

# Mapping the ethical landscape of wildland fire management: setting an agenda for research and deliberation on the applied ethics of wildland fire

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## ABSTRACT

**Background.** Virtually every decision within wildland fire management includes substantial ethical dimensions. As pressures increase with ever-growing fires, it is becoming increasingly important to develop tools for assessing and acting on the values intrinsic to wildfire management. **Aims.** This paper aims to foster an applied ethics of wildland fire by bringing values to the forefront of wildland fire management debates, highlighting areas where ethical issues have been previously discussed, and providing a framework to assist in future discussion. **Methods.** Through a literature review and collaborative thematic coding of a large set of ethical dilemmas, a list of ethical lenses was developed. **Key results.** Five ethical lenses were generated from the thematic coding process: Epistemologies and Representation, Values and Priorities, Risk and Uncertainty, Power, and Metaethics. **Conclusion.** The five lenses provide a framework to identify prospective ethical tensions in wildland fire decision-making, both within and cutting across categories. This framework provides a way of structuring future investigations into wildfire ethics, as well as a starting point for developing techniques to integrate community and stakeholder values. **Implications.** Developing a field of applied ethics for wildland fire will help support decision-making, create space to more inclusively reflect and deliberate on values, and ensure that fire management best serves the public interest.

**Keywords:** decision-making, ethics, planning, policy, priorities, values, wildfire, wildfire management, wildland fire.

## Introduction: the value of applied ethical analysis

Although better data, new technologies and improved science have helped to advance wildland fire management, they alone cannot resolve the many normative, ethical and value-based questions that continue to arise within the field. Scientific and technological innovations can help provide tools for carrying out fire management, but the questions of what goals we wish to pursue or how best to achieve them require a different form of inquiry. These questions are based on the values and priorities we hold and lack ‘objective’, singular solutions: what appears obvious to one person in one context may be entirely unacceptable to someone else, somewhere else. If fire management is to respond effectively to ever-increasing pressures, scientific and technological innovation must be paired with commensurate attention to the ethical dimensions of wildfire management, to developing the tools and processes that can facilitate more robust engagement of stakeholders around ethical issues, and to embracing the important role that value-based deliberation plays as a part of fire research and wildland fire planning and management.

In this paper, we highlight the value of a more systematic, integrated and explicit study of ethical issues in wildfire management that brings together existing work related to these issues and supports a broader range of ongoing research in the ethics of wildland fire. The development of ‘applied ethics’ (the context-specific application, deliberation and investigation of ethical issues) within emerging fields is an important part of

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disciplinary professionalisation. Medical ethics, for instance, supports the medical profession by rigorously considering tricky questions about vaccine prioritisation or the permissibility of assisted suicide (Childress *et al.* 2002). Likewise, environmental ethics – including formative texts like Carson's *Silent Spring* (1962) – has compelled broad, societal debates about environmental equity, intergenerational ethics (Düwell *et al.* 2018) and the management of global challenges like climate change (Gardiner 2006). Closer to the field of wildland fire, an emerging applied ethics of disaster and emergency management has experienced rapid growth over the past decade (Zack 2010; Etkin 2020). These and other forms of 'socially relevant philosophy' (see Fehr and Plaisance 2010) provide tools to help clarify debates, facilitate deliberation and improve the quality of outcomes, such as interventions like the 'Toolbox Project' (O'Rourke and Crowley 2013), which structure reflective conversation to help solve complex problems.

Our call for an applied ethics of wildland fire is based on three observations:

1. *Almost every issue in wildland fire management involves questions of values, priorities and, fundamentally, ethics.* Our judgments about which decisions are 'right' – and even what positions we believe the evidence supports – largely rely on subjective views, such as what goal ought to be pursued. When the 'right' answer seems obvious, it's often because we take for granted a particular ethical viewpoint and underlying assumptions.
2. *Decision-making within wildfire management already relies on highly consequential ethical judgements.* These judgements are often based on tradition, experience or policy rather than explicit deliberation or 'ethical analysis'. These past practices or norms still, however, represent particular values and priorities.
3. *Systematic and explicit study of ethics and values can help improve practice.* Just as ecology, meteorology and predictive technologies make valuable contributions to fire science – and disciplines like psychology, sociology and history are increasingly recognised as essential to understanding fire – so too must systematic, professional ethical inquiry play a role in researching fire and shaping policy and responses. Ethical inquiry can help to generate creative new solutions, identify hidden assumptions, engage the voices of wider communities and broaden the solutions available for dealing with a changing climate and evolving public expectations.

