

Zoology under threat: a distressing case of science under siege

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ABSTRACT

The most striking feature that links all the contributions to the theme of *Science under siege: zoology under threat*, is the rejection of the notion that science is optional in our society, i.e. that science can be ignored, even derided. In the main, these anti-science worldviews derive from religious groups that are hostile to science, a political or commercial stance that sees short-term gains in rejecting or undermining science, or a non-zoological understanding of animals that arrives at a philosophical position opposed to the study and management of wild animals. The extreme 'animal rights' position is also inimical to conservation of our native fauna, although an ethical approach to animals and the environment is a critical component to their long-term management and we both encourage, and participate in, this debate. Brian Martin, in his engaging paper on *Breaking the siege: guidelines for struggle in science*, observed that when scientists come under attack, it is predictable that the attackers will use methods to minimise public outrage over the attack, including covering up the action, devaluing the target, reinterpreting what is happening, using official processes to give an appearance of justice, and intimidating people involved. Zoology is under attack, so are working zoologists, and the distressing consequence for our fauna will be its continuing decline. With increasing rates of extinction that reflect threats, such as invasive species and climate change compounding the impact of simplified landscapes, Australia is being progressively robbed of its rich zoological legacy.

Key words: animal rights, betrayal of science, climate change, commercial harvesting of kangaroos, dangerous ideas, extinction, funding cuts to science, invasive species, journal impact factors.

Our stark conclusion

We might well have started out with some trepidation in preparing the forum on *Science under siege, zoology under threat*, because the subject title seemed too bold, but now, as we close the book with this review paper, we have arrived at the opposite conclusion. Paul Willis, formerly an ABC *Catalyst* journalist, and now director of the Royal Institution of Australia, wrote in the foreword that, "We have seen death threats issued, public rallies calling for the cessation of scientific research, tabloid opinion writers and shock jocks vilifying scientists, jobs in research biology axed in government contractions, and reduction in funding for specific research projects. In many ways not only has the situation become worse since the *Science under siege* forum, the breadth of the attack and its severity would have been inconceivable just a few years ago." This observation parallels the views of many of the forum participants. Zoology is under threat, and our fauna continues to decline. The climate change issue alone consolidates the view that ideologues and vested interests are devaluing, even corrupting, science, or dismissing, or selectively using, science and scientists. The intent of this review is to support this conclusion through the papers presented in this book, including the lively plenary discussions, and by drawing on a range of ideas in an eclectic selection of publications that intersect with this theme.

Our interest is in understanding the Australian fauna, putting forward views on how it might be effectively conserved, and urging all Australians to help avert the catastrophe of the continuing decline and extinction of an ever-increasing proportion of Australia's fauna. If those aspirations are being thwarted by ideological opposition to the basic tenets of biology, or views that argue that we should not manage populations, such as through research, or by those who continue to simplify the landscape for financial gain at the expense of our fauna, then we stand firm against them. When that stand is systematically attacked, and we see the losses to our fauna continuing to mount, then we identify it as zoology under threat and, more generally, as a distressing case of science under siege. We also recognise that if one component of science is attacked there is a flow-on effect that implies that it is acceptable to simply deny science rather than be obliged to incorporate its findings and approaches to understanding the decisions on how to manage our environment, and our fauna in particular. Therefore, we make the general point that we need to sustain the integrity of our approach to science across all disciplines, but our expertise in this particular forum lies in zoology and its associated disciplines. We open our case by presenting one concrete, local example of zoology being threatened, that emerged as we were drafting this paper. It gave us a pointed reminder of why we ran the forum and pressed on to publish the proceedings.

One of our colleagues wrote to us as we were preparing this paper and asked if we would consider making mention of the cuts in 2011 to the Forest Science Centre in the NSW government body, Forests NSW. As our colleague noted, the issue did get a bit of media attention at the time, but it would be really worthwhile for this outrageous decision to be cemented into text in a document like *Science under siege*. To do this, we cite two independent sources – a letter to the *Sydney Morning Herald* on the weekend of the 27-28 August 2011 and an article that appeared in *The Conversation* on 22 August 2011. These give public expression to the concern felt in the Royal Zoological Society of NSW on this matter. These views were taken to the NSW government by the president of the RZS (PB), among a group of peers in the zoological realm including a former RZS president. The cuts to staff were not stopped, so the story is worth recounting as it was presented in the two published items. Saunders (2011) opened his piece in *The Conversation*, entitled: “Chopping forest research: does NSW Government care about science?” with the challenge: “You really have to wonder what kind of message the New South Wales Government is trying to send about its attitude to science.” Saunders pointed out the obvious to fellow scientists so that others could readily see the point: “Scientists at the Forest Science Centre, part of the Department of Primary Industries, perform world-class research into biodiversity, response to climate change, biosecurity, carbon sequestration and salinity. I don’t need to point out the importance and relevance of these topics. It remains to be seen which of these research programs will survive the budget cuts. The work these researchers are doing directly supports the growth and sustainability of the timber industry in NSW. It has flow-on benefits to other agricultural sectors. There are less tangible, but just as important benefits of the research done at the centre, like understanding the effects of fire and forestry on threatened species.” Saunders added: “So why is it that the government can get away with cutting a chunk of the state’s research capacity during Science Week, barely rating a mention? The scientists we are about to lose do high quality, important research with wide-ranging impact. It does not reflect well that most people don’t even know this work is being done.” Saunders then added a sting in the tail of his article for fellow scientists: “Part of the responsibility has to lie with the scientists themselves. All of us receiving public research funding have a responsibility to engage the public and educate them about our research. Otherwise, we risk sliding down the road of policy being made in the absence of science. If we vacate the space, the lowest common denominator forum of squawking shock jocks and vested corporate interests will gain even greater influence.” We agree, and we commend Saunders’ article and add that the Royal Zoological Society of NSW has provided a regular venue for scientists to engage with the public about their research and its relevance and implications for conserving our zoological heritage.

Forest scientist Dolan Nichols, in the *Sydney Morning Herald* (27-28 August 2011), made his point starkly on this issue under the heading, “Sacking tree scientists wastes huge expertise”. He stated that, “In the last two

years a dozen or so top-notch scientists working for Forests New South Wales in Coffs Harbour were sacked. It has been announced that another lot of researchers, based in Sydney, will be made redundant. ...We risk losing a group of internationally respected scientists. We also risk losing a well-managed forest estate because it is being abandoned for short-term profit.” On a more general point, Nichols then added that: “The misguided notion there is no ecological value in forests where tree harvesting is allowed is also a threat to this estate.” This more general closing point identifies one of the reasons why keeping research scientists in commercial forests is part and parcel of the State’s responsibility to conserve the forests’ ecological values, and not simply maximising profit which, Nichols fears, will be the future if scientists are removed from the decision-making process. We can add that this issue is not confined to Forests NSW, but is a shadow that hangs over all government scientists, in all States and the Commonwealth. Charley Krebs’ paper in this book makes this point vividly for CSIRO and the Commonwealth government. We return now to the more general theme of science under siege before we are enmeshed in too many case studies of the mismanagement of science, and tragically, the scientists who have devoted their lives to solving the problems that confront us.

