 0.805$ | CB4 | I am interested in visiting a site where clearing and burning have taken place | 1–5 | 3.80 | 212 |
| Apollo | A1 | Apollo butterfly is an important species to protect | 1–5 | 4.82 | 221 |
| | A2 | Apollo butterfly is a valuable part of Finnish nature | 1–5 | 4.86 | 222 |
| Cronbach's $\alpha = 0.812$ | A3 | I'm interested in seeing Apollo butterfly in the wild | 1–5 | 4.83 | 227 |

(i.e., regression) equations (Byrne 2013). These structural relationships are often visualized in a diagram to understand the theory under scrutiny better. The hypothesized model is statistically tested with simultaneous analysis of all variables to determine consistency with the data. If the results show a good fit, the model supports the proposed relationships among variables; if not, the validity of such relationships is questioned.

CFA and SEM were fitted to the covariance matrix using the Maximum Likelihood Robust (MLR) estimation method, which is robust to the possible non-normality of the observed variables, with Mplus 8.4 (Muthén & Muthén 2017). Mplus analyses were performed using the missing data method, which used all the data available to estimate the model without inputting the data. Model fit was evaluated using chi-square, Comparative Fit Index (CFI), Tucker-Lewis Index (TLI), Root Mean Square Error of Approximation (RMSEA), and Standardized Root Mean Square Residual (SRMR). Chi-square evaluates the distance between the sample covariance matrix and the fitted covariance matrix. CFI indicates how much better the model fits than the independence model. The value of the CFI index should be close to 0.90 for the model to be acceptable, and values greater than or equal to 0.95 represent a well-fitting model (Hu & Bentler 1999; Schreiber et al. 2006). TLI also indicates how much better the model fits than the independence model, and its value should be 0.95 or greater for the model to be acceptable (Hu & Bentler 1999; Schreiber et al. 2006). RMSEA is an index of discrepancy per degree of freedom, and a cut-off value close to 0.06 indicates a good fit (Hu & Bentler 1999; Schreiber et al. 2006). Finally, the SRMR index is the average of the standardized residuals between the observed and predicted covariance matrix, and a cut-off value close to 0.08 indicates a good fit (Hu & Bentler 1999; Schreiber et al. 2006).

#### Ethical Approval

This research followed the Finnish National Board on Research Integrity (TENK) guidelines (more details in Supplement S2). Informed consent was obtained from anonymous respondents who accepted the survey's privacy policy by submitting their answers.

## Results

The questionnaire received 230 responses from participants aged 15 and over (Table 1). Most respondents (78%, $n = 180$) used the Finnish version of the questionnaire. The Swedish version was chosen by 17% ($n = 40$) and English by 4% ($n = 10$). Missing value analysis showed that the data is completely missing at random (Little's MCAR test: $\chi^2(800) = 845.446$; $p = 0.129$) in this data set. Most respondents reported having a higher level of education, which was higher than the general population (Table S11). In general, response rates increase as educational levels increase (Green 1996). Additionally, women and one age group were overrepresented in the survey data compared to the general population (Table S11). Generally, women are more likely to respond than men (Green 1996). A weighted version of the models was also tested, and the results were consistent with the primary analysis (see Supplement S3 for details). About half of the respondents were not residents but visitors of the area, and most were not members of an organization engaged in nature protection (Table 1).

### EFA Supported a Four-Factor Model

The EFA revealed a four-factor solution (Table S2) in which most variables loaded onto one factor (Table S3). There were exceptions, such as variable A4, that loaded on Factors 1, 2, and 4 (Table S3). Because of the relatively limited sample size, theoretical assumptions of factor structure, strong correlation, and small factor loadings, nine of the original 25 variables were excluded, leaving 16 variables (Table 2) for the subsequent analysis. The refined EFA on 16 variables confirmed the four-factor solution in which most items loaded strongly onto one factor (Table S5). Using geomin rotation provided a simple structure and accounted for correlations between factors, as supported by lower AIC and BIC values compared to alternative models (Table S4). Based on the EFA results and the content of the items in each factor, the four factors were labeled as follows: (F1) pro-environmental value orientation, (F2) general management, (F3) clearing and burning, and (F4) Apollo butterfly & conservation. Correlations between factors are presented in Table S6. The Cronbach $\alpha$-values for the factors ranged from 0.692 to 0.812, indicating acceptable measurement reliability (Table 2).

