



Is poor mental health an unrecognised occupational health and safety hazard for conservation biologists and ecologists? Reported incidences, likely causes and possible solutions

Paul I. Boon 

For full list of author affiliations and declarations see end of paper

***Correspondence to:**

Paul I. Boon
School of Geography, Earth and Atmospheric Sciences, The University of Melbourne, Parkville, Vic. 3010, Australia
Email: paul.boon@unimelb.edu.au

Handling Editor:

Graham Fulton

Received: 10 September 2021

Accepted: 25 April 2022

Published: 2 June 2022

Cite this:

Boon PI (2023)
Pacific Conservation Biology, **29**(4), 273–291.
doi:[10.1071/PC21059](https://doi.org/10.1071/PC21059)

© 2023 The Author(s) (or their employer(s)). Published by CSIRO Publishing.
This is an open access article distributed under the Creative Commons Attribution-NonCommercial-NoDerivatives 4.0 International License ([CC BY-NC-ND](https://creativecommons.org/licenses/by-nc-nd/4.0/)).

OPEN ACCESS

ABSTRACT

Workers in many professions suffer from poor mental health as a result of their employment. Although a bibliographic search generated little published evidence for poor mental health among conservation biologists and ecologists, the phenomenon has been reported among researchers working on coral reefs, climate change, wildfires and threatened species. Factors responsible for poor mental health include (1) epistemic attributes associated with conservation biologists' and ecologists' deep knowledge base; (2) non-epistemic values associated with their view of the natural world; and (3) a complex suite of factors relating to the wider social, political and economic milieu in which they practise their trade. Because it relates directly to employment, poor mental health among conservation biologists and ecologists must be differentiated from the phenomena of 'environmental grief' and 'solastalgia' reported in the wider community. A number of solutions to the problem have been suggested, including appreciating the conservation successes that have been achieved, recognising the importance of collegiality and comradeship, acknowledging the role of grieving rituals, active intervention via therapeutic counselling, reducing the incidence of censorship and repression of scientists' research, and the adoption of a Stoic view of the world. I propose a different approach: conservation biologists and ecologists should reposition their personal experiences within an historical perspective that sees them as part of a long tradition of struggle to protect the natural environment. An apt rallying cry to help conservation biologists and ecologists manage their mental health is Pablo Casals' 'The situation is hopeless. We must take the next step'.

Keywords: climate change, conservation, environmental change, extinction, fire ecology, Great Barrier Reef, social sciences, wildlife management.

Introduction

Each morning I take my dogs for an amble through my local suburban park in inner south-eastern Melbourne (Victoria, Australia). They enjoy their walk and I enjoy seeing my favourite trees, a particularly massive sugar gum (*Eucalyptus cladocalyx*) at least as big as the famed specimen in the Waite Arboretum in Adelaide (South Australia), a pair of redoubtable red ironbarks (*Eucalyptus tricarpa*), and a grove of graceful lemon-scented gums (*Corymbia citriodora*). I greet each tree with a warm welcome and congratulate it on being such a fine specimen, then bid it farewell until tomorrow ([Fig. 1a](#)).

I know that I am not alone in having meaningful conversations with trees. The heir apparent to the English throne and future head-of-state of the Commonwealth of Australia (i.e. HRH Prince Charles) is reported as saying that regularly talking to trees is something 'that keeps him relatively sane' ([Sydney Morning Herald 2010](#)). Poets have often enjoyed consequential relationships with trees, most notably the great 18th- and 19th-century nature poets William Cowper and John Clare ([Hayman 2003](#)). Photographers and artists make portraits of trees significant to them (e.g. [Pakenham 1998](#); [Allen and Baker 2009](#)); similarly, writers have been known to prepare essays – almost love letters – on their



Fig. 1. (a) Sugar gum (*Eucalyptus cladocalyx*). (b) *Eucalyptus* tree in the same urban park showing the terminal stages of infection with water mould (*Phytophthora cactorum*).

favourite trees (e.g. [Pembroke 2009](#)). And of course, Aboriginal people have for millennia spoken to Country, sung songs to it, worried about it, and longed for it ([Rose 1996](#)); the Australian anthropologist W.E.H. Stanner pointed out in his 1953 essay *The Dreaming* that in one Aboriginal tribe in the Northern Territory ‘... all women, without exception, call particular birds or trees by the same kinship terms which they apply to actual relatives. In the same way, all men without exception use comparable terms for a different set of trees or birds’ ([Stanner 2009](#), pp. 66–67).

Unfortunately my daily visits to the park are tempered by the knowledge that many of its trees face a dire threat: water mould, a disease caused by the pathogenic fungus *Phytophthora cactorum*, has already claimed nearly half-a-dozen victims among the eucalypts ([Fig. 1b](#)). Having worked on the (in)effectiveness of community education programs in controlling the spread of the related cinnamon fungus (*Phytophthora cinnamomi*) in the Brisbane Ranges National Park to the west of Melbourne ([Boon et al. 2008](#)), I understand well the terminal nature of the disease. The first sign is the death of the topmost leaves of an infected plant, followed by a progressive thinning of the crown, which over the course of the next few months becomes so depleted that a formerly magnificent tree is reduced to a pile of naked branches. The tree is by then dead, and its fate is to be grubbed out by the local council workers or their subcontractors. I have already seen a number of trees in the park succumb to *P. cactorum*, and during each walk I experience a feeling of dread that soon there will be signs of yet another magnificent tree having a death sentence passed on it.

This homily leads to the core theme of this paper: is the anxiety, the dread, the sense of impending loss that I experience in my daily walks through a local park – emotions induced by the death of nature and my impotence to do anything about it – indicative of a wider psychological malaise among conservation biologists and ecologists? From a global perspective, my dread of the impending loss of a few (planted) trees is clearly trivial. But is a sense of grief and helplessness at the loss of the natural world now sufficiently pervasive among conservation biologists and ecologists that it should be seen as a precursor to poor mental health and as a very real occupational health and safety (OH&S) hazard more generally?

I tackle this topic by asking three questions: (1) Can a case be made that conservation biologists and ecologists often suffer from work-related poor mental health? (2) If so, what are the likely causes? and (3) What correctives could be applied to ameliorate the situation? My examples are drawn primarily from Australia, for the simple reason that these are the ones I am most familiar with. There is little doubt, however, that the subjects tackled in this essay have a worldwide application. But before I tackle these questions, it is necessary to define what is meant by the term ‘mental health’ and what factors are recognised as contributing to its deterioration among the wider population.

What is mental health?

The [World Health Organization \(2018\)](#) defines mental health as ‘... a state of well-being in which an individual realises his

or her own abilities, can cope with the normal stresses of life, can work productively and is able to make a contribution to his or her community'. It acknowledges that a wide range of factors influence an individual's mental health, including socio-economic pressures, exposure to sexual, domestic or institutionalised violence, rapid and undesirable social change, stressful work conditions, gender discrimination, social exclusion, physical ill-health, and human-rights violations. Very often, an individual's employment and working conditions are also relevant, as illustrated below. It is important to stress that poor mental health is not the same as mental illness or the presence of specific mental disorders such as bipolar disorder, schizophrenia or other psychoses. Moreover, an individual's mental health is not a constant: it can vary from week to week and even from day to day.

Poor mental health as an OH&S hazard in workers in other professions

There is ample evidence that employment conditions are directly responsible for a suite of adverse mental health outcomes in many professions. People working in the 'caring professions' – social workers, nurses, paramedics etc. – are highly susceptible to compassion fatigue, burnout and depression (Hricová *et al.* 2020). Serving and returned military personnel are at a very high risk of developing post-traumatic stress disorder, frequently resulting in family breakdown and, at its worst, the soldier's suicide (Forrest *et al.* 2018; Jamieson *et al.* 2020). Fly-in/fly out mining workers in remote sites across Australia are well known to suffer from a high incidence of depression and anxiety, often also from various types of drug abuse and especially alcoholism (James *et al.* 2018), and construction workers have unusually high rates of suicide (Chan *et al.* 2020). Among the occupations with strong links to the natural environment, road-kill rescue workers and farmers are frequently documented as suffering from poor mental health (Edwards *et al.* 2015; Engelfield *et al.* 2018, 2019; Perceval *et al.* 2019; Yazd *et al.* 2020), as are veterinarians (Fritschi *et al.* 2009; Tomasi *et al.* 2019). Is there any evidence to suggest that conservation biologists and other scientists working in ecological or environmental disciplines are similarly prone to some form of mental ill-health arising directly from their employment?

Mental health of conservation biologists and ecologists: what does a bibliographic search indicate?

An automated search of the bibliographic database 'Web of Science' (all databases) in April 2021 using the search terms 'mental health ecologist Australia' returned only three records, and of these only the paper by Driscoll *et al.* (2021),

on censorship of ecological research, was relevant. The search terms 'ecologist depression' returned 49 reports, but only one was relevant (Woodwell 2016); 'nature conservation mental illness' generated 10 results, of which only three were potentially relevant (Freeman 1978; Dean *et al.* 2011; Reddon and Durante 2018). In contrast, a search using the more general terms 'mental health Australia' returned 16 221 results.

These results suggest that, although there is appreciable awareness of mental-health problems in Australia, there is little in the peer-reviewed scientific literature on the possibility that conservation biologists and ecologists also suffer from work-related mental health problems. There are, however, well-known limitations in the use of automated bibliographic databases (e.g. Calver *et al.* 2017; Brierley 2021, p. 145) and a less robotic interrogation of the available literature – articles in scientific journals not identified in the bibliographic search, as well as articles in the popular press, in the mass media and in web-based communication forums – provides a quite different interpretation.

The magnitude of the problem: evidence from other primary sources

As far as I can tell, the first article in the scientific literature reporting the negative psychological impact of their work on conservation biologists or ecologists is a short paper in *BioScience*, in which Windle (1992) drew attention to her sense of loss when confronted with the landscape-scale collapse of dogwood woodlands in north-western USA, losses caused by infection with the pathogenic fungus *Discula destructiva*. The topic has since been taken up in a large number of articles, few or none of which were identified in the electronic bibliographic search. Swaisgood and Sheppard (2010, p. 262), for example, contended that there was a 'continuing culture of hopelessness among conservation biologists' and that the discipline had yet to find a way to address the problem of widespread despair among its members. However, the hopelessness referred to by Swaisgood and Sheppard (2010) seemed to relate more to a poor prognosis for environmental improvement than to a wider psychological sense of despair occasioned by loss, grief, anxiety or even dread that forms the focus of this paper.

Harry Recher, the well-known bird ecologist, confessed in an article titled 'What makes this old scientist grumpy' that he was grumpy (i.e. sad, angry, cantankerous and complaining) because over his life he had 'witnessed his most cherished parts of the natural world destroyed before his eyes' (Recher 2013, p. 6). Agreed, grumpiness is not the same as poor mental health, but this is merely the beginning of the catalogue of examples.

Hobbs (2013, pp. 145, 146), when analysing attitudes to invasive species in Australia by conservation biologists, concluded that many scientists involved in ecological rehabilitation seemed to be 'grieving for the past': 'It could be argued that most ecologists and conservation biologists live mostly in a world characterised by loss, and hence are either wittingly or unwittingly in a constant state of grief. This has been discussed only rarely in the literature, and scientists and practitioners rarely talk about the emotional aspects of what they do'.

Griffiths (2015, p. 171) similarly observed that 'Australian history is like a giant experiment in ecological crisis and management, sometimes a horrifying concentration of environmental damage and cultural loss, and sometimes a heartening parable of hope and learning. Ecologists working in Australia today often feel like they are ambulance drivers arriving at the scene of an accident'.

Morton (2017) concurred, arguing that the prevailing attitude among Australian ecologists when confronted with the enormity of human impact on Australian landscape and biota was pessimism, although as with Swaisgood and Sheppard (2010) it is likely that this point of view derived more from doubts among conservation biologists that environmental improvement would ever take place than to the specific topic of mental ill-health occasioned directly from their employment.

Brierley (2021, p. 145) also recognised the problem of negativity among environmental scientists and asked the question, 'In contemplating prospective futures of the cosmic zoo, are we hopeful, envisaging and enacting the world as it could be, or do we act with fear and lethargy, despairing for the world as it is doomed to be ... Is that glass half full, or is it half empty?'

The philosopher and literary scholar Timothy Morton, when interviewed on ABC Radio National about his book 'Ecology without Nature', confessed to the interviewer that when considering the state and trajectory of the natural world, 'I'm really just bluffing because if I was [sic] to emotionally feel what I guess it's all about right now I'd be crying in the foetal position on the floor and be unable to do this interview' (Green 2021). Any job that reduces its practitioners or academic commentators to lying on the floor, weeping, must by any measure be considered as having negative mental health consequences. It goes far beyond merely feeling grumpy.

