



# Credible Science? Evaluating the Regional Forest Agreement Process in Western Australia

Pierre Horwitz and Michael Calver\*

**G**overnment proponents of the Regional Forest Agreement process in Western Australia have highlighted the use of scientific information in order to set criteria by which forests can be both reserved and managed in the future. Given the long-term significance of the process, and the central role played by science, we asked what would constitute a 'scientifically-credible process' for assessing a natural resource management issue? When could scientists in general, or conservation biologists in particular, be satisfied that such a process has been achieved? To address these questions we first examined the notion of sound science, based on norms for scientific processes, and the standards required by a range of journals to assess contributions prior to publication. From these, we developed criteria for assessing whether or not a process was scientific, asking:

- has the process involved scientists?
- has the process provided a framework, or facilitated in another way, scientific debate?
- has the process used scientific norms of peer review, publication and conferences?
- has the process involved explicit methodology from which conclusions can be justifiably drawn?

These questions were examined for the phases of the process during which scientific information was compiled, assessed and integrated, predominantly the Comprehensive Regional Assessment. Aspects dealing with the issues of biodiversity, endangered species, old-growth and wilderness were examined since they invoked the science of ecology. It was clear that the Regional Forest Agreement process had involved scientists, albeit selectively, but that it had not facilitated scientific debate, failed to adhere strictly to norms of peer review, and failed to be explicit regarding many methodologies employed. We concluded that the process could not be checked, and therefore failed to achieve what would notionally be regarded as credible science.

---

\* Pierre Horwitz is with the Centre for Ecosystem Management at the Edith Cowan University in Joondalup, WA, and Michael Calver is with the School of Biological Sciences at Murdoch University in Murdoch, WA.

## Introduction

At the national level, disputes over forest management have stimulated a series of inquiries and recommendations on forest use and forest policy (see listing in Braithwaite 1996) and, more recently, a growing literature on dispute resolution procedures which might be applied to specific contentious issues in forest management (e.g. Christie 1993, Cocks *et al.* 1995). The Regional Forest Agreement process (hereafter RFA) was conceived as a means of resolving the long-running disputes over forest planning, use and management. It arose from the most recent of Commonwealth inquiries into forest management issues, principally the Resource Assessment Commission inquiry (RAC 1992) and the ecologically sustainable development process (Ecologically Sustainable Development Working Groups 1991), which culminated in the National Forest Policy Statement (Commonwealth of Australia 1992; NFPS) (Dargavel 1998, Kirkpatrick 1998). The NFPS is recognised as being underpinned by four procedural principles: a regional (rather than State, or National) approach; criteria for a comprehensive, adequate and representative system of conservation reserves in each region; a coordinated approach between the relevant Commonwealth and the State bureaucracies for each region; and a negotiation to ensure a binding agreement covering land-use and forest management for each region (Dargavel 1998). The underlying objective was to provide security for both forest reserves and resource availability. Biological diversity, wilderness, old growth and other values were to be appropriately reserved and/or managed to ensure that forest use was sustainable, and to maximise economic development within these constraints (Kirkpatrick 1998). The resultant Regional Forest Agreements are designed to allow the Commonwealth to withdraw from forest debate, signaled by an intention "to virtually disable Commonwealth environmental legislation as it applies to forests in each region" (Dargavel 1998, p. 29). Accordingly, it was critical to the Commonwealth (in setting up the process) that scientifically credible criteria to protect nature conservation values, could be determined. The criteria were to contain "concrete, credible targets ... formulated by independent scientific experts" (Kirkpatrick 1998, p. 33).

In Western Australia, the RFA encompasses the forested south-west. The process has included the formation of a Steering Committee composed exclusively of representatives from State and Federal bureaucracies. This committee has overseen the operation of stakeholder reference group meetings, and the production of numerous reports, culminating in the release of the Comprehensive Regional Assessment (Commonwealth of Australia and Government of Western Australia, 1998a; CRA) report on February 10th 1998. This CRA report formed the background document for a "Public Consultation Paper" (Commonwealth of Australia and Government of Western Australia, 1998b) which outlined options ("approaches") for the use and reservation of public forests in the region. Announcing the release of the CRA report, the Commonwealth Minister for the Environment, the Commonwealth Minister for Primary Industries and Energy, and the Western Australian Minister for the Environment made a joint statement, in which the Western Australian Minister claimed that "this assessment provides the scientific base for sound decisions on how best to protect all ... environmental and cultural values for future generations" (Department of Conservation and Land Management, 1998a). In announcing the release of the Public Consultation Paper, a media release by the same politicians, made a similar claim - "We now have more detailed scientific information than ever before to help manage our unique forest resource..." and "that information is widely available" (Department of Conservation and Land Management, 1998b). Thus, the RFA in Western Australia has been labelled by governments and industry, in particular by the coordinators, as a "scientifically-credible" process.

Our principal objective in this paper is to present an assessment of these claims. We begin by developing criteria for judging scientific processes and then apply these to those aspects of the RFA using scientific information to assess natural systems. Overall, the paper may help clarify the status of the RFA in Western Australia and also offers a mechanism by which similar governmental processes might be evaluated.

## **Scientific norms and best practice**

### **Good science for whom?**

Clearly the involvement of 'science' in a decision-making process established by governments brings a form of credibility in its own right due to the high esteem held for science in the public sphere. At the same time there is a perception that elements of the general public

misunderstand science and even mistrust scientists (see Irwin and Wynne 1996). In terms of the RFA in Western Australia, the relationship between public groups and groups of scientists is a valid research topic, particularly given the perception that local or lay knowledge may not have been accorded suitable status in the process. While the public perception of 'credible science' may be relevant, and complex, we have chosen to focus on the community of scientists who might be called upon to judge the worth of science in a governmental process. What would constitute a 'scientifically-credible process' for assessing a natural resource management issue?

