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Evaluating the influence of nature connection and values on conservation attitudes at a tropical deforestation frontier.

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Abstract:

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Introduction

The neglect of 'inner worlds' is argued to hamper efforts to conserve tropical forests (Campos Tisovec-Dufner et al., 2019; Rueda et al., 2019), which are threatened by deforestation, degradation, fragmentation and defaunation (Barlow et al., 2018). Emerging scholarship proposes that external environmental outcomes, such as climate change, ecological degradation and biodiversity loss, are intrinsically connected to internal phenomena, including emotions, values, connections, and worldviews (Ives et al., 2020; Wamsler et al., 2021; Woiwode et al., 2021). Yet, most conservation research remains devoted to understanding, and intervening in, the 'outer world', constituted by the physical environment, governance systems, and economic and social structures (Hoelle, 2018; Rueda et al., 2019; Wamsler et al., 2021). In recent years, a number of theoretical frameworks have been advanced to help conceptualize the relationship between inner and outer change for environmental sustainability. Examples include the Three Spheres of Transformation (O'Brien, 2018), which emphasizes the importance of subjective mindsets that influence

how problems and solutions are perceived, the Leverage Points framework (Abson et al., 2017), which highlights the power of 'deep' interventions that target actors' underlying values, goals and worldviews, and the Inner-Outer Transformation Model (Wamsler et al., 2021), which demonstrates the interconnectedness of consciousness, cultures, behaviors and systems. Failure to consider 'inner worlds' across individual and collective scales can limit the transformative potential of environmental policy and action.

This oversight of inner phenomena is evidenced in Amazonia, where research into environmental change has mostly focused on the external factors, showing e.g., how a lack of economic assets, misaligned policy incentives, or inadequate storage and supply chains can trap farming households into low-income and environmentally degrading practices (Garrett et al., 2017). Some notable exceptions focusing on inner phenomena include survey-based studies highlighting the importance of psycho-social factors like intrinsic motivations, attitudes and identities on Amazonian farmers' forest preservation decisions (Campos Tisovec-Dufner et al., 2019; Rueda et al., 2019), anthropological insights into processes underpinning cultural embeddedness of cattle-raising and the association of cultural values like wealth and progress with deforested areas (Hoelle, 2011, 2018), or political-ecology research, showing how joint conservation and development projects based on limited interpretations of farmers' motivations often fail to achieve win-win outcomes (Chambers et al., 2020). Nonetheless, understanding how a variety of inner world phenomena – worldviews, values, and psychological attachments – may intersect with external factors to shape conservation outcomes remains understudied, especially in the Global South.

Here, we address this important research gap by focusing on the relative effects of inner motivational drivers and external economic, socio-demographic, and environmental factors on conservation attitudes of Amazonian farmers. Conservation attitudes refer to the subset of environmental attitudes that concern biodiversity conservation. Attitudes matter because they partially determine people's decision-making and the level of support for policies (Milfont et al., 2010). For example, a person holding a positive attitude to forest protection is more likely to protect the forest on their land or support policies that foster forest conservation (Mastrangelo et al., 2014). In psychological research, variation in environmental attitudes between individuals is typically ascribed to differences in deeper sources of psychological motivation (Milfont et al., 2010; Tam, 2013). Based on these differences, environmental attitudes are often classified as egoistic i.e., motivated by concern for self and close others, altruistic i.e., concerned with the wellbeing of other people, or biospheric i.e., motivated by concern for the wellbeing of nature (de Groot & Steg, 2009). In contrast, research in sociology, economics, and environmental sciences has focused more on the link between environmental attitudes and external, contextual factors like income, age, or ecosystem services (e.g., Beiser-McGrath & Huber, 2018; Campos Tisovec-Dufner et al., 2019). However, few studies explore the influence of inner and outer phenomena on attitudes simultaneously.

Our approach to the 'inner world' concept draws on methods from environmental psychology. Specifically, we evaluate how two types of deep inner motivational drivers – nature connection and personal values – influence conservation attitudes. Nature connection refers to the extent to which a person believes themselves to be part of nature

(cognitive nature connection, or 'connectedness') and feels emotionally attached to nature (emotional connection) (Perkins, 2010; Schultz, 2002). This connection is thought to originate from meaningful nature experiences that expand a person's concept of self to include elements of nature (e.g., mountains, birds), which become cared-for objects (Clayton et al., 2017; Schultz, 2002). Personal values, in turn, describe a set of universal, relatively stable abstract goals and principles, like fairness or health, which serve to express human needs and guide action across different situations (Schwartz, 1992). They are organized along two principal dimensions: Traditionalism and Universalism. Universalism captures values broadly corresponding to the spectrum from the egoistic (or 'self-enhancement') to altruistic and biospheric (or 'self-transcendent') values (de Groot & Steg, 2009). Traditionalism, on the other hand, captures a spectrum from conservative values, emphasizing restraint and control, to openness-to-change values, favoring stimulation and self-direction (Schwartz, 1992). At the individual level, values and nature connection can influence attitudes and behaviors (Milfont et al., 2010; Whitburn et al., 2020). At the societal level, dominant values underlie the goals or 'intent' of the paradigms that govern our planetary socio-ecological system (Abson et al., 2017). Set against the primacy of the global economic growth paradigm (Díaz et al., 2019), reconnecting people to nature and cultivating pro-environmental values are some of the deep-system levers necessary to transition towards sustainable economy and halt biodiversity decline (Abson et al., 2017; Chan et al., 2020; IPBES, 2022; Ives et al., 2018).

