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Using Q Methodology to Explore Risk Perception and Public Concern about Tree Pests and Diseases: The Case of Ash Dieback

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Abstract: This paper seeks to address the need for a more nuanced understanding of public perceptions of risk-related events by investigating the nature of and drivers for a 'concerned public' to an environmental issue, using the case study of the ash dieback outbreak in the UK. Q Methodology, an approach that combines both quantitative and qualitative data through factor analysis to identify different ways of thinking about a particular issue, was used to investigate the subjective response of local publics to ash dieback in East Kent, England, one of the early outbreak locations. Five narratives are identified, distinguishing perceptions of risk and management preferences: (1) call for better biosecurity; (2) resilient nature and techno-scientific solutions; (3) fatalistic; (4) disinterested; and (5) pro-active citizens. Four narratives demonstrated concern about the impacts of ash dieback on woodland ecosystems, but beliefs about whether the disease arrived in the UK on infected imported nursery stock or on windblown spores varied. The results of this study contribute to improving understanding of the drivers of differing public perceptions of tree health risks, an important consideration for designing socially acceptable strategies for managing tree pests and diseases, and other environmental risks, in the future.

Keywords: ash dieback; public concern; Q Methodology; tree pests and diseases; policy; risk communication

1. Introduction

Managing risk is an implicit part of environmental and land-use policy making, including forest management. While risk managers may draw on complex analyses and objective estimates of risk, the public often make risk judgements that are more subjective and based on personal experience or cognitive and affective perceptions [1,2]. Indeed, for policy makers, anticipating what hazards and risks may precipitate amplified public concern is an important dimension of risk management, including understanding why some risks deemed by experts as not significant elicit strong public attention and concern, while others do not [3–5].

Much research in this field has developed from psychometric, sociological and cultural theory approaches that recognise the need to better understand how environmental risks are perceived, experienced and judged by stakeholders and publics most exposed to their effects [6–8]. There is extensive evidence to suggest that how individuals respond to and perceive environmental risks is

likely to be influenced by individual perceptual differences such as environmental beliefs, values, worldviews and demographic factors [8–13]. In this regard, there is an extensive body of literature that asserts that individual and collectively held environmental beliefs are likely to influence how people perceive environmental issues and their management, as well as prompting their own behaviour (Corral-Verdugo et al., 2003; de Groot and Steg, 2007; Hernandez et al., 2000). Here, we refer to the concept of cultural environmental biases or so-called 'myths of nature' (Dake, 1992; Douglas and Wildavsky, 1982; Price et al., 2014). Rooted in cultural theory, Douglas and Wildavsky (1982) posited that people's cultural worldviews or biases act as a lens for how they view the world, determined by their underlying beliefs about the vulnerability or resilience of nature, and the degree to which they support an interventionist approach to management.

Furthermore, personal experience of the impacts of the hazard or the 'availability bias', the ability to relate to or recall a similar hazard, can also influence how people perceive risk [1,14]. For instance, Mase et al. (2015), revealed the extent to which direct personal exposure to unusual weather events shapes how agricultural advisors in the American Mid-West assess the risks of long-term climate change. Alongside this, the degree to which individuals trust institutions responsible for managing risks is important [15,16], with Petts et al. (2001) concluding that trust in risk management institutions involves perceptions about their competence to do the task; objectivity; procedural fairness in decision-making; consistency of approach and empathy.

Across a range of hazard events, 'public concern' is often attributed by policy makers when referring to what they perceive as an amplification of public risk perceptions about a hazard event or particular risk, and is used as a justification for policy action [4,17,18]. In the absence of empirical evidence to determine 'public concern', decision-makers may use heightened media attention as an indicator of public concern [3]. However, media attention is not always a useful barometer for signalling sustained public concern but may, at times, reflect a response to a novel and unknown issue that attracts public attention for a time and then, as it becomes more familiar or normalised, interest fades and moves on to other emerging issues [19]. If, as suggested by Urquhart et al. [3], the attributions made by decision-makers and risk managers about public concern amplify the perceptions of those charged with managing risk events, this may well lead to changes in institutional behaviour in attempts to address the problem [20]. As Fellenor et al. [21] assert, empirical evidence about how the public responds to and perceives hazard events is, therefore, imperative for more effective policy development and strategies for dealing with environmental risks. This paper seeks to address this need for a more nuanced understanding of public perceptions of risk-related events by investigating the nature of and drivers for a 'concerned public' to an environmental issue, using the case study of the ash dieback outbreak in the UK.

Ash dieback is one of a growing number of new invasive pests and pathogens that are threatening trees, woods and forests worldwide [22,23]. An increase in global trade, human movement and climate change has been recognised as key drivers of these outbreaks, with potentially severe impacts on ecosystem services, such as biodiversity and landscape [24]. Recent instances include the mountain pine beetle (*Dendroctonus ponderosae*) epidemic in the USA and Canada, impacting local economies and reducing the carbon sequestration capacity of forests [24,25]; oak processionary moth (*Thaumetopoea processionea*) in the UK, whose caterpillars cause skin and respiratory irritations [26]; and kauri dieback (*Phytophthora agathidicida*), a fungal disease identified in New Zealand in 2009, which is causing extensive loss of kauri trees [27].

Ash dieback is a disease, caused by the fungus *Hymenoscyphus fraxineus*, that is killing ash trees across Europe. The first case of ash dieback in the UK was identified in February 2012 on a consignment of ash saplings imported from the Netherlands [22], a country where ash dieback was already endemic. The subsequent period of intense media attention and public scrutiny raised tree health from an issue of expert and high-level stakeholder concern to a matter of public focus and debate [15,28,29]. The media reporting called into question the UK government's handling of biosecurity risks, claiming that the government failed to prevent the disease entering the UK on infected imported nursery stock and that

Britain's billions of ash trees were now under threat [30,31]. However, modelling undertaken by the University of Cambridge suggested that another route of entry could have been through windblown spores from continental Europe (Wentworth 2012). Whichever way it arrived, the public appeared to be very concerned about the potential decline of a native tree species, with reference made to the loss of elm in the British landscape in the wake of Dutch elm disease in the 1970s. According to Tomlinson [29], ash dieback represented a 'focusing event' which led to a policy shift around tree and plant health beyond dealing with ash dieback itself. There was a renewed focus on tree health and plant biosecurity and a re-assessment of policy, involving the setting up of a Tree Health and Plant Biosecurity Expert Taskforce to advise the government, the development of a plant health risk register and additional research funding. This shift, it seems, was precipitated by a combination of media coverage that ascribed blame to the government for failing to prevent the outbreak, as well as assumptions made by policymakers and government ministers that the public was deeply 'concerned' about tree health risks [32].

Empirical evidence on public perceptions of tree health risks has only begun to emerge in recent years. In the UK, such studies are predominantly associated with large-scale national surveys which identify moderate levels of public concern about tree pests and diseases, particularly in terms of impacts on woodlands and ecosystem services, but very low levels of awareness [33,34]. Other studies on the social acceptability of eradication and control measures provide a public mandate for management of outbreaks rather than a 'do nothing' course of action [35–37]. Such studies provide useful general indicators about the public mood and preferences for action, but their use of aggregated survey data provides little insight into the individual underlying subjective values and beliefs that influence the perceptions of respondents.

For tree health risks, then, a deeper understanding of how publics experience, interpret and respond to tree pest and disease outbreaks is needed to suggest ways in which policymakers and risk managers can better engage with the public based on an understanding of formative processes and underlying values. Some studies look at local responses to tree pest outbreaks, such as Porth et al.'s [38] evaluation of the eradication programme of the Asian longhorn beetle (*Anoplophora glabripennis*) in South-East England and Flint's [39] work in Alaska that suggests that other forest disturbances, such as wildfire, can alter risk perceptions about insect pests. However, there is very little empirical evidence to indicate what publics in an outbreak area are concerned about, if anything, and how their underlying beliefs and values may influence those perceptions.

