Core values underpin the attributes of forests that matter to people

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Managers of public forests are required to balance multiple values of forests. Developing policies to represent these can be impeded by uncertainty regarding how to understand and describe values relevant to forests. This paper addresses one source of ambiguity by examining forest values at two levels of abstraction: core values of people (principles that guide in life), and valued attributes of forests (qualities of forests important to people). We used in-depth interviews with 36 members of the public in Victoria, Australia to describe the values relevant to forests at both levels. We then examined relationships between values based on a survey of members of the Victorian public (*n* = 915). Our study revealed valued attributes encompassing natural, production, cultural and experiential categories. We demonstrated a broader range of core values relevant to forest management than previously recognized: security (safety and stability of society) and hedonism (pleasure and sensory gratification) were expressed in addition to biospheric, altruistic and egoistic values. Associations between core values and valued attributes revealed biospheric values underpin variation in the importance given to production and natural attributes of forests. The core value of security also underpinned multiple valued attributes. By revealing a comprehensive yet succinct range of values associated with forests, this research supports development of forest policy congruent with expectations of society.

Introduction

The development and framing of forest policy that is acceptable to the public requires a clear understanding of the diverse social values associated with forests (Kant and Lee, 2004; Eriksson *et al.,* 2013). Social values are an important motivator in forest-related attitudes and behaviours (Clement and Cheng, 2011), providing the basis for public acceptance of forest management and policy (e.g. Steel *et al.,* 1994; Brown and Reed, 2000), and influencing ways that members of the public perceive and act on information about forests (Ravlin and Meglino, 1987; Rossi *et al.,* 2015). The importance of understanding human values within the context of environmental management in general (e.g. Ives and Kendal, 2014; Jones *et al.,* 2016), and forest management in particular (e.g. McFarlane and Boxall, 2000; Richnau *et al.,* 2013), is well recognized. Currently, however, there is considerable ambiguity in the way values are conceptualized and measured.

Understanding values

Ambiguity in measuring forest-related social values arises in part from a blurred distinction between 'values' and the process of attributing or assigning 'value' to forests (Rohan, 2000; Reser and Bentrupperbäumer, 2005). Forest managers tend to use 'values' in reference to specific features or to benefits derived from biophysical systems, like ecosystem services (Lockwood, 2005; Reser and Bentrupperbäumer, 2005). Social scientists, on the other hand, consider 'values' to be psychological and social constructs or belief systems (Reser and Bentrupperbäumer, 2005). To resolve this ambiguity, we define values generally as beliefs about what is important to people, and distinguish between values at two levels of abstraction: valued attributes of forests, which are recognizable to managers as general qualities of forests, and more abstract core values that are cross-situational beliefs people hold about what is important in life (Kendal *et al.,* 2015; Rawluk *et al.,* 2017).

Forest valued attributes – the qualities or properties of forests that are valued or seen as important by individuals or society more broadly – have been described in a number of ways. For example, Bengston *et al.* (2004) identify anthropocentric, biocentric and moral/spiritual/aesthetic orientations toward forests. Ford *et al.* (2009) distinguish three valued 'objects' of forests: environment, timber, and aesthetic, which have some similarities to a Public Values for Forests scale utilized in the USA that identifies protection, amenity and output categories of values (Tarrant *et al.,* 2003). Valued attributes can include objective biophysical characteristics of forests, such as services, like the provision of wood and non-wood products, or more subjective feelings of wellbeing or social connectedness arising from forest experience (Kendal *et al.,* 2015; Rawluk *et al.,* 2017). In addition, individuals and social groups can value multiple and potentially competing forest attributes at the same time (Braithwaite, 1994; Nielsen-Pincus, 2011). For example, an individual may value a forest as a source of wood products and livelihoods and for the natural environment (Ford *et al.,* 2009).

At a more abstract level than valued attributes, core values are defined as relatively stable abstract beliefs that people hold about what is desirable or preferable, such as social justice, wealth and security. Such core values apply across different situations and contexts, and might be shared by individuals within social and cultural groups (Rawluk *et al.*, 2017). Core values are based on the theory of human values from social psychology (Schwartz *et al.*, 2012), from which three subsets of basic human values or value orientations are frequently associated with environmental attitudes and behaviour (Schultz, 2001). Egoistic values reflect self-interest (self-enhancement) concerns, and are contrasted with two self-transcendent values: a social-altruistic orientation (concern for other human beings), and a biospheric orientation (concern for other species or the biosphere) (Stern *et al.*, 1993, 1995; Dietz *et al.*, 2005). Many studies of core values use well-tested quantitative measures of basic human values, such as those reported by Schwartz *et al.* (2012), but there has been limited qualitative exploration of the structure of basic human values in the forest context.

Core values underlie and motivate more specific attitudes, including attitudes toward forest management (Fulton *et al.*, 1996; McFarlane and Boxall, 2000). For example, Eriksson *et al.* (2013) demonstrated that basic values on the self-transcendent/ self-enhancement dimension influenced the evaluation of forest management by members of the Swedish public. While there is support within the literature for considering forest values within a hierarchy (e.g. McFarlane and Boxall, 2000; Nordlund and Westin, 2011; Eriksson *et al.*, 2012), the relationship between abstract values and valued attributes has rarely been empirically examined. One study that comes close to achieving this framed core values as 'transcendental values' that influence valuation of ecosystem management and services (Raymond and Kenter, 2016). Their three case studies illustrate how core values can influence general concern and awareness of consequences for the welfare of self, other people and other species. These researchers use measures of concern and awareness as proxies for valuation of ecosystems, but do not directly conceptualize or measure the value given to attributes of those ecosystems. Another study examined core values and valued attributes in relation to public land (Kendal *et al.*, 2015). These researchers used survey methods to more directly observe importance given to valued attributes and core values. They demonstrated that egoistic core values were positively related to productive valued attributes, but not to other valued attributes. They also found that biospheric core values underpinned the importance given to both natural and experiential attributes.