This applied ethics of wildland fire offers value for practitioners, community members, decision-makers and researchers alike. For practitioners and community members, ethical deliberation offers not just attention to the work being done, but also to issues affecting the welfare of workers (e.g. foregrounding ethical issues surrounding risk, exposure and other harms, compensation and protection, and equity

and justice). For decision-makers, it offers an opportunity to increase stakeholder engagement before fire is on the landscape and improve the comprehensiveness of fire management planning. For researchers, not only does an applied ethics of wildland fire highlight the importance of a more well-rounded inquiry into fire – including humanities and social sciences – but it opens up richer terrain for exploring questions related to the *why*, *how* and *to what end* of wildfire.

In the sections that follow, we offer a taxonomy for identifying critical ethical issues in fire management. This taxonomy is not intended to be a definitive categorisation of all ethical issues, but rather a functional mapping of core themes that can help guide new research and serve as a tool for helping managers ensure they have considered key issues. We then offer some practical suggestions about how value-based analyses can be integrated into fire research and management practices and outline future research directions.

## A taxonomy of ethical issues

To illustrate the rich diversity of issues considered within an applied ethics of wildland fire, we developed an initial taxonomy highlighting common themes. To develop this taxonomy, we began by reviewing existing academic literature on ethical issues in wildland fire. We then conducted a broader search for ethical issues featured within press coverage of wildfires. Subsequently, we also enumerated a series of other possible and probable hypothetical issues drawing on our experience as researchers in emergency management. Taking these three sources, over multiple weeks, we then conducted a series of independent, inductive pile-sorting processes exploring how issues and dilemmas can be distributed into categories. Finally, we then compared each of the pile-sorting arrangements to identify commonalities, which led to the final five-category framework introduced below.

It is important to note that this taxonomy offers only one possible configuration of different clusters of ethical issues. Moreover, many ethical issues inherently relate to more than one of the categories. For an example of where some categories overlap, see Fig. 1. As such, this framework is meant to serve a functional role (such as identifying topics for deliberation within the development of a fire

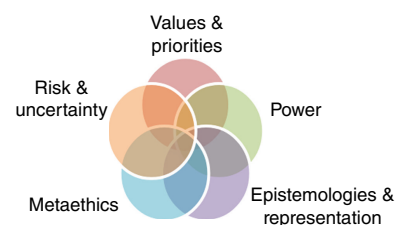


Fig. 1. Examples of overlap between ethical lenses.

management plan or response policy) rather than being definitive or exhaustive.

## Epistemologies and representation

Underlying any contested issue are questions of what forms of knowledge – and whose perspectives – count. As an example of forms of knowledge, or ‘epistemologies’, consider the shift from considering fire only in terms of area burned or suppression effectiveness to instead also monitoring the fire’s quality from an ecological perspective. The first approach emphasises quantitative measures of fire behaviour; the second includes much more space for considering qualities of the fire, localised impacts and the importance of context. As an example of whose perspectives count, or ‘representation’, consider movement towards the more meaningful inclusion of indigenous, traditional, or rural stakeholders as partners in fire management, each of whom brings rich and unique ways of knowing fire and landscapes. These two factors are closely linked: different stakeholders tend to bring with them different ways of knowing, different sources of evidence or knowledge, different aspects that are worth producing knowledge about, and different views of what kinds of knowledge are trustworthy.

Questions regarding epistemologies and representation are often motivated by two different justifications. One justification is that fairer, more inclusive knowledge systems generate better outcomes. For instance, meaningfully integrating different forms of knowledge – rather than perpetuating epistemic injustices (see [Fricker 2007](#)) – can result in fire management strategies that achieve better outcomes for their ecosystems, communities and stakeholders. Another justification is based on a priori appeals to justice: inclusion is something we must pursue as an ethical, moral practice regardless of whether or not it improves the outcome.

