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Surprisingly malleable public preferences for climate adaptation in forests

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Abstract
Researchers and policy-makers often assume that public preferences for climate change adaptation are positive and stable compared to those of mitigation. However, public judgments about adaptation in natural resource sectors (like forestry) require that people make difficult, value-laden and uncertain trade-offs across complex social-ecological systems. The deliberative methods (e.g. focus groups and in-depth interviews) that are typically used to explore the malleability of these judgments may underestimate the level of preference malleability in broader publics by encouraging participants to rationalize their choices in relation to their own knowledge, values and beliefs, as well as those of others. Here, we use a public survey (N = 1926) from British Columbia, Canada—where forestry is economically, environmentally and culturally vital—to investigate the malleability of public preferences for genomics-based assisted migration (AM) for climate change adaptation in forests. Following an initial judgment, respondents are given new information about AM’s potential implementation and impacts—simple messages similar to those that they might encounter through traditional and social media. The results show that respondents’ initial judgments are surprisingly malleable, and prone to large bi-directional shifts across all message types. The magnitude of this malleability is related to the degree of the proposed intervention, the type of message, and individuals’ demographic and psychographic characteristics. These results suggest that high levels of initial public support may be illusory, and that more attention should be paid to the potential for malleability, controversy and contradiction as adaptation policies are developed and implemented. Process-based arguments related to transparent, evidence-based and adaptive governance may be more influential than risk-based arguments related to climate change and economic impacts.

1. Introduction
Public engagement ahead of major environmental policy changes is imperative in a democratic system to achieve normative, substantive and instrumental objectives (Fiorino 1990, Pidgeon et al. 2017). For example, engagement has been shown to improve decisions by creating a more comprehensive understanding of potential policy impacts, and to increase the legitimacy of new policies and public trust in policy-making (Stehr 2015). Well-documented failures in public engagement—too late or too little (e.g. for genetically modified foods)—have encouraged earlier and more thorough elicitation of public and stakeholder preferences for emerging technologies in particular (Satterfield et al 2013). Vetting new technologies using ‘upstream’ engagement—dialogues among diverse publics and stakeholders early in the research and development process—helps ensure responsible innovation by identifying the range of potential risks, incorporating public and stakeholder values, and anticipating controversies prior to technological or policy changes that may have widespread and
irreversible consequences (Corner et al 2012, Chilvers and Kearnes 2015). However, people tend not to make well-reasoned judgments about emerging technologies, especially in public opinion surveys, which creates substantial challenges for scientists and policy-makers who seek to anticipate and mitigate potential controversies. Since respondents have limited information, time and cognitive power, they use heuristics to ‘construct’ their preferences in the process of answering survey or interview questions, rather than ‘revealing’ pre-existing judgments (Slovic 1995, Lichtenstein and Slovic 2006, Warren et al 2011). Absent specific knowledge of the problem at hand, they make best-guesses based on their affective response, their underlying values and beliefs, analogous problems that they have encountered before, and their knowledge of the broader context (Fischhoff 2006, Pidgeon et al 2017). Individual perceptions of unfamiliar problems are therefore prone to change depending on the information provided and its framing (Boudet et al 2014, Chong and Druckman 2007, Lorenzoni and Pidgeon 2006, Satterfield et al 2013, Weaver 2007).

Deliberative methods, such as focus groups and interviews, are commonly used to provide nuance and depth to upstream engagement, enabling researchers to observe the articulation and negotiation of judgments by informed members of publics and stakeholder groups (Gregory and Dieckmann 2019). Deliberative approaches reveal underlying logics by encouraging participants to rationalize their choices in relation to their own knowledge, values and beliefs, as well as those of others (Macnaghten 2017). However, the generalizability of the results is inhibited by small and non-random samples, and by differences between the participants engaged in deliberation and broader publics who are unlikely to be as informed or as thoughtful in their judgments. Participants also engage in intensive social learning, contributing varied individual knowledge to the group discussion and constructing a shared understanding of relevant issues (Pahl-Wostl et al 2007; Reed et al 2010).