The above examples refer to some generalised aspect of emotional unease among conservation biologists, ecologists and other types of environmental scientists. But during my hunt for relevant material not identified in the automated bibliographic search, I was able to uncover five unequivocal examples of grief, helplessness and dread among disparate groups of environmental scientists. The first is provided by coral-reef researchers working on the Great Barrier Reef, who are widely reported as having been emotionally devastated, even to have openly wept, when confronted

with the impacts of yet another coral-bleaching event (Yong 2017; Brodie and Grech 2019; Conroy 2019; Marshall *et al.* 2019).

Second, there are now many reports of climate-change scientists being subject to adverse mental-health outcomes as a direct result of their work (e.g. Head and Harada 2017; Clayton 2018; Harrison 2019; Jovarauskaite and Böhm 2021; Renouf 2021). Clayton (2018, p. 260) concluded that climate-change scientists were susceptible to mental ill-health precisely because 'they are immersed in depressing information and may face apathy, denial and even hostility from others'.

The third example comes from the experience of the wildfires of 2019–2020 in south-eastern Australia. The social effect of these fires and the abject failure of various levels of government to prepare for them or to manage their aftermath have been widely reported (e.g. Neiman 2020). The response of conservation biologists and ecologists was described in two articles in the online science-communication magazine, *The Conversation*. In the first, Garnett *et al.* (2020) introduced their essay with the observation that 'The nation's silent, apocalyptic firescapes have left many conservation biologists grieving – for the animals, the species, their optimism, and for some, lifetimes of diligent work'. They went on to observe that 'Many researchers are bereft and questioning their chosen vocation'. In the second article, Teixeira (2020) reviewed her responses to the fires on Kangaroo Island (South Australia) and reflected that 'I felt immense grief standing at the nesting site. I grieved not only for the glossy black cockatoos and other damaged species, but also the loss that would come in the future under climate change'. She then observed that, although that initial sense of bottomless grief had passed, '... an underlying sadness, and concern for the future, remains. From my discussions with other conservationists, I know I'm not the only one to feel this way'.

The two articles in *The Conversation* provide a telling juxtaposition: the contributing authors to Garnett *et al.* (2020) are senior ecologists at the professorial level; Daniella Teixeira is a recent PhD graduate, an early-career researcher. Clearly, the feelings of grief and despair are not limited to those with decades of experience in conservation biology but, worryingly, are apparent also in the youngest members of the ecological work force.

The fourth example concerns scientists working with threatened species and their extinction. Their experience is perhaps the most harrowing. Two examples follow, one a collation of personal experiences following the extinction of an island bat and the other a case study from Western Australia involving threatened shore birds.

Chapter 8 of John Woinarski's monograph on the extinction of the Christmas Island pipistrelle (*Pipistrellus murrayi*) collated the personal accounts of how the loss of this very small insectivorous bat from Christmas Island (Indian Ocean) affected many of the ecologists attempting

its conservation and, in some cases, those formally responsible for its management (Woinarski 2018). Weighing just over 3 g, the Christmas Island pipistrelle is among the smallest mammal in the world. It is also Australia's most recent mammal species to suffer extinction, having been extirpated in 2009. It is by no means the only mammal on Christmas Island to have gone extinct since the island was settled by Europeans in the late 19th century: both native species of *Rattus* became extinct within two decades of the island's colonisation, and the two remaining species of mammal, a shrew and a second species of bat, are listed nationally as threatened. Since the last record of the shrew was in 1985, it too is now probably extinct (James *et al.* 2019).

The first account of the bat's extinction in Woinarski's collation was provided by David James, the ecologist who led the Christmas Island Biodiversity Monitoring Programme: 'The extinction of the Christmas Island Pipistrelle will haunt and trouble me for the rest of my life' (Woinarski 2018, p. 183). Other terms used in James' account are equally distressing: 'harshly disillusioning', 'impotent', 'disappointing', 'grim reality' and 'bitter realisation', the latter made even worse by the realisation the extinction had occurred '... for the sake of a few trivial political manoeuvres'.

The second account comes from the ecologist who led the bat monitoring program since 1994, Lindy Lumsden: 'Even almost a decade on, I still find it very distressing to write, or talk, about the extinction of the Christmas Island pipistrelle and how I was unable to prevent it' (Woinarski 2018, p. 188). She confessed the causes (ecological and political) of the extinction were '... questions that will continue to haunt me for decades to come'; the last night she heard the bat's call was '... a date that will be etched forever on my mind'; and 'But I couldn't [prevent the extinction], and in addition to having to live with knowing the species went extinct, I have to live with my overwhelming feelings of inadequacy and failure' (p. 196).

The third account, from an independent consultant ecologist, recalled the experience as a 'heartbreak' and '... a very sad phase in my life' (p. 199). In providing a synthesis of these personal recollections, Woinarski (2018, p. 181) concluded 'In part, the risk of such pain is an occupational hazard in attempting to conserve threatened species, or the natural environment generally: there will be many losses and few wins. Some of these accounts should be read as victim impact statements'.

The Western Australian example concerns the monitoring of shore birds, including the threatened hooded plover (*Thinornis cucullatus*) and fairy tern (*Sternula nereis*), both species listed as vulnerable in Australia, on a beach in a Ramsar-listed wetland in suburban Perth (Fulton 2022). The author reports being shot at and threatened with being run over by drivers of 4WD vehicles on the beach and his reports of their illegal activities being ignored by the relevant

government departments. The emotional and mental consequences were described by Fulton (2022, p. 17) as:

So, after being shot at and threatened with being run over, then dismissed by the Government Departments charged with the responsibility of managing the parks (and cars) ... am I disheartened!? Well, yes, I am. The hooded plovers and fairy terns disappeared from Becher Point during my observations. If they returned I do not know. It is not safe for me to check. Sorry, no happy ending.

Despite the failure of the automated bibliographic search to identify relevant examples such as the ones described above, the peer-reviewed literature clearly does contain considerable evidence for poor mental health among conservation biologists and ecologists. In a short letter to the journal *Science*, Gordon *et al.* (2019) posited that environmental scientists were frequently, by the very nature of their work, exposed to severe environmental loss but had few or no professional mechanisms to deal with the grief and trauma that inevitably ensued. Along similar lines, Park *et al.* (2020, p. 1) pointed out that 'Grief and hopelessness are frequently part of the 'emotional labour' of conservation and environmental work...'. Batavia *et al.* (2020) also invoked grief at a number of points in their paper on the moral dimensions of conservation biology, suggesting that with regard to the matter of conservation-based animal culling '... grief may help conservationists retain moral integrity' and that conservationists should, in fact, '... intentionally open themselves to grief' (p. 1119). I also addressed the topic in my recent overview of the environmental history of Australia's rivers, where I pointed out the emotionally debilitating effect of decades of working on seriously degraded waterways and floodplains in the irrigation districts of northern Victoria and southern New South Wales (Boon 2020).

To conclude, I believe there are good *prima facie* grounds from the primary scientific literature as well as from other published sources that many conservation biologists and ecologists, working in a wide range of fields, experience psychological trauma – feelings of loss, grief, anxiety, dread, powerlessness, undischarged responsibility – as a direct result of their work. At the very least, conservation biologists and ecologists are deeply pessimistic as to the demonstrable state and trajectory of the natural world and the likelihood of improvement (e.g. Swaisgood and Sheppard 2010; Morton 2017; see also Sale 2011; Recher 2015). In the worst cases, they are traumatised by their experiences (e.g. Woinarski 2018; Teixeira 2020; Fulton 2022).

A central point of this paper is that these mental-health consequences have to be differentiated from the more general expressions of solastalgia and environmental grief that afflict much of the wider population. The distinction is

critical because in the case of conservation biologists and ecologists the adverse consequences can be traced directly to their employment. They then become a potential OH&S hazard, and this has a number of serious implications not only for the individual scientists but also for their employers.

Solastalgia and environmental grief

Around the same time as Windle (1992) was drawing attention to environmental loss among practising conservation biologists, an article in the *Washington Post* claimed that ‘eco-anxiety’ was a ‘national ailment’ in the USA (Wardell 2020). In more recent years, two other terms have come into widespread use to describe the distress suffered by people when they personally experience environmental degradation: (1) ‘environmental grief’, a term invoked by Kevorkian (2014); and (2) ‘solastalgia’, a term introduced by Albrecht *et al.* (2007). Kevorkian (2014, p. 2) defined environmental grief as ‘the grief reaction stemming from the environmental loss of ecosystems caused by natural or man-made events’. Albrecht *et al.* (2007, p. 95) defined solastalgia as ‘the distress that is produced by environmental change impacting on people while they are directly connected to their home environment’. In a later synthesis, Albrecht (2020, p. 9) described it as ‘the lived experience of negative environmental change’.

The concepts of environmental grief and solastalgia are now invoked in many articles, especially in relation to the psychological effects of climate change and biodiversity loss (e.g. Barnett *et al.* 2016; Landman and Cunsolo 2017; Cunsolo and Ellis 2018; Wake 2018; Harrison 2019; Clayton 2020; Cianconi *et al.* 2020; Cunsolo *et al.* 2020; Wardell 2020; Comtesse *et al.* 2021). The concept of solastalgia has struck a particular chord with many commentators, and the term appears in a range of research papers on the psychological responses of people to environmental change, usually degradation (e.g. Eisenman *et al.* 2015; Askland and Bunn 2018; Galway *et al.* 2019; Howell *et al.* 2019).

Although these two terms may be new, the despair they describe is not. It is clear that sensitive observers have for centuries been emotionally drained by the experience of environmental loss. The aforementioned nature poets of the 18th- and 19th-centuries, William Cowper (1731–1800) and John Clare (1793–1864), wrote in anguished terms about their distress when the well-loved landscapes in which they lived and worked were destroyed. It is even possible that John Clare’s long bouts of severe depression and subsequent incarceration in mental asylums for the last 27 years of his life were due at least in part to ‘the loss of almost all he knew and loved’ (Monbiot 2012). Writing on

his grief – and anger – at the imminent cutting down of two elm trees growing near his cottage, Clare wrote:

... my two favourite Elm trees at the back of the hut are condemned to dye it shocks me but tis true the savage who owns them thinks they have done their best and now he wants to make use of the benefits he can get from selling them – O was this country Egypt and was I but a caliph the owner should loose his ears for his arrogant presumption and the first wretch that buried his axe in their roots should hang on their branches as a terror to the rest – I have been several mornings to bid them farewell – had I £100 to spare I would buy their reprieves – but they must dye... (Bate 2000, p. 172).

Two centuries later, in the mid 1950s, W. G. Hoskins, Reader in Economic History at the University of Oxford, similarly lamented that ‘Since that time [the end of the 19th century], and especially since the year 1914, every single change in the English landscape has either uglified it or destroyed its meaning, or both’ (Hoskins 1956, p. 231).

In 1975, David Lowenthal, Professor of Geography at University College, London, observed that ‘As local ties dissolved, nostalgia became a generalised sense of loss, focused less on the locality than on the remembered childhood. For mobile modern man, nostalgia is not so much being uprooted as having to live in an alien present. If no longer fatal, it is an increasingly pervasive ailment’ (Lowenthal 1975, p. 2). Lowenthal’s description thus predated the notion of solastalgia (Albrecht *et al.* 2007) by at least three decades.

Feelings of loss, anguish and grief are by no means limited to Europeans. When the Micronesian population of Bikini Atoll in the Marshall Islands (north-western Pacific) was repatriated to their atomic-bomb-devastated home in 1969 (after having been removed by the US Army in 1946 to allow for the Crossroads series of atomic-bomb tests), they were so distressed at the scenes of carnage occasioned by the detonation of the Able and Baker atomic weapons in 1946 and the even more catastrophic Castle Bravo thermonuclear explosion of 1954 that one leader ‘was so overcome that he wept openly’ (Weisgall 1994, p. 314). Their anguish was worsened when they were forced again from their atoll home less than a decade later (in 1978), when it was discovered that physicists employed by the US government had underestimated by 100-fold the radiation dose the islanders received upon their return. The islanders had ‘one overwhelming and persistent desire: to return to Bikini, and they simply could not adjust emotionally to the fact that they could not go home’ (Weisgall 1994, p. 313).

Although arguably tangential to the focus of this paper, the very real sense of grief felt by Australian Aborigines having lost their Country – a ‘mourning for the land’ – is almost certainly just as agonising (e.g. Wynne-Jones *et al.* 2016).

Is there a paradox here?

