Climate change and the social responsibility of scientists: a reaction to Lunney and Hutchings

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ABSTRACT

A review of the writings of prominent scientists since the 1970s showed a reluctance to accept the realities of anthropogenic climate change until late in the first decade of the 21st Century. Sceptics, deniers, and vested interests used the indecision of the scientific community to delay action on preventing or even mitigating the effects of human-induced climate change. As a consequence, the changes needed in society are now too great to expect action in time to avoid catastrophic climate change and species extinction. It is evident that humans are not clever enough to prevent the collapse of global ecosystems or to understand the consequences of inaction on climate change. Scientists do understand, but have failed to communicate effectively with government, the general public, and the media. Too few have been advocates of action. In doing so, they have abrogated their social responsibility and condemned the future to a poorer world.

Key words: climate change, ethics, social responsibility, science education, extinction

Introduction

'For as in the days before the flood, they were eating and drinking, marrying and giving in marriage, until the day that Noah entered the ark' (Matthew Chapter 24, verses 37-38 the Bible).

'Nothing has changed. Humans have no capacity to anticipate the future nor a willingness to act if it means self-sacrifice. (H. F. Recher, 6 February 2012)

Lunney and Hutchings (2012) reviewed the history of the climate change debate since 1970, with particular reference to Australia. They focussed on biodiversity conservation and the need to adapt conservation management to anthropogenic climate change to avoid species extinction. Citing Jamieson (2008), Lunney and Hutchings (2012) likened species extinction and the loss of biodiversity to an environmental catastrophe. Their paper, they argued, added "*..one more voice to the many urging action on climate change..*" (Lunney and Hutchings 2012, p. 180). They concluded that action was possible and there was adequate understanding of the ecological consequences of climate change to devise '*robust strategies*' for conserving Australia's biodiversity. The implication was that there was also time in which to act.

I do not dispute what Lunney and Hutchings (2012) wrote except that they were too optimistic in their conclusions. Time and knowledge are only two elements in taking action to conserve Australia's biota in the face of climate change. There also needs to be a willingness to take action, not simply for the conservation of biodiversity, but to avoid the consequences of climate change for human society. Willingness relies on the community understanding and accepting the reality of climate change, including the role of people in creating the conditions that are rapidly changing the Earth's climate. There is no evidence that humanity either accepts or understands climate change, much less being willing to make the changes necessary to avoid even the worst effects of climate change. Without (massive[1]) self-sacrifice, catastrophic climate change is now inevitable.

Moreover, I see little evidence that the scientific community understands or accepts climate change as an imminent environmental catastrophe. Despite pronouncements from the world's science academies, scientists, including conservation biologists and ecologists, appear no more willing to act on climate change than the rest of society. Perhaps, as Jamieson (2008) expressed it, we see climate change in isolation from the other threats facing global ecosystems and have yet to understand how these act together to threaten planetary survival. I hope my ecological colleagues have a better understanding of planetary ecology, but their failure to collectively advocate controls over human population growth and economic development (consumption) suggests otherwise. Science needs to speak and advocate with a single voice, if only to counter the individuals who take a contrary position and represent vested interests in the *status quo*.

1 I've been asked by what I mean by 'massive self-sacrifice'. Although greater efficiency in the use of energy and more use of renewable energy will help, society cannot rely on technology to solve the problem of climate change. Instead we need to control our population and limit our consumption of resources, including energy. Massive self-sacrifice means immediately adopting zero population growth; a one-child policy is needed. In the medium to long term it means reducing the population to an ecologically sustainable level. This means redefining human welfare in other than economic terms and committing ourselves to sharing Earth's resources with other species and future generations. Sustainability means no extinctions as a result of human activity. Limiting the consumption of resources means sharing the world's wealth equitably among all people. This means austerity for the rich and a better, healthier life for the poor, but without reaching the pinnacles of extravagance seen among the world's wealthiest nations. All people will need to sacrifice to achieve sustainability.

Pp 202 - 207 in *Wildlife and Climate Change: towards robust conservation strategies for Australian fauna*, edited by Daniel Lunney and Pat Hutchings, 2012. Royal Zoological Society of NSW, Mosman, NSW, Australia.

