MAPS AND DATA ASSESSMENT

Preface and overview

Conservation Commission of Western Australia

July 2003

Preface

Issues related to the accuracy of maps and data used in the development of forest management plans and other policies have been raised by stakeholders over many years. In considering this issue the Commission acknowledges that there must be a balance developed between the resources put to mapping and data collection and the level of risk imposed by limitations to accuracy. That is to say that the Commission believes that it is acceptable to work with maps and data which have limitations as long as these are known, are accounted for and do not pose unacceptable risks for management outcomes.

Possible map and data limitations that affect two aspects of risk have been identified and are subject to this assessment. The principal focus was on issues raised that increased the risks to the accuracy of the calculation of sustained yield. Also dealt with to a lesser extent were risks to the establishment of the reserve system and biodiversity, although these matters are primarily addressed through actions to improve our biological data during the life of the new forest management plan.

The assessment of stakeholder concerns raised in relation to maps and data used in the calculation of sustained yield in the forest management plan was undertaken by Professor Ian Ferguson over the period 22-24 October 2002. The report (attached) made a number of recommendations, many of which related to matters that were to be the subject of review by the Independent Expert Panel that has subsequently convened to consider the proposed forest management plan. Many of the issues raised in the Map and Data Assessment have been commented on in more detail in the subsequent report of that Panel (Ferguson et al, 2003).

It is recommended that these reports be considered in conjunction so that a more complete picture of the status of maps and data used in the calculation of sustained yield is can be obtained.

In order to facilitate this the Conservation Commission has prepared an overview that provides responses to the recommendations in the Map and Data Assessment drawn from the Independent Expert Panel Stage 3 report (Ferguson et al, 2003), actions described in the proposed forest management plan and other actions initiated by the Conservation Commission.

Several actions in the Plan implementation chapter in the plan provide for ongoing research, monitoring, auditing and review as a commitment to improvement.

Overview

Mapping

***Maps and Data Assessment Recommendation 2.1**: The Sustained Yield Panel should report specifically on the basis of risk management provisions concerning errors in mapping undetected until the pre-logging survey.*

In its conclusion to Chapter 2 of its Stage 3 report the Independent Expert Panel (the Panel) reported:

> The Panel noted the substantial number of concerns expressed about the stratification and mapping. It concludes that these reflect a widespread misconception of the basis and nature of the system. Corrections or queries about strata from stakeholders are to be welcomed and will be checked and amended, if appropriate. However, they have no significant effect on overall capacity of the system to properly and to accurately calculate sustained yield.

The Panel also reported on the loss of productive forest area to meet requirements of forest management such as internal roads, water points and gravel pits, landings etc and noted that potential yield is also lost through the inability to harvest for reasons of slope, temporary exclusion or discovered as being operationally infeasible during harvest plan preparation. The conclusion of the Panel was:

> The Panel concludes that the level established and method used to make allowance for the risk is reasonable.

The Commission is satisfied that the conclusions of the Panel address this area of concern adequately.

***Maps and Data Assessment Recommendation 2.2**: The Conservation Commission should ensure that the draft protocol on Old Growth and audit provisions relating to that protocol are speedily completed and implemented. This protocol deals with recognising Old Growth (according to the Janis criteria and the Government's Old Growth policy) that has not been recognised in prior mapping but is in areas otherwise about to be logged or about to be disturbed or impacted by activities such as roading.*

In relation to this matter the Panel noted in Chapter 2 of its report:

> The area of greatest sensitivity in the concerns expressed by the public is the incorrect labelling of some 'old-growth' patches of forest. This would mean that the area concerned is not shown as 'old-growth' and might therefore be denied the protection which the policy introduced by the present Government seeks to implement - namely to set aside from timber harvesting all areas of old-growth on land vested in the Conservation Commission.
>
> This issue highlights the distinction between planning at a strategic level, which is the basis of the calculation of sustained yield, and operational planning and

management on the ground. Operational planning requires tree-markers to note and implement Government policy relating to such patches, so they would be identified in the field regardless of the stratum label, and would be reserved from logging. There is, however, a contingent issue relating to the area of forest available for timber production because the patch of 'old-growth' forest missed in typing from photos now forms part of the productive area, whereas it should not. But there are also patches typed as 'old-growth' that are not old-growth and that need similarly to be corrected after due process from field checking. These errors tend to cancel and the issue is what the net effect is and what allowance is made for the net effect on sustained yield, matters which are taken up in a later section.