A paradox I see with professional conservation biologists and ecologists being subject to a suite of psychological maladies as a direct consequence of their work is that it has been known for decades that exposure to the natural world has a demonstrably positive impact on mental health and well-being (e.g. Freeman 1978; Kaplan 1995; MacKerron and Mourato 2013; Aerts *et al.* 2018; Dean *et al.* 2018; Reddon and Durante 2018; Maund *et al.* 2019; Mavoa *et al.* 2019; Sanchez-Badini and Innes 2019; Sutton-Grier and Sandifer 2019; Ferraro *et al.* 2020; Harvey *et al.* 2020; Methorst *et al.* 2021). How then is it that professional conservation biologists and ecologists, who work so often in the field, may be affected so adversely by such prolonged and deep exposure to the natural world?

Likely causes of poor mental health

A number of explanations are possible for the incidence of poor mental health among conservation biologists and ecologists, and for the purposes of this paper I group them into three general types: (1) epistemic attributes associated with the deep knowledge base of conservation biologists and ecologists; (2) an array of non-epistemic values associated with how conservation biologists and ecologists view the natural world; and (3) a complex suite of factors relating to the wider social, political and economic milieu in which conservation biologists and ecologists practise their trade.

Underlying knowledge base

Perhaps the most obvious among possible causes of work-related poor mental health among conservation biologists and ecologists is the strong epistemic foundation of their discipline. Conservation biologists and ecologists necessarily have a profound insight into the complexity and sensitivity of the natural world, and their understanding of complex ecological topics thus transcends that of almost all the general public's. Clayton (2018, p. 260) expressed it succinctly:

The way in which climate scientists and conservation practitioners respond to climate change is likely to differ in several ways from that of the general public. They are typically more knowledgeable about, and attentive to, the evidence for a changing environment. Many are confronted with it, through research results or through personal experience, on an almost daily basis. Such an awareness of climate change is certainly a prerequisite for an emotional response.

Aldo Leopold made much the same point in his 1953 essay *The Round River*: 'One of the penalties of an ecological

education is that one lives alone in a world of wounds. Much of the damage inflicted on land is quite invisible to laymen' (Leopold 1953, p. 197).

Fig. 2 illustrates well this problem. In mid 2019 I camped at Ruby Gap, a spectacular, remote and poorly accessible gorge in the eastern extreme of the Macdonnell Ranges in central Australia. Although I marvelled at the wonderful gorge landscape and its isolated pools, I could not be but distracted by the waterway fringe dominated for kilometres by the invasive buffel grass (*Cenchrus ciliaris*). Driscoll *et al.* (2014) drew attention to the landscape-scale changes engendered by this terribly invasive plant, ranging from the exclusion of native species to irreversible changes in fire regimes. Conversations with the few other visitors to the gorge indicated that they also relished the isolation and beauty, but my delight was marred by the knowledge that even in this remote part of Australia the landscape was infested, often as far as the eye could see, with exotic weeds. None of the other visitors to the gorge recognised the plant growing along the waterway as introduced, invasive or problematic.

My point is that we, as conservation biologists or ecologists, can live too close to the dark side to see much room for celebration. As Windle (1992) noted, 'Ecologists are both blessed and cursed with seeing natural systems clearly. Thus, we see what is there and also know what is gone'. Conservation biologists and ecologists when gazing on a landscape not only see what is there, but with the recognition of the concept of shifting baselines (Pauly 1995), they are painfully aware of the species and communities that are not there, those that have been extirpated from the landscape.

To conclude, conservation biologists and ecologists are likely to be vulnerable to declining mental health precisely because they are so familiar with, and through their day-to-day work repeatedly exposed to, the ubiquity and severity of environmental degradation. It is, as observed by Woinarski (2018), now an 'occupational hazard' for



Fig. 2. Ruby Gap Nature Park (Northern Territory), showing buffel grass (*Cenchrus ciliaris*) infestation of the creekline.

conservation biologists and ecologists. In such conditions it is not unexpected that they could lapse into ‘abject pessimism’ (Sale 2011, p. 234) and lose hope (Swaigood and Sheppard 2010; Hobbs 2013; Morton 2017). Moreover, because they are aware of the likely trajectory of change in a given system, conservation biologists and ecologists are confronted with a scenario of ongoing loss into the future. It is this sense of pessimism which, I believe, informed the condition identified in Morton (2017) and accounts for the sense of dread that I outlined in the introduction to this essay when I walk through my local park. Moratis (2020) coined a term for such pessimistic expectations, ‘anticipatory solastalgia’. Cunsolo and Ellis (2018) showed that such feelings were commonplace among Inuit of northern Canada and wheatbelt farmers of central Western Australia, both communities living in permanent fear of irreversible environmental loss.

Non-epistemic values

The fact sheet on mental health prepared by the World Health Organization (2018) remarked on the existence of specific psychological and personality factors that make some people more vulnerable to mental health problems than others. In the case of conservation biologists and ecologists, the non-epistemic values that underpin their work may constitute one such factor.

Conservation biology has been acknowledged from its earliest days as an inherently value-laden and mission-orientated discipline, with a powerful non-epistemic component (e.g. Soulé 1985; Ehrenfeld 2000; Odenbaugh 2003; Mein *et al.* 2006; Baumgaertner and Holthuijzen 2017). Because of the centrality of non-epistemic values, conservation biologists and ecologists likely have different perspectives on the natural world than those held by many other scientists or indeed by the wider public, notwithstanding the manifest reality of environmental grieving and solastalgia experienced by many laypeople subjected to relentless environmental degradation. Dean *et al.* (2018), for example, investigated the influence non-epistemic values had on emotional responses to the natural world. When the relationship of people (not necessarily scientists) with the natural world was fundamentally one of enjoyment, the likely outcome of contact with natural systems was significantly reduced mental ill-health. In contrast, when the relationship included an aspect of self-identification or was part of a wider conservation-based world view (as is likely to hold with most conservation biologists and ecologists), the psychological outcomes of contact with natural systems was often increased depression, anxiety and stress.

Wang *et al.* (2018) reported similar findings with climate scientists: scientists with a higher regard for the natural world than for humanist values were more likely to experience feelings of anxiety, fear and guilt when contemplating the consequences of global climate change than were scientists

holding less ‘environmental’ perspectives. Jovarauskaite and Böhm (2021) likewise concluded that whether climate-change scientists experienced negative emotional reactions was influenced strongly by the degree to which they were emotionally engaged with the wider consequences of their research. Those researchers who were more environmentally engaged believed that ‘the consequences of climate change would appear both locally and globally, and to consider the consequences to be uncontrollable, dreadful, and morally unacceptable’.

Windle (1992) once again saw the practical implications of the strong non-epistemic foundations of conservation biology and of individual conservation biologists:

Although we rarely acknowledge the nature and depth of our biological and ecological loves, outsiders have a clear radar for them. Notice how quickly developers accuse us of caring more for spotted owls, snail darters, and wildflowers than for people. Our guilty backpedalling suggests we know they are right, at least about our love for the organisms and places in which we invest our life’s work . . .

Conflicts across dissimilar non-epistemic values may be particularly fraught for conservation biologists involved in some aspect of animal culling as part of broader conservation efforts (Batavia *et al.* 2020). As noted above, this group is especially susceptible to work-related grief, and I imagine many experience inner turmoil not only as a result of the planned death of the target pest animals but also because of the inconsistency between ‘compassionate conservation’ and ‘animal liberation’ on the one hand and sound environmental ethics on the other (Sagoff 1984).

Finally, there is quite likely an added dimension to the non-epistemic component of conservation biology: conservation biologists and ecologists are apt to feel so strongly about the research topics they specialise in that overwork becomes a very real threat. Campos-Arceiz *et al.* (2013), for example, reported that conservation biologists from many countries were likely to work excessively at night and on weekends, with seriously adverse consequences for work-life balance and personal relationships.

To conclude, conservation biologists and ecologists are vulnerable to poor mental health not only because of their awareness of the epistemic dimensions of environmental degradation but also because of the suite of powerful non-epistemic and psychological values that permeate their discipline and corresponding world view.

Social, political and economic milieu

Conservation biologists and ecologists necessarily work in the complex interface between scientific research and the worlds of politics and economics – an area that Cullen (1990) famously described as a ‘turbulent boundary’. I posit that by working in this ‘turbulent boundary’, conservation

biologists and ecologists are exposed to political and economic forces that exacerbate feelings of loss, grief, anxiety and hopelessness driven by epistemic and non-epistemic factors (e.g. Ehrenfeld 2000). The phenomenon undoubtedly has many dimensions, but here I focus on three only: (1) the negative impact of attitudes espoused by many conservative politicians, and some nominally of a more progressive bent, to conservation biology and, more broadly, to the environmental sciences; (2) the effect of scientific advice on conservation matters being routinely ignored by senior decision-makers; and (3) the thorny question of censorship of uncomfortable findings.

The past decade has produced many examples of the contempt with which some politicians hold conservation biology and the environmental sciences more generally in Australia. One notorious example will suffice: the reported comment by the then Commonwealth water minister (Barnaby Joyce, National Party) in July 2017 asserting that ‘We’ve taken water and put it back into agriculture so we can look after you and make sure we don’t have the greens running the show basically sending you out the back door’ (<https://www.smh.com.au/environment/stop-greens-running-the-show-joyce-unloads-on-four-corners-water-report-20170727-gxjp8s.html>). It is difficult to reconcile this terrifying partisan position with the fact that water management in the Murray–Darling Basin is widely acknowledged by conservation biologists, ecologists and resource economists as a failure (e.g. Bjornlund *et al.* 2018; Grafton and Wheeler 2018; Grafton *et al.* 2018). It has been variously described in learned articles as a ‘tragedy’ (Simons 2020) and as a ‘catastrophe’ by a Senior Counsel at the New South Wales Bar who assisted with the recent South Australian Royal Commission into the Murray–Darling Basin (Beasley 2021). Joyce’s comment was condemned by the (then) outgoing Commonwealth Environmental Water Holder and by the major environmental advocacy organisations.

An extension of the poor regard in which conservation biologists and ecologists are held by some politicians and decision-makers is the ignoring of their professional advice, indeed even the ridiculing of their expertise. Four examples illustrate the point. First, a previous Australian Prime Minister (Tony Abbott, Liberal Party) is reported to have claimed in 2009 that ‘the climate change argument is absolute crap’ (<https://www.theguardian.com/australia-news/2017/oct/10/tony-abbott-says-climate-change-is-probably-doing-good>; <https://www.newscientist.com/article/dn24173-australia-rips-up-climate-change-policies/>).

Second, a former National Party member for Monaro, a seat encompassing Kosciuszko National Park in southern New South Wales, the state’s largest national park and one receiving over one million visitors per year, is reported as saying in 2019 that evidence for feral horses damaging the park was ‘fake news’, a position adopted on the grounds that ‘I reject the science because I don’t trust the scientists’

(Slattery and Worboys 2020, p. 325). Such a belittling and, I imagine to most scientists, deeply offensive claim typifies the ‘degradation ritual’ exposed by Thérèse and Martin (2014) as one of the most commonly used approaches to denigrate scientific investigation.

Third, the above-mentioned Barnaby Joyce, Australia’s Deputy Prime Minister at the time of the writing of this essay, dismissed opposition to the proposed Hells Gate Dam on the Burdekin River, north Queensland – a development announced before an economic business case or even an environmental impact statement had been prepared – as coming from ‘green cynics’. Joyce went on to disparage any environmental opposition to the dam: ‘There’s a moss, there’s a frog, there is a beetle, there is [always] something that will stop it, but we know that the future of this nation depends on us doing it’ (Foley 2022). The desire to dam the headwaters of rivers such as the Tully and Burdekin in coastal north Queensland for use in irrigation and to avoid the ‘waste’ of their flowingly uselessly to the sea has a long and lamentable history, going back to the Bradfield Scheme of 1938 and periodically resurrected thereafter as a ‘nationally critical’ endeavour (Boon 2020).

Fourth, the personal recollections presented in Woinarski (2018) with respect to the extinction of the Christmas Island pipistrelle provide a number of examples of the studied neglect of scientific advice on the bat’s imminent demise. One participant noted that his reports ‘...were routinely dismissed by mainland-based bureaucrats who had no scientific qualifications as being ‘emotive’ and ‘non-scientific’ (Woinarski 2018, p. 185). A case pleading for the immediate establishment of a captive breeding program on the island was refused by the then Commonwealth Minister for the Environment, Heritage and the Arts, Peter Garrett, until it was too late to be effective. That this happened under a federal Labor government indicates that it is not only conservative politicians who can, at the worst, ignore or denigrate the findings of conservation biologists and ecologists or, at the least, delay decision making under the cloak of due administrative process. Fulton (2022) similarly reported that his pleas to government departments regarding illegal vehicular access and associated destructive activities to a Ramsar-listed wetland in Western Australia were ignored by department heads. Evidently, when it comes to matters of conservation and threatened species, politicians and senior decision-makers of all persuasions can be good, bad or simply indifferent, and this presents a problematic situation for conservation biologists and ecologists.

