

An overview of the Warra Long-Term Ecological Research Site

M.J. Brown*, H.J. Elliott and J.E. Hickey
Forestry Tasmania

Abstract

The Warra LTER Site is described. Reasons for its establishment, its location and management are given, together with a list of the research projects being conducted there.

Introduction

Managing forests sustainably is a complex business. It requires a mindset of forest care while seeking to provide goods and services for present and future generations. It involves optimising the provision of community benefits of wood and non-wood products, of nature conservation, of ecosystem services such as clean air and water, as well as other community needs such as spiritual, aesthetic and recreational experiences. It requires a broad skills base and information gathered over time so that trends and infrequent but potentially catastrophic events can be allowed for and incorporated into the management cycle.

The manager needs input from the public, from the policy arena, from other managers and planners, social sciences and economics as well as from a multitude of scientific fields. While many of the inputs needed are necessarily driven by the immediacy of current issues and political debate, management of forests requires long-term commitment. Forests are not static and so management ultimately must cater for their

growth and change over time. In the case of wet eucalypt forests, the dominant trees are dependent on disturbance for their regeneration and can reach ages of 400 years or more before they die. Thus managers need to plan and manage over very long time-frames if the range of ages and successional stages are to be maintained in the landscape so that forests retain their biological diversity. Even trees managed in native forest for wood production attain ages of 80–100 years before they are cut. The trees also require a long-term commitment to management if the harvest is to be realised in the face of broadscale disturbances such as wildfire or from more insidious pest, disease and weed outbreaks.

In 1992, Australian Governments explicitly recognised these needs and in the National Forest Policy Statement (NFPS 1992) made a commitment to achieving the goals of sustainable forest management (SFM):

- Maintaining ecological processes within forests (the formation of soil, energy flows, and the carbon, nutrient and water cycles);
- Maintaining the biological diversity of forests; and
- Optimising the benefits to the community from all uses of forests, within ecological constraints.

The policy also recognised that research and monitoring are needed to support proper and effective adaptive forest management.

Tasmania has more forest, as a proportion of its total area, than any other State in Australia. Thirty-nine per cent of its forest

* Corresponding author

e-mail: mick.brown@forestrytas.com.au
helliott@ozemail.com.au
john.hickey@forestrytas.com.au

area is reserved for nature conservation purposes. It also has a major timber industry based on native forest outside reserves, and plantations of eucalypt and pine on public and private land. Both wood production and conservation in dynamic forest ecosystems require active management with a sound ecological basis. While in the short term, conservation management may adopt the 'benign neglect' approach, production forestry can only effectively monitor the effects of particular silvicultural systems and forest management practices when the ecology of the major forest types in which it operates is understood.

Much of this research and monitoring can be done over relatively short time-frames, and proper monitoring schemes can assist in ensuring that we learn from mistakes and adapt practices to ensure that mistakes are not repeated. However, a much greater level of understanding about the variability of forests and impacts of differing management regimes can come from having a multi-disciplinary, long-term, site-based approach so that different specialists can bring their skills and understanding to bear on a common goal. It is also apparent that the scale of impacts differs greatly both in time and in space. Thus, around the world, there is a network of long-term ecological research (LTER) sites (Sprott 2000) which are dedicated to multi-disciplinary, long-term, site-based research that incorporates a range of scales, from the molecule to the landscape and from the nano-second to the century.

While much planning and decision-making is undertaken in the absence of long-term data, LTER sites can be used judiciously to underpin the decision-making process. As noted above, the longevity of forests extends over the lifetimes of many parliamentary election periods, even for the shortest plantation rotation. Therefore we need to be conscious of the idiosyncrasies that may arise from short-term data, and need to be especially cautious of applying such data where there are long-term implications.

A long-term ecological research (LTER) site was established at Warra in the Southern Forests of Tasmania in 1995 (Figures 1, 2). It is linked to the existing networks of national and international LTER sites.

Warra provides:

- A place where ecological and silvicultural experiments can be conducted;
- Baseline information for researchers;
- A research station/platform and data storage facilities across scientific disciplines.

These attributes can be used to capitalise on short funding cycles and can feed in to a longer term framework. Data can also be made readily available to other researchers who are involved in more theoretical studies and who may never even visit the site. However, they can make comparisons across the country, and around the world with contemporary data or with data that may have been collected before they were born.

The remainder of this overview provides a brief description of the Warra LTER Site, its resources and facilities, its management, and the research programs currently in place there. We then consider the results achieved to date and assess where we go from here.