Notwithstanding the issue of credibility, what constitutes 'science', or even 'credible science' is not the straightforward question it seems. Addressing the question "what is this thing called science?" Chalmers (1982, p. 166) said

"It presumes that there is a single category 'science', and implies that various areas of knowledge, physics, biology, history, sociology and so on, either come under that category or do not. I do not know how such a general characterisation of science can be established or defended. Philosophers do not have resources that enable them to legislate on the criteria that must be satisfied if an area of knowledge is to be deemed acceptable or 'scientific'."

An absence of clear philosophical boundaries does not, however, give anyone *carte blanche* to claim scientific validity or credibility for a governmental process. We take the viewpoint that science can be described either as a system of logic and philosophy or as a cultural activity, much like the dichotomy proposed by Simmons (1993, p. 20). In examining a governmental process there is a distinction that can be made between the higher philosophical questions of "what is science", where debate continues on the relative importance of induction, deduction, falsificationism, empiricism, objectivism and so on, and the more pragmatic questions of good scholarship and best practice in scientific endeavours. In this essay we choose to follow the latter course: what are the normal cultural activities under which a scientific process should operate, and what criteria could be established to evaluate the process accordingly?

### **Setting criteria for judging scientific practice**

"As multifarious as science has been and continues to be, a great deal about it can be explained by reference to just three elements: a desire to understand the world in which we live, the allocation of responsibility for one's contributions (both credit and blame) and the mutual checking of these contributions."

Hull (1988, p. 305)

Such notions of responsibility and checking require that scholarly practice in science involves not only the way a work is performed, but also the way a work is communicated. The imperative for communication of findings is an integral element of the scientific ethos (Merton 1973). Thus publication, the main means of scientific communication, is an ideal starting point for an evaluation of scientific best practice.

Referring to the activities of scientists and the origins of scientific processes, Hull (1988) claimed that publications had three functions: making discoveries public, awarding credit for contributions by the author(s), and conferring some form of authenticity on the work. Support for this position is widespread. For example, Malmer (1990) claimed that if results were not published they could just as well not exist, while Malmer (1996) outlined briefly some of the recourses available to editors to ensure that credit to authors is honest. Sonnert (1995) showed some of the benefits flowing from that credit. In short, according to Aronowitz (1988), the "court of scientific truth" is in reality the sociological notion of the scientific community itself, and that the determination of scientific validity (i.e. authenticity) is made by this community composed of associated individuals united by their training and knowledge.

Authenticity is conferred on a work by that community through the staged use of peer review, and other forms of exposure. Regarding the former, there are instances where peer review is less effectual than it might otherwise be (e.g. Wenneras and Wold 1997). However it remains both the usual mechanism used to judge the status of scientific work (Harding 1998), and a fundamental procedural component which brings credibility to science and to the scientists who publish their findings. Peer review can correct errors, improve analyses, assist in the interpretations of data and draw the author's attention to unaccessed works (Ratti and Garton 1996).

Additional, less formal exposure of work can be facilitated by the bringing together of scientists. Forums like conferences are seen by some as an increasingly desirable feature of scientific processes in natural resource research, which are able to supplement publication and peer review (Mattson 1996), since they allow for debate over issues of agreement and disagreement.

Science is also a tension between highly competitive and

highly cooperative affairs (Hull 1988; Wolpert and Richards 1988), but from these tensions it is clear that a rigorous evaluation of an idea comes not just from one's close colleagues, but also from one's opponents. This concept is implied in the use of peer review and conferences in the exposure of scientific ideas. From this we would argue that governmental processes using science need to include protagonists, and need to be developed over a time frame in which credit and checking can occur.

Subsumed within the scientific elements of credit and checking is the notion that a finding must be replicable to count as scientific (Hull 1988). To be replicable, sufficient methodological detail must be presented publicly for the science to be repeated. To determine whether generalisations about the importance of methodology are applied widely in scientific practices, we examined a number of international, national and regional scientific journals publishing studies in ecology, behavioural ecology and conservation biology<sup>1</sup> for the criteria used to assess the suitability of scientific work for publication. While the criteria varied widely in terms of their detail, consistencies were apparent. Reviewers are asked to assess works on the basis of:

- the use of appropriate and adequately presented methodology;
- the use of appropriate analytical tools;
- drawing appropriate conclusions based on good theories and sound data; and
- other criteria such as overall presentation, the significance, originality, organisation, soundness and clarity of the work.

While it is clear that subjectivity is involved in judgments on all these issues, they all emphasise the role of checking in determining the suitability of work for publication. Furthermore, the concern for presentation of methodology, use of appropriate methodology and soundness of data ensure that studies can be replicated by others and the results verified.

The discussion so far has taken the perspective that all scientists are the same, but this perspective is not necessarily valid (Rothman *et al* 1996). Scientists are nested within a range of peer groups increasing in size from those clustering around laboratories and specific research projects, and research topics, to broader disciplines, scientific societies, and finally to the broader

1. (Pacific Conservation Biology, Colonial Birds, Emu, Avian Biology, The Condor, Notornis, The Auk, Marine Ornithology, Australian Journal of Ecology, CSIRO Australian Journals of Scientific Research, Biological Conservation, Ecosystem Health, Journal of the Royal Society of Western Australia, Animal Behaviour).

scientific community itself. In addition, each scientist has an institutional affiliation or allegiance. Each of these carries with it a series of duties, obligations and constraints which assist in framing the context in which the scientist's research is funded, 'experiments' are conducted, and conclusions are reached. In an overall process, credibility comes with the inclusion of protagonists (as above), and there is every likelihood that protagonists will belong to different peer groups, and will have differing affiliations and allegiances which need to be stated and preferably balanced (see Wynne 1996).

Accordingly, we have chosen to examine the following questions as criteria for the scientific performance of a governmental process:

- has the process provided a framework, or facilitated in another way, scientific debates (such that progress towards a resolution of disagreements can be made)?
- has the process involved scientists, and if so what are their affiliations?
- has the process used scientific norms of publication, peer review, and conferences?
- has the process involved explicit methodology from which conclusions can be justifiably drawn?