Conservation biologists and ecologists, however, should be disabused of the notion that the isolation of contrarians and the dismissal of scientific advice and expertise is a purely modern phenomenon. Griffith Taylor, the great Australian geographer, was pilloried by politicians and many writers in the 1920s, especially in Western Australia and Queensland, for suggesting that the inhospitable conditions experienced across much of the continent would limit

Australia to a sustainable population to about 20 million. His 'pessimism' and 'unpatriotic' forecasts were in direct opposition to the prevailing 'Australia Unlimited' school of thought (e.g. Brady 1918) and, as Marshall (1964, p. 427) has pointed out, the battle '... cost him a great deal, and there was often a certain sadness apparent in his references to it'.

The Cold War and associated testing on nuclear weapons provides a second example of how scientists and other experts can be ridiculed if their positions – or even simply their data – are politically uncomfortable. The Japanese doctors who first raised concerns about radioactive poisoning of the crew of the fishing vessel *Lucky Dragon* (as a result of being caught in the fallout plume of the Castle Bravo test in 1954) were dismissed by senior military men in the USA as 'fuzzy-minded leftists'. Americans who expressed sympathy with the victims of the intense radioactive fallout across islands of the south-western Pacific Ocean occasioned by fission and fusion bomb tests were branded 'neutralists, pacifists, feminists, and professional anti-Americans' (Weisgall 1994, p. 305). In Australia, senior decision-makers likewise agreed that critics, including eminent scientists, who voiced concern about radioactive fallout arising from the testing of British atomic weapons in Western Australia and South Australia in the mid 1950s were to be labelled 'trouble makers' and ignored (Arnold 1987, p. 160). A specific example: Hedley Marston, head of the Division of Biology and General Nutrition at the CSIRO in Adelaide (South Australia), was chosen to lead the biological survey into the movement of radioactive fallout arising from the British Mosaic and Buffalo nuclear tests in Western Australia and South Australia, respectively. Marston concluded that fallout from the second Mosaic test (at the Monte Bello Islands, off the coast of northern Western Australia, in mid 1956) could be detected in a band 1600 km wide across the continent. The effects of the third, Buffalo, test at Maralinga (in northern-central South Australia, in late 1956) spread radioactive contamination across Adelaide and the surrounding countryside (Milliken 1986; Tynan 2016). In a review of the scientific and political debacle that ensued, Cross (2001, p. 132) concluded that attempts to censor the publication of Marston's results were 'remarkable and perhaps unprecedented in the annals of Australian science' and 'an affront to scientific protocol'.

The point I wish to make from these examples is that there is little evidence that politicians or senior decision-makers with firmly held negative attitudes towards the natural environment will be convinced by rational argument, even from well regarded and well qualified scientists armed with unequivocal data, when it threatens a political or ideological stance. Once more W.E.H. Stanner summed up the reality of the situation, this time in *The Aborigines*, an essay from 1938:

Here, apparently, is belief that prejudiced men, case-hardened viewpoints, vested interests, a bureaucracy with a long tenure of office yet to run, and a proven

difficult environment will belie their history and become conveniently malleable. Here is a partial and faulty grasp of the facts and forces which have to be reckoned with (Stanner 2009, p. 139).

The political realist acknowledges the naivety associated with a contrary viewpoint regarding the likelihood of positive change: 'Politics is all about power: who has it, how to keep it, and what to do with it. It is not about doing good or being right in some ethical sense' (Gray 2007, p. 134).

Given such an understanding of the relationship between politicians and scientists, it is a logical conclusion that Australia's conservation and biodiversity problems will not be resolved merely by scholarly argument, least of all by an appeal to the values of leading conservative politicians and other influential decision-makers on the basis of scientific evidence. This is because the political realist recognises that the goal of politics is not to engage in reasoned argument – it is simply to sway the will of the public and to manage their expectations to their own ends. Should this be seen as simply a cynical interpretation from an embittered ecologist, the statement by Sir Garfield Barwick, Attorney-General of Australia 1958–1964 and Chief Justice of the High Court of Australia 1964–1981, should be remembered: 'Men in government, though susceptible to argument and reason, are finally persuaded by their own estimate of the likely result of the ballot box' (cited in Lines 2006, pp. 112–113). In a two-party system, such as is implicit in the Westminster style of parliamentary democracy, the situation is made even worse by those in opposition often adopting a negative stance to any position presented by those in government, even when it is, on any other set of grounds, likely to prove beneficial.

Fundamentally, the problem for conservation biologists and ecologists is that their dealings with many politicians and senior decision-makers are often so fraught that the social contract of trust pivotal to scientific discourse finds no place in the gloomy and duplicitous world of real-world politics. In his review of the status of biodiversity in Australia, Kingsford (2013) queried whether anyone other than a handful of conservation biologists and ecologists (and, presumably, many concerned citizens) really cared about the crisis the country was experiencing in biodiversity conservation. The answer seems to be 'No', in terms of determined action that accrues, despite overwhelming evidence of continent-wide loss of species and rampant destruction of habitat (e.g. Woinarski *et al.* 2015, Johnson *et al.* 2017; Geyle *et al.* 2018). The recollections of Lindy Lumsden, provided in Woinarski (2018) support this position. Reflecting on responses by government and the media to the extinction of the bat on Christmas Island, she noted 'The press release created a flurry of media interest for a day. I did five radio and several newspaper interviews on 8 September 2009. And then the media lost interest and moved on to other stories. The loss of a species – the first

Australian mammal extinction for decades – made news for just one day’ (Woinarski 2018, pp. 195–196).

Further evidence for the disinterest (uninterest?) or at least ineffective action among decision-makers is provided by the status of the mammal emblems adopted by each Australian state or territory. Seven of the eight emblematic species are listed in some way: in the Australian Capital Territory, the southern brush-tailed rock wallaby *Petrogale penicillata* (locally extinct, the last individual seen in the wild in the Australian Capital Territory 1959; listed as critically endangered); in Victoria, Leadbeater’s possum *Gymnobelideus leadbeateri* (critically endangered); in New South Wales, the platypus *Ornithorhynchus anatinus* (near threatened); in Queensland, the koala *Phascolarctos cinereus* (endangered); in South Australia, the southern hairy-nosed wombat *Lasiorhinus latifrons* (near threatened); in Tasmania, the Tasmanian devil *Sarcophilus harrisii* (endangered); and in Western Australia, the numbat *Myrmecobius fasciatus* (endangered). Even if this example fails to indicate widespread public apathy, it does at least reveal the parlous state of many of the country’s vertebrate species, including even those deemed to be so iconic as to be jurisdictional faunal emblems.

A final observation on this point: it is indeed curious that professional advice on conservation and environmental matters can be so frequently rejected at a time when politicians and senior decision-makers in Australia wholeheartedly embrace scientific advice regarding the most appropriate ways to tackle the COVID-19 pandemic. Martínez-Abraín and Oro (2013) commented earlier on this type of paradox, noting that many other scientific disciplines – e.g. physics and chemistry – and engineering did not have to confront such repeated rejection of scientifically validated positions or recommendations.

The final of the three social-political-economic dimensions I want to address is the thorny matter of censorship. Censorship comes in many gradations and takes place at various levels of seriousness. At its simplest, censorship is manifest in the banning of particular words or phrases or their replacement with terms deemed more politically acceptable. As the novelist and social critic George Orwell pointed out three-quarters of a century ago, language is inherently political (Orwell 1946). The renaming of contentious subjects is an example of how language is inherently political in the world of conservation biology, ecology and the environmental sciences more generally. A contemporary example is the declaration in April 2021 by Cheryl Durrant, a long-term researcher in the Department of Defence, that she was reportedly told not to use the term ‘climate change’ in her work because it was ‘politically unacceptable’ (<https://www.abc.net.au/news/2021-04-20/former-adf-official-says-pressure-to-downplay-climate-change/100068558>). An older example: Australian authorities associated with the Mosaic atomic bomb tests on Monte Bello Island in 1956 demanded that the troublesome word ‘contamination’ was

not to be mentioned in any press release concerning the explosions (Arnold 1987, p. 131).

In some cases, specific words are not only banned but ugly neologisms are erected in their place in order to obscure the real state of affairs. Rivers in the Murray–Darling Basin so degraded and regulated as to have lost most of their ecological structure and function are now termed ‘working rivers’, as if that excuses the offence. ‘Clearfell logging’ is not an acceptable term: this environmentally disastrous practice now goes by the name of ‘even stand management’. Privatisation of public assets, a phenomenon for which the public has frequently shown little enthusiasm, is now repackaged as ‘asset recycling’ (https://www.domperrottet.com.au/tag/asset-recycling/page/15/?et_blog). All are examples of what Don Watson would call ‘weasel words’ (Watson 2004). Another give-away is evolution of the names of government departments originally with the term ‘conservation’ in their title to new ones lacking such a descriptive, unambiguous term. In Victoria, for example, the former Department of Conservation, Forests and Lands, established in 1983, morphed into the Department of Conservation and Environment (1990), then into the Department of Conservation and Natural Resources (1992), Department of Natural Resources and Environment (1996), Department of Sustainability and Environment (2003), Department of Environment and Primary Industries (2013) and, finally, into the current Department of Environment, Land, Water and Planning (<https://www.eoas.info/biogs/A002037b.htm>, accessed 6 April 2022). The replacement of the familiar and active word ‘conservation’, which explains an idea exactly, with flaccid terms such as ‘natural resources’ or ‘environment’, which generalise departmental function to the point of obscurity, is not accidental.

Perhaps the most egregious example of the censorship-renaming phenomenon comes from Kosciuszko National Park in southern New South Wales. In legislation introduced by the National Party member for Monaro (John Barilaro) in 2018 referred not to ‘feral’ horses but to ‘wild’ horses (Slattery and Worboys 2020). The shift in terminology is not without significance: ‘feral’ horses are destructive and out of place, but ‘wild’ horses are merely the continuation of a ‘noble tradition’ of high-country grazing of alpine areas in south-eastern Australia. A similar ‘distinction’ has occurred in North America with respect to environmental impacts and management of feral horses (Barnes 2021). Moreover, the proposed New South Wales legislation referred not to the control of feral horses or to the management of their environmental impacts, but explicitly to their supposed heritage value: the *Kosciuszko Wild Horse Heritage Act* 2018.

These examples are, from some perspectives, trivial cases of the ever-evolving nature of the English language with an overtone of political censorship. Further along the censorship gradient are the cases where censorship devolves into a vicious, prolonged and personal attack on the individual scientist (Martin 2019). The consequences for

the individual under attack can be severe, including alcoholism, depression and the breakdown of relationships, culminating in the loss of employment (Thérèse and Martin 2014). On the other hand, there is no evidence that vilification by government or senior decision-makers of conservation biologists or ecologists reduces their credibility among fellow scientists. Indeed, the contrary response may ensue (Garrard *et al.* 2016; Horton *et al.* 2016). However, that your colleagues recognise your integrity, value and efforts may provide little solace when your research has been censored and you have been hounded from your job, finding yourself depressed and, potentially, unemployed.

The ultimate end of the censorship spectrum is the termination of debate by killing or attempting to kill conservation biologists and ecologists or agency staff charged with administering conservation legislation and regulation. In one horrific example, Glen Turner, an environment compliance officer with the New South Wales Office of Environment and Heritage, was murdered on public land in 2014 by Ian Turnbull, a local farmer, in response to the latter's earlier prosecution for illegal clearing of native vegetation and suspected continued clearing (<https://awpc.org.au/cultivating-murder-a-brutal-political-killing/>, accessed 6 April 2022). Turner's work colleague, Robert Strange, was present at the killing and was also threatened with being shot – 'you'll get one in the heart' – by Turnbull (Holden 2021). Turnbull was convicted of murder and died in gaol. Reports exist of academic conservation biologists or ecologists being shot at and their lives threatened in other ways in Western Australia (e.g. Fulton 2017, 2022). Also threatening are bumper stickers such as the commonplace 'Aerial cull a greenie; save the Snowy Brumby' implying violent acts against those involved in conservation efforts (Slattery and Worboys 2020).