Global Spin

In her sharp book *Global Spin*, Beder (2002) described the corporate assault on environmentalism. In her chapter on global warming and corporate-sponsored confusion, Beder stated that: “When the US withdrew from a 1997 Kyoto agreement on climate change in early 2001, the world was shocked.” “White House spokesman Ari Fleischer told the press that: ‘The president has been unequivocal... He does not support the Kyoto treaty. It is not in the United States’ economic best interests.’” Ian Wallis, in his paper, gives a neat further example of this style of presidential thinking in his paper where a study of bears in Montana is considered wasteful, whereas war in Iraq is not. This theme is taken up by others who are also alarmed at this assault on science and the environment. In *Crimes against Nature*, Kennedy (2004) subtitled his book *Standing up to Bush and the Kyoto killers who are cashing in on our world*. Mooney (2005) dramatically entitled his book *The Republican War on Science*. Paul and Anne Ehrlich (1996) elaborated on a betrayal of science and reason and how anti-environmental rhetoric threatens our future. Under the heading “What can scientists do?” the Ehrlichs stated that: “Simplistic as it sounds the first thing that environmental scientists – indeed, all scientists – should do is to get involved. Educating the public should be an integral part of every scientist’s career; if something is worth discovering, it is worth communicating.” They also say that they recognise that scientists are loath to leave their laboratories and get involved in the public arena. Part of the reason, they say, may be a certain reticence among scientists that helps them focus on the details and the frequent tedium of their research. But all too often, they say, public involvement is avoided because it isn’t likely to contribute to gathering of professional perks: tenure, salary raises, promotion, or intradisciplinary

recognition. That's something, the Ehrlichs stated, that senior scientists have a special responsibility for changing, particularly in the field of ecology, which is so essential in dealing with the human dilemma. They add the important point that the system of professional rewards needs to be changed so that public outreach is counted as an important, positive element of high-calibre professional behaviour. Bolton (1981) put it succinctly: "One way of looking at the environmental history of Australia is to see it as a conflict between those who exploited the country to serve preconceived economic goals and imported attitudes of mind, and those on the other hand who sought to create a civilisation where human use of resources was compatible with a sense of identity with the land." In these battles of ideology, it will be no surprise that science is under siege, and zoology is under threat, if such a siege yields gains to the exploiters and zoological interests are relegated to being optional and dispensable.

This theme is not new, and there are celebrated figures, such as Galileo, who stand as landmark figures of science versus faith as to how the natural world, indeed the universe, functions. Arguably, it is the intellectual revolution following Charles Darwin's publication of *The Origin of Species* in 1859 that caused the most profound challenges within biology and society, where science was then the discipline of very few people. The repercussions of denial of Darwin persist and are the subject of papers in this forum by Martin Bridgstock and Rob Brooks. The very idea that you can select whether you accept evolution as one of the cornerstones of biology, or reject it and replace it with a faith-based approach, seems extraordinary in a world where education is widespread and the questioning and testing of ideas is encouraged.

Extreme animal rights

An insidious variant of a philosophical approach that denies science can be detected in the rapidly growing extreme animal rights groups that are intolerant of studying animals or using animals commercially, as well as of managing animal populations to prevent extinction or control invasive species. Menna Jones and her co-authors in this book give a crisp example of silly, if not incompetent, decisions relating to their research on Tasmanian devils. How did we reach a point where such ground-breaking research, such as conducted by this team on a magnificent creature that is hurtling towards extinction, is not approved by an Animal Ethics Committee? We are so pleased that Menna and her team have spoken up. The subject needs open discussion, not threats behind closed doors.

The standard approach to the treatment of animals, accepted by Australian governments, is welfare-based and demands high standards of care and accountability. The extreme animal rights position is totally opposed to human use of any animals. The difficulty that this philosophical position presents for science is that it is also hostile to almost all study and management of animals, even study for conservation purposes such as wildlife surveys, taking specimens for museums, undertaking pathological studies, or their use for teaching zoology students, let alone

killing those invasive species that are wreaking havoc with our vulnerable native fauna. What is seen by some as a sympathetic understanding of animals would lead, in our judgement, to an accelerated loss of Australia's native fauna and its replacement by large numbers of a few invasive species. To claim an ethical stand when advocating an extreme animal rights position is, in our view, based on a misunderstanding, or a lack of knowledge, of zoology. You can test this idea by reading some of the books that describe or support the animal rights position. They are almost completely bereft of any zoological references. DeMello (2010) in her chapter, "Introduction to human-animal studies", in a book entitled *The philosophy of animal rights: a brief introduction for students and teachers*, opened her overview with the statement that "Human-animal studies is a relatively new interdisciplinary field that takes the human-animal relationship as its central focus. Scholars in disciplines as diverse as anthropology, art history, drama, philosophy, social work, and veterinary medicine approach this subject from very different perspectives and different methodologies, but all are interested in analysing the complexities of the human-animal relationship." Zoology was not in the list, nor does it occur anywhere in the book.

In *Animal Rights*, Sunstein and Nassbaum (2004) take a much more sophisticated approach to the issues, and their book of essays reflects a diversity of opinion on the subject, such as the paper by Anderson (2004). She identified conflicting prescriptions: animal rights and animal welfare advocates, Anderson stated, disagree with environmentalism. She gives two examples: "Feral pigs, not native to Hawaii and reproducing rapidly in an environment without predators, are destroying the Hawaiian rainforest, threatening its unique biodiversity. Rabbits, not native to Australia, are similarly wreaking ecological havoc in the Australian outback. Environmentalists advocate hunting down the pigs and rabbits, even using germ warfare (*Myxomatosis* virus) to control their populations. From an animal rights perspective, this violates the pigs' and rabbits' rights to life. Rabbits in Australia are also driving various species of plants to extinction. Environmentalists advocate sacrificing the rabbits for the sake of the plants. This is perverse from both an animal rights and animal welfare perspective: the animals have moral considerability, but the plants have no competing claims to consider." It is this brand of animal rights or animal welfare for which we have little time. Anderson paused at this point. Her words matter: "Consideration of the values of ecosystems also makes me reluctant to endorse a general right to live for animals, even for highly intelligent mammals such as pigs. Ecosystems are wonderful and awe-inspiring. To take the responses seriously is to acknowledge reasons to protect and preserve the integrity of ecosystems. Ecosystems do not exist merely for the exploitation of humans, and not merely for the exploitation of other animals either. We have rightly enacted laws to protect the integrity and biodiversity of ecosystems and endangered plant and animal species. So we already acknowledge that we need not permit human beings to lay waste to the environment. Nor should we permit rabbits and pigs to do so, especially

given the fact that it was our own wrongdoing that enabled their destructiveness in the first place.” Anderson continued by saying that we acknowledge the right of humans not to be killed for harming the environment because we can reason with one another and reach a reasonable accommodation of our interests in exploiting and preserving nature. Anderson concluded that we cannot reason with feral pigs and Australian rabbits, so violent means are sometimes necessary to deal with their depredations. We note Anderson’s different use of the words “animal welfare” from that used in Australia. Anderson has lumped animal welfare in with animal rights, so that when we are debating the issues, it is important to recognise that the definitions are labile.