The relative importance of inner world and external world phenomena in shaping conservation attitudes in real-world landscapes in the Global South remains unclear. Despite the growing body of academic literature asserting that inner motivational drivers like values and nature connection are important for promoting conservation (Abson et al., 2017; Ives et al., 2018; Zylstra et al., 2014), there is scant empirical evidence comparing their effect on conservation attitudes relative to the effects of external factors such as socio-economic circumstances, socio-demographic characteristics, or local environmental conditions. Likewise, a clear understanding of which inner motivation dimensions (e.g., biospheric, egoistic, traditionalist) underpin people's conservation attitudes is lacking. The recent Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) values assessment report highlights that environmental policies often fail to accommodate the plurality of values that societies hold for nature, typically treating nature only as a material resource (IPBES, 2022). This failure has been linked to the hegemony of neoliberal conservation agendas, which assume that people act egoistically, in pursuit of material self-interest, and must be externally incentivized or legally obliged to behave in alignment with conservation goals (Chambers et al., 2020; Fletcher, 2010). Accordingly, the standard 'conservation toolbox' is based primarily on material incentives and sanctions (e.g., payments for ecosystem services or fines for environmental rule-breaking), overlooking other potential motivations for nature protection (Chambers et al., 2020; Muradian & Gómez-Baggethun, 2021).

A more nuanced version of the logic underpinning many common conservation approaches proposes a positive correlation between the external, material conditions of life and attitudes towards nature protection. This assumption intersects with 'affluence-based' theories in economy, politics and sociology (e.g., the Environmental Kuznets curve [Magnani, 2000], or the postmaterialist value change theory, [Inglehart, 1997, 2018]), which

view nature as a 'luxury good' or a 'postmaterialist' concern that poor people cannot afford to care about except in the context of pressing environmental issues and conflicts over natural resources (for an overview, see e.g., Guha & Alier, 2013; Mayerl & Best, 2018; Roberts & Mangold, 2021).

Accordingly, these concepts emphasize that biospheric motivations only influence people's attitudes towards the environment in wealthy societies and have little traction in economically more deprived contexts. However, studies supporting the affluence-based theories have tended to rely on large multi-country datasets with narrow definitions of environmental concern (framed mostly around the trade-off between economic development and nature protection preferences) and without explicit measures of biospheric motivations (Brechin, 1999; Dunlap & York, 2008). Typically, biospheric motivations behind environmental concern in these studies can only be inferred indirectly from correlations with other 'postmaterialist' values like freedom of speech and self-expression, versus 'materialist' values like maintaining social order and economic stability (e.g., Mayerl & Best, 2018, 2019).

We explore the importance of inner and outer phenomena by assessing the relative influence of nature connection, personal values, and external factors on conservation attitudes among non-indigenous colonist farmers living along the Transamazon Highway – a major deforestation frontier. With 44–49% of the population earning half a Brazilian minimal salary or less and the GINI inequality index of 0.45–0.68 (IBGE, 2010), the study region is characterized by relatively high levels of poverty and income inequality. Understanding the basis of concern about environment and nature protection at this frontier – as a case study of a low-income, peopled and highly-biodiverse landscape in the Global South – has important implications for policy design. If conservation attitudes were mostly influenced by socio-economic circumstances, then it might be most effective to focus on improving material circumstances and incentivize desired behaviors through the conventional array of material rewards and sanctions. If, however, biospheric motivations also shape attitudes among this population, then the conservation agenda may benefit from efforts to recognize and potentially cultivate these motivations. In other words, perhaps there is a need for a new inner-outer conservation paradigm in the Global South.

Specifically, we ask: 1) What are the levels of pro-conservation attitudes among Amazonian farmers along the Transamazon Highway? 2) What are the associations of conservation attitudes with inner motivations (cognitive and emotional nature connection and personal values), compared to outer world dimensions (economic, socio-demographic, and environmental factors)? 3) What are the differences and similarities in the way that different dimensions of inner motivations (biospheric, altruistic, traditionalist) associate with pro-conservation attitudes?

Methods

The study area was located in a deforestation frontier region along the Transamazon Highway in Pará state, within the municipalities of Brasil Novo, Medicilândia, and Uruará (Figure 1). This area is characterized by a human-modified mosaic of forests and farmland, where balancing people's wellbeing and livelihood opportunities with conservation and environmental sustainability remains a constant challenge. The farm-forest landscapes are

dominated by low-capitalized, family-based agriculture, centered primarily around extensive cattle farming and cocoa production. The vast majority of the inhabitants are non-indigenous *colonos* (colonists), migrants who, following government incentives for colonization, settled there from 1972 onwards along with their locally-born descendants (Moran, 1981). High nature connection is quite prevalent among the colonist farmers in the study area (Mikołajczak et al., 2019), but the political influence of right-wing ruralist perspectives on agriculture and deforestation in Amazonia (de Area Leão Pereira et al., 2020) demonstrates the on-going power of a development paradigm centered on production gains (Moran, 1981). This paradigm favors economic factors in decision-making and exemplifies motivational conflicts and limits to biospheric motivations in promoting pro-conservation attitudes. The study area, therefore, provides a suitable context for exploring the role of diverse inner motivations in shaping conservation attitudes in low-income, rural contexts in the Global South.