In order to evaluate these criteria, we have focused on the following documentation:

1. The "Scoping Agreement for a Western Australian Regional Forest Agreement" which confirms the intention of the State and Commonwealth governments to negotiate an agreement and establishes the process and timetable for its completion (Commonwealth of Australia and Government of Western Australia 1996). This document signifies a commencement of the phases in which scientific operations were conducted for the Western Australian RFA process.

2. The Comprehensive Regional Assessment (CRA) report for Western Australia, which, as stated above, is said to contain the scientific basis for decision-making (and, where available, the reports which were prepared for it).

3. Information obtained from the Western Australian Hansard - Questions in the Legislative Council and Legislative Assembly of the Western Australian Parliament. This source of information was chosen due to the difficulties encountered in obtaining the details required from the process itself, and publications emanating from it.<sup>2</sup>

Due to the on-going nature of political deliberations, we have chosen to focus on the processes of the RFA, rather than its outcomes. In terms of the science of the process, therefore, this limits our evaluation to the phases of the RFA in which scientific information was compiled and then merged for presentation to the public. Such phases included the CRA, followed by the "Integration Phase" (Commonwealth of Australia 1998).

### The Resolution of Scientific Disagreements

"The value of criticism and dissenting views is that they force a clearer articulation of the questions and the range of possible answers. This is the process that will hasten the resolution of fundamental issues."

(Rapport 1996, p. 100).

Few commentators would argue with this approach. For instance, Susskind (1994, pp. 77-8), speaking of the role of scientists in treaty-making at the international level, suggested that

"The key is to bring together not only each of the ... scientists at each step in the process, but to force them to confront the sources of their disagreements. Although this has traditionally been done behind the scenes, through the peer review process associated with professional publications and conferences, it needs to be done publicly if the contributions of the scientific community are to have credibility."

Scientific debate, particularly in contentious areas where conflicting interests and/or different ethical viewpoints operate, involves protagonists for each cause. For this reason, issues of agreement and disagreement over particular ecological principles in the forests are best dealt with through the inclusion in the debate of protagonists, who are given equal opportunity to contribute to the process. The advantages of such an equitable approach are obvious: contentious issues are made explicit, which removes claims of bias in the representation of views, provides a forum to resolve critical questions, and offers a measure of the reliability of scientific judgments.

The Scoping Agreement appears to recognise both the likelihood that scientific disagreements will occur in the process, and that a mechanism for their resolution is warranted. In Section 6(a) one of the Steering Committee's duties was "to resolve issues in dispute". In Attachment 1 of the Scoping Agreement, under Comprehensive Regional Assessments, Section 4, a structural administrative arrangement is set in place:

"Both Governments agree that any scientific matters on which agreement can not be reached, will be referred to a

2. In itself the necessity to use such a source says much about the transparency of this governmental process.

Panel of Independent Scientists and Experts (PoISE) at the discretion of the Steering Committee..."

A measure of the degree to which the process has been followed would be to determine if such a Panel was formed, and if so when it met, what were the scientific matters it was asked to address, and what methods it chose to resolve the disputes.

This structural option in the RFA process was used in only a limited way. Indeed, the Public Consultation Paper refers to the convening of such a panel only to advise governments on the appropriate level of vegetation mapping to be used in the assessment of forest ecosystems (Commonwealth of Australia and Western Australian Governments 1998b)<sup>3</sup>. For the purposes of the CRA, we are unable to find any documentation which supports the claim that a specific Panel was constituted to systematically address and resolve other areas of scientific disputation for the forests of Western Australia.

There are two possible conclusions here:

- that no scientific disputation exists in Western Australia over issues of forest management,

or

- that Governments were unwilling to acknowledge the existence of scientific disputation in Western Australia, and as such scientific disputation was not structurally addressed in the process (up to and including the release of the CRA report), contrary to the intent of the Scoping Agreement.

We contend that the latter conclusion is the correct one.

We support our claim by refuting the former option. By examining the recent literature concerning forest ecology, we have been able to identify many matters of scientific disputation of significance, where debates are on-going in the literature over matters of forest ecology in Western Australia. Of these we have taken three case studies, one involving the ecological sustainability of logging, one involving forest pathology, and one involving nest hollows. Each case study raises issues directly relevant to forest management.

### **Ecological sustainability of logging**

This case study refers to an on-going debate in the journal *Australian Forestry*, concerning the nature of

ecological principles which might be used to assess the ecological condition of forests in south-western Australia (Abbott and Christensen 1994; Calver *et al.* 1996; Abbott and Christensen 1996; Calver *et al.* (in press)). This literature was not referred to at all in the CRA report, despite the fact that it deals with pivotal issues of forest management. Issues raised in the debate were not the subject of an investigation by a specially convened panel.

### **Jarrah Dieback: *Phytophthora* and water-logging**

The spread of the plant pathogen *Phytophthora cinnamomi* has been accompanied by widespread deaths of endemic plants and structural changes in plant communities which are likely to affect fauna. Consequently, it is a significant concern (Shearer and Tippett 1989, Young 1994). During the 1970s several studies and reports suggested that forestry practices might increase the susceptibility of some forest stands by manipulating plant species composition, light intensity on the forest floor and water tables (Shea 1975, Christensen 1975, Forests Department 1973). These hypotheses were acknowledged by Shearer and Tippett (1989), although they stressed that they were unproven. More recently, the particular hypothesis that certain fire regimes might encourage the pathogen's spread were denied emphatically (Abbott and Christensen 1996), although they could only support the assertion by reference to unpublished data. This history of discussion of possible links between forestry practices and a major conservation issue was not acknowledged or discussed in the CRA report, nor was it the subject of investigation by a specially convened panel under the terms of the Scoping Agreement.