Aim and context

In this paper, we examine the structure of forest values at two levels of abstraction (core values and valued attributes) and their relationships. Our approach has practical importance since values at each level have distinct implications for policy and management. Understanding the core values held by members of the public can help in understanding the basis for forest conflicts, for example in the relative importance of the core values of benevolence and biospheric universalism in the broader population. On the other hand, identifying more specific valued attributes associated with forests or with tangible places and objects can help with identifying and prioritizing objectives and criteria for forest management in general, or for the management of particular forests (Bengston *et al.*, 2004; McIntyre *et al.*, 2008; Seymour *et al.*, 2010). For example, understanding the importance of experiential attributes of forests can assist with prioritizing management actions that support recreation activities (Ford *et al.*, 2017). Despite the relevance of values at both levels of abstraction, current frameworks for assessing forest values rarely consider underlying abstract core values. For example, the Montreal Criteria and Indicator framework for sustainable forest management (Hickey and Innes, 2008; Montreal Process Working Group, 2009), the Forest Values Scale (Steel *et al.*, 1994), and the popular forest values typology of Brown and Reed (2000) all focus on the somewhat more tangible valued attributes of forest. Our paper thus assists in progressing towards more comprehensive approaches to assessing forest values.

We explore values through research conducted in the state of Victoria, south-eastern Australia. Victoria has ~8.2 million hectares of natural or native forest, mostly on publicly owned land, which comprises just under 30 per cent of the total area of the State (Victorian Auditor-General, 2013). Forest composition and productivity vary with climate and topography, ranging from closed rainforest, and tall open forest dominated by single-species 'ash' forests (for example, *Eucalyptus delegatensis*, *E. regnans*,) to mixed-species eucalypt open forest and woodland at lower elevations (VicForests, 2014). As in other parts of Australia, there is considerable conflict over the management of forests in Victoria (Lane, 1999). While the factors underlying and contributing to forest conflict in Australia are multifaceted, conflict typically arises from the relative allocation of publicly owned forests among potentially conflicting uses (particularly timber harvesting, recreation, conservation), and in relation to contested values and cultural meanings of forests (Lane, 2003). This ongoing contest between diverse perspectives presents a useful context for exploring the structure and relationships of forest values.

We use two complementary studies (one qualitative, one quantitative) to examine:

- the nature and structure of valued attributes of Victoria's forests;
- the nature and structure of core values, focusing on those core values relevant to valuing forest attributes; and
- the relationships between core values and valued attributes of forests.

Methods

Our first qualitative study, based on in-depth interviews, was used as a 'bottom-up' approach to identify a wide range of valued attributes of forests and to identify the underlying core values motivating importance of specific valued attributes. This informed the design of our second study, a large-scale survey that allowed robust measurement of values, and quantitative analysis of the relationships between these values.

Study 1: In-depth interviews

To identify a wide range of values attributed to native forests among the public, we conducted 36 semi-structured interviews over a 3-week period in 2013.

Participants

Recruitment was designed to capture the views of people that interact with native forests in different ways and used a mix of purposive and snowball sampling. Participation was invited through stakeholder and other interest groups (e.g. conservation, recreation, tourism, business, professional and general community groups) based in and around Melbourne, Victoria, with groups purposefully selected to represent very diverse perspectives on forests. Approximately 60 such groups and individuals were contacted and asked to help by passing on the invitation to others who might be interested in participating in the study (a form of snowball sampling where participants assist in recruiting through their network of acquaintances). The resulting sample of 36 interviewees was predominantly male ($n = 27$), over 40 years of age ($n = 28$), and had a tertiary qualification ($n = 24$). During interviews participants were asked to describe their interest in forests to help characterize the sample. Half of the participants ($n = 18$) identified themselves as business operators, members of interest groups or other organizations having a public stated stance on forests. Four participants identified as land management professionals, with the remaining third ($n = 14$) describing other interests in forests, such as four-wheel driving, trail-bike riding, bushwalking, hunting, educational tourism, or just having a self-described 'love of forests'.

Procedure

Interviews were conducted at a place of the participants choosing, usually at their home or work. Interviews ran between 0.5 and 2 h and were digitally recorded and later transcribed. The interview structure included an adapted conceptual content cognitive mapping (3CM) task (Kearney and Bradley, 1998). This method provides a structured yet flexible approach to exploring beliefs (including values) that has proved useful in understanding individual perspectives on environmental issues (e.g. Lee and Kant, 2006; Marcus et al., 2011). Participants were asked to imagine or visualize a forest, and to think about why forests were important to them. Participants wrote reasons they valued forests on separate 15 × 10 cm cards, producing between 3 and 16 cards per participant. Participants then sorted the cards into groups (2–8 groups per participant) in a way that was useful to explain what they thought was important about forests. Finally, participants labelled the card groups to describe what the cards in a group had in common, and then ranked the card groups in order of importance to them. This process helped to identify the participant's valued attributes for forests. The ranked card groups provided the basis for the open-ended questions in the next interview stage.

Due to time constraints, up to three groups of cards were selected for further consideration in the interview. Usually the groups of cards ranked most important were selected for this purpose, but during later interviews, researchers sometimes requested exploration of card groups that were prioritized by only a few interviewees (e.g. production-related themes) to better understand these themes. Participants were asked to describe why each group (valued attribute) was important, and then asked a series of open-ended questions ('Why is this group important to you?') to reveal more abstract core values underlying the value beliefs expressed in the card group. This 'laddering' interview technique, based on techniques described by Pieters et al. (1995), was used to understand which core values motivated the importance given to valued attributes of forest.