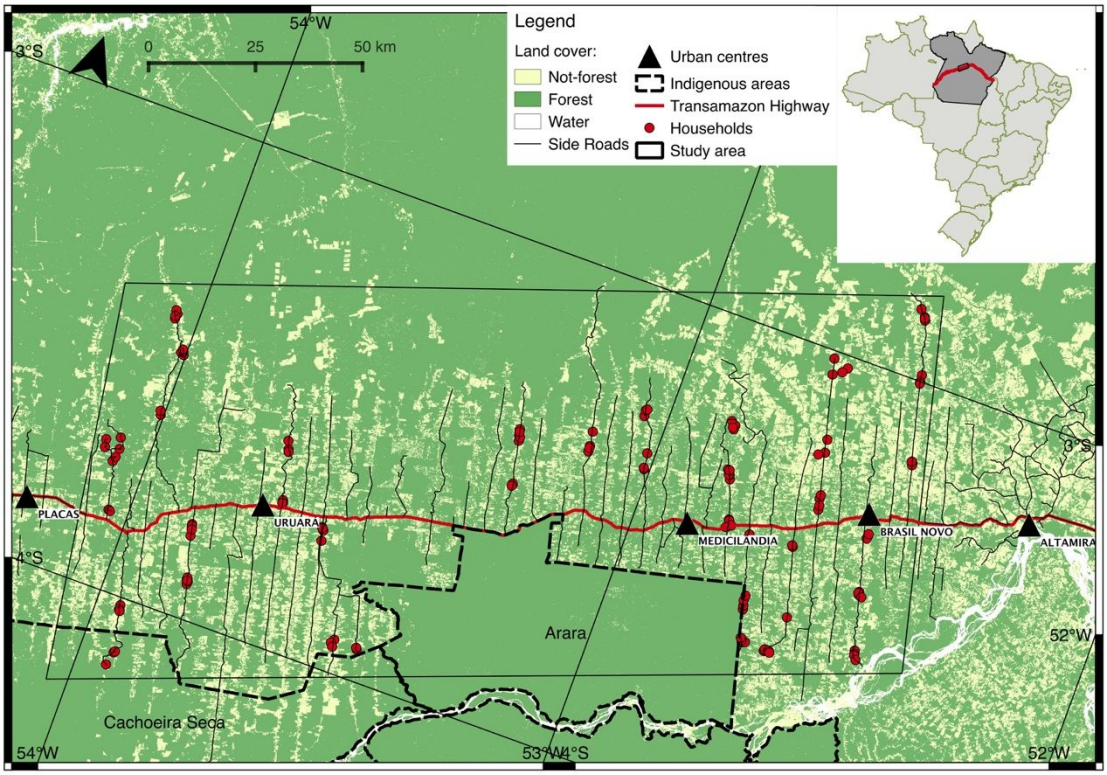

Figure 1. Study area around part of the Transamazon Highway and side-roads in Pará state. The bounding box of the study area covers ca. 17,838 km^2.

Sampling

Sampling was stratified across 45 points along 15 of the "fishbone" side-roads (i.e., 3 points per side-road) running perpendicular to the highway, incorporating gradients in forest cover and distance from the sub-regional urban center Altamira (details Mikołajczak et al. 2019). We aimed to interview the landowners and their spouses (or close family involved in running the farm) on the four properties closest to each sampling point. Hence the target sample was 12 properties per side-road, with a total target of 180 properties. When some landowners refused (n=23) or were unavailable (n unrecorded) we moved to the next closest farm property, not exceeding a 5 km radius from the sampling point. Six points were

abandoned due to inaccessibility to cars or an apparent lack of inhabitants. In total, we collected 241 individual responses.

Dependent variables

Using a structured questionnaire administered by an interviewer, we assessed nine diverse and locally-relevant conservation attitudes (Table 1). Four were general attitudes related to preferences between development and nature protection, extinction prevention, forest preservation, and the control of numbers of problematic wildlife on private properties. We use 'problematic wildlife' to refer to animals that can be dangerous or damaging, without specifying species (Table 1, item 4). We also measured five attitudes specific to landowner tolerance of different animal taxa: the lowland tapir (Portuguese 'anta', *Tapirus terrestris*), hyacinth macaw ('arara azul', *Anodorhynchus hyancinthinus*), jaguar ('onça pintada', *Panthera onca*), vipers ('jararaca', genus *Bothrops*), and vine snakes ('cobra cipó', genus *Chironius*). One of the indicators of tolerance is the size of the population of a species a person is willing to accept to coexist alongside (Marino et al., 2021). We measured species tolerance by asking about the desired changes in the population status of each animal on the farmer's property over the next ten years (Table 1).

We selected animal taxa which would be widely known to interviewees (verified during pre-study interviews in November 2015), and which would enable us to contrast the drivers of Amazonian farmers' tolerance to species perceived as threatening versus benign, and to those generally considered as charismatic versus uncharismatic. We classified jaguar and vipers as threatening, since they injure and kill cattle and, sometimes, humans (Campos Neto et al., 2011; Feitosa et al., 2015). In contrast, we classified tapir, hyacinth macaw, and vine snakes as relatively benign. Although tapirs and macaws occasionally damage crops (mentioned anecdotally by several respondents), they are herbivores that pose little bodily threat to humans, while bites from vine snakes are rare and, unlike vipers, harmless to humans. Charisma, in turn, refers to the aesthetic and emotional appeal of a species to humans (Lorimer, 2007), and has been linked to characteristics such as large size and bright or striking coloration (Macdonald et al., 2015; Mesquita et al., 2015). Additionally, birds and mammals (especially large cats) are typically more emotionally appealing than taxa, like insects, spiders, or snakes (*ibid)*. Based on these distinctions, the tapir, hyacinth macaw, and jaguar, being large-bodied birds and mammals, were classified as charismatic, while the snakes (vipers and vine snakes) were classified as uncharismatic.

We also collected responses to open-ended questions regarding the perceptions of desired levels of forest cover on the respondents' properties, how much forest should be protected by law, and respondents' approval or disapproval for selective logging projects in forest reserves on farming properties. All questionnaire items used in this study are presented in the Appendix S3.

Table 1. Attitude names and statements. Items 1 and 4 were phrased as negative, anti-conservation attitudes in the questionnaire. When responses to those items are reversed-scored, they are presumed to express the opposite sentiments.

Attitude name	Statement	Response scale
General conservation attitudes		

1. Prioritize nature	**Original:** The development of our region is much more important than the protection of nature. **Reverse-scored:** expresses support for prioritizing nature protection over development in the region.	1 – Completely disagree 2 – Somewhat disagree 3 – Neither agree nor disagree 4 – Somewhat agree 5 – Completely agree
2. Prevent extinctions	If some animal in the area begins to decline, people should act to not let that animal disappear.	
3. Protect forests	All the forests that still remain in the region should be protected.	
4. Control problem wildlife	**Original:** Animals that are dangerous or damage crops need to be controlled on private properties, even if they are rare. **Reverse scored:** Expresses objection to the need for controlling wild animals on private properties, even if they are dangerous or damage crops.	
Species tolerance attitudes		
5. Tapir 6. Hyacinth macaw 7. Jaguar 8. Vine snakes 9. Vipers	In the next 10 years, how would you prefer the population of [animal] to change on your property?	0 – Disappear completely 1 – Decrease a lot 2 – Decrease a little 3 – No change 4 – Increase a little 5 – Increase a lot

Explanatory variables

To assess cognitive nature connection, we used a graphical, single-item, 7-point scale called "Inclusion of Nature in Self " (INS) (Schultz, 2002), selected for its brevity and simplicity. For emotional nature connection, we used a bespoke 5-point Likert scale (from 1= 'Completely disagree' to 5 = 'Completely agree) called 'Love and Care for Nature – Rural' (LCNR), consisting of 7 simply-worded items intended to capture feelings such as love, beauty, joy and psychological wellbeing derived from nature (Mikołajczak et al., 2019) (Appendix S3).