By encouraging participants to rationalize their choices, deliberative methods may underestimate the changeability of the judgments made by broader publics who have only passing knowledge of the subject matter and superficial exposure to key debates through traditional and social media. To better capture the malleability of preferences expressed by broader publics, there is therefore a recognized need to develop survey methods that bridge the empirical divide between deliberative, small-sample approaches and less nuanced, large-sample surveys. Satterfield et al (2013), for instance, demonstrate the malleability of upstream public perceptions of nanotechnology by providing respondents with paired risk/benefit messages and observing significant changes in reported acceptability. In comparing alternative measures of risk and benefit perceptions for biofuels and nanotechnology, Binder et al (2010) emphasize the need to test the reliability and validity of public survey results, particularly for unfamiliar technologies, since simple measures are likely to conceal substantial malleability in complex judgments.

In the context of climate change adaptation, the dynamic nature of public opinion has not been well-explored, although Moser (2014) suggests that preferences for adaptation can be unexpectedly contentious. Despite the argument that adaptation is easier to communicate than mitigation (because it is less ideological and often has immediate co-benefits), Moser (2014) suggests that specific adaptations may disrupt long-standing legal frameworks, social norms and institutions, especially when innovation-driven. There is also mounting evidence that adaptation is cognitively challenging, particularly in sectors, like agriculture and forestry, that are embedded in social-ecological systems (Oakes et al 2016, Findlater et al 2018, 2019a, 2019b). Among commercial farmers who have the demonstrated incentive, capacity and willingness to adapt to climate change, Findlater et al find that they nonetheless treat climate change risks as distinct from weather and climate variability (Findlater et al 2019a), that they tend to isolate climate change from their otherwise highly networked mental models of on-farm risk management (Findlater et al 2018), and that they use heuristics (here called ‘cognitive thresholds’ and ‘hazy hedging’) to simplify the difficult trade-offs between competing risk management strategies (Findlater et al 2019b). For knowledgeable forest users and managers in Alaska, Oakes et al (2016) find that adaptation is a complex decision-making problem, drawing on a variety of cognitive, affective and evaluative processes.

Judgments about climate change impacts on forest ecosystems require that people consider at least three different sources of intractable uncertainty: the magnitude and direction of future climatic changes (Burke et al 2015), the cascading impacts of these climatic changes through complex social-ecological systems (Seidl et al 2017), and the potential non-climate-related impacts of the proposed adaptation interventions in those same systems (Keenan 2015). Such judgments are made even more difficult when they include a new and largely unfamiliar technology (such as genomics), as previously demonstrated for nanotechnology (Pidgeon et al 2017) and geoengineering (Corner et al 2012).

Climate-adaptive forestry requires long-term strategic innovation and policy-making to ensure future forest health, productivity and ecosystem services (Pedlar et al 2012). To protect the social, economic and ecological benefits of forests, scientists are now developing genomics-based assisted migration (AM) techniques that will help forests in British Columbia (BC), Canada, adapt to expected future climates. After harvest or wildfire, forests have traditionally been replanted with seedlings grown from local seeds. But these
trees are becoming increasingly mismatched with their changing local climates, threatening future forest health and productivity (Fettig et al 2013, Seidl et al 2017). Genomics-based AM would use genomic information to select seedlings for replanting based on their anticipated suitability for specific future local climates (Aitken and Whitlock 2013, Aubin et al 2016). Seedlings would then be planted away from where the seeds originated, typically further north or upward in elevation, both within and outside of the species’ historic natural range. Such new technologies for adapting to climate change will require public and stakeholder support, especially in the context of publicly-owned natural resources (e.g. BC’s forests), where governments must work with the private sector to protect and enhance societal benefits (Conroy and Peterson 2013). Although commercial forests have long been managed for human benefit, the implementation of AM is steeped in the kinds of ethical and scientific uncertainties that necessitate upstream public engagement (Aubin et al 2011). The BC government has therefore made robust and ongoing public engagement about AM a policy imperative, while beginning to implement a non-genomics version in the form of Climate-Based Seed Transfer (FLNRORD 2018).