Data analysis

Interview data were analysed using a two-stage approach. In the first stage, a thematic analysis conducted within the NVivo10 software package (QSR, 2009) was used to identify valued attributes of forests and core values expressed by participants. Data were first classified according to the two levels of values (valued attributes, and core values) on the basis of content and interview context. Both inductive and deductive approaches were used to categorize data within the two value levels. Identification of valued attribute themes was guided by previous research investigating valued attributes of natural areas (Kendal et al., 2015) and other related literature (e.g. Seymour et al., 2010; Brown et al., 2015), while also allowing new and novel themes to be identified. Themes at the core value level were categorized using a deductive approach guided by the social values literature (especially Schwartz et al., 2012). Consistent with the categorization of value orientations within environmental research, the value category universalism was represented as biospheric or altruistic (e.g. Schultz, 2001). In the second stage of analysis, valued attribute and core value categories were coded to identify where core values and valued attributes were linked by the participants during the laddering interview technique. Identification of co-occurrences then enabled further quantitative and qualitative evaluation of the association between valued attributes and the underlying core values.

Study 2: Values survey

We surveyed 915 members of the Victorian public in late 2016 with the aims of clarifying the structure of both core values and valued attributes relevant to forests, and of quantitatively describing relationships among core values and valued attributes.

Participants

Survey recruitment was designed to ensure participants were drawn from across the breadth of the Victorian public, including those with little or no interest in forests. To address the limitations of traditional mail-only survey modes, particularly low response rates (Stern et al., 2014), a mixed-mode survey approach was used:

- Postal survey: Delivery addresses were randomly selected from a commercially available database of residential postal addresses stratified to reflect the metropolitan/regional and rural population distribution in Victoria. Delivery followed a modified tailored design (Dillman, 2006) involving three contacts over a 3-week period (initial posting, reminder postcard and re-posting of the questionnaire to non-responders). A complimentary pen was included in the initial postage packages. Respondents had the choice of completing an online version of the survey, or completing the pen-and-paper survey and returning by reply paid post. The postal survey had a response rate of 18 per cent ($n = 503$) after adjustment for non-deliverable addresses.
- Forest attitudes research panel: Invitations to complete an online survey were emailed to participants of a previous survey who had indicated a willingness to participate in future studies. To address the tertiary education bias evident in the returned postal surveys, only those without a post-graduate qualification were invited to participate. Of the 507 contacted, 111 respondents completed the survey, giving a response rate of 22 per cent.
- On-line panel: On-line panellists ($n = 301$) were recruited through a commercial market research organization. Participants were stratified by age, education and metropolitan/rural/regional place of residence to represent the Victorian population. Surveys completed in a time of less than 5 min or obvious 'flat-liners' (little within-subject variability) were excluded (Menictas et al., 2011).

The final survey sample population ($n = 915$) was generally older, more highly educated and more rural than the population of Victoria, but had a similar gender balance (Australian Bureau of Statistics, 2011). In the sample: 51 per cent ($n = 462$) were aged over 55 years compared with 34 per cent within the Victorian population, while 36 per cent ($n = 324$)

had a Bachelor degree or higher, compared with 10 per cent of the Victorian population over 20 years of age. The proportion of respondents identifying as residing in rural or regional areas of Victoria (40 per cent) was greater than in the general population (25 per cent). Female representation in the sample (54 per cent) reflected that in the Victorian population (51 per cent). The majority of respondents (71 per cent) indicated that they were casual visitors to forests (e.g. going for short walks, picnics or camping trips a few times a year), compared with 22 per cent who identified as frequent visitors (many times a year). Twenty-seven per cent lived in or near forests, while over half of the respondents (57 per cent) indicated an interest in nature from home (e.g. viewing documentaries or reading books about nature). Only 3 per cent of respondents indicated that they had no interest in forests.

Questionnaire design

The survey questions were developed to measure importance assigned to valued attributes and related core values. Questionnaire development involved construction of the survey question items, pre-testing of these with a convenience sample, and then refinement of the final question set.

Wording of the core value items was guided by the theory of basic individual values (Schwartz, 2012) and other environmental values scales (e.g. Stern *et al.*, 1999; de Groot and Steg, 2008). In the questionnaire, core value items were explained to participants as 'principles or beliefs used to guide the way you live your life' (Schwartz, 2012). Participants indicated the importance of each principle on an 8-point Likert scale (0 = 'Opposed to my principles'; 1 = Not 'important to me'; 7 = 'Extremely important to me'). Selection and wording of the valued attribute items was guided primarily by categories identified through interviews (Table 1), but also by items in the Valued Attributes of Landscape Scale (Kendal *et al.*, 2015) and other forest values typologies

(e.g. Brown and Reed, 2000; Van Riper and Kyle, 2014). In the survey, valued attribute items were described as reasons why people value forests, and were prefaced with: 'I value forests for the …'. Respondents indicated the level of agreement with each statement on a 7-point Likert scale (1 = 'Strongly disagree'; 7 = 'Strongly agree'). The questionnaire was thoroughly pre-tested with a convenience sample of Victorian residents (n = 293). As a result, some core values were combined in the final questionnaire (described further in Study 2: Values survey of Results section). The final questionnaire comprised 20 items representing seven valued attributes (Table 4), and 19 items representing five categories of core values (Table 5). Each value category was reflected in at least three items, and introduction and response scales were as described in the pre-test.

Data analysis

An exploratory factor analysis (principal axis with oblimin rotation) was used to summarize and identify groupings of core values and valued attribute items that survey participants responded to in similar ways. Scree plots, factors with an eigenvalue of >1 and interpretability of resulting factors were all taken into account in selecting the final solution. Interpretation focused on item factors with a loading of >0.3 indicating strong contribution to the underpinning factor (Hair, 2006). Factor scores were calculated, and reverse coded in some cases, so that a higher score indicated stronger endorsement of that core value or valued attribute. Mean importance of each valued attribute and core value was calculated from parcelled item scores for each factor. Cross-loading items were only included on the factor on which they loaded most heavily.

Relationships among values at different levels of abstraction were examined using linear multiple regressions. All core value factor scores

Table 1 Valued attribute thematic categories identified in the analysis of the interview data.