In order to address this gap, this paper reports a study which aimed to better understand how local publics in East Kent, England, view the ongoing outbreak of ash dieback that is causing extensive mortality of ash (*Fraxineus excelsior*) trees in the UK, and across Europe [40]. East Kent was one of the first areas in the UK affected by ash dieback in 2012, with both newly regenerated and mature trees showing signs of infection. Using Q Methodology, we sought to identify the subjective narratives or points of view that characterise how local publics perceive the risks associated with the ash dieback outbreak and their attitudes towards its management in an area with high infection.

The paper proceeds with a description of the Q Methodology approach adopted, and then a presentation of the results. Finally, we discuss the implications of this study in understanding how people perceive the risks associated with a tree health issue such as ash dieback and implications for consideration of public concern in risk-related policy development.

2. Method: Q Methodology

Q Methodology was developed in psychology to investigate people's 'subjectivity' or 'point of view' [41]. Over the past two decades, it has been applied to explore human perceptions on various environmental risks and land use issues [42–53]. The approach combines both quantitative and qualitative data through factor analysis to identify different ways of thinking about a particular issue. While the results from Q Methodology cannot be considered as representative of wider populations, it allows for a clustering of individual viewpoints around shared attitudes [54], providing insights about

the range of views on a particular topic. It is, therefore, well suited to exploring public opinion of a tree health issue such as ash dieback.

Q Methodology involves asking respondents to sort a set of qualitative statements (the 'Q set'), according to how much they agree or disagree with the statements, onto a ranked grid (Figure 1), the 'Q sort'. The completed Q sorts are then subjected to factor analysis to extract discrete groupings that represent different 'points of view'. For a detailed explanation of Q Methodology, see McKeown and Thomas [55] and Watts and Stenner [56].
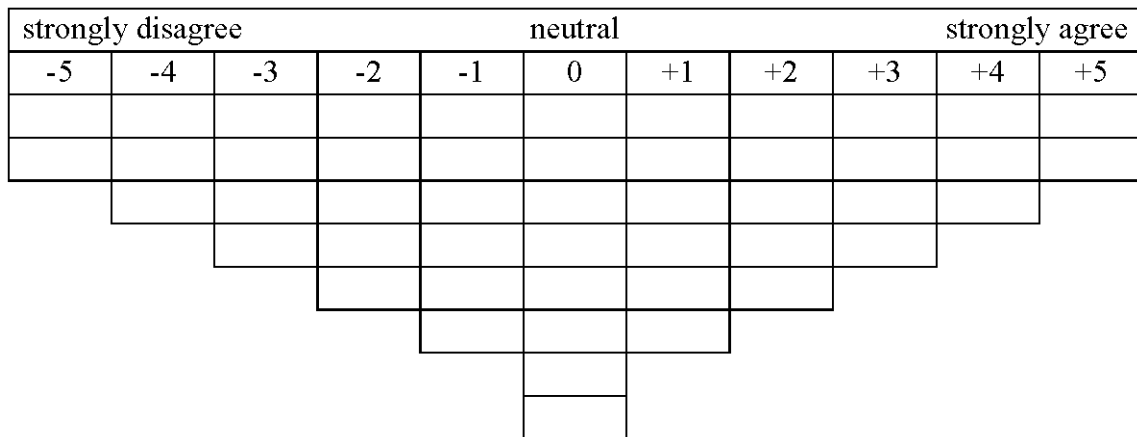

Figure 1. Q sort ranking grid.

Applying Q Methodology

The Q set is typically derived from a larger so-called 'concourse' of statements about the topic. In this case, the initial concourse of 153 statements was compiled from 9 semi-structured interviews with a sample of participants in East Kent and 21 interviews with high-level stakeholders and tree health policymakers across the UK [for further details on these interviews, see [3]. The statements were then sub-divided into categories according to whether each pertained to ash dieback specifically or tree pests and pathogens more broadly. Both positive and negative statements were included across two categories: (i) attitudes towards management and responsibility for the outbreak; and (ii) perceptions of the risks and potential impacts. A final set of 48 statements was selected (see Table 1), following Stainton Rogers' [57] recommendation that there are approximately three times as many statements in the concourse as in the Q set and ensuring a balance between the various categories described above (A 2 × 2 matrix was created to categorise the statements with 12 statements selected for each box; thus, 12 × statements reflecting (i) attitudes towards management and responsibility for ash dieback; (ii) perceptions of the risks and impacts of ash dieback; (iii) attitudes towards management and responsibility for tree pests and pathogens; (ii) perceptions of the risks and impacts of tree pests and pathogens.).

Table 1. Factor arrays representing the exemplifying Q sort for each of five narratives.

No.	Statement	Factor Scores				
		N1	N2	N3	N4	N5
1	I am disappointed that ash dieback was introduced to the UK on infected imported trees.	5	2	0	3	3
2	The Government think the public are more concerned about ash dieback than they really are.	1	2	2	1	0
3	Ash dieback is here to stay so we just have to accept and deal with it.	−4	4	3	−3	0
4	We survived Dutch elm disease and the countryside still looks beautiful and ash dieback will be the same.	−2	2	−3	0	−3
5	Even if ash dieback does affect a lot of ash trees, nature will eventually find a way to recover.	−1	4	1	−2	−1
6	We should tighten up our border controls to stop pest and disease invasions getting into our country.	3	5	0	0	0
7	There needs to be economic incentives in order for people to adopt more biosecure behaviours.	4	0	1	2	3

Table 1. *Cont.*

No.	Statement	Factor Scores				
		N1	N2	N3	N4	N5
8	Organisations such as the Forestry Commission and Defra worry more about their reputation than what tree diseases will actually do.	1	−4	0	−5	−1
9	The Government are not being open about the full extent of the disease threat to our trees and woodland so the public don't really know what is going on.	−1	−2	−2	−2	3
10	The general public always manage to understand issues like tree diseases so there is no real need for the Government to worry too much.	−2	−2	−2	−3	−5
11	I think plant nurseries should be much more responsible about where they source their plants from.	3	3	3	1	2
12	I am not sure what I can personally do about biosecurity and preventing future plant pest and disease outbreaks.	4	−1	−1	5	−3
13	Tree diseases and how to prevent them should be on the national curriculum in schools.	0	0	−3	−1	−1
14	The media have misrepresented the risks from tree diseases and made people worry unnecessarily.	−3	−1	−1	−2	−4
15	I trust information from organisations such as the Woodland Trust or Royal Horticultural Society more than the Government.	−1	−2	1	5	4
16	Experts are much more worried about tree diseases than the public seem to be at the moment.	0	3	−1	3	5
17	We all do things that increase the risk, like bringing plants back from holidays abroad.	−4	0	−2	2	1
18	I am much more likely to worry about tree pests and diseases that threaten the area where I live rather than other places.	−1	−3	−1	4	0
19	Scientific research is bound to find a way to deal with these issues sooner or later.	−2	0	−4	−4	0
20	The real pressure from tree diseases is on the professionals fighting them, not the public.	−3	2	0	−2	0
21	The biggest threat from tree diseases is that they will spoil the way people enjoy the countryside.	−2	−2	0	2	−1
22	We should just accept that tree pests and diseases are going to change the way our countryside looks.	−4	1	−2	−1	−2
23	I don't really care whether tree pests and diseases are likely to have any long-term effects on woodlands and ecosystems.	−5	−5	−5	−1	−5
24	The risk of introducing a new tree pest and disease is the price we pay for being able to trade plants around the world.	−2	−1	0	4	0
25	Trees and woodlands are not resilient enough to cope with the increasing number of pest and disease outbreaks.	2	−3	4	0	−1
26	The most crucial factor is getting the public involved in helping to stop tree diseases spreading any further.	1	0	1	2	2
27	Sound science, not a media frenzy, is the best way to tackle tree diseases.	5	4	5	4	1
28	All our trees are under threat from new diseases, thanks to climate change.	−1	−4	4	1	3
29	Tree disease is more of a problem in the UK than most other countries.	−1	−4	−1	0	−3
30	It is reassuring to know that there is a programme of work to identify disease tolerant varieties of ash to replant in the future.	2	5	4	1	4
31	There was nothing we could do about ash dieback arriving in the UK because it was blown in on the wind from Europe.	0	3	5	0	−4
32	I feel like the Government is not telling us the whole story about ash dieback.	1	−1	−3	−3	0
33	Before ash dieback I don't think the Government took tree health risks seriously enough.	4	−2	2	−1	2
34	Ash dieback is spreading because people who work with trees aren't following regulations properly and are transporting ash dieback from place to place.	1	−3	−4	−2	2
35	I try to make a note of any ash trees in the local area that seem to be tolerant of ash dieback.	0	0	0	−5	4
36	Ash dieback is sad but it's not really something I can do anything about.	−3	−1	0	1	−3
37	Most of what I know about ash dieback is from the news media.	0	−3	−4	1	−2
38	The Government really dithered over what to do about ash dieback.	0	−1	−3	0	2
39	The threat of ash dieback doesn't really bother me much.	−5	−5	−5	3	−4
40	Ash dieback is just another tree disease the Government has to deal with and there are hundreds more on the horizon.	0	0	2	0	1
41	I am more concerned about ash dieback now that I can see the effect it is having on trees in my local area.	2	1	3	−1	1
42	The public response to ash dieback demonstrates how much the British public value trees and woodlands.	2	1	2	2	1
43	Ash dieback makes me sad because some of my childhood memories are associated with ash trees or ash woodlands.	1	1	−2	−4	−2