We use the case of genomics-based AM in BC’s forests to explore large-scale survey methods that test the malleability of upstream public judgments and begin to reveal respondents’ underlying assumptions and concerns. Following brief descriptions of the climate problem and the potential biotechnological response, the survey elicited an initial assessment of AM’s acceptability. We then provided four different messages about the technology’s implementation and impact (figure 1), like those that respondents may be exposed to through social networks or media, to test the malleability of their initial preferences. We test four hypotheses through pairwise comparisons and regression analyses: (1) preferences for novel adaptation strategies (i.e. genomics-based AM within and outside of natural range) are malleable; (2) the magnitude of this malleability increases with the degree of the intervention (i.e. higher for AM outside of natural range than for AM within natural range); (3) some types of information are more influential than others; and (4) demographic and psychographic factors influence malleability. We thus capture the dynamic nature of these judgments, absent deliberation, assessing the magnitude of malleability, identifying key characteristics of the messages, respondents and technology that contribute to it, and elaborating its implications for adaptation policy.

2. Methods

To assess public views on genomics-based AM in the context of climate change adaptation in forests, we conducted an online survey with a representative sample of BC residents (N = 1926). Respondents completed the survey between 15 and 30 May 2017 through a link distributed by the panel survey company, ResearchNow. We used recruitment quotas to ensure that the sample was consistent with the most recent provincial census data available at the time (from 2011) regarding age, gender, and rural versus urban residence, in accordance with best practices (Czaja and Blair 2005, Wright 2006). Data from an additional 174 respondents were excluded because they completed the survey in less than eight minutes—the minimum time needed to read and answer all questions during pre-testing. In the final sample (N = 1926), 55% of respondents were female and 45% were male. One quarter (24%) were between 19 and 34 years of age, 37% were between 35 and 54 years, and 39% were 55 years and over. More than half of respondents (57%) were from the Vancouver metropolitan area, with another 10% from the Victoria metropolitan area. Descriptive statistics for each variable may be found in the supplementary information, which is available online at stacks.iop.org/ERL/15/034045/mmedia, and a further description of the survey method may be found in Peterson St-Laurent et al (2018).

Following a tutorial about climate change in BC’s forests, respondents were introduced to the two AM strategies (illustrated in figure 2) among six possible reforestation strategies in the context of climate change. The four other strategies provided context for...
the AM options; two represent relatively lower levels of intervention (natural regeneration and local tree breeding, which are both currently being used in BC), while the other two represent relatively higher levels of intervention (non-native or genetically modified trees, which are not currently being considered for use in BC). Respondents were then asked a variety of questions regarding their risk perceptions and preferences for these six options. These initial results may be found in Peterson St-Laurent et al. (2018), while the further analysis reported here tests the malleability of public preferences and elucidates underlying drivers of malleability.

To evaluate the malleability of public perceptions of AM, respondents were then asked whether they would change their level of support given four different messages that each provided some certainty about one uncertain aspect of AM’s implementation (the severity of climate change impacts, research and monitoring programs for AM, AM’s economic effects, and AM’s effect on forest resilience). Those who were initially supportive were provided negatively framed information (e.g. that AM would reduce forests’ resilience to natural disturbances), while those who were initially unsure or opposed to AM were provided positively framed information (e.g. that AM would increase forests’ resilience). Finally, they were asked questions about their age, gender, education, political orientation, environmental value orientation, forestry knowledge, and perceptions of climate change risks. These variables are listed in Table 1, while their descriptive statistics may be found in the supplementary information.