Valued attribute thematic category	Description and example (in italics) from interviews
Natural	Forests are valued for the biophysical functions and ecosystem services they provide, including the provision of habitat for biodiversity, support services such as nutrient cycling, and regulating services such as water purification: *'the work that forests do in sustaining the planet'*
Experiential	Forests are valued for the internal feelings, emotions and physical benefits individuals personally derive from experiencing forests. Experiential values are multi-sensory (visual, aural, tactile, olfactory) perceptions of the forest: *'…seeing new things …being very still and hearing birds …' 'Smells of the bush – clean fresh air…'*
Production	Forests are valued for the utilitarian benefits humans derive from forests. Within this category, forests are valued for provisioning services to satisfy human survival, including provision of timber and wood, non-wood products like pharmaceuticals, or as a source of flowering plants to support bees. *'…the resources that we as humans use in our everyday life, and how forests can supply those resources'*
Setting	Forests are valued as places providing the opportunity for individual and social experiences, including places for recreational activities, for social interaction, as well as being a valued workplace. *'Place for recreation such as bushwalking, horse riding, picnics etc.' 'Good places for walking/hiking and camping'*
Socio-economic	Forests are valued for forest-derived social and economic benefits, including the sense of community amongst people living in and around the forest, or economic benefits such as employment and tourism opportunities related to forests *'[Forests] potential for tourism and hence employment'*
Learning	Forests are valued for the opportunity to expand scientific knowledge, including pharmaceutical development, as well as learning about natural history, nature and forests. *'…a forest is really an expression of its history in that it is growing in time … you can look back and you can see things that happened 200 years ago in the expression of the forest in its current condition.'*
Cultural	Value related to the sense of place, identity and symbolism associated with native forests in Australia *'So that's our culture, even the logging … it's played a really important role in where we are today.'; '…it's something that you can identify with as an Australian that's unique – so unique only to us and the first Australians.'*

were potential explanatory variables for each valued attribute factor score. Core value variables were entered simultaneously into each analysis, since the goal was to determine the best combination of core values for explaining the importance given to each valued attribute. Interpretation of the output therefore emphasizes the overall and unique contribution of each core value factor score, based on unstandardized coefficients (B) and semi-partial correlation coefficients (Sr^2), respectively (Tabachnick and Fidell, 2007). Assumptions of regression were tested prior to these calculations. All analyses were conducted using IBM SPSS Statistics (IBM Corporation, 2016).

Results

Study 1: In-depth interviews

Valued attributes

Interview participants identified multiple reasons for valuing forests in the card-sorting task. Reasons for valuing forests, and the subsequent groupings of cards, were individualistic and idiosyncratic, particularly in relation to scale (ranging from local scale to landscape scale) and the degree of specificity (individual elements or more general). Deductive and inductive thematic coding resulted in identification of seven distinct categories of valued attributes occurring within the card groupings: natural, experiential, production, setting, socio-economic benefit, learning and cultural (Table 1).

Core values

The categorization of core values was guided by the theory of basic human values (Schwartz *et al.*, 2012). Eight categories of core values were identified within the interview: biospheric, security, hedonism, altruism, stimulation, benevolence, tradition and achievement (Table 2).

Relationships between valued attributes and core values

To explore relationships between values at the two levels in the interview data, we first analysed the transcripts to identify 'ladders', or instances during the laddering interview technique where a participant explained the importance of one or more valued attribute based on one or more core value. These 'ladders' comprised the valued attributes occurring within each card grouping along with related core value. We identified 88 valued attribute–core values ladders across the 36 interviews. Most ladders contained only one core value element, with 14 (16 per cent) having two core value elements. The two core values, tradition and achievement, occurred in only one ladder each. Descriptions of valued attributes within the card groupings were closely inter-woven within these ladders, with the number of valued-attribute elements per ladder ranging from 1 to 4 (average of 1.6). For example, one participant grouped five aspects of forests (valued attributes) they considered valuable (protection from the elements, habitat, sanctuary for people, food source, and wood/timber) under the label of 'What is derived'. They explained the grouping of these concepts as follows:

> *Habitat helps to make the forest go on so if you look at north Queensland …Cassowaries are a valuable distributor of seeds and they eat the fruit and then they travel and drop the seeds out, that sort of thing helps to - not just the wildlife coming in to eat the bugs that infest the trees and so on* [coded as natural attributes] …. *Sanctuary for people. I mean, that's a sort of hippie idea of being able to go and walk around and enjoy and people can get a sense of renewal from being able to spend that quiet time there, sort of spiritual renewal for some people* [coded as experiential attributes] … *Food source, I mean I'm not sure how much*

Table 2 Core value thematic categories identified in the analysis of the interview data.

Core value thematic category	Description and examples from interview (in italics)
Biospheric	Expressed as an underlying concern for protecting and respecting nature: '…*protecting all of life and all of the variety of life we have on the planet*'
Security	Expressed in two forms: concern for personal security, '*I think it's mental health, feeling of security. I mean, we want to feel that we're secure on the planet we have*', and concerns for the survival of humans and society in as a whole: '… *the human need for a sense of belonging or a team or a group to share experience with*'.
Altruism	Expressed as concern for the survival and wellbeing of future generations of people: '… *we actually have a responsibility to future generations to protect the forests and we are denying their survival and their wellbeing by not protecting them*'
Benevolence	Expressed as concern and caring for the welfare of family and close friends: '…*you need to be a breadwinner in some shape and form… I've got a wife and a family and commitments*'
Stimulation	Reflecting a need for excitement and challenge in life, evident in statements such as: '… *getting a sense that you're seeing areas that few people see…*'
Hedonism	Reflecting pleasure or sensuous gratification for the individual, e.g.: '*I like to enjoy my life, and I find a lot of enjoyment out of [the forest], so I value that part of it for sure*'
Tradition	Tradition relates to maintaining and respecting cultural and religious traditions: '… *you can continue on with something that was there before and that's been done before and you're still part of it*'
Achievement	Achievement relates to performance and motivation, pursuing success or demonstrating competence: '… *when I first started working in the forest, I found that I thought I could do it as good or better…*' and then later in interview '… *I could take you for a drive anywhere around here within ten minutes of the place and show you where I worked 35 years ago and stand in this regenerating forest where the trees are 45 foot high*'

that's - I suppose it is for the animals but for people I'm not sure how much for Indigenous people in different parts of the country that's very important. And then wood and timber is particularly useful for some industries [coded as production attributes] ... [Interviewee 26, November 2013]

When asked why these values were important, the interviewee stated: 'I can't imagine our world without forests…' and then later, 'Forests are important I suppose in a way for their own sake….' [coded as biospheric].

