

## PERSPECTIVE



# The shifting baseline syndrome as a connective concept for more informed and just responses to global environmental change

Heidi K. Alleway<sup>1</sup> | Emily S. Klein<sup>2</sup> | Liz Cameron<sup>3</sup> | Kristina Douglass<sup>4</sup> |  
Ishtar Govia<sup>5,6</sup> | Cornelia Guell<sup>7</sup> | Michelle Lim<sup>8</sup> | Libby Robin<sup>9</sup> |  
Ruth H. Thurstan<sup>10</sup>

<sup>1</sup>Provide Food & Water, The Nature Conservancy, Arlington, Virginia, USA; <sup>2</sup>The Pew Charitable Trusts, Washington, District of Columbia, USA; <sup>3</sup>School of Architecture and Construction, University of Newcastle, Newcastle, New South Wales, Australia; <sup>4</sup>The Climate School, Columbia University, New York, USA; <sup>5</sup>Caribbean Institute for Health Research, The University of West Indies, Kingston, Jamaica; <sup>6</sup>Institute for Global Health, University College London, London, UK; <sup>7</sup>European Centre for Environment and Human Health, University of Exeter Medical School, Cornwall, UK; <sup>8</sup>Yong Pung How School of Law, Singapore Management University, Singapore, Singapore; <sup>9</sup>Australian National University, Canberra, Australian Capital Territory, Australia and <sup>10</sup>Centre for Ecology and Conservation, University of Exeter, Cornwall, UK

## Correspondence

Heidi K. Alleway

Email: [heidi.alleway@tnc.org](mailto:heidi.alleway@tnc.org)

Handling Editor: Alexandros Gasparatos

## Abstract

1. The concept of the 'shifting baseline syndrome' has assisted researchers in understanding how expectations for the health of the environment deteriorate, despite known, often widespread, and significant impacts from human activities. The concept has been used to demonstrate that more accurate assessment of historical ecosystem decline can be achieved by balancing contemporary perceptions with other sorts of evidence, and is now widely referred to in studies assessing environmental change.
2. The potential of this concept as a model for examining and addressing complex and multidimensional social-ecological interactions, however, is underexplored and current approaches have limitations.
3. We perceive the shifting baseline syndrome as a rare working example of a 'connective concept' that can work across fields of science, the humanities and others and that re-envisioning the concept in this way would assist us to establish more complete, true and reflective environmental baselines.
4. Through our diverse author team, from a range of disciplines, geographies and cultural backgrounds, we identify gaps in current knowledge of the shifting baseline syndrome concept, its use and its effects, and describe several approaches that could be taken to improve investigations and capitalise on the connectivity that it fosters. This re-envisioning could support a more informed and just way forward in addressing global environmental change.

## KEYWORDS

ecology, environmental change, justice, shifting baselines syndrome

This is an open access article under the terms of the [Creative Commons Attribution](https://creativecommons.org/licenses/by/4.0/) License, which permits use, distribution and reproduction in any medium, provided the original work is properly cited.

© 2023 The Authors. *People and Nature* published by John Wiley & Sons Ltd on behalf of British Ecological Society.

## 1 | INTRODUCTION

The increasing scale and pace of human-driven environmental change is an extraordinary challenge. More than half of the world's oceans—environments on which all life depends—are experiencing increasing cumulative strain (Halpern et al., 2019). Declines in faunal abundance and rates of species extinction are escalating (Dirzo et al., 2014), and deterioration of the health and productivity of ecosystems is bringing to the fore complex public health issues, such as entrenched inequalities in food sovereignty, energy and water security and global disease epidemics (World Health Organization, 2021). The ecological impacts of these issues are immense, but they can also generate significant economic and social costs (Myers, 2017), including intense psychological and emotional responses (Albrecht et al., 2007; Cunsolo & Ellis, 2018). Yet, we still often fail to appreciate that human-driven environmental change has been occurring for longer and with greater consequence than we realise, which can lead us to misinterpret its scale and impact over time (Baisre, 2013; Jackson, 2001; Pandolfi et al., 2003). A narrow ecological view can also overlook the enduring supporting role of people and communities in environments, such as the environmental stewardship that Indigenous people have and continue to undertake (Weir, 2009). If we are to address issues such as biodiversity loss and climate change, we must also appreciate these complexities.

Here, we reflect on the shifting baseline syndrome as a concept and its use in identifying and resolving human perspectives of ecological change. In a one-page essay in 1995, the fisheries scientist Daniel Pauly named the tendency for a persistent and collective failure of fisheries researchers to recognise the magnitude of change in marine systems from one generation to the next, a phenomenon he termed the 'shifting baseline syndrome' (Pauly, 1995). This concept provides a lens for exploring how people can overlook prior conditions of ecological productivity and health, how values towards the environment can change, and how objectives and resourcing for conservation can be diluted despite the occurrence of human impacts being known. It is a basis for understanding how sustained environmental degradation can occur and lead to reduced expectations or limited imagination for how our environments and human–environmental relations could function, today and in the future.

We<sup>1</sup> consider how understanding and use of the shifting baseline syndrome as a concept has evolved over the last several decades and its relevance to a range of complex ecological and social-ecological issues. These include environmental degradation but also social and environmental injustice and the widespread effects of colonialism. We believe the shifting baseline syndrome should be more widely applied in the complex business of engaging with the human-altered state of 21st-century environments but identify several known and lesser-known limitations in its current use that must be addressed (Section 2). We also believe that the shifting baseline syndrome is an important working example of a 'connective concept'<sup>2</sup> (Simon, 2020). Like boundary objects (objects or concepts that facilitate communication between different communities, Trompette & Vinck, 2009)—although without as strong an emphasis on a common structure that is often

found or applied to boundary objects such as a typology (e.g. Brand & Jax, 2007)—connective concepts could be critical as a specific type of scholarly response to the extreme relatedness between human activities and the natural world in the Anthropocene. We discuss how re-envisioning the shifting baselines syndrome as a connective concept could motivate conservation and environmental restoration in ways that include community aspirations and that maximise cross-disciplinary as well as cross-cultural connections (Section 3). Last, we identify actions that researchers and practitioners can take to assist in rethinking how we observe and make opinions about environmental change, and work with others to develop more effective responses (Section 4).

## 2 | SUCCESS AND LIMITATIONS OF THE SHIFTING BASELINE SYNDROME

### 2.1 | Overview of the concept

In its original framing, the shifting baseline syndrome describes the ongoing deterioration of fisheries scientists' expectations for the health and productivity of the marine environment. If each new generation of scientists sets their expectations according to their own observations of ecosystem and resource health, this framing can discount changes that occurred before. These reduced, or 'shifted', expectations can result in systemic environmental degradation because previous declines are overlooked or dismissed (Box 1). In other fields we see some reciprocal thinking on this effect. In clinical medicine and psychology, this phenomenon is known as observer bias (Hróbjartsson et al., 2013; Protzko & Schooler, 2019; Salvia & Meisel, 1980) and in social sciences, it is sometimes reflected in oral histories (Goodall & Cadzow, 2009; Ritchie, 2014). Anthropologist Deborah Bird Rose refers to 'The Year Zero' as a defining structure for frontier concepts and behaviours (the colonial myth of land needing settlement and 'taming'), thus negating Indigenous people's experience and stewardship before that point (Rose, 1997). Also, intriguingly, 'drifting' baselines were referred to by the Australian Superintendent of Fisheries Investigations in Australia, H. C. Dannevig, in 1903, in relation to fishers' responses to the question of whether the supply of Murray cod was the 'same as before' or 'falling off'. His conclusion: "The remarkable evenness in the gradual change of opinion from the younger to the older [...] brings out very plainly how matters are drifting in regard to the natural supply of the Murray cod, whatever the cause may be" (Dannevig, 1903).

