



# Kent Academic Repository

Fish, Robert D., Austen, Gail E., Bentley, Jacob W., Dallimer, Martin, Fisher, Jessica C., Irvine, Katherine N., Bentley, Phoebe R., Nawrath, Maximilian and Davies, Zoe G. (2024) *Language matters for biodiversity*. *BioScience*, 74 (5). pp. 333-339. ISSN 0006-3568.

## Downloaded from

<https://kar.kent.ac.uk/104965/> The University of Kent's Academic Repository KAR

## The version of record is available from

<https://doi.org/10.1093/biosci/biae014>

## This document version

Author's Accepted Manuscript

## DOI for this version

## Licence for this version

UNSPECIFIED

## Additional information

## Versions of research works

### Versions of Record

If this version is the version of record, it is the same as the published version available on the publisher's web site. Cite as the published version.

### Author Accepted Manuscripts

If this document is identified as the Author Accepted Manuscript it is the version after peer review but before type setting, copy editing or publisher branding. Cite as Surname, Initial. (Year) 'Title of article'. To be published in **Title of Journal**, Volume and issue numbers [peer-reviewed accepted version]. Available at: DOI or URL (Accessed: date).

## Enquiries

If you have questions about this document contact [ResearchSupport@kent.ac.uk](mailto:ResearchSupport@kent.ac.uk). Please include the URL of the record in KAR. If you believe that your, or a third party's rights have been compromised through this document please see our [Take Down policy](https://www.kent.ac.uk/guides/kar-the-kent-academic-repository#policies) (available from <https://www.kent.ac.uk/guides/kar-the-kent-academic-repository#policies>).

# Language matters for biodiversity

Robert D. Fish<sup>\*1</sup>, Gail E. Austen<sup>1</sup>, Jacob W. Bentley<sup>1</sup>, Martin Dallimer<sup>2</sup>, Jessica C. Fisher<sup>1</sup>, Katherine N. Irvine<sup>3</sup>, Phoebe R. Bentley<sup>1</sup>, Maximilian Nawrath<sup>1,4</sup>, Zoe G. Davies<sup>1</sup>

\*Corresponding Author - [r.fish@kent.ac.uk](mailto:r.fish@kent.ac.uk)

1. Durrell Institute of Conservation and Ecology (DICE), University of Kent,  
Canterbury, CT2 7NR, UK

2. Sustainability Research Institute, School of Earth and Environment, University of  
Leeds, Leeds, LS2 9JT, UK

3. Social, Economic and Geographic Sciences Department, James Hutton Institute,  
Aberdeen, United Kingdom AB15 8QH

4. Norwegian Institute for Water Research, Oslo, 0579, Norway

## Abstract

Language is central to the way people learn about the natural world. A salient concern of the biodiversity conservation arena has been to understand how language can be employed by scientists to communicate knowledge to non-expert audiences and build ecological literacy. The use of analogy and narrative by scientists are prominent techniques. This paper considers how these two modes of language-based reasoning extend into ordinary conversational language use by the public, specifically when articulating everyday understandings and experiences of biodiversity. Drawing on a process of public engagement in a UK woodland environment, a typological framework based on principles of analogical and narrative reasoning is developed to characterize the precise character of processes of everyday biodiversity sense-making. The implications of the framework are discussed in the context of future biodiversity research, particularly its participatory and educational dimensions.

**Keywords:** analogy, biodiversity, language, learning, metaphor

## Introduction

Language is fundamental to the process of human cognition (Berwick et al. 2013, Lupyan 2016), so it follows that language provides one essential basis from which reasoning and sense-making about the natural world occurs. It is through language that people's experiences of nature are processed and represented in thoughts, and knowledge of nature is constructed and communicated. Understanding how people reason about nature through language can thus provide insight into the way learning in the biodiversity conservation arena occurs, and how learning environments might be enabled to excite interest, captivate imaginations, and inspire commitments and action.

Much of the scholarly interest in language-based reasoning among biodiversity conservationists is focused on the practices of experts. Most notably, the formal properties of language, and its various contexts in scientific and everyday use, are subject to concerted, though implicit, attention and scrutiny in the design and evaluation of science communication strategies as part of broader efforts to deepen ecological literacy across civil society (Novacek 2008, Kahan 2010, Bickford et al. 2012). From this vantage point, language is more than just a mechanism to describe a 'ready-made' world. It is a sense-making process that frames and constructs perceptions of nature, shapes values and beliefs towards it, and drives environmental behaviors. How language is crafted and used is therefore a key concern of the scientist (Kueffer and Larson 2014), for it potentially serves to ground abstract knowledge in discourses that resonate across civil society, and enables people to think and act in desirable ways depending on the role or identity they are assuming: that is, as leaders and decision makers; as consumers and economic agents; as families and household units; and as citizens and members of communities. Indeed, when scientists write of 'effective' communication, they are tacitly recognizing the social power invested in words (Weil 2020).