This interweaving of valued attributes means that across the 88 ladders in the interview data, we identified 169 instances of co-occurrence of any possible combination of a valued attribute with a core value (Table 3).

Concepts related to core values of security, biospheric and hedonism were most often drawn on to explain the importance of forest attributes, but their relative importance differed across valued attributes. Biospheric values were most often linked with natural attributes, and hedonism values with experiential attributes, whereas security values featured strongly in explanations of production, as well as natural and experiential values (Table 3). While patterns were less evident for other valued attributes due to their relatively infrequent correspondence with core values, all valued attributes co-occurred with multiple core values. That is, there was no simple one-to-one relationship between valued attributes and core values (Table 3).

In 14 of the 169 co-occurrences, participants explained the importance of a valued attribute on the basis of more than one core value. For example, one participant highlighted production qualities of the forest: 'I mean we use trees, and wood, and forests for a lot of things'. The importance of these production attributes was explained with regard to concepts that related to both altruism and security core values:

I think us as a human population or society, we obviously need to use nature in a way – we obviously require it to continue life [coded as security, personal]. *I mean we use paper every day, we breathe every day, trees provide that oxygen*

for us. So to me it is important to manage that, so that future generations can still enjoy forest for the beauty that they are, but still reap the benefits of using it as a resource [coded as altruism]. [Interview 14, November 2013]

In summary, multiple core values underpinned the importance given to each forest attribute in our interview data. While core values and valued attributes were related in meaningful ways, the relationships were not simple but multifaceted.

Study 2: Values survey

The analysis of Study 2 builds on Study 1, with most values identified through qualitative methods in Study 1 then assessed in Study 2 using quantitative methods. At the same time, the use of a quantitative strategy in Study 2 provided a different perspective on the structure of values identified in Study 1, as evident in the following sections.

Valued attributes

The exploratory factor analysis used to summarize and group responses to the survey resulted in only four valued attribute factors being identified, as distinct from the seven attribute groups identified qualitatively in Study 1. These four valued attributes together explained 63 per cent of total variance (Table 4). The first factor, named 'Cultural attributes', included items reflecting the natural and human cultural values embedded within forests, with several statements having an emphasis on the importance of conveying knowledge about traditions and cultures to future generations, and recognition of the unique heritage values of forests. Factor 2, 'Production attributes', incorporated utilitarian values associated with forests, including the provision of natural resources for human use, as well as the socio-economic benefits of forests. The third factor, 'Experiential attributes', included statements in which forests were valued as physical settings or places for recreation, and for experiencing nature and the outdoors, as well as statements relating to

Table 3 Frequencies of co-occurrence of valued attributes and core values within the 'ladders'; counts are based on 88 'ladders' identified within interviews, where a participant explained one or more core values underlying the importance given to the valued attributes within each card grouping.

Core value	Valued attribute							
	Experiential	Natural	Production	Learning	Setting	Socio-economic	Cultural	Total
Security	12	13	10	3	1	6	2	**47**
Biospheric	7	22	5	5	0	4	2	**45**
Hedonism	16	1	1	2	9	1	1	**31**
Altruism	2	5	2	2	1	4	2	**18**
Stimulation	7	1	0	2	1	0	1	**12**
Benevolence	2	2	1	0	3	3	0	**11**
Tradition	0	0	0	2	0	0	1	**3**
Achievement	0	0	0	0	1	1	0	**2**
Total	**46**	**44**	**19**	**16**	**15**	**18**	**9**	**169**

Multiple valued attributes and core values were contained in some ladders, resulting in a much higher total number of co-occurrences (169) than number of ladders.

Table 4 Factor loadings for valued attributes (principal axis factoring, oblimin rotation) in the survey data.

Valued attribute item statement	Factor 1: Cultural attributes	Factor 2: Production attributes	Factor 3: Experiential attributes	Factor 4: Natural attributes
Learn through scientific observation or experimentation	0.64			
Way people can learn about nature and the natural environment	0.46			0.35
Pass down knowledge, traditions and ways of life to future generations	0.68			
Natural and human history they contain	0.74			
Unique part of our natural heritage	0.60			
Sense of awe and respect they inspire in me	0.44		−0.35	
Natural resources such as timber that can be extracted from them		0.84		
Jobs and economic livelihoods they support		0.80		
Timber and other wood products they provide, such as for building and furniture		0.85		
Social and economic benefits they provide to Victoria as a whole.		0.51		
Enjoyment I get from experiencing forest sights, sounds and smells			−0.56	0.42
Sense of peace and tranquillity they give me	0.32		−0.45	
Helping me feel better, physically and mentally			−0.64	
Outdoor recreation activities			−0.73	
Experience physical and mental challenges			−0.66	
Challenge, excitement and adventure they provide to me			−0.60	
Places for family and friends to get together and socialize			−0.75	
Catchments for the supply of good quality water for human needs				0.38
Life support they provide, such as helping to produce and renew air, soil and water				0.82
Functions they perform for the planet as a whole, independent of humans	0.31			0.61
Factor mean (of parcelled items)	5.73	4.70	5.54	6.31
Factor standard deviation (of parcelled items)	1.04	1.40	1.06	0.86

Only factor loadings >0.30 are shown. Factors accounted for 63 per cent of total variance in valued attribute items. The mean and standard deviation for each factor (calculated from parcelled items) provide an indication of the relative importance given to these attributes across participants.

feelings of wellbeing and restoration associated with the personal experience of forests. The fourth factor, 'Natural attributes', included items reflecting the natural functions of forests, such as essential ecosystem services from forests to support all life forms. A small number of cross-loadings suggest that factors are related to each in meaningful ways. For example, valuing forests for the *sense of awe and respect they inspire in me* loaded on both Cultural and Experiential factors, while the more tangible enjoyment of the *sights, sounds and smells of forests* cross-loaded on both Experiential and Natural attribute factors. Mean ratings of items loading on each factor suggest that all four attributes tend to be valued by most people, although Production was on average valued lower than other attributes (Table 4).