Publication of the shifting baseline syndrome has been profoundly successful. While Pauly used the term in the context of fisheries science, his brief essay has been referenced 1560 times in the last 25 years (Web of Science, 28 March 2023) and connected to a range of topics, such as oil spills (Ruiz, 2004), disaster mitigation (Thomas, 2020) and ethnobotanical research (Hanazaki et al., 2013). Description of the phenomenon has precipitated a wealth of study and helped advance specific fields of work (e.g. Marine historical ecology and related initiatives, Schwerdtner Máñez et al., 2014), as well as unique methodologies to better integrate

### BOX 1 Understanding 'baselines' and when a shifting baseline becomes a syndrome.

The basic definition of 'baseline' can be inferred from Pauly's, 1995 description. He uses it to mean the starting point for comparison across time, for example, the baseline fish population size or species composition from which to compare future change. His framing is now usually used to trace a position at some point in the recent past ('in human memory') through to present or projected future change. However, setting a baseline therefore determines the point at which meaningful characteristics of environmental systems—climate conditions, species abundance and distribution—start to matter, which can imply or lead to the assumption that those before this point do not (Alagona et al., 2012). This distinction is not necessarily problematic and is often necessary for practical reasons. But baselines can themselves become a problem—that is, they become a patterned or characteristic response, a *syndrome*—when we fail at the process of accurately setting them (Alagona et al., 2012; Spennemann, 2022). In Pauly's original view, this limitation is experienced when we choose a baseline defined by our own experiences, and researchers, managers and society perceive conditions and set their standards for environmental health according to their experience, the experience of their immediate predecessors or the standards set by the hegemonic group. This is the point at which things start to matter and the decisions we and natural resource managers make, but it can discount all that came before. Similarly, changing social values might alter what is deemed 'fair', so what is considered a *just* response to change can also shift over time (Hirsch, 2020). Any loss of prior knowledge or experiences modifies the baseline in ways that obscure a more accurate picture of change and the perceptions of those before ourselves.

history and ecology and explore the implications of change over time (Beller et al., 2017; Meyer & Crumley, 2012). Awareness of the concept has also been used to inform management and policy and has motivated conservation and environmental restoration (Table 1). Furthermore, popular media and mainstream communications have embraced its use in a range of fora, including popular non-fiction (e.g. *The Unnatural History of the Sea* by Prof Callum Roberts, 2007). This is an impressive reach for a one-page article.

However, despite its widespread use the shift in thinking proposed by Pauly has not prompted information from the past to be widely adopted within disciplines or across disciplinary boundaries (Engelhard et al., 2016; Pauly, 2019; Poulsen & Schwerdtner Mániz, 2016). We also identify some critical shortcomings that have emerged as a result

of the ways in which this has been done. In particular, that use of the concept has not yet led to greater exploration of the ways in which baselines themselves are or have been wielded and weaponised.

## 2.2 | Shortcoming 1: Baselines as nostalgic pasts

Ecological hindsight can be coloured by the shock of present changes, leading to imagining of 'nostalgic pasts' and 'pristine' landscapes untouched by humans and the expectation that some pristine state can be restored through effective intervention (Campbell et al., 2009; Jones et al., 2020; Stoddard et al., 2006). The dynamic nature of change means there is also the chance for personal biases and cultural values to overly influence our perception of which outcomes are negative and which are positive (Papworth et al., 2009).

Research on shifting baselines can often assume a single trajectory of human influence, which promotes a perception of linear change over time and that human influence on ecosystems is always negative. While declining trends are certainly dominant, inverse effects of a distorted view of past environmental baselines have been observed, such as the recovery of species being perceived as invasive or overabundant (Lotze et al., 2011; Roman et al., 2015). Recollection of past environmental baselines can foster discussions that normalise solutions to dramatic environmental impacts, such as large-scale restoration (McAfee et al., 2020). Recollections based heavily on nostalgia and personal and cultural biases though, may not be appropriate to restoration approaches most needed now to address environmental degradation (Hobbs et al., 2009). They may be co-opted by human expectations, political imperatives and a moral justification for what is by and large unsustainable development, making the use of ecological baselines problematic for their own intended purpose (Alagona et al., 2012; Hobbs et al., 2009). Furthermore, the assumption that human influence is predominately negative can perpetuate the narrative that people around the globe are of equal blame for environmental degradation. This is not the case. Western and wealthy nations hold disproportionately more responsibility for continued negative environmental impacts, and within these nations, certain communities are more responsible than others (Althor et al., 2016; Robin, 2018).

One example of how ecological trends in species occurrence, population distributions and increases can combine with cultural expectations and biases to make baselines and trajectories of change difficult to reconcile (Estévez et al., 2015) is the continued stocking of invasive fish species for recreational fishing. Processes of human migration, exchange and the intentional introduction of plants and animals for domestication have occurred worldwide over long periods of time, with intentional introductions often predicated on making colonial settlements more familiar to European colonists (Crosby, 2004; Harris, 2004). Yet, despite the negative effects of these actions on biodiversity and ecosystems now being obvious (sometimes the subject of intense environmental reparation), invasive fish species continue to be stocked for personal or economic interests in many geographies, countering much needed conservation efforts for aquatic ecosystems (Skeate et al., 2022). To make our approach to global environmental

**TABLE 1** Management approaches, policy and restoration initiatives in aquatic environments influenced by awareness or quantification of a shifted baseline.

Environmental change	How was the shifting baselines concept used?	Effect on management, policy, restoration or other outcome
Functional extinction of oyster reefs across southern Australia	Model for why extensive loss and functional extinction was unknown in contemporary settings (Alleyway & Connell, 2015) Basis for increasing the legitimacy of policy and government investment into active restoration (McAfee et al., 2020) Encouragement and justification to engage in multi-disciplinary research to complete further historical analyses in areas where comparable losses were thought to have occurred (McAfee et al., 2022)	Public and private funding allocated to restoration initiatives on the basis of historical loss and potential to partially restore habitat and ecosystem services By 2023, > 40 shellfish reef restoration projects will be implemented across five states of Australia, including the largest area-based marine restoration project in the southern hemisphere A rapid increase in interest, public funding and links between knowledge of historical loss then recollection and restoration, prompting developments and investment into restoration of other marine species
Decline in snapper catch and effort and stock size across eastern Australia	Evidence of persistent fishery exploitation prior to previously set baseline (Thurstan et al., 2016) Justification for reconstructing estimates of past fish harvest and catch and effort trends, up to 60 years prior to the contemporary stock assessment baseline (Wortman et al., 2018)	Reconsideration of assumptions and parameters in contemporary fisheries management reference points (e.g. point at which modelling began was shifted back in time) Trends in historical catch rates included as data in stock assessment model
Persistent low stock status of Atlantic cod due to fishery exploitation	Justification for comprehensive description of stock sizes, dynamics and fisheries catch and effort pre-Second World War, concluding higher stock sizes at that time were a reference for biomass at low fishing impact (Eero et al., 2008) Justification to explore the effects of multiple, cumulative human activities; exploitation, climate-hydrographic conditions, climate change, marine mammal predation and eutrophication on cod stocks (MacKenzie, Eero, et al., 2011; MacKenzie, Ojaveer, et al., 2011)	New baselines were established for inclusion in fisheries management reference points, increasing the length of time over which Maximum Sustainable Yield could be considered for cod in the Baltic Sea and enabling impact of cumulative effects to be considered in plans for stock rebuilding

change more effective we see an immediate need to more comprehensively understand the implications of the shifting baseline syndrome specifically within the context of multiple ecological as well as social-ecological trajectories of change.

### 2.3 | Shortcoming 2: The weaponisation of baselines

The idea that 'pristine' ecosystems exist at all is also being challenged by new understanding of the Anthropocene (Thomas et al., 2020), and greater recognition that humans have provided stewardship for resources and lands over thousands of years (Ellis et al., 2021). We must recognise that framings of ecological pasts as pristine have been used to legitimise colonial dispossession of land, resources and autonomy, by casting Indigenous communities as primitive, lazy or ecologically destructive (Davis, 2007). In the majority of instances the loss of biodiversity is the result of the appropriation, colonisation and intensification of the use of environments that were sustainably used by Indigenous communities, rather than solely the result of human activity on untouched environments (Ellis et al., 2021). Believing that nature's healthiest form existed prior to human influence can erase Indigenous

people—and their homelands—from history. It is a profoundly colonialising mindset and enables the forced removal of Indigenous people from place and from history to be perpetuated. Similarly, when histories of stewardship are ignored, inaccurate or subverted views and claims can be used in conservation in problematic ways (Agrawal & Redford, 2009), which can increase the vulnerability of present Indigenous communities and their practices (Douglass & Cooper, 2020). Further work to expose these dynamics and their effects is needed.

## 3 | RE-ENVISIONING THE SHIFTING BASELINE SYNDROME

By recognising these shortcomings and addressing gaps in our current understanding of how the shifting baseline syndrome is used, as a concept and a basis for research, we see possibilities to achieve a more informed and just way forward in addressing environmental change. In relation to gaps, we note that prior studies of the phenomenon have made it clear that both cognitive and ecological baselines can vary over time, but empirical evidence of its action as a syndrome (i.e. why systemic shifts in baselines occur and can go unnoticed), is lacking (Jones et al., 2020; Papworth et al., 2009; Soga & Gaston, 2018). Also

scarce is research on the assumptions underlying the action of shifting baselines and variability in its effects (Campbell et al., 2009), including it having little to no influence on perceptions of environmental change (Jones et al., 2021).