*P. cinnamomi* is also accepted as a pathogen of jarrah trees, although in a recent paper Davison (1997) presented evidence to suggest that, at the very least, waterlogging increases the susceptibility of jarrah to dieback (see also Bunny *et al.* 1995), thus questioning the dominant view that fungal diseases like *Phytophthora cinnamomi* were the principal causal agents in the death of trees. Again, neither Davison nor Bunny *et al.* was cited in the CRA report; in fact the issue was not dealt with in any systematic way in the report. Our view that this omission is serious can be seen by the following two examples:

3. We are aware of the formation of other panels or committees to address particular issues during the course of the RFA. Two of these did not concern themselves with disputes over scientific matters concerning forest ecology (World Heritage Expert Panel, and Independent Expert Advisory Group on Ecologically Sustainable Forest Management; although the latter did identify problems with legislative and policy mechanisms in the way forest management occurred in Western Australia). Another panel consisting of scientists from a range of academic and research organisations, met during the Deferred Forest Agreement process (before the RFA commenced) when the criteria for forest reservation were the subject of a dispute between the Western Australian Government and the Commonwealth (as described above), but did not meet again.

- Wardell-Johnson and Nichols (1991) reviewed forest management in Western Australia and ranked dieback as second only to agricultural clearing as a conservation concern in the south-west:
- According to the JANIS (1997) criteria, old growth forest was to be reserved at a rate of at least 60 per cent of the areal extent of that forest community at the time of assessment. Forests were mapped for the occurrence of old growth, and maps were also constructed for forests showing symptoms of *Phytophthora cinnamomi*. These two maps were overlaid, and 'old growth' forest showing dieback symptoms was excluded from consideration (CRA report p. 165; but note the absence of an explicit methodology for these treatments). This exclusion occurred in the absence of a discussion of disturbance in forest ecology, and despite the fact that the symptoms may have little to do with fungal infections as principal causal agents. Thus, the premise for the exclusion may well have been incorrect, and far more forest might have been required to be reserved.

### Hollows

Examples such as Leadbeater's possum *Gymnobelideus leadbeateri* from south-eastern Australia (Lindenmayer and Possingham 1995) and the northern spotted owl *Strix occidentalis caurina* (in the forests of the Pacific north-west of the United States of America; Guitérrez and Harrison 1996) leave little doubt that hollows in standing trees are important to forest fauna, and this importance was at least recognised in the CRA report with a section devoted to the issue (pp. 160-162). However, the section omitted reference to relevant recent review articles (e.g. Gibbons 1994, Recher 1996) and contained obvious errors (e.g. a claim that the number of animals using hollows is 42, when clearly from the text vertebrates only are meant and invertebrates have been ignored; see Gibbons 1994). The section also made no reference to a recent debate on the matter (Mawson and Long 1994, Mawson and Long 1997; Stoneman, Rayner and Bradshaw 1997), instead referring only to an unpublished Honours thesis, an unpublished internal report, and unpublished data. The coverage of literature was not comprehensive and appeared very selective.

The discussion below takes the issue a step further and assesses the representation of the disputants in the RFA process.

### Involvement of Scientists

The RFA process in Western Australia proceeded with Commonwealth funding for key and strategic reports.

According to media releases (available on the internet at <http://www.rfa.gov.au>), 38 reports were commissioned, involving over 200 experts. For assessments relating to forest biodiversity, topics were presumably authorised by the Steering Committee, and expert reports were commissioned from the scientific community. However the methods used to choose scientists, and to prioritise and select the project topics, are not specified in publicly available material. Our assessment of the process at this level would ideally examine the involvement of scientists with different agency affiliations, and with differing views on forest ecology, use and management. However, attempts to reconstruct the number and type of reports commissioned, along with the affiliation of the scientists undertaking the work, for studies relevant to nature conservation in the RFA, proved intractable. The CRA report gave details on some of the projects undertaken, but did not present a complete list of the project topics and authors/investigators. In several places the CRA report claimed that project reports were to be available on request, and on the internet, but for at least four months after the release of the document was announced, and despite numerous requests from members of the public, reports were neither distributed nor made available.

An illuminating source of information comes from a series of questions in the Parliament of Western Australia. The Minister for the Environment was asked to enumerate which of the 38 reports that had been commissioned had the involvement in part or in whole, of the lead agency in Western Australia, the Department of Conservation and Land Management (CALM). The Minister's response was "26" (Legislative Council, Question on Notice No. 1160, November 12, 1997).

Although unable to reproduce the required information from publicly available material, a compilation of a list of commissioned projects was achieved through contacts with various individual scientists, a member of the Stakeholder Reference Group, personal communications with State and Commonwealth bureaucrats, and from the details given in an answer to a question in Parliament provided by the Minister for the Environment (Legislative Assembly, Question on Notice No. 2493, 15 October 1997). Table 1 presents the preliminary findings of these investigations. The information is limited to agency involvement and implies no judgment on those individuals who took part in each consultancy. The Table does not include projects already undertaken or already completed, and not funded by the RFA process, but which were incorporated directly into it.

The CRA report did not consistently attribute specific consultancies and reports to specific pieces of

**TABLE 1: Specific consultancies and/or projects undertaken for the Comprehensive Regional Assessment (CRA), on topics relevant to nature conservation, biodiversity, old-growth and wilderness assessments.**

<b>PROJECT</b>	<b>AGENCY AFFILIATION</b>
Mapping of vegetation complexes (2 stages)	Private Consultants
Geoheritage	Private Research Organisation
Old growth data review	EA
Fauna database compilation	WAM
Species modelling	University of New England
Soil and landform mapping	Agriculture WA
Identification & classification of remnant native vegetation on private lands	CSIRO/CALM
Data review & evaluation for biodiversity species/assemblage distribution projects	EA
Landscape assessment - refuges	EA/CALM
Biodiversity - flora (Distribution mapping and key ecological attributes of plant species present in the SW forest region)	EA/CALM
Biodiversity - fauna (Distribution of species of special interest, Distribution and habitat quality mapping of fauna)	WAM/CALM
Review of knowledge of key disturbances (6 projects)	Curtin University, Edith Cowan Uni, Murdoch Uni., CSIRO, and Private Consultants
Historical fire frequency in SW region	CALM
Contemporary fire regime	CSIRO
Survival of hollow-bearing Jarrah, Marri & Karri trees in the SW forest region	CALM
Biodiversity attributes of old-growth	CALM (n.u.)
SW forest region old-growth forest surveys	CALM
National estate wilderness identification & assessment	EA
National estate natural heritage assessment	EA/CALM
World Heritage values	Independent Panel

**KEY**

EA	Environment Australia
CALM	Department of Conservation and Land Management
WAM	Western Australian Museum
n.u.	Project apparently not undertaken

information which made this task more difficult. It was therefore extraordinarily difficult to determine which scientists contributed to the CRA, and hence the RFA. There appeared to be a strong contingent of reports involving in whole or in part scientists from the lead agency in forest management (CALM), while there appeared to be a commendable spread of contributions

across research organisations, government departments and private consultants.