Values were measured using the Portrait Value Questionnaire 21 (PVQ–21), translated and validated for use in Brazil (Sambiase et al., 2014). Raw value scores on the PVQ-21 measure were transformed to the Universalism and Traditionalism dimensions using fixed equations derived through exploratory factor analysis (Strack & Dobewall, 2012) (Appendix S1). According to Schwartz's Theory of Basic Human Values (Schwartz, 1992), personal values have a near-universal structure organized along the two main axes of Universalism and Traditionalism. The Traditionalism dimension comprises the spectrum from conservative values (like conformity, security, and tradition) to openness-to-change values (like freedom, self-direction, and pleasurable experiences) and has rarely been linked to pro-environmental attitudes. The Universalism dimension comprises the spectrum from Self-Enhancement and Self-Transcendence values. Self-enhancement values are egoistic, concerned with the wellbeing of self and close others (like power and achievement). 'Self-

transcendence', includes altruistic values, concerned with the wellbeing of other people (like helping others) and biospheric values, concerned with the wellbeing of nature (like living in harmony with nature). However, in the PVQ-21 measure, out of the twenty-one items (of which six capture Self-Transcendence), only one item indicates a biospheric orientation. Thus, we consider the PVQ-21 to capture the egoistic-altruistic spectrum, and consider nature connection measures as indicators of biospheric motivation.

Socio-economic factors included monetary income, material insecurity experienced in childhood, years of formal education, and household remoteness from Altamira – the largest local urban center affording better access to healthcare, markets, and services. Income was assessed at the household level and its potential effect was analyzed either as a linear predictor or as a binary measure of relative poverty. Households in the lowest monetary income quartile (<R$1650 per month, equivalent to US$511 in 2016) were classified as income-poor, others as not-poor. Wealth measured as household income did not show any significant associations and was excluded from further analysis in favor of the binary poor-non poor measure. Material, or 'existential', insecurity experienced in childhood was assessed with a statement: '*When you were a child, did you ever have difficulty in acquiring food and/or medicine?'.* Responses 'never', and 'sometimes' were grouped into 'Not much'; responses 'often' and 'everyday' were grouped into 'A lot'. This measure was included to account for the assertion in the postmaterialist theory that utilitarian attitudes towards nature are shaped by scarcity and a sense of existential insecurity experienced during formative childhood years rather than in the adult life (Inglehart, 1997, 2018).

Socio-demographic factors included interviewee age and gender; environmental factors included forest cover, as a proxy for the "amount" of nature remaining in the household's neighborhood. Forest cover was calculated using Global Forest Change maps (Hansen et al. 2013) (details in Appendix S1), and measured at 4 different distances: 500 m, 1000 m, 1500 m, and 2000 m buffer around the household. For each attitude, only the distance with the least AICc in single-predictor models was included in the subsequent model averaging approach (Table S.2.)

Attitude modelling

Quantitative data were analyzed in R v.3.3.3 (R Core Team, 2018). Each attitude was modelled separately using generalized linear models with a beta-binomial distribution. Explanatory variables are summarized in Table 2, with further details on analysis found in Appendix S1. For each attitude, we collected complimentary qualitative data from comments relating to questionnaire statements, and from opportunistic semi-structured interviews, analyzed thematically in Microsoft Excel. The research was approved by the Lancaster University Research Ethics Committee (RS2015/68).

Table 2. Descriptive statistics for the explanatory variables.

Indicated latent construct	Measured variable	n	mean	SD	median	range

Biospheric motivation	Cognitive nature connection (INS scale)	240	5.15	1.48	5	1 – 7
	Affective nature connection (LCNR scale)	241	4.5	0.62	4.71	2.12 – 5
Altruistic over egoistic motivation	Universalism (PVQ-21)	238	0.68	0.9	0.6	-1.56 – 3.12
Traditionalist over openness-to-change motivation	Traditionalism (PVQ-21)	238	0.5	0.79	0.49	-1.77 – 2.62
Socio-economic status	Household monthly income (R$)	241	4095	3646	2846	286 – 43450
	Travel distance to urban center Altamira (km)	236	141	72	111	42 – 262
	Education (years)	241	4.95	3.84	4.00	0 – 19
Environment: Amount of nature	Forest cover % (500 m radius)	238	51	18	51	14 – 93
	Forest cover % (1000 m radius)	238	54	16	53	25 – 87
	Forest cover % (1500 m radius)	238	57	16	57	58 – 89
	Forest cover % (2000 m radius)	238	59	14	59	59 – 90
Demographic characteristics	Age (years)	241	46.91	13.27	48.00	18 – 75
	Gender	241	Female = 42%, Male = 58 %			
Socio-economic status	Childhood material insecurity	239	'A lot' = 26%, 'Not much' = 74%			

Results

Most respondents were male (58%). Respondents' age ranged from 18 to 75 years (mean 47), with little formal education (mean 5.0 years, median 4.0) (Table 2). Mean household monthly income was R$4095 whereas median income was R$2846. Twenty-six percent of respondents had experienced significant material insecurity in childhood. On average, households were located 140 km of travel from the city of Altamira (range 42-262 km). Forest cover around households ranged from 14-93%, with mean cover increasing from 51% within a 500m radius to 59% cover within a 2000m radius.