Core values

Study 1 identified eight core values relevant to forest management: biospheric, altruistic, benevolence, hedonism, stimulation, tradition, achievement and security. The core value of tradition was observed in only a single value ladder, suggesting it is not a salient core value in the study region, and so was not included in the Study 2 survey. The core value of achievement was also only observed in one value ladder, but egoistic values such as achievement have been identified as relevant to views on forests and forest management in other quantitative studies (e.g.

Eriksson *et al.*, 2013). It is possible that such values are less evident in qualitative research because participants may not be comfortable expressing such views in person. Pre-testing of a survey with 27 core values items showed that items for hedonism and stimulation were highly related (high correlations and loaded on a single factor in a preliminary Principal Components Analysis) as did altruism with benevolence. This is consistent with their close relation in Schwartz's (2012) circular model, and elsewhere (Cieciuch and Schwartz, 2012). Based on this preliminary analysis, we removed redundant items from the question set, resulting in the final set of 19 items designed to measure five core values: biospheric, altruistic/benevolence, hedonism/stimulation and security.

Consistent with this, five factors were identified in the factor analysis of core value items, together explaining 61 per cent of the total variance (Table 5). The three core value items that loaded on Factor 1, labelled 'Security', reflected the importance of the nation having order and stability, and protecting the country from threats. Factor 2 incorporated 'Egoistic' values, with loaded items concerned with being influential, including having authority and social status, and, to a lesser degree, economic success (having wealth and material possessions). Factor 3, reflecting 'Biospheric' core values, incorporated item statements related to respecting and protecting nature and living in harmony with nature. Factor 4 comprised statements related to

Table 5 Factor loadings for core values (principal axis factoring, oblimin rotation) in the survey data.

Core value item statement	Factor 1: Security	Factor 2: Egoistic	Factor 3: Biospheric	Factor 4: Hedonism/ Stimulation	Factor 5: Altruism/ Benevolence
Our country protects itself against all threats	0.67				
Having order and stability in our society	0.87				
Avoiding anything that may endanger our society	0.48				
Being influential, having an impact on people and events		0.54			
Having authority, such as the right to lead or command		0.89			
Having social status and power and being able to tell others what to do		0.87			
Wealth, having material possessions and money		0.48			
Respecting nature and having harmony with other species			−0.85		
Having unity with nature where people fit in with nature			−0.77		
Protecting the natural environment from destruction or pollution			−0.75		
Working against threats to the world of nature			−0.66		
Having excitement in life				−0.86	
Having a good time whenever possible				−0.86	
Enjoying life's pleasures				−0.63	
Having adventure and physical challenges in life				−0.55	
Caring for the wellbeing of family and friends					0.32
Everyone is treated justly, even people I don't know					0.79
Protecting society's weak and vulnerable members					0.74
Being there to help people who rely on me					0.54
Factor means (for parcelled items)	5.93	4.02	6.07	5.24	6.28
Factor standard deviations (for parcelled items)	0.94	1.32	0.93	1.17	0.73

Only factor loadings >0.30 are shown. Factors accounted for 61 per cent of total variance in core value items. Factors based on negative loading of items were reverse coded and treated as positive values in further analyses. The mean and standard deviation for each factor (calculated from parcelled items) provide an indication of the relative importance given to these core values among participants.

'Hedonism and stimulation', with the emphasis on enjoyment, pleasure and the opportunity for adventure and excitement. The final factor for core values had elements of social justice: protecting the weak and vulnerable, and ensuring all people are treated justly. In line with Schwartz *et al.* (2012), it was interpreted as relating to both 'Altruism and benevolence'.

Relationships between core values and valued attributes of forests

Four separate regressions were conducted, one for each of four identified valued attribute factors (i.e. valued attribute factor scores as the dependent variables). Factor scores for all core values other than Egoistic, and all valued attributes other than production were negatively skewed, and analysis also suggested likely heteroscedascity. Transformation improved distribution of only two core value factors (Biospheric and Hedonism/stimulation). These transformed variables were entered into regressions, along with remaining untransformed variables. Presence of heteroscedasticity is likely to weaken rather than invalidate the regression solution (Tabachnick and Fidell, 2007).

About 56 per cent of variation in the value placed on Cultural attributes of forest was explained by core values in regression analyses, with Egoistic, Biospheric and Altruistic/benevolence values all contributing (Table 6). Of these, semi-partial correlations indicated that Biospheric core values were by far the most important explanatory variable for Cultural attributes.

A more modest 24 per cent of variance in value placed on Production attributes of forests was explained by core values. Biospheric core values were negatively associated with factor scores for Production attributes, while Security, Egoistic and Hedonism/ stimulation core values were all positively associated. Semi-partial correlations indicated that individual values made little unique contribution to the variance explained, suggesting interactive effects.

Around 37 per cent of variance in value placed on Experiential attributes of forests was explained by core values. All core values other than Security contributed significantly to this, with semi-partial correlations again suggesting little unique contribution from these core values. Just over half of the variance in importance given to natural attributes of forest was explained by core values. Biospheric core values again played a key explanatory role, with all other core values other than Security having a significant relationship.