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For each message, preference malleability was captured in a binary variable where ‘1’ indicated a change in preference (e.g. initially opposed, now supportive) and ‘0’ indicated no change (e.g. initially supportive, still supportive). We then analyzed the frequency with which respondents changed their positions supporting, opposing or unsure. We compared malleability for the two AM strategies (within and outside of}

Table 1. Description of the independent variables used in the binary and logistic regressions.

| Name                  | Type      | Description                                                                 |
|-----------------------|-----------|------------------------------------------------------------------------------|
| Age                   | Discrete  | In years, from 19 to 87.                                                     |
| Gender                | Nominal   | Two categories, male and female. Female is the reference category.           |
| Education             | Ordinal   | Six levels, from elementary school [1] to graduate degree [6]. Represents the highest level of formal education completed. |
| Political orientation | Ordinal   | From ‘Left’ [−5] to ‘Right’ [+5].                                             |
| Biocentric            | Continuous| Created from a factor analysis (with Varimax rotation) of ten Likert-scale questions (see Peterson St-Laurent et al (2018) for details), along with Anthropocentric. |
| Anthropocentric       | Continuous| Created from a factor analysis (with Varimax rotation) of ten Likert-scale questions (see Peterson St-Laurent et al (2018) for details), along with Biocentric. |
| Trust orientation     | Nominal   | Three categories: trust coalition, distrustful, trustful. Trustful is the reference category. Created from a K-means cluster analysis using seven Likert-scale questions (see Peterson St-Laurent et al (2018) for details). |
| Forest knowledge      | Discrete  | Correct number of answers out of ten true/false questions testing knowledge of the BC forestry context. From [0] to [10]. |
| Perceived climate risk| Continuous| Index variable created from seven Likert-scale questions on climate risk perceptions. |
natural range) and in response to the four different kinds of information (about climate change severity, economic impacts, research and monitoring, and forest resilience impacts). The overall malleability of respondents’ preferences for each AM strategy was captured in an aggregate ordinal variable (change index), which was the sum of the binary variables indicating malleability in response to each type of information. The binary variables and the two change indices (for AM within and AM outside) were then compared and analyzed using binary and ordinal logistic regression, with respondents’ demographic and psychographic factors as independent variables.

A variety of statistical analyses were used to test the four hypotheses in SPSS v.25. The Wilcoxon signed-rank test was used to compare the change indices between AM within (natural range) and AM outside (of natural range), because they were treated as ordinal variables. McNemar’s test was used to compare the effects of each kind of information between AM within and outside. Cochran’s Q test was used to compare effects across the four messages, overall, with McNemar’s test used for post-hoc pairwise comparisons. Binary and ordinal logistic regressions were used to assess the effects of demographic and psychographic variables on preference malleability. The independent variables were the same across all regressions: age, gender, education, political orientation, biocentric and anthropocentric environmental value orientations, trust orientation (trust coalition, trustful, distrustful), forest knowledge, and perceived climate risk. Binary regressions were used for the binary dependent variables: the individual malleability variables for each message on AM within and AM outside (eight in total). Ordinal regressions were used for the two change indices. There was no significant multicollinearity among the dependent variables. Ordinal and discrete dependent variables were entered as continuous in the regression models. While the four types of new information were presented in randomized order, that ordering data is unfortunately unavailable. We cannot therefore test for ordering effects (e.g., whether respondents were more likely to change their minds after the fourth question compared with the first), which Satterfield et al. (2013) found to be significant in their study of nanotechnology. However, here the four messages appeared together in a single matrix, so respondents were able to adjust their answers. Ordering effects are therefore expected to be minimal.

3. Results and discussion

3.1. Overall malleability of public preferences

A majority of respondents were initially supportive of the implementation of the two AM strategies (figure 3), and support for AM within natural range (i.e. the less novel intervention) was higher than for AM outside of natural range (see Peterson St-Laurent et al. (2018) for further detail on this initial support). However, when provided with new information about specific aspects of AM’s implementation, about two thirds of those initially supportive or opposed, and 90% of those initially unsure, changed their preferences (figure 3).