In relation to re-envisioning the shifting baseline syndrome as a 'connective concept' (Simon, 2020), we see this could add valuable context to systemic or complex environmental challenges and the approaches we must take to overcome them. Environmental managers deal daily with situations at the intersection of human and natural systems. Such management is best guided when these systems are studied together and not treated as independent; the connectivity appreciated and investigated rather than siloed. Opportunities to address known gaps, the shortcomings we identify and to further develop the shifting baseline syndrome as a connective concept are discussed below. Additional examples of disciplinary needs and opportunities linked to each discussion, to expand the use of the shifting baselines syndrome as a connective concept in a range of disciplines, adding context or improving perceptions of ecological and social-ecological change, are provided in Table 2.

### 3.1 | Extending the disciplinary reach

Pauly originally defined the shifting baseline syndrome to illuminate the "true social and ecological costs of fisheries" (Pauly, 1995). Pauly pointed to other fields as models for integrating the past and people to generate more evidence-based baselines, noting astronomy and oceanography as those illustrating the value of "ancient observations". Considerable opportunity exists to explore the shifting baseline syndrome in a broader range of fields, including those that play a pivotal role in global social-ecological issues, such as public health and law; the former being a field of science affected by nature, the latter a field with extraordinary influence over its health and preservation.

In law, legal frameworks exist to regulate human behaviours, but law is also a reflection of societal values held by the hegemonic class. The shifting baseline syndrome could provide useful framing for considering the 'context' and factual situation of prior verdicts, and why the doctrine of precedent may be problematic in the new setting (Table 2). In addition, laws to respond to disasters or pressing environmental needs are often reactive (e.g. implementing a requirement for double-hulled oil tankers in response to the Exxon Valdez oil spill in 1989). Such responses in legal systems have systematically failed to prevent some of the world's most challenging environmental issues, such as the continued, escalating loss of biodiversity (Leadley et al., 2022). Ways, and impetus, to better pre-empt effective responses to environmental change are needed, which would be assisted by, for example, hindcasting, assessing the effects of historical resource use and its effects or investigating past ecosystem responses to climatic states and events.

In public health, 'planetary health' contends that the well-being of the environment and the well-being of people are intrinsically linked (Kahn, 2017; Seltenrich, 2018). However, the concept of the shifting baseline syndrome, to our knowledge, has not made its way

into the analytical vocabulary of this field. Historical analyses in public health often do not make a connection between contemporary trends and longer-term social-ecological transitions (McLennan & Ulijaszek, 2015), with analyses predominately limited in time, or focused on understanding the current setting rather than changes and their drivers. Interrogating community perspectives over time and how they have changed could help to fold in knowledge and explanation typically less foregrounded in health research, such as a communities' understanding and memories of the food systems they and their ancestors experienced but also shaped (Harper et al., 2019; and see Table 2).

Extending the disciplinary reach of the concept of shifting baselines could also assist to address known but as yet unresolved challenges in its use. In particular, it is commonly assumed by researchers that the reliability of accounts sourced from peoples' recall of events remain similar across individuals, cultures and generations or that scientific objectivity is not prone to cognitive and social biases, despite research showing otherwise (Berney & Blane, 1997; Bradburn et al., 1987; Daw, 2010). Engaging with other fields and schools of thought, such as sociology and cognitive science for better consideration of the assumptions underlying the shifting baseline syndrome and associated research would greatly improve our perspective on why, and how, the shifting baseline syndrome occurs and the variation in its effects across individuals, cultures and contexts.

### 3.2 | Expanding what is valued as evidence and expertise

A broader disciplinary perspective could be coupled with greater inclusion of evidence, expertise and 'ways of knowing'. Spurred by Pauly, ecology researchers have turned to published sources not typically used in contemporary sciences, such as archival data, fisheries and exploration logbooks, historical surveys, photographs, artwork and even cookbooks (Lozano-Montes et al., 2008; Pinnegar & Engelhard, 2008; Sáenz-Arroyo et al., 2006). Spanning ecology, sociology and history, documentation of oral histories has generated evidence of prior fish and stock sizes (Sáenz-Arroyo et al., 2005; Thurstan et al., 2016) and uncovered changing societal attitudes and expectations for fishing (Frawley, 2018). However, in many fields, there remains a tendency to privilege evidence from certain forms of information, such as statistically powered computational models that draw primarily on recent data (Thurstan et al., 2015). Past records continue to be questioned for their reliability, dismissed as lacking relevance or rigour, or remain unused because they are not yet formatted in ways that suit these new methods (Engelhard et al., 2016; Thurstan, 2022). In addition to these methodological biases, structural biases can further marginalise certain types of knowledge. For example, archives play a fundamental role in retaining historical information but they do not represent an unbiased record of the past. Certain stories, storytellers and types of knowledge are given primacy and privilege in these settings, which exerts authority over the information society accesses and therefore values (Schwartz & Cook, 2002).



TABLE 2 Examples of needs and opportunities to address knowledge gaps or expand the use of the shifting baselines syndrome as a connective concept.

Shortcoming or opportunity	Field	Example, action or event	Status or perception without consideration of the shifting baseline syndrome	Expanded perception with consideration of the shifting baselines syndrome
Extending the disciplinary reach	Medical sciences	Short time scales and datasets for baselines in 'before and after' and cohort studies	Medical and public health trends traced across relatively recent histories of globalisation and cultural change can overlook systemic trends or influences, including impacts from health issues and food consumption on the environment	Considering medical and health trends over longer periods of time can highlight additional societal and healthcare challenges, such as the recurrent nature of some issues and alternative approaches that may be more influential in addressing them (Parades, 2016). The shifting baseline syndrome could emphasise the importance of evaluating change over time and how this may influence health issues, and the environmental impacts of food production and consumption and its ecological burden
	Law	Contradictions within environmental law and privileging of certain knowledge and values	Western legal frameworks can be underpinned by property law, privileging the monetary value of land and by extension the means by which private ownership is secured, leading to the physical and social-ecological requirements of land protection being overlooked	More complete understanding of social and ecological change in locations and environments could enable the values that law privileges and upholds to be explored with respect to land rights and effective reparation (Graham, 2010). Examining shifting baselines would assist to identify where linked social-ecological changes may need to be more thoroughly understood
Expanding what is valued as evidence and expertise	Conservation science, ecology	A lack of creative approaches to inquiry and communication	Conservation science and ecology favour data-driven evidence, which requires specific models to be developed, with past data passively or actively excluded because it does not fit model parameters or data form	Adding narrative to science fosters reflection on data and results, providing a means to prompt thought and ideas beyond data-driven approaches, including transformative and ambitious conservation strategies (Louder & Wyborn, 2020; Wyborn et al., 2020). This creativity could foster new ways of thinking about or incorporating historical information in contemporary analyses, including ecological models
	Economics	Economic implications of fisheries stocks and the use of subsidies or incentives	Socioeconomic conditions determine economic responses to fisheries management, including the use of public-funded subsidies and incentives to influence market access or other economic stimuli. Focusing on contemporary stock status and needs can lead to unintended cultivation, illegal fishing or trade-offs between short-term fishery success and conservation needs	Evaluating changes in fishing pressure and fishing stocks over longer periods of time can identify 'hidden' effects that influence socioeconomic conditions, and could support more effective economic responses such as changing the choice or extent of economic stimuli and supporting policies, including policies that better balance fisheries needs with conservation (Abdallah & Sumaila, 2007; Brown & Trebilco, 2014). Shifting baselines in fisheries are well documented and the impetus for exploring the shifting baseline syndrome
Enhancing the potential for reflection and connection	Ecology	Ongoing introduction of non-native and invasive fish species despite their significant ecological impacts	Individuals and community groups such as recreational fishing groups, engage in the intentional, ongoing stocking of invasive fishes perceiving this to be a legitimate cultural activity and right	Examining European fisheries and the demand-drive transition from freshwater to marine fisheries affected by overfishing in that region highlights similarities in other regions, and the extent to which current practices are predicated on neo-European expectations and prejudices but how these can be overlooked (Alleway et al., 2016; Barrett et al., 2011)
	Indigenous ecological knowledge, ecology	Declines in keystone species and effects on opportunities for intergenerational knowledge exchange	Settler-driven declines and then recovery in keystone and culturally significant top predators have occurred and been reversed through conservation, but these approaches can exclude biocultural knowledge and contemporary needs of Indigenous communities	Including consideration of changing cultural connections through the lens of the shifting baseline syndrome in even well known, high-visibility keystone species can uncover unknown cultural legacies. For example, legacies of historical unregulated commercial hunting of Kingia, the saltwater crocodile <i>Crocodylus porosus</i> , and its effects on local Indigenous land owners including loss of access for customary harvesting and opportunities for biocultural knowledge exchange (Ligtermoet et al., 2022)
	Natural resource management	Exclusion or diminishment of the role of Indigenous practices in effective stewardship of resource use	Perpetuated perceptions that Indigenous use of natural resources over long periods of time has been low or non-existent, or that approaches to resource use have been simplistic	Indigenous communities have been undertaking sustainable use of resources for extraordinarily long periods of time, such as the use of shellfish for more than 10,000 years in North America and Australia (Reeder-Myers et al., 2022), and by engineering environments such as the making of ponds and keeping of fish (Costa-Pierce, 2022). Disregarding the significance of this role can be both a symptom and cause of shifting baselines, and the shifting baseline syndrome could be a tool to more justly explore this past