The plan requires the Department and the Forest Products Commission to survey areas where operations are planned to identify old-growth forest that has not been previously mapped and that must be protected by informal reserve. In addition, the plan requires the Department to maintain and make publicly available variations made to the old-growth forest database.

The Commission is satisfied that the conclusions of the Panel address this area of concern adequately together with the measures in the plan related to ongoing monitoring and reporting of variations.

***Maps and Data Assessment Recommendation 2.3**: As a matter of urgency, the Conservation Commission should commission an ecologist to report on the occurrence of Eucalyptus staeri, or hybrids thereof, in the south-western areas of the Jarrah South region, especially those currently available for timber harvesting.*

The Commission initially sought further advice from the Department on the most effective mechanism to carry out a detailed review of the distribution of *E.staeri*, but notes that preliminary advice from the Department indicates that *E.staeri* is not widely distributed and is unlikely to require further protection through reservation or otherwise. It also noted that *E.staeri* hybridises readily with a number of other eucalypt species with five such hybrids being recorded including that with jarrah. The Commission will ensure that the report of the review to be undertaken on this is made public and that any measures required to secure protection for biodiversity conservation purposes are applied.

***Maps and Data Assessment Recommendation 2.4**: The Conservation Commission should ensure that, in the next Plan period, more specific attention is given by the relevant agencies to the development of better and more representative databases on fauna habitat and heritage matters.*

In the chapter on biodiversity, the plan includes an action to undertake biological surveys targeted to areas of high priority to improve the knowledge of, among other things, the distribution of fauna and its associated habitat. The results of these surveys will be used to improve the quality of databases on fauna for ongoing management. The plan also has an action in the section on heritage to undertake systematic surveys to enhance databases of cultural and natural heritage.

The Commission is satisfied that the measures in the plan related to targeted biological surveys and the enhancement of cultural and natural heritage databases satisfy this area of concern.

Inventory of Standing Volume

***Maps and Data Assessment Recommendation 3**: The Sustained Yield Panel should specifically review and report on the present inventories of standing volume and the needs for the next (2013-23) Plan period.*

The Panel report provides a detailed review of inventory for both jarrah and karri in its Chapter 3. In regard to the jarrah inventory the Panel has concluded that:

> The Panel considers that the design of the inventory system represents Australian best practice, and that with the adjustments described above, provide inventory estimates at an appropriate level of precision and confidence for strategic yield scheduling.

For karri it has concluded:

> The Panel endorses the inventory system that is in place, and until more data is available, the Panel has no basis for suggesting variation to the current allowances while recognising that they are likely to be conservative.

The Panel has recommended the following in relation to future inventory needs:

> In refining the inventory during the life of the Plan, greater emphasis should be placed by the Department of Conservation and Land Management on increasing the sampling framework for monitoring, and extending the analysis of monitoring data to separate inventory bias from the utilisation factor, in addition to updating the field sampling.

The Commission is satisfied that the conclusions and recommendation of the Panel address this area of concern adequately. Actions within the plan will ensure that the recommendation is implemented.

Growth Plots

***Maps and Data Assessment Recommendation 4.1**: The Sustained Yield Panel should report specifically on the concerns raised in relation to estimates of diameter growth and the estimates of sustained yield.*

The specific comment on this from the Map and Data Assessment was:

"A concern was expressed that the sustained yield estimates were not consistent with the estimates of diameter growth given by Abbott et al. (1989). The Sustained Yield Panel will review this.

The Panel were provided with the following explanation of this reported inconsistency:

> The average diameter growth rates stated by Abbott *et al* 1989[1] were generalized from earlier work (e.g. Abbott and Loneragan, 1986[2]) reporting a selection of measurements in overstocked stands. Patches of forest representing such stand conditions occur throughout the forest, and at varying stages of stand development. A more comprehensive reporting of the range of diameter growth rates across sites, ages and stand development stages is contained in a later chapter of the same book in an article by Stoneman *et al* (1989)[3].
>
> The sustained yield calculations incorporate the wide range of relative diameter growth reported in these and later publications (e.g. Stoneman et al 1996)[4] to encompass the full suite of stand conditions and management. They therefore incorporate the earlier estimates of diameter growth reported in Abbott *et al* 1989. The Sustained Yield Panel examined the estimates of diameter growth and concluded that appropriate estimates had been used for the estimation of sustained yield.

In relation to the growth estimates used for jarrah the Panel concluded that:

> the growth estimates that have been used are appropriate for the estimation of sustained yield in this plan.

