

# **Environmental Justice for Unregarded Others – Human Responsibility for a Forgotten Kingdom in World Conservation and Agriculture**

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## **Abstract**

Charismatic organisms are a keystone of global conservation for which flora and fauna have been the focus. Meanwhile, another kingdom of organisms has been almost entirely neglected. The kingdom Fungi provides the connective fibre between all kingdoms through mutually beneficial symbioses, underpinning almost every terrestrial ecosystem on the planet. How can we be serious about environmental justice when we disregard an entire kingdom? Leading mycologists consider that ecosystem approaches to conservation that exclude fungi are so compromised as to be critically invalid.

Failure to recognise the role of fungi in soil health in industrialised farming is directly reflected in the global explosion of human health issues. Rethinking current agricultural approaches to incorporate fungi in the nutrient dynamics of soils could reverse this trend.

Innovative approaches to forging human connections with fungi are vital to their recognition and inclusion in conservation and agriculture. Fungi represent not only a critical part of our biodiversity, but are also deeply entwined in our cultural heritage. Civilisations have been enriched and extended by fungal remedies and wild edible fungi are harvested in over 80 countries providing vital subsistence nutrition. This paper will include an examination of cultural connections with fungi and the challenges of ensuring their protection, focussing on Australia and Europe. It will also examine the use of fungi in English speaking cultures as a means to reconnecting people with ‘natural’ environments.

Much of the dynamism of the natural world occurs in transition zones or ‘interface’ environments. This is also the domain of fungi. Likewise, the best possibilities for conserving both ‘natural’ environments and agricultural systems through inclusion of fungi are likely to emerge at the intersections of disciplinary thought.

**Key Words:** Fungi, mycology, conservation, soils, charismatic organisms, environment, agriculture, Australia.

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## **1. The forgotten majority**

Charismatic faunas are major drawcards of Australian tourism. These species are referred to in a common idiom as ‘cute and cuddly’ and they’ve achieved iconic status, appearing on coats of arms, coins and stamps for over a century.

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Tourist shops overflow with koalas and kangaroos in the form of fluffy toys and trinkets more often than not, imported from China.

Conservation, both in Australia and internationally, has not had a dissimilar focus. If you're glamorous and rare you're more likely to arouse public sentiment and increase your chance of being legislatively protected.<sup>1</sup> This is all very well if you're charismatic but try being a less well-regarded weevil, fruit bat or mushroom.

Nevertheless, substantial conservation successes have been achieved through the advocacy of charismatic organisms, otherwise known as flagship species.<sup>2</sup> Flagship species are often large vertebrate fauna, suitable for emotive promotion that attracts public support and conservation dollars. These species are usually representative of broader ecosystem threats and can hence catalyse more extensive conservation efforts. Through their protection, many other organisms and ecosystems have benefited by default of being in the same geographical region or ecological niche.

There is continued debate, however, as to whether promoting flagship species is still a valid conservation approach, as it focuses on relatively few species often to the neglect of a diverse majority.<sup>3</sup> In recent decades the single-species approach to conservation has transitioned to broader ecosystem-based approaches improving the potential for conservation funding to reach a wider range of initiatives. However, there still remains an enormous group of organisms, largely unrecognised and unrepresented in conservation and biodiversity management, without which, the cute and cuddly could not exist. We could perhaps call this group, unregarded others, or the forgotten majority.

## **2. Entangled kingdoms**

Fungi are not an insignificant minority. They are, in fact, one of the most diverse groups of organisms on the planet, with an estimated 1.5 million species worldwide.<sup>4</sup> Fungi, are not animals or plants, but occupy an entire kingdom of their own and are present in two others.<sup>5</sup> Yet despite their importance and ubiquity, fungi are overlooked in both Australian and international conservation and agriculture.<sup>6</sup>

In a fitting metaphor fungi have been described as the 'earth's internet', in reference to their vast interconnecting mycelial networks that link the earth's ecosystems.<sup>7</sup> Fungi not only create soil through the decomposition of organic matter in a process known as pedogenesis, they also bind soils and increase their capacity to retain water. Fungi connect the major kingdoms through mutually beneficial relationships with the great majority of plants, assisting in the uptake of water and nutrients, as well as providing food for animals.<sup>8</sup> These close alliances are crucial to ecosystem resilience, persistence and longevity.

Effective conservation requires recognition of all biodiversity and its interrelationships in their entirety. Mycologist, David Minter, purports that failure

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to include fungi in conservation of ecosystems is so compromised as to be invalid.<sup>9</sup> So why is there resistance to including fungi in biodiversity conservation? One might start by examining attitudes toward fungi by delving into the history of ethnomycology.