General attitudes were largely pro-conservation, except for preferences to control populations of problematic wildlife (Figure 2a). Sixty-five percent of respondents wanted to prioritize nature over development, at least to some degree, 92% at least partially agreed with the need for local action to prevent extinctions, and 80% agreed partially or fully with the need to protect all remaining local forests. Only 16% agreed that problematic wildlife did *not* need control on farms. Charismatic and benign species were more widely tolerated than those considered uncharismatic or threatening (Figure 2b). Virtually everyone wanted the populations of relatively benign species to stay the same or increase, but a sizable proportion of interviewees (29%) did not want to see population reductions even of

venomous snakes. Nonetheless, 52% of respondents wished to eradicate vipers from their farms completely – in line with the wish to control problematic wildlife but somewhat contradicting the stated widespread desire to prevent local extinctions.

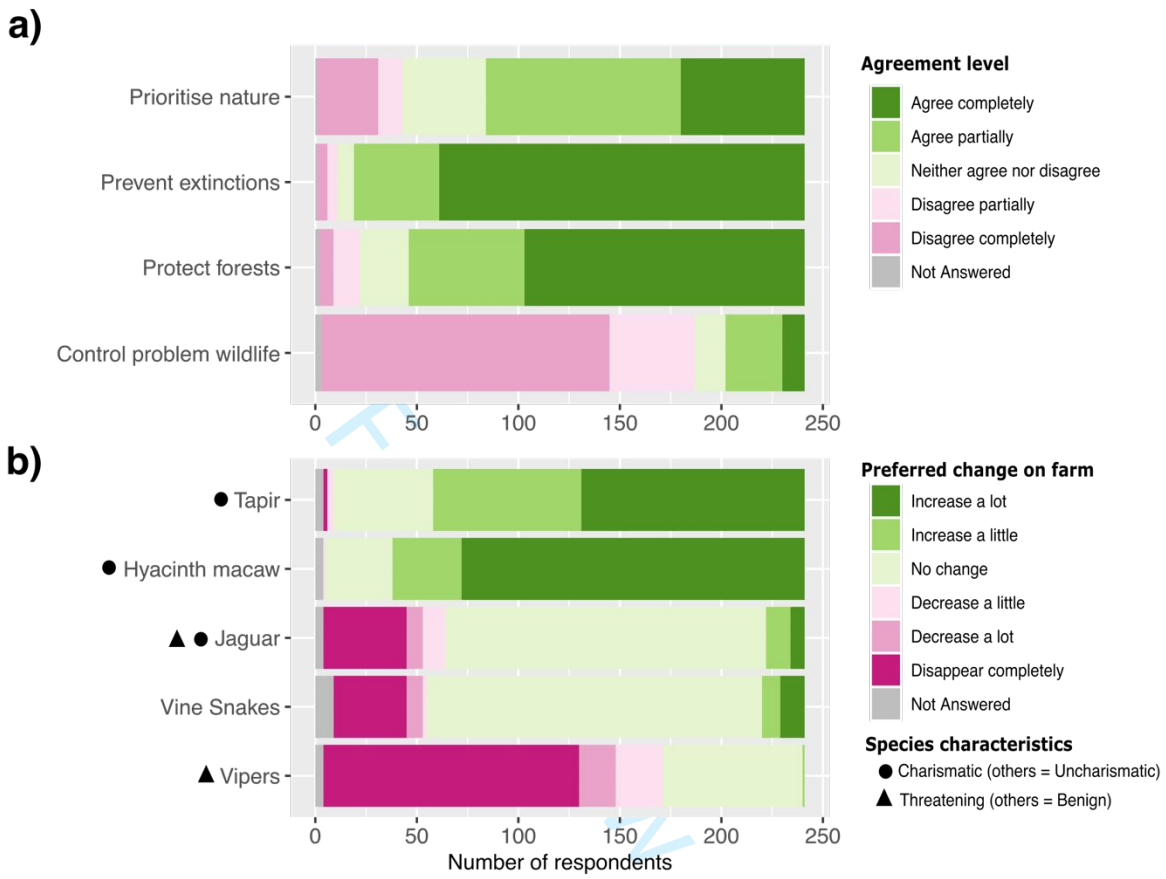

Figure 2. Distributions of attitude responses. All responses were scaled such that higher agreement indicates stronger pro-environmental attitude**. a)** Respondent's level of agreement with general pro-conservation attitudes; **b)** Respondents' stated preferences for population trends on their own properties over the next 10 years for five locally-occurring species with different characteristics.