For karri it concluded:

> growth and future stand condition has been estimated at a precision appropriate for sustained yield calculation with the expectation that the precision of the model will progressively improve as more data becomes available over time.

The Commission is satisfied that the conclusions of the Panel and the explanation of the reported inconsistency address this area of concern adequately.

***Maps and Data Assessment Recommendation 4.2**: The Sustained Yield Panel should specifically review and comment on the present distribution and adequacy of growth plots and future needs.*

While noting that the growth estimates used were appropriate, the Panel also concluded that:

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[1] Abbott, I., Dell, B. and Loneragan, O. (1989) The jarrah plant *In* The Jarrah Forest. Eds B. Dell, N.J. Malajzcuk and J.J. Havel. Kluwer Academic Publishers, Dordrecht, pp 41-51.
[2] Abbott, I. and Loneragan, O. (1986) Ecology of jarrah (*Eucalyptus marginata*) in the northern jarrah forest of Western Australia. Bulletin No. 1, Department of Conservation and Land Management, Perth.
[3] Stoneman G.L., Bradshaw, F.J., and Christensen, P. (1989) Silviculture. *In* The Jarrah Forest. Eds B. Dell, N.J. Malajzcuk and J.J. Havel. Kluwer Academic Publishers, Dordrecht, pp 335-355.
[4] Stoneman G.L., Crombie, D.W., Whitford, K., Hingston, F.J., Giles, R., Portlock, C.C., Galbraith, J.H. and Dimmock, G.M. (1996) Growth and water relations of *Eucalyptus marginata* (jarrah) stands in response to thinning and fertilization. Tree Physiology 16, 267-274.

The precision of the output from the JARSIM model can be improved over time in several ways:

- As more data becomes available from younger stands over a greater range of sites as a basis for initialising the model;
- Improving the estimates of stand condition following thinning as a result of post thinning monitoring;
- Improving the understanding of forest dynamics by further research on the response to multiple thinnings;
- Reviewing the existing framework of growth plots and establishing new plots in stands that more closely represent the structure of future stands.

The Panel also recommended that:

> In refining the growth models over the life of the Plan, the Department of Conservation and Land Management should adopt a strategic approach and seek to obtain data from a broader range of ages and conditions as those opportunities become available. Major refinement of the growth models is therefore unlikely to be feasible until towards the end of the Plan period.

The plan includes an action in the section on productive capacity to maintain and enhance the quality and coverage of the data sets used in the calculation of sustained yield giving particular regard to the recommendations from the Panel and the standard of inventory and growth data and the model used to project sustained yield.

The Commission will ensure that the actions in the plan noted above are implemented to ensure there is continual improvement in the accuracy of the calculation of sustained yield while accepting that the Panel have concluded that the allowances provided for in the current calculations provide an appropriate sustained yield figure.

***Maps and Data Assessment Recommendation 4.3**: The Conservation Commission should recommend that the Department of Conservation and Land Management develop and ensure the implementation of an adequate and representative set of permanent plots to monitor change in the reserve system.*

The plan includes an action to implement the species, community and process monitoring program FORESTCHECK that has the objective of identifying the response to forest management activities and natural variation. However, resource limitations mean that it will only be implemented in State forest subject to management disturbance in the medium term.

It is also noted that many permanent growth plots are now located within the reserve system. As these plots exist and already have a body of monitoring data associated with them it is proposed that they be used on an ongoing basis to monitor change in the reserve system. The adequacy and representativeness of these will be reviewed by the Commission's soon to be established Research Advisory Committee and the Commission will seek implementation of this measure or other appropriate monitoring measures through this mechanism.

Sustained Yield Methodology

***Maps and Data Assessment Recommendation 5.1**: The Sustained Yield Panel should review the field stockpile inventory system and should consider and make recommendations on future needs for biomass and carbon accounting.*

The Panel did not provide any specific comment on the systems to inventory field stockpiles. This is a matter of a separate assessment undertaken and reported by the Commission[5] and the plan includes an action to periodically audit the grading and removal of logs.

The Panel made recommendations with regard to measures of timber products that can provide for improved accounting of biomass, noting that:

> There are proposals to change the basis of timber sale to whole bole measures. The Panel notes proposed action 11.A6 in the Interim Proposed Forest Management Plan and recommends that additional work (if necessary) be undertaken to ensure both grade and whole bole measures are accurately predicted by the IRIS and SILVIA processing systems. The plot process currently employed by the Department of Conservation and Land Management provides a sound basis for ongoing development of these factors.