Discussion

Our study defines values relevant to forests in terms of both abstract principles (core values) and more tangible qualities (valued attributes). This conceptual framework assists forest managers and researchers to make sense of the divergent ways values have been conceptualized in different disciplines. The framework has practical importance for forest management in that decisions affecting manageable outcomes for forests can

Table 6 Summary of multiple regressions of core values factor scores (explanatory variables) on four valued attribute factor scores (dependent variables), including unstandardized coefficients (B), standardized coefficients (β) and semi-partial correlations (Sr^2), ($n = 915$).

	B	β	Sr^2 (unique)
Dependent variable: Cultural attributes of forest			
Security	0.02	0.02	0.00
Egoistic	0.12**	0.12	0.01
Biospheric	0.58**	0.59	0.20
Hedonistic/stimulation	0.13	0.03	0.00
Altruistic/benevolence	0.17**	0.16	0.01

Intercept = −0.43; $R^2 = 0.60$; $R = 0.75$; Adjusted $R^2 = 0.56$; $F(847) = 213.86$

	B	β	Sr^2 (unique)
Dependent variable: Production attributes of forest			
Security	0.25**	0.23	0.03
Egoistic	0.26**	0.26	0.04
Biospheric	−0.26**	−0.26	0.04
Hedonistic/stimulation	0.78**	0.16	0.01
Altruistic/benevolence	0.06	0.06	0.00

Intercept = −1.88; $R^2 = 0.25$; $R = 0.50$; Adjusted $R^2 = 0.24$; $F(847) = 54.90$

	B	β	Sr^2 (unique)
Dependent variable: Experiential attributes of forest			
Security	−0.02	−0.02	0.00
Egoistic	0.07*	0.07	0.00
Biospheric	0.33**	0.33	0.06
Hedonistic/stimulation	1.16**	0.24	0.03
Altruistic/benevolence	0.19**	0.19	0.02

Intercept = 3.10; $R^2 = 0.37$; $R = 0.61$; Adjusted $R^2 = 0.37$; $F(847) = 100.35$

	B	β	Sr^2 (unique)
Dependent variable: Natural attributes of forest			
Security	0.07*	0.06	0.00
Egoistic	−0.08*	−0.08	0.00
Biospheric	0.58**	0.59	0.20
Hedonistic/stimulation	−0.25	−0.05	0.00
Altruistic/benevolence	0.18**	0.18	0.02

Intercept = 0.51; $R^2 = 0.55$; $R = 0.74$; Adjusted $R^2 = 0.54$; $F(847) = 202.08$

*$p < 0.05$, **$p < 0.01$.

be meaningfully linked to the cross-situational ideals and principles that drive public concern for forests.

New insights to experiential and cultural valued attributes of forests

The valued attributes identified through detailed qualitative study extend beyond the findings of previous quantitative research on forest values by differentiating valued attributes that involve experience and cultural relationships with forests. Our findings echo past work in identifying valued attributes relating to natural and production aspects of the environment (Ford *et al.*, 2009). But while previous studies have identified aesthetic values – a form of hedonic value – as a third factor, our analysis provides a more nuanced insight to enjoyment based on valued attributes of forests. Experiential valued attributes as observed in our qualitative research include a broad range of positive feelings and personal benefits, beyond aesthetic enjoyment: peace and tranquillity, restoration of health, socializing, as well as challenge and excitement. A less diverse set of valued attributes was distinguished in the quantitative analysis, perhaps reflecting the survey method, or different levels of interest in forests in the two samples, but the distinction between experiential and cultural values is evident. The moral/spiritual/aesthetic orientation described by Bengston *et al.* (2004) has some resonance with both cultural and experiential attribute factors identified in the current research. But again, our analysis makes more nuanced distinctions, suggesting we should separately consider valuing forest for attributes related to learning and heritage from attributes relating to enjoyment and health. The distinct importance of cultural attributes of forests is consistent with an emerging body of work on cultural and shared values of ecosystems (Chan *et al.*, 2016; Kenter, 2016).

The structure of valued attributes identified in our study has important implications for forest management and monitoring. Forest management is sometimes approached as a tension between two primary valued attributes of forests: natural and production (Ford, 2013). Our research adds to a body of work demonstrating that a broader range of values, here characterized as experiential and cultural attributes, also deserve consideration in forest management policy and planning. As such, framing forest management as a trade-off between environmental and production values risks oversimplifying public expectations of management. For example, the Montreal Criteria and Indicators (Montreal Process Working Group, 2009), an international policy tool in the implementation of sustainable forest management, does not include a criterion that adequately represents experiential values (Ford *et al.*, 2017). Forest assessment approaches might better align with societal expectations if they included the full range of values identified in this study including those relevant to health, aesthetic and spiritual connections with forests.

New insights to core values relevant to forests

Our research identified a smaller number of core values relating to forests and forest management than the 19 core values included in Schwartz's (2012) human value theory. Our in-depth interviews indicate eight core values expressed in verbal accounts of forest value, while just five categories of core values explained much of the core-value variance in the survey data. The quantitative data should not be understood as defining a final set of values relevant to forest management, rather the two studies provide complementary perspectives on values. Considered together we interpret these findings as suggesting that the importance of forests to people is most closely related to the guiding principles of ensuring welfare of other people (altruism/benevolence), welfare of all living things (biospheric), personal achievement (egoistic), personal enjoyment (hedonism/stimulation) and personal and societal stability and safety (security).

While simplifying the data in some ways, the research also points to the importance of some core values that have been

given relatively little attention in environmental research. Past research on environmental issues more typically contrasts concerns for self-enhancement (egoistic) with 'beyond the self' or self-transcendent values (specifically, biospheric and altruism) (e.g. Schultz, 2001; Vaske *et al.*, 2001). Our research suggests that security and hedonism-stimulation should also be considered. The latter is consistent with the work of Steg *et al.* (2014) who demonstrate the relevance of hedonic values to broader environmental concern.