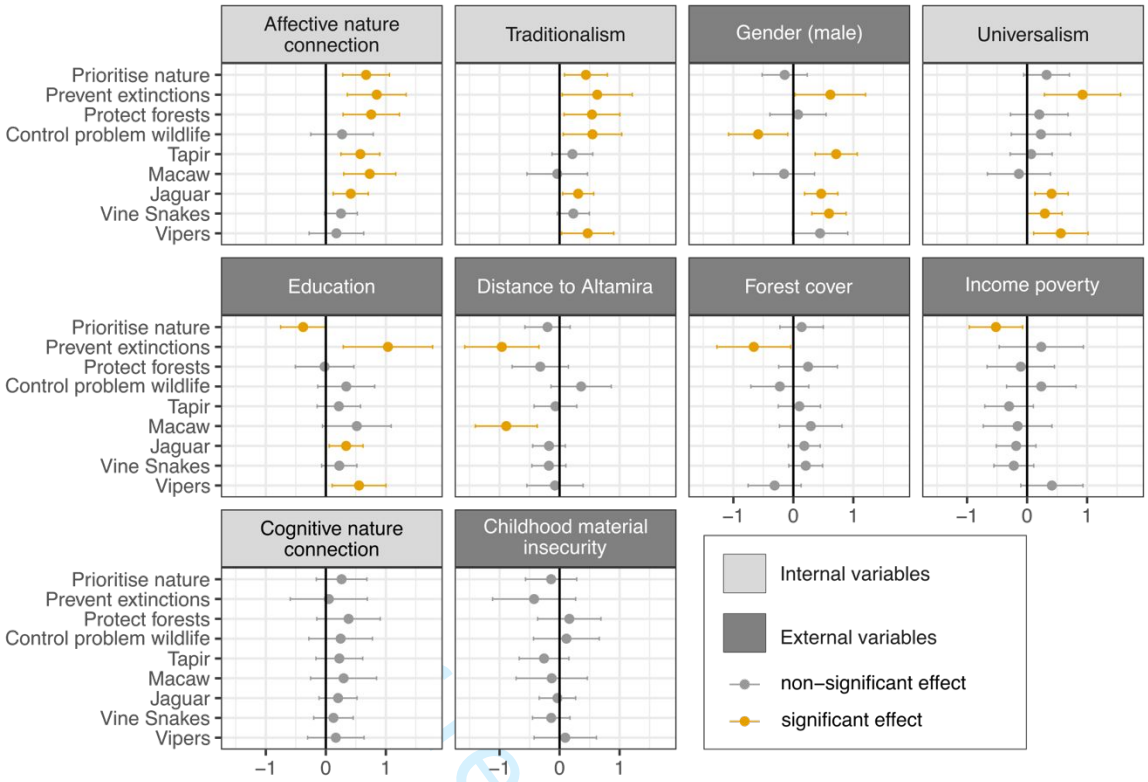

Figure 3. Associations between predictor variables (relating to internal and external phenomena) and conservation attitudes based on averaged models. Each panel corresponds to a single predictor. Attitudes are listed on the y-axis; the first four refer to general pro-conservation attitudes; the lowest five refer to tolerance of different animal species on one's property based on stated preferences for population trends. Solid dots represent estimated Beta coefficients. Error bars represent the 95% CI.

Positive associations between emotional nature connection and pro-conservation attitudes were identified. We found no evidence that cognitive nature connection affects environmental attitudes. Emotional nature connection and values in the Traditionalism dimension were both positively associated with six out of nine attitudes, more than any other predictors (Figure 3). Nature connection related positively to all attitudes except tolerance of snakes and opposition to controlling problematic wildlife on farms. Traditionalism was associated positively with all attitudes except tolerance of benign species. Values in the Universalism dimension explained variation in four attitudes, positively associating with tolerance of threatening or uncharismatic animals, support for preventing extinctions, and disapproval of prioritizing development over nature protection. Gender was also important: men were generally more tolerant of tapirs, jaguars, and vine snakes, and more supportive of preventing local extinctions, but less opposed than women towards controlling problematic wildlife populations on farms.

Formal education enhanced tolerance of threatening animals and support for preventing extinctions but was also associated with prioritizing development over nature. Economic factors and geographic covariates explained relatively little attitudinal variation. However, people living in income poverty were more likely to put development before nature; this association persisted when observations with imputed income data were excluded from the

analysis. Farmers living farther from the urban center Altamira were less tolerant of macaws and less supportive of preventing local extinctions. Farmers in high forest-cover environments were also less supportive of preventing local extinctions. The remaining variables, including cognitive nature connection, were not significantly related to conservation attitudes. Summarizing, we found that diverse conservation attitudes were more related to inner motivational drivers (emotional nature connection, values) than to external factors (socio-economic, socio-demographic, environmental). Nonetheless, some external factors did associate with specific attitudes.

Qualitative insights revealed important barriers to farmers taking actions to protect forests or wildlife (S2). The most common was the perceived lack of viable economic alternatives to deforestation. Farmers frequently expressed a personal tension in feeling unable to simultaneously meet their families' subsistence needs and preserve as much forest as they would like: "the desire is to protect, but one has to deforest some, too [to survive]". This was often compounded by the perception that without government assistance, "there is no way" to protect more. Several women highlighted their perceived lack of agency to protect forests as a source of emotional distress: "If it depended on me, I wouldn't burn the forest, it's the greatest sorrow for me". Another barrier was the perceived unfairness of rule enforcement. Some respondents did not feel responsible or obliged to follow legal restrictions on deforestation because they were not seen as fairly applied to all actors; "*fazendeiros*" [large-scale cattle ranchers] were often perceived to "do what they want" and go unpunished despite causing much greater *per capita* damage to forests than medium- and small-holders. Importantly, even farmers who expressed biospheric motivations to conserve nature often had opposing beliefs and attitudes about forest management practices, such as commercial selective logging. For example, some believed that even selective logging "ends up destroying lots" and is unacceptable, while others approved of it, believing that "logging doesn't harm the forest at all. If you remove one tree, thousands of new ones are born in its place".

Discussion

Our study at an Amazonian deforestation frontier examined the relative influence of deep inner world phenomena (nature connection and personal values) and outer world, external factors (socio-economic, socio-demographic, environmental) on the conservation attitudes of colonist farmers. We found that a diverse set of nine conservation attitudes (related to forest and wildlife conservation) was most consistently explained by inner motivational drivers: emotional nature connection and personal values summarized along the axes of Universalism and Traditionalism. In contrast, the external factors – relative household poverty, material and health insecurity experienced in childhood, household remoteness, local forest cover, formal education, and gender – associated only with specific attitudes.

The use of psychological measures of nature connection and values is a novel approach to exploring conservation motivations in the Global South, and contributes much-needed empirical evidence to substantiate emerging conceptual research on the role of inner motivations in conservation and sustainability (Raymond et al., 2019; Wamsler et al., 2021). Firstly, the results provide support for the importance of inner motivations in understanding attitudinal antecedents of pro-conservation behavior. Secondly, they suggest that biospheric motivations to protect nature can be common in low-income tropical areas and

are not exclusively associated with wealthy and economically developed societies (although poverty may still constrain the willingness to protect nature in the face of perceived tradeoffs with development). Thirdly, we show that the Transamazon colonist farmers' inner motivations and attitudes generally support nature protection, and point towards economic, governance and knowledge barriers as primary factors restricting nature conservation in Amazonian farm-forest landscapes.