Driscoll *et al.* (2021) recently showed that censorship was a widespread problem in the reporting of environmental research in Australia. Almost the entire suite of nature-conservation fields was subject to some form of censorship, but among the most commonly affected were threatened-species management, mining impacts, urban development, native-vegetation clearing, logging, climate change, and feral-animal impacts and control. Driscoll *et al.* (2021, p. 1) found that 'One third of respondents reported personal suffering related to suppression, including job losses and deteriorating mental health' and this response was reported roughly equally across scientists working in government, industry and university sectors. These findings should come as no surprise, as 20 years earlier Martin (1999a, 1999b; see also Martin *et al.* 1986) had pointed out the wide variety of ways in which research findings could be suppressed to suit employer or political ends. The previously mentioned example of Hedley Marston and the British atomic-bomb tests provides a powerful example of censorship from more than 60 years ago, as well as of the detrimental

psychological impact such political interference had on the recipient: 'after 1958, Marston appeared to slow down and retreat into his beloved division in Adelaide. He grew strangely introverted and almost a recluse in his office. It was as if he was emotionally and intellectually drained by the battle' (Cross 2001, p. 185). A similar response was reported for Griffith Taylor in the 1920s, as related earlier. A more recent example comes, again, from the experience of the extinction of the Christmas Island pipistrelle. One ecologist lamented bitterly that:

To this day, none of my taxpayer-funded, scientific research reports on the biodiversity of Christmas Island have been made available to the public by the government, and I have not been allowed to publish any scientific papers. The environment department had my final report rewritten to tell a 'better' story in their own words without my knowledge and presented it to the departments for immigration and finance, but not to the taxpayers or the scientific community (Woinarski 2018, p. 185).

As an illustration of the potential for job loss, this ecologist then relayed that:

One very senior bureaucrat in the environment department told me that I would lose my job if I persisted in speaking about biodiversity declines, notwithstanding that my job involved studying them (Woinarski 2018, p. 186).

To conclude, I believe that a wide suite of factors exacerbates the hazard conservation biologists and ecologists face with declining mental health as a direct result of their work. First is the obvious fact that they are acutely aware of the state and trajectory of the natural world, a consequence of the epistemic component of their discipline (e.g. Clayton 2018), and that the prognosis for improvement is poor (e.g. Morton 2017). Second is the intense non-epistemic value set implicit in conservation biology, which probably worsens the psychological impact of the empirical knowledge held by conservation biologists and ecologists (e.g. Dean *et al.* 2018; Wang *et al.* 2018; Jovarauskaite and Böhm 2021). Third, the ruthless milieu of vituperative environmental politics is unlikely to foster conditions in which conservation scientists or ecologists are felt valued and their findings readily accepted by ruling elites. Scientific findings are frequently censored (e.g. Martin *et al.* 1986; Martin 1999a, 1999b, 2019; Woinarski 2018; Driscoll *et al.* 2021) and, in the worst case, individual scientists are pursued relentlessly by their political adversaries because of the positions they hold and the empirical findings they report (e.g. Martin 2019) and may even be murdered because of their beliefs or (lawful) actions to uphold environmental legislation.

Possible solutions to the problem

Poor mental health among conservation biologists and ecologists is problematic for a number of reasons. First, it affects an individual's capacity to realise his or her own abilities (World Health Organization 2018). Second, it limits an individual's ability to cope with the normal stresses of life; third, it lowers their ability to work productively and enjoyably with other people in their chosen profession; and fourth, it limits their ability to make significant and meaningful contribution to the wider society. There are thus many reasons why a solution has to be found to the problem I believe I've demonstrated exists within conservation biology-ecology disciplines.

Central to the resolution of poor mental health are actions that improve psychological well-being, and this almost always involves the creation of an environment that explicitly supports good mental health. Foremost among these actions must be the recognition that, despite the generally downward trend, conservation efforts can be successful, and successful at a wide range of scales (Sodhi *et al.* 2011). Examples at the global scale include international control over acid rain and the use of some pesticides, such as DDT (dichloro-diphenyl-trichloroethane, Phillis *et al.* 2013); at the regional scale, the reversing of population decline in humpback whales (*Megaptera novaeangliae*), various species of sea turtles and a number of other threatened species, as well as the repeated success of marine protected areas in many parts of the world (Edgar *et al.* 2014; Bejder *et al.* 2016; Mazaris *et al.* 2017; Garnett *et al.* 2018); at the local scale there must be many examples of successful interventions which, because they are judged parochial, mostly go unreported in the published literature. Conservation biologists and ecologists should rejoice in these successes.

For conservation biologists and ecologists, comradeship and solidarity in the work-place environment is one obvious and frequently invoked solution. Reflecting on what alleviated his ecological grumpiness, Recher (2013, p. 6) recognised that a salve was 'Working with colleagues for decades who share these ideas and, even though their responses may be different, they too can see the issues'. Even the 'opportunity to be grumpy' in professional forums was recognised as helpful. Clayton (2018) and Gordon *et al.* (2019) noted how comradeship with other scientists could offer a way through environmental grief, and in this way scientists may have a mechanism for building resilience that is not so readily available to other members of the public, who often suffer solastalgia alone and in social isolation. The concept of 'constructive hope', as opposed to 'unrealistic hope, grounded in denial' was proffered as a coping mechanism by Clayton (2018). Hope was also invoked by Swaisgood and Sheppard (2010) as a necessary response, as it was by Park *et al.* (2020). Maybe we could

call such a position one of 'adept reconciliation' with the state of the natural world.

When confronted with life-changing situations, such as the death of a parent or a child or the dissolution of a marriage, experts urge us to grieve, not only for its own benefits but because failure to grieve can have many undesirable consequences. Harrison (2019) argued that people suffering from climate-change solastalgia should be encouraged to openly mourn for what has been lost. Ritual has traditionally played a central role in the grieving process and it may hold a central place in environmental grieving too. Swaisgood and Sheppard (2010, p. 626) argued for the '... establishment of professional rituals that force us to regularly confront despair and seek out the positive, even when things take a turn for the worse'. This may include therapeutic counselling (Gordon *et al.* 2019) or at least the recognition that mourning (and recovery) involves a number of well-identified phases (Hobbs 2013).

Conversely, a 'narrative of retreat' was invoked by Morse (2003) as a coping mechanism widely employed. This is one I referred to in my recent environmental history of Australian rivers (Boon 2020) and one that must appear as a viable option to anyone even mildly conversant with *Walden* (Thoreau 1854). However, as I pointed out in Boon (2020), solitary journeys from civilised society into the wildest and most remote parts of the natural world can offer only temporary relief, may themselves be counter-productive (Fig. 2), and in any case offer no resolution to the fundamental problem of global environmental degradation. In my case at least, the action is a necessary but not sufficient coping mechanism. I know it helps me, but it does nothing for the natural world other than to allow me to better connect with the less disturbed parts of it and continue to express my wonder and intellectual curiosity.

More recently, Freeling and Preston (2020, p. 1189) argued that '... the philosophy of Stoicism can help environmental practitioners navigate these troubling times'. There is superficially some attractiveness to this position, foremost because the Stoics of Classical Greece believed the cosmos was a living entity and that all things, living and unliving, were interconnected, concepts that today resonate with the Gaia hypothesis of James Lovelock (Lovelock 1979) and, less controversially, with the generally accepted idea that ecology concerns itself with the study of the interrelationships between organisms and their environment or, more latterly, the study of the structure and function of ecosystems (Odum 1962). Moreover, the Stoics stressed the ethical dimensions of human effort, especially as it dealt with resistance, struggle and intent, clearly an idea congruent with the value-laden and mission-orientated nature of conservation biology. On the other hand, a Stoic position can be interpreted as one of aloofness and emotional detachment, attitudes that most ecologists and conservation biologists could not countenance because of the deep

non-epistemic roots of their discipline. Stoicism may be an admirable position when facing an affront on one's person, but I am less convinced that it is an appropriate attitude to take when the harm is being experienced by something outside oneself, such as the natural world. To me, it could be seen as calculated indifference.

Nevertheless, the Classical world does provide fertile allegorical ground for contemporary conservation biologists and ecologists. We could compare our situation with Odysseus who, returning from Troy, was confronted with a swirling whirlpool created by an embittered Charybdis on one side and treacherous cliffs defended by Scylla and her terrifying dogs on the other. Are not modern-day conservation biologists and ecologists similarly often confronted with unpleasant – perhaps irreconcilable – alternatives? Or perhaps we could see ourselves as Sisyphus, eternally condemned by Zeus to push the same boulder uphill in Hades only to have it roll back down again as he neared the summit. Or maybe the tale of Prometheus is more appropriate: punished for giving humanity fire (and science and knowledge) by having an eagle eat his liver each day, only for it to grow back overnight, again an eternal torment. However, instead of these models from Classical Greece the Roman god Janus is arguably a better archetype for contemporary conservation biologists and ecologists. The god of beginnings and endings, the two-headed Janus could see forwards and backwards simultaneously. In his right hand he held a staff that informed travellers of the correct path, and in his left hand he held a set of keys that unlocked doors and gates (Davenport 2018). Although the latter two features are obviously relevant from the perspective of providing advice on alternative courses of action and their likely consequences, it is Janus' ability to see forwards and backwards simultaneously that is most relevant to contemporary conservation biology and ecology. The ability to look forwards is critical, since for many, perhaps almost all, conservation biologists seek preservation of the natural world not only for its own sake but also for future generations of humans. As one reviewer of this essay noted, it was a matter of the desire to 'bequeath a legacy of nature to future generations'. But it is the ability to look backwards that I think offers a viable solution to the problem of poor mental health among conservation biologists and ecologists.

Contemporary battles played out by today's conservation biologists and ecologists therefore should be understood as the continuation of a historical (and historic) struggle to preserve the natural world. In Australia there is a splendid tradition of people from all walks of life defending the country's natural heritage and fighting for the natural world (Pollak and MacNabb 2000; Lines 2006). Novelists (e.g. Xavier Herbert with his *Poor Fellow My Country* (Herbert 1975); more recently, Tim Winton's *Island Home* (Winton 2015)), poets, playwrights, film makers and song smiths have all fought in their own way to protect the

natural environment (Pollak and MacNabb 2000). So have artists, most notably Arthur Streeton, doyen of the Australian Impressionists, who vigorously opposed proposals to mine coal at Cremorne, on Sydney Harbour, and in the 1920s agitated to protect the forests of the Dandenong Ranges and Gippsland in Victoria. As Bonyhady (2020, pp. 313–314) pointed out, 'Other Australian artists had campaigned for environmental protection and expressed their environmental concerns in their art ... But Streeton was exceptional in how frequently he did it'. Photographers have deployed their skills in defence of the natural world, most notably Peter Dombrovskis with his photograph *Rock Island Bend*, which played a pivotal role in the successful campaign of 1983 to prevent the damming of the Franklin River in south-western Tasmania (Dombrovskis 1983). So too have cohorts of journalists, including those who exposed the environmental and human impacts of British nuclear testing in the mid 1950s (e.g. Milliken 1986) and those who publicised the parlous nature of Australia's inland river systems throughout the 2000s (e.g. Wahlquist 2008). The legal fraternity has also been involved, either in the form of adverse reports on environmental matters from Auditors General (e.g. Victorian Auditor General 2016), the public positions taken by organisations such as the Environmental Defenders Office, or the critical writings of prominent lawyers such as Senior Counsels (e.g. Beasley 2021).

Of course a wide range of activists have engaged in the battle, including Myles Dunphy (Greater Blue Mountains National Park), Milo Dunphy (Clutha coalmine, Colong Caves) and John Sinclair (Fraser Island). It was dedicated, philanthropic and long-suffering activists who were responsible for the establishment of many of the country's national parks, including those in the Sydney region in the late 19th and early 20th centuries, such as Brisbane Water National Park (Minard Crommelin, acting post-mistress at Woy Woy Post Office), Kur-ring-gai Chase National Park (Eccleston Du Faur, who agitated the reserve be created for the '... fullest preservation of natural flora and at the establishment of an area over which marsupials and other Australian fauna might roam and breed in safety': Bonyhady 2000, p. 194), and Muogamarra Nature Reserve (John Duncan Tipper, who after having first visited the area in 1923 obtained a lease of 600 acres in 1934 with the aim of protecting its flora, fauna and Aboriginal sites: Boon 2017). Similar arguments can be made for other protected areas, such as Little Desert in Victoria, defended vigorously by the Victorian National Parks Association and the Field Naturalists Club of Victoria (Lines 2006) and Kakadu National Park (Lawrence 2000). In the latter case especially, Aboriginal activists were centrally involved too.