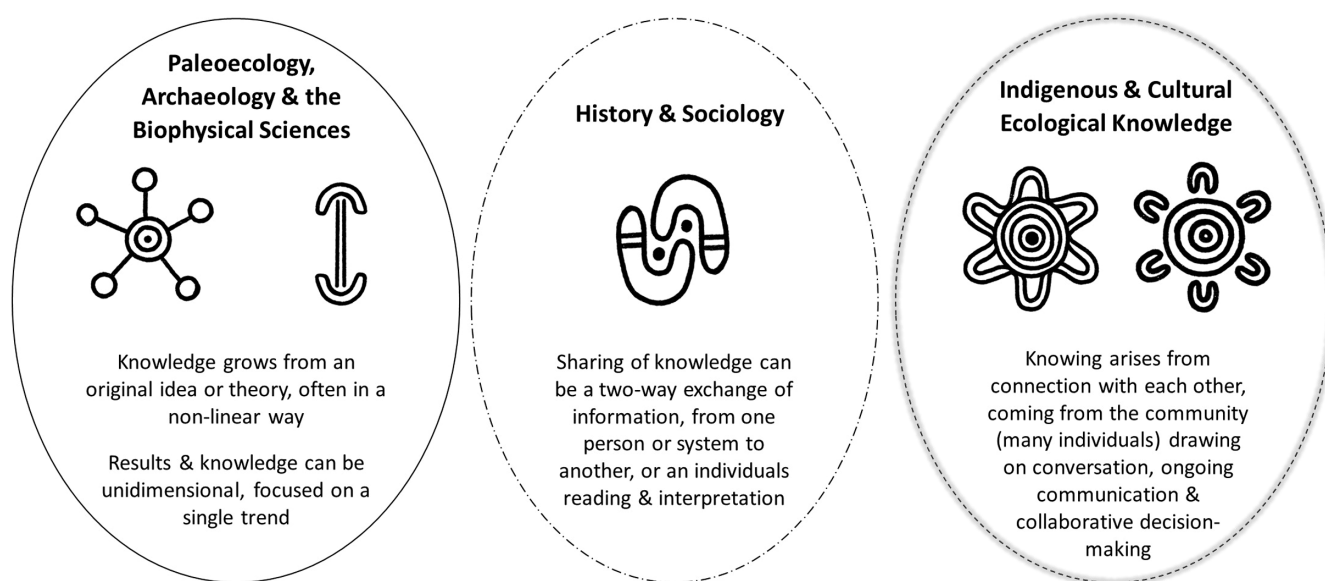
From our experience, Indigenous views of knowledge and 'ways of knowing' are also effectively missing from research on how base-lines shift. Yet, Indigenous cultures naturally respond to many ways of knowing, some of which draw on the interrelated self (Cameron, 2020); self being a driver of the shifting baseline syndrome. Indigenous and traditional ecological knowledge systems recognise and value the multiple ways in which knowledge is formed. These systems often arise from a non-linear approach to thinking, form cultural narratives that keep ways of living alive (Cameron, 2020), and come together to view complexity in as well as across ways of knowing as intrinsic and valuable. Conversely, a Western approach to inquiry typically aims to centralise information and understanding around a single view of a system, to reduce complexity to a more simplified point of reasoning. For instance, ecological modelling favours centralisation and simplification of a system and data. In these settings, knowledge exchange largely reflects a process of acquisition, an exchange of knowledge or data from 'here to there' ('what do you know, what do I know?'). By contrast, communication of Indigenous knowledge occurs through a process that is respected as adding to a narrative, which provides a means to understand and view multiple states and reasoning for the world around us. Narrative could be an important way to add thought and ideas for new approaches to conservation that foster greater reflection (Louder & Wyborn, 2020), while creativity in ways of thinking and communicating could foster the transformative change that is needed to address longstanding environmental challenges (Wyborn et al., 2020; and see Figure 1).

In addition, missing from current research on the shifting baseline syndrome is understanding of the role of 'place' in interpreting baselines and change (McAfee et al., 2021). Cultural and disciplinary differences in envisioning what is natural can influence the evidence that is consciously or subconsciously included in analyses (Table 2).

For example, an Indigenous sense of belonging is characterised by ancestry and connections to land and people, which recognises the interrelationship between humans and nature, reinforcing the inherent connection to Country (Cameron, 2020). A Western view of belonging is also characterised by place, but this sense of place often resonates deeply with owning; owning land and the primacy of individual property rights (Govind, 2020), occupying position and having a form of trade that binds an individual's identity to a location. The connection of these themes with the shifting baseline concept carries great potential to expand our awareness of human-nature relationships over time, what they mean in a contemporary setting and what their implications for the future may be.

### 3.3 | Enhancing the potential for reflection and connection

Specialist fields enable deeper analysis of specific problems. Yet, in entering specialist fields there is a risk that researchers lose sight of the broader foundations of their work and how those foundations shape their investigations (Table 2), which can lead to a lack of critique and the unexamined acceptance of paradigms (Graham & Dayton, 2002; Kuhn, 1962; Williams & Gordon, 2015). Science is increasingly recognising it must address imbalances, inequalities and scientific racism. Calls for researchers to build their practice on principles of community—both within and across disciplines—are particularly resonant here, as they highlight how interconnection and an ethic of care will improve equity in science and benefit society (Douglass, 2020; Rivera Prince et al., 2022). The shifting baseline syndrome provides a lens to look inwards. It is a concept that can help us better understand our personal and learned structural biases



**FIGURE 1** Symbolic Aboriginal cultural communication illustrates disciplinary approaches to knowledge and knowledge exchange. Symbols created by Prof Liz Belanjee Cameron.

associated with our perspectives, thereby recognising the limits of our own knowledge while respecting that of others (Cornell et al., 2013; O'Cathain et al., 2008; see Section 4 for further discussion on 'how').

The shifting baseline syndrome could also assist us to approach investigations of the present and future in dialogue with the past, making difficult conversations and the sharing of knowledge less confronting. Pauly's original purpose was to encourage fisheries scientists to engage with the past to inform an improved endpoint, to better perceive change in a system over time. But the past is real. It is an evolving part of the world around us connected to the current challenges we face. As a concept and a basis for research, the shifting baseline syndrome validates the importance of investigations that engage specifically with time, including deep time. In doing so, though, as highlighted above we will need to be mindful that we do not assume or bias a linear view of change, because this literal view could disconnect us from the broader implications of our more dynamic relationship with nature and our willingness to revisit past narratives and baselines once it is supposed that a more accurate baseline has been established.

## 4 | FOSTERING A MEANINGFUL RESPONSE

Re-envisioning the shifting baseline syndrome as a connective concept would assist us to establish more complete, true and reflective environmental baselines and responses to environmental change. This will require cross-disciplinary discourse and interdisciplinary studies, which we recognise take time and effort (effort not always rewarded through conventional structures in research), and field-specific language can perpetuate disciplinary silos or create misunderstanding in the viewpoints of others (Kuhn, 1977). Despite progress in interdisciplinarity (transdisciplinary work already exists describing approaches to bridge this gap in ecology and history, e.g. O'Cathain et al., 2008; Szabó & Hédl, 2011) there remain epistemological, methodological, and functional challenges to the inclusion of historical information and Indigenous knowledge that could inhibit research on this phenomenon, its wider spread use and its ongoing development as concept.