These findings are consistent with suggestions that intrinsic motivation to protect nature promotes greater forest preservation by farmers in Latin America (Chambers et al., 2020; Rueda et al., 2019), and with agricultural-economic research showing the inter-related persistence of poverty and environmentally degrading land-uses in Amazonia (Garrett et al., 2017). We propose that integrating inner motivations with economically-oriented policies in conservation and development interventions could simultaneously help to cultivate biospheric attitudes and to reduce poverty. Specifically, alongside poverty-alleviation measures, policies should seek to enable latent sustainability-aligned motivations to be voiced and "unleashed" (Chan et al., 2020). For example, through public deliberation and citizen engagement, as outlined in the IPBES values assessment report (IPBES, 2022). This inner-outer conservation approach would also speak to development agendas that foster environmental justice, human rights, and dignity.

Internal and external drivers help shape conservation attitudes

Consistent with environmental-psychological theory, the results suggest that although external, outer-world drivers often associate with specific attitudes, inner motivational drivers (values, psychological connections) provide the underlying coherence to a person's stance on diverse environmental attitudes (de Groot & Steg, 2009; Zylstra et al., 2014). High levels of emotional nature connection, Traditionalism and Universalism values all contributed positively towards a wide range of pro-conservation attitudes (4 – 6 each). Cognitive nature connection did not associate with any attitudes; this may be true or an artifact of the INS scale used to measure it (chosen for its simplicity), which has previously shown somewhat lower correlations with attitudes and behaviors than other measures of nature connection (Tam, 2013). Remarkably, Traditionalism (indicating priority for tradition and conformity over socially liberal values) appeared to positively influence a wider spectrum of attitudes than Universalism (indicating priority for altruistic over egoistic values). This finding is important, given that in Western societies, Traditionalism shows little association with pro-environmental views and studies on pro-environmental attitudes and behaviors often focus only on values in the Universalism dimension, usually categorised as biospheric, altruistic, and egoistic (de Groot & Steg, 2009).

Differences in the way that emotional nature connection, Traditionalism, and Universalism associated with different attitudes related mainly to wildlife tolerance. Tolerance of jaguar – a threatening but charismatic mammal (Campos Neto et al., 2011; Macdonald et al., 2015) – was positively associated with emotional nature connection, Traditionalism, and Universalism. However, only emotional nature connection promoted tolerance of the charismatic and benign tapirs and macaws, and only Traditionalism and Universalism promoted tolerance of the uncharismatic vine snakes (benign) and vipers (threatening). Although people have evolved to fear snakes (Barrett & Broesch, 2012), in Hungary, where wild snakes present minimal risks to lay people (Malina et al., 2008), stronger nature

connection has been associated with lower fear of snakes and spiders (Zsido et al., 2022). However, for rural Amazonians, the fear of snakes is easily reinforced through experience, due to a high incidence of snakebites, which may be fatal or cause life-changing injuries (Feitosa et al., 2015). Thus, it is possible that a sense of connection with nature may not easily encompass taxa perceived as uncharismatic and experienced as threatening. Moreover, the discord between the seemingly widespread support for preventing local extinction and the simultaneous desire to control problematic wildlife and eradicate vipers from private properties suggests that phenomena such as "not-in-my-backyard" claims (whereby stakeholders approve of something in principle but not directly in their vicinity) may also be at play in shaping attitudes to more problematic fauna (von Essen & Allen, 2020). These results show that nature connection is not always associated with biophilic attitudes, hence the dominant framing of nature as benevolent within research from Western nations is overly simplistic and may not always be generalizable to other contexts (Zylstra et al., 2014).

The influence of external factors on attitudes was less consistent, nonetheless, some interesting patterns were apparent. For instance, people living in more forested areas, or more remotely from the urban center Altamira, were less supportive than average of preventing local extinctions, and had less desire to increase macaw populations. Given that remote areas and those with high forest cover are generally more abundant in wildlife (Parry & Peres, 2015), their inhabitants might perceive less need for wildlife conservation.

Other external effects also highlight that people's inner worlds interact with outer phenomena, like social processes and structures (O'Brien, 2018; Wamsler et al., 2021). For instance, we found gendered differences in conservation attitudes, where men were more tolerant of certain species and supportive of preventing extinctions, yet more willing than women to control problematic wildlife on farms. According to the concept of ecological habitus, our thoughts, feelings, perceptions, and actions towards the environment are influenced by the social world we inhabit (Kasper, 2009). In rural Amazonia, socialization into a gendered division of livelihood-related tasks begins in childhood (Menegaldo et al., 2013). For example, boys may go fishing or hunting with their fathers, developing knowledge of local fauna, whereas girls are generally expected to perform more domestic tasks, assisting their mothers. The gendered lives of adult men and women embody the socially-constructed differentiation in attitudes, responsibilities, knowledge and abilities in interacting with the local environment (e.g., farming, hunting, preparing food, etc.) (*ibid*). This illustrates how outer phenomena like social structures and gender may interact to affect inner phenomena, like individuals' environmental attitudes or group-level norms and practices (which, in turn, reproduce social structures). This constant interplay between inner and outer worlds calls for an integrated perspective on conservation challenges, which accounts for inner and outer dimensions across the individual, social, and institutional scales (O'Brien, 2018; Wamsler et al., 2021).

Poverty, development, and the endorsement of biospheric motivations for nature protection in the Global South

Following the emergence of environmental economics (and associated logics of narrow self-interest and infinite rationality) in the 1990s, many present-day conservation interventions rely on the assumption that people in economically developing societies can only be motivated to protect nature for materialistic reasons i.e., for material gain or avoidance of sanctions. This view goes back to the argument that biospheric motivations and valuing nature as a good in itself are a 'postmaterialist' concern, which promotes pro-environmental views only in societies that have reached a threshold of affluence and stability that allows their young people to grow up without a constant fear for their physical and economic security (Inglehart, 1997; Mayerl & Best, 2018).