Table 1. *Cont.*

No.	Statement	Factor Scores				
		N1	N2	N3	N4	N5
44	Reading about ash dieback in the media made me feel that this is a serious issue.	2	1	2	0	−2
45	People interested in the countryside are more likely to be concerned about ash dieback.	3	3	1	3	5
46	Ash dieback has been useful because it has raised awareness that we need better biosecurity in the UK.	3	1	3	−3	1
47	The loss of ash is going to be so gradual that people probably won't really notice it.	−3	0	−1	−4	−1
48	The biggest impact of ash dieback will be the cost to local authorities of dealing with dangerous diseased trees.	0	2	1	−1	−2

Note: −5 = strongly disagree; 5 = strongly agree. Factor scores represent those of the 'ideal' Q sort for each factor): N1 = Call for better biosecurity; N2 = Resilient nature and techno-scientific solutions; N3 = Fatalistic; N4 = Disinterested; and N5 = Pro-active citizens.

Twenty-two participants completed a Q sort, in line with Webler et al. [58] who recommend that there should be fewer Q participants than Q statements, with the highest ratio being 1:2. To purposively select participants for this study, we first identified the range of stakeholder organisations and publics that may have an interest in ash dieback in East Kent. The criteria were that they should have been, or have the potential to be, affected by ash dieback (e.g., infected trees on land) or have responsibility for managing trees or woodlands at risk from ash dieback. The list of potential participant groups was compiled based on the project team's extensive experience of working within the tree health domain, supplemented by an internet search (using the key terms 'ash dieback' and 'chalara' (The scientific name for fungus which causes ash dieback was formerly Chalara fraxinea, with the disease often referred to as 'Chalara'. It was re-named Hymenoscyphus fraxineus in 2014.) and preliminary qualitative interviews with stakeholders in the study area. The final list of four groups represented (i) local residents who may have ash trees in their garden or encounter ash trees through their recreational activities (n = 9); (ii) woodland owners (n = 3); (iii) local businesses directly affected (e.g., wood fuel suppliers, forestry consultants) (n = 2); and (iv) public space managers and tree/woodland officers (n = 8). Depending on availability, between 2 and 6 participants were included from each of the five participant groups. Potential participants were initially contacted by email, with the Q sorts undertaken in person with the first author between November 2016 and February 2017. The participants were asked to sort the statements onto a Q grid in the form of a quasi-normal distribution (Figure 1) with an 11-point scale from strongly disagree (−5) to strongly agree (+5). The constraints of the grid meant that participants had to rank each statement in relation to the others. On completion, participants were asked to explain their reasons for sorting the statements, particularly those statements located at the extreme ends of the scale (i.e., −5, −4, +4, +5). This debriefing session was recorded as written notes by the researcher and used to qualitatively supplement the statistical analysis to describe the emergent narratives by providing insight into the subjective interpretation of statements.

The ranked statements were analysed using the free software package PQMethod to undertake a factor analysis involving Principal Components Analysis, followed by a Varimax rotation. A solution of five factors was produced as the most plausible to group the rankings. Each factor represents a cluster of participants sharing similar opinions with factor loadings indicating the association of each participant with each factor [59]. See Table S1 in the Supplementary Material for details on the analytical process that resulted in this solution.

After controlling the weighting of each of the factor loadings, an exemplifying Q-sort was produced for each of the factors. Based on these exemplifying Q sorts, interpretation involves describing each factor's 'point of view' based on the distinguishing statements that are associated with each factor, as well as the highest and lowest ranking statements [56].

In addition to the statistical analysis of the Q sorts, the qualitative data collected as part of the nine preliminary interviews with residents and stakeholders (interview transcripts), and the debrief interviews with each of the Q sort respondents (interviewer notes), were analysed thematically. The transcripts and notes were coded manually, specifically around the 'points of view' that emerged from the Q sort analysis but also with a view to identifying if any further perspectives were expressed.

Next, the qualitative data were used to corroborate the emergent Q sort narratives. In the following section, we present the interpretation of the five factors that emerged from the analysis.

3. Results

The five factors (hereafter 'narratives'), based on the 48 statements in Table 1, represent discrete viewpoints or subjective perceptions about ash dieback and tree health, typified as: (N1) Call for better biosecurity; (N2) Resilient nature and techno-scientific solutions; (N3) Fatalistic; (N4) Disinterested; and (N5) Pro-active citizens. Weighted averaging is used to calculate statement scores, which are then transformed back into whole-number scores (+5, −5 etc.) for interpretation (Valenta and Wigger 1997). These narratives explained 65% of the variance among the 22 Q sorts and represent the opinions of 19 participants (see Table S3 in Supplementary Material). Three participants did not load onto any narrative.

Of the 22 Q participants, four loaded on N1, 8 on N2, 3 on N3; 1 on N4 (Although it is desirable to have >1 participant loading on a factor, the characteristics and sort of N4 are distinct from the other factors and represent a unique point of view, thus it was retained.); and 4 on N5 (see Table S3 in Supplementary Material). Each narrative is labelled with a descriptive name that best describes the dominant characteristics or viewpoint of that narrative. While there is some overlap between the narratives in terms of their key attitudes or perceptions, there are also a number of distinguishing differences, which are highlighted in the interpretation.

A description of each narrative follows, drawing on the exemplifying Q sorts (Figure 2), the distinguishing statements for each narrative, individual participant factor loadings (Table S3, Supplementary Material), the participant characteristics (Table S2, Supplementary Material) and qualitative debrief data. Of the 48 statements, five can be classed as 'consensus statements' (indicated in bold in Figure 2—statements 2, 11, 26, 40, 42). These represent statements that do not distinguish between any pair of factors. Of note is agreement that plant nurseries should be more responsible about where they source plants from (statement 11) and that the public response to ash dieback demonstrates how much the public value trees and woodland (statement 42).

					Q sort values					
-5	-4	-3	-2	-1	0	+1	+2	+3	+4	+5

N1: Call for better biosecurity

-5	-4	-3	-2	-1	0	+1	+2	+3	+4	+5
39	17	14	4	5	13	**2**	25	6	7	1
23	22	20	10	9	16	8	30	**11**	12	27
	3	36	19	15	31	32	41	46	33*	
		47	21	18	35	34	**42**	45		
			24	28*	37	43	44			
				29	38	**26**				
					40					
					48					

N2: Resilient nature and techno-scientific solutions

-5	-4	-3	-2	-1	0	+1	+2	+3	+4	+5
23	8	18	9	12	7	22	1	**11**	3	6
39	28**	25*	10	14	13	41	**2**	16	5**	30*
	29	34	15	24	17	**42**	4	31*	27	
		37	21	32	19	43	20*	45		
			33	36	**26**	44	48			
				38	35	46				
					40					
					47					

Figure 2. *Cont.*

N3: Fatalistic

23	19	4	9	12	1	48	**2**	**11**	25	27
39	34	13	10	14	6	5*	33	41	28*	31**
	37*	32	17	16	8	7	**40**	46	30	
		38*	22	18	20	15	**42**	3		
			43	29	21	**26**	44			
				47	24	45				
					35					
					36					