To assist individuals and teams to more deeply engage with shifting baselines as a connecting concept we identify several actions that would support critical but respectful thinking about how we observe and make opinions about environmental change. These actions effectively form 'principles' for investigations, where we may need to recognise that perspectives and ways of knowing will be different. These principles could be used as a soft or structural basis for enquiry, and can be viewed as both distinct and interlinked. For example, *decolonisation* (point 4) can be a need that underpins all principles, while *pluralist perspectives* or *interdisciplinarity* (points 1 and 2) could be adopted as more specific principles, to guide specific studies or needs.

1. *Commit to pluralist perspectives.* Pluralism in our understanding and presentation of information and knowledge, and ways of knowing, adds depth to our ability to perceive, share and

respect conclusions more accurately. Commitment to pluralism can also force a frank and transparent discussion about whose knowledge is prioritised, how knowledge is used, for what purpose and for whose benefit.

2. *Actively engage in interdisciplinarity.* An interdisciplinary approach must be actively enabled through using and, if need be developing, appropriate methods or tools that facilitate effective engagement across disciplines. It is the responsibility of individuals and disciplines equally to implement authentic and respectful integrative approaches.
3. *Work to reverse structural inequities.* Attention must be given to structural inequities in research that have led to marginalisation and exclusion of particular voices and value systems. These inequities diminish the opportunity to find new information and perspectives, which will ultimately add the knowledge and perspectives needed to address environmental change.
4. *Support social justice and decolonisation.* Decolonisation is recognising that Western ecological knowledge systems have been used to displace Indigenous people from their homelands, creating a void in equity and inclusion of a diversity of worldviews and an imbalance in how ecological research is produced and disseminated. Decolonisation is fundamentally about giving back what has been taken, recognising the value, consequences, and imperative of returning stolen lands, resources, knowledge, heritage, sovereignty and people. Understanding where baselines have shifted can assist us to assess and reassess what has been taken, the impacts of these actions and our responsibilities to return.
5. *Understand and appreciate time.* Time is an anchor for the representation of ecological and social baselines, but scientific processes can disproportionately focus on recent timeframes and a singular view of change. Actively building a more dynamic view of time could enable investigations of shifting baselines to be more informed and true. Examples include appreciating notions of cyclical time (as seen in some Indigenous ontologies) as opposed to the singular dominant lens of linear time and expanding understanding of the shifting baseline syndrome to include the application of deep time.

## 5 | CONCLUSION

A broader discussion on the presence and influence of the shifting baseline syndrome will help to shine light on the fact that every field of research has its own principles, perspectives and cultural context, and that these both influence and are influenced by the wider community. No science is truly objective (Daston & Galison, 2010; Haraway, 1988; Kuhn, 1962). By acknowledging the frailty of memory and remaining open to multiple perspectives, across disciplines, cultures and times, we can greatly improve how we view and use baselines in their many forms. It can enrich our understanding of what came before the present 'moment', helping to contextualise patterns of change, negative and positive, continuous and catastrophic. Achieving a more holistic and connected interpretation of ecosystem change and why it occurs is fundamental to effective and equitable reparation of environmental



and social-ecological issues (Lukasiewicz et al., 2017). Importantly, it can also provide a unique lens through which past environmental states can, and should, be iteratively revisited in dynamic ways. Ongoing, repeated reflection on the progress that is being made to address environmental challenges is at the centre of several significant global efforts, such as the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) and the Intergovernmental Panel on Climate Change (IPCC). Pauly originally concluded, for fisheries, that the shifting baseline concept can enable a more thorough evaluation of ecological change. We encourage his argument to be extended to embrace all sorts of environmental as well as social-ecological dynamics and believe the shifting baseline syndrome, as a connective concept, should be more widely used in the complex business of engaging with the anthropogenically altered nature of many 21st-century environments.

## AUTHOR CONTRIBUTIONS

Heidi K. Alleway and Ruth H. Thurstan conceptualised the evaluation and basis for the work, and with Emily S. Klein organised author discussions and development of the manuscript. All authors participated in discussions, exchanging of ideas, knowledge and information, and development of the manuscript including writing and review.

## ACKNOWLEDGEMENTS

We acknowledge and greatly thank the Editor, Associate Editor and several reviewers for their supportive, constructive and enjoyable engagement with our work during its review.

## CONFLICT OF INTEREST STATEMENT

The authors declare no conflict of interest.

## DATA AVAILABILITY STATEMENT

This manuscript does not include any data.

## ORCID

Heidi K. Alleway  <https://orcid.org/0000-0002-9322-5967>

Emily S. Klein  <https://orcid.org/0000-0001-9514-7344>

Liz Cameron  <https://orcid.org/0000-0002-4455-0288>

Kristina Douglass  <https://orcid.org/0000-0003-0931-3428>

Ishtar Govia  <https://orcid.org/0000-0001-6852-102X>

Cornelia Guell  <https://orcid.org/0000-0003-0105-410X>

Michelle Lim  <https://orcid.org/0000-0002-0559-0113>

Libby Robin  <https://orcid.org/0000-0002-5202-9185>

Ruth H. Thurstan  <https://orcid.org/0000-0002-8045-1631>

## ENDNOTES

<sup>1</sup> A collaborative multi-disciplinary team with expertise in ecology, historical ecology, environmental humanities and history, anthropology, Indigenous knowledge, archaeology, public health, food systems, psychology, law, and policy. Some team members were familiar with the shifting baseline syndrome and its use in ecology, policy, and communication, while others had no prior knowledge of Pauly's, 1995 paper and its applications. Our approach included unstructured conversation and structured questioning, specifically:

What is the shifting baseline syndrome and what does it mean to different fields of research (e.g. knowledge of the phenomenon, standing in research, impact upon research and management approaches, and the scope of general and community knowledge)? What do we know and not know about the shifting baseline syndrome? How does this standing affect our approach to environmental change and degradation? Are analogous ideas or models adopted in fields other than ecology? How would fields of science better proceed in understanding, measuring and applying the shifting baseline concept into the future, to influence action on environmental degradation and associated inequalities?

<sup>2</sup> Zoltán Boldizsár Simon defines connective concepts as those that "link not only certain disciplines, but ... also the work of the humanities and the work of the sciences" (Simon, 2020). He notes they are rare "and extremely difficult to intentionally develop", yet critical to transcending the sciences that treat the natural world as independent of humanity, and the knowledge systems that focus so much on humanity that the natural world is ignored or regarded as unchanging.

## REFERENCES

- Abdallah, P. R., & Sumaila, U. R. (2007). An historical account of Brazilian public policy on fisheries subsidies. *Marine Policy*, 31, 444–450. <https://doi.org/10.1016/j.marpol.2007.01.002>
- Agrawal, A., & Redford, K. (2009). Conservation and displacement: An overview. *Conservation and Society*, 7, 1–10.
- Alagona, P. S., Sandlos, J., & Wiersma, Y. F. (2012). Using historical ecology and baseline data for conservation and restoration projects in North America. *Environmental Philosophy*, 9, 49–70. <https://doi.org/10.5840/envirophil2012914>
- Albrecht, G., Sartore, G.-M., Connor, L., Higginbotham, N., Freeman, S., Kelly, B., Stain, H., Tonna, A., & Pollard, G. (2007). Solastalgia: The distress caused by environmental change. *Australasian Psychiatry*, 15, S95–S98. <https://doi.org/10.1080/10398560701701288>
- Alleway, H. K., & Connell, S. D. (2015). Loss of an ecological baseline through the eradication of oyster reefs from coastal ecosystems and human memory. *Conservation Biology*, 29, 795–804. <https://doi.org/10.1111/cobi.12452>
- Alleway, H. K., Gillanders, B. M., & Connell, S. D. (2016). 'Neo-Europe' and its ecological consequences: The example of systematic degradation in Australia's inland fisheries. *Biology Letters*, 12, 20150774. <https://doi.org/10.1098/rsbl.2015.0774>
- Althor, G., Watson, J. E. M., & Fuller, R. A. (2016). Global mismatch between greenhouse gas emissions and the burden of climate change. *Scientific Reports*, 6, 20281. <https://doi.org/10.1038/srep20281>
- Baisre, J. A. (2013). Shifting baselines and the extinction of the Caribbean monk seal. *Conservation Biology*, 27, 927–935. <https://doi.org/10.1111/cobi.12107>
- Barrett, J. H., Orton, D., Johnstone, C., Harland, J., Van Neer, W., Eryvynck, A., Roberts, C., Locker, A., Amundsen, C., Enghoff, I. B., Hamilton-Dyer, S., Heinrich, D., Hufthammer, A. K., Jones, A. K. G., Jonsson, L., Makowiecki, D., Pope, P., O'Connell, T. C., de Roo, T., & Richards, M. (2011). Interpreting the expansion of sea fishing in medieval Europe using stable isotope analysis of archaeological cod bones. *Journal of Archaeological Science*, 38, 1516–1524. <https://doi.org/10.1016/j.jas.2011.02.017>
- Beller, E., McClenachan, L., Trant, A., Sanderson, E. W., Rhemtulla, J., Guerrini, A., Grossinger, R., & Higgs, E. (2017). Toward principles of historical ecology. *American Journal of Botany*, 104, 645–648. <https://doi.org/10.3732/ajb.1700070>
- Berney, L. R., & Blane, D. B. (1997). Collecting retrospective data: Accuracy of recall after 50 years judged against historical records. *Social Science & Medicine*, 45, 1519–1525. [https://doi.org/10.1016/S0277-9536\(97\)00088-9](https://doi.org/10.1016/S0277-9536(97)00088-9)