The Commission considers that this measure together with the plan's requirement of having regard to the function of the forest as a carbon sink in the ongoing development of the State's greenhouse gas position and policy on emissions, sequestration, and bioenergy will ensure that appropriate responses are made through the life of the Plan.

***Maps and Data Assessment Recommendation 5.2**: The Sustained Yield Panel should review the methodology for calculating sustained yield and make recommendations as to future directions and methods of improving the transparency of the process.*

The methodology for the calculation was the focus of the Panel's review and a number of suggestions for ways to improve transparency are included in its report. The Commission is committed to improving the transparency of the future management of forests in WA and so supports this recommendation in relation to sustained yield calculations and more broadly in relation to all aspects of forest operations, management and policy development. The plan includes actions in the section on productive capacity to make timber harvesting plans publicly available and to refine the methodology used for sustained yield calculations.

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[5] Conservation Commission Advice and Recommendations to the Minister for Environment and Heritage - An Assessment of Log Stockpiles and Forest Residues, Conservation Commission of Western Australia, May, 2002

MAPS AND DATA ASSESSMENT

Report on a consultancy for the Conservation Commission

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22-24 October, 2002

Executive Summary

1. Introduction

The consultancy was intended to provide the basis for an assessment of stakeholder concerns raised in relation to maps and data used in the development of sustained yield in the forest management plan. It was carried out over the period 22-24 October 2002. Submissions were sought and interviews were conducted in person and by phone. Previous submissions were also examined

2. Mapping

Where errors are discovered in the course of field work, changes to the database are made under a well-established protocol, and the dependent area data are recalculated at the next revision of the database. The remaining issues related to how errors in mapping undetected until the pre-logging survey are handled and their implications for sustained yield and prescriptions

Recommendation 2.1: The Sustained Yield Panel should report specifically on the basis of risk management provisions concerning errors in mapping undetected until the pre-logging survey.

Recommendation 2.2: The Conservation Commission should ensure that the draft protocol on Old Growth and audit provisions relating to that protocol are speedily completed and implemented. This protocol deals with recognising Old Growth (according to the Janis criteria ad the Government's Old Growth policy) that has not so be recognised in prior mapping but is in areas otherwise about to be logged or about to be disturbed or impacted by activities such as roading.

An additional issue has arisen in the Jarrah South region regarding the possible occurrence of *Eucalyptus staeri* and hybrids in the south-western section of that region.

Recommendation 2.3: As a matter of urgency, the Conservation Commission should commission an ecologist to report on the occurrence of *Eucalyptus staeri*, or hybrids thereof, in the south-western areas of the Jarrah South region, especially those currently available for timber harvesting

Deficiencies in the datasets on fauna habitat and heritage were noted. In the present calculation of sustained yield, allowances or discounts can be made based on previous experience, but better databases are required for the future.

Recommendation 2.4: The Conservation Commission should ensure that, in the next Plan period, more specific attention is given by the relevant agencies to the development of better and more representative databases on fauna habitat and heritage matters

3. Inventory of Standing Volume

A new Karri inventory is being undertaken. The Jarrah inventory, though technically well based, documented and evaluated, is now becoming out of date (1991).

Recommendation 3: The Sustained Yield Panel should specifically review and report on the present inventories of standing volume and the needs for the next (2013-23) Plan period.

4. Growth Plots

A concern was expressed that the sustained yield estimates were not consistent with the estimates of diameter growth given by Abbott *et al.* (1989).

Recommendation 4.1: The Sustained Yield Panel should report specifically on the concerns raised in relation to estimates of diameter growth and the estimates of sustained yield.

Concerns were expressed about the sampling design, location, species association, structure, measurements dates, and (where relevant) reasons for cessation of measurement of permanent growth plots.

Recommendation 4.2: The Sustained Yield Panel should specifically review and comment on the present distribution and adequacy of growth plots and future needs.

Recommendation 4.3: The Conservation Commission should recommend that the Department of Conservation and Land Management develop and ensure the implementation of an adequate and representative set of permanent plots to monitor change in the reserve system.

5. Sustained Yield Methodology

Concerns were expressed about the need to change to whole bole logging, improve stockpile inventory systems and review the sustained yield methodology.

Recommendation 5.1: The Sustained Yield Panel should review the field stockpile inventory system and should consider and make recommendations on future needs for biomass and carbon accounting.

Recommendation 5.2: The Sustained Yield Panel should review the methodology for calculating sustained yield and make recommendations as to future directions and methods of improving the transparency of the process.