When commenting on a draft of Lunney and Hutchings (2012) for the authors, I expressed the view that there was no longer any time in which to mitigate the effects of climate change or conserve Australia's biota. This does not mean that there is nothing that can be done, only that what the world must do to avert catastrophe is now so extreme (zero population growth, for example) that there is no prospect of national or international agreement, let alone action. Even if agreement could be reached and action taken, it is doubtful, given the inertia in human society and global ecosystems, whether there is time remaining to significantly mitigate the effects of climate change. The historical approach to the subject taken by Lunney and Hutchings (2012) exposed the timidity and indecision in the public communication by scientists about climate change, effectively abrogating their responsibilities to society and other species. I urged the authors to tackle the weakness they had exposed. They agreed with my conclusions, but took the position that they were arguing for action to conserve Australia's fauna, not admonish their colleagues. On that basis, they invited this response.

I have been in the position before of appearing the doomsayer. Each time I've wrestled with the risks and benefits of saying there is no hope without massive change in society and human behaviour. When I presented the inaugural Allan Sefton Memorial Lecture at the University of Wollongong in 1993 and discussed the global environmental crisis, I quoted E. F. Schumacher ("*Small is beautiful: Economics as if people mattered*") who wrote:

> *"People ask 'Will we survive the present age?' I f I should answer Yes,' they will lapse into complacency. If I should answer 'No,' then they will be filled with despondency. It is better for now that we leave the question unanswered while we all set to work to resolve the problems of survival." (p. 149 in Recher 1994).*

Schumacher's words hung beside those of Bill Mollison, the father of permaculture, at Amery Acres in the Shire of Dowerin in the wheatbelt of Western Australia. Mollison's words were:

> *". . . all of us..are..concerned that we leave a continent in which our own children and grandchildren can survive and exist and have a good life..a healthy life." (source unknown; Recher 1994; p. 149).*

Mollison words express the concerns that have driven my life. Schumacher's position is one taken by too many scientists (Recher 1994). It is the position taken by most of the scientists whose writings on climate change were reviewed by Lunney and Hutchings (2012). In the Sefton Lecture, I disagreed with Schumacher that we should leave the question unanswered. I wrote:

> *".. It is better to present the facts as we know them and let people know what the future will be like given different courses of action. We may not like the future. We may not even like the choices, but by not answering the question of survival we risk following the same paths to the future that we have followed to the present. Paths that place our very survival at risk." (Recher 1994; p. 149).*

I did not consider myself a pessimist in 1993 nor do I consider myself a pessimist now. As James Lovelock put it in an interview with the BBC in 2010 (http://news.bbc.co.uk/today/hi/today/newsid_8594000/8594561.stm), '*it is just the way things are*'. I can add that there is no point in shooting the messenger. Nor is there any benefit in ignoring the message.

I find it sad that words I wrote in 1993 remain relevant in 2012. As scientists, we need to ask ourselves 'where have we failed?'. Science has provided people with amazing technology, but has failed to provide moral direction in how that technology should be used. Science has given people the means to exploit the world's land, water, air, forests, fisheries, minerals, energy, and biodiversity without limit. Not only has this enabled people to live longer, it has allowed the exponential growth of the human population and its consumption of resources. The world's problems with climate change are the consequence of ever more people consuming ever more resources at ever increasing rates, a relationship not lost on Kellogg and Schneider (1974) nor Linacre and Hobbs (1977). We have exceeded the capacity of global ecosystems to neutralise the waste products we generate. Not since the evolution of photosynthesis polluted Earth's atmosphere with oxygen has a species changed the chemistry of the atmosphere and oceans. That event led to mass extinction (see >http://en.wikipedia.org/wike:/Great_Oxygenation_Event< for a brief account of this time in Earth's history), as will climate change (Schneider 2009 cited by Lunney and Hutchings 2012, Thomas *et al.* 2004).

In their review of publications dealing with climate change since 1970, Lunney and Hutchings (2012) cite more than 60 books, papers, and reports. Through the 70s and 80s, the publications cited are notable for their equivocation on whether the world's climate was changing and the role of humans in forcing climate change. There were exceptions. Linacre and Hobbs (1977) cited by Lunney and Hutchings (2012) linked resource development and population growth with climate change. They were clear about the risks society faced with global warming and rising sea levels, pointing out that enough CO_2 would be added to the atmosphere by 2020 to melt the polar ice, raise sea levels and force the relocation of 19% of the world's population. Despite such warnings, others remained ambivalent about causes and effects (see, for example, Pearman 1988a and papers therein, cited by Lunney and Hutchings 2012) using such words as 'might' and 'if they come to pass' (Bee *et al.* 1988, cited by Lunney and Hutchings 2012). The International Panel on Climate Change (IPCC) reports were criticized by Moss and Schneider (2000) for the use of such words and terms as 'improbable', 'doubtful', and 'high or low confidence', without explaining exactly what these meant.