- Bradburn, N. M., Rips, L. J., & Shevell, S. K. (1987). Answering autobiographical questions: The impact of memory and inference on surveys. *Science*, 236, 157–161. <https://doi.org/10.1126/science.3563494>
- Brand, F. S., & Jax, K. (2007). Focusing the meaning(s) of resilience: Resilience as a descriptive concept and a boundary object. *Ecology and Society*, 12, 23.
- Brown, C. J., & Trebilco, R. (2014). Unintended cultivation, shifting baselines, and conflict between objectives for fisheries and conservation. *Conservation Biology*, 28, 677–688. <https://doi.org/10.1111/cobi.12267>
- Cameron, L. (2020). “Healthy country, healthy people”: Aboriginal embodied knowledge systems in human/nature interrelationships. *The International Journal of Ecopsychology*, 1, 3.
- Campbell, L., Gray, N. J., Hazen, E. L., & Shackeroff, J. M. (2009). Beyond baselines: Rethinking priorities for ocean conservation. *Ecology and Society*, 14, 14.
- Cornell, S., Berkhout, F., Tuinstra, W., Tàbara, J. D., Jäger, J., Chabay, I., de Wit, B., Langlais, R., Mills, D., Moll, P., Otto, I. M., Petersen, A., Pohl, C., & van Kerkhoff, L. (2013). Opening up knowledge systems for better responses to global environmental change. *Environmental Science & Policy*, 28, 60–70. <https://doi.org/10.1016/j.envsci.2012.11.008>
- Costa-Pierce, B. (2022). The anthropology of aquaculture. *Frontiers in Sustainable Food Systems*, 6, 1–20. <https://doi.org/10.3389/fsufs.2022.843743>
- Crosby, A. W. (2004). *Ecological imperialism: The biological expansion of Europe, 900–1900* (2nd ed.). Studies in environment and history. Cambridge University Press. <https://doi.org/10.1017/CBO9780511805554>
- Cunsolo, A., & Ellis, N. R. (2018). Ecological grief as a mental health response to climate change-related loss. *Nature Climate Change*, 8, 275–281. <https://doi.org/10.1038/s41558-018-0092-2>
- Dannevig, H. C. (1903). *Murray cod fisheries. Extracts of evidence collected by the South Australian Authorities during October, 1900, with notes.* Department of Fisheries.
- Daston, L., & Galison, P. (2010). *Objectivity*. MIT Press.
- Davis, D. K. (2007). *Resurrecting the granary of Rome. Environmental history and French colonial expansion in North Africa*. Ohio University Press.
- Daw, T. M. (2010). Shifting baselines and memory illusions: What should we worry about when inferring trends from resource user interviews? *Animal Conservation*, 13, 534–535. <https://doi.org/10.1111/j.1469-1795.2010.00418.x>
- Dirzo, R., Young, H. S., Galetti, M., Ceballos, G., Isaac, N. J. B., & Collen, B. (2014). Defaunation in the Anthropocene. *Science*, 345, 401–406. <https://doi.org/10.1126/science.1251817>
- Douglass, K. (2020). Amy ty lilin-draza'ay: Building archaeological practice on principles of community. *African Archaeological Review*, 37, 481–485. <https://doi.org/10.1007/s10437-020-09404-8>
- Douglass, K., & Cooper, J. (2020). Archaeology, environmental justice, and climate change on islands of the Caribbean and southwestern Indian Ocean. *Proceedings of the National Academy of Sciences of the United States of America*, 117, 8254–8262. <https://doi.org/10.1073/pnas.1914211117>
- Eero, M., Köster, F. W., & MacKenzie, B. R. (2008). Reconstructing historical stock development of Atlantic cod (*Gadus morhua*) in the eastern Baltic Sea before the beginning of intensive exploitation. *Canadian Journal of Fisheries and Aquatic Sciences*, 65, 2728–2741. <https://doi.org/10.1139/F08-176>
- Ellis, E. C., Gauthier, N., Klein Goldewijk, K., Bliege Bird, R., Boivin, N., Diaz, S., Fuller, D. Q., Gill, J. L., Kaplan, J. O., Kingston, N., Locke, H., McMichael, C. N. H., Ranco, D., Rick, T. C., Shaw, M. R., Stephens, L., Svenning, J.-C., & Watson, J. E. M. (2021). People have shaped most of terrestrial nature for at least 12,000 years. *Proceedings of the National Academy of Sciences of the United States of America*, 118, e2023483118. <https://doi.org/10.1073/pnas.2023483118>
- Engelhard, G. H., Thurstan, R. H., MacKenzie, B. R., Alleway, H. K., Bannister, R. C. A., Cardinale, M., Clarke, M. W., Currie, J. C., Fortibuoni, T., Holm, P., Holt, S. J., Mazzoldi, C., Pinnegar, J. K., Raicevich, S., Volckaert, F. A. M., Klein, E. S., Lescrauwaet, A.-K., & Handling editor: Emory Anderson. (2016). ICES meets marine historical ecology: Placing the history of fish and fisheries in current policy context. *ICES Journal of Marine Science*, 73, 1386–1403. <https://doi.org/10.1093/icesjms/fsv219>
- Estévez, R. A., Anderson, C. B., Pizarro, J. C., & Burgman, M. A. (2015). Clarifying values, risk perceptions, and attitudes to resolve or avoid social conflicts in invasive species management. *Conservation Biology*, 29, 19–30. <https://doi.org/10.1111/cobi.12359>
- Frawley, J. (2018). “Dancing to the Billabong’s tune” oral history in the environmental histories of murray-darling basin Rivers. In *Telling environmental histories: Intersections of memory, narrative and environment, palgrave studies in world environmental history*. Springer International Publishing.
- Goodall, H., & Cadzow, A. (2009). *Rivers and resilience: Aboriginal people on sydney's georges River*. UNSW Press.
- Govind, P. J. (2020). Extinction in the anthropocene and moving toward an ethic of responsibility. 29, 534–560 <https://doi.org/10.1080/10383441.2020.1924951>
- Graham, N. (2010). *Landscape: Property, environment, law* (1st ed.). Routledge-Cavendish. <https://doi.org/10.4324/9780203847169>
- Graham, M. H., & Dayton, P. K. (2002). On the evolution of ecological ideas: Paradigms and scientific Progress. *Ecology*, 83, 1481–1489.
- Halpern, B. S., Frazier, M., Afflerbach, J., Lowndes, J. S., Micheli, F., O'Hara, C., Scarborough, C., & Selkoe, K. A. (2019). Recent pace of change in human impact on the world's ocean. *Scientific Reports*, 9, 11609. <https://doi.org/10.1038/s41598-019-47201-9>
- Hanazaki, N., Herbst, D. F., Marques, M. S., & Vandebroek, I. (2013). Evidence of the shifting baseline syndrome in ethnobotanical research. *Journal of Ethnobiology and Ethnomedicine*, 9, 75. <https://doi.org/10.1186/1746-4269-9-75>
- Haraway, D. (1988). Situated knowledges: The science question in feminism and the privilege of partial perspective. *Feminist Studies*, 14, 575–599.
- Harper, S. L., Berrang-Ford, L., Carcamo, C., Cunsolo, A., Edge, V. L., Ford, J. D., Llanos, A., Lwasa, S., & Namanya, D. B. (2019). The indigenous climate–food–health nexus: Indigenous voices, stories, and lived experiences in Canada, Uganda, and Peru. In *People and Climate Change*. Oxford University Press. <https://doi.org/10.1093/oso/9780190886455.003.0010>
- Harris, C. (2004). How did colonialism dispossess? Comments from an edge of empire. *Annals of the Association of American Geographers*, 94, 165–182. <https://doi.org/10.1111/j.1467-8306.2004.09401009.x>
- Hirsch, S. L. (2020). Anticipatory practices: Shifting baselines and environmental imaginaries of ecological restoration in the Columbia River basin. *Environment and Planning E: Nature and Space*, 3, 40–57. <https://doi.org/10.1177/2514848619857523>
- Hobbs, R. J., Higgs, E., & Harris, J. A. (2009). Novel ecosystems: Implications for conservation and restoration. *Trends in Ecology & Evolution*, 24, 599–605. <https://doi.org/10.1016/j.tree.2009.05.012>
- Hróbjartsson, A., Thomsen, A. S. S., Emanuelsson, F., Tendal, B., Hilden, J., Boutron, I., Ravaut, P., & Brorson, S. (2013). Observer bias in randomized clinical trials with measurement scale outcomes: A systematic review of trials with both blinded and nonblinded assessors. *Canadian Medical Association Journal*, 185, E201–E211. <https://doi.org/10.1503/cmaj.120744>
- Jackson, J. B. C. (2001). What was natural in the coastal oceans? *Proceedings of the National Academy of Sciences of the United States of America*, 98, 5411–5418. <https://doi.org/10.1073/pnas.091092898>