N4: Disinterested

8	19	3	5	13	4	**2**	7	1	18**	12
35**	43	10	9	22	6	**11**	17	16	24*	15
	47	32	14	23**	25	28	21	39**	27	
		46**	20	33	29	30	**26**	45		
			34	41	31	36	**42**			
				48	38	37				
					40					
					44					

N5: Pro-active citizens

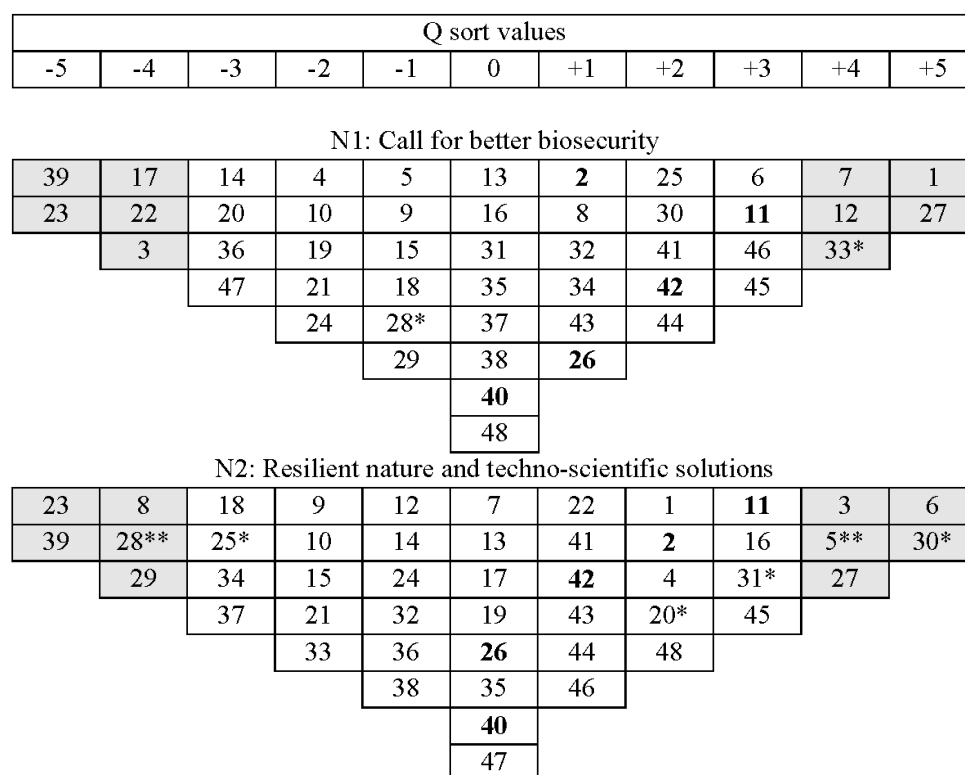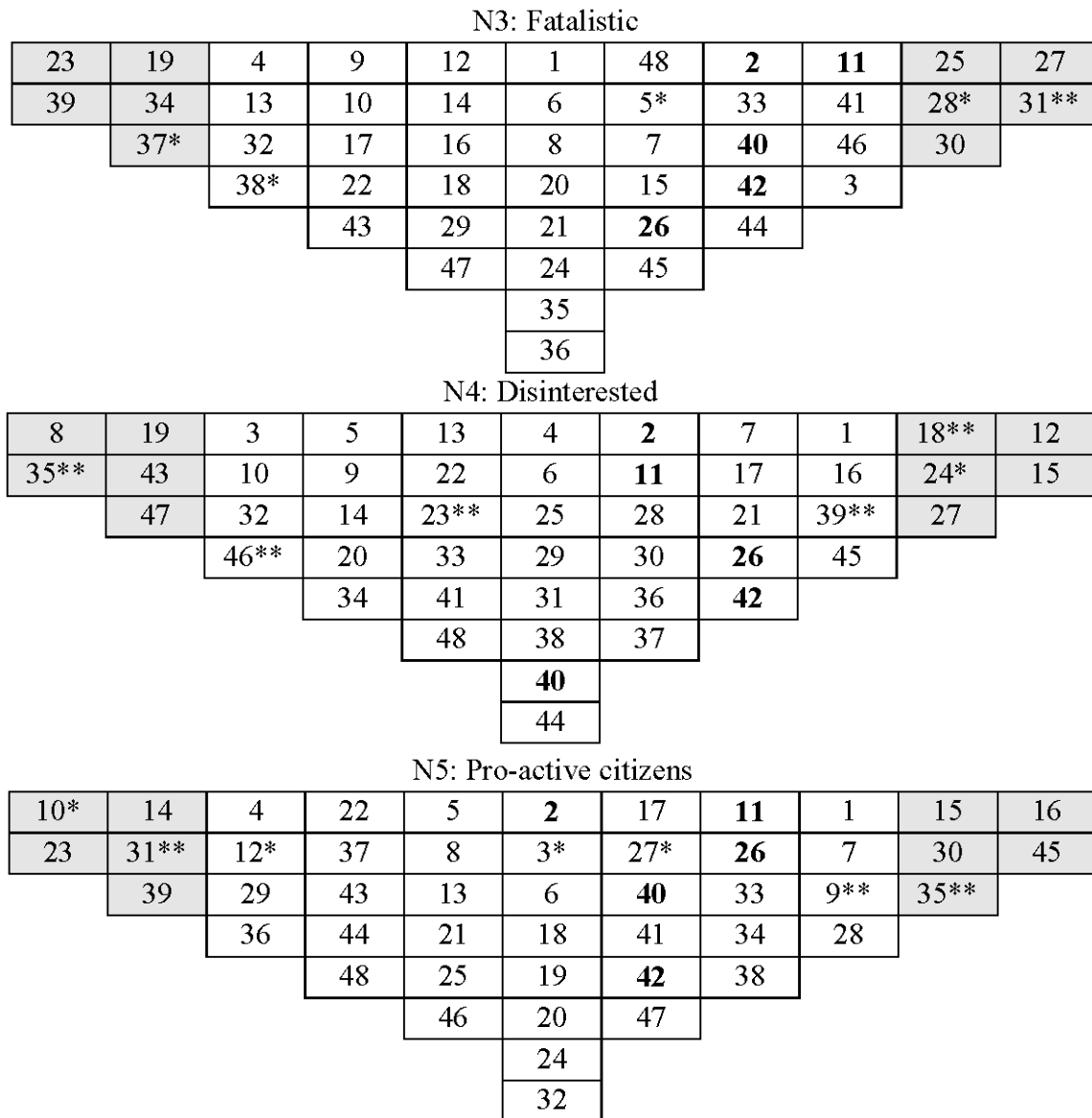|										
10*	14	4	22	5	**2**	17	**11**	1	15	16
23	31**	12*	37	8	3*	27*	**26**	7	30	45
	39	29	43	13	6	**40**	33	9**	35**	
		36	44	21	18	41	34	28		
			48	25	19	**42**	38			
				46	20	47				
					24					
					32					

Figure 2. Exemplifying Q sorts for narratives about tree health which represent the 'ideal' sort for each factor. The 10 most important statements in each narrative (−5, −4, +4, +5) are highlighted in grey. Consensus statements are in bold. Distinguishing statements are marked * for $p < 0.05$ and ** for $p < 0.01$.

3.1. N1: Call for Better Biosecurity

As shown in Table S3, participants P1, P4, P6 and P8 comprise N1. The exemplifying Q sort for N1 (Figure 2) identifies that this narrative represents a belief that the government did not take tree health risks seriously enough before ash dieback (+4). Participants who loaded highly on this narrative include a retired inspector who checked imports of fruit and vegetables at Dover (P1). This participant was quite critical of the government's approach to handling pest and disease outbreaks, based on his personal observations of the difficulties of adequately inspecting the large volume of imports. A further participant (P8), the chairman of a local association, with an infected tree in his garden, indicated that he does not trust the government at all. The concerns of the other two participants (P4 and P6), both involved in protected area management, were around impacts on landscape and ecosystems, but they also felt strongly that the government should have acted earlier to prevent ash dieback from reaching the UK. This narrative is further distinguished by a belief that something should be done to prevent future outbreaks, although they are unsure what they can do personally. Similarly, they feel that

the UK should not just accept ash dieback and other diseases but should be proactive in preventing future incursions, as woodlands are not resilient enough to cope with pests and diseases. They feel that there is a need for action and support increased border controls, plant nurseries taking a more responsible approach to importing plants and the provision of economic incentives. As with N4 and N5, participants who load on this narrative are likely to believe that ash dieback was imported to the UK on infected plants (and are disappointed that this happened).