The initial measurement models of all latent variables are presented in Figures S1–S4.

### CFA of the Pro-Environmental Value Orientation

We applied CFA to construct a measurement model with a pro-environmental value orientation as a latent variable (Fig. 6). Variables presented in Table 1 were used as covariates in the measurement model of pro-environmental value orientation. The global fit of the CFA model to the data was acceptable ($\chi^2(28) = 32.780$; $p = 0.02439$; CFI = 0.984; TLI = 0.980; RMSEA = 0.027 [90% CI 0.000–0.060]; SRMR = 0.046). All the indicator variables and covariates of gender and being a member of an environmental group had significant loadings onto the pro-environmental value orientation factor ($p$-value <0.05).

The indicator variable 11c, "How willing would you be to accept cuts in your living standard to protect the environment?", was used as the marker variable to scale the latent variable in the measurement model (Fig. 6).

Pro-environmental value orientation was associated with, and the standardized factor loadings from highest to lowest were; willingness to accept cuts in living standards to protect the environment, reported higher concern about environmental issues, disagreement with the claim that "many of the claims about environmental threats are exaggerated," agreeing to do what is right for the environment, even when it costs more money or takes more time, and disagreement with the claim that "it is just too difficult for someone like me to do much about the environment" (Fig. 6).

Gender is a significant positive coefficient of pro-environmental value orientation, that is, women have a more pro-environmental value orientation than male respondents in this data set. The same positive effect was observed among respondents who reported being members of any group whose main aim is to preserve or protect the environment. We did not find evidence that respondents' age, education level, or being considered residents in the archipelago had a significant effect on the latent variable.

### The SEM of the Association between Pro-Environmental Value Orientation and Attitudes

The SEM investigated if the pro-environmental value orientation latent variable was associated with attitudes toward ecological management in general and more concrete local examples of restoration actions of clearing and burning and the conservation of the Apollo butterfly (Fig. 7). The latent variables were measured by their indicator variables (Table 2). We fixed the indicator variable loadings for the latent pro-environmental value orientation to equal the measurement model results (Fig. 6). The global fit of the SEM model to the data was acceptable ($\chi^2(99) = 117.06$; $p = 0.103$; CFI = 0.978; TLI = 0.973; RMSEA = 0.028 [90% CI 0.000–0.047]; SRMR = 0.056). In this model, the pro-environmental value orientation had a moderate association (0.57) with the attitude toward ecological management in general, explaining 32% ($R^2$) of the reported attitude (Fig. 7). The pro-environmental value orientation had a weak association (0.36 and 0.37, respectively) with the two other latent variables: it contributed circa 13% to the attitude toward clearing and burning as restoration actions and conserving the Apollo butterfly. Nevertheless, all latent variables were correlated with each other. The general management factor was strongly correlated (0.514) with the factor of clearing and burning. The Apollo butterfly & conservation factor had a weak correlation with the general management factor (0.335) and factor clearing and burning (0.221). The results of SEM with covariates and without the pro-environmental value orientation latent variable are presented in Figure S5. The correlation matrices for the indicator variables are presented in Tables S7–S10.

## Discussion

### Influence of Pro-Environmental Values on Support for Ecological Management

This study investigated the relationship between pro-environmental values and attitudes toward general ecological