Significant research has touched on the way that inclusion of individual and community epistemologies is relevant to decision-making in fire contexts. For example, [Paveglio and Edgeley \(2017\)](#) explored the question of why different communities vary in their uptake of wildfire adaptation measures, finding that individuals’ local lived experiences and the evolution of community identities helped to inform local adaptations and implementations of preparedness behaviours. Inclusion of new voices in management regimes can also lead to better outcomes in fire events when appropriate measures are taken to incorporate local knowledge and expertise, like [Setten and Lein \(2019\)](#) documented in a Norwegian fire. Likewise, representation has direct impact on management organisations as well, where gender-based marginalisation can lead to everything from explicit experiences of discrimination (e.g. [Reimer and Eriksen 2018](#)) to increased barriers – and even exposure to hazards – thanks to ill-fitting personal protective equipment ([Fleming 2021](#)).

Additional work has investigated important issues surrounding the marginalisation of indigenous communities in

fire and demonstrated what it can look like to begin to acknowledge, respect and elevate indigenous epistemologies. For example, seminal papers have documented indigenous experiences with evacuations (e.g. [Asfaw et al. 2019, 2020](#); [McGee et al. 2019](#)) and with wildfire seasons more broadly (e.g. [Dodd et al. 2018](#)), revealing the ways in which lived experiences can differ for members of remote communities, for those whose traditional practices are extensively disrupted by evacuation and who have been disenfranchised from decision-making through colonial practices. Further work (e.g. [Wanvik 2019](#); [Kehoe 2020](#)) has linked vulnerability to hazards and negative disaster experiences to settler and colonial governance, demonstrating the way that the oppression of indigenous voices, epistemologies and perspectives continue to adversely affect fire experiences. This disenfranchisement is also found in examples like the ‘let burn’ policies (e.g. [Zahara 2020](#)) that may appear as reasonable solutions for governments while having deleterious outcomes for particular communities. By contrast, case studies (e.g. [Eriksen and Hankins 2014](#); [Smith et al. 2021](#)) have also revealed the value of subverting these practices, creating meaningful representation and widening the forms of knowledge integrated in management practices.

## Values and priorities

Questions of ‘values and priorities’ are ethical questions about which factors or goals should have the strongest influence on decision-making. Often, these issues are framed as ‘ethical dilemmas’, wherein two or more competing options have relative advantages and disadvantages. This binary can be useful in foregrounding competing viewpoints, but also risks concealing the actual range of creative alternatives possible.

The contestation of values for the determination of priorities is very common in wildfire management. One example of competing values can be found in how we define the ‘natural’, particularly in relation to the actions of humans, a challenging question explored by [Regan \(2015\)](#) and [Minteer and Pyne \(2015\)](#), among others. Likewise, [Kennedy \(2019\)](#) argues wildfire decision-making often relies on subjective value trade-offs rather than ‘objective’ truths, which he illustrates ([Kennedy 2020](#)) through the ways that identical computational modelling outputs can be used to justify divergent goals. This subjectivity is what makes questions of value so difficult to pursue. A few authors have also begun exploring fire’s role in the construction of environmental values. [Fowler \(2018\)](#) examines the re-formulation of values and community ethics post fire, while [Gade \(2018\)](#) explores the influence of the Qur’an on environmental ethics during the 2015 peat forest burning in Indonesia. Addressing more applied topics, [Muller and Gawenda \(2010\)](#) look at how pressures to report can lead journalists to prioritise ‘the story’ and, in turn, create problems for both managers and fire victims. This challenge must be resolved, as journalists play an important role in wildfire,

particularly in their ability to bring to light unattended areas of ethical tension. As one example, Abigail Hess (2018) from CNBC has explored how the use of prisoner firefighters can devalue prisoner autonomy and contributes to the incentivisation of incarceration.

Understanding a decision requires insight into the underlying values from which it was constructed. Both Morehouse *et al.* (2010) and Jakes and Langer (2012) demonstrate that ignoring values deprives decision makers of information that has substantial value in the planning process. Beyond being an important source of information, values in competition may be a major source of conflict. For example, Zahara (2020) explores how settler institutions only value indigenous sovereignty as long as it does not conflict with greater (in this case Canadian) community needs. Competing values and priorities can also be seen in the impact of skyrocketing fire suppression costs and the impact on preparedness of public institutions (Ingalsbee 2010).