### **3. Dark and sinister associations**

The poor profile of fungi can be understood partly by trawling through the curious history of suspicious and sinister associations, from witchcraft to the supernatural. Fungi have become deeply infused in the mythologies of many cultures through a uniting thread of negativity; with death and decay, witchcraft, the supernatural, unexplained happenings, poisonings, hallucinogens and a suite of other odious associations. Although advances in scientific understanding have dispelled many of these myths, old superstitions are firmly ingrained and enduring.

Conservation managers may dismiss fungi in conservation initiatives as they are often perceived as an obscure group, tricky to identify, to quantify and hence difficult to incorporate in management strategies. However, this obscurity and poor profile even further reinforces the urgency for their conservation as habitat loss, global warming and other anthropogenic processes increasingly threaten their survival. Furthermore, species conservation is often driven by perceived charisma of an organism, rather than any scientific rationale of the repercussions of their loss to nature including humanity.<sup>10</sup>

### **4. Conservation innovations**

Due to high diversity and endemism, Australia has one of the richest and most unique biotas, including fungi, on the planet.<sup>11</sup> Less positively, Australia also has one of the world's highest species extinction rates. This combination of high diversity and high extinction rates, along with a variable and unreliable climate and nutrient-limited soils, has arguably mobilised Australians into taking innovative approaches to conservation management. Australia has set a precedent in developing cooperative models for national park management that incorporate both conservation managers and traditional landowners. These have critically influenced thinking about the coexistence of nature and culture, of biodiversity and people.<sup>12</sup> Australia also has the tremendous advantage of being one of two among the 17 nations considered as megadiverse that has a developed, industrialised economy.<sup>13</sup> That is, given this affluence, coupled with a relatively scientifically literate society, Australia is in good stead to become leaders in conservation management.

However, it is not only conservation of fungi in 'natural' ecosystems that needs addressing, but also in agricultural systems. In addition to the macrofungi and their visible fruit bodies discussed so far, it is the covert workings of microfungi in agricultural soils that directly influence the future success of global food production and hence human civilisation.

## **5. Dirt health**

Dirt is more than it may at first appear. Every farmer knows this. Soils are the cornerstones or building blocks of all terrestrial agriculture. Healthy soils writhe with multitudes of unseen organisms, including fungi, whose subterranean activities drive biogeochemical cycles, recycling and releasing vital nutrients essential to plant growth.

The success of civilisations was traditionally dependent on the existing fertility of their soils and possibilities for nutrient replenishment through natural processes. In recent times, less fertile soils have been made arable through the addition of fertilisers, with a resultant massive increase in global populations.<sup>14</sup> But alongside other peaking resources such as crude oil, we are also nearing peak phosphate indicating that synthetic fertilisers and petro-chemical based agricultural processes are nearing the end of their short life spans.<sup>15</sup>

Furthermore, industrialised farming that involves synthetic fertiliser and herbicide application has severely comprised soil nutrient dynamics, especially the delicate balance between plants and soil fungi. Fungi have the unique capacity to selectively absorb and concentrate essential nutrients as opposed to the non-selective uptake processes that occur with fertiliser application. Essentially, rather than choosing to mimic nature in agricultural food production, humanity has opted for a short-term, high yield approach that is not only destroying soils, but is unsustainable in terms of fertiliser production costs as oil prices rise.<sup>16</sup>

The nutritional value of agricultural crops is directly related to soil condition. Fortunately there has been a recent shift among more innovative thinkers to try and recreate the soils in Australia that existed prior to the changes resulting from European agricultural systems. These include non-till agriculture, no-dig gardening and permacultural principles.<sup>17</sup> Greater recognition of Australia's unpredictable and variable climate and hence dependency on our soils' capacity to infiltrate and store water, has stimulated new approaches that maximise organic content, including fungal networks. However, these are still small-scale and rarely infiltrate industrialised agriculture.

To degrade soil fungi is to degrade our own health. There is ever-increasing evidence that widespread nutritional decline and the exponential rise of global diseases are directly related to the reduced nutritional density and integrity of foods produced through industrialised agriculture.<sup>18</sup> Unless we urgently reassess current agricultural practices, not only soils and natural systems are at risk of demise, but also the future of humanity.