There are two prominent, often connected, ways in which language-based reasoning is used to build understanding of scientific knowledge among wider audiences; however both of these have been subject to critique. First, scientists frequently draw on analogies to help people make sense of nature, using figurative language to build understanding through comparison (Dunbar 2000, Brown 2003). Researchers have specifically examined the analogical dimensions of popular and public-facing science and policy discourse on the environment, especially the use of metaphors. For example, biodiversity declines have been likened to the conflagration of the Great Library at Alexandria (Sayre 2017) or a bioholocaust (Valiverronen and Hellsten 2002). Such

metaphors exert their influence culturally, but can be out of step with prevailing scientific wisdoms or obscure scientific nuance and complexity (Ball 2011, Larson 2011, Olsen et al. 2019). For instance, Ladle and Gillson (2009) have explained how science has increasingly asserted a 'flux of nature' metaphor to characterize ecosystem dynamics, one distinct from the more established and popularized idea of a 'balance of nature'. As Trudgill (2001) argues, metaphor choice is not only culturally significant, but deeply value laden, and thus open to ethical interrogation. In this vein, recent work in the field of invasion biology has highlighted the way that militaristic metaphors (e.g., 'a war on invasive species') shape wider perceptions of scientific research and researchers often negatively, for example implying a xenophobic stance (Larson 2005, Herbers 2007, Taylor and Dewsbury 2018, Janovsky and Larson 2019). This has led to calls for responsible metaphor management as fields of scientific knowledge integrate into policy, practice, and civil society, recognizing that language choices matter and necessitate reflexivity (Verbrugge et al. 2016, Kohl et al. 2020).

Second, language is used to build understanding of scientific knowledge through the enactment of narrative, with many analogical devices themselves dependent on a larger narrative frame. For instance, the metaphoric power of appeals to the conflagration of the Great Library at Alexandria is drawn from the recounting of events that form a wider historical narrative. From the oral transmission of ancestral sacred stories about land and environment in the aboriginal cultures of Australia (Chatwin 1987), to the parables of nature in the 19th Century Gothic Horror Novel (Hammond 2004), sources and forms of narrative are, of course, multiple and diverse within environmental discourse and are important repositories of cultural knowledge. Narrative-based science communication provides a further venue for this universal human practice, an enduring feature of which is to construct causally connected sequences of events from which a substantive

scientific dilemma or conflict can be addressed and, to varying extents, resolved (Cobley 2013).

Critical to the practice of storytelling, the process of narrative construction is viewed by communication scholars as a dynamic tool by which the complexities of scientific information can be rendered meaningful across diverse audiences (Rowcliffe 2004, NASEM 2017). This ‘dissemination’ model of narrative can be understood to reflect the western and Eurocentric provenance of science communication, implicitly reinforcing problematic distinctions between ‘knowledge’ and ‘storytelling’ not found in other cultural and historical contexts (Orthia, 2020). As such, research has shown the way different narrative techniques, such as plot design, causation and characterisation, can be interpreted as forms of persuasion, that is, promoting acceptance of particular ideas, to the extent that storytelling has “a bad reputation within science” (Dahlstrom 2014: 13614). While the narration of science may well excite the interest and attention of non-expert audiences, narrative can thus be viewed as partial and non-objective, creating a paradox for scientific researchers, namely: “how can science preserve its credibility as curator of knowledge while engaging audiences with a communication format that is agnostic to truth?” (Dahlstrom and Scheufele 2018: no pagination)

Overall, the implication is that while practices of analogical or narrative-based reasoning invite lay audiences to find greater meaning in scientific knowledge, these techniques are also tools to influence and popularize, potentially coming at the cost of appreciating the deeper complexities and ambiguities of scientific knowledge production; and at their worst, practices tantamount to propagating fictitiousness, lies, and falsity within scientific practice. For Kueffer and Larson (2014: 719), this situation is symptomatic of an increasingly competitive and congested marketplace for ideas, such that scientists now find themselves inclined, if not compelled, to adopt marketing inspired strategies “to get their message across”.

128 And yet, such discrepancies between scientific practice and language-based  
129 reasoning can be overstated. Analogy and narrative are not only tools for curating and  
130 communicating knowledge, but epistemic devices for producing, organizing, and  
131 advancing knowledge, a point well-established in the study and valorization of  
132 alternative knowledge systems (Varghese and Crawford 2021), but also in accounts of  
133 scientific practice itself (Kuhn 1979, Raymond et al. 2013, Morgan et al. 2022). As such,  
134 the issue is not how to protect science from the apparently distorting effects of these  
135 modes of reasoning, but rather how to recognize and harness them as critical resources  
136 for learning, experimentation, and collaboration among those without scientific training  
137 or interest in the products of scientific knowledge production. Or to put this another way,  
138 through the enactment of analogical or narrative reasoning, we are provided with two  
139 critical ways in which expert and lay learning about nature converge.