Too many scientists are prevented from speaking publicly or are censored by governments and institutions. It is the fear of reprisal, including from one's colleagues, that prevents others from speaking. The scientific community tolerates, some would say encourages, censorship and reprisal under the guise of impartiality. Until the scientific

community accepts its responsibilities to society and other species, reprisal and censorship will continue to the detriment of life on Earth (Recher 1992b, 1998, 2002b). Recher and Ehrlich (1999) advocated requiring all scientists, including those working for government, to speak publicly and without fear. Unfortunately nothing has changed in the past decade, with the consequence being reports on climate change so highly qualified as to prevent effective action. This allows climate change sceptics and deniers to dominate the opinion pages of the media (see Lunney 2012).

From the 1990s onwards, most scientists accepted climate change as a reality, but the ambivalence remained. In 2000, the independent scientific committee under the New South Wales *Threatened Species Conservation Act 1995* concluded that 'Anthropogenic Climate Change' was a threatening process (Lunney and Hutchings 2012). As noted by Lunney and Hutchings (2012), the committee's determination was qualified by the heavy use of 'may' leaving the reader uncertain as to the threat. As recently as 2009, climate change was described as an issue that abounded with 'uncertainties' (Jubb *et al.* 2010). It was not until 2007, with the release of its fourth report, that the IPCC was confident that climate change was driven by humans (Schneider 2009). Pittock (2009, cited by Lunney and Hutchings 2012) went further and reported that 'climate change and its impacts were occurring faster than expected' (Lunney and Hutchings 2012).

At a meeting of the American Association for the Advancement of Science in 2009, Chris Field, founding director of the Carnegie Institution's Department of Global Ecology at Stanford University, attributed the increasing rate of change to the increasing rate of consumption of coal and feedback loops, such as the melting of the tundra. As the tundra melts and the oceans warm, large amounts of greenhouse gases (CO_2, methane) are released (http://rs.resalliance.org/2009/02/15/chris-field-says-rate-of-climate-change-faster-than-estimated/). Less heat is reflected and more absorbed as the area of sea ice is reduced by warmer temperatures. These are additive effects that accelerate the rate of change and must be acknowledged, as Linacre and Hobbs (1977). did three decades earlier, when discussing the extent and rate of climate change.

Although the climate change models have proven accurate in their ability to track change in average global temperatures (www.skepticalscience.com/lessons-from-past-climate-predictions-ipcc-far.html), they underestimate the increasing rate of consumption and do not fully account for feedbacks within global ecosystems. As a result, they are likely to present a more optimistic scenario of the future than that which will eventuate. None of this was missed by James Lovelock, who, in his BBC interview, was candid about the threat of climate change. Lovelock concluded it was too late to change the future, although he could not be certain what that future would be.

The future for Lovelock was a different world, but it was also one in which he expected fewer than one billion people to survive. His 2006 book, *The Revenge of Gaia*, predicted a hotter world, with most of it uninhabitable by the middle of the century. This, Lovelock argued, was the result of changes to Earth's environment by humans that led to the breakdown of *Gaia's* buffering systems through negative feedbacks (e.g., release of methane from the tundra and ocean). In his 2010 book, *The Vanishing Face of Gaia*, Lovelock is scornful in his assessment of how science dealt with climate change. He rejected the models that predicted small or slow rates of change, because they did not incorporate the feedback loops that accelerated rates of change. So far as Lovelock was concerned, the Earth's climate will soon be similar to the Palaeocene-Eocene Thermal Maximum when CO_2 concentrations in the atmosphere were 450 ppm and the Arctic Ocean was 23°C, with crocodiles. In December 2011, atmospheric CO_2 was 391.8 ppm and increasing at ca. 2.1 ppm per year compared with 1.6 ppm per year from 1992 to 2001 (http://www.esrl.noaa.gov/gmd/ccgg/trends/). At an increase of 2 ppm per year, the 450 ppm threshold will be exceeded within 30 years. Actually it will be exceeded much sooner given the increasing rate of emissions with the world's population and growing economy.