3.2. N2: Resilient Nature and Techno-Scientific Solutions

As shown in Table S3, participants P2, P5, P7, P13, P14, P16, P18 and P22 comprise N2, including two rangers, two residents, two woodland owners, a land manager and a professional gardener. This narrative (Figure 2) does not think that climate change is a factor in the spread of pests and diseases, but they believe nature is resilient and will recover in time, although it may need a helping hand from science. In the debriefing session, most of the participants spoke about their lack of knowledge about the issues, but trusted the experts/scientists to deal with it appropriately, supporting scientific work to identify tolerant varieties of ash to replant in the future. For the woodland owners who loaded on this narrative (P13, P18), there were concerns about what replacement tree species are available for their lost ash trees. While this narrative places trust in science to find the answers, participants also felt that there should be better border controls. Although they believe that ash dieback was imported on infected plants, they also agree that it was blown into the UK and so there was little that could be done to prevent its arrival. In this regard, a number of participants (P2, P5, P16) demonstrated a fatalistic approach in the debriefing sessions, indicating that as the disease is already here, we should just accept it. This view aligns with that of N3 and, indeed, P16 also loaded highly on this factor. Further, N2 shares three distinguishing statements (5, 31 and 28) with N3, highlighting both shared and divergent opinions between these two groupings. While both narratives agree that ash dieback was blown in on the wind from Europe, N3 also believes that climate change is likely to play a part, while N2 doesn't. N2 feels more strongly than N3 that nature is resilient and will recover.

3.3. N3: Fatalistic

As shown in Table S3, participants P3, P9 and P16 comprise N3, including a resident, an environmental consultant and a government forestry officer. This narrative (Figure 2) shared a strong opinion that it was not possible to prevent ash dieback arriving in the UK because it was blown in from Europe, with climate change being a contributing factor. Participants loading on this narrative are unlikely to get information about tree health issues from the news media. Their disagreement with the statement about the government not acting early enough is likely a reflection of their view that the pathogen was blown in, so there was nothing the government could do to prevent it. Thus, they believe we should just accept it and deal with the impacts. They are unsure whether nature is resilient enough to recover but believe that science can help and are reassured that there is a programme of work to identify tolerant varieties of ash, even though science may not have all the answers. This narrative shares three distinguishing statements with N2 (5, 28 and 31), although a key difference between the two is their attitude towards the role of climate change (statement 28). While N2 did not feel that climate change was an issue for tree pests and disease outbreaks, N3 strongly agreed with this statement.

3.4. N4: Disinterested

Participants who load highly on this narrative are likely to have very little knowledge about or interest in ash dieback or tree health more broadly. As shown in Table S3, only one participant, P20, loaded highly on N4. P20 was an employee at a district council who had only come across ash dieback through processing Tree Preservation Orders and other conservation issues. This was the only participant who agreed with the statement "The threat of ash dieback doesn't really bother me much". As illustrated in Figure 2, this respondent was concerned about local impacts, although accepted the

risk of introducing new pests and diseases as a price worth paying for the global trade in plants. A lack of concern was displayed by a strong negative response to the statement about making a note of diseased trees in the local area. Indeed, P20 indicated a lack of knowledge of how to identify an ash tree or one with ash dieback disease. N4 is ambivalent about the impacts of pests and diseases on woodlands and ecosystems. Although there is likely to be more trust in information from charitable organisations such as the Woodland Trust or the Royal Horticultural Society (RHS) than government agencies, P20 felt that the government had been open about the issue.

3.5. N5: Pro-Active Citizens

As shown in Table S3, participants P10, P12, P15 and P19 comprise N5 and included a public space manager, forester and two woodland owners. Figure 2 identifies that this narrative shared a willingness to actively play their part in dealing with the outbreak by making a note of trees in their area that appear tolerant. They feel that the government has not been open about the threat and, therefore, the public do not fully understand the issues. Further, they trust information from the Woodland Trust or RHS more than notifications from the government. They believe that ash dieback was imported on infected plants, rather than being blown in. While they find it reassuring that scientific research is being undertaken to identify tolerant variants of ash for the future, they recognise that science is unlikely to provide all the answers. They feel that people interested in the countryside are more likely to be concerned about ash dieback, as are experts rather than publics. In the debriefing sessions, the participants who loaded highly on this narrative indicated that citizens have a role to play in biosecurity, whether as individuals themselves, or as part of a collective effort by the wider general public. One participant (P10), a manager of public space, suggested that there is a lack of broad understanding amongst the public about trees in particular (e.g., most people wouldn't be able to recognise an ash tree) and nature more broadly. This respondent felt that unless people are aware of or value something then its loss is unlikely to be of high concern to them.

4. Discussion

Understanding the perceptions of the public towards the risks posed by a series of new invasive tree pests and pathogens, such as ash dieback, is important for the development of socially acceptable management strategies and informing risk communication about tree health. We, therefore, used Q Methodology to investigate the public perceptions of ash dieback in East Kent, an area where the pathogen is well established and its impact is becoming visible in the landscape. The analysis revealed five distinct patterns of thought, or narratives: one that is concerned about preventing future outbreaks (N1); one that believes nature is resilient and, with help from science, will cope (N2); one that is pessimistic about future tree health (N3); one that demonstrates a lack of concern or interest in tree health (N4); and one that is locally aware and active (N5). These distinct narratives provide insight into the subjective viewpoints of individuals that are aligned to beliefs about how ash dieback arrived in the UK and underlying beliefs about the vulnerability or resilience of nature.

4.1. Pathway of Introduction and Degree of Acceptance

From the analysis, the narratives coalesced around beliefs about how ash dieback entered the UK (Figure 3). Consequently, there was an association between beliefs about how ash dieback arrived and the extent to which participants thought 'we should just accept it'. In general, participants who believed that ash dieback blew in (N3), or is likely to have blown in as well as being imported (N2), and thus could not be prevented by border controls, took a fatalistic approach of 'it is here now so we just have to accept it'. Conversely, participants who believe it was imported on infected plants (N1) do not think we should just accept it but should be active in managing the outbreak and preventing future pest and disease incursions, although N5 is unsure about whether we should just accept it. Those who load highly on N5 are, however, active in their local area trying to identify tolerant ash trees, indicating engagement with the issues.

Belief that ash dieback was blown in on wind
• N3 Fatalistic

Belief that ash dieback was blown in & imported
• N2 Resilient nature & techno-scientific solutions

Belief that ash dieback was imported on infected saplings
• N1 Call for better biosecurity • N4 Disinterested • N5 Pro-active citizens
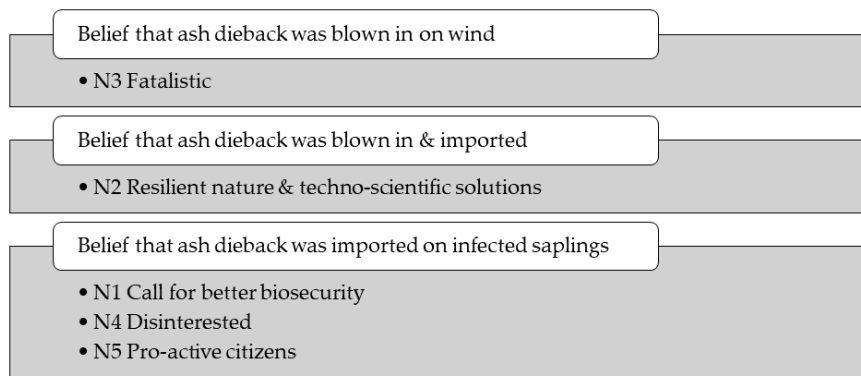
Figure 3. Narratives associated with beliefs about pathways of introduction.