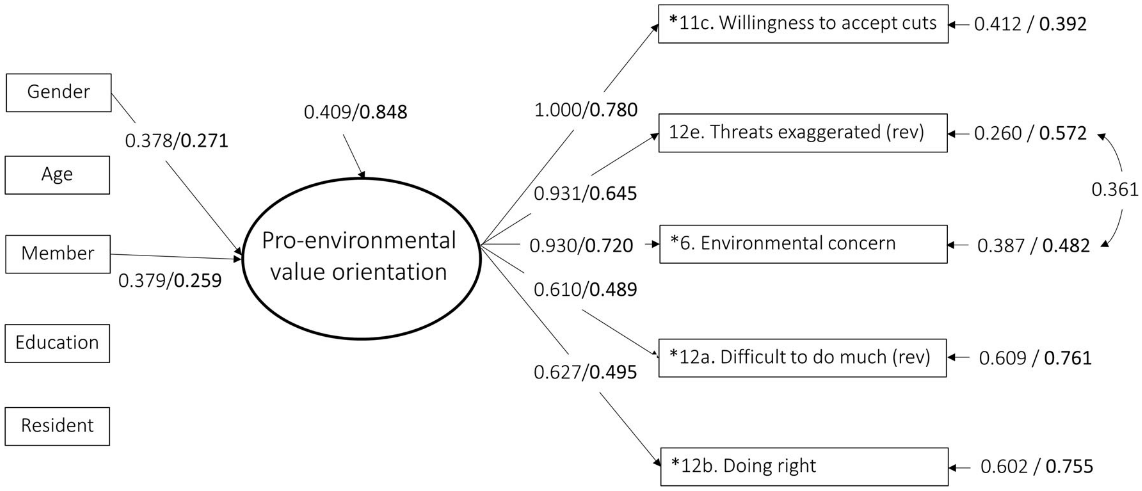


Figure 6. The measurement model of latent variable pro-environmental value orientation and its reflective indicator variables with covariates ($n = 230$). The latent variable is circular, and the observed variables are rectangles. Covariates and indicator variables are presented in more detail in Tables 1 and 2. The model's fit values are: $\chi^2(28) = 32.780$; $p = 0.2439$; CFI = 0.984; TLI = 0.980; RMSEA = 0.027 (90% CI 0.000–0.060); SRMR = 0.046. Two indicator variables are reversed, marked as (rev), meaning that a higher value indicates disagreement with the statement presented. The estimates presented are unstandardized and standardized, respectively. Standardized estimates are in bold. The covariates presented by arrows pointing to the latent variable show the significant ($p$-value <0.05) associations between the latent variable (note that the non-significant covariates were not omitted from the model). Error terms signifying the variance not explained by the model are included for the latent variable and its indicator variables. The error terms of 12e and 6 were allowed to be correlated based on the model modification indices. The indicator variables' loading values from this model were used in the SEM.