Site description

The Warra LTER Site is a 15 900 ha area which lies between the Huon and Weld Rivers, approximately 60 km west south-west of Hobart (Figure 1). The Site includes Mount Weld and Mount Frederick, and has an altitude range of 37–1260 m; it is geologically diverse but dominated by Jurassic dolerite. Most of the area is forested: the rest is composed mainly of buttongrass moorlands, with some alpine moors and scrub. The most common forest type at Warra is wet *Eucalyptus obliqua* forest which is the most widespread forest community in Tasmania. Temperate rainforest is also present. The western

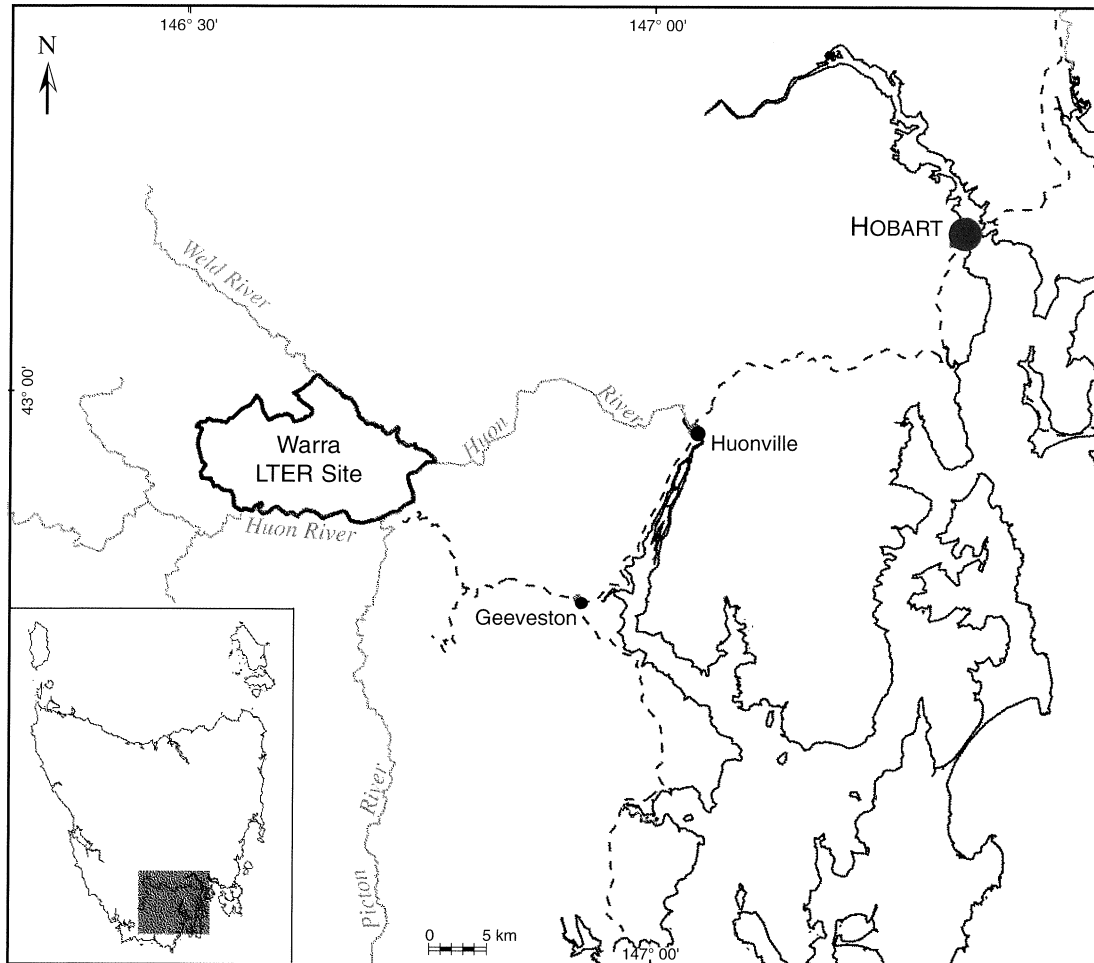


Figure 1. Location of the Warra Long-Term Ecological Research Site.

portion of the Site is part of the Tasmanian Wilderness World Heritage Area (Figure 2) and is managed primarily for conservation values by the Department of Primary Industries, Water and Environment. The eastern portion is State forest managed by Forestry Tasmania for multiple uses, including sustainable timber harvesting.

Infrastructure resources

Access

The Warra LTER Site is one and a half hours from Hobart. It contains several major roads which provide access to the eastern half. The western half of the Site is wilderness,

with access only by foot or river (Figure 2). Some permanent tracks have been established for long-term monitoring within the area, both within the working forest and in the wilderness forest areas. Accessible control areas occur in the vicinity.