1. Introduction

The Terms of Reference for the consultancy were as follows:

Tasks

1. Interview key individuals or groups who have been critical of maps and data to determine in detail their concerns.
2. Analyse this and provide comment on the extent to which these possible flaws in maps and data may affect sustained yield calculations and whether adequate allowance has been/can be made for them in the SY calculations.
3. Identify those, which will be subject to detailed analysis within the existing TOR of the Ferguson Panel.
4. For others, which are deemed to be of significance, make recommendations as to the most efficient way to review and correct.

Reporting

Provide a written draft report for comment from the Department and a final report to the Conservation Commission of the findings in relation to the tasks listed above. This report will be assessed by the Commission and transmitted to the Minister before it is made public.

This consultancy was carried out over the period 22 –24 October 2002 at the Conservation Commission Office. My thanks go to John Bailey, Peter Baldwin and their staff for assistance.

Lists of submissions received (or referred to) and of interviews and correspondence conducted are attached (Appendix A).

2. Mapping

Many of the concerns arise because the respondents assume mapped types to be absolutely correct. For example, the interpretation of remote sensing (principally aerial photography) data by CALM identifies species mixtures (e.g. jarrah, jarrah-marri, karri, karri-marri, karri-marri-jarrah etc.) and structural types (e.g. old growth, two-tiered , regrowth etc) on the resulting maps. As noted in earlier reports (e.g. Ferguson et al., 2000), the mapping of species mixtures or structures is not and cannot be perfectly accurate, given the present tools and resources.

The questions to be addressed are:

a) How are errors rectified?
b) How are any remaining undetected errors taken into account in the calculation of sustained yield?
c) How do any remaining undetected errors affect prescriptions and forest practices?

2.1 Errors in structures

Errors in the mapping of structures (old growth, two-tiered, regrowth etc) arise principally because of the difficulty of identifying crown characteristics following fires, or pest attack, poor quality imagery, or errors in the historical records of previous harvests. Where errors are discovered in the course of field work, changes to the database are made under a well-established protocol, and the dependent area data are recalculated at the next revision of the database. The database is revised prior to each new planning run of the sustained yield model. Thus each current set of estimates of sustained yield is based on the best available set of area data at the time.

Instances have arisen, and may well continue to arise, where specific investigations and corrections are required, as in the case of part of Warren 6 classified as immature unlogged karri forest. Additional work was carried out by CALM on this area because of community and CALM staff concerns that a substantial area of Old Growth had been misclassified. The review established that about 21 ha of Old Growth had been misclassified and this has been corrected.

The Warren 6 example should not be construed as indicating a systematic bias in the classification system. Such errors will not always be in the one direction, such as to misclassify Old Growth structures as something else. There are alleged and past instances of the reverse in the Mt Barker townsite, the Bridgetown area, and elsewhere, where areas classified as Old Growth have been found to be substantially disturbed and therefore requiring reclassification in other structures. Errors may occur in any structures or species groups. The issues therefore concern how these errors affect sustained yield and how they affect the choice and application of prescriptions.

For the calculation of sustained yield, some form of objective sampling is required for ground truthing, so that the error rates can be assessed and discounts for risk management made in the calculation of sustained yield accordingly.

The Jarrah inventory involved multi-stage sampling in which the broad area classification and mapping was sampled by large-scale photography and further sub-sampled by ground plots. These forms of sampling enable error rates in the classification system to be evaluated and reported. . Work is in progress on a new inventory of the Karri available for timber production that will hopefully also address the issue of ground truthing. The Sustained Yield Panel will assess this work and the appropriateness of the discounts when the Forest Management Plan has been completed and sent to the Panel for review.

Recommendation 2.1: The Sustained Yield Panel should report specifically on the basis of risk management provisions concerning errors in mapping undetected until the pre-logging survey.

However, leaving the calculation of sustained yield aside, the community would rightly be concerned if these errors also led to Old Growth being logged that ought to be reserved under the Janis criteria and the Government policy on Old Growth. The protocols for pre-logging surveys established under the Code of Harvesting Practice, other guidelines and checklists should ensure that, within the limits of human error, this does not occur. Appendix 14 in the Draft Forest Management Plan documents the interim guidelines for the management of informal reserves, which include patches of old growth. The finalisation of the operational guidelines by the Department of Conservation

and Land Management will include consideration of public and external agency submissions as well as the settings being discussed concerning buffers around old growth patches. Thus work has progressed in developing a draft protocol but decisions on its implementation need to be accelerated. The protocol also needs to embrace areas about to be disturbed or impacted by activities such as roading.