In contrast to media analyses which highlight government blame for failing to prevent ash dieback from being imported to the UK [30,60], trust (or distrust) in public authorities was not a major influencing factor for most narratives and many respondents were largely ambivalent about the government's role in ash dieback introduction. That being said, respondents aligned with N1 (Call for better biosecurity) had little trust in the public authorities responsible for managing risks to tree health and considered failings in biosecurity measures as responsible for allowing ash dieback to be imported on infected nursery stock. N1, along with N5, identified a need for collective action, involving environmental non-governmental organisations (NGOs), voluntary behaviour on the part of the horticultural sector, and individual behaviour change to minimise the risk of new incursions.

4.2. Environmental Biases

The findings suggest that an important determinant of tree health risk perceptions and their views about how outbreaks and broader biosecurity should be managed, may be related to people's underlying beliefs about the resilience or vulnerability of nature (see Table 1, statements 5 and 25). Firstly, the N2 narrative (Resilient nature and techno-scientific solutions) aligns with a view that nature is resilient and will recover from the impact of pests and diseases over time, with proper regulation and input from science. Thus, individuals that align with the N2 narrative will support an interventionist approach to management, with a call for better biosecurity regulation and support for technological solutions to moderate perverse effects. N2 trusted that technological solutions and regulation of the plant trade would be sufficient to protect the country from the negative impacts of future incursions.

Conversely, the N3 narrative (Fatalistic) sees nature as vulnerable and takes a pessimistic view of nature's ability to deal with the increasing number of tree pests and diseases. Further, with a perception that ash dieback blew into the country via windblown spores and is exacerbated by climate change, individuals aligned with N3 are unlikely to express strong support for management and may well see it as a waste of limited resources. However, there was support from N3 for scientific work to identify tolerant strains of ash, in order to mitigate the impacts of what they perceive as an inevitable decline of ash over the coming decades.

For narratives N1, N4 and N5, the ability of nature to recover from shocks such as tree pests and diseases was less of an influencing factor in how they perceived tree health risks. For N4, individual freedoms, in the form of maintaining global trade and the associated economic benefits, were valued over the increased risk in pest and disease incursions. However, the N4 narrative displayed more concern for local rather than more dispersed environmental issues, reflecting Lima and Castro's [61] assertion that because those with such an 'individualist' worldview "are not as alarmed by global threats as the other groups, it seems as if they can be focused in local issues" (p. 33).

4.3. Expressions of 'Public Concern'

N1, N2, N3 and N5 represent discrete views that all coalesce around concern about ash dieback or tree pests and diseases more broadly. Only one participant (P20) loaded on N4, representing a point of

view that is not interested in ash dieback or tree health. Two statements were frequently sorted in the −5 or −4 columns by the 'concern' narratives (N1, N2, N3, N5): "The threat of ash dieback doesn't really bother me much" and "I don't really care whether tree pests and diseases are likely to have any long-term effects on woodlands and ecosystems" (Table 2). The positioning of these statements in the 'strongly disagree' column of the Q grid suggests that the majority of participants are 'concerned' about the impacts of ash dieback, especially in terms of their ecological impacts.

Table 2. Factor array for statements of 'concern'.

		N1	N2	N3	N4	N5
39	The threat of ash dieback doesn't really bother me much	−5	−5	−5	3	−4
23	I don't really care whether tree pests and diseases are likely to have any long-term effects on woodlands and ecosystems	−5	−5	−5	−1	−5

Clearly our sample frame, in terms of both participants and statements presented, will influence the sort of responses that we got. Given that the majority of participants had some interest in or knowledge of ash dieback, it is perhaps unsurprising that most could be classed as 'concerned'. However, participant P20 suggests that there is a broader set of lay publics who may have very little knowledge about tree health issues or biosecurity (see, for instance, [33]).

However, as we proposed in the introduction, 'public concern' is unlikely to be a homogeneous or static concept. In the preliminary interviews, a number of respondents spoke about how they rationalised their response to the outbreak over time. One resident in the area indicated that when s/he first read about ash dieback in the media "I felt worry and irritated. Worried because it's here and . . . we went through the Dutch elm thing and that was very worrying . . . ash is one of the commonest trees we have. And so the irony of the whole lot dying would leave vast areas of blighted country." However, this respondent went on to indicate they felt the media attention, which suggested people would be unable to visit woodlands and foresters would be out of business, was an overreaction and that "to start with I was concerned, and not too sure about it and as I learnt more and more about it . . . the concern is easing off a bit with the efforts to counter it." Another resident also referred to Dutch elm disease, but took a pragmatic view: "We survived Dutch elm disease and the countryside still looks beautiful, so it's not the end of the world." However, s/he went on to express certain concerns: "It's a super tree and it's got a lot of uses, the wood has, and it's part of the landscape. So there was a degree of concern but not quite as much as with elm." These examples suggest that, while perceptions about ash dieback were likely to have been framed initially in response to media coverage about a new and unknown tree disease, concerns may attenuate over time as the impacts are rationalised, often by comparing to similar events in the past (e.g., Dutch elm disease) and they perceive an appropriate policy and management response to minimize the negative impacts.

5. Conclusions

The broad purpose of this paper was to understand better the nature of public concern and its relation to improved policy development. By exploring the subjective viewpoints of local publics to a tree disease outbreak, we have begun to reveal the complex drivers influencing how people respond to an environmental risk event.

The use of Q Methodology in this study provided an approach to take subjective perceptions into account and suggests that it is necessary for policymakers and risk communicators attending to 'public concern' to recognise the diversity of attitudes, beliefs and likely behaviours of a heterogeneous public. While the concept of public concern is pivotal in the risk literature and influential in informing policy development and responses to hazard events, it is often presented as an unproblematic and homogeneous object [21]. Doing so fails to consider the multiple and subjective ways in which individuals respond to risk events. For instance, in the ash dieback case, there were diverse opinions about the impacts and management of tree pest and disease outbreaks, alongside expressed views

about the prevention of future incursions. Previous outbreaks (e.g., Dutch elm diseases) were called upon to make sense of a new hazard, along with underlying environmental worldviews and attitudes that shape risk perceptions and acceptability of likely strategies for preventing future outbreaks. As Kahan [62] suggests, such narratives or 'cultural cognitions' "cause people to interpret new evidence in a biased way that reinforces their predispositions" (p. 296), influencing their behaviour and what they believe.

Given the relationship between public concern and managing environmental risks, we suggest that a deeper understanding of the heterogeneous ways that people interact with such risks is crucial, both for providing empirical evidence on which to base policy and responses to risk events, but also in terms of how risks are communicated to the public. Our findings concur with other critics of the 'deficit model' that simply communicating scientific facts in the belief that the more knowledge the public have, the more supportive of government policy they will be, is ineffective and fails to recognise that citizens are not passive receivers of information [63–65]. For instance, if there is a relationship between underlying beliefs about nature and public perceptions of the risks to tree health, communication that simply presents scientific data without consideration of how calls for behaviour change may threaten underlying values is unlikely to succeed. Whilst some narratives may be more predisposed to support collective societal behaviour change (e.g., N5 and N4), others may be resistant, rationalising action as pointless and ineffective (N2).

Therefore, risk management and risk communication must tailor messages to these different public viewpoints if they are to be effective. For instance, individuals aligning with N5 (Pro-active citizens) recognise that all citizens have a role to play and are likely to have an interest in the countryside already. Thus, communication should seek to inform them about biosecure behaviours and they should be valued as engaged partners and encouraged to act as champions. However, there is a need to build this group's confidence and trust in the government, and NGOs could provide useful gatekeepers in this regard. Communication that seeks to build trust in the government is also needed for N1 (Call for better biosecurity) and should demonstrate how the government is improving biosecurity, border controls and working with the nursery sector. Alongside this, while N1 recognises a need to protect against future incursions, this group is unsure what they can do personally so communication should encourage a partnership approach with practical suggestions for what individuals can do. In contrast, N2 (Resilient nature and techno-scientific solutions) takes a technocentric view and has confidence that science and management, along with nature's own ability to bounce back, will ensure the sustainability of trees and woodlands into the future. Communication should reinforce this confidence and highlight scientific successes and progress. N2 individuals are pragmatic, recognising that once a disease like ash dieback has established, it is unlikely to be eradicated, thus the focus should be on the prevention and detection of pests and diseases not yet present in the UK. N3 (Fatalistic) is pessimistic, believing that climate change will exacerbate new outbreaks. Communication should, therefore, educate about progress in biosecurity and that not all incursions are inevitable or unpredictable, stressing that everyone has a role to play in minimizing the risk of new outbreaks.