On-site facilities

Currently there are no on-site accommodation facilities or field stations in the area but there is a café, shelter, toilet and barbecue facilities located at the entry to Warra on the Huon River near a canopy level walkway known as the Tahune AirWalk. The Huon District office of Forestry Tasmania is located at Geeveston, 40 minutes from the Site.

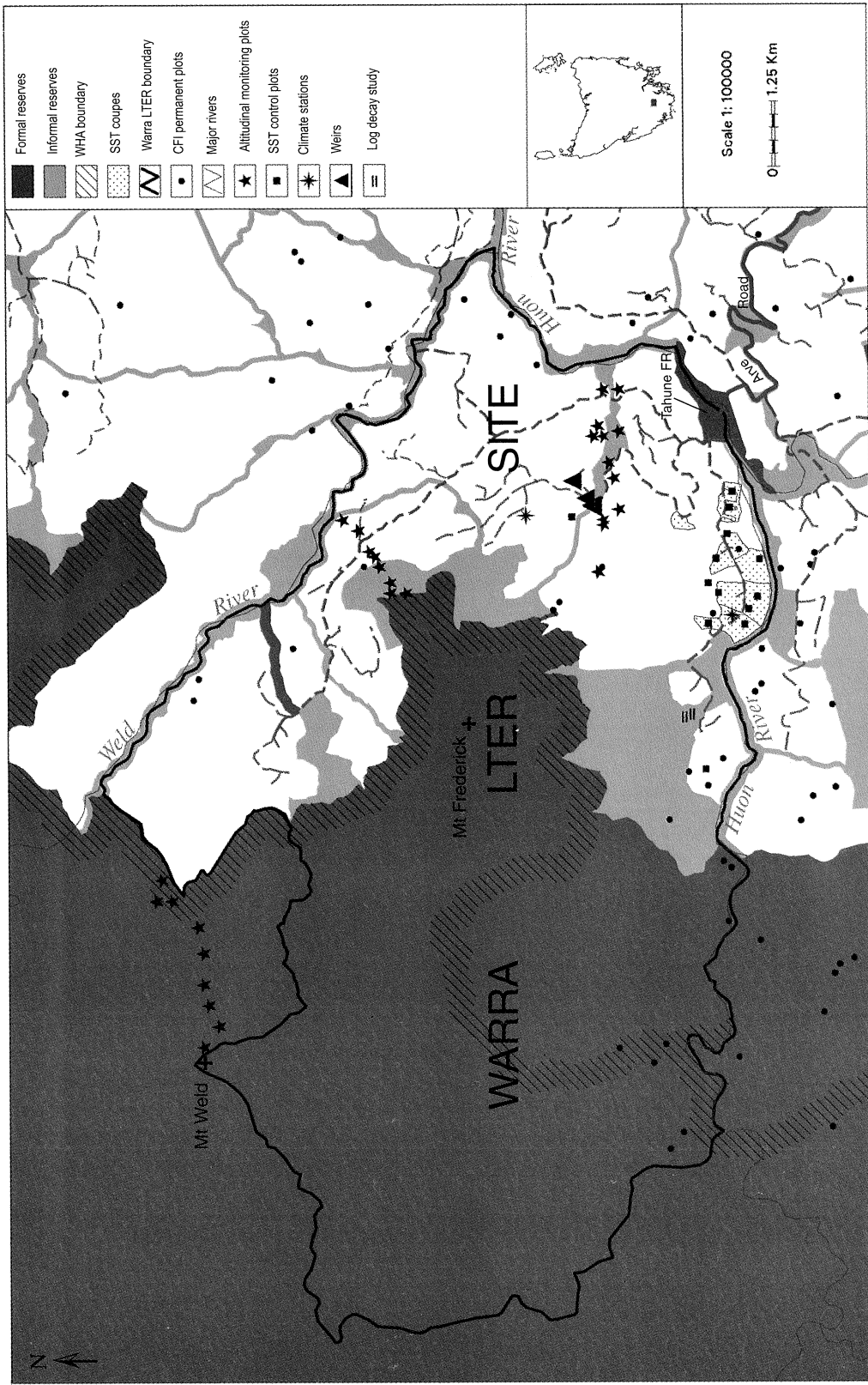


Figure 2. The Warra LTER Site showing reservation status and major long-term monitoring locations.

Laboratory facilities

There are no on-site laboratory facilities at Warra. Laboratory space at Hobart may be available through negotiation with the Tasmanian land management and research agencies represented on the Policy Committee.

With the recent completion of the Tahune AirWalk and associated visitor centre, the intention is to eventually provide for on-site research accommodation and field laboratory facilities.