- Jones, L. P., Turvey, S. T., Massimino, D., & Papworth, S. K. (2020). Investigating the implications of shifting baseline syndrome on conservation. *People and Nature*, 2, 1131–1144. <https://doi.org/10.1002/pan3.10140>
- Jones, L. P., Turvey, S. T., & Papworth, S. K. (2021). Is there evidence of shifting baseline syndrome in environmental managers? An assessment using perceptions of bird population targets in UK nature reserves. *Journal of Environmental Management*, 297, 113308. <https://doi.org/10.1016/j.jenvman.2021.113308>
- Kahn, L. H. (2017). Perspective: The one-health way. *Nature*, 543, S47. <https://doi.org/10.1038/543S47a>
- Kuhn, T. S. (1962). *The structure of scientific revolutions* (1st ed.). University of Chicago Press.
- Kuhn, T. S. (1977). *The essential tension*. University of Chicago Press.
- Leadley, P., Gonzalez, A., Obura, D., Krug, C. B., Londoño-Murcia, M. C., Millette, K. L., Radulovici, A., Rankovic, A., Shannon, L. J., Archer, E., Armah, F. A., Bax, N., Chaudhari, K., Costello, M. J., Dávalos, L. M., Roque, F. D. O., DeClerck, F., Dee, L. E., Essl, F., ... Xu, J. (2022). Achieving global biodiversity goals by 2050 requires urgent and integrated actions. *One Earth*, 5, 597–603. <https://doi.org/10.1016/j.oneear.2022.05.009>
- Ligtermoet, E., Narndal Gumurdul, J., Nayinggul, C., & Baker, R. (2022). The return of the Kinga (*Saltwater crocodile*): Population 'bust then boom' shapes shifting baselines in indigenous biocultural knowledge in northern Australia. *Biological Conservation*, 277, 109746. <https://doi.org/10.1016/j.biocon.2022.109746>
- Lotze, H. K., Coll, M., Magera, A. M., Ward-Paige, C., & Airoidi, L. (2011). Recovery of marine animal populations and ecosystems. *Trends in Ecology & Evolution*, 26, 595–605. <https://doi.org/10.1016/j.tree.2011.07.008>
- Louder, E., & Wyborn, C. (2020). Biodiversity narratives: Stories of the evolving conservation landscape. *Environmental Conservation*, 47, 251–259. <https://doi.org/10.1017/S0376892920000387>
- Lozano-Montes, H. M., Pitcher, T. J., & Haggan, N. (2008). Shifting environmental and cognitive baselines in the upper gulf of California. *Frontiers in Ecology and the Environment*, 6, 75–80.
- Lukasiewicz, A., Dovers, S., Robin, L., McKay, J., Schilizzi, S., & Graham, S. (2017). *Natural resources and environmental justice: Australian perspectives*. CSIRO Publishing.
- MacKenzie, B. R., Eero, M., & Ojaveer, H. (2011). Could seals prevent cod recovery in the Baltic Sea? *PLoS ONE*, 6, e18998. <https://doi.org/10.1371/journal.pone.0018998>
- MacKenzie, B. R., Ojaveer, H., & Eero, M. (2011). Historical ecology provides new insights for ecosystem management: Eastern Baltic cod case study. *Marine Policy*, 35, 266–270. <https://doi.org/10.1016/j.marpol.2010.10.004>
- McAfee, D., Alleway, H. K., & Connell, S. D. (2020). Environmental solutions sparked by environmental history. *Conservation Biology*, 34, 386–394. <https://doi.org/10.1111/cobi.13403>
- McAfee, D., McLeod, I. M., Alleway, H. K., Bishop, M. J., Branigan, S., Connell, S. D., Copeland, C., Crawford, C. M., Diggles, B. K., Fitzsimons, J. A., Gilby, B. L., Hamer, P., Hancock, B., Pearce, R., Russell, K., & Gillies, C. L. (2022). Turning a lost reef ecosystem into a national restoration program. *Conservation Biology*, 36, e13958. <https://doi.org/10.1111/cobi.13958>
- McAfee, D., Reinhold, S.-L., Alleway, H. K., & Connell, S. D. (2021). Environmental solutions fast-tracked: Reversing public scepticism to public engagement. *Biological Conservation*, 253, 108899. <https://doi.org/10.1016/j.biocon.2020.108899>
- McLennan, A. K., & Ulijaszek, S. J. (2015). Obesity emergence in the Pacific islands: Why understanding colonial history and social change is important. *Public Health Nutrition*, 18, 1499–1505. <https://doi.org/10.1017/S136898001400175X>
- Meyer, W. J., & Crumley, C. L. (2012). Historical ecology: Using what works to cross the divide. In *Atlantic Europe in the first millennium BC: Crossing the divide*. Oxford University Press.
- Myers, S. S. (2017). Planetary health: Protecting human health on a rapidly changing planet. *The Lancet*, 390, 2860–2868. [https://doi.org/10.1016/S0140-6736\(17\)32846-5](https://doi.org/10.1016/S0140-6736(17)32846-5)
- O'Cathain, A., Murphy, E., & Nicholl, J. (2008). Multidisciplinary, interdisciplinary, or dysfunctional? Team working in mixed-methods research. *Qualitative Health Research*, 18, 1574–1585. <https://doi.org/10.1177/1049732308325535>
- Pandolfi, J. M., Bradbury, R. H., Sala, E., Hughes, T. P., Bjorndal, K. A., Cooke, R. G., McArdle, D., McClenachan, L., Newman, M. J. H., Paredes, G., Warner, R. R., & Jackson, J. B. C. (2003). Global trajectories of the long-term decline of coral reef ecosystems. *Science*, 301, 955–958. <https://doi.org/10.1126/science.1085706>
- Papworth, S. K., Rist, J., Coad, L., & Milner-Gulland, E. J. (2009). Evidence for shifting baseline syndrome in conservation. *Conservation Letters*, 2, 93–100. <https://doi.org/10.1111/j.1755-263X.2009.00049.x>
- Paradies, Y. (2016). Colonisation, racism and indigenous health. *Journal of Population Research*, 33, 83–96. <https://doi.org/10.1007/s12546-016-9159-y>
- Pauly, D. (1995). Anecdotes and the shifting baseline syndrome of fisheries. *Trends in Ecology & Evolution*, 10, 430.
- Pauly, D. (2019). *Vanishing fish: Shifting baselines and the future of global fisheries*. Greystone Books.
- Pinnegar, J. K., & Engelhard, G. H. (2008). The 'shifting baseline' phenomenon: A global perspective. *Reviews in Fish Biology and Fisheries*, 18, 1–16. <https://doi.org/10.1007/s11160-007-9058-6>
- Poulsen, B., & Schwerdtner Máñez, K. (2016). *Perspectives on oceans past: A handbook of marine environmental history*. Springer Science.
- Protzko, J., & Schooler, J. W. (2019). Kids these days: Why the youth of today seem lacking. *Science Advances*, 5, eaav5916. <https://doi.org/10.1126/sciadv.aav5916>
- Reeder-Myers, L., Braje, T. J., Hofman, C. A., Elliott Smith, E. A., Garland, C. J., Grone, M., Hadden, C. S., Hatch, M., Hunt, T., Kelley, A., LeFebvre, M. J., Lockman, M., McKechnie, I., McNiven, I. J., Newsom, B., Pluckhahn, T., Sanchez, G., Schwadron, M., Smith, K. Y., ... Rick, T. C. (2022). Indigenous oyster fisheries persisted for millennia and should inform future management. *Nature Communications*, 13, 2383. <https://doi.org/10.1038/s41467-022-29818-z>
- Ritchie, D. (2014). *Doing Oral history: A practical guide* (3rd ed.). Oxford University Press.
- Rivera Prince, J. A., Blackwood, E., Lanázuri, H. A., Leclera, E., Barnes, M., Douglass, K., Gutiérrez, M., Herr, S., Maasch, K. A., & Sandweiss, D. H. (2022). An intersectional approach to equity, inequity, and archaeology: A pathway through community. *Advances in Archaeological Practice*, 10, 382–396. <https://doi.org/10.1017/aap.2022.26>
- Roberts, C. (2007). *The unnatural history of the sea*. Shearwater.
- Robin, L. (2018). From the environment to the anthropocene: A history of changing expertise 1948–2018. In P. Warde, L. Robin, & S. Sörlin (Eds.), *The environment: The history of and idea*. John Hopkins University Press.
- Roman, J., Dunphy-Daly, M. M., Johnston, D. W., & Read, A. J. (2015). Lifting baselines to address the consequences of conservation success. *Trends in Ecology & Evolution*, 30, 299–302. <https://doi.org/10.1016/j.tree.2015.04.003>
- Rose, D. (1997). Chapter 2—The year zero and the north Australian frontier. In *Tracking knowledge in north Australian landscapes. Studies in indigenous and settler ecological knowledge systems*. The Australian National University, North Australia Research Unit.
- Ruiz, J. M. (2004). Oil spills versus shifting baselines. *Marine Ecology Progress Series*, 282, 307–309.
- Sáenz-Arroyo, A., Roberts, C. M., Torre, J., & Cariño-Olvera, M. (2005). Using fishers' anecdotes, naturalists' observations and grey literature to reassess marine species at risk: The case of the Gulf grouper in the Gulf of California, Mexico. *Fish and Fisheries*, 6, 121–133. <https://doi.org/10.1111/j.1467-2979.2005.00185.x>