Consideration also needs to be given to audit of this issue by the Conservation Commission, both through CALM and independently of it in terms of quality control. Obviously, audit of the old growth policy on logging coupes can only be carried out immediately prior to logging, or that part of the coupe as yet unlogged, after the delineation of the coupe and other provisions has been completed. The development of an audit process will need to give due consideration to the extended lead-time that will arise for the approval of operations to occur in areas likely to contain old growth.

Recommendation 2.2: The Conservation Commission should ensure that the draft protocol on Old Growth and audit provisions relating to that protocol are speedily completed and implemented. This protocol deals with recognising Old Growth (according to the Janis criteria ad the Government's Old Growth policy) that has not so be recognised in prior mapping but is in areas otherwise about to be logged or about to be disturbed or impacted by activities such as roading.

2.2 Errors in species associations

While the same comments apply to the species associations in general, an additional complication has arisen in the case of a naturally distributed species and hybrids of it.

A species that hybridises with Jarrah, Albany blackbutt (*Eucalyptus staeri*), occurs in the Jarrah South region. It is well known around Mt Barker, and the Herbarium records show occurrences as far west as Walpole-Nornalup National Park. Most of the Eastern portion this region is in reserves and the main occurrences of the pure species are therefore protected. However, a local stakeholder believes that substantial areas of Jarrah in the western section, as far west as the Blackwood River, are in fact Albany blackbutt or hybrids with Jarrah. The distribution of the Albany blackbutt hybrid is said to be associated with a particular soil type identified by Churchwood in earlier soil surveys.

In the time available, it has not been possible to obtain definitive advice on this matter. I therefore recommend that an ecologist be commissioned to report on the occurrence of this species, or hybrids thereof, in the south-western areas of the Jarrah South region, especially those currently available for timber harvesting.

Recommendation 2.3: As a matter of urgency, the Conservation Commission should commission an ecologist to report on the occurrence of *Eucalyptus staeri*, or hybrids thereof, in the south-western areas of the Jarrah South region, especially those currently available for timber harvesting

2.3 Inadequacies of mapping of other values

Concerns were expressed regarding the inadequacies of the present mapping of fauna habitat types, including the recent Forest Vertebrate Fauna Distribution Information

System (Conservation Commission of Western Australia, 2002:p61). This is based on relationships between the largely opportunistically collected data on the occurrence of certain (predominantly threatened) fauna and the associated forest types and flora. The weakness of these data was thus the paucity of occurrences in the central areas of the South-West forest, where observations in the database are infrequent or lacking. It was acknowledged that a comprehensive survey might be unattainable because of the cost. A system of establishing objectively selected and monitored sites for up to 5 species in each of four groups (mammals, birds, frogs and reptiles) was also advocated to supplement this survey. The Department of Conservation and Land Management has recently introduced the FORESTCHECK system (Conservation Commission of Western Australia, 2002:p129), which addresses this long term monitoring issue on a fairly comprehensive basis. In time it will also assist in filling some of the gaps in the information system, but the present dearth of observations in the central areas of the South-West forest warrants specific attention during the next Plan period.

The point is consistent with an earlier recommendation (5.8) of the Independent Expert Advisory Group on the Assessment of ESFM in the South-West Region of Western Australia. The Department of Conservation and Land Management and other relevant agencies should review and expand their databases on fauna habitat during the next Plan period to ensure that the existing gaps in data do not represent a major source of bias. While this issue potentially has some implications for sustained yield, the current processes do take account of the local occurrences and informal reserves in the course of pre-logging surveys and the extent of those informal reservations is taken into account in calculating the sustained yield.

A further concern was expressed regarding the dataset for heritage sites, which is also largely opportunistic in origin. Again, a systematic and objective survey was advocated. This, too, has merit and goes beyond the recommendation (4.4) of the Independent Expert Advisory Group on the Assessment of ESFM in the South-West Region of Western Australia and more recent improvements to the database. The Conservation Commission does need to develop better database in the next Plan period and the Draft Management Plan (Conservation Commission of Western Australia, 2002:p113) includes a general statement about the progressively undertaking systematic surveys. A more specific recommendation as to the target coverage, priorities and time scale would be desirable.

Recommendation 2.4: The Conservation Commission should ensure that, in the next Plan period, more specific attention is given by the relevant agencies to the development of better and more representative databases on fauna habitat and heritage matters..