Biologists have often been in the vanguard, including for example Jock Marshall, Foundation Chair of Biology at Monash University, with his pioneering text from 1966, *The Great Extermination* (Marshall 1966) and his remarkable

1962 collaboration with the artist Russell Drysdale, *Journey Among Men* (Marshall and Drysdale 1962). Many scientists have involved themselves in science-based advocacy to various degrees in environmental debates (e.g. Lindenmayer 2007), some in overt activism and others taking a less public – but still invaluable – stance (Boon 2019). Scientists, including anthropologists and ecologists, were central in the (failed) protection of Lake Pedder and the (successful) protection of the Franklin River in the late 1960s and mid 1980s, respectively (Lines 2006). Scientists have also been responsible for a rich research literature on Kosciuszko National Park, which now extends over 160 years, and the fight to protect the park against feral animals and exotic weeds (Slattery and Worboys 2020). Not to be forgotten either are the many employees in government departments – park rangers, staff in environment departments etc. – who work tirelessly to conserve the natural world, but whose conditions of employment generally preclude their involvement in public discussions of conservation matters. For some of these employees their conservation work can be fatal, as shown by the case of the murder of Glen Turner described earlier.

The state of mind I propose could also be of help when conservation biologists and ecologists are subject to public ridicule, or worse, by politicians who find their results ideologically unacceptable. A deeper recognition that an individual scientist is not alone, but is in fact part of a much wider community of broadly like-minded people, with continuity over decades if not centuries, may prove an added bulwark against political attack, belittlement and many forms of ideologically driven censorship. Thérèse and Martin (2014) and Martin (2019) have shown how such a sense of collegiality is essential if individuals are not to be broken by *ad hominem* attacks. Garnett *et al.* (2020) summed up the core message in the coping mechanism I outline in this paper:

But as we grieve, we must also remember that decades of conservation work has not been in vain. Some populations and species may indeed have been lost in the recent fires – we shall not know until long after the smoke clears. But the conservation efforts of the past mean fewer species have been lost than would have been the case otherwise.

A serviceable guide to the recommended approach is Pablo Casals' declaration 'The situation is hopeless. We must take the next step'. Casals (1876–1973), the famed Catalan cellist, drew this conclusion late in life, when reflecting on his experiences, including his time opposing Franco's fascists during the Spanish Civil War. The Australian social commentator Phillip Adams drew on Casals' observation when granted an honorary doctorate from Macquarie University: 'The first sentence is beyond pessimism; fatalistic, defeatist. Then: "We must take the next step." A clarion call to arms' (Adams 2014). It is a clarion call that

could provide moral sustenance to many conservation biologists and ecologists. Interestingly, Casals' quote has been invoked as a palliative too for psychologists acting on behalf of asylum seekers and refugees (Hartley *et al.* 2013).

To conclude, contemporary conservation biologists and ecologists should find solace in recognising that they are central participants, often the vanguard, in a prolonged struggle to protect the natural environment and that they are continuing a battle that many others joined in the past, sometimes at great personal cost. It is one of the two mechanisms I have found useful in my attempt to deal with an overwhelming sense of ecological loss and dread: to give up and become despondent would not only fail all those who preceded me in the great struggle for the natural world, but would hand victory to those who care nothing for it or actually want to see it destroyed. This 'philosophic' strategy is then bolstered and my emotional state reinvigorated by periodic trips into remote and largely unviolated areas in which I can 'recharge my batteries' – the 'narrative of retreat' invoked by Morse (2003) but intended not as an acknowledgement of defeat but, instead, of strategically withdrawing in order to reform and to then go back on the attack, to continue the fight others, from many walks of life, have fought in the past. To give up would be to admit failure and to undermine that tradition. Regardless of the situation, there is no choice but to continue on.

Conclusion

This essay posed three questions: (1) Can a case be made that conservation biologists and ecologists often suffer from work-related poor mental health? (2) If so, what are the likely causes? and (3) What correctives could be applied to ameliorate the situation? The answer to the first question is 'Yes', but that answer would not have been obtained had reliance been placed solely on an automated search of a bibliographic database. Instead, there is much evidence from many formal and informal sources that adverse mental health outcomes are commonplace among conservation biologists and ecologists, including among coral-reef researchers, climate scientists, those involved in wildfire research and in road-kill rescue and, especially, those working on threatened species.

The answer to the second question is 'A range of factors', including epistemic and non-epistemic factors and the complex, often antagonistic, social, political and economic milieu in which conservation biologists and ecologists work. Importantly, any psychological trauma experienced by conservation biologists and ecologists has to be differentiated from the related phenomena of 'environmental grief' and 'solastalgia' experienced by the broader community. Conservation biologists and ecologists may well (and

probably do) experience environmental grief and solastalgia along with the rest of society, but the question this essay poses is whether they do so as a direct result of their working and the 'lived experience' of their chosen scientific discipline. If so, there may be strong grounds for considering adverse mental health outcomes to be an OH&S hazard.

The final question addressed, then, is 'What can be done about it?'. A range of coping mechanisms have been proposed recently in the literature, but one with much promise for conservation biologists and ecologists is to reposition their personal experience within an historical perspective that recognises their efforts as part of a long tradition of struggle to protect the natural world. This is a struggle that has been maintained not only by diverse types of environmental scientists but also by poets and artists, photographers, journalists and lawyers among many other professions – as well as, of course, by many laypeople similarly appalled at the loss of the natural world and who struggle at their own personal level to do something about it. To sum up, a realisation that they are not alone could help conservation biologists and ecologists manage the poor mental health consequences frequently occasioned by their work.

Post script

The first drafts of this essay were written in March 2021. The final drafts were prepared in April 2022, after receiving the referees' reports. In the intervening ~12 months, another tree had succumbed to *P. cactorum* in my local park. My 'anticipatory solastalgia' (Moratis 2020) had, unfortunately, been validated.

References

- Adams P (2014) The situation is hopeless. We must take the next step. *The Australian*, 17 May 2014.
- Aerts R, Honnay O, Van Nieuwenhuijse A (2018) Biodiversity and human health: mechanisms and evidence of the positive health effects of diversity in nature and green spaces. *British Medical Bulletin* **127**, 5–22. doi:10.1093/bmb/ldy021
- Albrecht GA (2020) Negating solastalgia: an emotional revolution from the Anthropocene to the Symbiocene. *American Imago* **77**, 9–30. doi:10.1353/aim.2020.0001
- 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** (Suppl 1), S95–S98. doi:10.1080/10398560701701288
- Allen R, Baker K (2009) 'Australia's remarkable trees.' (The Miegunyah Press: Melbourne)
- Arnold L (1987) 'A very special relationship: British atomic weapons trials in Australia.' (Her Majesty's Stationary Office: London)
- Askland HH, Bunn M (2018) Lived experiences of environmental change: solastalgia, power and place. *Emotion, Space and Society* **27**, 16–22. doi:10.1016/j.emospa.2018.02.003
- Barnes A (2021) Domestic, feral, or wild? What's the difference? Available at <https://opensanctuary.org/article/domestic-feral-or-wild-whats-the-difference/> [Viewed 7 September 2021]
- Barnett J, Tschakert P, Head L, Adger WN (2016) A science of loss. *Nature Climate Change* **6**, 976–978. doi:10.1038/nclimate3140
- Batavia C, Nelson MP, Wallach AD (2020) The moral residue of conservation. *Conservation Biology* **34**, 1114–1121. doi:10.1111/cobi.13463
- Bate J (2000) 'The song of the earth.' (Harvard University Press: Harvard)
- Baumgaertner B, Holthuijzen W (2017) On non-epistemic values in conservation biology. *Conservation Biology* **31**, 48–55. doi:10.1111/cobi.12756
- Beasley R (2021) 'Dead in the water: a very angry book about our greatest environmental catastrophe ... The death of the Murray–Darling Basin.' (Allen & Unwin: Sydney)
- Bejder M, Johnston DW, Smith J, Friedlaender A, Bejder L (2016) Embracing conservation success of recovering humpback whale populations: evaluating the case for downlisting their conservation status in Australia. *Marine Policy* **66**, 137–141. doi:10.1016/j.marpol.2015.05.007
- Bjornlund H, Connor J, Crase L, Davis R, Grafton Q, Harris G, Hatton D, Kingsford R, Paton D, Quiggin J, Wheeler S, Williams J (2018) The Murray–Darling Declaration. Available at <https://murraydeclaration.org/> [Viewed 21 September 2018]
- Bonyhady T (2000) 'The colonial earth.' (Miegunyah Press: Melbourne)
- Bonyhady T (2020) Beware the axe. In 'Streets'. (Ed. W Tunnicliffe) pp. 311–331. (Art Gallery of New South Wales: Sydney)
- Boon PI (2017) 'The Hawkesbury river: a social and natural history.' (CSIRO Publishing: Melbourne)
- Boon PI (2019) Advocacy in conservation science: an introduction to the Special Issue. *Pacific Conservation Biology* **25**, 1–6. doi:10.1071/PCv25n1_ED
- Boon PI (2020) The environmental history of Australian rivers: a neglected field of opportunity? *Marine and Freshwater Research* **71**, 1–45. doi:10.1071/MF18372
- Boon PI, Fluker M, Wilson N (2008) A ten-year study of the effectiveness of educative and interpretive programs in ensuring ecological sustainability of recreational activities in the Brisbane Ranges National Park, south-eastern Australia. *Journal of Sustainable Tourism* **16**, 681–697. doi:10.1080/09669580802397053
- Brady EJ (1918) 'Australian unlimited.' (George Robertson & Company: Melbourne)
- Brierley GJ (2021) 'Finding the voice of the river: beyond restoration and management.' (Springer Nature: Cham)
- Brodie J, Grech A (2019) 'This situation brings me to despair': two reef scientists share their climate grief. *The Conversation*. Available at <https://theconversation.com/this-situation-brings-me-to-despair-two-reef-scientists-share-their-climate-grief-123520> [Viewed 21 April 2021]
- Calver MC, Goldman B, Hutchings PA, Kingsford RT (2017) Why discrepancies in searching the conservation biology literature matter. *Biological Conservation* **213**, 19–26. doi:10.1016/j.biocon.2017.06.028
- Campos-Arceiz A, Koh LP, Primack RB (2013) Are conservation biologists working too hard? *Biological Conservation* **166**, 186–190. doi:10.1016/j.biocon.2013.06.029
- Chan APC, Nwaogo JM, Nasland JA (2020) Mental ill-health risk factors in the construction industry: a systematic review. *Journal of Construction and Engineering Management* **146**, 04020004. doi:10.1061/(asce)co.1943-7862.0001771
- Cianconi P, Betrò S, Janini L (2020) The impact of climate change on mental health: a systematic descriptive review. *Frontiers in Psychiatry* **11**, 74. doi:10.3389/fpsy.2020.00074
- Clayton S (2018) Mental health risk and resilience among climate scientists. *Nature Climate Change* **8**, 260–261. doi:10.1038/s41558-018-0123-z
- Clayton S (2020) Climate anxiety: psychological responses to climate change. *Journal of Anxiety Disorders* **74**, 102263. doi:10.1016/j.janxdis.2020.102263
- Comtesse H, Ertl V, Hengst SMC, Rosner R, Smid GE (2021) Ecological grief as a response to environmental change: a mental health risk or functional response? *International Journal of Environmental Research and Public Health* **18**, 734. doi:10.3390/ijerph18020734
- Conroy G (2019) 'Ecological grief' grips scientists witnessing Great Barrier Reef's decline: studying ecosystems affected by climate change takes