Similarly, Paul Waldau (2011) has produced a thoughtful book in *Animal rights: what everyone needs to know*. He does mention zoology, he makes extensive references to wildlife, and his book can be read as an argument for caring about the survival of wildlife. Waldau states that, “wildlife poses a most basic question to us – what will we leave for our children and their children?” He added that a reason that the wildlife category of animal rights is important is that many habitat and population problems already exist for free-living populations, and many more are coming. The trajectory of habitat destruction, the expanding problem of alien or invasive species altering ecosystems, the tragedy of species extinction, and the problem of emerging and re-emerging diseases moving from humans to wildlife and vice versa mean that these problems will not soon be solved. Waldau noted that in some very significant ways we have started to honour even unpopular, non-mammalian species at risk of extinction, and even whole ecosystems. He noted that, collectively, our species still remains remarkably apathetic about harm to wild populations of some of the most popular animals – it is not only populations of many obscure animals that are at risk. His book, he stated, documents that human-nonhuman relationships are changing in some encouraging ways. Animal protection issues will continue to develop, he said, for we are only now beginning to consider a wide range of problems, such as species impacted by global climate change. Except for some keywords, such as ‘animal protection’ and ‘animal rights’, the parts of Waldau’s text cited here will sit comfortably with those interested in studying and conserving Australia’s native animals. This expands the meaning of animal rights from its common use as being at the extreme end of the spectrum in the animal protection movement. Waldau sees that animal rights, as a general movement, benefits from healthy, open-minded science communities, but even it insists that all of us must pay attention to the ways in which ethics is, always has been, and will surely remain part of human existence. Animal rights, stated Waldau, is thus an area where ethics and science must be in constant dialogue. We have no argument with that position, it is the detail that matters. It is when the extreme animal rights position is hostile to science and scientists, and takes such positions as elevating all animals (by which it is usually meant vertebrates, particularly mammals and birds) to having equal status with humans—thereby, in their view—prohibiting most of the activities of research and wildlife

management that underpin our capacity to study and conserve Australia’s native fauna, that we object. In fact, the concern for wildlife, expressed by Waldau, and couched as an ethical issue, is consistent with our case for fauna conservation. This brief overview is covered more extensively elsewhere (Lunney 2012a,b,c) but the central point is the same: the extreme animal rights position is inimical to conservation of our native fauna, but an ethical approach to animals and the environment is a critical component of their long-term conservation management, and we both encourage and participate in the debate. What also matters here are the words “animal rights”. It is evident that there is not a settled view on what it means, and the term includes what we argue is the conservation and management orientation of animals. It therefore means that we do need to pay attention to what a person is actually driving at when they say they support “animal rights” or “animal welfare”.

A weak understanding of zoology

A galling anti-science position is the use of sophisticated intellectual constructs, particularly the language of science, to present a position that seeks to undermine science and replace it with a philosophical or theological view that is constructed on what we contend is a weak understanding of zoology. This conspicuously occurs when a group has a set agenda against the use of animals in research, or for food. It also occurs when a religious group claims to have a superior, or even the only, understanding of the meaning of life, particularly human life. The necessity for acts of parliament to prevent threatened species from going extinct, establish national parks, control pest species, or manage the land sustainably, reflects society’s understanding of how the world works and how a burgeoning human population with increasing technology has so disrupted the ecosystems of the world that its biological wealth is being depleted at an ever-increasing rate. There is overwhelming evidence that we are losing species in what is graphically called a mass extinction episode in world history. Even to understand that point requires a grasp of science, and an acceptance of the view that science has made a crucial contribution to understanding how the world works and therefore how we might stem the losses and repair the damage. The sustained loss of the natural world is an outrage to humanity, yet it is continuing all around us. It is bizarre that decision after decision can be made to deplete the world of its natural assets, threaten entire ecosystems, deny any human role in climate change, and reduce rather than increase our scientific understanding of zoology and natural resource management, and underpinning these decisions is a view that science is optional, or even wrong, or that science can be brought in later to fix any errors of judgement. Hoegh-Guldberg, in relation to the Barrier Reef, Dickman and Danks in relation to importing a new super-predator (the Savannah cat) and Tom Grant in relation to platypus and the EIS process, all give powerful examples of where we shall pay a huge price for ignoring science and pushing ahead with short-term profits. That price will not only be the diminution of our wild heritage, but the cost of repair we hand on to future generations.

We are not saying that anti-science rhetoric predominates in our society. There is too much at stake for those who are keen on medical advances, defence research or commercial technology for that to be true. These are all science-based disciplines. Our concern is where science appears to be optional, such as in conserving our natural environment, our wildlife, or maintaining and advancing the disciplines that underpin them. This is apparent in arguments about whether evolution can be accepted or rejected, climate change denied, or funding can be cut when natural areas or zoological matters compete for funds, space or priority with what some people call development, progress or wealth creation based on our finite resources. Hutchings, in her paper, points out that, “While in principle governments support the need to document and manage Australia’s biodiversity, this rarely translates into adequate funding. With climate change threatening Australia’s biodiversity, the need for adequate funding for the conservation of Australia’s invertebrates is more critical than ever.” Miller added to that list of matters of concern by pointing to the lack of opportunity for early career zoologists. Lunney, in his paper on climate change and the media, illustrated how biased opinion pieces can overwhelm good science journalism, and David McKnight in his paper put it most pointedly: “As with many public debates, the debate on climate change has a number of participants whose activities are influential, secretive and unethical.” Indeed, this whole matter of climate change and wildlife has been taken up by the Royal Zoological Society of NSW in a forum, and it is now a book (Lunney and Hutchings 2012).