An example of effective deliberation on values and priorities can be found in robust, well-developed fire management plans. These documents – created before the time pressures of a blaze – allow a wide range of stakeholders to be involved in identifying their priorities and values, enabling facilitated de-escalation of conflict and co-development of management objectives. Some priorities might be easily aligned (such as opportunities to reduce smoke and exclude fire from timber stands); others might require creative solutions (such as considering balance between early and late succession species across a landscape, where their needs conflict locally), while others may be entirely incompatible (e.g. a particular cabin may simply not be safely defensible). But by identifying and deliberating on the divergent priorities of different stakeholders, we can grapple with these difficult decisions and develop workable plans rather than determining our priorities based on the goals that are easiest to accept once fire is on the landscape.

## Risk and uncertainty

‘Risk and uncertainty’ considers the willingness to accept the possibility of varied adverse consequences. The ethics of risk are oriented around tolerance for different kinds of uncertainty. For example, how do we weigh the certainty of smoke exposure from a prescribed fire today against the possibility of future benefits from a reduced hazard? In other words, risk builds on the questions of priorities with an added temporal complexity: not just ‘what do we want?’ but ‘what are we willing to wager?’

Although there is little wildfire literature that engages with these questions through formal ethical analysis, the subject of risk itself has seen widespread discussion within the field. Some of the more prolific works come from fire literary greats Norman and John MacLean whose case studies of Mann Gulch (Maclean 2017; see Weltzien 1994 and Atnip 2020 for analysis) and the Esperanza Fire

(MacLean 2013) explored themes related to the trade-offs between firefighter and community risk. These questions of risk and uncertainty are also at the heart of many issues within the prescribed fire community, with debates about risk often looking at risk caused versus risk responded to (e.g. Yoder *et al.* 2004; Weir *et al.* 2019).

Despite the volume of work considering risk, much of this literature emphasises quantification rather than ethical reflection. This is in some way a continuation of a trend that sees the increasing de-moralisation of risk (see Adams *et al.* 2003). The growing use of predictive risk modelling and other algorithmic approaches (see Kennedy 2020) may further obscure the subjective nature of risk. Computational modelling already embodies tensions around risk tolerance, particularly with key wildland fire questions that compare timeliness versus accuracy (Neale *et al.* 2021) and reveal how models must be interpreted through personal values. Additionally, the dynamic impact of climate change (Littell *et al.* 2018) and changing settlement patterns can trouble conventional ways of approaching these calculations, forcing increasingly subjective calls about how much precaution is prudent. Fortunately, there are clear benefits towards an ethically conscious approach to risk. Beyond just enhancing one's understanding of risk, Morehouse *et al.* (2010) and Williams *et al.* (2018) demonstrate that by utilising the varied public perceptions of risk and land value, one gains access to information of strategic importance, and a means to provide a clear avenue for public engagement in fire management.

## Power

Power encompasses the ability for an individual or group to take actions or exert influence. These actions can have many different forms and effects, seen through the influencing of public policy, or the freedom to move unopposed through disaster zones. One manifestation of power is that of ‘responsibility’ – which people or institutions are responsible for managing particular challenges. Such works range from McLennan and Eburn's (2014) exploration of the hidden value trade-offs in discussion of responsibility, to an examination of how the Black Saturday Royal Commission ran against trends in ‘Western countries’ in focusing the responsibility for risk management on government rather than communities (McLennan and Handmer 2012).

For a more focused examination of the ethical dimensions of power in wildfire, several authors stand out. Eburn and Cary (2017) examine how Australian laws incentivise risky fire management practices. Similarly, using the example of how US air quality regulation can discourage prescribed fires owing to their smoke production, Engel (2013) demonstrates how a lack of nuance in determining ‘good’ and ‘bad’ states can result in legislative incentivisation of long-term ‘bad’ outcomes. An added layer of complexity comes when observing how the detrimental effects of smoke and fire are



unevenly distributed owing to the by-product of power differentials, namely vulnerability and affluence (Eriksen and Simon 2016; Simon and Eriksen 2021). These power differentials are especially present within wildfire management organisations, where a normalisation of gendered discrimination by leadership has come to define many firefighters' lived experiences (Reimer and Eriksen 2018).