140 In this paper, we wish to counterpoint this scholarly emphasis on experts with a  
141 focus on conversational language; that is, on language expressed through ordinary  
142 lived experience. Building from the assumption that language is a sense-making  
143 process from which phenomena in the natural environment are invested with meaning  
144 and significance, we specifically explore: (i) how features and attributes of biodiversity  
145 make sense to people through these processes of analogical- and narrative-based  
146 reasoning; and (ii) the generalizable elements of those reasoning processes that may  
147 have utility for biodiversity education and biodiversity conservation.

148 In pursuing these goals, we follow the long-standing interest of environmental  
149 scholars in understanding the role of alternative knowledge systems - variously  
150 described as 'traditional', 'lay', 'indigenous' and 'local' - in contextualising, informing,  
151 and indeed sometimes disrupting, scientific wisdoms about and framings of  
152 environmental phenomena (Johnson et al. 2016, Lam et al. 2020). We also follow the  
153 concerns of the divergent field of ecolinguistics, where the broad focus is to

understand language use not only as a property of living systems, but as an agent of everyday discourse with real environmental effects (Chen, 2016). A key preoccupation of this field is to employ critical discourse analysis to understand how everyday communication, in a variety of linguistic manifestations (e.g. the popular media, policy discourse), shapes and reinforces the “stories we live by” (Stibbe 2015: 183). One distinguishing concern of this scholarship is to critique and transform the linguistic basis of discourses that subtly feed environmental degradation. However, in this study, our interest is not in passing critical judgement on the normative content of ordinary language use. Rather, we attend to the contours and patterns of the more capricious and idiosyncratic qualities of language, so as to better understand the way it holds together people’s values, knowledge, and assumptions about biodiversity.

We do so through a large-scale participatory research process conducted with a diverse public living in England, Scotland, and Wales. Through the analysis and coding of qualitative data from a series of workshop discussions centered on woodlands, we develop a typological framework that characterizes and exemplifies the analogical- and narrative-based reasoning recurring in conversations about biodiversity attributes. The implications of the framework are discussed in the context of future research in the biodiversity conservation arena, particularly its participatory and educational dimensions.

## **Study approach**

We held four 2.5-day public workshops during 2019 across the calendar year to encompass seasonal interactions with biodiversity. Overall, we had 194 participants (February,  $n = 50$ ; April,  $n = 46$ ; June,  $n = 50$ ; October,  $n = 48$ ), representing 485 person days. Participants were recruited by a social research agency to maximize the diversity of perspectives. Individuals were recruited from both rural ( $n = 62$ ) and urban ( $n = 132$ ) areas across Britain (England,  $n = 173$ ; Scotland,  $n = 11$ ; Wales,  $n = 10$ ;). They varied



in age (18-29 years,  $n = 59$ ; 30-59 years,  $n = 70$ ; 60+ years,  $n = 59$ ; prefer not to say,  $n = 6$ ), gender (male,  $n = 90$ ; female,  $n = 103$ ; prefer to say,  $n = 1$ ), ethnicity (white British,  $n = 131$ ; other ethnicities,  $n = 60$ ; prefer to say,  $n = 3$ ) and social grade (AB,  $n = 56$ ; C1,  $n = 58$ ; C2,  $n = 42$ ; DE,  $n = 38$ ). The workshops were delivered in central England to maximize their accessibility from all regions and followed a common process design. Workshops were held at weekends, with participation incentivized to financially compensate people for their time and to reduce the risk of recruitment failure across hard-to-reach social cohorts. To avoid recruitment of self-selecting participants (e.g. nature enthusiasts, environmentalists) background information on the workshops was strictly limited to include information about broad purpose (i.e., a research workshop led by a university) and approach (i.e., that participation would involve spending time outside).

During the workshops, an emphasis was placed on learning from participants about their general reactions to and interactions with British woodlands, as opposed to priming participants with information about woodlands provided by experts and specialists. Each workshop involved a combination of indoor and outdoor activities, delivered under different levels of direction. Participants were told that the project was focused on learning about public perceptions of woodlands and the animals, plants and fungi found within them. Participants were divided into five groups, which they remained within for the course of the workshop. They were supported in their activities by a group facilitator, clarifying instructions and structuring discussion, and a technical assistant, managing the recording of data.

Data were gathered using two techniques. First, in group-based discussions, after visits to a broadleaved and a mixed woodland, where participants were asked to pay attention to what they noticed about these environments and to make a written record of some of the things they encountered in terms of smell, texture, color, sound, and

shape. Working alone, participants were instructed to note initial reactions – likes and dislikes – to what they observed. Alongside personal phones, participants were provided with access to instant cameras to record any attributes of interest as photographs. These materials were then used as resources for participant recall in a one-hour group discussion, led by the facilitator who prompted participants to describe and explain in their own words what they noticed. Overall, this process produced ~60 hours of group discussion.