Environmental debates about high-intensity logging, creating national parks either on land or at sea, constraints on clearing native vegetation, or constraints imposed for the protection of species, have intergenerational equity as an overarching theme. The underlying tension from our viewpoint is that these are science-based arguments on the one hand competing with human material benefits in the immediate future on the other hand. Material benefits are easy to quantify, visible, and are seen by many as the generative force for entrepreneurship in our society. By contrast, a museum collection, a well-researched understanding of the causes of population changes of animals and plants, and a reliable workforce that can both undertake research and communicate it to students and the broader community, are seen by many as something that can be expanded or contracted to fit budget cycles that are measured in years, whereas scientific study and sustained contributions by skilled scientists are measured in lifetimes.

All these points were raised in the various papers and plenary sessions. In some ways, the plenary sessions were particularly illuminating because of the use of the spoken word, with all its force, rather than the carefully crafted sentence. A point that did emerge consistently was that scientists are too quiet when they should be speaking out. Consider the following comments from plenary sessions, starting with David Horton: “It wouldn’t worry me at all to find a koala in a threatened area, even if there wasn’t one there to start with. I think the problem we’ve got is exactly the reverse of that. It’s when we know there are koalas

there, and we say very quietly, ‘Did you know there were some koalas there?’ Because all of us, as scientists, we’re not forceful enough in the media, it seems to me. When we get the opportunity with a camera and a microphone in front of us, we should be speaking out for the animals that we’re all working on or that we all understand, or the areas we’re working on and understand. If somebody says to you, ‘Is your area, is your species threatened?’ You don’t say, ‘Well, it might be in 10 years. I can’t say that for sure, we haven’t done all the research. We need to do a bit more on that, and maybe I can come back in 20 years and tell you.’ Say, ‘Yes, it’s bloody threatened’. Get stuck into these buggers, because the opposition will certainly get stuck in, and they’ll make the most outrageous statements without even blinking.”

Harry Recher expanded that point: “You shouldn’t overlook the fact that it’s the scientific community itself which has often impeded government and public action on these issues. Long after a large section of the scientific community was concerned about global warming, for example, a large number – an equally large number – of scientists in the area of climate change were standing up and saying, ‘We’re not certain. We need more data.’ By the time those data were obtained, it was, and is, probably too late to avoid some of the most serious consequences of global warming. That’s the scientific community. It’s because of the way we train scientists. I said before that we need to teach scientists to communicate better. We’ve heard a lot of that. We also need to have scientists prepared to be advocates. Scientists need to do more than just present scientific information to the community. There’s no point in presenting scientific information to a community which is not trained in science; you need to lead people into using that science, and you need to be an advocate of positions.” This forum is a contribution to communicating science to a much wider audience than a highly-skilled professional elite of successful scientists.

The plenary sessions were also characterised by the outspoken identification of fundamental problems, and on how we might address them. Gordon Grigg made the following point: “In my view, the credibility of CSIRO, and of the people within it, has deteriorated as a consequence of the different funding model. I think that universities are afflicted with the same thing, and also the way in which universities, during the Howard years, were increasingly required to potentially become corporatised and run as businesses. That’s had a lot of very serious negative effects. The universities have become private companies, so you are sometimes unsure about the value of the research and statistics, because you wouldn’t know who funded it.”

Nick Holmes added to that with his views: “It may well be that I’m going to join Professor Grigg’s grumpy old man club, but there has only been one mention on the screen of the dreaded ‘postmodern’ word. One of the things we’ve found over the last 30 years, particularly – 20 years, actually – is the growth of the notion that if you’ve got an idea in your head that makes sense to you, it’s as good as anybody else’s idea. This is directly counter to the whole ethos, the whole nature of science, which is that your ideas have to be tested against reality.” Charley Krebs added to that with the following view: “I think... that retired people

– university professors in particular, and government people – are really the conscience of an ecological nation, if you like. I think university people, even before they're retired, have the ability to speak out about things, which I think government people, consultants often cannot speak out about." The Council of the Royal Zoological Society of NSW combined these ideas, and the 2012 forum of the society is entitled, 'Grumpy scientists: the ecological conscience of a nation.' The RZS dropped the 'old' on the basis that you don't have to be old to be grumpy, because an ecological conscience can emerge long before retirement age. The 'old' actually picks up on the successful BBC series 'Grumpy old men' and 'Grumpy old women' and the humour they engendered by making their grumpy points.

Animal ethics matters

A weak understanding of science can lead to a weak application of ethics to the processes of science, and zoology in particular. Menna Jones and her co-authors have recounted their experience of dealing with Tasmanian devils and what bedevilled them in the Animal Ethics Committee process. As authors of a presented paper in this forum on the question of whether animal rights constitute a key threatening process for Australian fauna, we acknowledge the thoughtful paper on the devils, and then wonder how many papers will not be written, because of fear of reprisal from their Animal Ethics Committee. Rather than include our spoken animal ethics and research paper in this forum, we have elected to make our points in this concluding paper. Our sense of the issue is that there is much disquiet among research zoologists about this process because they are totally dependent upon approval of research from one Animal Ethics Committee, but there is not a reciprocal relationship with other ethics committees that would have found a protocol to be acceptable. There is a grievance procedure, but it is usually only a grievance directed back to the committee that rejected the research protocol in the first place. In fact, the difficulties of process, it can be argued, inhibit submissions. It is our view that there is no real mechanism for dealing with concerns about process under the current rules. This matters when some members of a committee are fearful of approving a protocol that they would have to defend should the research be publicly attacked, consequently they can delay or not approve a protocol that would be seen as perfectly reasonable to another committee. This issue emerged in the plenary sessions.

Rachael Dunlop asked Peter Banks in the plenary session whether he was "aware of the firebombing and threats that have been going on at the University of Santa Cruz quite recently, where some in fact were forced to give up their animal work for fear of – well, they've had threats against their families, they've had graffiti on their houses, they've had their cars firebombed. I just wonder what you think about people's reactions. Do you think it's because they don't understand the animal ethics process, and that animal welfare is incredibly strict in science, and we go about it under all the rules, and

we are very, very careful about how we treat animals, because we care for them as well? It seems that these people just don't have any idea about how the process works." Peter Banks responded by saying: "No, I guess they don't understand. They're fundamentalists; they have fundamental views on how things are. ...Their philosophy is fundamentally different. They don't accept the animal ethics process is all about animal welfare, which permits animal use under that sort of framework. They're operating outside of that framework, so it's a very hard task. I suppose my message there was for us to realise what the potential impact is, and you gave some good examples, which thankfully do not happen here". He concluded, "I'm saying be prepared to stand up for what you're doing, that you're doing it for a bigger-picture perspective, and that's what's important, rather than just the narrow view, which is easy to give in to, and is what's motivating those sorts of violent acts."