3. Inventory of Standing Volume

Concerns were expressed regarding the out-dated (1985) and now unsatisfactory (because of changes of tenure) nature of the karri inventory. This is currently being addressed by a new inventory. The Sustained Yield Panel will review the outcomes.

There were also concerns that the Jarrah inventory, though technically well based, documented and evaluated, is now becoming out of date (1991). A new inventory is

needed to set the base for the next (circa 2013) Forest Management Plan. The Sustained Yield Panel will review this issue.

Recommendation 3: The Sustained Yield Panel should specifically review and report on the present inventories of standing volume and the needs for the next (2013-23) Plan period.

4. Growth Estimates

A concern was expressed that the sustained yield estimates were not consistent with the estimates of diameter growth given by Abbott *et al.* (1989). The Sustained Yield Panel will review this.

Recommendation 4.1 The Sustained Yield Panel should report specifically on the concerns raised in relation to estimates of diameter growth and the estimates of sustained yield.

Concerns were expressed that CALM was currently unable to respond to requests to provide detailed summaries setting out the sampling design or origin, location, species association, structure, measurements dates, and (where relevant) reasons for cessation of measurement of permanent growth plots. Some respondents had particular concerns that the expansion of the reserve system may be accompanied by a failure to maintain measurements on those plots in reserves. Others were concerned over the adequacy of sampling of potentially dieback-affected sites, or the assumption of zero growth on stands over 200 years of age or 120 years in Karri.

It is a pity that members of the public have not been given summary data on the growth plots. This obviously needs to be limited to information readily available and not requiring substantial time or resources to compile However, any request for information on the specific locations of these plots should be denied as it would not be worth risking possible vandalism (which has occurred previously) or interference with the plots by extremists on either side of the conservation-development debate. Access to them can also be constrained by dieback hygiene requirements. The Sustained Yield Panel will review these matters further, other than the remeasurement of plots in reserves.

Recommendation 4.2: The Sustained Yield Panel should specifically review and comment on the present distribution and adequacy of growth plots and future needs.

The remeasurement of plots in the reserve system forms part of the process of monitoring change and health and vitality under ecologically sustainable forest management and is a matter that merits consideration by the Conservation Commission. Whether in the reserve system or outside it, the present array of permanent growth plots is ill-suited to reflect a comprehensive and representative sample of the ecosystems, species associations or structures. This is not to suggest that more of the present system be abandoned because some data, albeit imperfectly representative, are better than none. However, the changes to the use and management of the forest area warrant an examination of a more adequate and representative system that might be established progressively. This need not be a substantial additional cost, if phased in over several

years. It would provide a basis for monitoring the effects of climate change, health and vitality consistent with the commitment to ESFM.

Recommendation 4.3: The Conservation Commission should recommend that the Department of Conservation and Land Management develop and ensure the implementation of an adequate and representative set of permanent plots to monitor change in the reserve system.

5. Sustained Yield Methodology

Concerns were raised over the use of merchantable volume as the basis of calculation of sustained yield and a preference for whole bole volume expressed. This matter has already been considered by the Sustained Yield Panel, whose main concern was that such a change be introduced on a dual track basis, maintaining both the old and the new systems over at least the next Plan period, to enable transparency. The matter also linked to the maintenance of records for logs held at landings or other field storage sites. Following an earlier inspection by Conservation Commission staff, the Forest Products Commission are developing their information system to deal with this issue.

However, the extension to whole bole logging does not answer all of the underlying issues, because there are still volumes of biomass left in the field. This aspect links to the issue of carbon accounting and will be reviewed further by the Sustainable Yield Panel.

Recommendation 5.1: The Sustained Yield Panel should review the field stockpile inventory system and should consider and make recommendations on future needs for biomass and carbon accounting.

Other concerns were that the methodology for calculating sustained yield was flawed in that it appears to take a particular level of cut as a given. In the present approach, a particular level of cut does have to be specified as a starting point. This value is then tested to see if it can meet the non-declining cut criterion. If it cannot, the level is reduced and the process repeated. If, on the other hand, there is a clear margin to supply more throughout the 200-year period, it may be increased and the process repeated.

This iterative process is not well understood, in that it ultimately provides a lowest common denominator to the final sustained yield and so accommodates much of the risk. It ensures that the cut in all periods in the future is capable of being delivered without endangering the productive capacity in later periods. As a result of the lack of understanding, community groups concerned feel they have no ownership of the alternative options examined and are therefore suspicious of them and the methodology.