In my view, Lovelock's assessment is correct; it is too late to do anything meaningful to prevent atmospheric CO_2 levels exceeding 450 ppm. Even if CO_2 levels had been stabilised at 2000 levels, a further increase in average global temperatures of 0.9°C was inevitable. Unfortunately atmospheric CO_2 levels were not stabilised and, with the development of China and India, are increasing at an accelerating rate (CO_2Now.org). There is too much inertia in the system, no effective action in place, and no agreement that anything needs to be done to expect this to change. As Lovelock expressed it in an interview in 2010 with Leo Hickman of *The Guardian* newspaper, humans are not clever enough to prevent climate change '*from radically impacting our lives*' (http://www.guardian.co.uk/science/2010/mar/29/james-lovelock-climate-change.). In the BBC interview, Lovelock was asked if he wasn't being pessimistic to which he replied '*no, that's just the way it is*'.

It may be too late, but why did it take so long for scientists to admit that human-induced climate change was a reality? Why have so many scientists hedged their statements with 'might' and 'may' or considered the 'uncertainties' of their climate models more compelling than the reality of climate change? The uncertainty presented by scientists empowers climate sceptics and deniers to deride the science. It allows the sceptics to argue that no action should be taken to mitigate climate change until the science is proven and that humans are the cause of climate change[2]. If there is no problem, why bother? If humans are not causing climate change, then anything we did would be futile and wasteful. As the evidence for human-induced climate change begins to satisfy even the most cautious scientist, the argument

2 Human-induced climate change is a reality. Thus, it cannot be prevented and all that can be hoped for is mitigating its effects. This is why I talk about 'mitigation' and not 'prevention'. At current rates of change, greenhouse gas levels in the atmosphere will exceed the equivalent of 450 ppm of carbon dioxide by 2030, if not sooner. At this level global temperatures will exceed those needed to melt the polar ice caps causing sea level rises of ca. 70 m. Lovelock's predictions of catastrophic change will be verified sooner than anyone likes to admit.

has shifted to adaptation - we can adapt to the changes, so action to mitigate effects are still not necessary. This argument is bolstered by the scientists who continue to express uncertainty about the 'precision' of models and the 'exact' degree of change that will occur.

There is no need to be precise about how hot the world will become, how high sea levels will rise, or when particular events will occur. Lovelock says as much in his interview with *The Guardian.* It is enough to know it will be much hotter and the seas much higher to take action. The fact that water will be scarcer, extreme weather events more frequent, arable land diminished, and tens of millions displaced from where they now live, not to mention that billions will die, should be sufficient for urgent action. In an interview on the ABC (2 February 2012), the former leader of Australia's National Party, Tim Fisher, spoke of a global famine from which Australia will not be immune (www.abc.net.au/environment/?type=news). He attributed the prospect of famine to the growing human population and the impacts of climate change. Fisher did not say in which year famine will strike or how many people will starve, but this should not stop Australia from taking action to secure its food supply. The same applies to the loss of biodiversity. It will be catastrophic, but do we need to say when, how many, and which species will become extinct? As I predicted for Australia's birds (Recher 1999), half the world's biodiversity will disappear within the next few decades as climate change accelerates, the population grows, and humans continue to consume ever increasing amounts of the world's resources.

If, as I argue, precision is not necessary to justify action, why do scientists insist on hedging their conclusions. Science is full of uncertainties and expression of uncertainty is fundamental to the conduct of science. However, expressing uncertainty or remaining silent because the data are not complete is not how scientists need to communicate with non-scientists. Science in Australia suffers from poor communication with the wider community. This is because Australian universities neglect the importance of communication skills, history, economics, ethics, language, and religion, among many other disciplines in the humanities, in the education of scientists (Recher 1992b, 2008; Recher and Ehrlich 1999).

Uncertainty has no place in a court (Recher 1992a) or when communicating with the wider community. Scientists need to accept Lovelock's word that people are not very clever. Even in the most developed nations, the vast majority of people have no training in or understanding of science or the place of humanity in the global environment. Hiding behind weasel words (may, likely, could) and stating the obvious ('more data are needed', 'our predictions are not precise') is an evasion of responsibility. By using such words a scientist leaves interpretation of data and events to people not qualified to make interpretations or who have a self-interest in making interpretations that protect their personal position. The scientist who does this in relation to climate change has taken a stand that, in my opinion, is morally indefensible. It is an evasion of responsibility and condemns the future to a poorer world. Yes, we may make mistakes and we may predict a future that will not happen, but we will not know until the future arrives and then it will be too late.