An alternative evaluation of this criterion might be the approach taken in the previous section, whereby the participation of disputants in well-known debates on forest ecology have been included formally in the RFA process (see above discussion of three case studies). In

each case, participation by protagonists has been unbalanced, with one 'side' represented poorly, preventing a rigorous evaluation of competing ideas. Given Hull's (1988) belief that the most rigorous assessment of arguments comes from one's opponents, the absence of protagonists could well mean that opinions expressed through the RFA process have not been scrutinised thoroughly.

The apparent dominance of the lead forestry agency (CALM) can be interpreted as any or all of the following:

1. necessity, due to the location of the expertise and/or data (with the corollary that expertise and/or data were less available/relevant outside CALM);
2. a sign of willingness of CALM's scientists to be involved in a governmental process;
3. a sign of a desire by CALM to retain control of the scientific aspects of the process, and/or avoid perceptions that alternative scientific viewpoints on forest ecology, use and management exist.

It was not our intention to favour one of these interpretations over others. However, the fact that the process has been structured to allow the third possibility to be considered viable, weakens its credibility.

### Scientific Norms of Peer Review, Publication and Conferences

In an ambitious process like the RFA which sets out to collate existing knowledge and examine all relevant facts and opinions about forest ecology, use and management, many smaller, and to a certain extent, discrete projects have been undertaken (see for example Table 1). Ideally, as discussed above, the findings of each of these projects should be made public. On its own, the failure to release to the public reports on which the CRA report was apparently built, does not conform with credible scientific practice.

Each project has involved different methodologies to achieve its aims in the context of the RFA process; as such each project is assessable much like a scientific paper might be assessed for publication in an international journal. For the purposes of evaluating a governmental process for its use of 'best practice' peer review, we propose three separate components:

- the participation of one or more authorities who are asked to provide a formal review of a piece of work;
- the participation of a third agency (usually an editor or editorial board acting on behalf of the publisher)

which solicits the review, assesses the response, and makes a decision as to the validity of the work, and recommends changes;

- the formalised changes to the work by the author, as recommended by the reviewer and the publisher, and submission for publishing the work.

Peer review of the projects listed in Table 1 has been, to our knowledge, *ad hoc* and partial at best, or absent at worst. We are aware of some instances of review:

- a 'peer review' of technical procedures (to validate methods and explore scientific issues associated with natural values of the national estate)(CRA report p. 170);
- an 'independent review' of some of the data used to compile the map of old growth forest (Legislative Council, Question No. 105 18 March 1998, of WA);
- the distribution of the six disturbance reports (see Table 1) to nominated scientists for written 'feedback', and verbal feedback given from members of a technical committee (composed of officers from the lead agencies - CALM and Environment Australia (EA)).

We understand that the last-mentioned form of review may have operated for other reports as well. However, this feedback was not dealt with in a formal way. The authors of the reports communicated with officers of the Commonwealth's Environment Australia who gave no explicit advice as to how to attend to the feedback before submitting to the Commonwealth final versions of their reports. In an answer to a question in Parliament, the Minister for the Environment said that the reports were "cleared" by the RFA Steering Committee but, at least for the disturbance reports, no changes were made or recommended (Legislative Council, Question on Notice No. 1532 April 9, 1998).

Thus, reviews may have been undertaken on a limited basis. However, the lack of formal instruction or formal written acceptance of the works by a publisher, and the failure of the Steering Committee to publish the reports within the time frame during which the scientific aspects were publicised and integrated, renders the process susceptible to claims that it was not undertaken according to scientific best practice. In addition, a major opportunity to include formally a broader representation of the scientific community in the RFA process, by soliciting reviews widely, was lost.

Here we draw a parallel with another governmental process: the Commonwealth's State of Environment Reporting. The product of the process was a published



Report, prepared by seven working (reference) groups, working under the direction of an independent State of the Environment Advisory Council. The (former) Commonwealth Department of Environment, Sport and Territories commissioned specialist technical reports from within and outside relevant government agencies, for use by each reference group. All technical reports were summarised for inclusion in a final published report. All reports were formally peer reviewed and published as the State of the Environment Technical Paper Series.

Finally, another structural mechanism which could have been used to formally include scientists in the RFA process, and resolve areas of disputation, is the strategic use of symposia or workshops, by invitation or open to the public, in which contentious areas might be debated, areas of disagreement identified, and critical tests designed. For instance, the workshop summaries and recommendations found in the proceedings of recent major conservation conferences (Grigg *et al.* 1995, Hale and Lamb 1997) are examples of how groups of scientists can use such gatherings most effectively.

We are aware of two semi-formal meetings called to discuss aspects of the CRA. The first was a meeting of 15-20 experts to discuss proposed RFA projects relating to fire; no specific outcomes were released. The second dealt with disturbances in the forests; it was by invitation only, and the aim of the day's proceedings was to determine a suitable approach for the letting of tenders to undertake a review of knowledge of key disturbances. The workshop finished with an agreed procedure for undertaking the review (and culminated in the letting of 6 projects to scientists outside the lead agencies - see Table 1). With the exception of these limited, though laudable attempts, we are not aware of any formal use of symposia or workshops to canvas the views of the scientific community. A proposal for a specialist workshop to integrate the findings of the six disturbance reports was not implemented, despite the willingness of scientists to participate. Instead the author(s) of each individual report were interviewed by its technical committee, in a private forum, without any form of public advertisement.