Unlike the other categories of this taxonomy, there already exists a rich set of supporting knowledge, some of which explicitly draws on concepts of moral philosophy. Not only are there clear policy and practice implications that stem from the discussions that occur (for example, see Tibbitts *et al.* (2008) or the Victorian Bushfires Royal Commission (2010) for some of the Australian discussion on 'Stay and defend'), but the topic has attracted a relatively high degree of attention from scholars. This is not to say that more cannot be done; greater connection can be made between the various works, and as always, ethics should be brought to the forefront of these conversations.

## Metaethics

Metaethical questions consider the 'building blocks' of ethical deliberation (like key terms) and the processes by which ethical questions are resolved. Questions in this category will often focus on high-level ideas such as 'What beliefs should guide decisions between freedom and fire safety?' or 'How do we decide what is good or bad fire?' Moreover, ethical processes in fire management can be particularly thorny, both because of the compressed timelines that can be present (e.g. facing ethical debates while a fire burns) and because of the power differentials that can exist between 'manager' and 'victim'. Metaethics does not suggest that there is only one approach to resolving these questions; rather, it suggests we need to think about the ethics of how we think about ethics.

This is a relatively underdeveloped vein of wildfire ethics, with only a handful of examples – such as Green (2018) – that explicitly interrogate what kinds of considerations should be included when discussing wildfire ethics. Some of these considerations – such as those looking at climate change and the environment – tie into the environmental ethics of Leopold (2014), whose values have begun to see some degree of use within the wildland fire community. Conversely, Thackaberry looks at ethics already widespread within the field, as he points out that some agencies have begun to shift towards virtue ethics via the 'Ten Standard Fire Orders' (Thackaberry 2005). Meanwhile, Strohmaier (2000) has looked at the value and development of professional ethics in the prescribed burn community, which may parallel early work within fields with highly developed professional ethics, such as urban fire and medicine, as described by Sandin (2009).

A challenge faced in this category is that even understanding these questions can be a daunting task. This is best exemplified when looking at the time-honoured debate of *what is good and bad fire?* This notoriously tricky question

(see Haugo 2013) can be understood in many different ways. Through universalist consequentialism, good fire is always that which produces the most of a desired outcome (reduces future risk or supports ecological diversity); for a moral relativist, the answer to this question depends on the socio-cultural context the question is asked within, whereas a stoic absolutist might need to consider a set of rules established in accordance with nature, and how a given relationship with fire contributes to the development of an individual's virtues. All of this helps illustrate the variety of considerations, assumptions and approaches that must be understood prior to even answering the question itself. In many ways, clarifying metaethical assumptions helps to unpack and de-escalate the issues raised in the previous four elements of the taxonomy. Conflict between stakeholder groups can often arise because of different views on how a debate should be resolved, on what kinds of arguments make sense within their respective ways of knowing (e.g. monetary incentives for a for-profit firm versus identity and experience of a local resident). Metaethics challenges us to, in essence, grapple with the 'terms of reference' of our ethical deliberations, of what our deliberative processes might look like and how we should come to a decision.

## Conclusion

This article advances a seemingly simple – yet profoundly challenging – argument: nearly every issue in wildfire management has substantial ethical dimensions. These may be obscured through long-standing assumptions; they may go unchallenged in one country only to look very different in another, and they may not yet even be realised because of perspectives that traditionally have not had a voice in wildfire management. But the more we are willing to systematically and explicitly discuss these ethical dimensions, the more likely we are to be able to make thoughtful decisions, continue to help our practices evolve and address potential injustices or ethical failings.

This taxonomy of ethical issues – the lenses of epistemologies and representation, values and priorities, risk and uncertainty, power, and metaethics – provides the first step towards a tool for asking ethical questions within wildfire. During the process of developing a fire management plan, for example, facilitators could ensure that stakeholder deliberations explicitly engage with each of these five aspects: setting the 'terms of reference' for how the planning process will be conducted justly, determining what forms of knowledge and what knowers will be included, working to broadly empathise with their priorities, seeking to understand how they prefer to manage uncertainty, and ensuring that no individual interests dominate the planning process.