One view expressed was that the entire methodology was poorly documented, lacking peer review, and inappropriately *ad hoc* in relation to a model to be used for long term forecasting over 200 years. The Sustained Yield Panel has already drawn attention to the desirability of moving to a more comprehensive scheduling algorithm, such as that provided by the use of Spectrum.

There is also some justification for the dissatisfaction with documentation in the public domain, which is incomplete and scattered over different monographs and journals. However, this is coloured by a lack of trust and inability to integrate the available material, together with confusion about totally different datasets. For example, one group said that they had been told that data were 'commercial-in-confidence' and therefore not available to them. I am informed that the only reference to 'commercial-in-confidence' was to growth data for plantations that included FPC joint ventures. CALM is the custodian of various commercial-in-confidence datasets that are not available to the public because they were funded partially or fully on that understanding by external sources. Thus there are some developments and inventory datasets that contribute to the Forest Management Plan that cannot be made public. Nevertheless, in the interests of transparency, wherever data can be made available to the public at a low cost to CALM, it should be.

The preceding concerns also highlight issues that are, in part, attributable to a lack of transparency in the process, which the Sustained Yield Panel and various predecessors have commented on. More needs to be done in getting the underlying data and models into peer-reviewed publications and into more reader-friendly publications.

Recommendation 5.2: The Sustained Yield Panel should review the methodology for calculating sustained yield and make recommendations as to future directions and methods of improving the transparency of the process.

The lack of trust that was manifest in relation to CALM during the Karri and Tingle review (Ferguson *et al.*, 1999) in large measure remains and spills onto the other two bodies involved, the Conservation Commission and the Forest Products Commission.

Literature Cited

Abbott, I., Dell, B. and Loneragan, O., 1989. The jarrah plant. In Dell, B., Havel, J. and Malajczuk (Eds), *The Jarrah Forest: A Complex Mediterranean Ecosystem*. Kluwer, Dordrecht.

Conservation Commission of Western Australia, 2002. *Draft Forest Management Plan*. The author, Perth, 248pp

Ferguson, I., Adams, M., Bradshaw, J., Davey, S., McCormack, R., and Young, J. , 2001. *Calculating Sustained Yield for the Forest Management Plan (2004-2013): A Preliminary Review*. Conservation Commission, Perth. 61pp

Ferguson, I., Gardner, J., Hopper, S., and Young, J., 1999. *Report to the Minister for the Environment by the Ministerial Advisory Group on Karri and Tingle Management*. The author, Perth.

APPENDIX A
List of Submissions and Interviews

1. Dr John Dell. Via Royal Society. Mapping of fauna habitat. Interviewed.
2. Dr Beth Schultz, Peter Robertson, David Mackenzie, Paul Davis. Conservation Council of WA. Definitions of Sustained Yield, Area data, Inventory of standing volume, Sustained Yield Methodology, Growth rates vs Sustained Yield Estimates. Submission and interviewed.
3. Alex Syme, South Coast Environment Group Inc, Denmark Conservation Society Inc, Denmark Environment Centre Inc. Submission and phone interview.
4. Jim and Mary Frith, Bridgetown Greenbushes Friends of the Forest. Submission 173 to Draft FMP, and phone interview.
5. Walter Jones, Western Australian National Parks and Reserves Association. Forest growth data. Forest log stockpile inventory. Whole bole volume. Interview with Graham Rundle.
6. John Austin, Karri inventory. Mapping. Draft FMP submission #77 and Email to Peter Baldwin of 23 October, 2002.
7. Ken Waterhouse*, Biodiversity survey. Fauna habitat. Whole bole volume. Draft FMP submission #61
8. Rod Whittle*, Growth rates. Mapping of species associations. Draft FMP submission #190
9. John Tredinnick*, Biodiversity. Karri inventory. Draft FMP submission #79
10. Dr Ian Crawford*, Growth rates. Cultural heritage. Submission to Independent Review of Sustained Yield within context of ESFM, Oct 2000.
11. Peta Sargison*, Methodology. Inventory. Growth rates. Submission to Independent Review of Sustained Yield within context of ESFM, Oct 2000.
12. Geoff Fearnie*, Growth rates. Inventory. Submission to Independent Review of Sustained Yield within context of ESFM, Oct 2000.
13. Elaine Davidson*, Growth rates and plots. Submission to Independent Review of Sustained Yield within context of ESFM, Oct 2000.
14. Tom Perrigo, National Trust of W.A., phone interview.

* Attempts to contact these persons to see if they had specific or additional information relevant to the current review were unsuccessful in the limited time available.