Second, data were collected using image-based Q-methodology to explore preferences for encountering woodland species (see details in Austen et al. 2021). Participants were presented with four image sets to stimulate responses: vertebrates ( $n = 32$  species images), invertebrates ( $n = 43$ ), trees ( $n = 32$ ), and understory plants and fungi ( $n = 32$ ). The invertebrate image set was larger to capture the range of diversity within this taxonomic group. Images were presented on A5 cards against a blank, white background to minimize the influence of context and artistic style. Images were selected to embody a diverse mixture of biodiversity attributes, including colors, morphologies, textures, sounds, smells, and behaviors. All species were associated with British woodland and represented species found in different woodland layers (e.g., understory, canopy), active at different times (e.g., diurnal, nocturnal), and linked with ecosystem services (e.g., food provision, pollination, cultural significance). Individual and group discussions focused on thoughts and reactions to the species and their attributes. Overall, this process produced ~80 hours of discussion, the transcripts of which were uploaded to NVivo (Version 12).

During the workshops, participants were never instructed to interpret and represent their thoughts about woodland biodiversity in analogical or narrative terms. The focus was on what, how and why people notice biodiversity in woodlands, particularly in terms of what they are drawn to and (dis)like. The presence of analogies and narratives in

participant understandings of biodiversity was noted informally by the research team during the data collection phase but did not feature within our initial approach to the coding of qualitative data, which followed what Braun et al. (2018) term a 'codebook' approach to thematic analysis. Here data were organized deductively according to different dimensions of human-biodiversity interaction, such as biodiversity attributes (e.g., shapes, colors, behaviors), time (e.g., day, night, season), and wellbeing (e.g., physical, emotional, cognitive). The final codebook acted as both a set of guidelines by which text was coded by the research team, and a mitigation tool against ambiguity as each code had accompanying descriptions and text examples. The salience of analogies and narrative as themes of potential analysis emerged as the team reviewed data across these a priori codes. At this stage in the process, several of the research team noted examples of conversational language that were evidently striking or evocative in their description of biodiversity attributes (e.g. humorous, touching). We consequently searched systemically for all examples of analogies and narratives, grouping and regrouping these into subthemes to form the general framework we describe below. In other words, our specific interest and focus on analogies and narrative emerged reflexively and interpretatively as the cycle of coding, analysis, and theme development iterated (Braun and Clarke, 2016).

### **Analogical reasoning about biodiversity attributes**

Varied comparative devices were used by participants to speculate, explore and learn about attributes of biodiversity. These included implied and indirect forms of comparison, as in the frequent use of metaphors (i.e., A is B). Direct comparisons were also made, either simply stated, as in the use of similes (e.g., C is like D), or more elaborate analogies with an evident explanatory basis (e.g., A is to B, what C is to D).

In cognitive terms, this analogical reasoning process is based on analyzing the similarities between two domains – a 'source' and 'target'. In essence the source

domain provides the basis for the analogy. It is a domain of knowledge, understanding, and familiarity, used to make sense of the target domain; a domain of doubt and uncertainty (Holyoak and Thagard 1995). In this study, biodiversity attributes represent the target domain. They are the objects of analogical reasoning.

Overall, we found that participants draw on a diverse repository of everyday social and cultural references to build inferences about the natural world. Our research identified 12 configurations of language that act as ‘source’ domains in the biodiversity sense-making process (Figure 1; Table S1). For example, the wood that protrudes from a tree is a squirrel’s “dining table” (Analogical Domain 1; AD1), the nut in the spiky green shell of the horse chestnut tree (*Aesculus hippocastanum*) is a “Kinder Egg” [a children’s confectionary brand] and a “Happy Meal” [children’s fast food brand] (AD2); the tawny owl (*Strix aluco*) has the appearance of a “loaf of bread” (AD3); the dawn chorus is “mother nature’s alarm clock” (AD4); the texture of the tree resembles the “skin of an elephant” (AD5); the woodland is like a “cathedral” (AD6); the vertical lines of the silver birch tree (*Betula pendula*) resemble “soldiers” (AD7); the fly agaric mushroom (*Amanita muscaria*) is “channeling some ‘Super Mario’ vibes” [a computer gaming franchise] (AD8); the mushrooms have “fairies” beneath them (AD9); the oak tree (*Quercus robur*) is an “English countryside outline” (AD10); the holly (*Ilex aquifolium*) is “very Christmassy” (AD11); and the sound of the trees are like “waves crashing” (AD12).

The specific examples that define these analogical domains are perhaps less important than what they indicate about how people give meaning, significance, and value to perceptually abstract, partially noticed and, in some instances, poorly understood natural phenomena. A key finding is that this mode of reasoning involves four key sense-making processes that cut across the 12 analogical domains, namely:

- **Evaluations of ecological quality.** When the woodland understory is described as “like a carpet” (AD1) it is a positive evaluative statement, based on

aesthetic judgment that is being made. When likened to a “fantastic *Axminster* carpet” [a brand of carpet synonymous with artisanship and luxury], judgments of ecological quality are being further empowered by appeals to cultural taste.