There will also, however, be opportunities to develop more specific tools for facilitating ethical conversations amidst the multitude of other fire management challenges.

Some may look like the Toolbox Project (O'Rourke and Crowley 2013), laying out strategies for conducting productive ethical conversations. Other tools might provide journalists with support in how to cover complex stories ethically, or offer decision aids for managers to help consider issues of firefighter or public risk in more systematic ways.

Our hope is that this discussion can serve as an inclusive call and invitation for more work on the ethical dimensions of wildland fire. There are hundreds of questions to be explored across geographical, historical, institutional and situational contexts. There are significant lessons to be learned through facilitating multi-disciplinary and multi-jurisdictional conversations on this topic. As our community faces increased stressors through a changing climate, budgetary constraints, changing settlement patterns and evolving science, addressing ethical and value-based questions will be every bit as important as technological advances.

## References

- Adams J, Ericson RV, Doyle A (2003) 'Risk and morality.' (University of Toronto Press)
- Asfaw HW, Nation SLF, McGee TK, Christianson AC (2019) A qualitative study exploring barriers and facilitators of effective service delivery for Indigenous wildfire hazard evacuees during their stay in host communities. *International Journal of Disaster Risk Reduction* 41, 101300. doi:10.1016/j.ijdr.2019.101300
- Asfaw HW, McGee TK, Christianson AC (2020) Indigenous elders' experiences, vulnerabilities and coping during hazard evacuation: The case of the 2011 Sandy Lake First Nation wildfire evacuation. *Society & Natural Resources* 33(10), 1273–1291. doi:10.1080/08941920.2020.1745976
- Atnip L (2020) From tragedy to apocalypse in Norman Maclean's *Young Men and Fire*. *Literary Imagination* 22(1), 74–88. doi:10.1093/litimag/imz069
- Carson R (1962) 'Silent spring.' (Houghton Mifflin Harcourt)
- Childress JF, Faden RR, Gaare RD, Gostin LO, Kahn J, Bonnie RJ, et al. (2002) Public health ethics: mapping the terrain. *The Journal of Law, Medicine & Ethics* 30(2), 170–178. doi:10.1111/j.1748-720x.2002.tb00384.x
- Dodd W, Scott P, Howard C, Scott C, Rose C, Cunsolo A, Orbinski J (2018) Lived experience of a record wildfire season in the Northwest Territories, Canada. *Canadian Journal of Public Health* 109(3), 327–337. doi:10.17269/s41997-018-0070-5
- Düwell M, Bos G, van Steenbergen N (2018) 'Towards the ethics of a green future.' (Taylor & Francis)
- Eburn M, Cary GJ (2017) You own the fuel, but who owns the fire? *International Journal of Wildland Fire* 26(12), 999–1008. doi:10.1071/WF17070
- Engel KH (2013) Perverse incentives: The case of wildfire smoke regulation. *Ecology Law Quarterly* 40, 623–672.
- Eriksen C, Hankins DL (2014) The retention, revival, and subjugation of Indigenous fire knowledge through agency firefighting in eastern Australia and California. *Society & Natural Resources* 27(12), 1288–1303. doi:10.1080/08941920.2014.918226
- Eriksen C, Simon G (2016) The affluence–vulnerability interface: intersecting scales of risk, privilege and disaster. *Environment and Planning A: Economy and Space* 49(2), 293–313. doi:10.1177/0308518X16669511
- Etkin D (2020) 'The Ethical Emergency Manager: Issues, Morality, and Dilemmas'. (David Etkin)
- Fehr C, Plaisance KS (2010) Socially relevant philosophy of science: an introduction. *Synthese* 177(3), 301–316. doi:10.1007/s11229-010-9855-7
- Fleming B (2021) Nomex for every body [webinar]. *International Association of Wildland Fire*. May 6, 2021. Available at <https://www.iawfonline.org/events/webinars/>
- Fowler CT (2018) Emerging environmental ethics for living with novel fire regimes in the Blue Ridge Mountains. *Ethnobiology Letters* 9(1), 90–100. doi:10.14237/eb1.9.1.2018.1049