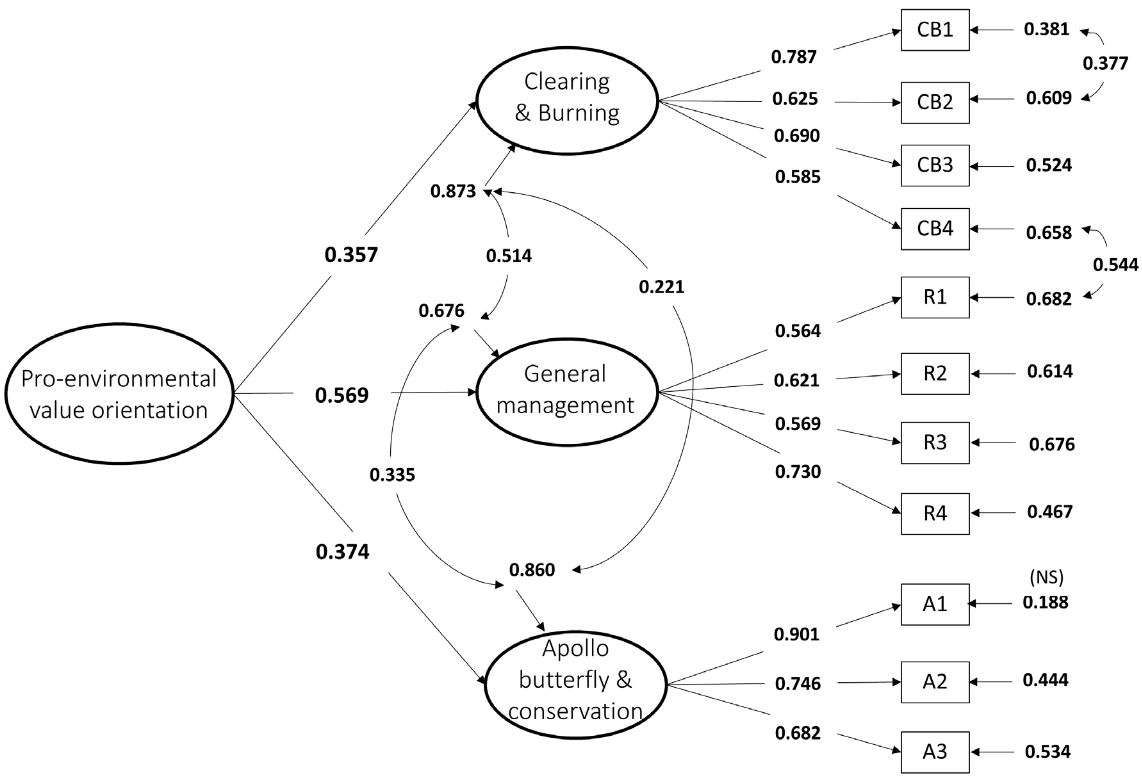


Figure 7. The SEM model results of pro-environmental value orientation's association with attitude toward ecological management in general, restoration actions of clearing and burning, and the conservation target, the Apollo butterfly (standardized solution, $n = 230$). The latent variables are circular, and the observed variables are rectangles. The model's fit values are: $\chi^2(99) = 117.06$; $p = 0.103$; CFI = 0.978; TLI = 0.973; RMSEA = 0.028 (90% CI 0.000–0.047); SRMR = 0.056. All connections are significant ($p < 0.05$) except the observed variable A1 error term that is marked with (NS). Error terms signifying the variance not explained by the model are included for latent and indicator variables. The error terms allowed to correlate are based on the model modification indices and concept and verbal similarity of the statement between latent variables.

management and specific restoration aimed at conserving the Apollo butterfly in the SW Finnish archipelago. We examined whether general ecological support extends to specific, localized practices by focusing on conspicuous restoration activities like clearing and burning shrubs. By exploring how values align with specific restoration measures, our study adds depth to existing research on the social dimensions of conservation (Gifford & Nilsson 2014; Pueyo-Ros et al. 2019; Kamal et al. 2024). Pro-environmental values provide a way to understand broader public attitudes, offering insights into how individuals support both general ecological policies and localized interventions. Our findings confirm that individuals with pro-environmental values demonstrate higher support for both general ecological management and targeted restoration efforts, consistent with previous research linking pro-environmental values to support for environmental policies and conservation initiatives (Harring & Jagers 2013; McCright et al. 2016; Nilsson et al. 2016).

However, the association between pro-environmental values and localized actions was moderate, suggesting that public concerns regarding visibility, intrusiveness, and perceived necessity may temper support (Matzek & Wilson 2021). Specific restoration activities might be viewed as less effective or too localized. This perception can influence the level of support for particular projects, as people may prioritize initiatives that they believe will yield substantial and visible benefits (Matzek & Wilson 2021). This divergence highlights the importance of aligning restoration actions with community priorities and values to foster acceptance. Conservation efforts are more likely to inspire public support when they deliver tangible benefits or resonate with cultural and emotional connections (Schelhas & Pfeffer 2009; Pueyo-Ros et al. 2019). The moderate support observed in our study underscores the need to better communicate the ecological rationale behind specific restoration methods to gain broader public approval.

### Social and Demographic Influences on Attitudes

Gender and respondents' membership in environmental groups emerged as influential factors in shaping pro-environmental values and attitudes toward ecological management. Women, consistent with prior research, expressed greater environmental concern, which is often linked to socialization processes fostering empathy and care (Chodorow 1974; Zelezny et al. 2000; Schultz 2001). Interestingly, environmental concern may also relate to individuals' perceptions of femininity or masculinity rather than strictly biological gender (Xiao & McCright 2007). Awareness is another important factor influencing the intensity of environmental concern and attitudes (Schahn & Holzer 1990; Levine & Strube 2012) and is shaped by education level and interest in the subject (Yang 2024). Education and environmental group membership likely contributed to higher awareness among respondents, as education is associated with greater ecological knowledge and support for biodiversity conservation (Gifford & Nilsson 2014). Respondents affiliated with environmental organizations demonstrated stronger pro-environmental value orientations, potentially reflecting greater exposure to conservation issues. However, demographic factors alone do not fully explain the moderate support for localized actions, suggesting that place-based connections and cultural values also play important roles.