- ***Understanding of ecosystem processes.*** The growth rings of a fallen tree are understood as “a clock, a timepiece, documenting the life of the tree” (AD4), while the texture of a rotten tree is interpreted as “a bit like when you open a can of tuna. It looks solid and it looks like it will resist you, but when you put weight on it, it all flakes and you realize how weak it is” (AD3). Similarly, a tree shedding its bark is interpreted as a metamorphosing process akin to the “Incredible Hulk [a comic superhero character] bursting out of its clothes” (AD8).
- ***Wonder and pleasure in nature.*** Protective plastic packaging is used metaphorically to convey the pleasing texture and sound of walking on leaves in winter: “nature’s bubble wrap” (AD2). The meaning of the “Kinder Egg” and the “Happy Meal” (AD2) with respect to the spiky green shell of the horse chestnut tree, hinges on the sensation of surprise arising from the small toy found inside.
- ***Ecological basis of social systems.*** Metaphors of majesty and grandeur in nature are the basis for assumptions about biodiversity attributes providing inspirations for human design and creativity. Thus, trees are understood to take on the quality of “Doric columns,” while woodlands exude the feel of a “Roman forum” or “a cathedral,” informing the practice of biomimicry, since “people have mimicked those natural shapes and tried to order them in architecture” (AD6).

## **Narrative reasoning about attributes of biodiversity**

Whereas analogy alerts us to reasoning about biodiversity using parallels and imaginative allusion, narrative provides a foundation of memory and learning through sequences of events. The creation and recounting of events are the building blocks of

stories, which encompass a range of real and imaginary characters and worlds. In the present context, stories are understood as repositories of personal and cultural information that condition, convey, and reproduce particular ways of thinking about biodiversity. Our results revealed four types of narrative:

- **Personalized narratives.** These narratives are rooted in the encounter between biodiversity attributes and personal memory. Here, biodiversity functions as an “event” in wider stories of the self. Micro-interactions with nature recounted through experiences of childhood feature prominently. These include embodied and visceral responses to components of nature. For instance, “kicking up” leaves and “climbing” trees, are frequently connected with affirmative constructions of childhood and family, such as the recalling of a formative nature experience (e.g., “berry picking” with grandparents) or reflecting on the active present (e.g., a parent counting tree rings with his daughter). These narratives are personalized versions of a wider and powerful set of cultural discourses asserting biodiversity and its various surrogates (e.g., ‘countryside,’ ‘rurality’ and ‘nature’) as sites and contexts for an idyllic childhood.
- **Popular cultural narratives.** By this we mean the wider hinterland of cultural stories brought to bear upon biodiversity attributes, with reference points in a variety of media and folk knowledge. Allusions to “fairies” and “fairy kingdoms” in relation to mushrooms (and specifically the fly agaric) provide a way of emphasizing the cultural allure and fantastical nature of woodland environments. These are made with occasional reference to the mass media and entertainment conglomerate, *Disney*, where woodlands have featured prominently (e.g., the 1959 animation of Charles Perrault’s *Sleeping Beauty*), as well to texts reflecting more specific cultural registers (e.g., Colin Dann’s 1979 novel *The Animals of Farthing Wood*, which has a UK focus). These

popular cultural narratives are also notable in the way they invite ambiguity and nuance in people's readings of biodiversity. Thus, components of woodlands are invested with foreboding in the context of the genre of horror, *vis a vis* "The PR [public relations] that [mushrooms] get, you know, 'away with the fairies'. When you see these fairy stories, little fairies underneath. Magical creatures; something magical that takes you to another dimension".

- **Management stories.** These concern narratives of biodiversity arising in the context of wider assumptions about land and habitat management; the events that have shaped, and continue to shape, the setting in which human-biodiversity interactions occur. Reference to the "manmade" (*sic.*), "constructed", "managed", and "ordered" character of the setting are common. Specific human interactions with attributes of biodiversity are noted (e.g., "the low branches of trees had been taken off") and explained at various scales for significance, from management that is intended to prevent accident or injury for visitors ("health and safety"), through to broad characterizations of economic purpose ("commercial") and associated evaluation of change ("monoculture"). Notably, components of biodiversity are frequently interpreted as the legacy of historical management and shifting demands over time, both within living memory ("planted after the war") and across deeper spans of time ("hundreds of years ago, people would have managed it, wouldn't they, because they needed the wood to live?").
- **Nature as narrative.** Nature can also be constructed as a story in and of itself. Here, woodland environments are rendered meaningful as a setting for an unfolding series of natural events, propelled by their own forces, most notably expressed through temporal cycles of growth and decay over seasonal and generational time (e.g., "it's the circle of life kind of thing, one tree is dead but