Relatively few studies have considered how the core value of security might be considered within environmental concern. One exception is research on values of forest owners and the public in Finland, where security was highly rated (Karppinen and Korhonen, 2013). Our research confirms the relevance of security to forests, but also suggests that security may be understood in multiple ways when considered in relation to forests. Schwartz's (2012) human value theory highlights security as national stability and safety. In relation to forests, our qualitative analysis also links security to ideas of personal stability and integrity, often expressed in terms of health and wellbeing. The survey we conducted nevertheless measured core values of security primarily in relation to national stability and safety, confirming that both personal and broader societal security are relevant to understanding the value of forests.

These findings are important for forest management in that they confirm that individuals hold multiple and potentially conflicting core values that are relevant to forests (Tsirogianni and Gaskell, 2011). Importantly, in both studies these values span contrasting poles of Schwartz's (2012) circular model of values. Hedonism and stimulation reflect concern for personal enjoyment and pleasure. The structure identified in this research suggests they are distinct from egoistic values, which reflect concern for personal influence and achievement. Frequently conceptualized as reflecting values of self-enhancement, this group of values contrasts with self-transcendent values including biospheric, social altruism and benevolence. Self-transcendent values reflect concern for the welfare of others, whether for the welfare of all people within the wider society (social altruism), or concern primarily for the welfare of those within the individual's own social orbit (benevolence), or the welfare of other living beings (biospheric). The prevalence of both self-enhancement and self-transcendent values in the context of forest management may be useful in understanding that conflict over forest management is based in fundamental differences of values. Core values are not directly amenable to management, but by understanding their relationships with valued attributes, it is possible to ensure management objectives cover a full range of core values. Policy tools for balancing or 'trading off' values in tension have been explored elsewhere and include structured approaches such as multi-criteria decision making and more discursive approaches such as citizen juries (Nitschke *et al.*, 2017; O'Brien, 2003).

Complex associations between core values and valued attributes of forests

Some core values explain the importance given to valued attributes of forests in ways that clearly illuminate conflict over forest management. Biospheric core values help explain the importance given to cultural and natural attributes of forests. The survey we conducted indicates that for both Cultural and Natural valued attributes factors, Biospheric core values contributed to at least half the variation explained, a pattern consistent with the co-occurrence of these values in the qualitative study. In the survey, Biospheric core values were negatively associated with valuing forests for Production attributes. Analysis of interviews suggests a more complex picture, with biospheric values co-occurring with importance given to production values (albeit not frequently). This may emerge partly because production and natural attributes were often linked together within value ladders observed during interviews: participants sometimes noted that production attributes are dependent on natural attributes of forests. Nevertheless, viewed together these findings suggest that differences in the importance of biospheric values to members of the public explain many of the differences in the ways people value forests. The self-enhancement core values of hedonism and egoism are also helpful in explaining the value given to more anthropocentric attributes of forests. Both were positively associated with experiential and production attributes, while negatively associated with natural valued attributes. This confirms the role of contrasting self-transcendent values (e.g. biospheric) and self-enhancement values (e.g. egoistic and hedonistic) in explaining societal differences over forest management (Eriksson *et al.*, 2013).

The inclusion of the core value of security in this study is novel and the first opportunity to see how it influences valuing of forest attributes. Viewed across findings of interviews and the survey, security is a significant explanatory variable for valuing both natural and production attributes of forests, attributes more typically considered as antagonistic. This suggests that the life support functions of forests included among natural attributes are viewed as being important to a secure and stable existence, alongside the livelihood and resource related production attributes. This in turn suggests an important opportunity for communicating the importance of forests to members of the public. Community engagement (through direct experience or media) that emphasizes the life-support role of forests in ensuring a secure society, may engage with people who might otherwise hold quite divergent value orientations.

While biospheric and security core values play a role, an overarching finding of our research is the complexity of relationships between core values and valued attributes of forests. Such complexity has been previously observed by other researchers based on qualitative research alone (Rawluk *et al.*, 2017). Here we confirm and extend this observation, utilizing both qualitative and quantitative strategies. A further example of this complexity can be seen in relation to cultural and experiential attributes of forests. We found these valued attributes were underpinned by both self-transcendent core values (biospheric and altruistic/benevolence values in the survey) and by self-enhancement core values (hedonism in qualitative research, and egoistic values in the survey), with no strong unique contributions evident based on semi-partial correlations. Again, this suggests that these cultural and experiential attributes of forests might present a 'meeting place' for people with diverse value orientations. There are opportunities to design community engagement events that facilitate such shared experience. Consider for example, how opportunities to learn through bird watching in forests might be consistent with principles of nature protection and with personal achievement.

Our research demonstrates that core values help to explain valued attributes of forests in meaningful ways, but it is important to note that only part of variance in valued attributes is explained by core values. Valued attributes of forest are evidently also shaped by factors not measured in this study. This might include beliefs about how forest function and so impact on one's own life (see for example, Williams, 2002). Future research might consider this possibility.

Conclusion

The mixed methods used in this study provide a unique perspective on forest values. By starting with in-depth and personal interviews regarding how forests matter, we have identified a broader range of valued attributes of forests and related core values than typically considered in forest research. Quantitative measurement of these values has then allowed us to reduce the complexity while retaining the breadth of values considered.

Noting the limitations outlined above, we have demonstrated that abstract core values can meaningfully explain the importance given to valued attributes of forests. This supports the contention that an understanding of values at the more abstract level can provide insights into the motivations underlying more specific values attributed to natural forests by members of the public. Consideration of values at both levels of abstraction provides insights that can assist in setting objectives for forest management, establishing priorities, and structuring criteria that can be used in monitoring, evaluation, communication about forest policy and management initiatives and other policy tools in sustainable forest management.

Authors contributions

K.W., L.B., C.N. and R.F. developed the project proposal. N.A. undertook detailed planning of the interviews and the survey with guidance from K.W. and R.F. L.B. and C.N. commented on methods. Data were collected by N.A. and R.F. with support from a survey management company. Data were analysed by N.A. and K.W. Manuscript was written by K.W. and N.A. R.F., L.B. and C.N. commented on and edited drafts.

Conflict of interest statement

None declared.

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