- Sáenz-Arroyo, A., Roberts, C. M., Torre, J., Cariño-Olvera, M., & Hawkins, J. P. (2006). The value of evidence about past abundance: Marine fauna of the Gulf of California through the eyes of 16th to 19th century travellers. *Fish and Fisheries*, 7, 128–146. <https://doi.org/10.1111/j.1467-2979.2006.00214.x>
- Salvia, J. A., & Meisel, C. J. (1980). Observer bias: A methodological consideration in special education research. *Journal of Special Education*, 14, 261–270. <https://doi.org/10.1177/002246698001400213>
- Schwartz, J. M., & Cook, T. (2002). Archives, records, and power: The making of modern memory. *Archival Science*, 2, 1–19. <https://doi.org/10.1007/BF02435628>
- Schwerdtner Máñez, K., Holm, P., Blight, L., Coll, M., MacDiarmid, A., Ojaveer, H., Poulsen, B., & Tull, M. (2014). The future of the oceans past: Towards a global marine historical research initiative. *PLoS ONE*, 9, e101466. <https://doi.org/10.1371/journal.pone.0101466>
- Seltenrich, N. (2018). Down to earth: The emerging field of planetary health. *Environmental Health Perspectives*, 126, 072001. <https://doi.org/10.1289/EHP2374>
- Simon, Z. B. (2020). *The epochal event: Transformations in the entangled human, technological, and natural worlds, studies in the history of science and technology*. Palgrave Macmillan, Springer Nature.
- Skeate, E. R., Perrow, M. R., Tomlinson, M. L., Madgwick, G., Harwood, A. J. P., Ottewell, D., Berridge, R., & Winfield, I. J. (2022). Fish stocking for recreational angling is culpable for the poor condition of many English lakes designated for conservation purposes. *Inland Waters*, 12(1), 19–32. <https://doi.org/10.1080/20442041.2020.1867467>
- Soga, M., & Gaston, K. J. (2018). Shifting baseline syndrome: Causes, consequences, and implications. *Frontiers in Ecology and the Environment*, 16, 222–230. <https://doi.org/10.1002/fee.1794>
- Spennemann, D. H. R. (2022). The shifting baseline syndrome and generational amnesia in heritage studies. *Heritage*, 5, 2007–2027. <https://doi.org/10.3390/heritage5030105>
- Stoddard, J. L., Larsen, D. P., Hawkins, C. P., Johnson, R. K., & Norris, R. H. (2006). Setting expectations for the ecological condition of streams: The concept of reference condition. *Ecological Applications*, 16, 1267–1276. [https://doi.org/10.1890/1051-0761\(2006\)016\[1267:SEFTEC\]2.0.CO;2](https://doi.org/10.1890/1051-0761(2006)016[1267:SEFTEC]2.0.CO;2)
- Szabó, P., & Hédli, R. (2011). Advancing the integration of history and ecology for conservation. *Conservation Biology*, 25, 680–687. <https://doi.org/10.1111/j.1523-1739.2011.01710.x>
- Thomas, J. A., Williams, M., & Zalasiewicz, J. (2020). *The Anthropocene*. Polity.
- Thomas, K. A. (2020). Shifting baselines of disaster mitigation. *Climate and Development*, 12, 147–150. <https://doi.org/10.1080/17565529.2019.1605875>
- Thurstan, R. H. (2022). The potential of historical ecology to aid understanding of human–ocean interactions throughout the Anthropocene. *Journal of Fish Biology*, 101, 351–364. <https://doi.org/10.1111/jfb.15000>
- Thurstan, R. H., Campbell, A. B., & Pandolfi, J. M. (2016). Nineteenth century narratives reveal historic catch rates for Australian snapper (*Pagrus auratus*). *Fish and Fisheries*, 17, 210–225. <https://doi.org/10.1111/faf.12103>
- Thurstan, R. H., McClenachan, L., Crowder, L. B., Drew, J. A., Kittinger, J. N., Levin, P. S., Roberts, C. M., & Pandolfi, J. M. (2015). Filling historical data gaps to foster solutions in marine conservation. *Ocean & Coastal Management*, 115, 31–40. <https://doi.org/10.1016/j.ocecoaman.2015.04.019>
- Trompette, P., & Vinck, D. (2009). Revisiting the notion of boundary object. *Revue d'anthropologie Des Savoirs* 3.
- Weir, J. (2009). *Murray River country: An ecological dialogue with traditional owners*. Australian Institute of Aboriginal and Torres Strait Islander Studies.
- Williams, S. J., & Gordon, H. L. (2015). Paradigms and progress in conservation science. *Conservation Biology*, 29, 3–4. <https://doi.org/10.1111/cobi.12424>
- World Health Organization. (2021). *Nature, biodiversity and health: An overview of interconnections*. WHO Regional Office for Europe.
- Wortman, J., O'Neill, M. F., Sumpton, W. D., Campbell, M. J., & Stewart, J. (2018). *Stock assessment of Australian east coast snapper, Chrysophrys auratus predictions of stock status and reference points for 2016 (technical report)*. Department of Agriculture and Fisheries, State of Queensland.
- Wyborn, C., Davila, F., Pereira, L., Lim, M., Alvarez, I., Henderson, G., Luers, A., Martinez Harms, M. J., Maze, K., Montana, J., Ryan, M., Sandbrook, C., Shaw, R., & Woods, E. (2020). Imagining transformative biodiversity futures. *Nature Sustainability*, 3, 670–672. <https://doi.org/10.1038/s41893-020-0587-5>

**How to cite this article:** Alleway, H. K., Klein, E. S., Cameron, L., Douglass, K., Govia, I., Guell, C., Lim, M., Robin, L., & Thurstan, R. H. (2023). The shifting baseline syndrome as a connective concept for more informed and just responses to global environmental change. *People and Nature*, 00, 1–12. <https://doi.org/10.1002/pan3.10473>