## **6. Charisma under the microscope**

What are the possibilities for informing a wider audience of the vital importance of fungi? Returning to the use of charismatic organisms in biodiversity conservation, it is paradoxical that fungi do not fit into the charismatic basket, given their exquisite colouration, intriguing morphologies and the recognition of

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fruiting bodies as a culinary delight by many cultures.<sup>19</sup> Highly prized white truffles,<sup>20</sup> for example, can fetch a higher price per kilo than Beluga caviar, Kopi Luwak coffee, Kobe beef or pretty much any other food derived from animals or plants. It's something of an odd contradiction that we put a high price on the culinary value of fungi, but not on their conservation.

Charisma generally implies more than just attractiveness. Understanding which attributes are considered charismatic offers vital clues to understanding attitudes toward fungi. In addition to attractiveness, charisma also involves perception of a species as having exceptional or extraordinary characteristics.<sup>21</sup> It is also about familiarity. The frequency with which we encounter an organism, and our capacity to recognise it, to name and classify it,<sup>22</sup> and hence give it a place and meaning in the world, also contribute to our perception of charisma.

The challenge is to demonstrate that exceptional or extraordinary traits of fungi can also be considered charismatic. A starting point could be in identifying physical and physiological attributes of fungi - such as edibility, luminosity or morphological peculiarities - that contribute to perception of them as being extraordinary as a means to pique curiosity and stimulate conservation.<sup>23</sup>

## **7. Strange as charismatic**

While some may consider that Australia lacks the grandeur and scale of spectacularly dramatic landscapes that exist, for example, in parts of the United States or Europe, it does have a most extraordinary natural history. Australia's geological history, isolation, extremely variable climate and topography have all contributed to a unique and diverse biota. In this context, the exceptional and the extraordinary could arguably replace the cute and cuddly as the new charismatic. Australia's biota has long been perceived as strange by outsiders and this was an impetus for early European expeditions to document Australian natural history. Historian, Libby Robin, describes how historically 'Australian flora and fauna challenged perceptions of the orderliness of the known world.'<sup>24</sup> Arguably, Australian fungi could also challenge expectations through their extraordinariness.

This sense of the extraordinary, of difference, both of the landscape and its biota, is also tightly intertwined with Australian identity. Robin discusses how 'the potential for Australia's environmental difference to contribute seriously to global knowledge remains unrealised'<sup>25</sup> and that this difference could be our greatest contribution to the 'global journey towards sustainability' .

## **8. Familiarity with the ephemeral**

Familiarity with flora and fauna among the general population is often a reflection of the greater frequency of encounters, relative to those with fungi. Encounters with fungi are less likely due to their short fruiting periods and hence invisibility for much of the year. Being unseen raises huge challenges as ecologist, Aldo Leopold, commented 'We can be ethical only in relation to something we can

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see, feel (or) understand....'<sup>26</sup> However, this perceived ‘rarity’ could also work to the advantage of fungi, whether one’s interest is in fungal ecology, foraging for edible species or documenting fungal aesthetics. In the same way that people treasure the short fruiting season of mangoes, a run of scallops, or a rarely-flowering cactus, the ephemeral nature of many fungi, in a sense, their rarity or at least the rarity of one’s encounters with them, increases their perceived ‘value’.

## **9. Kinship and culture**

Familiarity also leads to kinship. Our capacity to form kinship with species is embedded in our cultural and educational backgrounds.<sup>27</sup> Fungi are not only a vital part of our biodiversity, but are also part of our natural and cultural heritage.

Numerous fungi have cultural, historical or spiritual significance and have been utilised for thousands of years, from the shamans of Siberia to the Mayans of Guatemala. Fungal lore has been passed through generations, predominantly among non-English speaking cultures. Mycologist, Regis Courtecuisse discusses the ‘heritage dimension’ of fungi as integrating aspects of historical, management, biodiversity and conservation factors.<sup>28</sup> While species protection generally hinges on natural values, cultural significance of fungi could also be explored as a valid reason for their protection. Given that conservation is a value-based cultural construct, effective construction can only be achieved within a context that values cultural significances.

## **10. Insidious impacts**

If we continue to overlook the importance of fungi, we will not only lose them but also the interconnected species and ecosystems, including our food production systems and ultimately, our civilisations. Processes that threaten fungi, indeed entire ecosystems, are characteristically slow and insidious. The most destructive processes generally occur at rates that are not detectable until the species or ecosystem is already in a vulnerable state. The media seldom assist in reporting these issues as it is typically drawn to environmental stories that are highly visible, calamitous, event and time-focussed,<sup>29</sup> preferably with a charismatic species in the lead role. Unseen and undocumented extinction of fungi due to habitat loss rarely possesses the same visceral, shock-value power of tsunamis, volcanic eruptions or slaughtered megafauna.<sup>30</sup> The challenge is to attract attention to invisible organisms and slow processes. Arresting images and narratives that convey the pervasive and elusive impacts are required, especially given that impacts are likely to be not just attritional in their effect, but exponential.<sup>31</sup>