- an emotional toll on researchers. *Nature* **573**, 318–319. doi:10.1038/d41586-019-02656-8
- Cross R (2001) 'Fallout: Hedley Marston and the British bomb tests in Australia.' (Wakefield Press: Adelaide)
- Cullen P (1990) The turbulent boundary between water science and water management. *Freshwater Biology* **24**, 201–209. doi:10.1111/j.1365-2427.1990.tb00319.x
- Cunsolo A, Ellis NR (2018) Ecological grief as a mental health response to climate change-related loss. *Nature Climate Change* **8**, 275–281. doi:10.1038/s41558-018-0092-2
- Cunsolo A, Harper SL, Minor K, Hayes K, Williams KG, Howard C (2020) Ecological grief and anxiety: the start of a healthy response to climate change? *The Lancet Planetary Health* **4**, e261–e263. doi:10.1016/S2542-5196(20)30144-3
- Davenport C (2018) Who was Janus, the Roman god of beginnings and endings?. *The Conversation*. Available at <https://theconversation.com/who-was-janus-the-roman-god-of-beginnings-and-endings-86853> [Viewed 4 April 2022]
- Dean J, van Dooren K, Weinstein P (2011) Does biodiversity improve mental health in urban settings? *Medical Hypotheses* **76**, 877–880. doi:10.1016/j.mehy.2011.02.040
- Dean JH, Shanahan DF, Bush R, Gaston KJ, Lin BB, Barber E, Franco L, Fuller RA (2018) Is nature relatedness associated with better mental and physical health? *International Journal of Environmental Research and Public Health* **15**, 1371. doi:10.3390/ijerph15071371
- Dombrovskis P (1983) 'Wild rivers.' (Self-published: Hobart)
- Driscoll DA, Catford JA, Barney JN, Hulme PE, Inderjit Martin TG, Pauchardi A, Pyšek P, Richardson DM, Riley S, Visser V (2014) New pasture plants intensify invasive species risk. *Proceedings of the National Academy of Sciences of the United States of America* **111**, 16622–16627. doi:10.1073/pnas.1409347111
- Driscoll DA, Garrard GE, Kusmanoff AM, Dovers S, Maron M, Preece N, Pressey RL, Ritchie EG (2021) Consequences of information suppression in ecological and conservation sciences. *Conservation Letters* **14**, e12757. doi:10.1111/conl.12757
- Edgar GJ, Stuart-Smith RD, Willis TJ, et al. (2014) Global conservation outcomes depend on marine protected areas with five key features. *Nature* **506**, 216–220. doi:10.1038/nature13022
- Edwards B, Gray M, Hunter B (2015) The impact of drought on mental health in rural and regional Australia. *Social Indicators Research* **121**, 177–194. doi:10.1007/s11205-014-0638-2
- Ehrenfeld D (2000) War and peace and conservation biology. *Conservation Biology* **14**, 105–112. doi:10.1046/j.1523-1739.2000.99325.x
- Eisenman D, McCaffrey S, Donatello I, Marshal G (2015) An ecosystems and vulnerable populations perspective on solastalgia and psychological distress after a wildfire. *EcoHealth* **12**, 602–610.
- Engelfield B, Starling M, McGreevy P (2018) A review of roadkill rescue: who cares for the mental, physical and financial welfare of Australian wildlife carers? *Wildlife Research* **45**, 103–118. doi:10.1071/WR17099
- Engelfield B, Candy S, Starling M, McGreevy P (2019) The demography and practice of Australians caring for native wildlife and the psychological, physical and financial effects of rescue, rehabilitation and release of wildlife on the welfare of carers. *Animals* **9**, 1127. doi:10.3390/ani9121127
- Ferraro DM, Miller ZD, Ferguson LA, Taft BD, Barber JR, Newman P, Francis CD (2020) The phantom chorus: birdsong boosts human well-being in protected areas. *Proceedings of the Royal Society B: Biological Sciences* **287**, 20201811. doi:10.1098/rspb.2020.1811
- Foley M (2022) Government's \$5b for dam before business case. *The Age*, 24 March 2022, pp. 8–9. Reported also in *The Sydney Morning Herald*. Available at <https://www.smh.com.au/politics/federal/government-pledges-5-4bn-for-north-queensland-dam-before-business-case-2022-0323-p5a751.html> [Viewed 31 March 2022]
- Forrest W, Edwards B, Daraganova G (2018) The intergenerational consequences of war: anxiety, depression, suicidality, and mental health among the children of war veterans. *International Journal of Epidemiology* **47**, 1060–1067. doi:10.1093/ije/dyy040
- Freeling BS, Preston TK (2020) How can ecologists thrive during the global environmental crisis? Lessons from the ancient world. *Restoration Ecology* **27**, 1189–1191. doi:10.1111/rec.13042
- Freeman H (1978) Mental health and the environment. *British Journal of Psychiatry* **132**, 113–124. doi:10.1192/bjp.132.2.113
- Fritsch L, Morrison D, Shirangi A, Day L (2009) Psychological well-being of Australian veterinarians. *Australian Veterinary Journal* **87**, 76–81. doi:10.1111/j.1751-0813.2009.00391.x
- Fulton GR (2017) Owl survey of the Peel–Harvey Estuary in southwestern Australia. *Australian Journal of Zoology* **65**, 71–76. doi:10.1071/ZO17027
- Fulton GR (2022) Researcher disillusionment and ungoverned damage to Becher Point Wetlands, Western Australia. *Pacific Conservation Biology* **28**, 15–17. doi:10.1071/PC20091
- Galway LP, Beery T, Jones-Casey K, Tasala K (2019) Mapping the solastalgia literature: a scoping review study. *International Journal of Environmental Research and Public Health* **16**, 2662. doi:10.3390/ijerph16152662
- Garnett S, Latch P, Lindenmayer D, Woinarski J (2018) 'Recovering Australian threatened species: a book of hope.' (CSIRO Publishing: Melbourne)
- Garnett S, Wintle B, Lindenmayer D, Woinarski J, Maron M, Legge S (2020) Conservation scientists are grieving after the bushfires – but we must not give up. *The Conversation*. Available at <https://theconversation.com/conservation-scientists-are-grieving-after-the-bushfires-but-we-must-not-give-up-130195> [Viewed 17 March 2022]
- Garrard GE, Fidler F, Wintle BC, Chee YE, Bekessy SA (2016) Beyond advocacy: making space for conservation scientists in public debate. *Conservation Letters* **9**, 208–212. doi:10.1111/conl.12193
- Geyle HA, Woinarski JCZ, Baker GB, Dickman CR, Dutton G, Fisher DO, Ford H, Holdsworth M, Jones ME, Kutt A, Legge S, Leiper I, Loyn R, Murphy BP, Menkhurst P, Reside AE, Ritchie EO, Roberts FE, Tingley R, Garnett ST (2018) Quantifying extinction risk and forecasting the number of impending Australian bird and mammal extinctions. *Pacific Conservation Biology* **24**, 157–167. doi:10.1071/PC18006
- Gordon TAC, Radford AN, Simpson SD (2019) Grieving environmental scientists need support. *Science* **366**, 193. doi:10.1126/science.aaz2422
- Grafton RQ, Wheeler SA (2018) Economics of water recovery in the Murray–Darling Basin, Australia. *Annual Review of Resource Economics* **10**, 487–510. doi:10.1146/annurev-resource-100517-023039
- Grafton RQ, MacDonald DH, Paton D, Harris G, Bjornlund H, Connor JD, Quiggin J, Williams J, Kingsford R, Wheeler SA, Crase L (2018) The Murray Darling Basin Plan is not delivering – there's no more time to waste. *The Conversation*. Available at <https://theconversation.com/the-murray-darling-basin-plan-is-not-delivering-theres-no-more-time-to-waste-91076> [Viewed 26 April 2021]
- Gray CS (2007) 'Fighting talk: forty maxims on war, peace and strategy.' (Praeger: London)
- Green J (2021) Thinking ecologically with Timothy Morton. Blueprint for Living, ABC Radio National, 17 July 2021. Available at <https://www.abc.net.au/radionational/programs/blueprintforliving/thinking-ecologically-with-timothy-morton/13446416> [Viewed 17 July 2021]
- Griffiths T (2015) Environmental history, Australian style. *Australian Historical Studies* **46**, 157–173. doi:10.1080/1031461X.2015.1035289
- Harrison M (2019) The mental pain of climate change: on the rise of solastalgia. *New Statesman* 25–31 October 2019, p. 18.
- Hartley LK, Pedersen A, Fleay W, Hoffman S (2013) 'The situation is hopeless; we must take the next step': reflecting on social action by academics in asylum seeker policy debate. *The Australian Community Psychologist* **25**, 22–37.
- Harvey DJ, Montgomery LN, Harvey H, Hall F, Gange AC, Watling D (2020) Psychological benefits of a biodiversity-focussed outdoor learning program for primary school children. *Journal of Environmental Psychology* **67**, 101381. doi:10.1016/j.jenvp.2019.101381
- Hayman R (2003) 'Trees: woodlands and western civilisation.' (Hambledon & London: London)
- Head L, Harada T (2017) Keeping the heart a long way from the brain: the emotional labour of climate scientists. *Emotion, Space and Society* **24**, 34–41. doi:10.1016/j.emospa.2017.07.005
- Herbert X (1975) 'Poor fellow my country.' (Collins: Sydney)
- Hobbs RJ (2013) Grieving for the past and hoping for the future: balancing polarizing perspectives in conservation and restoration. *Restoration Ecology* **21**, 145–148. doi:10.1111/rec.12014
- Holden K (2021) An environmental worker was shot dead: so why do the locals say the murderer was the real victim? *The Sydney Morning*