Management

The Site is managed by a Policy Committee and by a Research Management Group. The Warra Policy Committee has representatives from the Tasmanian Department of Primary Industries, Water and Environment (DPIWE), Forestry Tasmania (FT), the Tasmanian Forests and Forest Industry Council (FFIC), the University of Tasmania (UT), the Australian Bureau of Rural Sciences (BRS), and the Cooperative Research Centre for Sustainable Production Forestry (CRCSPF). This Committee meets annually, and has responsibilities to develop policy (external and internal), appoint members of the research management group and vet projects beyond parameters of currently approved projects. The functions of the Research Management Group are to attract research projects and funds for the Site, facilitate interdisciplinary research, co-ordinate research proposals, approve research projects within guidelines set by the Policy Committee, and oversee data co-ordination, curation and access.

Research and data management

Data are managed and curated by the individual research agencies, with common datasets on vegetation and biodiversity, climate, soil, water and geology, being held by Forestry Tasmania and the Department of Primary Industries, Water and Environment. GIS layers are available on CD-ROM, and

data will eventually be available via the Warra website at www.warra.com.

GIS layers have been collected at 1:25 000 scale and include:

- Digital elevation model, aspect, altitude and slope;
- Forest type maps (vegetation structure) derived from aerial photography;
- Geology;
- Vegetation;
- Fire history;
- Modelled climate surfaces (ANUCLIM);
- Satellite images;
- Aerial videography;
- Environmental stratifications.

Forestry data

There has been a history of data collection for forestry purposes since the late 1960s. Continuous forest inventory (CFI) plots have been established in the area since the late 1960s to early 1970s. These are measured at establishment, at five years, 10 years and then at 10-yearly intervals. Parts of the area were first harvested in the early 1970s. The complete logging history, recent fire histories and vegetation survey data are available.

Hydrology and climate

There are instrumented weirs on Warra Creek, Swanson Creek and King Creek. Sampling commenced in 1998. There is an operational weather station on Manuka Road and 16 river sites on Manuka Road, Warra Road and South Weld Road sampled fortnightly. A second weather station has been established near the top of the Warra Creek catchment.

Biodiversity

Species lists (and locations) are available for vascular plants, vertebrate fauna and some non-vascular plants and invertebrate

groups. A stratified system of baseline, long-term vegetation monitoring plots is being established at Warra to complement the CFI plots.

Past, current and proposed research programs

The objectives of management at the Site are to:

- Understand fundamental ecological processes in wet *E. obliqua* forests;
- Assess and monitor biodiversity and geodiversity;
- Determine the long-term effects of different forest management regimes on natural diversity and ecological processes and thus assess their sustainability;
- Research the relationships among ecological, social and economic aspects of sustainability;
- Develop alternative management regimes where needed;
- Provide an integrated multi-disciplinary focus which complements research programs elsewhere in Tasmania;
- Link Tasmanian forest research with national and international programs;
- Maintain the operational management regimes appropriate to the statutory responsibilities of the land management agencies.

The research needed occurs at many different scales. At the local level, forest management issues are major research priorities; for example, soil and water prescriptions, the viability of protection zones and other subjects relevant to the Tasmanian Forest Practices Code. The development of alternative silvicultural systems is another example (Hickey *et al.* 2001). At the regional level, there is a need to ensure that management across the landscape is sustainable and also to establish the Warra 'footprint' in the landscape (Neyland *et al.* 2000). At the national level, there are programs to establish

consistent standards of forest management such as the Montreal Process regional sustainability indicators. At the international level, there are research links to other ILTER sites to study the effects of global change. Researchers at Warra are participating in such programs in hydrology, productivity and biodiversity studies. The Warra Site is part of a formal network of Australian forest LTER sites (Bradley *et al.* 2000), which are linked to the ILTER network (Sprott 2000), and the Warra Site is a registered Terrestrial Ecosystem Monitoring Site on the TEMS database. Research at the Site will contribute to national and international programs on long-term ecological research and monitoring.

There are six major program themes currently being addressed:

- Inventory and site characterisation;
- Hydrological and nutrient cycling studies in pristine and managed catchments;
- A log-decay study to investigate aspects of the decay cycle;
- Establishment of baseline altitudinal monitoring plots (Barker 1998) for biodiversity;
- A silvicultural systems trial investigating alternatives to clearfell, burn and sow techniques;
- Research into the practicability of indicators of sustainable forest management.

The first four of these relate primarily to fundamental understanding of the ecology of the forests and the development of a conceptual ecological model for the Site. The last two relate primarily to aspects of human impacts, monitoring of effects of those impacts and, where appropriate, developing more benign human-ecosystem interactions. However, all six themes are contributing both to fundamental understanding of ecosystem process and to practical management outcomes.