## **11. Interdisciplinary perspectives**

Conservation is about nature, which means it’s also about people. Effective conservation is about having the right balance of skills; it not only requires scientific expertise but also perspectives that offer alternative knowledge and

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values. Furthermore, it requires consideration of the individuals and communities who may be directly affected by conservation initiatives and ensuring that their lives are maintained or improved in a way that is consistent with conservation goals. Most critically, it is essential to avoid the tendency toward a destructive dichotomy between the ‘human’ and the ‘natural’.<sup>32</sup>

Much of the dynamism of the natural world occurs in transition zones or ‘interface’ environments. This just so happens to be the domain of fungi. Likewise, the best possibilities for understanding and conserving natural environments emerge at crossroads - at the intersections of disciplinary thought. There is great opportunity to join forces with sympathetic advocates including indigenous people, aesthetes, philosophers, politicians, natural historians, artists and others to form a collective voice to present the great suite of views on the value of fungi.

Determining what constitutes a species or ecosystem worthy of protection relies on value judgements. With its foundations in objectivity, science rarely offers value judgements found in other fields such as philosophy or the arts. Given that many of the issues in conservation rely on inclusion of value judgements, a collective process reflecting a spectrum of views and approaches enriches possibilities for fungal protection.

## **12. Embracing the challenge**

Australia has been an innovative world leader in many areas of conservation management. We are in a unique position of having a megadiverse biota and the knowledge and economic capacity to invest in conservation. However, our approach to agricultural systems must address the role of fungi in soils if we are to slow the current rapid deterioration of soil and human health. We now have a good understanding of the issues and the immediate imperative is to urgently activate solutions. But will we react swiftly enough, or as soil scientist, Walter Jehne questioned, ‘will we rely on nature to use these same fungal ecologies to regenerate these bio-systems for us, but after us?’<sup>33</sup> Determining time frames is challenging but given the aridification of much of the world’s soils, extremes of climate change and population pressures, we may have only a few decades to regenerate our natural and agricultural systems.<sup>34</sup>

Central to this is the recognition that humanity is just one part of an intricate symbiosis of relationships, at which fungi and bacteria are the foundation. The solution to a healthy and resilient future lies in respecting and restoring the microbial ecologies that drive soil health, hydrology, biosphere and climate.<sup>35</sup> The extraordinary fruit bodies of our macrofungi offer a wonderful conduit to reconnecting people with our ‘natural’ environments. Experiences in nature that capture people’s imaginations and explore possibilities for enlightening and humbling experiences all serve as a bridge to connectedness and realisation of the importance of fungi.

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Pivotal to activating solutions is fostering innovative thinking that challenges existing paradigms embedded in the charters of governments, conservation agencies and the agricultural industry. We need to actively endorse innovative approaches of individuals and groups that advocate alternatives to fertiliser and herbicide dependent agriculture and strive to mimic the clever work of nature. Furthermore, we need to enhance the message that fungi provide a pathway, a conduit to ensure sustainability of the biosphere throughout future generations.

## Notes

<sup>1</sup> ‘Are conservation groups right to prioritize ‘iconic’ species?’ modified 21 May 2012, Viewed 25 November 2012, <<http://www.earthtimes.org/conservation/conservation-groups-prioritize-iconic-species/2001/>>

<sup>2</sup> Maan Barua, ‘Mobilizing metaphors: the popular use of keystone, flagship and umbrella species concepts’. *Biodiversity Conservation* 20 (2011): 1247-1440.

<sup>3</sup> Joaquin Munoz, ‘Biodiversity conservation including uncharismatic species’, *Biodiversity Conservation* 16 (2007): 2233-2235.

<sup>4</sup> David L. Hawksworth, ‘The magnitude of fungal diversity: The 1.5 million species estimate revisited’, *Mycological Research* 105 (2001): 1422-1432.

<sup>5</sup> George A.M. Scott, et al., *A conservation overview of Australian non-marine lichens, bryophytes, algae and fungi*. (Canberra: Environment Australia, 1997), chap. 5.

<sup>6</sup> Alison M. Pouliot and Tom W. May, ‘The third F – fungi in Australian biodiversity conservation: actions, issues and initiatives.’ *Mycologia Balcanica* 7 (2010): 41-48.

<sup>7</sup> Mycelium is the vegetative part of a fungus, usually existing beneath soil or in wood, comprising often vast networks of interconnecting hyphae; Paul Stamets, *Mycelium Running: How mushrooms can help save the world* (USA: Ten Speed Press, 2005), 4.