Terry Dawson weighed in to the debate: "Now that I'm sort of retired and no longer actually working with kangaroos, I can actually be upfront and talk about them. The problem I had is that whenever I got anything in the press, or any of my students got anything in the press about kangaroos, the university would get a barrage of letters, complaints. There would be complaints to the Animal Ethics Committee – I had considerable difficulties with them early on. ...Everything settled down, but I was one of those people who was working actively with kangaroos. I was a physiologist. I mean, if I was an ecologist working with kangaroos it would be reasonable, but as a physiologist, you're just evil incarnate to some people. So I just had to be very careful. My students and I had to be very careful with anything that we put out or talked about, or we would have these problems to deal with. Now, though under the carpet, our Animal Ethics Committee was largely supportive. They protected me. They protected my group. They went to great lengths to do so, because I went through the committee. I knew I had problems with certain groups in the community. We used to go through everything in detail to make sure everything was cut and dried and they [the AEC] knew what we were doing. Once they accepted my proposal, they said they would support me, and they did."

Funding of science and scientists

Nick Holmes, in his concluding remarks at the end of the final plenary session, made the following points: "I think we have identified two issues today, with a third implicit one. The first issue is declining public interest and literacy in science. What can we do about it? Given my view as expressed earlier, that we're fighting a trend of dumbing-down, of a sort of intellectual pretension in our society, I don't think we do much except support people like you [Mark Horstman, ABC journalist and facilitator of the plenary sessions] and other sympathetic media as much as we can. Second issue is the misuse of science by agencies of government and other institutions. What can we do about that? Well, if we are, like Gordon [Grigg] and me, retired, bomb-proof, we can make comments about it, criticisms, and make them pointed, and make them

cogent, and make them backed up with data. For people who aren't bomb proof, it may well be that scientific societies can provide some sort of an umbrella by making more general statements at a society level. The implicit problem is the funding of science, because if you crawl up the nose of government, government may not wish to fund science. We haven't talked about that, but I think it could be a potential issue."

The paper by Pat Hutchings in this forum has turned that potential issue into an identified potent problem, especially for the long-term, less spectacular organisms and the scientists who study them. This problem is neither new nor confined to Australia. In the *Science News Yearbook 1969/1970*, a US publication (Science Service 1969), the opening sentence under the heading 'Science Policy' was: "United States scientific research effort suffered severe setbacks in 1968 after more than a decade of unparalleled growth. Stemming primarily from involvement in a costly Vietnam war, the Federal research and development budget took its first downward turn since 1957, when the first Soviet Sputnik sparked a national commitment to developing science. Troubles on the nation's university and college campuses turned the public and its elected officials – including an unsympathetic lame-duck president – against the general academic community." Under the subheading 'A loss of momentum', the text says that the "United States' efforts in the International Biological Program also collapsed in 1968 as federal funds failed to materialise. The American committee was successful in organising broad-scale research programs which fit under the IBP umbrella. However, most of the projects which were claimed to be IBP dealt with such matters as grasslands, the polar peoples, human adaptability, tropical animal populations as sources of food, the migration of plants and animals on a global basis. ...But neither the officers nor the few Congressional friends could stir interest or support for a massive attack on the environment." Such bold writing on a national scale is needed in Australia to make the point that science funding, or lack of it, can undermine significant long-term programs that require support from government if they are to address issues of national and international importance. As we finalise this paper, in 2012, we are acutely aware of budget cuts in universities and government departments across the nation. It appears to us that such matters as the environment, fauna conservation based on sustained programs of research and management, climate change and scientific careers are issues reflecting troubles elsewhere in society. Those troubles will not be resolved by avoiding the science of each issue, nor the sacking of scientists. In fact, it is exactly the wrong tack, in our view. The lack of continuity of skilled scientists in the critical disciplines required for studying and managing our fauna arguably comprises a key threatening process. If we are to study fauna, implement change and conservation measures, assess their effectiveness, and sharpen our efforts to get better results, then we need to keep both institutions and their scientists as alive as we want the fauna to be. Charley Krebs' disturbing story of the collapse of the CSIRO Division of Wildlife Research shows just how vulnerable we are to the loss of our best scientists.

That Division was regarded as the premier wildlife research institute in Australia. Liza Miller added another dimension to this matter by looking at it from the point of view of the individual displaced scientist. This is a particularly disturbing issue, it is not just about upswings and downturns in support for science. Scientists' lives are affected, often permanently, when the funding is cut, and individual specialists are cast adrift and potentially lost to the discipline, with decades of training and experience lost because of a capricious decision to constrain budgets in a particular year or two.

Diluting science

Rachel Dunlop, in her paper, made a powerful point about co-opting the language of science. Dunlop noted that corporations often use scientific language and imagery to make the products and services they are promoting appear more state-of-the-art or innovative than their competition's offerings, but lend a false air of scientific legitimacy to products that may have little or no proof of efficacy. In a time when there appears to be an under-current of mistrust in science, Dunlop pointed out, including but not exclusive to climate change and vaccination, this activity is particularly mischievous since it effectively co-opts science for nefarious purposes. The result is an undermining of the public trust in scientists and science in general.

In their paper on the role of science in public policy development, Rachel Walmsley and Josie Walker noted that the NSW Government has attempted to give biodiversity offsetting schemes (biobanking and biocertification) ecological legitimacy by legislating that scientific assessment tools must be used. However, they point out, the negotiation and public policy development process involving different stakeholders has meant the tools have been modified and potentially weakened by the inclusion of non-scientific assessment criteria.

Responding to the challenge

Brian Martin, in his engaging paper on *Breaking the siege: guidelines for struggle in science*, makes the observation that when scientists come under attack, it is predictable that the attackers will use methods to minimise public outrage over the attack, including covering up the action, devaluing the target, reinterpreting what is happening, using official processes to give an appearance of justice, and intimidating people involved. To be effective in countering attacks, Martin argued, it is valuable to challenge each of these methods, namely by exposing actions, validating targets, interpreting actions as unfair, mobilising support and not relying on official channels, and standing up to intimidation. We encourage readers to read Martin's example from the University of Adelaide, and in this book we have included a further example of the corruption of science. Rosie Cooney and her team tackled the recurring matter of endeavouring to get the facts straight on kangaroo harvesting and conservation. They refer to a recent publication from the Think Tank for Kangaroos (THINKK) in the Institute of Sustainable Futures at the University of Technology Sydney which