Table 1. Some current research projects at Warra.

A. Silviculture

1. Alternative silvicultural systems trial (SST).
2. Low intensity slash-burning techniques in wet forest.
3. Long-term responses to pre-commercial thinning of eucalypt regrowth.
4. Measures of regeneration success.

B. Soils

1. Impacts of silvicultural treatments on soils.
2. Effects of clearfelling on soils.
3. Earthworms as indicators of soil sustainability.
4. Assessment of pre- and post-logging chemistry of forest soils.

C. Hydrology

1. Characterisation of stream hydrology.
2. Effects of forest operations on hydrology.
3. Invertebrates as indicators of stream health.
4. Determination of organic colouring of water in Warra Creek.

D. Biodiversity

1. Establishment and maintenance of long-term monitoring plots.
2. Effects of silvicultural treatments on flora and fauna.
3. The development of sustainable forest management practices in relation to the decaying-log habitat.
4. Microclimate and floristics at forest edges.
5. Effects of logging on beetle communities.
6. Monitoring of European wasps.
7. Effects of logging on vascular plants.
8. Effects of logging on bryophytes.
9. Canopy fogging of invertebrates.
10. Effects of logging on frogs in wet forests.
11. Comparison of pitfall sampling and hand collecting of molluscs.
12. Spread of bumble bees.

E. Ecological process

1. Feasibility studies on forest productivity, including leaf-area index, net primary productivity and site nutrient dynamics.
2. Landscape modelling.
3. Climate reconstruction for Warra using dendrochronology.
4. Use of airborne digital multi-spectral imagery.
5. Remote sensing of biomass.
6. Assessment methods for coarse woody debris.
7. Carbon cycling.
8. Global litter decomposition experiment.

F. Social and economic

1. Social assessment of SST.
 2. Economic analysis of SST.
 3. Economic indicators of relative wood and non-wood values of forest stands.
-

Current and proposed research projects being undertaken at Warra are shown in Table 1, grouped by subject area. Many of these projects are discussed in this

issue of *Tasforests*. In all, there are over 60 researchers from more than 20 institutions working in the area. Contacts for individual projects can be found at www.warra.com.

Where to from here

Our vision for Warra is that it remains a flagship for site-based, long-term, multi-disciplinary forest research in Tasmania. Currently, the network links, the numbers and diversity of people involved, and the accrued knowledge are growing rapidly. To succeed it must continue to receive a base level of resources and to seek a judicious mix of topical and relevant operational research as well as more theoretical longer term projects. The Site needs also to be placed firmly in the context of the wider landscape, regionally, nationally and internationally.

The Site should continue to be a testing place for operational changes needed to meet community perceptions of sustainable forest management. It can do this by involving the community, by demonstrating sound forest practice as

well as undertaking manipulative and descriptive research and development.

It must have an ongoing plan of management and ensure that infrastructure facilities and data management are maintained. It must also seek active involvement of the wider community as well as researchers and land managers. The outputs from the research benefit Tasmania directly through improved forest management and indirectly through the inputs of high level expertise from beyond Tasmania. In turn, Tasmania through Warra is contributing key information to assist research and management in temperate forests elsewhere in the world.

Acknowledgements

We thank Joanne Dingle for preparing the maps used in Figures 1 and 2.

References

- Barker P.B. (1998). A design for long-term quadrats to sample and monitor vegetation change along the altitudinal gradient at the Warra LTER site. *Forestry Tasmania*.
- Bradley, J., Howell, C., Brown, M. and Norman, P. (2000). Australia's Long Term Ecological Research Forest Sites. In: *The International Long Term Ecological Research Network 2000 – Perspectives from Participating Networks* (ed. P. Sprott), pp. 8–13. US Long Term Ecological Research Network Office, New Mexico.
- Hickey, J.E., Neyland, M.G. and Bassett, O.D. (2001). Rationale and design for the Warra silvicultural systems trial in wet *Eucalyptus obliqua* forests in Tasmania. *Tasforests* 13 (2): 155–182.
- Neyland, M.G., Brown, M.J. and Su, W. (2000). Assessing the representativeness of long term ecological research (LTER) sites: a case study at Warra in Tasmania. *Australian Forestry* 63: 194–198.
- NFPS (1992). National Forest Policy Statement. Commonwealth of Australia, Canberra.
- Sprott, P. (ed) (2000). *The International Long Term Ecological Research Network 2000 – Perspectives from Participating Networks*. US Long Term Ecological Research Network Office, New Mexico.