<sup>8</sup> Over 30 species of Australian mammals as well as an unknown number of invertebrates feed on fungi.

<sup>9</sup> 'A future for fungi – the orphans of Rio' last modified 06 October 2010, Viewed 01 April 2012, <<http://www.iucn.org/involved/opinion/?6197/A-future-for-fungi---the-orphans-of-Rio>>.

<sup>10</sup> Peter K. Buchanan and Tom W. May, 'Conservation of New Zealand and Australian Fungi', *New Zealand Journal of Botany* 41 (2003): 407–421.

<sup>11</sup> 'Biodiversity and progress' last modified 14 July 2011, Viewed 25 November 2012,  
[http://www.abs.gov.au/ausstats/abs@.nsf/Lookup/by%20Subject/1370.0~2010~Chapt](http://www.abs.gov.au/ausstats/abs@.nsf/Lookup/by%20Subject/1370.0~2010~Chapter~Biodiversity%20and%20progress%20%286.1.1%29)  
er~Biodiversity%20and%20progress%20%286.1.1%29

<sup>12</sup> Libby Robin, *How a continent created a nation* (Sydney: UNSW Press, 2007), 180.

<sup>13</sup> Robin, *Continent created a nation*, 202.

<sup>14</sup> Transcript of interview with Walter Jehne, Director 'Healthy Soils Australia' last modified 13 July 2009, Viewed 04 April 2012,  
<<http://www.abc.net.au/austory/content/2007/s2626742.htm>>.

<sup>15</sup> 'Peak phosphorus fuels food fears' last modified 06 February 2012, Viewed 06 April 2012, <<http://www.abc.net.au/science/articles/2010/08/05/2973513.htm>>.

<sup>16</sup> Walter Jehne, The role of fungi in soil health. Unpublished paper presented at Fungimap Conference, Hobart 2012 Abstract at:  
<<http://www.rbg.vic.gov.au/fungimap/fungi-conservation-and-management-symposium#WJ>>.

<sup>17</sup> The production of food within diverse perennial ecosystems.

<sup>18</sup> Walter Jehne, The role of fungi in soil health.  
<<http://www.rbg.vic.gov.au/fungimap/fungi-conservation-and-management-symposium#WJ>>.

<sup>19</sup> Fungi also provide a vital subsistence food source for numerous countries.

<sup>20</sup> Truffles are a diverse group of fungi and many are considered edible but the white truffle, *Tuber magnatum*, is often considered the most desirable in terms of its culinary value.

<sup>21</sup> Kees Terlouw, ‘Charisma and space’, *Studies in Ethnicity and Nationalism* (2010): 10, 3, 225-248.

<sup>22</sup> Jamie Lorimer, ‘Nonhuman charisma’, *Environment and Planning D: Society and Space*, 25 (2007): 911–932.

<sup>23</sup> Michael C. Hall, Michael James and Tim Baird, ‘Forests and trees as charisma mega-flora: Implications for tourism, heritage and conservation’, *Journal of Heritage Tourism* 6(4) (2011): 309–323.

<sup>24</sup> Robin. *Continent created a nation*, 203, 210.

<sup>25</sup> Ibid., 187, 206, 215,

<sup>26</sup> Aldo Leopold. *A sand country almanac* (USA: Oxford University Press, 1968).

<sup>27</sup> Jurg Schlegel and Reto Rupf, ‘Attitudes towards potential animal flagship species in nature conservation: A survey among students of different educational institutions’, *Journal for Nature Conservation* 18 (2010): 278-290.

<sup>28</sup> Regis Courtecuisse, ‘Current trends and perspectives for the global conservation of fungi’, in *Fungal Conservation, Issues and Solutions*, eds. David Moore, Marijke M. Nauta, Shelley E. Evans and Maurice Rotheroe (Cambridge: Cambridge University Press, 2001), 7–18.

<sup>29</sup> Rob Nixon, *Slow violence and the environmentalism of the poor* (Cambridge: Harvard University Press, 2011), 3.

<sup>30</sup> Ibid., 3.

<sup>31</sup> Ibid., 276.

<sup>32</sup> ‘Conservation is not about nature’ last modified 07 September 2011, Viewed 24 March 2012  
<http://www.iucn.org/involved/opinion/?8195/Conservation-is-not-about-nature>

<sup>33</sup> Walter Jehne, The role of fungi in soil health.

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<sup>34</sup> Ibid.

<sup>35</sup> Ibid.

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