evaluated, but found wanting, the idea that eating wild-harvested kangaroo meat is environmentally beneficial, compared to other meats produced on rangelands. They examined this publication with reference to available literature, and found that it was neither well-reasoned nor accurate. They concluded with their view that this publication makes an inaccurate and potentially misleading contribution to the scientific, legal and social debate on kangaroo management. Gordon Grigg added to their contribution by treating the THINKK publication as he would any paper submitted for peer review. This was particularly pertinent because it had not been peer-reviewed. Grigg noted that the THINKK manuscript erects a set of four assumptions which it claims “underpin the sheep replacement concept and the eating of kangaroo meat on environmental grounds”. Three of them, Grigg observed, are badly distorted and only one is actually relevant to the current industry. Grigg concluded that, as presented, the THINKK manuscript did not, in his opinion, qualify as acceptable for scientific publication. There is a footnote to this story. The senior author of the THINKK publication was sent a copy by Rosie Cooney of their paper in this book. As editors, we invited a response from the THINKK team. That was accepted, but with the caveat from them that their response be the last and final response. We did not accept that condition, and the matter has lapsed. A point that emerged for us as editors is when to close a debate. We note that the Royal Zoological Society of NSW first put this issue of kangaroo harvesting into the public arena in 1987, with a paper by Gordon Grigg. It has remained alive as a subject for public debate, so we do not see why it should be closed down. More importantly, it does not make good editorial policy to allow any position to have the last word. The criterion should be, as Grigg made clear, whether any manuscript passes muster following peer review.

Issues within the science community

The community of scientists is so large and so diverse that a wide range of opinions on a great many topics is expressed and argued vigorously. There are a few examples in this book. The role of dingoes in ecosystems is the current hot topic and Brad Purcell and co-authors are protagonists for a particular viewpoint. They examined Euro-Australian culture and dilemmas within the science and management of the dingo and concluded that minimising conflicts of interest, whether they be cultural or financial, will open a new era for the science behind dingo management. Likewise, Bob Kearney decried the focus on over-fishing as a problem for sustaining our fisheries, pointing instead to potent but less recognised threats that affect fish populations that arise from land-based pollution. Shelley Burgin and Adrian Renshaw addressed quite a different subject. They looked at the cutbacks to science funding and concluded that if science were not under siege there may not have been the incentive to change the *status quo* and drive the research-teaching nexus. Mike Calver and Kate Bryant tackled an issue that is of widespread concern within the scientific community, but seems to

be quite unknown elsewhere, and that subject is the rise of bibliometric evaluation of research. They provided a brief history by outlining how citation tracking was first devised as a tool for reference searching and mapping the linkages between articles, connecting papers on related topics with far greater efficiency than keyword searches. A derivation of citation data, the Journal Impact Factor (JIF) (a journal's impact factor for a particular year is the number of citations in the year immediately preceding it, divided by the total number of papers published by the journal in those two years) was developed initially to assist librarians in prioritising journals to choose for subscriptions. The JIF has arisen as scientific publication is undergoing rapid change. Most importantly, the prevailing fashion for ‘quantifying’ the quality of academic papers, academic journals, authors and institutions is affecting where authors publish, what they publish and also the content of what journals want to publish. In particular, they point out, research on uniquely Australian natural history and ecology may suffer because, despite its value for local conservation issues, such regional research is seldom accepted by the major journals in North America and Europe or by the growing number of Australian journals aspiring to an international profile. Crowther and colleagues made a similar point in their paper and concluded that Journal Impact Factors impose an inappropriate corporate ethic on scientific publishing, and should not be the major metric used to allocate resources, determine academic appointments and gauge the value of Australian zoological research. In their view, being beholden to JIFs produces research and publication outcomes which obstruct, by distorting research priorities, the conservation of Australia's biodiversity. In short, they say, Journal Impact Factors place science, or at least Australian zoological science, under siege.

Gordon Grigg gave the opening paper at the forum, which remains the first paper in this book. He has this place because he has seen enough in a long working life to make general observations. Some are stark indeed: “Unfortunately, biological and zoological knowledge simply has not cut through, and people in general are very significantly under-informed about science in general, biological science in particular, and evolution as well. Most people, of course, learn about science in school. Most schools have some sort of biological curriculum, but it just seems not to be working, and most people in general learn about science through its outputs, and these outputs are usually technological. So they see the outcome of science, but not the process.” Of course, one can become obsessed with process, and that can occur when one becomes locked into one dimension in the broad aim of conserving biodiversity. Those dimensions can appear to be overwhelmingly important, such as policy writing, political manoeuvring, media management, administration, on-ground fire fighting, writing a thesis or just getting on with the job and not listening to new or contrary ideas. Communicating your interests and your decisions, or preferably the drafts of your decisions, can help everyone, and arguably everyone will be better off. This reiterates the point that we drew from the Ehrlichs’ (1996) text at the outset of this paper. Grigg closed with what we regard as all too disappointingly true: “The climate change debate has also revealed how poorly equipped our leaders are to explain

complex issues. Their lack of scientific understanding and their lack of understanding of the processes of science, have been on show.” Grigg also made another point that we spend some time focusing on but not nearly to the extent that the problem deserves: “Another issue about which there has been considerable recent comment and concern is rising prices of food. Is this a surprise? To an ecologist this is a natural correlate of population increase. The other natural correlate is competition for space, and there is a lot of that going on too.” These are all major issues, they go to the heart of the issue of science under siege, and in particular, to zoology under threat. There is far more room for discussion on all these themes, but the point here is to bring them together to show that collectively they underline a common problem of how science is seen and understood within our wider community and, even more importantly from our specialist viewpoint, the necessity to embrace science to be effective in, understanding and conserving Australia’s biological heritage.

How did this matter become so serious?

Broks’ (1996) amusing but enlightening book on media science before the Great War identified that ignorance, language and the problems of simplification all contributed in making the scientist appear remote and divorced from everyday life. In popular fiction, argued Broks, this would lead to the stereotype of scientists being unemotional, detached and even inhuman and insane. The legacy of this image has lingered. Broks also found that at the heart of 19th century opposition to science was the perception of science as a dehumanising and impersonal process, seen especially in the fear and mistrust of evolutionary theory, reductionist biology and statistics. It does seem amazing that now, in the 21st century, the shadow of this image lingers, and arguably is being fanned and exploited by those who gain by avoiding the science of such subjects as climate change, or ignore the importance of the relentless loss of our native fauna. Paul Adam, in his paper in this forum, drew on his extensive knowledge of the practice of science in the UK and made valuable comparisons with Australia. He examined a diverse range of issues including the status of scientists, public concern about science, changes in the publishing industry, and managerialism with its short term vision. These matters are part and parcel of managing science as a discipline and across disciplines and national boundaries. Mis-handled, they place a science under siege.

Walker (2003a) explored how science and ideology interacted in the decades since the Second World War and noted that it was dominated by the legacy of National Socialism and the pressures of the Cold War. The influence of this interaction has been long lasting, Walker maintains, and it is clear in his view that ideology can affect science through pressure on scientists, along with everyone else, for political conformity and ideological interference in the practice of science itself. Although this latter influence is more difficult to determine but, said Walker, more interesting. The approach taken in the book *Science and Ideology* (Walker 2003b) is one of comparative history. It presents one way of examining the claims and

counter claims made in this volume of *Science under Siege*, and it points to room for scholars of such disciplines as history to contribute to our grasp of the consequences of science being under siege by political, commercial or ideologically-entrenched positions. Our task in this book is to bring this matter to light and invite others to see the issues and speak up.