In general, preferences for AM shifted considerably in response to each of the messages (see figures 4 and 5 for those initially supportive or opposed, respectively, and figure S3 in the supplementary information for those initially unsure). These messages had broadly similar destabilizing effects irrespective of whether respondents initially supported or opposed AM. However, information pertaining to ongoing research and monitoring and AM’s impact on forest resilience resulted in a...
higher propensity to change preferences than did information about the severity of climate change impacts and the economic effects of AM. This kind of preference malleability has been shown in studies of nanotechnology and biofuels (Binder et al 2010, Satterfield et al 2013). However, to our knowledge, this
is the first demonstration in the context of climate change adaptation. While it is unsurprising that preferences for AM are malleable, given that respondents were unlikely to be familiar with it prior to the survey, the magnitude, bidirectionality and consistency of this malleability across message types is surprising when compared to previous studies.

3.2. Degree of intervention
We evaluated the malleability of respondents’ preferences for each AM strategy using an aggregate ordinal variable (change index), which was the sum of the four binary variables indicating a change in preference in response to each message. Contrary to our expectation, the degree of intervention (i.e., AM within natural range versus AM outside of natural range) had little bearing on the malleability of preferences overall. Respondents were equally likely to change their positions whether AM occurred within or outside of natural range, as indicated by a Wilcoxon signed-rank test (Z = −1.018, p = .309) of the two change indices. For specific messages, however, significant differences were noted in the proportions of respondents who changed their preference for AM within versus AM outside of natural range. As indicated by McNemar’s test, when given information about climate change severity ($\chi^2(1) = 6.756$, $p = .009$) and economic impacts ($\chi^2(1) = 6.113$, $p = .013$) respondents were significantly more likely to change their minds about AM outside of range than about AM within range. In contrast, when given information about forest resilience, they were more likely to change their minds about AM within range ($\chi^2(1) = 8.363$, $p = .004$).

3.3. Type of information
Malleability also clearly differed by message. Information about research and monitoring and forest resilience had the largest effects on public preferences, while information about climate change severity had the least effect, followed by information about economic impacts. The overall significance of this result was confirmed using Cochran’s Q to test differences across the four messages for both AM within natural range ($\chi^2(3) = 700.139$, $p < .001$) and AM outside of natural range ($\chi^2(3) = 514.311$, $p < .001$). McNemar’s pairwise test ($p < .001$) showed that the differences between the messages were significant, aside from research and monitoring and forest resilience which had similarly large effects.

One notable and unanticipated result is the marked shift in preference from opposition to support when respondents were assured that there would be a program of ongoing research and monitoring, and the reverse when respondents were told that there would be no ongoing research and monitoring. This effect may relate to perceived scientific uncertainty; research and monitoring would enable ongoing improvements in implementation and quicker detection of unexpected and problematic impacts, which may otherwise go unnoticed. Respondents also reported high levels of public trust in scientists and low public trust in government and industry in the BC context (Tindall et al. 2010, Peterson St-Laurent et al. 2019). AM may, therefore, be more acceptable when scientists are perceived to inform policy and management decisions. Information about forest resilience was also highly influential, presumably because increased forest resilience (to climate change impacts) is one of the plausible outcomes of AM’s successful implementation (Gray and Hamann 2011). It is therefore surprising that information about the severity of climate change was least influential, since the main rationale for AM is to lessen climate change impacts on forests (Williams and Dumroese 2013). This may relate to the cognitive challenge inherent in first understanding climate change risks and then judging their long-term implications for forest health. Finally, messages about economic benefits also had lesser effects on respondents’ preferences. This is also a notable result given that the maintenance or improvement of the productivity and economic value of forests is one of the main incentives for government and industry to propose AM policies (Pedlar et al. 2012). Proponents may therefore achieve more success in swaying public opinion by emphasizing transparent, evidence-based, and adaptive policy-making approaches rather than by making arguments based primarily on the threat of climate change to BC’s economy.