Despite strong statements of concern from some scientists, such as Kellogg and Schneider (1974) and Linacre and Hobbs (1977), acceptance of climate change evolved incrementally from the 1970s to the modern era when serious concern for the future began to dominate the climate change debate (see Lunney and Hutchings 2012). I've argued here that the scientific community has been too conservative, failing in its responsibilities to society. It has failed me and my grandchildren, and their children's children. Our understanding of the role of greenhouse gases in the atmosphere is not new, as illustrated by Spencer Weart's following chronology (http://www.livescience.com/1292-history-climate-change-science.html) (see also Le Traut *et al.* 2007).

In 1824, Joseph Fourier calculated that the atmosphere retained heat making Earth habitable. By 1859, John Tyndall had demonstrated that CO_2, water vapour, and other gases in the atmosphere blocked/absorbed infrared radiation and kept the Earth warmer. He speculated that changes in the concentration of these gases might affect the climate. In 1896, Svante Arrhenius calculated the effect of CO_2 emitted by burning fossil fuels on global warming. A global warming trend was first published in the 1930s and Guy Callendar linked rising CO_2 levels to global warming. By the 1950s and 60s, there was discussion of feedback effects between and within the atmosphere and ocean affecting climate systems. In the 1960s, recognition was given to the possibility of sudden shifts in the climate. This was confirmed in the 1970s with studies of ice cores indicating rapid climatic changes in as little as a thousand years. Other studies suggested melting and collapse of the Antarctic ice sheets was possible. Even from this brief chronology, it is clear that science has been aware of the key issues related to climate change - the physics and chemistry of greenhouse gases, the feedback loops between land, sea, and air, the role of humans in forcing climate change, and sudden changes in climate for 150 years or longer. So why did it take until late in the first decade of the 21st Century for scientists to admit the role of humans in climate change? Why does science still hesitate to advocate urgent action to mitigate the consequences of a rapidly warming planet? Why do some scientists still dismiss human-induced climate change, and why do the media give them so much coverage?

Lunney (2012) reviewed the coverage of climate change in the *Sydney Morning Herald* from 2008 to 2012. He concluded that science journalists in the *Herald* who reported on climate change issues were informative and not destructive of the science being presented. The destructive element in respect to climate change came from the opinion writers, either challenging the science outright, or promoting just one scientist, particularly Ian Plimer, a well-known climate sceptic and Professor of mining geology at the University of South Australia. Everyone is entitled to their opinions and to expressing those opinions in the media. The problem is that too few

scientists are prepared to set aside the 'uncertainties' in the data and present an opinion on where climate change is taking us. This allows the sceptics to dominate the opinion pages and unduly influence government.

Paul Ehrlich and I presented the view that no one could be considered a 'world-class' scientist who did not make their knowledge and expertise directly available to the general public (Recher and Ehrlich 1999). It is not sufficient to simply publish research and communicate with colleagues. Research is not complete until it has been interpreted for the public (non-scientists) and that requires giving an opinion and communicating in simple English (Recher and Ehrlich 1999). The scientist who lacks the skills for effective communication can readily acquire these, or can work with those who are skilled at this form of science communication. *Pacific Conservation Biology* and the forums and publications of the Royal Zoological Society of NSW demonstrate that this can be done. It would be more productive to judge the quality of scientists on the effectiveness and extent of their involvement with the public than by how many times colleagues cite their papers. Students need to be taught ethics and made to understand their responsibility to society (Recher and Ehrlich 1999). They need to be given good communication skills. Scientists need to be advocates and pressure decision-makers through public dialogue and debate to take action on climate change, as well as on biodiversity conservation. Scientists need to raise community awareness of climate change and the risks it poses to society and biodiversity (Kingsford and Watson 2011). To do this effectively they cannot hedge their predictions of what it means to the future to delay changing the way we use the world. If scientists continue to hedge their predictions on climate change when communicating with the public and the media, then the words of Paul Collins will be prophetic:

> *"We will be hated by the people who come after us because we will have denied them their birthright by destroying so much of the natural world in our selfish and self-engrossed attempt to take everything for ourselves." (Collins 1995. p. 2).*
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> *And I can add, 'and by scientists failing to have confidence in their observations and capacity to interpret events and predict the future'.*

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References

Bee, C., Furler, W. and Quinn, N. 1988. Greenhouse: international and national policy approaches. Pp 725-735 in *Greenhouse: planning for climate change,* edited by G. I. Pearman. CSIRO East Melbourne Victoria, Australia.

Collins, P. 1995. *God's Earth: Religion as if Matter Really Mattered.* Dove, North Blackburn, Victoria, Australia.