- Fricker M (2007) 'Epistemic injustice: Power and the ethics of knowing.' (Oxford University Press)
- Gade AM (2018) Smoke, fire, and rain in Muslim southeast Asia: Environmental ethics in the time of burning. In 'Piety, politics, and everyday ethics in southeast Asian Islam: Beautiful behavior'. (Ed. R Rozehnal) pp. 169–188. (London: Bloomsbury Academic) doi:10.5040/9781350041745.ch-008
- Gardiner SM (2006) A perfect moral storm: Climate change, inter-generational ethics and the problem of moral corruption. *Environmental Values* 15(3), 397–413. doi:10.3197/096327106778226293
- Green B (2018) What ethical issues are involved in wildfires? Available at <https://www.scu.edu/ethics/all-about-ethics/what-ethical-issues-are-involved-in-wildfires/>
- Haugo R (2013) Good fire, bad fire: an ecologist's perspective. Available at <https://blog.nature.org/science/2013/05/15/good-fire-bad-fire-an-ecologists-perspective/>
- Hess A (2018) California is paying inmates \$1 an hour to fight wildfires. *CNBC*, 12 November. Available at <https://www.cnbc.com/2018/08/14/california-is-paying-inmates-1-an-hour-to-fight-wildfires.html>
- Ingalsbee T (2010) 'Getting burned: A taxpayer's guide to wildfire suppression costs.' (Firefighters United for Safety, Ethics, and Ecology)
- Jakes PJ, Langer ER (Lisa) (2012) The adaptive capacity of New Zealand communities to wildfire. *International Journal of Wildland Fire* 21(6), 764–772. doi:10.1071/WF11086
- Kehoe AK (2020) Fanning the flames of disaster: the role colonialism plays in the impact of wildfire on Indigenous people in northern Alberta. Masters Thesis. The University of Western Ontario, London, Canada. Electronic Thesis and Dissertation Repository. 7370. Available at <https://ir.lib.uwo.ca/etd/7370/>
- Kennedy EB (2019) Values in science: lessons from wildfires. *Environmental Communication* 13(2), 276–280. doi:10.1080/17524032.2018.1560965
- Kennedy EB (2020) Predictive rebound & technologies of engagement: science, technology, and communities in wildfire management. *Journal of Responsible Innovation* 7(sup1), 104–111. doi:10.1080/23299460.2020.1844954
- Leopold A (2014) The land ethic. In 'The ecological design and planning reader'. (Ed. FO Ndubisi) pp. 108–121. (Island Press: Washington, DC) doi:10.5822/978-1-61091-491-8\_12
- Littell JS, McKenzie D, Wan HY, Cushman SA (2018) Climate change and future wildfire in the western United States: an ecological approach to non-stationarity. *Earth's Future* 6(8), 1097–1111. doi:10.1029/2018EF000878
- MacLean JN (2013) 'The Esperanza Fire: arson, murder, and the agony of Engine 57.' (Counterpoint)
- Maclean N (2017) 'Young men and fire.' (University of Chicago Press)
- McGee TK, Nation MO, Christianson AC (2019) Residents' wildfire evacuation actions in Mishkeegogamang Ojibway Nation, Ontario, Canada. *International Journal of Disaster Risk Reduction* 33, 266–274. doi:10.1016/j.ijdr.2018.10.012
- McLennan B, Eburn M (2014) Exposing hidden-value trade-offs: sharing wildfire management responsibility between government and citizens. *International Journal of Wildland Fire* 24(2), 162–169. doi:10.1071/WF12201
- McLennan BJ, Handmer J (2012) Reframing responsibility-sharing for bushfire risk management in Australia after Black Saturday. *Environmental Hazards* 11(1), 1–15. doi:10.1080/17477891.2011.608835
- Minteer BA, Pyne SJ (Eds) (2015) 'After preservation: Saving American nature in the age of humans.' (University of Chicago Press)
- Morehouse BJ, O'Brien S, Christopherson G, Johnson P (2010) Integrating values and risk perceptions into a decision support system. *International Journal of Wildland Fire* 19(1), 123–136. doi:10.1071/WF08064
- Muller D, Gawenda M (2010) Ethical free-for-all over media access to the fire zone. *Media International Australia* 137(1), 71–79. doi:10.1177/1329878X1013700109
- Neale T, Vergani M, Begg C, Kilinc M, Wouters M, Harris S (2021) 'Any prediction is better than none'? A study of the perceptions of fire