3.4. Demographic and psychographic factors
Demographic and psychographic factors also predicted the malleability of respondents’ preferences in ordinal and linear regressions (table 2). Overall, shifting preferences were predicted by age, gender, anthropocentric value orientation, trust orientation and forestry knowledge (see table 1 in the methods for a description of these variables). All of these independent variables were significant for at least one message, with perceived climate risk having the narrowest effect (i.e. only for AM outside of natural range in response to information about climate change severity) and age having the broadest effect (significant for seven of the ten dependent variables).

The effects of the demographic and psychographic factors differed both by AM strategy and by message. Although age, education, political orientation, forest knowledge and perceived climate risks were all significant predictors of changes in preference, the effects of environmental value orientation (anthropocentrism and biocentrism) and trust orientation (trust coallition, distrustful and trustful) were particularly instructive. People who exhibit a more anthropocentric value orientation are much more likely to change their minds when given new information about economic impacts and climate change severity. They are also much less sensitive to information about
Table 2. Regression coefficients for changes in preference for AM within and outside of natural range when respondents were given new information. The change indices were analyzed using ordinal logistic regression, while the different messages were analyzed using binary logistic regression. The change index is the sum of the four binary variables indicating changes in preference in response to each message.

| Variable          | Change index | Climate change severity | Economic impact | Research and monitoring | Forest resilience |
|-------------------|--------------|-------------------------|-----------------|-------------------------|------------------|
|                   | AM within    | AM outside              | AM within       | AM outside              | AM within       | AM outside       |
| Age               | .008**       | .010***                 | −.001           | .002                    | .014***         | .014***          | .006             | .014***         | .012**          | .011**          |
| Gender (male)     | −.234**      | −.143                   | −.135           | −.101                   | −.119           | −.103            | −.332**          | −.168           | −.346**         | −.244*          |
| Education         | −.048        | .041                    | −.103**         | .011                    | −.037           | −.018            | .004             | .107*           | .064            | .123**          |
| Political orientation | .032        | .037                    | .011            | .025                    | .065**          | .081***          | −.006            | .009            | .044            | .050            |
| Environmental value orientation | .055 | .067                    | .124            | .099                    | −.179*          | −.003            | −.081            | .204*           | .058            | .063            |
| Biocentric        | −.324***     | .271***                 | .378***         | .320***                 | .448***         | .271***          | −.022            | .120            | −.050           | .002            |
| Anthropocentric   | −.185        | −.193                   | −.258*          | −.246*                  | −.275*          | −.304*           | .164             | .155            | .163            | −.129           |
| Trust coalition   | −.250*       | −.282*                  | −.253*          | −.328**                 | −.187           | −.164            | −.184            | −.238           | −.254           | −.386*          |
| Forest knowledge  | .009         | .045*                   | −.028           | .025                    | .021            | .052*            | .072**           | .105***         | .094**          | .087**          |
| Perceived climate risk | .084 | .095                    | .072            | .129*                   | −.035           | .020             | .123             | .130            | .086            | .057            |

n = 1887. All models are significant (p < .001) using the likelihood ratio chi-square test. All regression coefficients are unstandardized.

p < .05; **p < .01; ***p < .001.
forest resilience and research and monitoring. Additionally, individuals who tend to express trust in all major forest-related actors (i.e. ‘trustful’) are more likely to change their minds when given new information about economic impacts, climate change severity and forest resilience, while distrustful individuals are less likely to change their minds overall.