### Scientific Methodology

A weakness of the RFA process has been the reporting of the methods used to arrive at scientific findings. The CRA report summarised a large number of studies, and presented a large number of maps, tables and figures. In these summaries, the details of the methodology used in the original reports were missing or abbreviated and incomplete. Those wishing to find out how studies were actually done were referred to separate project reports.

However, as indicated above, individual project reports were not made available. This non-availability of individual reports during the public phase of the CRA is the clearest example we can give of the lack of transparency of the process, and the inability of an independent observer to replicate or check the science.

An example of detailed, well-documented methodology in the gathering and use of literature to overview scientific knowledge is provided by Resource Assessment Commission (1993). This report presents the results of a comprehensive survey of Australian research papers that measured impacts of forest use and was undertaken to assist the Resource Assessment Commission's Forest and Timber Inquiry. The methodology included comprehensive accounts of the search techniques undertaken to locate both published scientific papers and unpublished or 'grey literature', nine clearly-defined decision rules for deciding which papers were to be included and which excluded from the final analysis and detailed descriptions of the categories into which publications were grouped to facilitate interpretation. The initial survey identified over 2000 papers of possible relevance, from which a subset of 626 were selected for closer analysis. A further subset of 327 papers from this group was finally used. However, appendix 3 of the report included an annotated bibliography of the initial subset of 626 papers, allowing readers to make their own assessments of the later stages of the selection process and to check whether the methods had been followed correctly. The detail with which the methods and data are presented facilitates use of the data, not just the summary conclusions, by third parties (see Abbott and Christensen 1996, Calver *et al.* in press) and gives confidence in the procedures followed. It also allows anyone who disagrees with the classification and assessment procedures to apply their own approaches to the data base and ensures that the main procedures are indeed transparent to anyone wishing to check or query them.

Overall, as a governmental process, RAC (1993) sets high, but achievable, standards for methodology in literature surveys for government inquiries or assessments in contentious areas. Sadly, in the RFA process, these standards have not been maintained.

### Discussion

Overall, our findings in this paper make no comment on the quality of work undertaken by the scientists involved. Instead, our principal concern is for the process which led to the inclusion of the scientific work into a decision-making process. We found that areas of agreement and disagreement among scientists were not acknowledged in

the process, and that a structural mechanism available for resolving such was used in only a limited way. We also found that the essential ingredients of publication (including peer review, public conferences and availability of scientific works), and explicit methodology, were inadequately delivered during the phases of the process in which the scientific information was assimilated, integrated, and presented to the public. Accordingly we found that the science could not be checked *sensu* Hull (1988).

We can confirm that a large number of scientists, from a variety of agencies, took some formal part in the RFA process, but that the majority of projects relied upon participation by the lead agency in forest management, and the much broader scientific community was not as well represented as it might (or could) have been.

The claim for scientific credibility may also emanate from the process set up to establish the JANIS criteria for the comprehensive, adequate and representative reservation system. However, while the criteria (Commonwealth of Australia 1995), were largely accepted at the national level, they proved unacceptable to many of the States. Western Australia, in particular, was not happy with a number of issues, including the composition of the group of scientists, the exclusion of forests road-side and river-side from reserve criteria, and the need to recognise diversity in forest types and communities (see for example the Scoping Agreement, Attachment 1 Section 1(a) paragraph 2). The criteria that were formally agreed to by the States and the Commonwealth (JANIS 1997), while maintaining the general emphasis of the original, were reworded by bureaucrats who made

"additions and deletions... apparently ... largely designed to avoid any necessity to conform to any concrete targets. The most critical addition was the strong proviso that the targets within the document *could be varied for socioeconomic purposes*"

(Kirkpatrick 1998, p. 34, emphases added).

Such amendments severely compromised the scientific credibility of the RFA process.

A point of special concern arises when the scientific information and viewpoints used in an inquiry or report come predominantly from one source. This is not to say that the source is biased, but it may still be an advocate for particular actions or policies (Susskind 1994) and may carry the stigma of past legal action related to this very question (for example, see Gardner 1994 for accounts of court cases of direct relationship to the issue of information accessibility relating to management of WA forests, which itself lies at the heart of the scientific

aspects of the RFA process). Furthermore, as noted by Wagner (1996), Mattson (1996) and Zemansky (1996), scientists from different sectors of the scientific community may find themselves in situations of ethical conflict when assessing particular issues and may not be free to follow their preferred course without personal cost. Accusations of bias may also follow when there is a perceived conflict of interest for an organisation involved in a report or inquiry (Babbitt 1995). Overall, the complaints and accusations that may follow when one agency is used as the primary source of data and expert opinion, do have rational grounds in relation to past experience, even if completely unfounded in a particular case under consideration. They are also extremely hard to refute. Good process should avoid this dilemma by consulting a wide range of expert opinion: "In short, giving science its due depends on the selection of experts credible to all the stakeholders." (Susskind 1994, p.69). For the projects undertaken in the RFA in Western Australia, this credibility has not been tested.

We find little solace in the fact that other authors have detected perceptions of bias or conflict of interest. Lackey (1996, p. 67) provides a salient warning (particularly if applied to the RFA options for Western Australians):

"... those of us who are technocrats, scientists, biological resource managers, or scientific advisors should remain humble in our dealings with the public and elected officials and overcome the tendency to advocate political choices driven by strong personal interest and packaged under the guise of a scientific imperative. However, it is equally important not to permit tough policy choices to masquerade in the cloak of scientific imperative - a prostitution of science and scientists that sometimes provides a convenient cover for avoiding difficult social choices. The complete implications of each alternative public choice should be fully and clearly explained, including the short- and long-term consequences. This is the proper role of scientists, and we must exercise great care not to abuse our positions as independent counsel."