To conclude, the results of this study can contribute to planning more socially acceptable policies and risk management strategies that take publics' subjective perceptions into account, rather than attributing public concern based on a period of heightened media coverage. Further, an important conclusion for policy is designing public engagement and communication programmes in such a way that they speak to diverse public opinions, manage expectations and enhance recognition of the challenges faced by biosecurity policy makers and outbreak managers. While this study has gone some way to shed light on the subjective viewpoints of individuals in the case of one tree disease outbreak, further work that seeks to develop a better understanding of the underlying cultural determinants of public perceptions of environmental risks more broadly is necessary in order to manage societal expectations and influence behaviour change as new tree pest and disease outbreaks emerge.

References

1. Science Communication Unit. *Science for Environment Policy Future Brief: Public Risk Perception and Environmental Policy*; Report produced for the European Commission DG Environment; University of the West of England: Bristol, UK, 2014.

2. Kasperson, R.E.; Renn, O.; Slovic, P.; Kasperson, J.X.; Emani, S. Social Amplification of Risk: The Media and public response. In *Waste Management '89: Waste Processing, Transportation, Storage, and Disposal. Vol J: High-level Waste and General Interest*; Post, R.G., Ed.; University of Arizona Press: Tuscon, AZ, USA, 1989; Volume 1, pp. 131–135.

3. Urquhart, J.; Potter, C.; Barnett, J.; Fellenor, J.; Mumford, J.; Quine, C.P. Expert risk perceptions and the social amplification of risk: A case study in invasive tree pests and diseases. *Environ. Sci. Policy* **2017**, *77*, 172–178. [CrossRef] [PubMed]

4. Busby, J.; Duckett, D. Social risk amplification as an attribution: The case of zoonotic disease outbreaks. *J. Risk Res.* **2012**, *159*, 1049–1074. [CrossRef]

5. Kasperson, R.E.; Renn, O.; Slovic, P.; Brown, H.S.; Emel, J.; Goble, R.; Kasperson, J.X.; Ratick, S. The Social Amplification of Risk: A Conceptual Framework. *Risk Anal.* **1988**, *8*, 177–187. [CrossRef]

6. Slovic, P. Perception of risk. *Science* **1987**, *236*, 280–285. [CrossRef] [PubMed]

7. Clarke, L. *Acceptable Risk: Making Decisions in a Toxic Environment*; University of California Press: Berkeley, CA, USA, 1989.

8. Douglas, M.; Wildavsky, A. How Can We Know the Risks We Face?: Why Risk Selection Is a Social Process? *Risk Anal.* **1982**, *2*, 49–51. [CrossRef]

9. de Groot, J.I.M.; Steg, L. Value orientations and environmental beliefs in five countries. *J. Cross-Cult. Psychol.* **2007**, *38*, 318–332. [CrossRef]

10. Corral-Verdugo, V.; Bechtel, R.B.; Fraijo-Sing, B. Environmental beliefs and water conservation: An empirical study. *J. Environ. Psychol.* **2003**, *23*, 247–257. [CrossRef]

11. Hernandez, B.; Suarez, E.; Martinez-Torvisco, J.; Hess, S. The study of environmental beliefs by facet analysis: Research in the Canary Islands, Spain. *Environ. Behav.* **2000**, *32*, 612–636. [CrossRef]

12. Dake, K. Myths of nature: Culture and the social construction of risk. *J. Soc. Issues* **1992**, *48*, 21–37. [CrossRef]

13. Price, J.C.; Walker, I.A.; Boschetti, F. Measuring cultural values and beliefs about environment to identify their role in climate change responses. *J. Environ. Psychol.* **2014**, *37*, 8–20. [CrossRef]

14. Eiser, J.R.; Bostrom, A.; Burton, I.; Johnston, D.M.; McClure, J.; Paton, D.; van der Pligt, J.; White, M.P. Risk interpretation and action: A conceptual framework for responses to natural hazards. *Int. J. Disaster Risk Reduct.* **2012**, *1*, 5–16. [CrossRef]

15. Urquhart, J.; Barnett, J.; Fellenor, J.; Mumford, J.; Potter, C.; Quine, C.P. The social amplification of tree health risks: The case of ash dieback disease in the UK. In *The Human Dimensions of Forest and Tree Health: Global Perspectives*; Urquhart, J., Marzano, M., Potter, C., Eds.; Palgrave-Macmillan: London, UK, 2018.

16. Burns, W.J.; Slovic, P.; Kasperson, R.E.; Kasperson, J.X.; Renn, O.; Emani, S. Incorporating Structural Models into Research on the Social Amplification of Risk: Implications for Theory Construction and Decision Making. *Risk Anal.* **1993**, *13*, 611–623. [CrossRef]

17. Fellenor, J.; Barnett, J.; Potter, C.; Urquhart, J.; Mumford, J.; Quine, C.P.; Raum, S. 'I'd like to report a suspicious looking tree': Public concern, public attention and the nature of reporting about ash dieback in the UK. *Public Underst. Sci.* **2018**. [CrossRef] [PubMed]

18. McDermont, M. Acts of translation: UK advice agencies and the creation of matters-of-public-concern. *Crit. Soc. Policy* **2013**, *33*, 218–242. [CrossRef]

19. Downs, A. Up and down with ecology—The 'issue-attention cycle'. *Public Interest* **1972**, *28*, 38–50.

20. Smith, D.; McCloskey, J. Risk and Crisis Management in the Public Sector: Risk Communication and the Social Amplification of Public Secctor Risk. *Publicy Money Manag.* **1998**, *18*, 41–50. [CrossRef]

21. Fellenor, J.; Barnett, J.; Potter, C.; Urquhart, J.; Mumford, J.; Quine, C.P. "Real without being concrete": The ontology of public concern and its significance for the Social Amplification of Risk Framework (SARF). *J. Risk Res.* **2019**. [CrossRef]

22. Boyd, I.L.; Freer-Smith, P.H.; Gilligan, C.A.; Godfray, H.C.J. The Consequence of Tree Pests and Diseases for Ecosystem Services. *Science* **2013**, *342*, 823–831. [CrossRef]

23. Freer-Smith, P.; Webber, J. Tree pests and diseases: The threat to biodiversity and the delivery of ecosystem services. *Biodivers. Conserv.* **2015**, *26*, 3167–3181. [CrossRef]

24. Potter, C.; Urquhart, J. Tree disease and pest epidemics in the Anthropocene: An analysis of drivers, impacts and policy responses in the UK. *For. Policy Econ.* **2017**, *79*, 61–68. [CrossRef]

25. Carroll, A.L.; Régnière, J.; Logan, J.A.; Taylor, S.W.; Bentz, B.; Powell, J.A. *Impacts of Climate Change on Range Expansion by the Mountain Pine Beetle*. *Natural Resources Canada, Canadian Forest Service*; Pacific Forestry Centre: Victoria, BC, Canada, 2006; p. 20.

26. Potter, C.; Bayliss, H.; Tomlinson, I.; Leather, S. *Oak Processionary Moth in the UK: Lessons from the London Outbreak*; Final report for Defra; Imperial College London, Birkbeck College London, Harper Adams University: Newport, UK, 2014.

27. Ministry for Primary Industries. *Kia toitū he kauri. Keep Kauri Standing: New Zealand's Strategy for Managing Kauri Dieback Disease*; Ministry for Primary Industries: Wellington, New Zealand, 2014.

28. Mumford, J.D. Biosecurity management practices: Determining and delivering a response. In *Biosecurity: The Socio-Politics of Invasive Species and Infectious Diseases*; Dobson, A., Barker, K., Taylor, S., Eds.; Routledge: London, UK, 2013.