This has important implications for policymakers, since public trust is a crucial determinant of individuals’ willingness to accept and respond to new information. Again, combined with respondents’ sensitivity to research and monitoring efforts, this suggests that the public may be particularly resistant to AM where the government and industry are perceived to be making decisions that are not adequately supported by scientific knowledge (as also found in the United States by Nelson et al (2017)). Our respondents therefore seem to use their overall trust in forestry-related actors as a heuristic to simplify judgments characterized by high uncertainty (similar to the findings of Cummings (2014) in the health sector). That is, when faced with novel technologies and uncertain outcomes within a context steeped in legacies of mistrust (Cashore et al 2001, Nelson et al 2017), trust plays a strong role in shaping people’s risk perceptions (Siegrist 2019).

3.5. Future research
These results raise questions about the malleability of public preferences and the difficulty of eliciting public judgments for the complex and uncertain trade-offs inherent in adaptation problems. These questions would best be followed up using a narrower, experimental design to find the crux of the elicitation challenge, contrasted with deliberative focus groups to evaluate processes of social learning and rationalization that may decrease malleability as the public dialogue continues to develop around adaptation in general and genomics-based AM in particular. The survey questions required that respondents make difficult trade-offs under uncertainty, given only relatively un specified information. More detailed testing is needed to identify the specific elements of the adaptation problem and technical solution that are most problematic for respondents in making overarching judgments. The malleability-testing questions were also framed as hypothetical and the wording was slightly different for each type of information, so we cannot cleanly say, for instance, that economic messages were less impactful than ecological messages. We can only say that the specific economic message used here was less impactful than the specific forest resilience message. A more focused study could, for example, provide different tutorial information to two groups of respondents, emphasizing economic or forest resilience outcomes, and thereby more precisely measure the effect of the two framings. These results are a step towards understanding how survey methods may be used to reveal preference malleability, and a logical path forward would be to develop and test innovative survey tools that include deliberative design features.

4. Conclusions
Broadly speaking, the observed malleability of attitudes is consistent with upstream public risk perceptions of other novel technologies (Binder et al 2010, Corner et al 2012, Satterfield et al 2013). However, our results provide a clear example of preference construction with surprisingly high amplitude and bi-directional dependency in people’s shifting preferences, alongside the apparent use of trust as a heuristic in making judgments about new information. Support for AM was initially high, but more than two thirds of respondents changed their position when provided with new information about AM’s implementation, regardless of whether they initially supported or opposed it. This result strongly suggests that preferences will shift as the public dialogue around AM develops. Depending on their direction, these shifts may have important implications for the ongoing development of climate change adaptation policies in BC’s forests and beyond, leading to unexpected opposition for interventions that initially appear to have broad public support. This challenge may be compounded if experts misconstrue adaptation as ‘easy to sell,’ as documented by Moser (2014). In communicating adaptation policies in the BC context, the findings presented here indicate that process-based arguments emphasizing transparency, evidence-based decision making, and ongoing research and monitoring are more likely to sway public opinion than risk-based arguments related to climate change severity and economic impacts.

As society navigates the realities of a rapidly changing climate, both researchers and policy-makers need to recognize and account for the increasing difficulty of the upstream judgments asked of publics and stakeholders. This demonstrated malleability of public preferences reinforces the need for robust upstream public engagement using approaches that bridge the methodological divide between public surveys and deliberative techniques. Upstream surveys may provide a sense of the acceptability of new technologies across large, diverse, and relatively uninformed publics; however, the results are a static snapshot of dynamic preferences, and should therefore be interpreted with care. Deliberative techniques are indispensable in revealing the underlying logics of participants’ initial judgments (Macnaghten 2017), but they may underestimate the malleability of these judgments by encouraging participants to rationalize their choices. To address these shortcomings, approaches that include mixed-methods designs that explicitly seek to anticipate and measure shifting
preferences are essential and may include innovative survey tools with deliberative design features.

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Contributions

KMF wrote the paper. All authors reviewed and revised the paper. KMF and GPS analyzed the data. GPS, SH and RK designed the survey. SH and RK conceptualized and supervised the overarching project, and acquired the funding.

Data availability statement

The data that support the findings of this study are available from the corresponding author upon reasonable request.

Competing interests

None.

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