Finally, we concur with coordinators of this governmental process that credibility is absolutely desirable. In seeking such credibility, Meffe *et al.* (1998) proposed a mechanism to ensure that environmental decisions and policy making reflect the best scientific knowledge of the day. They argued that an "Independent Scientific Review" would result in decisions or policies being achieved in an open and transparent manner, with all relevant information considered and evaluated, all conclusions drawn being consistent with the available scientific information, and where assumptions have been made explicit. While such outcomes may only be achievable under somewhat ideal political circumstances,

the authors' point is not lost on us: scientific credibility, as assessed by the scientific community at large, is linked with an explicit decision-making process. We believe that the lack of scientific transparency in the Western Australian RFA process makes possible the interpretation that decision-makers may well be using science as a facade in the process.

In this article we hope to have provided a structure with which a governmental process might be evaluated for its credibility in terms of its use of science. We would, of course, be pleased to hear how the structure might be improved, or indeed how the RFA process in Western Australia has actually performed better than we have been able to assess. However, on the basis of information available to us (and therefore probably to other members of the public, the stakeholders in the forest issue in Western Australia), our conclusion is unavoidable. While the RFA process appears to have been set up with the clear intent of achieving scientific credibility, the management of the process in Western Australia has fallen well short of this mark.

## Acknowledgments

We are grateful to numerous people for their comments and advice on issues related to the RFA, to Jackie Alder, Jonathan Majer, Edyta Jasinska, Simon Judd, and Pam Nichols for their comments on an earlier version of the manuscript, and to an anonymous reviewer for constructive comments on the submitted manuscript.

## References

- Abbott, I. and Christensen, P. 1994. Application of ecological and evolutionary principles to forest management in Western Australia. *Australian Forestry*. 57: 109-122.
- Abbott, I. and Christensen, P. 1996. Objective knowledge, ideology and the forests of Western Australia. *Australian Forestry*. 59: 206-212.
- Aronowitz, S. 1988. *Science as power: discourse and ideology in modern society*. MacMillan Press, London.
- Babbitt, B. 1995. Science: Opening the next chapter of conservation history. *Science*. 267: 1954-1955.
- Braithwaite, L. W., 1996. Conservation of arboreal herbivores: The Australian scene. *Australian Journal of Ecology*. 21: 21-30.
- Bunny, F. J., Crombie, D. S. and Williams, M. R., 1995. Growth of lesions of *Phytophthora cinnamomi* in stems and roots of jarrah (*Eucalyptus marginata*) in relation to rainfall and stand density in mediterranean forest of Western Australia. *Canadian Journal of Forest Research*. 25: 961-969.
- Calver, M. C., Hobbs, R. J., Horwitz, P. and Main, A. R. 1996. Science, principles and forest management: a response to Abbott and Christensen. *Australian Forestry*. 59: 1-6.
- Calver, M., Dickman, C., Feller, R., Hobbs, R., Horwitz, P., Recher, H. and Wardell-Johnson, G. (in press). Towards resolving conflict between forestry and conservation in Western Australia. *Australian Forestry*.
- Chalmers, A.F. 1982. *What is this thing called science?* University of Queensland Press, Brisbane.
- Christensen, P. 1975. Jarrah dieback - soil temperature and moisture regimes of some southern forest types. Bulletin No. 88. Forests Department of Western Australia.
- Christie, E. 1993. Ecologically sustainable development and environmental dispute resolution. *Australian Dispute Resolution Journal*. 4: 257-272.
- Cocks, K.D., Lee, J.R. and Clark, J.L. (eds). 1995. Forest issues: Processes and tools for inventory, evaluation, mediation and allocation. Report on a case-study of the Batemans Bay area, New South Wales, Australia. CSIRO Australia.
- Commonwealth of Australia. 1992. *National Forest Policy Statement*. AGPS, Canberra.
- Commonwealth of Australia. 1995. *National forest conservation reserves: Commonwealth proposed criteria: a position paper*. AGPS, Canberra.
- Commonwealth of Australia. 1998. RFA Fact Sheet. What is the RFA? URL: <http://www.rfa.gov.au/rfa/wa/wapcpfact/watisrfa.pdf>. Consulted 27 May 1998.
- Commonwealth of Australia and Government of Western Australia. 1996. *Scoping Agreement for a Western Australian Regional Forest Agreement*. 18 pp.
- Commonwealth of Australia and Government of Western Australia. 1998a. *Comprehensive Regional Assessment. A Regional Forest Agreement for Western Australia*. Commonwealth and Western Australian Regional Forest Agreement Steering Committee. 185 pp.
- Commonwealth of Australia and Government of Western Australia. 1998b. *Towards a Regional Forest Agreement for the south-west forest region of Western Australia*. Commonwealth and Western Australian Regional Forest Agreement Steering Committee.
- Dargavel, J. 1998. Politics, policy and process in the forests. *Australian Journal of Environmental Management*. 5: 25-30.
- Davison, E. M. 1997. Are jarrah (*Eucalyptus marginata*) trees killed by *Phytophthora cinnamomi* trees or waterlogging? *Australian Forestry*. 60: 116-124.
- Department of Conservation and Land Management. 1998a. Media Release 6 February 1998. URL: <http://www.calm.wa.gov.au/forestfacts/rfa.news.060298a.pdf>.
- Department of Conservation and Land Management. 1998b. Media Release 25 May 1998. URL: <http://www.calm.wa.gov.au/forestfacts/rfa.news.250598.pdf>.
- Ecologically Sustainable Development Working Groups. 1991. *Final Report: Forest use*. AGPS, Canberra.
- Forests Department. 1973. *Marri wood chip project environmental impact statement*. Forests Department of Western Australia, Perth.