29. Tomlinson, I. The discovery of ash dieback in the UK: The making of a focusing event. *Environ. Politics* **2016**, *25*, 709–728. [CrossRef]

30. Fellenor, J.; Barnett, J.; Potter, C.; Urquhart, J.; Mumford, J.; Quine, C.P. The social amplification of risk on Twitter: The case of Ash dieback disease. *J. Risk Res.* **2017**, *21*, 1163–1183. [CrossRef]

31. Tree Council. *Chalara in Non-Woodland Situations: Findings from a 2014 Study*; undertaken by the Tree Council on behalf of Defra: London, UK, 2015.

32. Defra. *Tree Health Management Plan*; Department for Environment, Food and Rural Affairs: London, UK, 2014.

33. Urquhart, J.; Potter, C.; Barnett, J.; Fellenor, J.; Mumford, J.; Quine, C.P.; Bayliss, H. Awareness, concern and willingness to adopt biosecure behaviours: Public perceptions of invasive tree pests and pathogens in the UK. *Biol. Invasions* **2017**, *19*. [CrossRef]

34. Bayliss, H.; Potter, C. *Survey of Public Awareness and Understanding of Introduced Tree Pests and Diseases in the United Kingdom*; Defra Project TH0104; Imperial College London: London, UK, September 2013.

35. Jepson, P.; Arakelyan, I. Exploring public perceptions of solutions to tree diseases in the UK: Implications for policy-makers. *Environ. Sci. Policy* **2017**, *76*, 70–77. [CrossRef] [PubMed]

36. Fuller, L.; Marzano, M.; Peace, A.; Quine, C.P.; Dandy, N. Public acceptance of tree health management: Results of a national survey in the UK. *Environ. Sci. Policy* **2016**, *59*, 18–25. [CrossRef]

37. Sheremet, O.; Healey, J.R.; Quine, C.P.; Hanley, N. Public preferences and willingness to pay for forest disease control in the UK. *J. Agric. Econ.* **2017**, *68*, 781–800. [CrossRef]

38. Porth, E.F.; Dandy, N.; Marzano, M. "My garden is the one with no trees:" Residential lived experiences of the 2012 Asian longhorn beetle eradication programme in Kent, England. *Hum. Ecol.* **2015**, *43*, 669–679. [CrossRef]

39. Flint, C.G. Changing forest disturbance regimes and risk perceptions in Homer, Alaska. *Risk Anal.* **2007**, *27*, 1597–1608. [CrossRef] [PubMed]

40. Thomas, P.A. Biological Flora of the British Isles: *Fraxinus excelsior*. *J. Ecol.* **2016**, *104*, 1158–1209. [CrossRef]

41. Stephenson, W. *The Study of Behavior: Q Technique and its Methodology*; University of Chicago Press: Chicago, IL, USA, 1953.

42. Urquhart, J.; Courtney, P.; Slee, B. Private woodland owners' perspectives on multifunctionality in English woodlands. *J. Rural Stud.* **2012**, *28*, 95–160. [CrossRef]

43. Barry, J.; Proops, J. Seeking sustainability discourses with Q methodology. *Ecol. Econ.* **1999**, *28*, 337–345. [CrossRef]

44. Davies, B.B.; Hodge, I.D. Exploring environmental perspectives in lowland agriculture: A Q methodology study in East Anglia, UK. *Ecol. Econ.* **2007**, *61*, 323–333. [CrossRef]

45. Walter, G. Images of success: How Illinois farmers define the successful farmer. *Rural Sociol.* **1997**, *62*, 48–68. [CrossRef]

46. Hermelingmeier, V.; Nicholas, K.A. Identifying five different perspectives on the ecosystem services concept using Q methodology. *Ecol. Econ.* **2017**, *136*, 255–265. [CrossRef]

47. Hugé, J.; Vande Velde, K.; Benitez-Capistros, F.; Japay, J.H.; Satyanarayana, B.; Nazrin Ishak, M.; Quispe-Zuniga, M.; Lokman, M.; Husain, B.; Sulong, I.; et al. Mapping discourses using Q methodology in Matang Mangrove Forest, Malaysia. *J. Environ. Manag.* **2016**, *183*, 988–997. [CrossRef] [PubMed]

48. Nijnik, M.; Nijnik, A.; Bergsma, E.; Matthews, R. Heterogeneity of experts' opinion regarding opportunities and challenges of tackling deforestation in the tropics: A Q methodology application. *Mitig. Adapt. Strateg. Glob. Chang.* **2014**, *19*, 621–640. [CrossRef]

49. Cuppen, E.; Bosch-Rekveldt, M.G.C.; Pikaar, E.; Mehos, D.C. Stakeholder engagement in large-scale energy infrastructure projects: Revealing perspectives using Q methodology. *Int. J. Proj. Manag.* **2016**, *34*, 1347–1359. [CrossRef]

50. Raadgever, G.T.; Mostert, E.; van de Giesen, N.C. Identification of stakeholder perspectives on future flood management in the Rhine basin using Q methodology. *Hydrol. Earth Syst. Sci.* **2008**, *12*, 1097–1109. [CrossRef]

51. Sala, R.; Oltra, C.; Gonçalves, L. Attitudes towards urban air pollution: A Q methodology study. *Psyecology* **2015**, *6*, 359–385. [CrossRef]

52. Venables, D.; Pidgeon, N.; Parkhill, K.A.; Henwood, K.L.; Simmons, P. Living with nuclear power: Sense of place, proximity, and risk perceptions in local host communities. *J. Environ. Psychol.* **2012**, *32*, 371–383. [CrossRef]

53. Kim, T.; Park, H. Perceptional differences in the factors of local acceptance of spent nuclear fuel repositories. *Land Use Policy* **2017**, *67*, 702–709. [CrossRef]

54. Stainton Rogers, R.; Stainton Rogers, W. What the Brits got out of the Q: And why their work may not line up with the American way of getting into it! *Electron. J. Commun.* **1990**, *1*, 1–11.

55. McKeown, B.; Thomas, B. *Q Methodology*; Sage Publications Inc.: Newbury Park, CA, USA, 1988.

56. Watts, S.; Stenner, P. Doing Q methodology: Theory, method and interpretation. *Qual. Res. Psychol.* **2005**, *2*, 67–91. [CrossRef]

57. Stainton Rogers, R. Q Methodology. In *Rethinking Methods in Psychology*; Smith, J.A., Harre, R., Van Langenhove, L., Eds.; Sage: London, UK, 1995; pp. 178–192.

58. Webler, T.; Danielsen, S.; Tuler, S. *Using Q Method to Reveal Social Perspectives in Environmental Research*; Social and Environmental Research Institute: Greenfield, MA, USA, 2009; Available online: http://www.seri-us.org/sites/default/files/Qprimer.pdf (accessed on 17 May 2017).

59. Valenta, A.L.; Wigger, U. Q-methodology. *J. Am. Med Inform. Assoc.* **1997**, *4*, 501–510. [CrossRef] [PubMed]

60. Fellenor, J.; Barnett, J.; Potter, C.; Urquhart, J.; Mumford, J.; Quine, C.P. Ash dieback and other tree pests and pathogens: Dispersed risk events and the Social Amplification of Risk Framework. *J. Risk Res.* **2019**. [CrossRef]

61. Lima, M.L.; Castro, P. Cultural theory meets the community: Worldviews and local issues. *J. Environ. Psychol.* **2005**, *25*, 23–35. [CrossRef]

62. Kahan, D. Fixing the communications failure. *Nature* **2010**, *463*, 296–297. [CrossRef]

63. Yamashita, H. The problems with a 'fact'-focused approach in environmental communication: The case of environmental risk information about tidal flat developments in Japan. *Environ. Educ. Res.* **2015**, *21*, 586–611. [CrossRef]

64. Friedman, D.B.; Toumey, C.; Porter, D.E.; Hong, J.; Scott, G.I.; Lead, J.R. Communicating with the public about environmental health risks: A community-engaged approach to dialogue about metal speciation and toxicity. *Environ. Int.* **2015**, *74*, 9–12. [CrossRef]

65. Ziman, J. Not knowing, needing to know, and wanting to know. In *When Science Meets the Public*; Lewenstein, B.V., Ed.; American Association for the Advancement of Science: Washington, DC, USA, 1992; pp. 13–20.