- behaviour analysis users in Australia. *International Journal of Wildland Fire* 30(12), 946–953. doi:10.1071/WF21100
- O'Rourke M, Crowley SJ (2013) Philosophical intervention and cross-disciplinary science: the story of the Toolbox Project. *Synthese* 190(11), 1937–1954. doi:10.1007/s11229-012-0175-y
- Paveglio T, Edgeley C (2017) Community diversity and hazard events: understanding the evolution of local approaches to wildfire. *Natural Hazards* 87(2), 1083–1108. doi:10.1007/s11069-017-2810-x
- Regan SE (2015) Austrian ecology: reconciling dynamic economics and ecology. *Journal of Law, Economics & Policy* 11, 203–228. Available at <https://www.perc.org/wp-content/uploads/2015/12/JLEconPolyReganAustrianEcology.pdf>
- Reimer R, Eriksen C (2018) The wildfire within: gender, leadership and wildland fire culture. *International Journal of Wildland Fire* 27(11), 715–726. doi:10.1071/WF17150
- Sandin P (2009) Firefighting ethics: Principlism for burning issues. *Ethical Perspectives* 16(2), 225–251. doi:10.2143/EP.16.2.2041653
- Setten G, Lein H (2019) 'We draw on what we know anyway': the meaning and role of local knowledge in natural hazard management. *International Journal of Disaster Risk Reduction* 38, 101184. doi:10.1016/j.ijdrr.2019.101184
- Simon G, Eriksen C (2021) The unequal social consequences of smoke in California. *Bay Nature*. Available at <https://baynature.org/2021/04/20/the-unequal-social-consequences-of-wildfire-smoke-in-california/>
- Smith W, Neale T, Weir JK (2021) Persuasion without policies: The work of reviving Indigenous peoples' fire management in southern Australia. *Geoforum* 120, 82–92. doi:10.1016/j.geoforum.2021.01.015
- Strohmaier DJ (2000) The ethics of prescribed fire: a notable silence. *Ecological Restoration* 18(1), 5–9. doi:10.3368/er.18.1.5
- Thackaberry JA (2005) 'Wisdom in the lessons learned library: Work ethics and firefighter identities in the Fire Orders.' (The International Association of Wildland Fire)
- Tibbits A, Handmer J, Haynes K, Lowe T, Whittaker J (2008) Prepare, stay and defend or leave early. In 'Community Bushfire Safety'. (Eds J Handmer, K Haynes) pp. 59–71.
- Victorian Bushfires Royal Commission (2010) 2009 Victorian Bushfires Royal Commission. Final Report: Summary. (Melbourne: Parliament of Victoria)
- Wanvik TI (2019) Wildfire politics: the role of a natural disaster in Indigenous–State relations. In 'Extracting home in the oil sands'. (Eds CN Westman, TL Joly, L Gross) pp. 101–118. (Routledge)
- Weir JR, Kreuter UP, Wonkka CL, Twidwell D, Stroman DA, Russell M, Taylor CA (2019) Liability and prescribed fire: Perception and reality. *Rangeland Ecology & Management* 72(3), 533–538. doi:10.1016/j.rama.2018.11.010
- Weltzien OA (1994) The two lives of Norman Maclean and the text of fire in Young Men and Fire. *Western American Literature* 29(1), 3–24. doi:10.1353/wal.1994.0069
- Williams KJH, Ford RM, Rawluk A (2018) Values of the public at risk of wildfire and its management. *International Journal of Wildland Fire* 27(10), 665–676. doi:10.1071/WF18038
- Yoder J, Engle D, Fuhlendorf S (2004) Liability, incentives, and prescribed fire for ecosystem management. *Frontiers in Ecology and the Environment* 2(7), 361–366. doi:10.1890/1540-9295(2004)002[0361:LIAPFF]2.0.CO;2
- Zack N (2010) 'Ethics for disaster.' (Rowman & Littlefield Publishers)
- Zahara A (2020) Breathing fire into landscapes that burn: wildfire management in a time of alterlife. *Engaging Science, Technology, and Society* 6, 555–585. doi:10.17351/ests2020.429

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