now these other ones are trying to come from that"). Such cycle of life narratives, and the sense of drama they evoke, intersect with a wider narrative of people's place in a living cycle (e.g., "I've had death in my family this year and the new life of young children and old people dying; it's the whole circle thing, and it's there graphically in front of you. It's just what the tree does in a year, let alone the rest of the forest"). These appeals to "life's design" are put in conversation with human feelings of insignificance within nature ("the bigger picture") and the ephemerality of human life relative to trees (e.g., "It makes me kind of feel a bit insignificant in a way, because they're there and they live beyond us!"). The trials and tribulation of ordinary human life are thus thrown into perspective: "[the woodland] has been here forever and it will just carry on [...] The things we stress about, do they really matter?"

## **Discussion and conclusion**

Analogies and narratives are critical conceptual resources in the process of making sense of biodiversity. Ordinary language use among a diverse public reveals analogies serve to convey assumptions about how nature works, assert judgments about ecological quality, express awe and wonder about processes in nature, as well as make wider inferences about the ecological basis of human societies. These analogical processes are rooted in a wider set of everyday references that people actively bring to bear upon their encounters with biodiversity, from the aesthetics of carpet to the sounds of protective plastic packaging. In turn, these sense-making processes work in conjunction with a diversity of narratives that link biodiversity to deeper repositories of personal experience and cultural memory, from affirmative stories of childhood and fantastical constructions of mass and folklore culture, through to stories of human management and life itself. When analogies and narrative converge, we are offered



powerful glimpses of how attributes of biodiversity are framed as meaningful and knowable entities. These sense-making dynamics are at the very center of immediate and visceral – in a word ‘relational’ – nature-based experiences.

It has been suggested that, “language must not only be adequate for environmental scientists, but must also be socially adequate if the goal is to engage diverse groups in environmental research, decision making, and action” (Raymond et al. 2013: 537). Although the heuristic, non-exhaustive and non-prescriptive status of our framework and findings must be emphasized, it is notable how a socially, culturally, and geographically diverse public builds conversational discourse about biodiversity through a common set of analogical and narrative resources. That these resources are enabled by the ordinary everyday worlds of junk-food, comic characters and interior decoration tells us something important about what it may mean for language to be socially adequate.

In one respect, it is tempting to speculate that, in our respondents’ choice of analogies, we see reflected a broader alienation of people from nature in late modernity (Hailwood 2015); an evident disconnection or ‘lack’ that needs correcting (Soga and Gaston 2016). Yet, we also contend these reasoning processes could equally be viewed as potent reminders of human capacities to engage and connect with the natural world in terms that exemplify lived experience. Is this analogical and narrative tendency revealed in contemporary publics so radically different from the localized folk taxonomies that have served science so well in the naming, identification, and classification of living organisms (Berlin 1973), or the Songlines used in aboriginal cultures to sing the land into existence and chart a map through otherwise unknowable terrain (Chatwin 1987)? Care has to be taken in drawing overly simplistic parallels between languages rooted in deep, stable and embodied engagements with the natural world and the rather more ephemeral signifiers of biodiversity arising in this study. There is nonetheless the need to understand better how processes of biodiversity sense

414 making take shape in the language communities and lived realities of everyday publics,  
415 be that as individuals residing in material locales, or as consumers sewn into deeply  
416 liberalised commodity chains.

417 It was noted earlier that reference to narrative and analogy excite interest and  
418 concern in equal measure when mapped onto the norms of scientific practice, with one  
419 implication being the need for scientists to reflect carefully on the framing devices they  
420 use. But such an evaluative need means little in the context of ordinary conversational  
421 use of language, where sense making draws on any cultural resources and experience  
422 an individual deems necessary to reason about biodiversity. The question is not to seek  
423 the correct conceptual framework, but to use a diversity of these frames to develop in  
424 people capacities for environmental sense making; as Bell (2006: 66) says: “we make  
425 most progress - we learn most - when we work cooperatively to deliberate and discuss  
426 new and existing conceptual and metaphorical frameworks and the relationships among  
427 them”.

428 The focus of Bell’s point is on sense making among environmental experts, but we  
429 suggest this is true of the sense-making process that occurs more broadly between and  
430 across expert and lay discourses of biodiversity. The implicit provocation of this paper  
431 is that, if we want to appreciate how people understand and reason about the natural  
432 world, and assign it meaning and significance to their lives, we must start with the way  
433 language is put together and used in these ordinary, everyday, and diverse ways. The  
434 framework we have produced was developed in the context of a diverse British public,  
435 but points to generic categories that warrant testing, elaborating and qualifying across  
436 contrasting and divergent cultural and ecosystem contexts and at larger spatial scales.  
437 There is also potential to extend the analysis to a consideration of language use across  
438 a variety of non-conversational media. Such endeavors would proceed from the  
439 assumption that, through attention to language, biodiversity researchers and educators

can become more fluent in the values, knowledge, and assumptions people hold about nature. It is time to re-engage with what Abram (2006: 273) has described as the “earthy intelligence” of our words.