- Herald*, 28 May 2021. Available at <https://www.smh.com.au/national/an-environmental-worker-was-shot-dead-so-why-do-locals-say-the-murderer-was-the-real-victim-20210503-p570dp.html> [Viewed 6 April 2022]
- Horton CC, Peterson TR, Banerjee P, Peterson MJ (2016) Credibility and advocacy in conservation science. *Conservation Biology* **30**, 23–32. doi:10.1111/cobi.12558
- Hoskins WG (1956) 'The making of the English landscape.' (Hodder & Staughton: London)
- Howell JP, Kitson J, Clowney D (2019) Environments past: nostalgia in environmental policy and governance. *Environmental Values* **28**, 305–323. doi:10.3197/096327119X15519764179809
- Hricová M, Nežkusilová J, Rázová B (2020) Perceived stress and burnout: the mediating role of psychological, professional self-care and job satisfaction as preventative factors in helping professions. *European Journal of Mental Health* **15**, 3–22.
- James C, Tynan R, Roach D, Leigh L, Oldmeadow C, Rahman M, Kelly B (2018) Correlates of psychological distress among workers in the mining industry in remote Australia: evidence from a multi-site cross-sectional survey. *PLoS ONE* **13**, e0209377. doi:10.1371/journal.pone.0209377
- James DJ, Green PT, Humphreys WF, Woinarski JCZ (2019) Endemic species of Christmas Island, Indian Ocean. *Records of the Western Australian Museum* **34**, 55–114. doi:10.18195/issn.0312-3162.34(2).2019.055-114
- Jamieson N, Usher K, Maple M, Ratnarajah D (2020) Invisible wounds and suicide: moral injury and veteran mental health. *International Journal of Mental Health Nursing* **29**, 105–109. doi:10.1111/inm.12704
- Johnson CN, Balmford A, Brook BW, Buettel JC, Galetti M, Guangchun L, Wilmshurst JM (2017) Biodiversity losses and conservation responses in the Anthropocene. *Science* **356**, 270–275. doi:10.1126/science.aam9317
- Jovarauskaite L, Böhm G (2021) The emotional engagement of climate experts is related to their climate change perceptions and coping strategies. *Journal of Risk Research* **24**, 941–957. doi:10.1080/13669877.2020.1779785
- Kaplan S (1995) The restorative benefits of nature: towards an integrative framework. *Journal of Environmental Psychology* **15**, 169–182. doi:10.1016/0272-4944(95)90001-2
- Kevorkian KA (2014) Environmental grief: hope and healing. Available at <http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.561.289&rep=rep1&type=pdf> [Viewed 8 June 2021]
- Kingsford RT (2013) Australia's biodiversity conservation crisis – does anyone care? In 'Grumpy scientists: the ecological conscience of a nation'. (Eds D Lunney, P Hutchings, HR Recher) pp. 31–38. (Royal Zoological Society of New South Wales: Sydney)
- Landman K, Cunsolo A (2017) 'Mourning nature: hope at the heart of ecological loss and grief'. (McGill-Queen's University Press: Montreal)
- Lawrence D (2000) 'Kakadu: the making of a national park.' (Miegunyah Press: Melbourne)
- Leopold A (1953) 'A sand county almanac with essays on conservation from round river.' (Ballantine Books: New York)
- Lindenmayer D (2007) 'On borrowed time: Australia's environmental crisis and what we must do about it.' (Penguin: Melbourne)
- Lines WJ (2006) 'Patriots: defending Australia's natural heritage.' (University of Queensland Press: Brisbane)
- Lovelock J (1979) 'Gaia: a new look at life on earth.' (Oxford University Press: Oxford)
- Lowenthal D (1975) Past time, present place: Landscape and memory. *Geographical Review* **65**, 1–36. doi:10.2307/213831
- MacKerron G, Mourato S (2013) Happiness is greater in natural environments. *Global Environmental Change* **23**, 992–1000. doi:10.1016/j.gloenvcha.2013.03.010
- Marshall A (1964) Griffith Taylor. *Geographical Review* **54**, 427–429. doi:10.2307/212661
- Marshall AJ (Ed.) (1966) 'The great extermination: a guide to Anglo-Australian cupidity, wickedness and waste.' (Heinemann: London)
- Marshall AJ, Drysdale R (1962) 'Journey among men.' (Hodder & Stoughton: London)
- Marshall N, Adger WN, Benham C, Brown K, Curnock MI, Gurney GG, Marshall P, Pert PL, Thiault L (2019) Reef grief: investigating the relationship between place meanings and place change on the Great Barrier Reef. *Sustainability Science* **14**, 579–587. doi:10.1007/s11625-019-00666-z
- Martin B (1999a) Suppressing research data: methods, context, accountability, and responses. *Accountability in Research* **6**, 333–372. doi:10.1080/08989629908573935
- Martin B (1999b) Suppression of dissent in science. *Research in Social Problems and Public Policy* **7**, 105–135.
- Martin B (2019) Preparing for advocacy, resisting attack. *Pacific Conservation Biology* **25**, 105–110. doi:10.1071/PC17015
- Martin B, Baker CMA, Manwell C, Pugh C (Eds) (1986) 'Intellectual suppression: Australian case histories, analysis and responses.' (Angus & Robertson: Sydney)
- Martínez-Abrán A, Oro D (2013) Preventing the development of dogmatic approaches in conservation biology: a review. *Biological Conservation* **159**, 539–547. doi:10.1016/j.biocon.2012.10.020
- Maund PR, Irvine KN, Reeves J, Strong E, Crommie R, Dallmer M, Davies ZG (2019) Wetlands for wellbeing: piloting a nature-based health intervention for the management of anxiety and depression. *International Journal of Environmental Research and Public Health* **16**, 4413. doi:10.3390/ijerph16224413
- Mavoa S, Lucassen M, Denny S, Utter J, Clarke T, Smith M (2019) Natural neighbourhood environments and the emotional health of urban New Zealand adolescents. *Landscapes and Urban Planning* **191**, 103638. doi:10.1016/j.landurbplan.2019.103638
- Mazaris AD, Schofield G, Gkazinou C, Almanidou V, Hays GC (2017) Global sea turtle conservation successes. *Science Advances* **3**, e1600730. doi:10.1126/sciadv.1600730
- Mein C, Soulé M, Noss RF (2006) 'A mission-driven discipline': the growth of conservation biology. *Conservation Biology* **20**, 631–651. doi:10.1111/j.1523-1739.2006.00449.x
- Methorst J, Rehdanz K, Mueller T, Hansjuergens B, Bonn A, Bohning-Gaese K (2021) The importance of species diversity for human wellbeing in Europe. *Ecological Economics* **181**, 106917. doi:10.1016/j.ecolecon.2020.106917
- Milliken R (1986) 'No conceivable injury: the story of Britain and Australia's atomic cover-up.' (Penguin: Melbourne)
- Monbiot G (2012) John Clare, the poet of the environmental crisis – 200 years ago. *The Guardian*, 10 July 2012. Available at <https://www.theguardian.com/commentisfree/2012/jul/09/john-clare-poetry> [Viewed 28 May 2021]
- Moratis L (2020) A new form of solastalgia? *Australasian Psychiatry* **28**, 670. doi:10.1177/1039856220933331
- Morse K (2003) Putting history at the core: history and literature in environmental studies. *The History Teacher* **37**, 67–72. doi:10.2307/1555599
- Morton SR (2017) On pessimism in Australian ecology. *Austral Ecology* **42**, 122–131. doi:10.1111/aec.12410
- Neiman A (2020) Have some mental health: the Black Summer bushfires, COVID-19, and the governance of psychic retreat. Available at <https://aesengagement.wordpress.com/2020/05/05/have-some-mental-health-the-black-summer-bushfires-covid-19-and-the-governance-of-psychic-retreat/> [Viewed 17 March 2022]
- Odenbaugh J (2003) Values, advocacy and conservation biology. *Environmental Values* **12**, 55–69. doi:10.3197/096327103129341225
- Odum EP (1962) Relationships between structure and function in the ecosystem. *Ecological Society of Japan* **12**, 108–118.
- Orwell G (1946) Politics and the English language. Available at <https://www.orwellfoundation.com/the-orwell-foundation/orwell/essays-and-other-works/politics-and-the-english-language/> [Viewed 7 September 2021]
- Pakenham T (1998) 'Meetings with remarkable trees.' (Weidenfeld & Nicholson: London)
- Park A, Williams E, Zurba M (2020) Understanding hope and what it means for the future of conservation. *Biological Conservation* **244**, 108507. doi:10.1016/j.biocon.2020.108507
- Pauly D (1995) Anecdotes and the shifting baseline syndrome of fisheries. *Trends in Ecology & Evolution* **10**, 430. doi:10.1016/S0169-5347(00)89171-5
- Pembroke M (2009) 'Trees of history and romance: essays from a Mount Wilson Garden.' (Blooming Books: Melbourne)
- Perceval M, Kölves K, Ross V, Reddy P, De Leo D (2019) Environmental factors and suicide in Australian farmers: a qualitative study. *Archives*

- of *Environmental & Occupational Health* **74**, 279–286. doi:10.1080/19338244.2018.1453774
- Phillips CC, O'Regan SM, Green SJ, Bruce JEB, Anderson SC, Linton JN, Earth2Ocean Research Derby, Favaro B (2013) Multiple pathways to conservation success. *Conservation Letters* **6**, 98–106. doi:10.1111/j.1755-263X.2012.00294.x
- Pollak N, MacNabb M (2000) 'Hearts and minds: creative Australians and the environment'. (Hale & Iremonger: Sydney)
- Recher HF (2013) What makes this old scientist grumpy. In 'Grumpy scientists: the ecological conscience of a nation'. (Eds D Lunney, P Hutchins, HF Recher) pp. 1–8. (Royal Zoological Society of New South Wales: Sydney)
- Recher HF (2015) Failure of science, death of nature. *Pacific Conservation Biology* **21**, 2–14. doi:10.1071/PC14907
- Reddon JR, Durante SB (2018) Nature exposure sufficiency and insufficiency: the benefits of environmental preservation. *Medical Hypotheses* **110**, 38–41. doi:10.1016/j.mehy.2017.10.027
- Renouf JS (2021) Making sense of climate change—the lived experience of experts. *Climatic Change* **164**, 14. doi:10.1007/s10584-021-02986-5
- Rose DB (1996) 'Nourishing terrains.' (Australian Heritage Commission: Canberra)
- Sagoff M (1984) Animal liberation and environmental ethics: bad marriage, quick divorce. *Osgoode Hall Law Journal* **22**, 297–307.
- Sale P (2011) 'Our dying planet: an ecologist's view of the crisis we face.' (University of California Press: Berkeley)
- Sanchez-Badini O, Innes JL (2019) Forests and trees: a public health perspective. *Sante Publique* **S1**, 241–248. doi:10.3917/pub.190.0241
- Simons M (2020) Cry me a river: the tragedy of the Murray–Darling Basin. *Quarterly Essay* **77**, 1–114.
- Slattery D, Worboys GL (2020) 'Kosciuszko: a great national park.' (Envirobook: Sussex Inlet, NSW)
- Sodhi NS, Butler R, Laurance WF, Gibson L (2011) Conservation successes at micro-, meso- and macroscales. *Trends in Ecology & Evolution* **26**, 585–594. doi:10.1016/j.tree.2011.07.002
- Soulé ME (1985) What is conservation biology? *BioScience* **35**, 727–734. doi:10.2307/1310054
- Stanner WEH (2009) 'The dreaming and other essays.' (Black Inc.: Melbourne)
- Sutton-Grier AE, Sandifer PA (2019) Conservation of wetlands and other coastal ecosystems: a commentary on their value to protect biodiversity, reduce disaster impacts, and promote human health and well-being. *Wetlands* **39**, 1295–1302. doi:10.1007/s13157-018-1039-0
- Swaigood RR, Sheppard JK (2010) The culture of conservation biologists: show me the hope! *BioScience* **60**, 626–630. doi:10.1525/bio.2010.60.8.8
- Sydney Morning Herald (2010) I talk to plants, but that doesn't mean I'm potty', says Charles. *The Sydney Morning Herald*, 21 September 2010. <https://www.smh.com.au/entertainment/celebrity/i-talk-to-plants-but-that-doesnt-mean-im-potty-says-charles-20100920-15jor.html> [Viewed 20/04/2021]
- Teixeira D (2020) I felt immense grief: one year on from the bushfires, scientists need mental health support. *The Conversation*. Available at <https://theconversation.com/i-felt-immense-grief-one-year-on-from-the-bushfires-scientists-need-mental-health-support-148251> [Viewed 17 March 2022]
- Thérèse S, Martin B (2014) Resist, scientist! Countering degradation rituals in science. *Prometheus* **32**, 203–220.
- Thoreau H (1854) Walden. In 'The portable Thoreau'. (Ed. C Bode) pp. 258–572. (Penguin: New York)
- Tomasi SE, Fechter-Leggett ED, Edwards NT, Reddish AD, Crosby AE, Nett RJ (2019) Suicide among veterinarians in the United States from 1979 through 2015. *Journal of the American Veterinary Medical Association* **254**, 104–112. doi:10.2460/javma.254.1.104
- Tynan E (2016) 'Atomic thunder: the Maralinga story.' (NewSouth: Sydney)
- Victorian Auditor General (2016) 'Meeting obligations to protect Ramsar wetlands.' (Victorian Government Printer: Melbourne)
- Wahlquist A (2008) 'Thirsty country: options for Australia.' (Allen and Unwin: Sydney)
- Wake B (2018) Focus on climate change and mental health. *Nature Climate Change* **8**, 259. doi:10.1038/s41558-018-0128-7
- Wang S, Leviston Z, Hurlstone M, Lawrence C, Walker I (2018) Emotions predict policy support: why it matters how people feel about climate change. *Global Environmental Change* **50**, 25–40. doi:10.1016/j.gloenvcha.2018.03.002
- Wardell S (2020) Naming and framing ecological distress. *Medicine Anthropology Theory* **7**, 187–201. doi:10.17157/mat.7.2.768
- Watson D (2004) 'Watson's dictionary of weasel words: contemporary clichés, cant and management jargon.' (Knopf: Sydney)
- Weisgall JM (1994) 'Operation Crossroads: the atomic tests at Bikini Atoll.' (Naval Institute Press: Annapolis)
- Windle P (1992) The ecology of grief. *BioScience* **42**, 363–366. doi:10.2307/1311783
- Winton T (2015) 'Island home: a landscape memoir.' (Penguin: Melbourne)
- Woinarski J (2018) 'A bat's end: the Christmas Island Pipistrelle and extinction in Australia.' (CSIRO Publishing: Melbourne)
- Woinarski JCZ, Burbidge AA, Harrison PL (2015) Ongoing unraveling of a continental fauna: decline and extinction of Australian mammals since European settlement. *Proceedings of the National Academy of Sciences of the United States of America* **112**, 4531–4540. doi:10.1073/pnas.1417301112
- Woodwell GMA (2016) 'A world to live in: an ecologist's vision for a plundered planet.' (MIT Press: Cambridge MA)
- World Health Organization (2018) Mental health: strengthening our response. Available at <https://www.who.int/news-room/fact-sheets/detail/mental-health-strengthening-our-response> [Viewed 17 March 2022]
- Wynne-Jones M, Hillin A, Byers D, Stanley D, Edwige V, Brideson T (2016) Aboriginal grief and loss: a review of the literature. *Australian Indigenous Health Bulletin* **16**(3). Available at <http://healthbulletin.org.au/articles/aboriginal-grief-and-loss-a-review-of-the-literature> [Viewed 21 March 2022]
- Yazd SD, Wheeler SA, Zuo A (2020) Understanding the impacts of water scarcity and socio-economic demographics on farmer mental health in the Murray–Darling Basin. *Ecological Economics* **169**, 106564. doi:10.1016/j.ecolecon.2019.106564
- Yong E (2017) How coral researchers are coping with the death of reefs. *The Atlantic*, 21 November 2017. Available at <https://www.theatlantic.com/science/archive/2017/11/coral-scientists-coping-reefs-mental-health/546440/> [Viewed 21 April 2021]

Data availability. Data sharing is not applicable as no new data were generated or analysed during this study.

Conflicts of interest. The author declares no conflicts of interest.

Declaration of funding. This research did not receive any specific funding.

Acknowledgements. Special thanks are due to Mike Calver, Don Driscoll and Peter Xeni for their insightful feedback on pre-submission versions of this article and for recommending a number of papers I had missed. John Woinarski and Graham Fulton are thanked heartily for their supportive – but deeply penetrating – critiques of the original submission and their identification of a number of reports that proved excellent food for thought and further relection as I prepared the revised version.

Author affiliation

^ASchool of Geography, Earth and Atmospheric Sciences, The University of Melbourne, Parkville, Vic. 3010, Australia.