Home (1983), in the preface to *Science under scrutiny*, noted that during the first half of the 20th century, science was seen in Western societies in almost wholly optimistic terms. More recently, Home considered that science has been displaced from its lofty pedestal in the eyes of many and its image has become tarnished by such products as nuclear weapons, pesticides, and unemployment brought about by science-based technology. In many quarters, said Home, science is seen no longer as an innocent and dedicated search after truth, but as an integral and therefore tainted part of a discredited economic system. From the standpoint of a specialist in the history and philosophy of science, Home concluded that what is needed is intelligent discussion in our science curricula as well as in our laboratories and government agencies. This book is one contribution to that intelligent discussion, but it takes a different tack by looking at the consequences of casting aside science, the biological sciences in particular, at a point in history when our fauna is fading and in urgent need of rescue before an ever-increasing number of Australian native species become extinct.

Kitcher (2001) looked at science, truth and democracy through the lens of a philosopher. In his view, issues about the value of science, or about science and values, assume a special interest at the beginning of the 21st century because of the recent eruption of the ‘science wars’, a controversy that typically pits two inadequate views of science against one another. Enthusiasts for the sciences, said Kitcher, write books and articles that proclaim the search for objective knowledge as one of the crowning achievements of our species. Detractors deny the objectivity of the sciences, question their ability to attain truth and knowledge, and conclude that the sciences are instruments of oppression. Kitcher commented on the impact of Darwin’s ideas on human aspirations and self-conceptions and noted that people continue to resist the claim that there is overwhelming evidence that Darwin was right about the history of life. Their struggles with his doctrines often take the form of conjuring a conspiracy against religion and suggesting that this is the place in which science has been distorted by prejudice. Ironically, says Kitcher, the conception of Darwinism itself as a religion masquerading as science is not far from some academic suggestions that all science is permeated by prejudices and social values. In his views on research in an imperfect world, Kitcher offered a broad conception of responsibilities. Scientists, he said, have the obligation to do what they can to nudge the practice of enquiry in their society closer to the state of well-ordered science, and citizens have the responsibility to do what they can to better approximate democratic ideals. The narrow function of the sciences is to generate significant truths and the broad function is to promote the democratic practice of science, as conceived in the ideal of well-ordered science. From this broad function

flows the responsibility to attempt to lessen the gap between actual practice and the ideal and, beyond that, at an even wider level, scientists as citizens also have the obligation to do whatever is possible to realise more fully democratic ideals in society. In short, Kitcher considered that contemporary discussions of the sciences are divided into two false images: one, that of the faithful, which views enquiry as liberating, practically beneficial, and the greatest achievement of human civilisation; and the other, that of the detractors, which sees science as an expression of power, a secular religion with no claims to truth and which systematically excludes voices and interests of the greater part of the species. Kitcher considered what an appropriate ideal for the practice of science might be. He stated that he was endeavouring to show how the traditional conception of the function of science as aiming at truth should be expanded, and he proposed the notion of well-ordered science. In the ideal of well-ordered science, truth retains a place, but it is set within a democratic framework that takes the proper notion of scientific significance to be that which would emerge from ideal deliberation among ideal agents. His final thought is that democracy in science, exemplified in well-ordered science, is worth aiming for because democracy is generally preferable to the alternatives. Kitcher's endeavour to integrate the concepts of science, truth and democracy is beyond the boundary of our particular set of skills, but the very idea that this discussion is occurring encourages us to persist with our science and recognise our role as citizens in a democracy where all voices are heard.

Kirk's (2007) views of science and certainty raise a number of insightful points about science and the environmental movement. Kirk identified two extreme poles of environmental attitudes in our society today. On the one hand, there are the ruthless exploiters who would chop down the last tree on earth if it would make a dollar and, on the other hand, the ecological extremists who view the works of humans with hostility and who seem to want humanity to revert to the hunter-gatherer stage of development. Kirk asked, where does the rational, environmentally-aware, scientifically-literate person locate themselves? He further asked, can science help at all? Is science the answer, or is science the problem? His own views become clear when he identifies what he sees as a worrying tendency apparent within some elements of the environmental movement, namely a distinct hostility to science and the scientific approach in general. People of this mind, Kirk considers, hold science responsible for most of the environmental problems which beset humankind and the sense of alienation, of the loss of meaning and purpose that so many people in our society now feel. Furthermore, says Kirk, because of their mistrust of science, this element in the ecological movement does not even believe that science has a role to play in solving environmental problems which confront us. These attitudes, Kirk noted, surface periodically in such publications as *The Ecologist* or in articles at the extreme end of the organic farming movement. Kirk considers the anti-scientific bias of some elements within the environmental movement to be ironic as well as worrying. It is ironic, Kirk says, because the environmental movement, certainly the movement which

has arisen since the Second World War, is very much a product of science. The founding fathers and mothers, the prophets crying in the wilderness, Kirk said, have mostly been scientists. Kirk contends that major changes in our patterns of consumption and our lifestyle will certainly be required, but there is no escaping the absolute necessity to continue our search for a fundamental scientific understanding of the problems, and the development of technical solutions based on this understanding.

In *Lies, damned lies and science: how to sort through the noise around global warming, the latest health claims, and other scientific controversies*, Seethaler (2009) has written a book to help people make sense of the science-related issues that impact their daily lives. She makes a strong point when she says that, in a society in which science and technology drive the economy and infiltrate every aspect of daily life, it is dangerous for an elite few to make the decisions about how technology is used, who will be given access to it, and how money is spent to research scientific solutions to societal problems. Ironically, she says, those with the power to make decisions rarely have a background in science. Therefore, she added, they are especially vulnerable to being hoodwinked by those who hold a stake in an issue and have the money to get their voices heard. She makes the observation that too many people have lost confidence in their ability to understand science, and that school and college science tend to be focused on facts, formulae, and experiments with known outcomes. She takes the view that, in the real world, there is much more uncertainty and need for interpretation. Decisions about contemporary scientific issues, she says, often must be made on the basis of incomplete information, and conflicting viewpoints are the norm rather than the exception. The task she set herself in her book was to unravel the complexity and help scientists and non-scientists identify hogwash and make reasoned decisions about science in everyday life. Towards the end of the book, she stated that at the heart of any scientific issue is the process of science, including how information came to be, and the degree of consensus within the scientific community. She added that within, and one level out from, the process of science, conclusions are drawn on the basis of the science. This level, she says, comprises whether the findings make it possible to distinguish definitely between cause and coincidence, how broadly conclusions can be applied, and what is the most sensible interpretation of statistical information from any study. That Seethaler felt compelled to write such a book demonstrates the scale and nature of the gap between practising scientists and non-scientists, and therefore the potential for science to be misapplied if decisions of what issues to study, and what issues to leave aside, are not in fact being made by those with scientific training, but rather by an elite with particular interests that do not necessarily benefit society or conform to sound and reliable science. These views explore how science can come under siege, but also present one of the escape routes, namely better education in the process of science, not just lists of facts or learning accepted formulae. Broadly, to the authors in this book, so much of the pleasure of science is in thinking of ideas, testing them, and interpreting and discussing the results with colleagues and those who are likely to

use these ideas. For conserving and managing our fauna, there is a good range of people who are interested in the outcome of zoological science studies.