We contribute to this debate by showing that biospheric motivations for nature protection – as indicated by emotional nature connection – associate consistently positively with various pro-conservation attitudes among Transamazonian farmers. Hence, biospheric motivations may play a significant role in promoting local support for conservation in Amazonia and, potentially, in other income-poor areas in the Global South.

We also found that, independent of nature connection and personal values, poor farmers were more likely than their wealthier peers to reject the proposition of putting nature before development. Hence, where trade-offs exist between environmental protection and socio-economic outcomes, unmet material needs and precarity of the rural poor may constrain their willingness and capacity to translate nature connection into conservation actions. Related, several studies report a positive association between relative income and the willingness to prioritize nature over development or to pay for environmental protection (although this association gets suppressed by income inequality) (e.g., Mayerl & Best 2018; Roberts & Mangold 2021). However, relative poverty was not related to any of the other conservation attitudes in our study, highlighting the importance of using a range of diverse attitudes when examining the association between socio-economic drivers and environmentalism (Brechin, 1999; Dunlap & York, 2008). Thus, our results support the claim that poverty constrains willingness to protect nature where trade-offs between conservation and development are perceived, but, following Dunlap & York (2008), we challenge the assertion that poor people lack biospheric concern for nature. Consequently, conservation efforts in the tropics may benefit from complementing current externally-oriented interventions with others that aim to understand, and possibly foster biospheric motivations (IPBES, 2022).

Strengthening conservation policy through the inner-outer perspective

Recent developments in climate policy, in particular during COP26, have unlocked unprecedented levels of interest and finance for the protection and restoration of forested landscapes (*The Global Forest Finance Pledge*, 2021). We present results suggesting that biospheric motivations and pro-conservation attitudes are common among Transamazonian farmers, which could provide a rich foundation of support for conservation action. Nonetheless, Amazonian deforestation continues, and our qualitative results point to

external rather than internal factors – most of all to the lack of viable economic alternatives to deforestation – as the main constraints on effective forest conservation on private farms in our study region. Many respondents were torn because they felt that without governmental assistance, they were unable to support their families without continued deforestation on their properties. This suggests that the apparent discord between farmers' internal motivations and economic needs has costs to their emotional wellbeing (Riechers & Duse 2021). In line with the IPBES Values Assessment report (IPBES, 2022), these tensions indicate that current policies fail to ensure conditions that would permit people to fully realize their "existing, but-latent" pro-conservation values.

The inner-outer sustainability perspective posits that the adoption of sustainable practices is most likely when people's inner worlds and outer conditions are aligned and conducive to this goal (Hoelle, 2018; Wamsler et al., 2021). In behavioral terms, people must feel capable and motivated for change, and have the means to do so (Maller, 2021; Michie et al., 2011). Drawing on multidisciplinary insights, we propose that conservation policy should integrate both dimensions by combining classical outer-oriented interventions, such as monetary mechanisms, regulations, monitoring and rule enforcement, with inner-oriented interventions, aimed to cultivate caring and stewardship of more-than-human nature.

Investment is undoubtedly necessary to overcome external barriers to sustainability, but comes with challenges. In the Amazon, support is urgently required for colonist farmers to adopt more sustainable agricultural practices (e.g., rotational grazing), and improve access to certification and foreign markets for high-end-value products (Garrett et al., 2017; Metzger et al., 2019). In addition to better ecological outcomes and higher returns for farmers, support for adopting more sustainable practices could also have emotional benefits, empowering biospherically-motivated farmers to conserve more without sacrificing their material circumstances. It is also crucial to increase compliance with environmental regulations and, as highlighted by our qualitative insights, these regulations must be more fairly applied. However, outer-oriented interventions alone, especially based on monetary mechanisms, can replace, or 'crowd-out', biospheric and altruistic motivations to protect nature with egoistic ones e.g., increasing profits, making long-term protection more conditional on continual funding (Cinner et al., 2021; García-Amado et al., 2013). Moreover, in the absence of biospheric motivations, interventions to increase farm profits can facilitate more deforestation, as farmers gain capital necessary for further expansion (Chambers et al., 2020). Outer-oriented interventions also rarely succeed in instilling biospheric motivations where they are not already embraced (*ibid*). Approaches fostering nature stewardship may help mitigate these challenges (García-Amado et al., 2013).

West et al. (2018) frame stewardship as the intersection of knowledge, agency and care, arguing that an ethic of care emerges from embedded, complex social-ecological relationships. In practice, establishing cultures of care and stewardship could involve multiple approaches e.g., deliberation and co-visioning exercises (Horcea-Milcu et al., 2019), communication strategies (Bicchieri, 2017), or engaging people in social pro-environmental activities such as community forest management (Agrawal, 2005; Maller, 2021). Combined, outer- and inner-oriented interventions could help create enabling socio-ecological environments necessary to cultivate pro-conservation motivations, incentivize sustainable practices, and foment a mutually-reinforcing culture of meanings, norms and identities

aligned with conservation goals (Maller, 2021; Walton & Wilson, 2018). These cultural levers can exercise strong external pressure to conform to conservation practices and, over time, potentially even internalize the underlying pro-environmental motivations (Agrawal, 2005; Bicchieri, 2017; Maller, 2021; Walton & Wilson, 2018). Thus, the integrated inner-outer approach to conservation interventions holds the promise of enhanced ecological and wellbeing benefits, supported by positive socio-ecological relationships.

Although the importance of intrinsic motivations for nature protection is increasingly recognized in theory, empirical measurement of nature connection, personal values and environmental attitudes remains scarce in the Global South. We characterized the personal values and nature connection among colonist farmers in an Amazonian deforestation frontier, finding that biospheric motivations shape pro-conservation attitudes. We suggest these linkages should be leveraged for change towards greater sustainability. The integrated inner-outer approach to conservation policy has the potential to simultaneously advance conservationist and wellbeing objectives in farm-forest landscapes in Amazonia and elsewhere, offering an exciting new direction for transformative conservation research and practice.

Supporting Information

Additional supporting information may be found in the online version of the article at the publisher's website

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