## **Acknowledgements**

The authors would like to thank the participants who took part in the studies. The research was funded by the European Research Council (ERC) under the European Union’s Horizon 2020 research and innovation program (Consolidator Grant No. 726104).

## **References cited**

- Abram D. 2006. *The Spell of the Sensuous: Perception and Language in a More-than-human World*. Vintage Press.
- Austen GE, Dallimer M, Irvine KN, Maund PR, Fish RD, Davies, ZG 2021. Exploring Shared Public Perspectives on Biodiversity Attributes. *People and Nature* 3: 901-913
- Ball P. 2011. A metaphor too far. *Nature*: 23 February.
- Bell DR. 2005. Environmental learning, metaphors and natural capital, *Environmental Education Research* 11: 53-69.
- Berwick RC, Friederici, AD, Chomsky N, and Bolhuis JJ. 2013. Evolution, brain, and the nature of language. *Trends Cogn. Sci.* 17: 89–98.
- Berlin B. 1973. Folk systematics in relation to biological classification and nomenclature. *Annual Review of Ecology and Systematics* 4: 259–271.
- Bickford D, Posa MR, Qie L, Campos-Arceiz A, Kudavidanage EP. 2012. Science communication for biodiversity conservation. *Biological Conservation* 151: 74-76.
- Braun V, Clarke V. 2006. Using Thematic Analysis in Psychology. *Qualitative Research in Psychology* 3:77–101.

466 Braun V, Clarke V, Terry G, Hayfield N. 2018. Thematic Analysis. Pages 843-860 in  
 467 Liamputtong P, ed., *Handbook of Research Methods in Health and Social Sciences*.  
 468 Springer.  
 469 Brown TL. 2003. *Making Truth: Metaphor in Science*. Illinois University Press.  
 470 Chatwin B. 1987. *Songlines*. Jonathan Cape.  
 471 Chen S. 2016. Language and Ecology: A Content Analysis of Ecolinguistics as an  
 472 Emerging Research Field. *Ampersand* 3: 108–116.  
 473 Cobley P. 2013. Narrative. Routledge.  
 474 Dahlstrom MF. 2014. Using narratives and storytelling to communicate science with  
 475 nonexpert audiences. *Proceedings of the National Academy of Sciences* 111:  
 476 13614–13620.  
 477 Dahlstrom MF, Scheufele DA. 2018. (Escaping) the paradox of scientific storytelling.  
 478 *PLoS Biology* 16: e2006720.  
 479 Dunbar K. 2000. How scientists think in the real world: implications for science  
 480 education. *Journal of Applied Developmental Psychology* 21: 49–58.  
 481 Hailwood S. 2015. *Alienation and Nature in Environmental Philosophy*. Cambridge  
 482 University Press.  
 483 Herbers JM. 2007. Watch Your Language! Racially Loaded Metaphors in Scientific  
 484 Research, *BioScience*, 57: 104–105.  
 485 Hammond K. 2004. Monsters of modernity: Frankenstein and modern  
 486 environmentalism *Cultural Geographies* 11: 181-198.  
 487 Holyoak KJ, Thagard P. 1996. *Mental leaps: Analogy in Creative Thought*. MIT Press.  
 488 Janovsky RM, Larson ER. 2019. Does invasive species research use more militaristic  
 489 language than other ecology and conservation biology literature? *NeoBiota* 44: 27-  
 490 38.

491 Johnson JT, Howitt R, Cajete G, Berkes F, Louis RP, Kliskey A. 2016. Weaving  
 492 Indigenous and sustainability sciences to diversify our methods. *Sustainable*  
 493 *science* 11: 1-11.

494 Kahan D. 2010. Fixing the communications failure. *Nature* 463: 296–297.

495 Kohl PA, Collins SJ, Eichholz M. 2020. Metaphor, trust and support for non-native  
 496 species control. *Environmental Communication* 14: 672-685.

497 Kueffer C, Larson B. 2014. Responsible use of language in scientific writing and  
 498 science communication. *BioScience* 64: 719–724.

499 Kuhn TS. 1979. Metaphor in science. Pages 409-19 in Ortony A, ed., *Metaphor and*  
 500 *Thought*. Cambridge University Press.

501 Ladle RJ, Gillson L. 2009. The (im) balance of nature: a public perception time-lag? *Public*  
 502 *understanding of science* 18: 229-242

503 Lam DE, Hinz D, Lang DJ, Tengö M, von Wehrden H, Martín-López B. 2020.  
 504 Indigenous and local knowledge in sustainability transformations research: a  
 505 literature review. *Ecology and Society* 25: 3.