In an intellectually captivating book, *What is your dangerous idea* (Brockman 2006), Steven Pinker (2006) said that he had urged John Brockman to devote his annual Edge questions to dangerous ideas because they are likely to confront us at an increasing rate and we are ill-equipped to deal with them. Pinker takes the view that, when done right, science, along with other truth-seeking disciplines such as history and journalism, characterises the world as it is, without regard to whose feelings are hurt. Pinker identifies that science has always been a source of heresy and that today's advances in areas such as genetics, evolution and environment are bound to throw unsettling possibilities at us. We note that the three science examples Pinker named are all in the biological sciences. Pinker also considered that universities cannot be relied on to defend the rights of their own heretics, and that it is often the court system or the press that has to drag them into the policies of tolerance. In government, says Pinker, the intolerance is even more frightening because the ideas considered there are not just matters of intellectual sport, but have immediate and sweeping consequences. By way of example, Pinker names Chris Mooney's (2005) *The Republican war on science* and Hunt's (1999) *The new know-nothings* in showing how corrupt and demagogic legislators are increasingly stifling research findings they find inconvenient to their interests. These books are indeed disturbing reading. Hunt (1999), as a long-time science writer, stated that he was becoming alarmed by a rising tide of ideological opposition to certain areas of scientific research, particularly in the social sciences, the fields in which he specialises. In the last half a dozen years, Hunt said, many valuable and critically important psychological and sociological research projects have been seriously impeded or totally halted by actions of activists on the far right, the radical left and all the points in between in the political spectrum.

Martin Rees (2006), as president of the Royal Society, added to this discussion by noting that public surveys in Britain reveal a positive attitude towards science but also a widespread worry that it may be running out of control. That idea is dangerous, says Rees, because it could be self-fulfilling. In the 21st century, he said, technology will change the world faster than ever and we are more empowered by science than any previous generation. Science offers immense potential, Rees says, but cautions that there could be catastrophic downsides. Almost any scientific discovery, said Rees, has a potential for evil as well as good, depending on our personal and political choices. He took the view that choices on how science is applied should be the outcome of debate that extends way beyond the scientific community. He concluded by stating that the future will be best safeguarded, and science has the best chance of being applied optimally, through the efforts of people who are not fatalistic—fatalism being the belief that science is advancing so fast and is so strongly influenced by commercial and political pressures that nothing we do will make any difference. We agree with Rees. The Royal Zoological Society of NSW in its activities is also not fatalistic, and runs forums, and airs and publishes dangerous ideas.

Paul Davies (2006) in his piece, entitled alarmingly 'Fight against global warming is lost', put the viewpoint that the idea of giving up the global warming struggle is dangerous because it should not have come to this. We lack the political will, says Davies, and giving up on global warming will set an ugly precedent. Morton (2006), in his contribution, commented on climate change and the loss of species and added that many people will feel themselves and their world diminished by such extinctions. Morton then put forward the view that many people in the green movement feel compelled to add on the notion that the planet itself is in crisis. This idea, says Morton, is an easy target for those who argue against any action at all on the carbon/climate crisis. Here, says Morton, bad science is hostage to fortune, and what is worse, he added, the idea distorts environmental reasoning. Philip Campbell (2006), as editor in chief of *Nature*, considered that scientists and governments developing public engagement in science and technology are missing the point. This is true, he says, when there are collapses in consensus that have serious societal consequences. Campbell gave as examples climate change, genetically-modified crops or vaccines, and alternative science networks developed among people who are neither ignorant nor irrational but have different perceptions about science from those prevailing in the scientific community. These perceptions may be half baked, says Campbell, but are no less powerful for that. Researchers and governments have not yet learned how to respond to such 'citizens' science', as he called it. Campbell's solution is to better understand the influences at work at an early stage in the debate in order to counter bad science and minimise the impact of falsehoods.

Linking all the contributions

The most striking feature that links all the contributions to the theme of science under siege is the rejection of the notion that science is optional in our society, i.e. that science can be ignored, even derided. The insidious idea that one can choose to reject science as a critical strand in our society manifests itself across diverse subjects ranging from climate change, evolution, journal impact factors, the media, the management of invasive species, sustaining scientific expertise and the dismissal or underfunding of the national premier organisations that study our wildlife, and their staff. These anti-science worldviews may be derived from religious groups that are hostile to science, a non-zoological understanding of animals that arrives at a philosophical position that is opposed to the study and management of wild animals, or a political or commercial stance that sees short-term gains in rejecting or undermining science. These anti-intellectual ideas are more than vexatious; they threaten to turn back the scholarly gains of millennia of insight, experimentation and testing of ideas in an open international forum. Often it is short-term commercial or narrow interests that are driving the abuse of science, but of more fundamental concern are the philosophical opponents of science who see their interpretations of how the world works as being the only valid ways of seeing the world. These concerns range across the broad dimension of science, but our primary focus here has been on our discipline of zoology. Zoology is under attack, so are working

zoologists, and the distressing consequence for our fauna will be its continuing decline. With increasing rates of extinction that reflect threats, such as invasive species

and climate change compounding the impact of simplified landscapes, Australia is being progressively robbed of its rich zoological legacy.

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We are indebted to Mark Horstman, ABC *Catalyst* presenter, for managing the evocative plenary sessions. We are pleased to see that he picked up on this theme in a *Catalyst* program on 8 September 2011. We are also pleased that the matter is gaining such a public airing, and the ABC website is quite explicit: "Scientific institutions are working to combat a rising wave of attacks on the integrity of scientists and their work. A range of scientific

endeavours, including nanotechnology, immunisation and atmospheric physics, are the target of misinformation campaigns that have led to unwarranted abuse and even death threats. Mark Horstman highlights the damage being done to the public's trust in science and the impact these attacks have on the personal lives of hard working and conscientious scientists."¹

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