Jubb, I., Holper, P. and Cai, W. 2010. (eds). *Managing Climate Change.* CSIRO Publishing, Collingwood.

Houghton, J. T., Jenkins, G. J. and Ephraums, J. J. 1990. (eds). *Climate change. The IPCC scientific assessment.* Intergovernmental Panel on Climate Change. Cambridge University Press, Cambridge, UK.

Jamieson, D. 2008. *Ethics and the environment. An introduction.* Cambridge University Press, Cambridge, UK.

Kellogg, W.W. and Schneider, S.H. 1974. Climate stabilization: for better or worse? *Science* **186**: 1163-1172.

Kingsford, R. T. and Watson, J. E. M. 2011. What hope for biodiversity in the face of anthropogenic climate change in Oceania? *Pacific Conservation Biology* **17**:166-167.

Le Traut, H., Somerville, R. and six others. 2007. Historical overview of climate change. Pp 95-127 in *Climate change 2007: The physical science basis. Contribution of working group I to the fourth assessment report of the International Panel on Climate Change.* Cambridge University Press, N.Y.

Linacre, E. and Hobbs, J. 1977. *The Australian climatic environment.* John Wiley and Sons, Milton, Queensland, Australia.

Lunney, D. 2012. "What's the difference between climate science and climate journalism?" Pp xxx– xxx in *Science under siege: zoology under threat*, edited by P. Banks, D. Lunney and C. Dickman. Royal Zoological Society of NSW, Mosman, NSW, Australia, in Press.

Lunney, D. and Hutchings, P. 2012. Wildlife and climate change: are robust strategies for Australian fauna possible? Pp 180– 201 in *Wildlife and climate change: towards robust strategies for fauna conservation*, edited by D. Lunney and P. Hutchings. Royal Zoological Society of NSW, Mosman, NSW, Australia.

Moss, R. H. and Schneider, S. H. 2000. Uncertainties in the IPCC TAR: Recommendations to lead authors for more consistent assessment and reporting. Pp. 33-51 in *Guidance papers on the cross cutting issues of the Third Assessment Report of the IPCC*, edited by R. Pachauri, T. Taniguchi and K. Tanaka. World Meteorological Organization, Geneva.

Pearman, G. I. (ed.). 1988a. *Greenhouse: planning for climate change*. CSIRO, East Melbourne, Victoria, Australia.

Pearman, G. I. 1988b. Greenhouse gases: evidence for atmospheric changes and anthropogenic causes. Pp 3-21 in *Greenhouse: planning for climate change,* edited by G. I. Pearman. CSIRO, East Melbourne, Victoria, Australia.

Pittock, A. B. 2009. *Climate change: the science, impacts and solutions. (Second edition).* CSIRO publishing, Collingwood, Victoria, Australia.

Recher, H. F. 1992a. Ecology on trial. pp. 25-34. in *Zoology in Court,* edited by D. Lunney. Royal Zoological Society of New South Wales, Mosman, NSW, Australia.

Recher, H. F. 1992b. Simple journalists or simple scientists?: Are environmental issues too complex for the media? *Australian Zoologist* **28**: 19-23.

Recher, H. F. 1994. Science and conservation, towards alternative strategies for protecting Australia's biological resources. *Australian Zoologist* **29**: 148-57.

Recher, H. F. 1998. Public and political: the challenge for ecologists. pp. 9-15 in *Ecology for Everyone: Communicating Ecology to Scientists, the Public and the Politicians.* R. Wills and R. Hobbs (eds), Surrey Beatty & Sons, Chipping Norton.

Recher, H. F. 1999. The state of Australia's avifauna: a personal opinion and prediction for the new millennium. *Australian Zoologist* **31**: 11-27.

Recher, H. F. 2002a. Challenges for nature conservation. *Australian Zoologist* **32**: 112-116.

Recher, H. F. 2002b. Scientists in the wilderness. *Australian Zoologist* **32**: 139-149.

Recher, H. F. 2008. Good English, God's Nature: Science Education. *Pacific Conservation Biology* **14**: 3-4.

Recher, H. F. and Ehrlich, P. R. 1999. The Essence of Science: The Social Responsibility of Communicating. *Pacific Conservation Biology* **5**: 161-62.

Schneider, S. H. 2009. *Science as a contact sport: inside the battle to save Earth's climate.* National Geographic Society, Washington DC, USA.

Thomas, C. D., Cameron, A. and 17 others. 2004. Extinction risk from climate change. *Nature* **427**: 145-148.