506 Larson BMH. 2005. The war of the roses: demilitarizing invasion biology. *Frontiers in*  
 507 *Ecology and the Environment* 3: 495–500.

508 Larson BMH. 2011. *Metaphors for Environmental Sustainability: Redefining our*  
 509 *Relationship with Nature*. Yale University Press

510 Lupyan G. 2016. The Centrality of Language in Human Cognition. *Language Learning*  
 511 66: 516-553.

512 Morgan MS, Hajek KM, Berry DJ. 2022. Narrative Science: Reasoning, Representing  
 513 and Knowing since 1800. Cambridge University Press.

514 Novacek MJ. 2008. Engaging the public in biodiversity issues. *Proceedings of the*  
 515 *National Academy of Sciences* 105: 11571–11578.

516 Olson ME, Arroyo-Santos A, Vergara-Silva F. 2019. A user's guide to metaphors in  
 517 ecology and evolution. *Trends in Ecology and Evolution* 34: 605-615.

518 Orthia LA, 2020. Strategies for including communication of non-Western and  
 519 indigenous knowledges in science communication histories. *Journal of Science*  
 520 *Communication* 19: A02.

521 [NASEM] National Academies of Sciences, Engineering, and Medicine. 2017. *Using*  
 522 *Narrative and Data to Communicate the Value of Science: Proceedings of a*  
 523 *Workshop—in Brief*. Washington, DC: The National Academies Press

524 Raymond CM, Singh GG, Benessaiah K, Bernhardt JR, Levine J, Nelson H, Turner  
 525 NJ, Norton B, Tam J, Chan KM. 2013. Ecosystem services and beyond: using  
 526 multiple metaphors to understand human–environment relationships. *BioScience*  
 527 63: 536–546.

528 Rowcliffe S. 2004. Storytelling in science. *School Science Review* 86: 121-126.

529 Sayre GM. 2017. The Alexandrian Library of life: a flawed metaphor for biodiversity.  
 530 *Environmental Humanities* 9: 280-299.

531 Soga M, Gaston K. 2016 Extinction of experience: the loss of human-nature  
 532 interactions. *Front. Ecol. Environ.*, 14, 94-10

533 Stibbe A. 2015. *Ecolinguistics: Language, Ecology, and the Stories We Live By*. New  
 534 York: Routledge.

535 Taylor C, Dewsbury BM. 2018. On the problem and promise of metaphor use in  
 536 science and science communication. *Journal Of Microbiology and Biology*  
 537 *Education* 19: 1-5.

538 Trudgill S. 2001. Psychobiogeography: meanings of nature and motivations for a  
 539 democratized conservation ethic. *Journal of Biogeography*, 28(6), 677-698

540 Valiverronen E, Hellsten I. 2002. From "burning library" to "green medicine" - The role  
 541 of metaphors in communicating biodiversity. *Science Communication* 24: 229-245.

542 Varghese J, Crawford, SS, 2021. A cultural framework for Indigenous, Local, and Science  
543 knowledge systems in ecology and natural resource management. *Ecological*  
544 *Monographs*, 91: e01431.

545 Verbrugge LNH, Leuven RSEW, Zwart HAE. 2016. Metaphors in invasion biology:  
546 implications for risk assessment and management of non-native species. *Ethics,*  
547 *Policy and Environment* 19: 273-284.

548 Weil S. 2020. *The Power of Words*. Penguin, London.

549

550

551

552

553

554

555

556

557

558

559

560

561

562

563

564

565

566

567



569

570

571

572

573

574

575

576

577

578

**Figure 1.** An overview of the 12 Analogical domains of biodiversity sense making revealed in the participatory workshops. Each domain represents a repository of everyday social and cultural meaning (source domain) from which inferences about the natural world are created (target domain). For example, under the analogical domain of ‘clocks and timepieces’, the phrase ‘nature’s alarm clock’ is the source domain for the target domain of the ‘dawn chorus’. Likewise, under the analogical domain of ‘animal bodies the word ‘elephant’ is the source domain for the target domain of ‘tree bark’.



579 **Biographical narratives**

580

581 Robert D. Fish and Gail E. Austen, Jacob W. Bentley, Jessica C. Fisher, Phoebe R.  
582 Bentley and Zoe G. Davies are affiliated with the Durrell Institute of Conservation and  
583 Ecology at the University of Kent in Canterbury, United Kingdom. Martin Dallimer is  
584 affiliated with the Sustainability Research Institute, School of Earth and Environment,  
585 University of Leeds, United Kingdom. Katherine N. Irvine is affiliated with the Social,  
586 Economic and Geographic Sciences Department, James Hutton Institute, Aberdeen,  
587 United Kingdom. Maximilian Nawrath is affiliated with the Durrell Institute of  
588 Conservation and Ecology at the University of Kent in Canterbury and the Norwegian  
589 Institute for Water Research, Oslo, Norway.