### The Role of "Sense of Place" in Conservation Support

The "sense of place" concept provides a valuable framework for interpreting the moderate support observed for localized restoration actions. The SW Finnish archipelago's unique biodiversity and cultural significance likely contribute to residents' and visitors' place attachment (Hausmann et al. 2016; Nasir et al. 2024). This attachment may influence attitudes toward conservation, consistent with prior studies linking place-based connections to enhanced civic engagement and conservation support (Buta et al. 2014).

Interestingly, residency in the archipelago did not significantly affect pro-environmental attitudes or support for restoration actions. This suggests that emotional and cognitive connections to the area extend beyond residency. The Apollo butterfly, as a symbolic and biological figure, presents an opportunity to strengthen public engagement. However, our findings suggest that emotional ties alone are insufficient to overcome skepticism, particularly for restoration methods perceived as intrusive. Aligning restoration strategies with local cultural values and emotional dimensions is critical for fostering acceptance (Pueyo-Ros et al. 2019).

### Implications of Moderate Support for Local Restoration

While our study did not find strong evidence of the classic NIMBY phenomenon, the weaker connection between pro-environmental values and local management suggests a nuanced form of skepticism. This skepticism may arise from perceived intrusiveness, limited understanding of ecological benefits, and inadequate communication about restoration outcomes (Boyle et al. 2019). These findings emphasize the importance of community engagement and shared decision-making to foster public trust and acceptance (Rodgers 2016; Boyle et al. 2019).

To bridge the gap between general and localized support, communication strategies should emphasize the ecological and cultural significance of the Apollo butterfly and clearly explain the necessity and expected outcomes of restoration actions. Incorporating local stakeholder perspectives into the planning process can reduce resistance and foster shared responsibility.

### Limitations and Directions for Future Research

Our study has several limitations. Although the University of Turku and its associated animal museum are public spaces, having ads in these locations likely resulted in an overrepresentation of highly educated respondents. The overrepresentation of individuals with higher education levels and women may have influenced the findings, particularly the positive correlation between pro-environmental values and attitudes toward ecological management in general (Gifford & Nilsson 2014). Future research should aim to include more representative samples to better capture the diversity of public attitudes and reasons for localized skepticism.

Additionally, although most respondents (78%, $n = 180$) chose the Finnish language, the subtle differences in different languages and phrasing can lead to varied interpretations. The multilingual nature of the questionnaire introduces potential variability in respondents' interpretations of questions, underscoring the need for more precise and consistent survey wording across languages (Blasius & Friedrichs 2009). Addressing acquiescence bias, where respondents agree with statements regardless of content (Vainio & Paloniemi 2014), could further improve data reliability.

The regional focus and specificity of restoration actions, such as clearing and burning shrubs, limit the generalizability of our findings. However, research in other contexts supports the notion that engaging local communities and addressing their environmental values can significantly enhance the acceptance of conservation initiatives (Kleftoyanni & Vrahnakis 2024). Future studies could replicate this research in different ecological and cultural settings to provide a broader understanding of the dynamics between pro-environmental values, NIMBY attitudes, and place-based connections.

Longitudinal studies could also investigate whether visible ecological improvements and sustained communication reduce public skepticism over time. Expanding interdisciplinary approaches to include aesthetic and recreational indicators, as Schulz-Zunkel et al. (2022) demonstrated, could provide a more holistic understanding of public perceptions of restoration efforts.

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## Supporting Information

The following information may be found in the online version of this article:

**Supplement S1:** Preliminary information provided to the participants.
**Supplement S2:** Ethical approval.
**Supplement S3:** Comparison of survey data with the population of Southwest Finland for weighting purposes.

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