- Gardner, A. 1994. A landmark case. Casenote: Re Minister for the Environment (WA), ex parte South West Forests Defense Foundation. *Brief*. 21: 8-11.
- Gibbons, P. 1994. Sustaining key old-growth characteristics in native forests used for wood production: Retention of trees with hollows. Pp. 59-84 In: Norton, T. W. and S. R. Dovers (eds) *Ecology and sustainability of southern temperate ecosystems*. CSIRO Publications, Melbourne.
- Grigg, G., Hale, P. and Lunney, D. (eds) 1995. *Conservation through sustainable use of wildlife*. Centre for Conservation Biology, The University of Queensland, Brisbane.
- Guitérrez, R.J. and Harrison, S. 1996. Applying metapopulation to Spotted Owl management: a history and critique. In: McCullough, D.R. (ed) *Metapopulations and wildlife conservation*. pp 167 - 186. Island Press, Washington DC.
- Hale, P. and Lamb, D. 1997. *Conservation Outside Nature Reserves*. The University of Queensland, Centre for Conservation Biology.
- Harding, R. (ed.) 1998. *Environmental Decision-making. The role of scientists, engineers and the public*. The Federation Press, Leighhardt, NSW.
- Hull, D. 1988. *Science as a process*. University of Chicago Press, Chicago.
- Irwin, A. and Wynne, B. 1996. Introduction. In: Irwin, A. and Wynne, B. (eds) *Misunderstanding science? The public reconstruction of science and technology*. Cambridge University Press, Cambridge.
- JANIS (Joint ANZECC/MCFFA National Forest Policy Statement Implementation Sub-Committee). 1997. *Nationally agreed criteria for the establishment of a comprehensive, adequate and representative reserve system for forests in Australia*. AGPS, Canberra.
- Kirkpatrick, J.B. 1998. Nature conservation and the Regional Forest Agreement process. *Australian Journal of Environmental Management*. 5: 31-38.
- Lackey, R.T. 1996. Pacific salmon, ecological health and public policy. *Ecosystem Health*. 2: 61-68.
- Lindenmayer, D. B. and Possingham, H. P. 1995. The conservation of arboreal marsupials in the montane ash forests of the central highlands of Victoria, south-eastern Australia - VII. Modelling the persistence of Leadbeater's Possum in response to modified timber harvesting practices. *Biological Conservation*. 73: 239-257.
- Malmer, N. 1990. The new editor-in-chief gets the floor. *Oikos*. 57: 3-5.
- Malmer, N. 1996. Duplicate publications. *Oikos*. 77: 377.
- Mattson, D.J. 1996. Ethics and science in natural resource agencies. *BioScience*. 46: 767-771.
- Mawson, P. R. and Long, J. L. 1994. Size and age parameters of nest trees used by four species of parrot and one species of cockatoo in South-west Australia. *Emu*. 94: 149-155.
- Mawson, P. R. and Long, J. L. 1997. Size and age of nest trees: A reply to Stoneman, Rayner and Bradshaw (1997). *Emu*. 97: 181-182.
- Meffe, G.K., Boersma, D., Murphy, D.D., Noon, B.R., Pulliam, H.R., Soulé, M.E. and Waller, D.M. 1998. Independent scientific review in natural resource management. *Conservation biology*. 12: 268-70.
- Merton, R.K. 1973. *The Sociology of Science: Theoretical and empirical observations*. University of Chicago Press.
- Ratti, J.T. and Garton, E.O. 1996. Research and experimental design. In: Bookhout, T. (ed) *Research and management techniques for wildlife and habitats*. pp. 1-23. The Wildlife Society, Bethesda, Maryland.
- Rapport, D.J. 1996. Encouraging dissent. *Ecosystem Health*. 2: 99-100.
- Recher, H. F. 1996. Conservation and management of eucalypt forest vertebrates. In: DeGraaf R. M. and R. I. Miller (eds) *Conservation of faunal diversity in forested landscapes*. pp. 339-388. Chapman and Hall, London.
- Resource Assessment Commission. 1992. *Forest and timber inquiry: final report*. AGPS Canberra.
- Resource Assessment Commission. 1993. *Ecological impacts of forest use: a survey of completed research*. Research paper no. 9. Resource Assessment Commission, Canberra.
- Rothman, H., Glasner, P. and Adams, C. 1996. Proteins, plants, and currents: rediscovering science in Britain. In: Irwin, A. and Wynne, B. (eds) *Misunderstanding science? The public reconstruction of science and technology*. Cambridge University Press, Cambridge.
- Shea, S. R. 1975. *Environmental factors of the northern jarrah forest in relation to pathogenicity and survival of Phytophthora cinnamomi*. Forests Department of Western Australia, Perth, Western Australia.
- Shearer, B. L. and Tippett, J. T. 1989. Jarrah dieback: the dynamics and management of *Phytophthora cinnamomi* in the jarrah (*Eucalyptus marginata*) forest of south-western Australia. Research Bulletin No. 3, Department of Conservation and Land Management, Perth, Western Australia.
- Simmons, I.G. 1993. *Interpreting nature: cultural constructions of the environment*. Routledge, London and New York.
- Sonnert, G. 1995. What makes a good scientist?: Determinants of peer evaluation among biologists. *Social Studies of Science*. 25: 35-55.
- Stoneman, G. L., Rayner, M. E. and Bradshaw, F. J. 1997. Size and age parameters of nest trees used by four species of parrot and one species of cockatoo in south-western Australia: Critique. *Emu*. 97: 94-96.
- Susskind, L.E. 1994. *Environmental diplomacy: negotiating more effective global agreements*. Oxford University Press, New York.
- Wagner, F.H. 1996. Ethics, science and public policy. *BioScience*. 46: 765-6.
- Wardell-Johnson, G. and Nichols, O. 1991. Forest wildlife and habitat management in southwestern Australia: knowledge, research and direction. In: D. Lunney (ed.) *Conservation of Australia's Forest Fauna*. pp. 161-192. The Royal Zoological Society of New South Wales, Mosman, New South Wales.

Wenneras, C. and Wold, A. 1997. Nepotism and sexism in peer-review. *Nature*. 387: 341-343

Wolpert, L. and Richards, A. 1988. *A passion for science*. Oxford University Press, New York.

Wynne, B. 1996. Misunderstood misunderstandings: social identities and public uptake of science. In: Irwin, A. and Wynne, B. (eds.) *Misunderstanding science? The public reconstruction of science and technology*. Cambridge University Press, Cambridge.

Young, J. T. 1994. The future - effects of plant disease on society. *Journal of the Royal Society of Western Australia*. 77: 185-186.

Zemansky, G.M. 1996. Ethical tensions in technical consulting. *BioScience*. 46: 779-82.